CLIC Implementation Studies

Ph. Lebrun & J. Osborne
CERN

CLIC Collaboration Meeting addressing the 2012-2016 Work Packages
CERN, 3-4 November 2011

CLIC long-term plan

2011-2016 – Project Preparation phase

Goal for 2016: Develop a project implementation plan for a Linear Collider (at CERN):

- ✓ addressing the key physics goals as emerging from the LHC data
- ✓ with a well-defined scope (i.e. technical implementation and operation model, energy and luminosity), cost and schedule
- ✓ with a solid technical basis for the key elements of the machine and detector
- ✓ including the necessary preparation for siting the machine at CERN
- ✓ within a project governance structure as defined with international partners

After 2016 – Project Implementation phase, including an initial period to lay the grounds for full approval

Considering the preparation steps foreseen and the resources situation it is clear that several key tasks will need further effort before the project can move into construction:

- finalization of the CLIC technical design, taking into account:
  - results of technical studies done in the previous phase
  - final energy staging scenario based on the LHC Physics results, which should be fully available by the time
- possible construction of CLIC Zero as first CLIC phase
- further industrialization and pre-series production of large series components with validation facilities
- further detector and physics studies, with increased emphasis on technical coordination issues and integration
- revision of the project implementation plan of CLIC, following the energy staging strategy and detailed resource discussion with all partners – providing the basis for a staged or full approval, and subsequent construction start up

During this initial period we will need to produce the necessary documents to support a proposal for CLIC construction start-up

The next steps 2012-2016

Define **the scope, strategy and cost of the project implementation**.

Main input:

- The evolution of the physics findings at LHC and other relevant data
- Findings from the CDR and further studies, in particular concerning minimization of the technical risks, cost, power as well as the site implementation.
- A Governance Model as developed with partners.

Define and keep an up-to-date optimized **overall baseline design** that can achieve the scope within a reasonable schedule, budget and risk.

- Beyond beam line design, the energy and luminosity of the machine, key studies will address stability and alignment, timing and phasing, stray fields and dynamic vacuum including collective effects.
- Other studies will address failure modes and operation issues.

Indentify and carry out **system tests** and programs to address the **key performance** and operation goals and mitigate risks associated to the project implementation.

- The priorities are the measurements in: CTF3+, ATF and related to the CLIC Zero Injector addressing the issues of drivebeam stability, RF power generation and two beam acceleration, as we as the beam delivery system.

  (other system tests to be specified)

  (technical work-packages and studies addressing system performance parameters)

Develop the **technical design basis**. i.e. move toward a technical design for crucial items of the machine and detectors, the MD interface, and the site.

- Priorities are the modulators/klystrons, module/structure development including testing facilities, and site studies.

  (technical work-packages providing input and interacting with all points above)

CLIC activities & work packages 2012-2016

	Old Name	New Name	Name	WP Holder
General	CLIC-001		CLIC General	S. Stapnes
Parameters and design	BPH-BASE	CD-BASE	Integrated Baseline Design and Parameters	D. Schulte
Daniel Schulte	BPH-SIM	CD-SIM	Integrated Modelling and Performance Studies	A. Latina
	BPH-FEED	CD-LUMI	Feedback Design	D. Schulte (interim)
	BPH-MP	CD-OP	Machine Protection & Operational Scenarios	M. Jonker
	BPH-BCKG	CD-BCKG	Background	D. Schulte (interim)
	BPH-POL	CD-POL	Polarization	-
	BPH-SRC E	CD-ESRC	Main beam electron source	S. Doebert
	BPH-SRC P	CD-PSRC	Main beam positrion source	
	BPH-DR	CD-DR	Damping Rings	Y. Papaphilippou
	BPH-RTML	CD-RTML	Ring-To-Main-Linac	A. Latina
	BPH-ML	CD-ML	Main Linac - Two-Beam Acceleration	D. Schulte (placeholder)
	BPH-BDS	CD-BDS	Beam Delivery System	R. Tomas
	BHP-MDI	CD-MDI	Machine-Detector Interface (MDI) activities	L.Gatignon
	BPH-DRV	CD-DRV	Drive Beam Complex	B. Jeanneret
Experimental verification	CTF3-001		CTF3 Consolidation & Upgrades	F. Tecker
Roberto Corsini	CTF3-002		Drive Beam phase feed-forward and feedbacks	P. Skowronski
	CTF3-003		TBL+, X-band high power RF production & structure testing	S. Doebert
	CTF3-004		Two-Beam module string, test with beam	-
	CLIC0-001		CLIC 0 drive-beam front end facility (including Photoinjector option)	S. Doebert
	CLIC0-002		Drive Beam Photo Injector	S. Doebert
	BTS-001		Accelerator Beam System Tests (ATF, Damping Rings, FACET,...)	R. Tomas
	BTS-002		Sources Beam System Tests	-
Technical Developments	CTC-001	CTC-WIG	Damping Rings Superconducting Wiggler	P. Ferracin
Hermann Schmickler	CTC-002	CTC-SUR	Survey & Alignment	H. Mainaud
	CTC-003	CTC-QUA	Quadrupole Stability	K. Artoos
	CTC-004	CTC-TBM	Two-Beam module development	G. Riddone
	CTC-005	CTC-WMP	Warm Magnet Prototypes	M. Modena
	CTC-006	CTC-BDI	Beam Instrumentation	T. Lefevre
	CTC-008	CTC-PCLD	Post Collision Lines and Dumps	E. Gschwendtner
	CTC-011	CTC-CO	Controls	M.Draper
	CTC-012	CTC-RF	RF Systems (1 GHz klystrons & DB cavities, DR RF)	E. Jensen (placeholder)
	CTC-013	CTC-EPC	Powering (Modulators, magnet converters)	S. Pittet
	CTC-014	CTC-VAC	Vacuum Systems	C. Garion
	CTC-015	CTC-MM	Magnetic stray Fields Measurements	S. Russenschuck
	CTC-016	CTC-BT	Beam Transport Equipment	M. Barnes
	CTC-017	CTC-MME	Creation of an "In-House" TBA Production Facility	F.Bertinelli (placeholder)
X-band Technologies	RF-DESIGN	RF-DESIGN	X-band Rf structure Design	A.Grudiev, I. Syratchev
Walter Wuensch	RF-XPROD	PRODUCTION	X-band Rf structure Production	G.Riddone
	RF-XTESTING	TESTING	X-band Rf structure High Power Testing	S.Doebert
	RF-XTESTFAC	TEST AREAS	Creation and Operation of x-band High power Testing Facilities	E.Jensen (placeholder)
	RF-R&D	HIGH-GRADIENT	Basic High Gradient R&D	S.Calatroni
Implementation studies		IS-CES	Civil Engineering & Services	J. Osborne
Philippe Lebrun		IS-PIP	Project Implementation Studies	P.Lebrun

