HL-LHC Procurement Strategy and Risk Mitigation

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Outline

1. Procurement Plan (Make or Buy Plan)
2. Update 2022
3. Upcoming Tenders
4. Risk Mitigation
5. Conclusions

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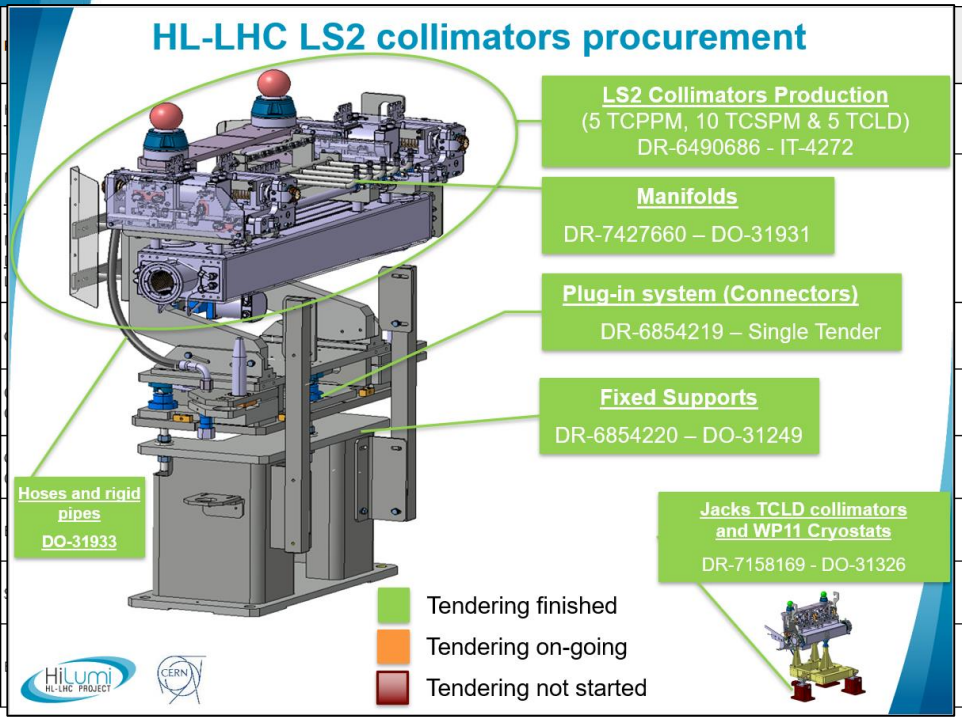
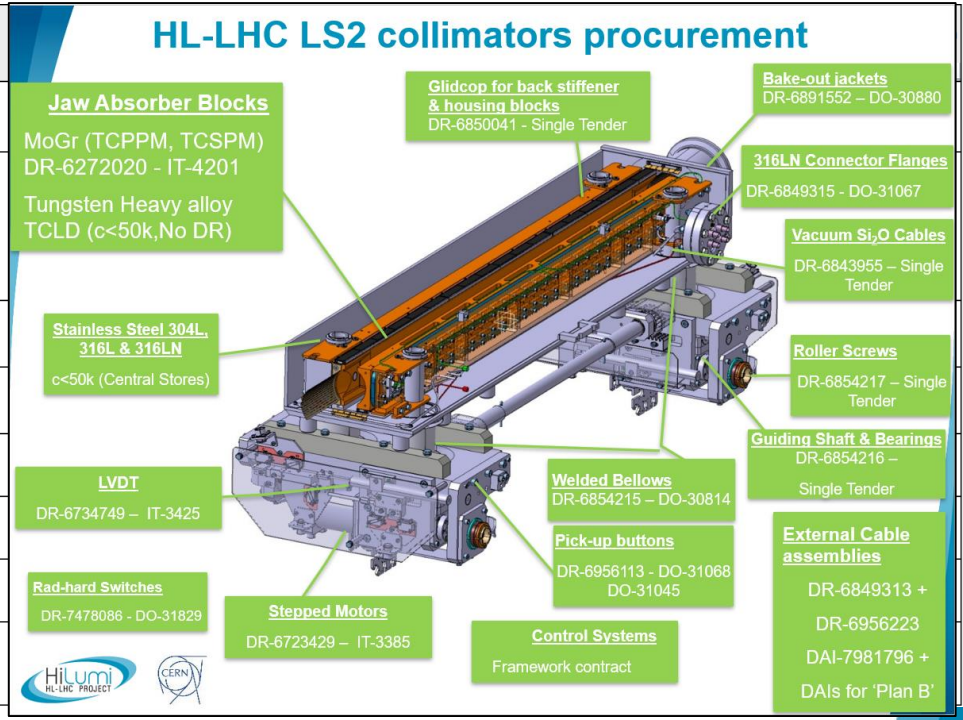
HL-LHC Procurement Plan - Briefing

- Acquisition process is a valuable input for the **Project Planning** and **Follow-up**. Procurement can be used as one of the project progress indicators. **Delays** in procurement will likely have **impact** on the **following activities**
- HLPO has been driving the **Make or Buy Plan** (**Procurement Plan**) since 2015:
  - Plan for all tenders (**contracts**) above **50 kCHF** for the next (**at least**) **18 months** in line with the Project Master Schedule
  - Fostering **Transparency**, **Equality** & **Competitiveness (CERN Financial Rules)**
  - Launch the procurement the **earliest possible**. Early procurement allows building **schedule margin** and **absorb** potential **delays** during the production. It also **avoids** specifying **too aggressive delivery schedules** (impact on **cost and number of Bids received**)
- The **past two years** of **global pandemic** entailed **a big challenge** due to the **disruptions** in the **supply chain** and the **unprecedented increase of prices**. This has been **exacerbated** by the unexpected **geopolitical** conflict in **Feb-2022**

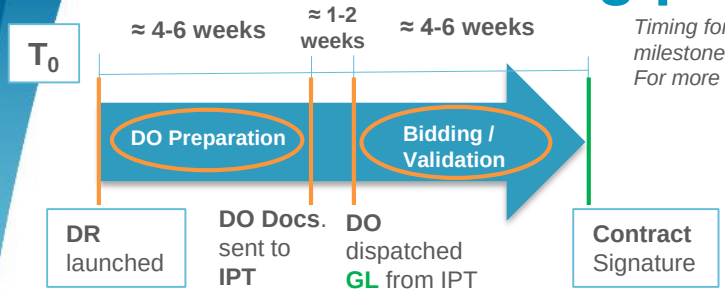
Make or Buy Plan





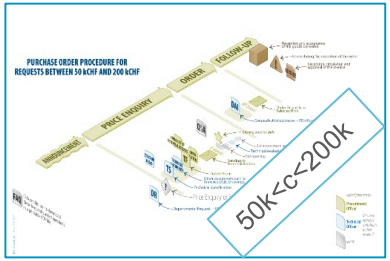
- **Bottom-up approach** in order to identify what what can be produced with industrial partners
- **Breakdown** of **Contracts** to be included within the **HL-LHC Procurement Plan**

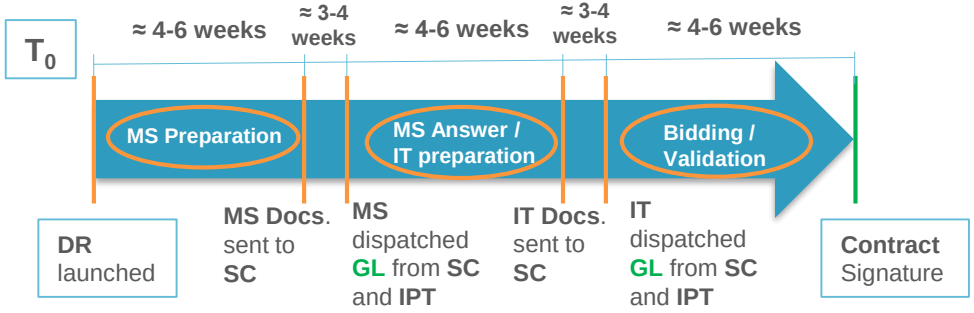
Tendering processes and timeline



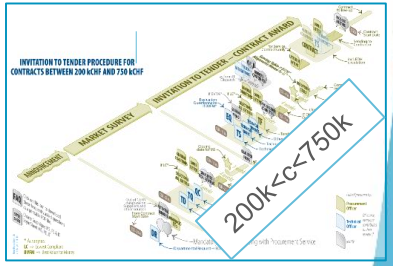
*Timing for **regular** cases, for which there are no qualification samples or additional milestones between phases (i.e feasibility studies)*
For more info: https://procurement.web.cern.ch/cern-personnel/procurement-guidelines