CLIC Implementation Studies

WP Civil Engineering and Services

WP: IS-CES Workpackage leader: J. Osborne	Purpose/Objectives/Goals	Deliverables (incl. approx. resource estimate)	Schedule
Task 1: Site studies	Develop site criteria, conduct geological investigations, optimize site layout & shaft positions	1. Establish site selection matrix, 2. Produce internal Siting Studies report, 3. Issue Siting Studies report to external authorities	Deliverable 1 mid 2012; deliverable 2 mid 2013; deliverable 3 end 2016
Task 2: Environmental Impact	Prepare Environmental Impact Study	1. Outline of Environmental Impact document, 2. Issue Environmental Impact document	Deliverable 1 mid 2012; deliverable 2 end 2016
Task 3: Services	Update technical definition of services	1. Electrical distribution 2. Cooling & ventilation 3. Handling & transport 4. Survey and alignment	All deliverables end 2016

http://indico.cern.ch/categoryDisplay.py?categId=1882

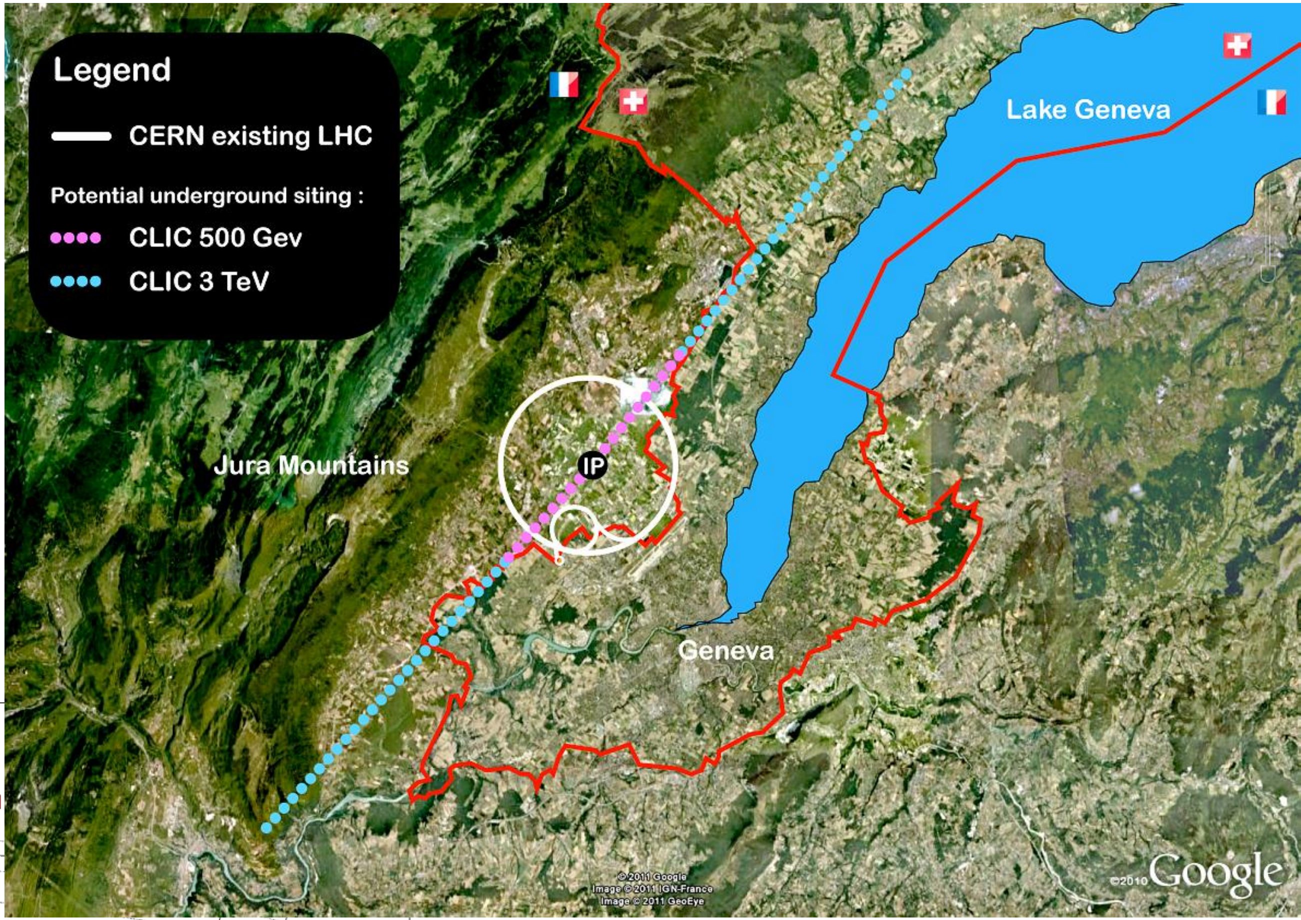
CERN support required from BE-ABP, EN-CV, EN-EL, EN-HE, EN-MEF, GS-SE