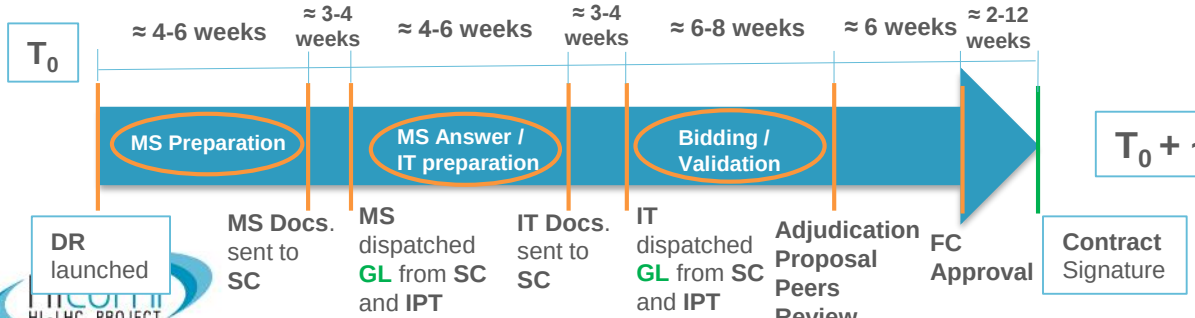
T_0 + ~2.5-3 months



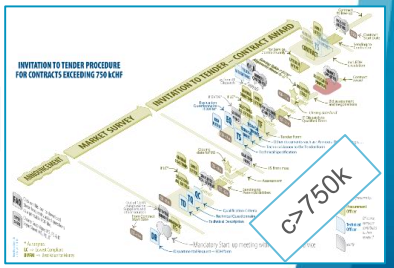


T_0 + ~5-6 months

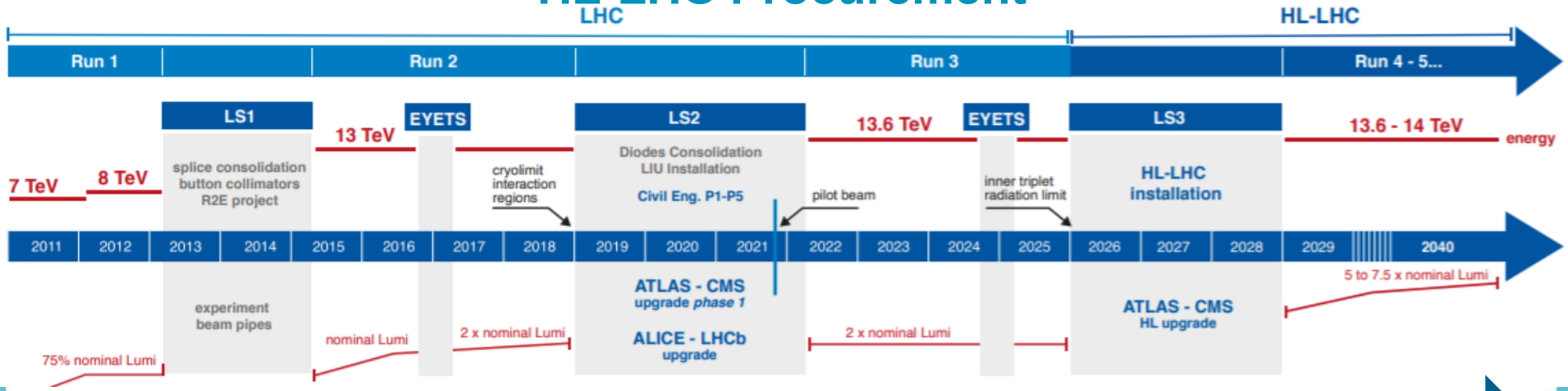




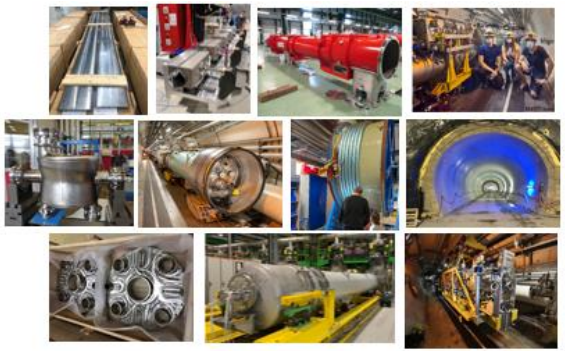
T_0 + ~10-12 months

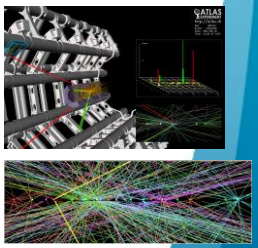


HL-LHC Procurement



MOCK-UPS / SHORT MODELS/ PROTOTYPES | LS2 / CE / LONG LEAD ITEMS RAW MATERIALS / MECHANICS | ELECTROMECHANICS SERVICES / IT STRING | ELECTRONICS TRANSPORT





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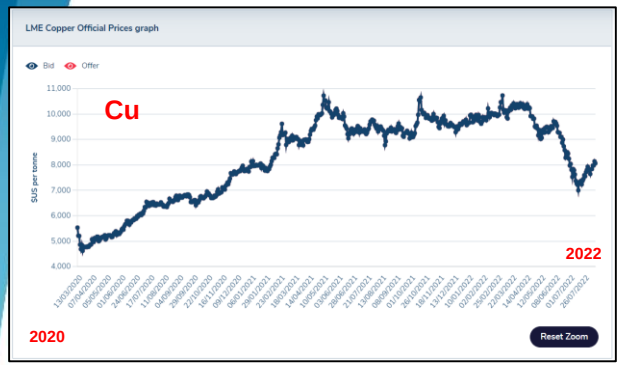
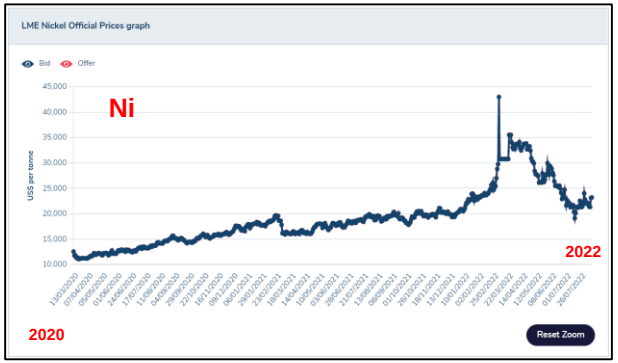
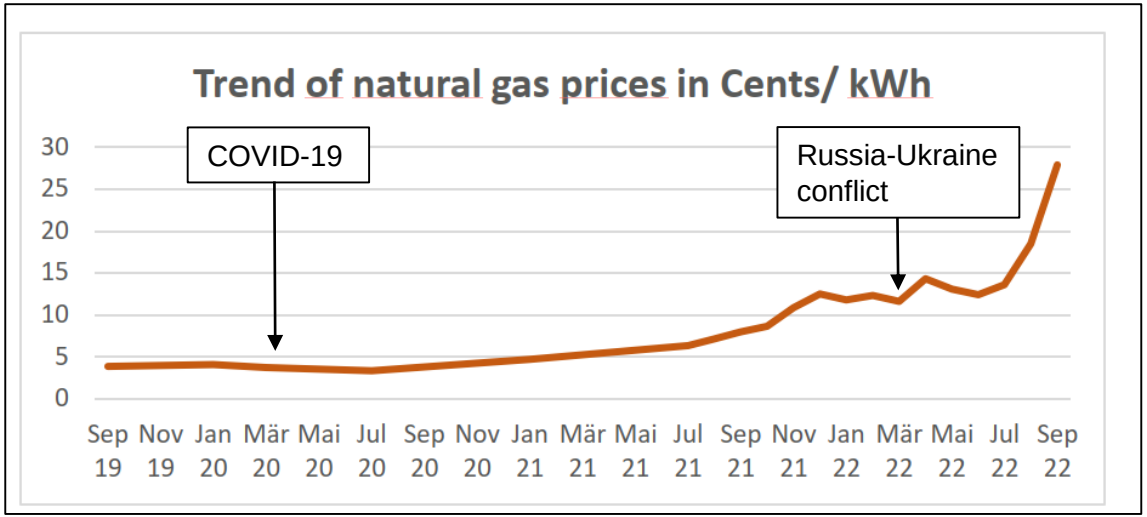
HL-LHC Procurement – A major challenge

- Last two years of global pandemic entailed major challenges on the procurement activities
- In early 2022, slight recovery of the market was observed (still far from pre-pandemic times in terms of stability though)
- The Russia-Ukraine conflict strongly affected the still weak markets, further increasing the risk exposure (budget and schedule) of the Project:
  - **Vendors cannot guarantee prices for more than few weeks – This uncertainty is reflected in the Bids - Margins in offers are largely increased**
  - **Market volatility has increased – Suppliers decline to bid, limiting options and reducing competition**
  - **Energy and oil prices increasing – manufacturing and transportation costs highly impacted**
  - **Shortages or limited availability of many conventional components – Lead times are increased (schedule risk highly increased)**
  - **On-going Contracts also affected – Claims for extra costs, price revision formulas to be applied before the specified date**

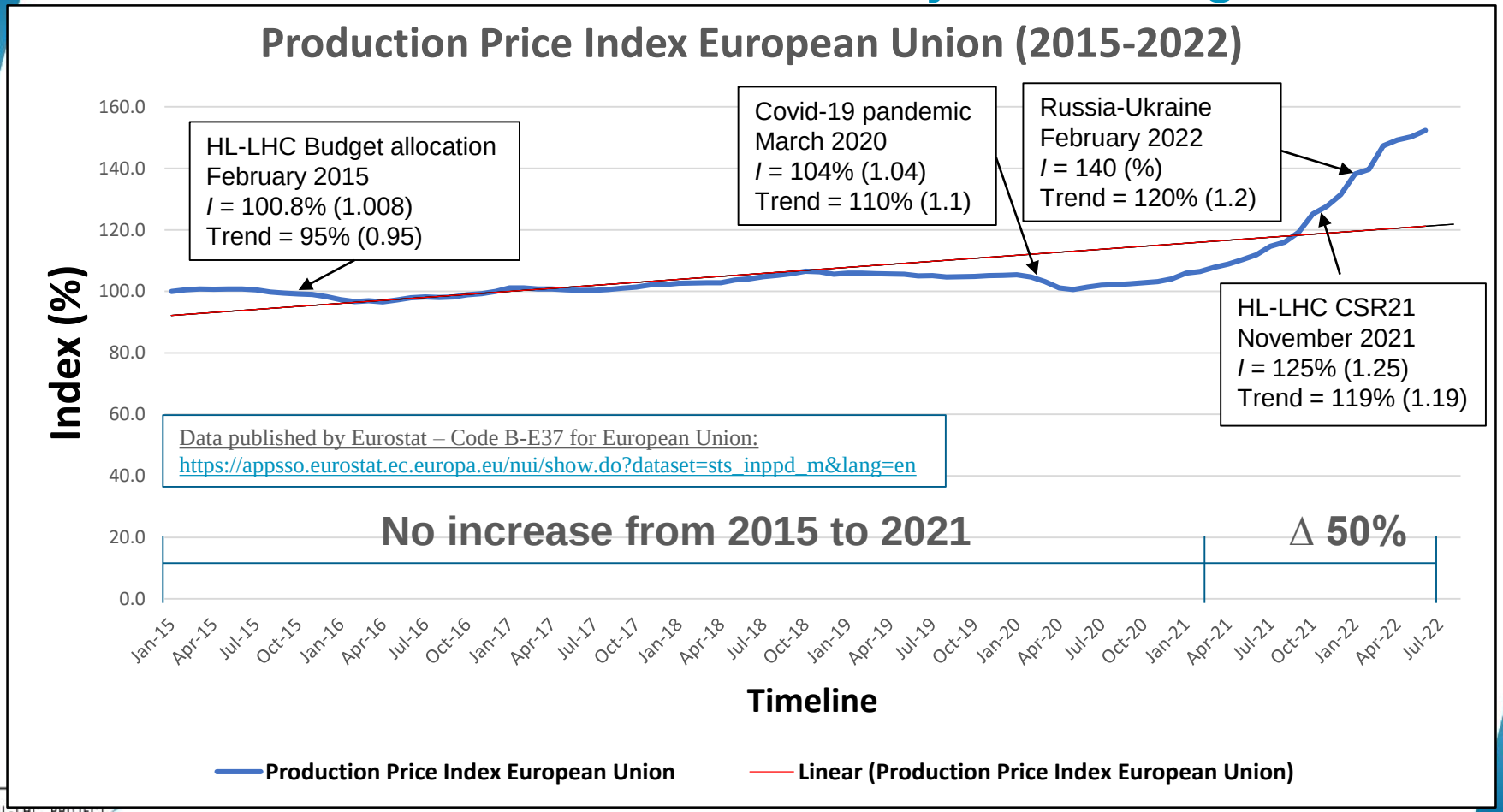
HL-LHC Procurement – A major challenge







HL-LHC Procurement – A major challenge



HL-LHC Procurement – A major challenge

An example of an EPC (Engineering, Procurement, Construction) Contract at CERN

Budget is updated based on Adding / Removing Scope (documented via ECR) or due to recent quotations (prototypes) (Documented via DMRs or Budget ECRs)

Tendering Phase

Execution Phase

HL-LHC Budget Profile is built. All the WPs provide their estimations for the scope of work (Deliverables and activities) defined at that point in time

The tendering process is launched for an EPC Contract, which will cover one of deliverables of the Work Package
1. DR estimation in line with the allocated budget

3. Invitation to Tender is sent out and Bids are received / assessed (Fixed price for the whole duration of the Contract)

5. Starting of the Contract Advance Payment (10%)

7. Completion of the Procurement phase Payment (40%)

9. Take Over. Starting of warranty period Payment (5%)

2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029

Phase	Breakdown Costs Bid	Level of Uncertainty (before 2020)	Level of Uncertainty (after 2020)
Engineering	20%	Low →	Moderate
Procurement	50%	Moderate →	Very High
Construction	30%	Moderate →	High

Under the situation faced during the last two years, you can imagine how difficult it is not only to stay within the estimations when the budget was allocated but also to provide a reasonable low-risk Bid by the Vendors (higher risk for the Project)

Russian in-kind (impact on HL-LHC Procurement)

Crystal collimators V3	2 units successfully produced and installed during the EYETS21, 4 additional units on-going production at CERN for installation in the EYETS22 (Procurement of main components driven by SY-STI)	
Resistive part HTS Current Leads	Already integrated in the Procurement plan. Production is taking place at CERN (EN-MME Main Workshop). Price Enquiries for Raw Materials and finished components launched by EN-MME [illegible] effort during 2022)	
BPM mechanical bodies	Already integrated in the procurement plan. Production is taking pla[illegible] Workshop) as we already built the pre-series (to cope with t[illegible] purchased, other components (electrodes, feedth[illegible]	
LS3 Collimators and masks	Major impact (about 20 contracts [illegible] production). All the upc[illegible]	
RF transmission chain		
TAXN, TAXS Vacuum Chambers	[illegible] TAXN, TAXS Cu absorbers (looking for an alternative as [illegible]roduction strategy under discussion (most likely in-house production of 1+4	
BLM (25% HL-LHC)	[illegible]everse engineering and production of few prototype units by MME. Plan for the Series under discussion (in-house vs manufacturing in Industry)	
High Power RF	High Power RF – developed with IOTs (looking for an alternative as Collaboration) – Market Survey to be launched at CERN	

- The integration of the Russian in-kind Contribution has led not only to a non-negligible effort to minimize the impact but also an in-sourcing of the risk due to the present market situation (we are re-insourcing financial risk to the project)

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Procurement in 2022

January	February	March	April	May	June	July	August	September	October	November	December
IT-4630 (WP9) Cryogenic Lines (QXL)	DO-XXXXX (WP9, WP17) Platforms PM17-57	DO-33240 (WP6B) Crowbar Diodes Stack 2 kA	DO-33204 (WP5) BPM Ti buttons for LS3 Collimators	DO-33299 (WP6A) Current Leads Materials - EN/MME	DO-XXXXX (WP4) Vaccum Vessel for DQW Cryomodule	DO-XXXXX (WP12) Formed Vacuum Bellows	DO-33445 (WP3) Vaccum Vessels DCM Series	DO-XXXXX (WP13) RF Feedthroughs	~~MS-XXXX (WP6B) Crowbar Diodes Stack 18 kA~~	DO-XXXXX (WP6A) Install. Tooling IT String - Spooling	DO-XXXXX (WP5) CuNi cooling pipes
	IT-4666 (WP17.5) Shielding Doors	DO-33243/33244 (WP8) Y-chamber 1st unit (PoP)	DO-33299 (WP6A) Current Leads Materials - EN/MME	DO-33282 (WP6A) Current Leads Materials - EN/MME	DO-XXXXX (WP13) BPM Button Electrodes	Stores (WP12) Raw materials - Flanges	DO-33341 (WP3) Thermal Shields DCM Series	DO-XXXXX (WP6B) Mosfets, AOPs, Cooling Fans	~~IT-XXXX (WP14) MKBH Coils~~	MS-4713 (WP6A) REBCO Tape	DO-XXXXX (WP15) Targets for CM Monitoring
	IT-4514 (2nd Phase) (WP6B) DCCTs Class 0	DO-33250 (WP6A) Current Leads Materials - EN/MME	DO-XXXXX (WP6A) Current Leads Materials - EN/MME	DO-33283 (WP6A) Current Leads Materials - EN/MME	DO-33379 (WP6A) Current Leads Materials - EN/MME	DO-XXXXX (WP12) Vacuum modules with DRF & bellows	DO-XXXXX (WP17.2) Power Transformers	MS-XXXX (WP15) Customized Forklift	~~IT-XXXX (WP14) MKBH Cores~~	MS-XXXX (WP5) Lead Screws for LS3 Collimators	DO-XXXXX (WP15) Feedthroughs for CM Monitoring
	Single Tender (WP3, WP15) Jacks for IT String	DO-33169 (WP6A) Current Leads Materials - EN/MME		DO-33284 (WP6A) Current Leads Materials - EN/MME	DO-33377 (WP6A) Current Leads Materials - EN/MME	DO-XXXXX (WP12) Vacuum Chamber include assembly & tubes	IT-4513 (2nd Phase) (WP6B) DCCTs Class 2	MS-4810 (WP5) Production of LS3 Collimators	IT-XXXX - SEF58 - Harmonic Filters slab	IT-4813 (WP5, WP13) SiO2 Cables - LS3 Collimators & BPMs	MS-XXXX (WP6B) 600A Power Converters
		IT-4703 (WP3, WP6A) SnAg Plating of NbTi wire		~~MS-XXXX (WP14) MKBH Coils~~		DO-XXXXX (WP12) Insulation vaccum EPDM gaskets	MS-4802 (WP9) GHe Storage Tanks	MS-XXXX (WP1) Rad-tol and Rad-hard cables	MS-XXXX (WP17.2) Electrical Works SubS in P5	MS-XXXX (WP7) Quench Heater Power Supply - Series	IT-4713 (WP6A) REBCO Tape
				~~MS-XXXX (WP14) MKBH Cores~~		DO-XXXXX (WP12) Insulation vacuum valve blocks	IT-4643 (WP17.2) Water Cooled Cables	MS-XXXX (WP17.1) Vertical Cores Excavation	MS-4807 (WP17.2) Transformer SubS in P5	Single Tender (WP9) Subcooling heat exchangers	IT-XXXX (WP17.2) Electrical Works Sub-Station in P5
						DO-XXXXX (WP12) Pumping Ports	Single Tender (WP3) Cutting machines		MS-XXXX (WP5) MoGr for TCSPMs (LS3 Collimators)	Single Tender (WP9) Quench Valves	IT-4807 (WP17.2) Transformer SubS in P5
									MS-XXXX (WP6B) Power Modules 18kA PCs		IT-XXXX (WP7) 2kA / 600A Mech. Switches EE System
									MS-XXXX (WP9) Interconnecting Piping		IT-4802 (WP9) GHe Storage Tanks