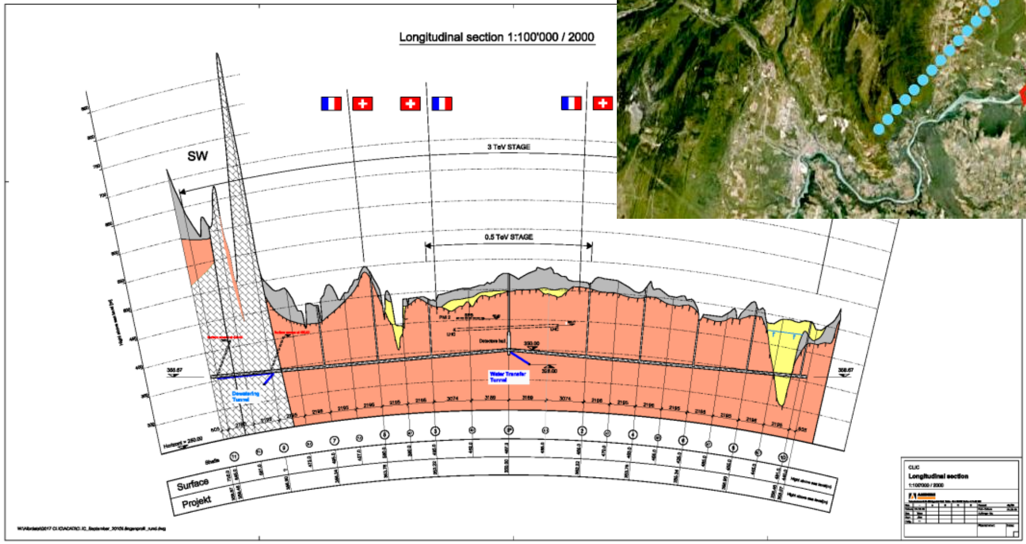
Lead collaborator(s): CERN (J.Osborne et al); FNAL (V.Kuchler); KEK (A.Enomoto), DESY (W.Bialowons), JINR (G.Shirkov)

Estimated resources (needed):	2012	2013	2014	2015	2016	Total
Material (kCHF)	100	100	100	100	100	500
Personnel (FTE)	2.5	3	3	3	3	14.5

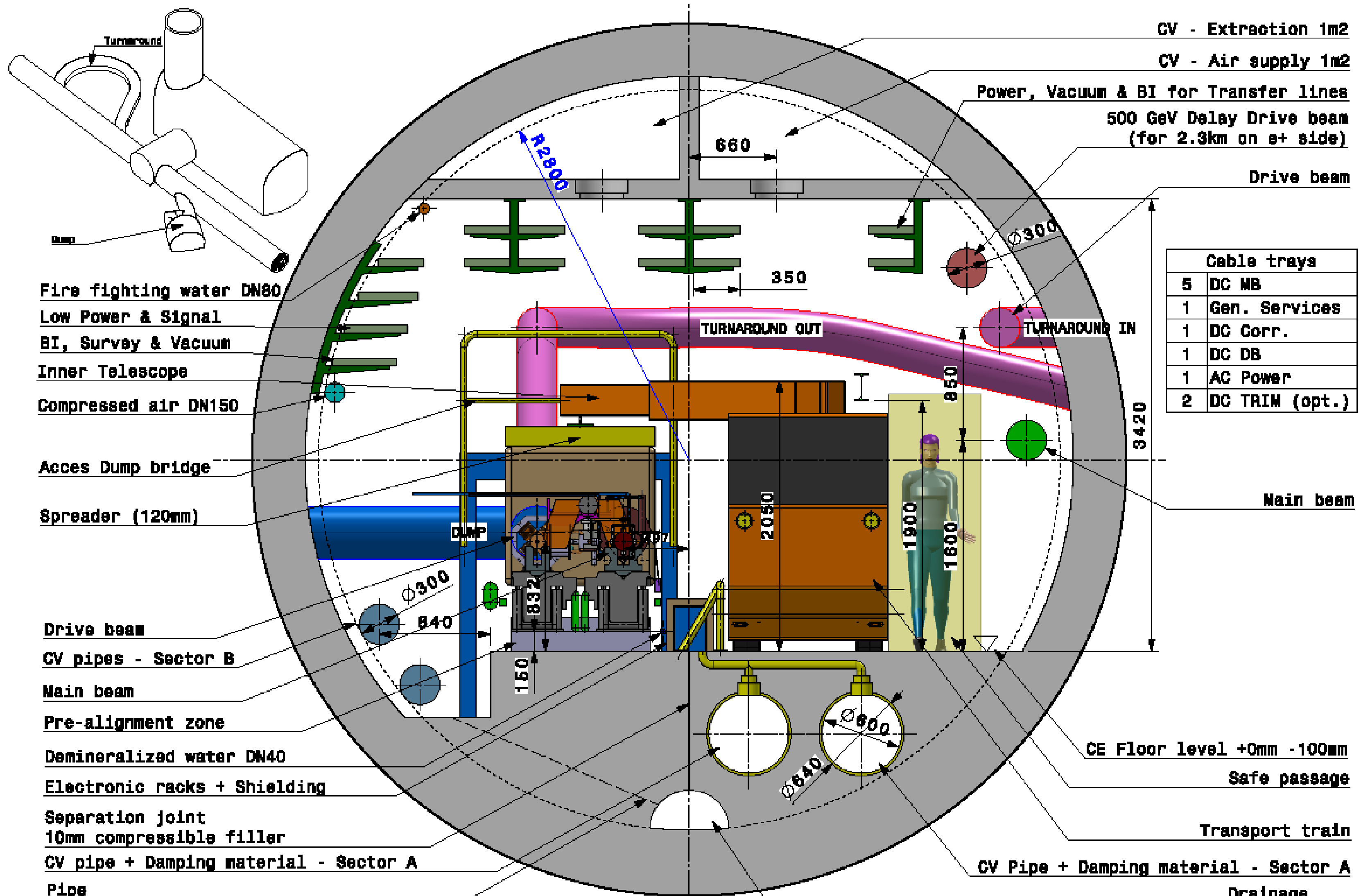
Resource comment: material budget for external consultancy services (e.g. geologist, environmental expert, engineer & architect)