Cost estimation [50 kCHF , 200 kCHF]
Cost estimation [200 kCHF, 750 kCHF]
Cost estimation > 750 kCHF
Potential Non-competitive Tender

Already dispatched
Under preparation
Under discussion
Cancelled

Upcoming Procurement (2023)

January	February	March	April	May	June	July	August	September	October	November	December
DO-XXXXX (WP6B) Assembly of CDB 2.0/0.6 kA	DO-XXXXX (WP5) Welded Bellows for LS3 Collimators	DO-XXXXX (WP9) LN2 Storage Tanks	MS-XXXX (WP6B) Power Modules 14kA PCs	DO-XXXXX (WP12) Bake-out System LS3	DO-XXXXX (WP15) FSI Series	IT-XXXX (WP5) Roller Screws for LS3 Collimators		MS-XXXX (WP15) Hydrostatic Levelling Sensors Series	DO-XXXXX (WP5) FMC Cards for Motion Control	IT-XXXX (WP5) Chains for flanges	DO-XXXXX (WP8) Plug-in connectors for VAX
DO-XXXXX (WP6B) Cooling Plates for CDBs/WCBBs	DO-XXXXX (WP6B) DCCTs Class 3	MS-XXXX (WP5) CuCD for LS3 Collimators	MS-XXXX (WP6B) Frames 14kA PCs	IT-XXXX (WP13) BGV vacuum system	DO-XXXXX (WP15) Targets for CCs Monitoring	IT-XXXX (WP5) CuCD for LS3 Collimators		MS-XXXX (WP15) Wire Positioning Sensors Series	DO-XXXXX (WP5) PXI-e COMe Adapter		IT-XXXX (WP5) Vacuum interconnects
DO-XXXXX (WP18) Crates	MS-XXXX (WP5) Production LS3 Masks	IT-XXXX (WP6B) DCCTs Class 4	MS-XXXX (WP5) PXIe Carrier	IT-XXXX (WP5) Jig and Jacks for AUP Platforms	DO-XXXXX (WP15) Feedthroughs for CCs Monitoring	IT-XXXX (WP1) Rad-tol and Rad-hard cables		IT-XXXX (WP5) Production LS3 Masks	MS-XXXX (WP8) Y-chamber Series		IT-XXXX (WP15) ITMB for MAFI-like
DO-XXXXX (WP18) Rad-tol Power Supplies	MS-XXXX (WP5) Jig and Jacks for AUP Platforms	~~IT-XXXX (WP6B) Crowbar Diodes Stack 18 kA~~	Single Tender (WP5) GLIDCOP for LS3 Collimators	MS-XXXX (WP5) Chains for flanges	MS-XXXX (WP15) Unloading Equipment	Single Tender (WP5) Guiding Shaft for LS3 Collimators		IT-XXXX (WP5) PXIe Carrier	IT-XXXX (WP8) TAXN Absorber		IT-XXXX (WP15) Unloading Equipment
DO-XXXXX (WP18) Rad-tol System Boards	IT-XXXX (WP9) Interconnecting Piping	MS-XXXX (WP14) Material for Dump Cores			MS-XXXX (WP15) ITMB for MAFI-like			IT-XXXX (WP5) Stepping motors drivers	IT-XXXX (WP8) TAXS Absorber		IT-XXXX (WP13) BLM Electronics
DO-XXXXX (WP18) Field bus mezzanine	IT-XXXX (WP5) MoGr absober blocks TCSPM				MS-XXXX (WP8) TAXN Absorber			Single Tender (WP5) Connectors for LS3 Collimators	IT-XXXX (WP5) Production of LS3 Collimators		
DO-XXXXX (WP5) Hydroformed Bellows for LS3 Collimators	IT-XXXX (WP7) Quench Heater Power Supply for LHC				MS-XXXX (WP8) TAXS Absorber						
DO-XXXXX (WP5) CuCr1Zr for LS3 Collimators					MS-XXXX (WP13) BLM Electronics						
MS-XXXX (WP6B) DCCTs Class 4					IT-XXXX (WP6B) 600A Power Converters						
MS-XXXX (WP13) BGV vacuum system					IT-XXXX (WP6B) Power Modules 14kA PCs						
IT-XXXX (WP15) Customized Forklift					IT-XXXX (WP6B) Frames 14kA PCs						
MS-XXXX (WP5) Stepping motors drivers											
IT-XXXX (WP6B) Power Modules 18kA PCs											
IT-XXXX (WP17.1) Vertical Cores Excavation											

Cost estimation [50 kCHF , 200 kCHF]
Cost estimation [200 kCHF, 750 kCHF]
Cost estimation > 750 kCHF
Potential Non-competitive Tender

Already dispatched
Under preparation
Under discussion
Cancelled

Upcoming Procurement (2024)

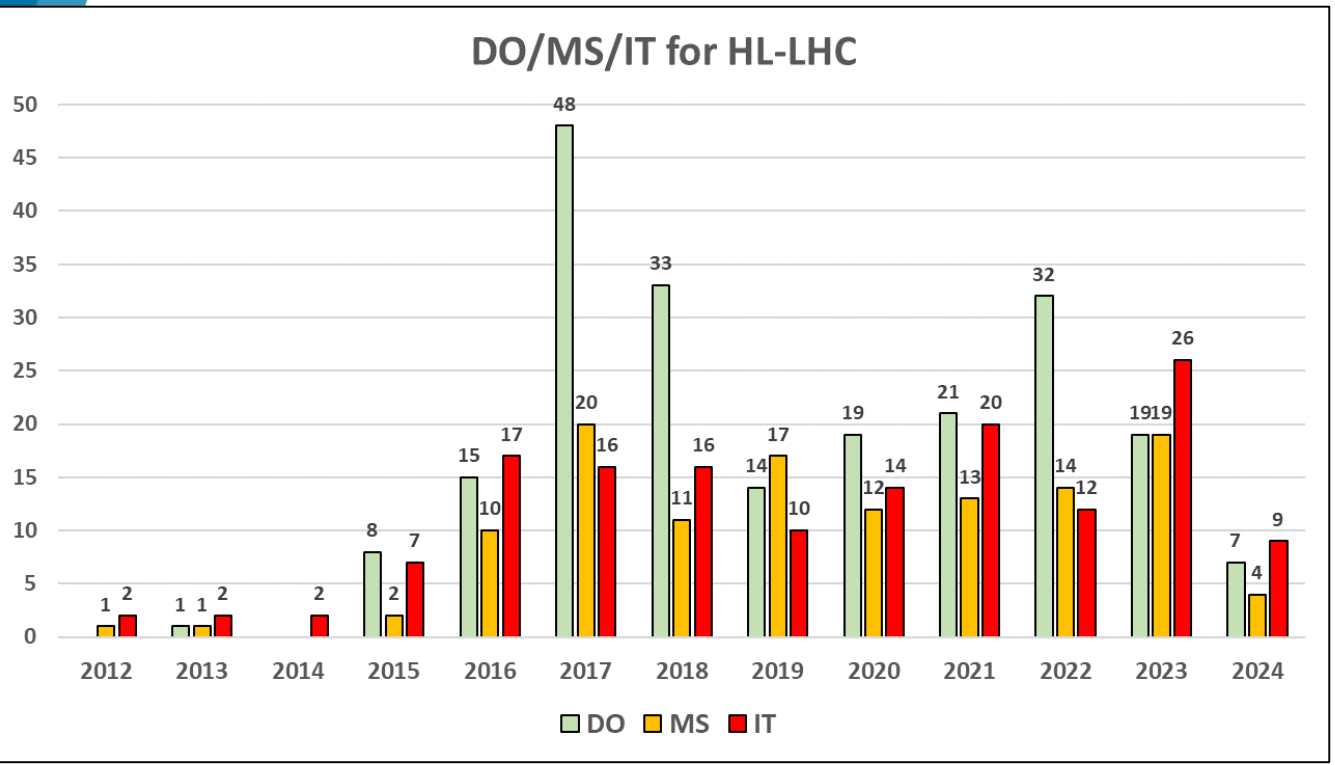
January	February	March	April	May	June	July	July	August	September	October	November	December
DO-XXXXX (WP15) Tractor for TAN, TAXN	MS-XXXX (WP14) Vaccum Vessel TDE		IT-XXXX (WP15) Hydrostatic Levelling Sensors Series	IT-XXXX (WP5) Vacuum interconnects	DO-XXXXX (WP3) W Bellows				DO-XXXXX (WP5) Bakeout jackets for LS3 Collimators			
DO-XXXXX (WP15) Trasnfer System for TAN, TAXN			IT-XXXX (WP15) Wire Positioning Sensors Series	IT-XXXX (WP13) BPM Electronics	MS-XXXX (WP4) LLRF Fararday Cages				IT-XXXX (WP4) LLRF Fararday Cages			
DO-XXXXX (WP15) Trailer for TAN, TAXN				IT-XXXX (WP5) Supports/Craddles LS3 Collimators	IT-XXXX (WP4) High Power RF Lines				MS-XXXX (WP14) Vaccum Vessel TDE			
DO-XXXXX (WP5) Manifolds for LS3 Collimators					IT-XXXX (WP14) Material for Dump Cores							
DO-XXXXX (WP5) COMe CPU												
MS-XXXX (WP5) Supports/Craddles LS3 Collimators												
MS-XXXX (WP13) BPM Electronics												
IT-XXXX (WP8) Y-chamber Series												
MS-XXXX (WP4) High Power RF Lines												