Civil engineering: tunnel profile & footprint





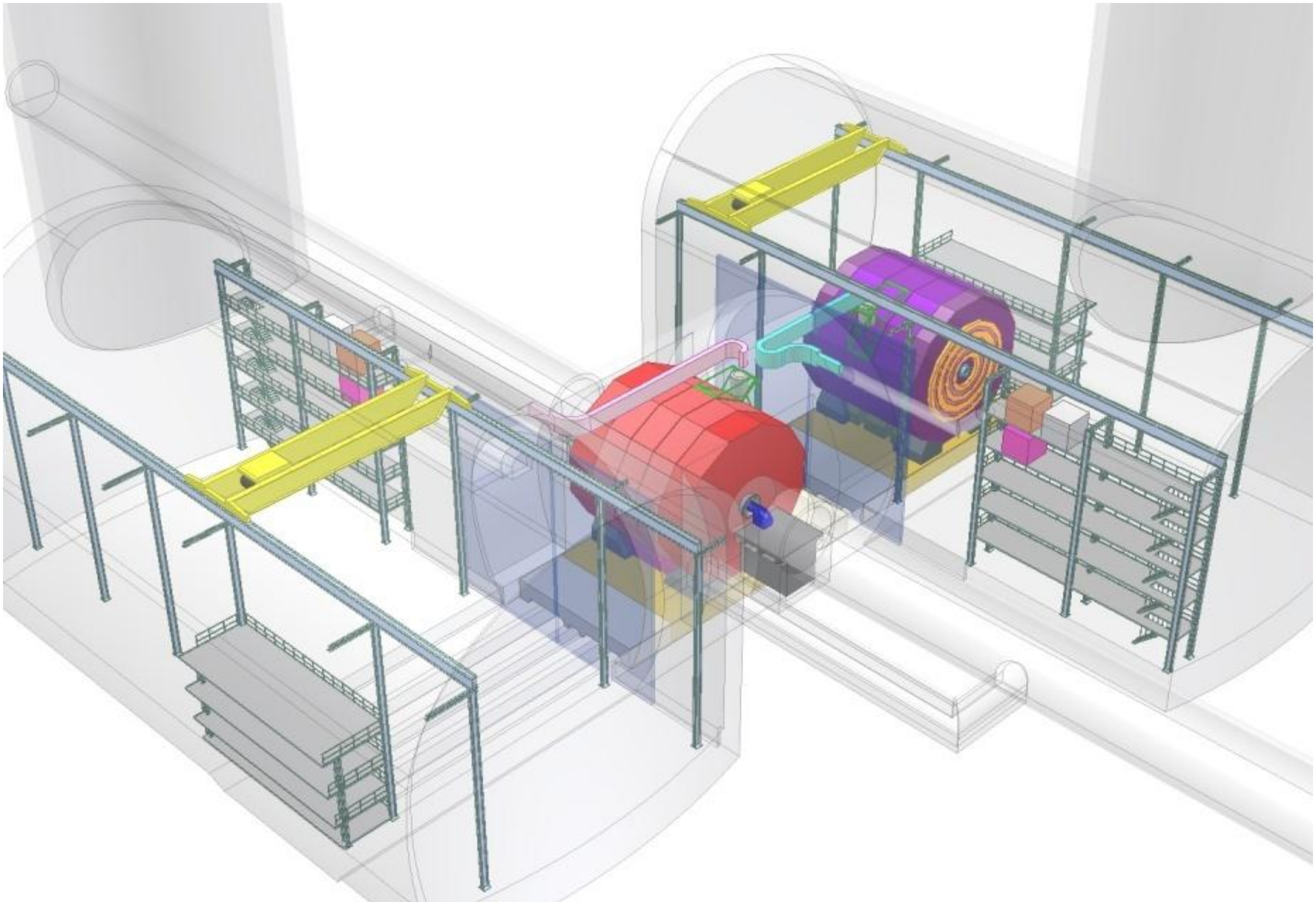
Integration: tunnel cross-section



Cable trays	
5	DC MB
1	Gen. Services
1	DC Corr.
1	DC DB
1	AC Power
2	DC TRIM (opt.)

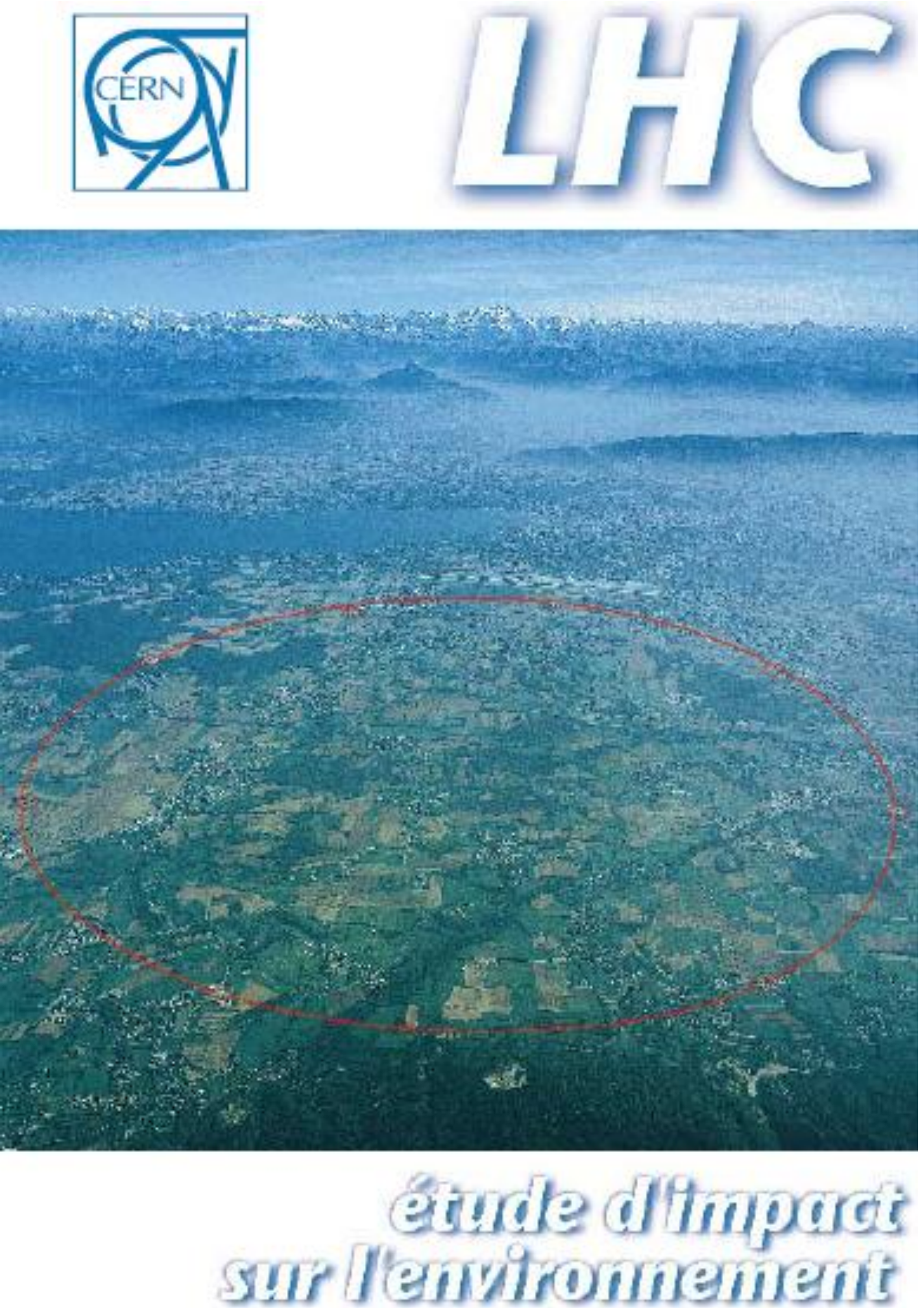
CLIC - Typical Cross Section - Diameter 5600mm - Junction with Turnaround - 1:25
Draft - J.Osborne / A.Kosmicki - August 9th 2010

Integration: experimental area



Environmental impact study

encompasses complete lifecycle, from construction to D&D



Le Conseil du CERN a décidé à l'unanimité, le 16 décembre 1994, de construire le grand collisionneur de hadrons (LHC), qui donne aux physiciens des particules européens et du monde un instrument exceptionnel pour la poursuite de leurs travaux.

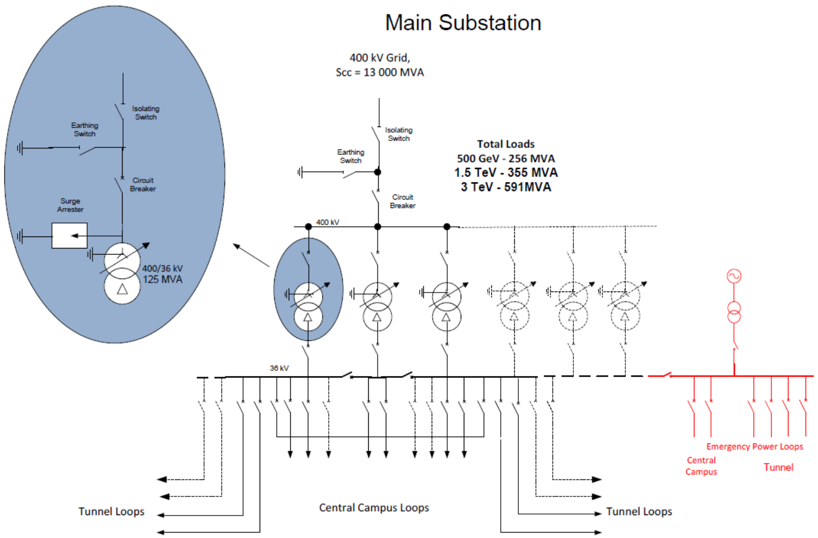
Cet instrument sera réalisé sur le domaine que la Suisse et la France, Etats-hôtes de l'Organisation, ont mis à la disposition de celle-ci.

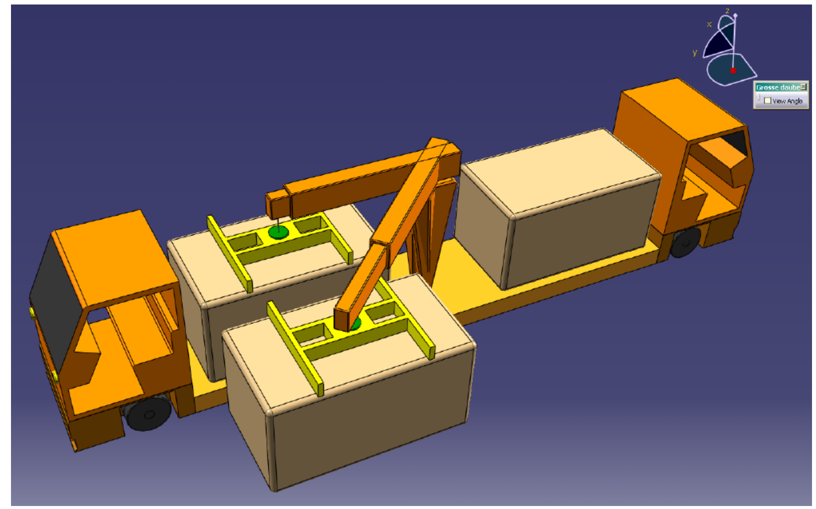
Comme il l'a fait pour ses grands accélérateurs antérieurs, en particulier le SPS et le LEP, le CERN réalisera le LHC en concertation avec les autorités nationales et les élus locaux.

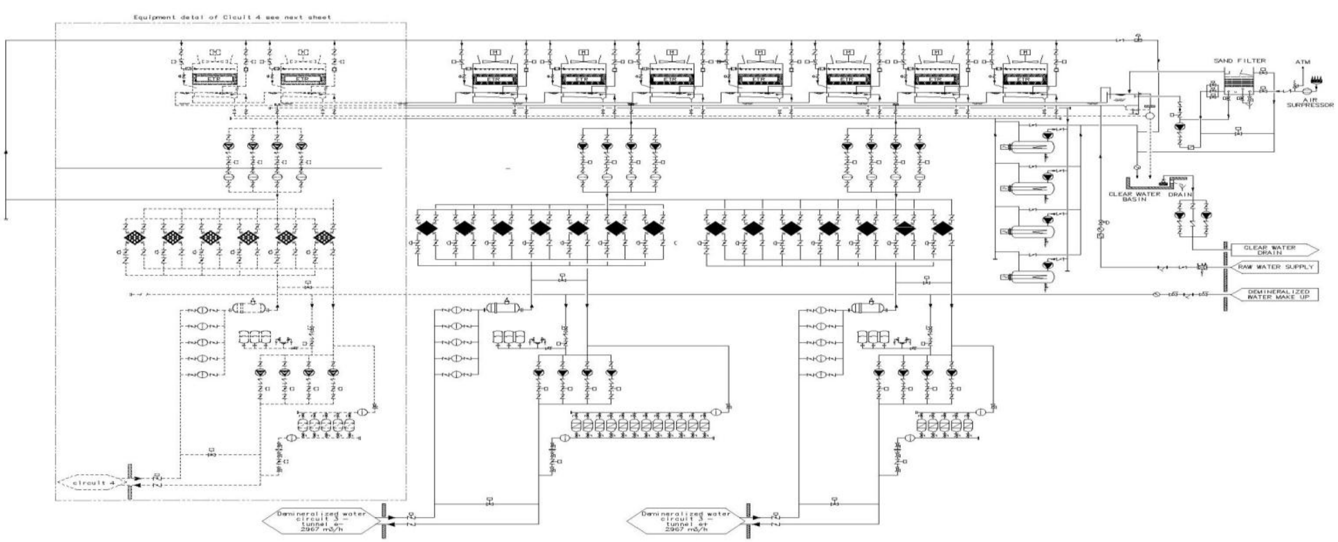
Hubert Curien
Président du Conseil du CERN
lors de l'approbation du projet LHC
Ancien Ministre de la Recherche
du Gouvernement français