Next update of the plan in early 2023, so more tenders will be added to the plan. We expect a decrease of the activity after second half of 2024.

- Cost estimation [50 kCHF , 200 kCHF]
- Cost estimation [200 kCHF, 750 kCHF]
- Cost estimation > 750 kCHF
- Potential Non-competitive Tender

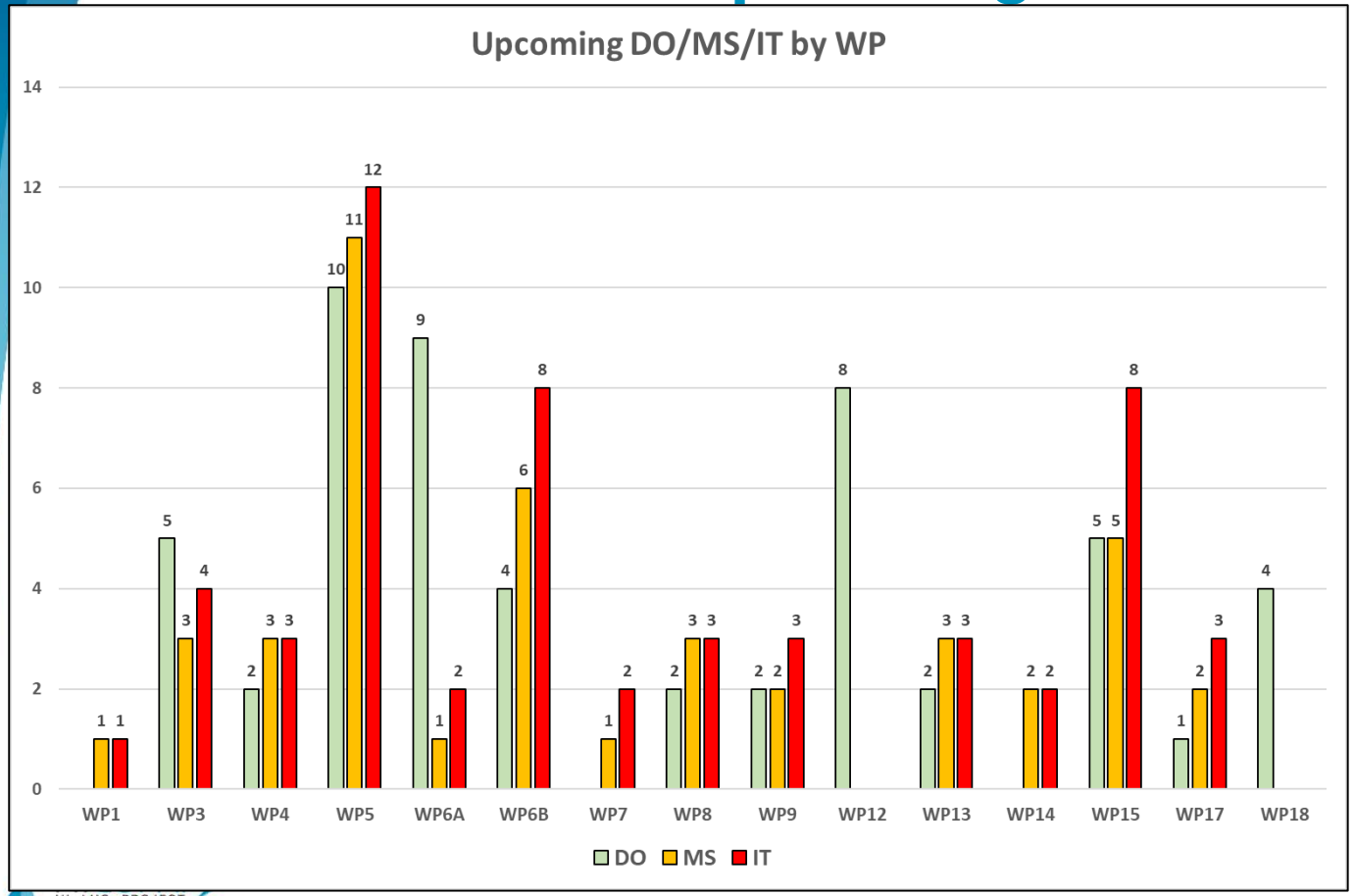
- Already dispatched
- Under preparation
- Under discussion
- Cancelled

2022 and Upcoming Procurement



- Still very hectic procurement activity expected for the next three years
- About 100 contracts (c > 50 kCHF) to be awarded in various domains (Raw materials, Vacuum, Cryogenics, mechanics, Electromechanics, Power Converters, Transport…)
- Opportunity for CERN Member State Industries

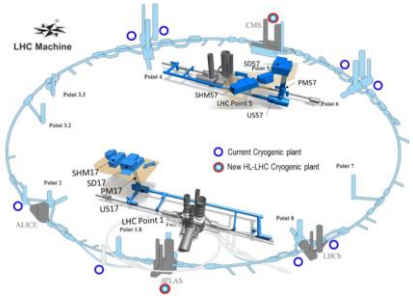
2022 and Upcoming Procurement

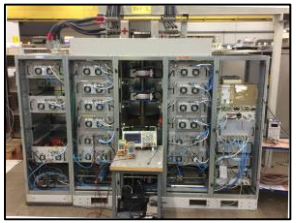


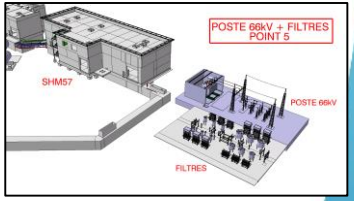
- For some WPs (WP6B, WP12, WP15) it was already foreseen some intense procurement in the upcoming years
- For WP4, WP5, WP6A and WP8 the insource of Russian contribution are/will be leading to more procurement than expected

Main Contracts for HL-LHC to be awarded

Contract	Contract Signature by (Tentative dates)
P1/P5 Refrigerators (Cryogenics)	FC June 2022 ✅
QXL - Cryogenic distribution line	FC September 2022 (next week) ✅
Raw materials for Current Leads and production	Through Price Enquiries ✅
WCC for WP17	FC March 2023
GHe Storage Tanks	FC June 2023
18kA Power Converters	FC June 2023
600A / 2kA Mechanical Switches for EE System	FC June 2023
Interconnecting Piping (Cryo)	FC September 2023
Quench Heater Power Supplies (if no Collaboration)	FC September 2023
High Power RF Systems (IOTs)	FC December 2023
Actuators for FRAS (Motors and Gear Boxes)	FC December 2023
Vertical Cores Excavation	FC June 2024
LS3 Collimators Production	FC June 2024
Core Material for TDE Dump	Depends on material choice







The two biggest remaining Contracts for HL-LHC approved by FC in 2022!!!