Services

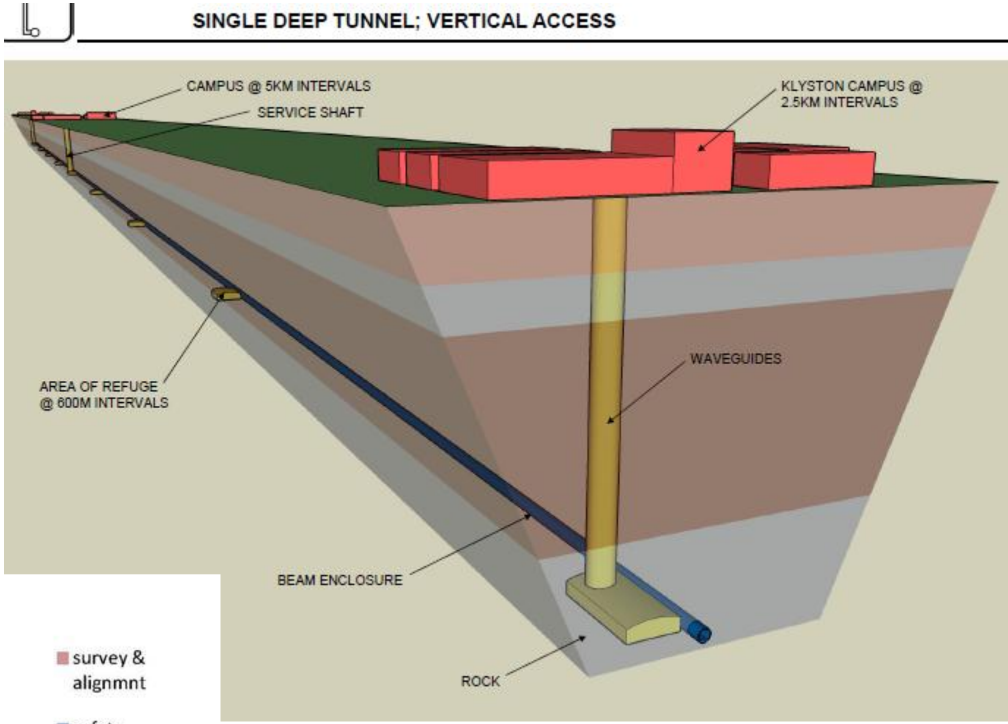
Electrical distribution, Cooling & ventilation, Installation, Alignment