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Mitigation Actions after CSR21

- In-source of the Russian Contribution by phases as presented in the CSR21 and to the ATS management /DHs (list of priorities)
- De-scope of some of the items from the Russian Collaboration (See Oliver and Markus' presentation)
- Looking for alternatives for some items included in Russian Collaboration (and some other items) with other potential Collaborations. Discussions on-going
- Manufacturing of some urgent items via EN-MME (Current Leads, BPMs), for which the full tendering would have impacted the project schedule (due to the non activation of the in-kind Contribution) - Industries are involved too.
- Use of Framework Contracts and Central Services at CERN (prices are less volatile)
- Revision of number of units to be produced (i.e jacks) or material choices (i.e collimator's jaws) aiming at savings

Mitigation Actions after CSR21

- Foster Competitive Tenders – It usually helps to have better prices (limited options are risky)
- Sharing risks with Suppliers in tenders by applying price revision formulas in the Contracts:
  - Price Index according to Producer prices in industry, domestic market - monthly data", published by Eurostat, code B-E36 for European Union – 27 countries for contracts in euro (EUR) or similar indices if the contract is in another currency: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sts_inppd_m&lang=en
  - For raw material costs, CERN may apply price revision formulae based on the average London Market Exchange (LME) Closing Price (https://www.lme.com) of the month preceding that of the price revision, converted in the currency of the contract.

Outline

1. Procurement Plan (Make or Buy Plan)
2. Progress since last C&S Review
3. Upcoming Procurement
4. Lessons Learned
5. **Conclusions**

Conclusions

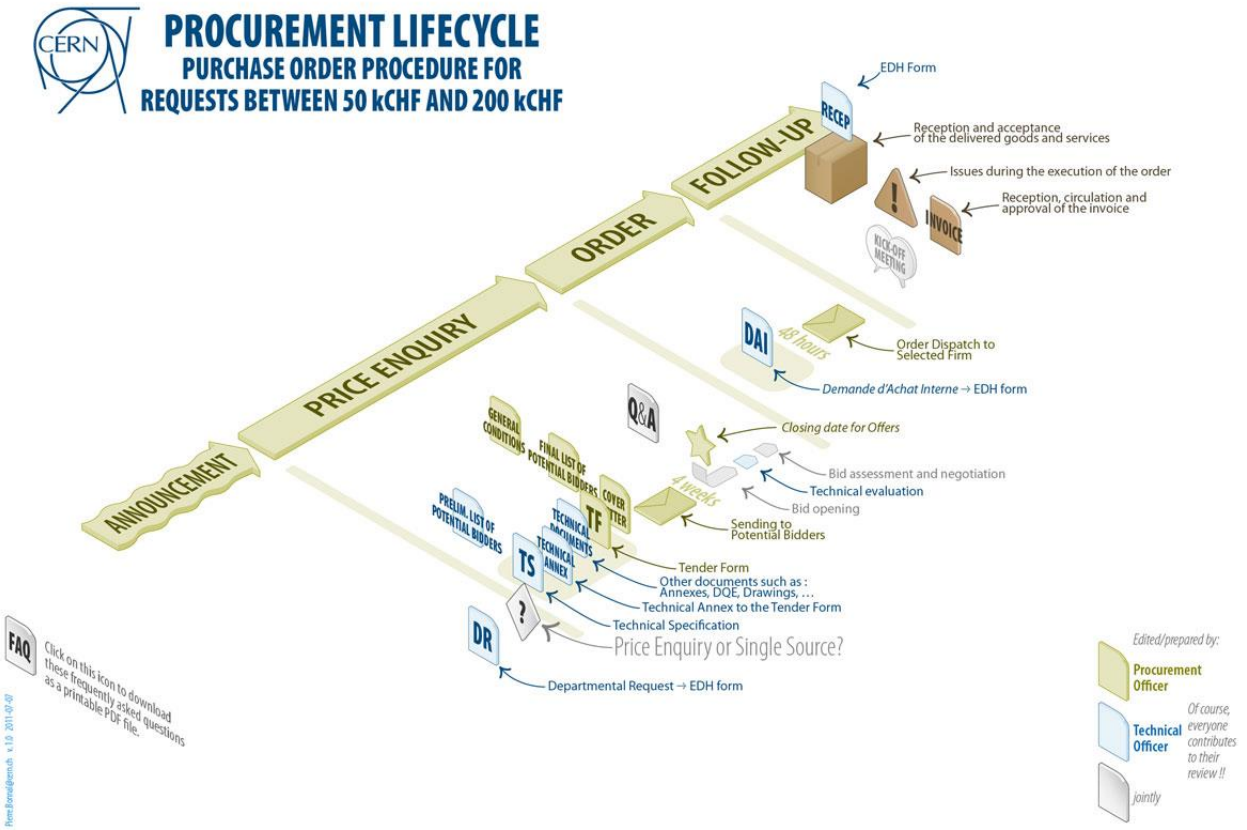
- **Procurement** activities have become a major **challenge** due to the **global market situation** (**financial** & **schedule** risk)
- Markets are moving **from fixed to variable prices** (linked to energy costs, price of raw materials, etc)
- Still **high uncertainty in short term** - **Energy** is becoming an issue and **we cannot still quantify the full impact**
- Despite the **LS3 shift** the message from the Project was **to keep the procurement schedule** all along the project **unless there were significant financial benefits by shifting it**
- Very **intense period of activity for procurement** (more than foreseen) during 2022 (*it is not over until it is over*)
- **Important Contracts** approved (or close to be) by **FC in 2022 (Big Step in the budget committed by the Project)**

Many Thanks

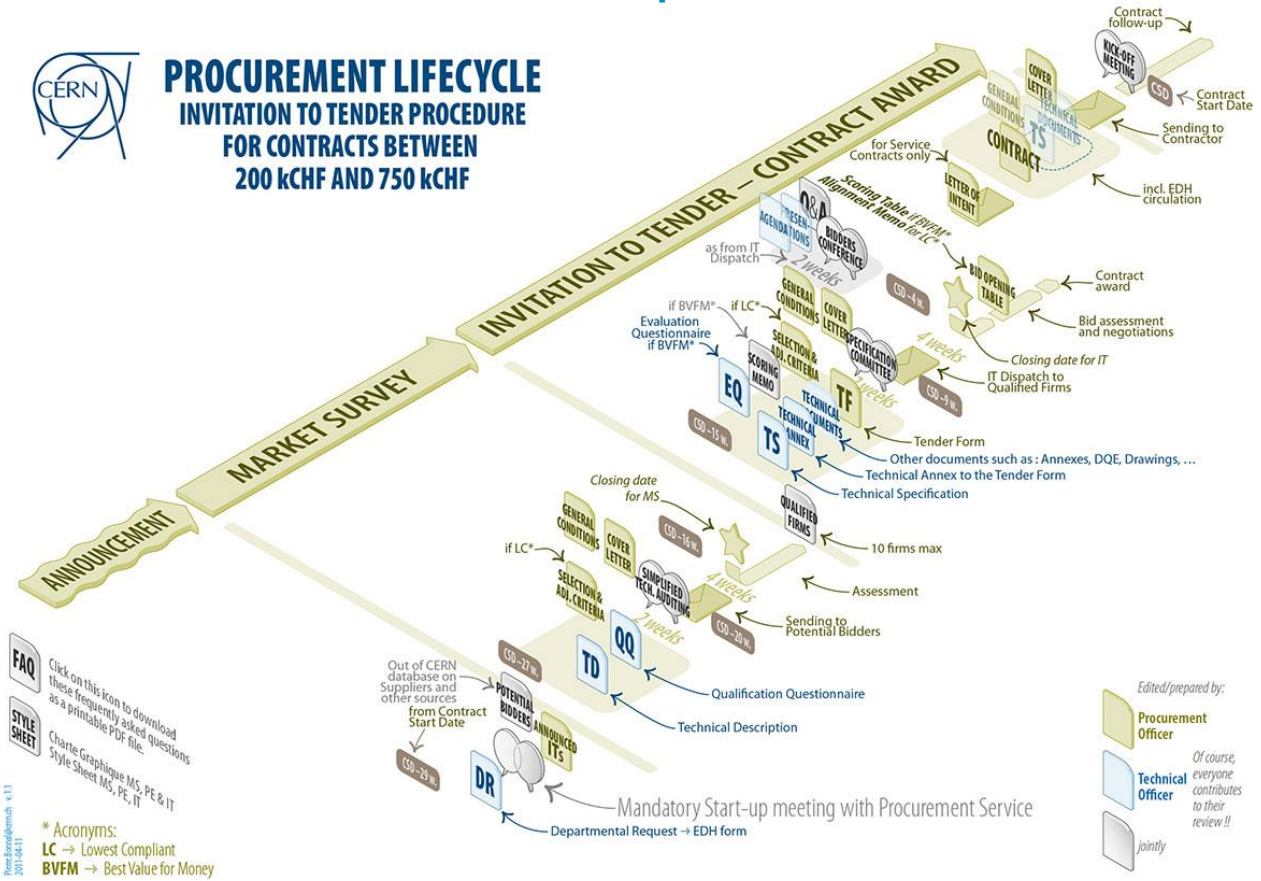
Special Thanks to IPT colleagues, my colleagues from the PDQR Office (Victor and Lorcan), SCE (Leila) and many others for their contributions to this presentation