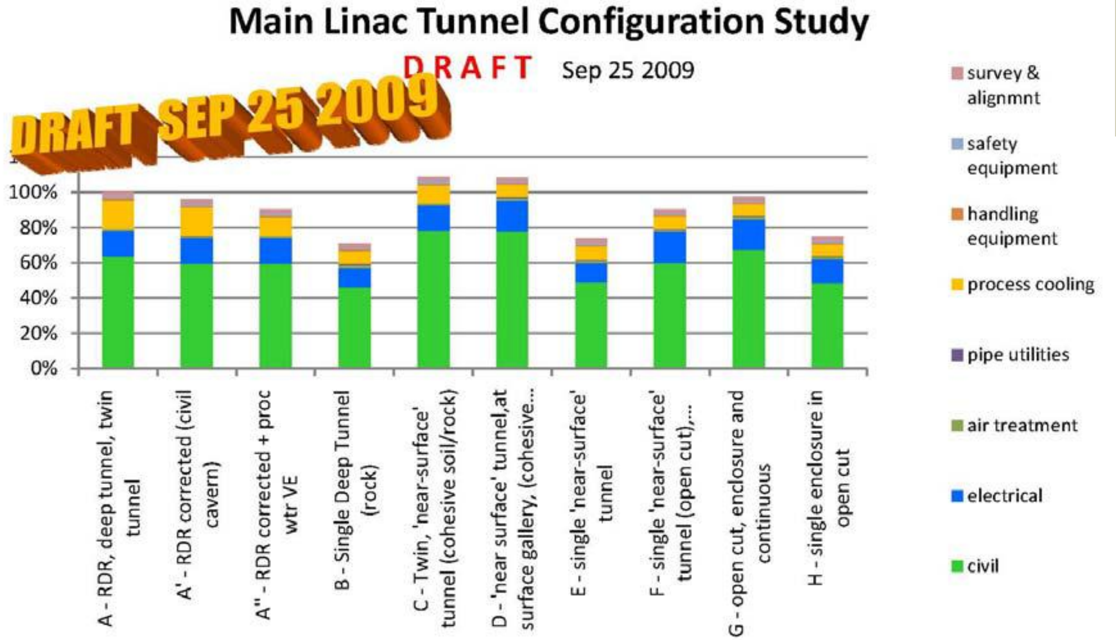






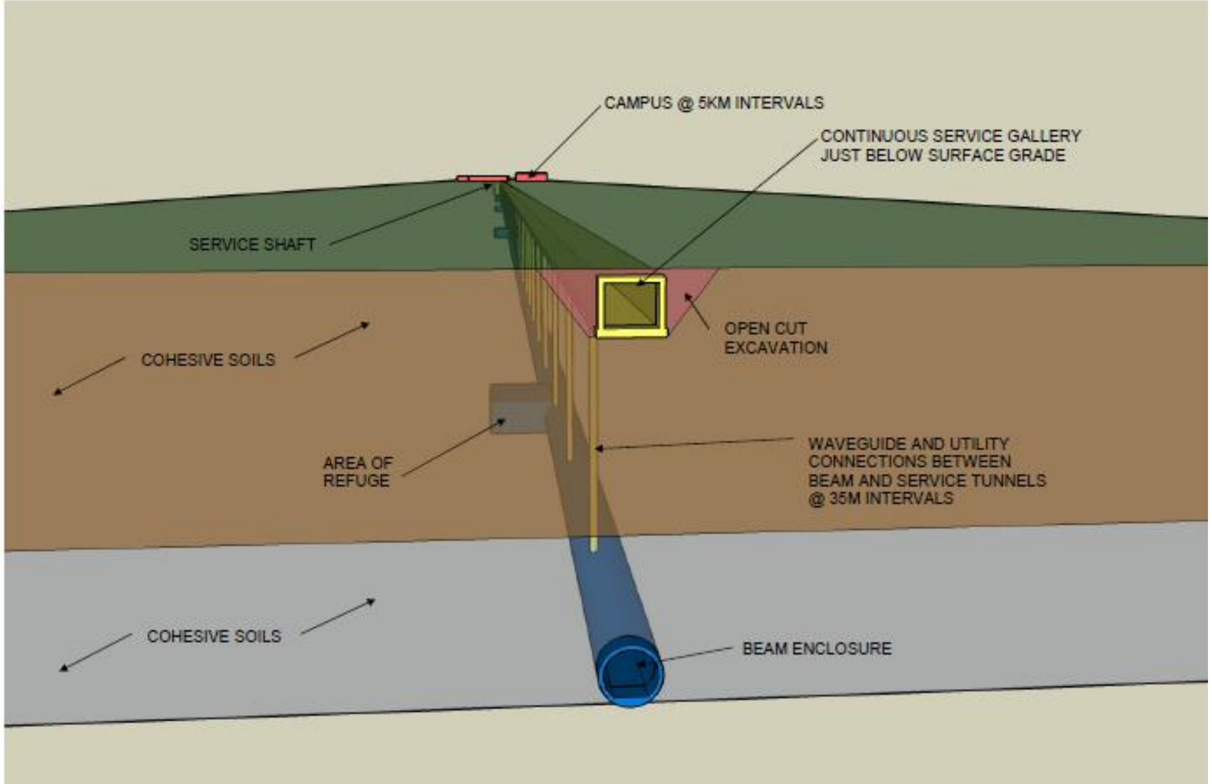
Continued Collaboration with CES & ILC CFS Groups e.g. ILC tunnel configurations





ILC-HiGrade WP5 : ILC Siting in Europe

- The purpose of this Work Package is the preparation and the investigation of possible European sites for the construction of the International Linear Collider. The work concentrates on the investigation of potential sites in Europe and the adaption and optimization of the tunnel design to the different sites in the framework of the GDE activities.
- For example the single tunnel with surface gallery "Dubna" solution :