Spare Slides

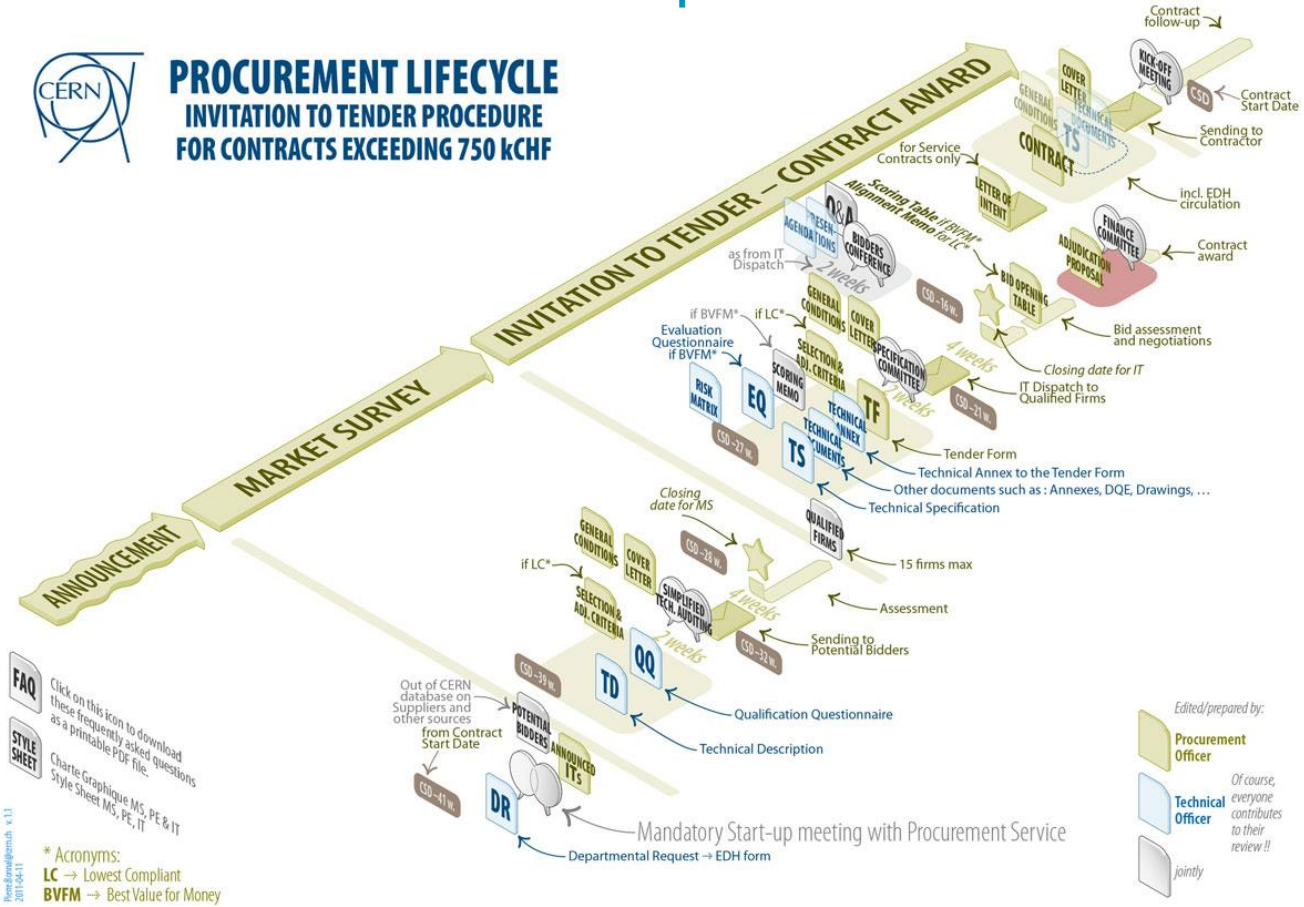
Procurement processes



Procurement processes



Procurement processes



Lessons Learned

PROCESS	SOME LESSONS LEARNED
PROCUREMENT PROCESS	• **Processes** that imply **MS/IT take time** (even **standard cases** without prototypes, qualification samples or studies in the MS phase): easily **5-6 months** from **process start** to **signature** If **FC** is required it can easily take **one year**. **Accommodate** this minimum **time** in the **planning** • Main **approach** for **HL-LHC** - **Launch the procurement as earliest as possible**. **Early signature** may help to **absorb potential issues during the production** (Delays, Nonconformities, etc.) …but not too early (mature final technical solution and strategy is needed). Sometimes to find the **balance** is **not trivial** • **Standardization** is also important in medium term to be **more competitive** (components, materials, off-the-shelf products) – **Standardization Committee** being set. This will also help to **optimize** the processes
ESTIMATIONS	• **Estimating prices** for **exotic components** with requirements for testing and documentation that go **beyond typical industrial practice** is **difficult** (**companies** are **reluctant** to give prices if there is **no official RfQ** from IPT)
MARKET SURVEYS	• **Involve management** at an early stage to discuss the **strategy** and form a **common understanding** • **Markets Surveys** are issued to **qualify companies** and the **documents should be oriented to this goal** • **Qualification/No qualification** of Firms must take place **at this stage** of the process • Even a **detailed** and thoroughly prepared **MS** is sometimes **not enough to qualify/disqualify firms**. **Visit the Suppliers before qualifying in case of doubts**. **COVID-19 times** - either a virtual visit or a video showing the facilities/tools would be advised • **Qualification samples/units** during the MS phase are very useful. We have seen **much better prices as the final specification can be tuned based on the outcome** (relax/tight requirements). However, w**e do not have the luxury to request this for every MS** as it implies time, budget and resources

Lessons Learned

PROCESS	SOME LESSONS LEARNED
INVITATION TO TENDER	• **Avoid over specifying** (aka **Gold-plated specifications**) • **Aggressive delivery schedule** has **impact on cost**. **Same** for **multi-year contracts** with gaps in between contracts phases. **Strategies** are to be **discussed** with the **management** well in advance. • **Hold Points** and **Testing Deadline** should be clear defined. Check that **Contractor** understands **schedule impact** • **Bidders conference** are useful in **complex cases** to solve general concerns and **clarify** the main points of the specifications
PRICING	• **High-requirements** and **small series production** are **not** a very **good combination** (low interest) • Mainly **small contracts** for HL-LHC (low risk for companies and low priority) • **Competition leads to better prices** • **New markets are now involved. Lack of previous experience**
FIRMS	• **Single Source Tenders** have a **high risk** and **should be avoided whenever possible** • **Qualification** of **new suppliers** is **costly** (time, budget and resources) and it is **not** always **easy**. Nevertheless to **open the market** is in the end very well paid off (**Strategy** at **Organizational** level) • Even if **we invest** for **suppliers to meet a CERN need**, if this doesn't address a **broader market**, **there is no guarantee** they will **maintain that capability** in the **long-term** for the next time we need it • Rely on **single companies** in close markets is **not recommended**. In SMEs mainly but not only, **changes** in availability of a **key resource** over time **can make a huge difference** (do not assume that a company can make something just because they did in the past) • **Sourcing** is an important activity. **IPT**, Requests to **ILOs**, etc can be very helpful if needed

Lessons Learned

PROCESS	SOME LESSONS LEARNED
CONTRACT SIGNATURE & FOLLOW-UP	• Organize a **kick-off** meeting upon **Contract signature** to clarify well the scope, discuss any details, and avoid any misunderstanding from the beginning • **Industrialization** and **transfer of knowledge** takes time. We are mostly buying non-standard industrial products and **ramping-up will require time** • **Pre-series Phase** of utmost **importance** to settle the full production • **Major changes during series production are not easy-handling** (slow-down the production, extra-costs, etc.) • **Industrial contracts** for **non-mature technologies does not give the required flexibility**. Strategy to be widely discussed before starting the procurement process • The role of the **CERN Technical Officer** is very **important** for the correct execution of the contract. **Close follow-up and steering of decisions during the production**. The Technical Officer to have full knowledge of the field • **On-site** visits at Contractor's facilities are required to **unblock situations** and **get first-hand information** about the production
SUPPLY ACCEPTANCE	• **We should not only rely on the documentation provided by companies** (QC Tests during production, FAT Reports). **Counterchecks** upon arrival (SAT) **are recommended whenever possible**. **Testing** (or **at least** some **% randomly**) of some **critical sub-components upon reception** is advisable **even if the Supplier provides the conformity certificates and full documentation** • According to the **General Conditions of CERN Contracts**, we have **3 months by default to perform the acceptance tests upon delivery**. If you believe **this time is too short** for your specific case, add a **clause** in the **Invitation to Tender** to **extend** this deadline

Lessons Learned

PROCESS	SOME LESSONS LEARNED
	• Organize a **kick-off** meeting upon **Contract signature** to clarify well the scope, discuss any details, and avoid any misunderstanding from the beginning

- ❑ **Minimum time for tendering should be accommodated in the planning**
- ❑ **Challenge for small series production (less attractive, less interest)**
- ❑ **Open the Market – Single Tenders are a huge risk (Organizational strategy)**
- ❑ **Changes during series production not easy to handle (delays, extra costs…)**
- ❑ **Visits during the Contract execution are fundamental (COVID-19 situation)**
- ❑ **Site Acceptance Tests (do not rely only in documentation provided by Vendors)**
- ❑ **Timeline in industry ≠ Timeline CERN Projects**

SUPPLY ACCEPTANCE	• **We should not only rely on the documentation provided by companies** (QC Tests during production, FAT Reports). **Counterchecks** upon arrival (SAT) **are recommended whenever possible**. **Testing** (or **at least** some **% randomly**) of some **critical sub-components upon reception** is advisable **even if the Supplier provides the conformity certificates and full documentation** • According to the **General Conditions of CERN Contracts**, we have **3 months by default to perform the acceptance tests upon delivery**. If you believe **this time is too short** for your specific case, add a **clause** in the **Invitation to Tender** to **extend** this deadline

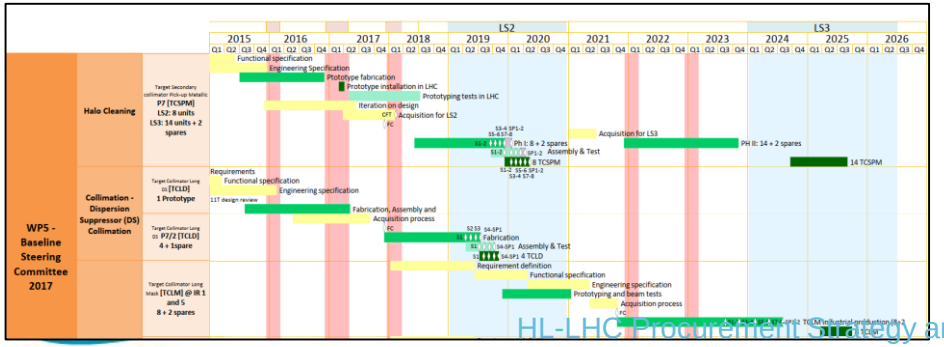
HL-LHC Procurement Plan – Modus Operandi

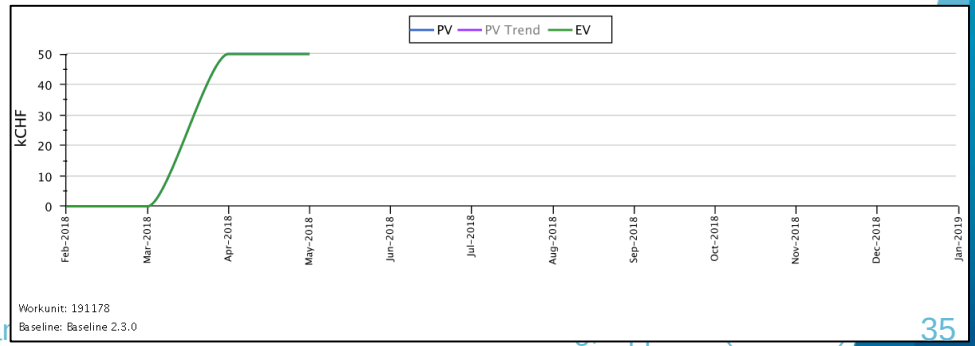
Based on the **expenditure profile**, the **Project Schedule** and together with the Bill of Materials **(BOM)**, the acquisition of each of the main components of the equipment is assessed and planned (**bottom-up approach**)

Package Name	Work Package Referenc	Detailed Description	Foreseen Cost Range	Current Tender Status	Department Request No	Tender Reference	Starting Date for Tendering (PE, MS or IT)	Financial Committee (when c>750k)	Contract Required	Manufacturing time	Required On Site

- How much is the **cost estimation**?
  This triggers the process to be followed according to **CERN Procurement Rules**
  It also has **impact** on the time required (**next slide**)
- **When** is the **Supply required on Site?**
- **How much time will** the **production take?**
- **Competitive** Tender? Limited Market?
- Does the order have any link to others? Deliverables

- **Best Strategy to be followed:**
  Industrial Procurement / Framework Contract / In-house
- If **outsourcing**, based on the **deadline to award** the contract we can already determine the date to **start the tendering process**
- Milestones in the Master Schedule and EVM Workunits (link to Cost and Schedule)





Make or Buy plan – Collaborations (Who does what)

LHC DQW CRYOMODULES	SERIES DQW (1 cryomodule) - CM1				SERIES DQW (4 cryomodule) - CM2-CM5			
	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION
Bare Cavity	CERN	CERN - Industry (RI)	-	CERN	CERN	CERN - Industry (RI)	-	CERN
Jacketed Cavity	CERN	CERN - Industry (RI)	CERN - Industry (RI)	CERN	CERN	CERN - Industry (RI)	CERN - Industry (RI)	CERN
HOMs & Pick-ups	CERN	CERN	CERN	CERN	CERN	CERN	CERN	CERN
Cold Magnetic Shield	UK	UK - Industry (-)	CERN - Industry (RI)	-	UK	UK - Industry (-)	CERN - Industry (RI)	-
Tuning System	CERN	CERN	CERN	CERN	CERN	CERN	CERN/UK	CERN / UK
FPC	CERN	CERN	CERN	CERN	CERN	CERN	CERN/UK	CERN / UK
Dressed Cavity	CERN	CERN	CERN	CERN	CERN	CERN	CERN/UK	CERN / UK
Vacuum Vessel	CERN / UK	CERN - Industry (-)	CERN - Industry (-)	CERN - Industry (-)	CERN / UK	UK	UK	UK
Warm Magnetic Shield	CERN / UK	CERN - Industry (-)	CERN	CERN	CERN / UK	UK - Industry (-)	UK	UK
Thermal Shield	CERN / UK	CERN	CERN	CERN	CERN / UK	UK	UK	UK
Cryogenic Circuits	CERN	CERN	CERN	CERN	CERN	UK	UK	UK
Coaxial RF Lines	CERN	CERN	CERN	CERN	CERN	CERN	UK	CERN / UK
Beam Screen	CERN	CERN	CERN	CERN	CERN	CERN	UK	CERN / UK
Instrumentation	CERN	CERN	CERN	CERN	CERN	CERN / UK	CERN / UK	CERN / UK
Cryomodule Assembly	CERN	CERN	CERN	CERN	CERN	UK	UK	CERN / UK

LHC RFD CRYOMODULES	SERIES RFD (1 cryomodule) CM1				SERIES RFD (4 cryomodules) CM2-CM5			
	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION
Bare Cavity	AUP / CERN	AUP - Industry (Zanon)	-	AUP	AUP / CERN	AUP - Industry (Zanon)		AUP
Jacketed Cavity	AUP / CERN	AUP - Industry (Zanon)	AUP - Industry (Zanon)	AUP	AUP / CERN	AUP - Industry (Zanon)	AUP - Industry (Zanon)	AUP
HOMs & Pick-ups	AUP / CERN	AUP (JLab)	AUP (JLab)	AUP (JLab)	AUP / CERN	AUP (JLab)	AUP (JLab)	AUP (JLab)
Cold Magnetic Shield	AUP / CERN	AUP - Industry (-)	AUP - Industry (Zanon)	-	AUP / CERN	AUP - Industry (-)	AUP - Industry (Zanon)	-
Tuning System	CERN	CERN / CANADA	CANADA	CANADA	CERN	CERN / CANADA	CANADA	CANADA
FPC	CERN	CERN	CERN / CANADA	CERN / CANADA	CERN	CERN	CERN / CANADA	CERN / CANADA
Dressed Cavity	AUP / CERN	AUP	AUP / CANADA	AUP / CANADA	AUP / CERN	AUP	AUP / CANADA	AUP / CANADA
Vacuum Vessel	CERN / UK	CANADA	CANADA	CANADA	CERN / UK	CANADA	CANADA	CANADA
Warm Magnetic Shield	CERN / UK	CANADA - Industry (-)	CANADA	CANADA	CERN / UK	CANADA - Industry (-)	CANADA	CANADA
Thermal Shield	CERN / UK	CANADA	CANADA	CANADA	CERN / UK	CANADA	CANADA	CANADA
Cryogenic Circuits	CERN	CANADA	CANADA	CANADA	CERN	CANADA	CANADA	CANADA
Coaxial RF Lines	CERN	CERN	CANADA	CERN / CANADA	CERN	CERN	CANADA	CERN / CANADA
Beam Screen	CERN	CERN	CANADA	CERN / CANADA	CERN	CERN	CANADA	CERN / CANADA
Instrumentation	CERN	CANADA	CANADA	CERN / CANADA	CERN	CANADA	CANADA	CERN / CANADA
Cryomodule Assembly	CERN	CANADA	CANADA	CERN / CANADA	CERN	CANADA	CANADA	CERN / CANADA