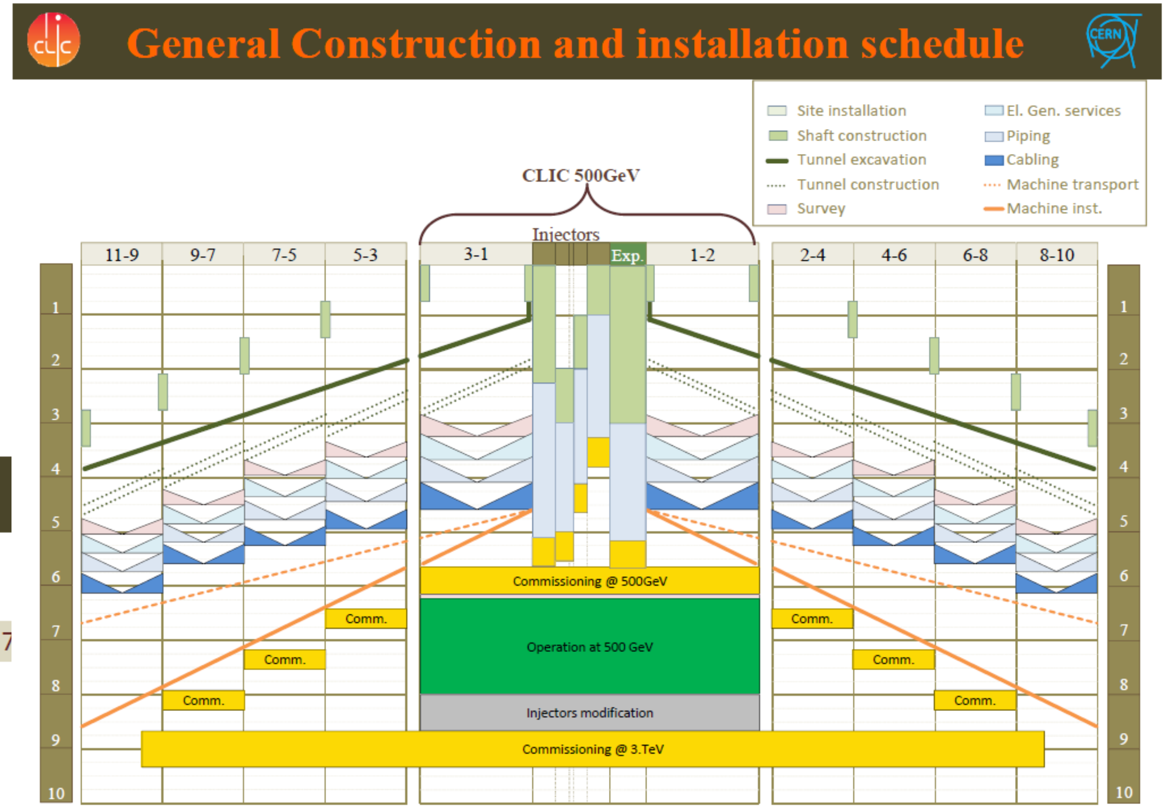
CLIC Implementation Studies

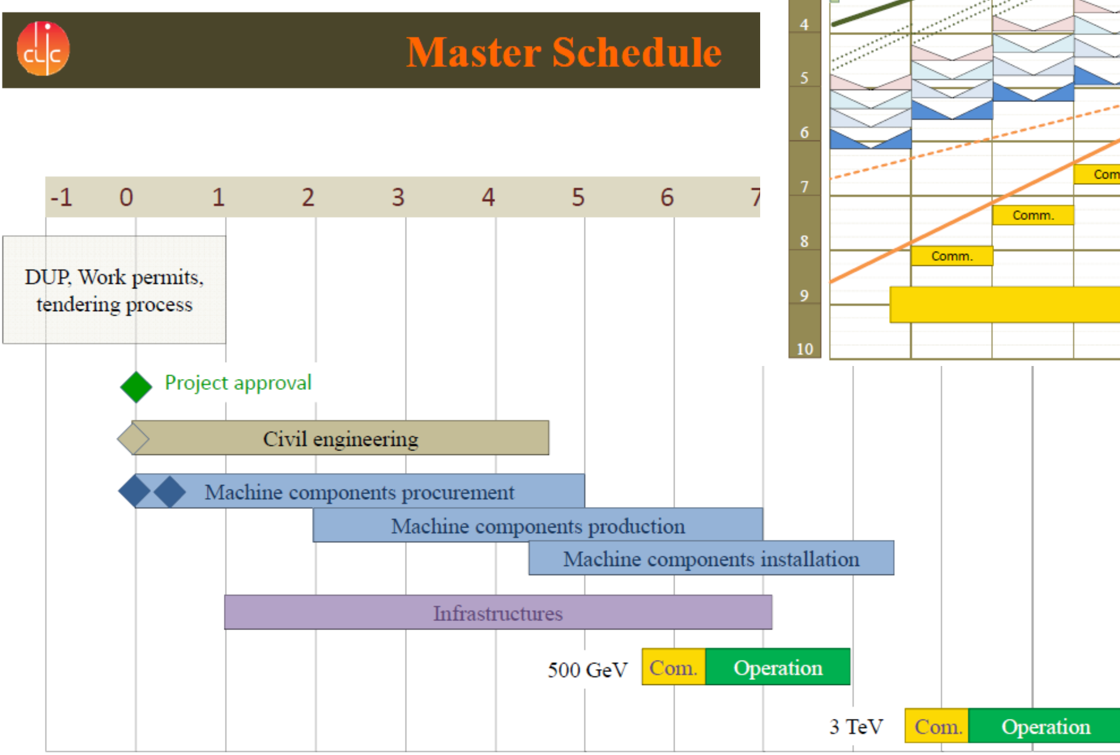
WP Project Implementation Plan

WP: IS-PIP Workpackage leader: Ph. Lebrun	Purpose/Objectives/Goals	Deliverables (incl. approx. resource estimate)	Schedule
Task 1: PBS/WBS	Update and maintain project PBS/WBS compatible with revised parameters and configuration in PP phase	1. First update of PBS/WBS for value estimate, 2. Final update of PBS/WBS for project submission	Deliverable 1 end 2013, deliverable 2 end 2016
Task 2: Value estimate	Refine value estimates compatible with revised parameters and configuration in PP phase; conduct value engineering of critical cost drivers	Revised value estimates	End 2016
Task 3: Schedule	Update and maintain general schedule	1. Updated general schedule, 2. Updated detailed schedules for system/component production	Deliverable 1 end 2013, deliverable 2 end 2016
Task 4: Safety	Conduct preliminary safety assessment of project	1. Preliminary safety document; 2. Conduct safety hearings of critical systems, 3. Final safety document	Deliverable 1 end 2013, deliverable 2 2014-2015, deliverable 3 end 2016
Task 5: Energy & power	Refine energy and power consumption estimates; identify and develop actions towards energy and power efficiency (e.g. load shedding, heat recovery)	1. Definition of operating modes influencing power consumption, 2. Updated power & energy consumption estimates	Deliverables 1 end 2013, deliverable 2 end 2016
CERN support required from BE-ABP, EN-CV, EN-EL, EN-HE, EN-MEF, GS-SE, HSE			

Estimated resources (needed):	2012	2013	2014	2015	2016	Total
Material (kCHF)	50	50	50	50	50	250
Personnel (FTE)	2.5	2.5	3	3.5	3.5	15

General construction & installation schedules





Safety assessment
Analyses, Hearings, Documents

CERN
CH1211 Genève 23
Suisse

Nº EDMS	REV.	VALIDITÉ
634739	1.0	APPROUVÉ

RÉFÉRENCE INB
RPS section **I.1**

Date : 2006-01-11

DOCUMENT D'EXPLOITATION

RAPPORT PROVISOIRE DE SÛRETÉ DU SPS/CNGS ET DU LHC

SECTION I.1
INTRODUCTION

DOCUMENT PRÉPARÉ PAR :	DOCUMENT VÉRIFIÉ PAR :	DOCUMENT APPROUVÉ PAR :
Enrico Cennini / SC André Faugier / SC (Éditeurs)	Pierre Bonnal / AB John Poole / AB Ghislain Roy / AB	Steve Myers / AB *Chef d'Installation*

GROUPE D'APPROBATION

CERN
CH1211 Genève 23
Suisse

Nº EDMS	REV.	VALIDITÉ
699391	1.0	APPROUVÉ

RÉFÉRENCE INB
RGE section **0**

Date : 2006-01-11

DOCUMENT D'EXPLOITATION

RÈGLES GÉNÉRALES D'EXPLOITATION DU SPS/CNGS ET DU LHC

SECTION 0
INTRODUCTION

DOCUMENT PRÉPARÉ PAR :	DOCUMENT VÉRIFIÉ PAR :	DOCUMENT APPROUVÉ PAR :
Enrico Cennini / SC André Faugier / SC (Éditeurs)	Pierre Bonnal / AB John Poole / AB Ghislain Roy / AB	Steve Myers / AB *Chef d'Installation*

GROUPE D'APPROBATION

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
European Laboratory for Particle Physics

Large Hadron Collider Project — **LHC Project Report 324**

PRELIMINARY RISK ANALYSIS OF THE LHC CRYOGENIC SYSTEM

M. Chorowski,[1] Ph. Lebrun,[2] and G. Riddone[2]

Abstract
The Large Hadron Collider (LHC), presently under construction at CERN, will require a helium cryogenic system unprecedented in size and capacity, with more than 1600 superconducting magnets operating in superfluid helium and a total inventory of almost 100 tonnes of helium. The objective of the Preliminary Risk Analysis (PRA) is to identify all risks to personnel, equipment or environment resulting from failures that may accidentally occur within the cryogenic system of LHC in any phase of the machine operation, and that could not be eliminated by design. Assigning a gravity coefficient and one analyzing physical processes that will follow any of the recognised failure modes allows to single out worst case scenarios. Recommendations concerning lines of preventive and corrective defence, as well as for further detailed studies, are formulated.

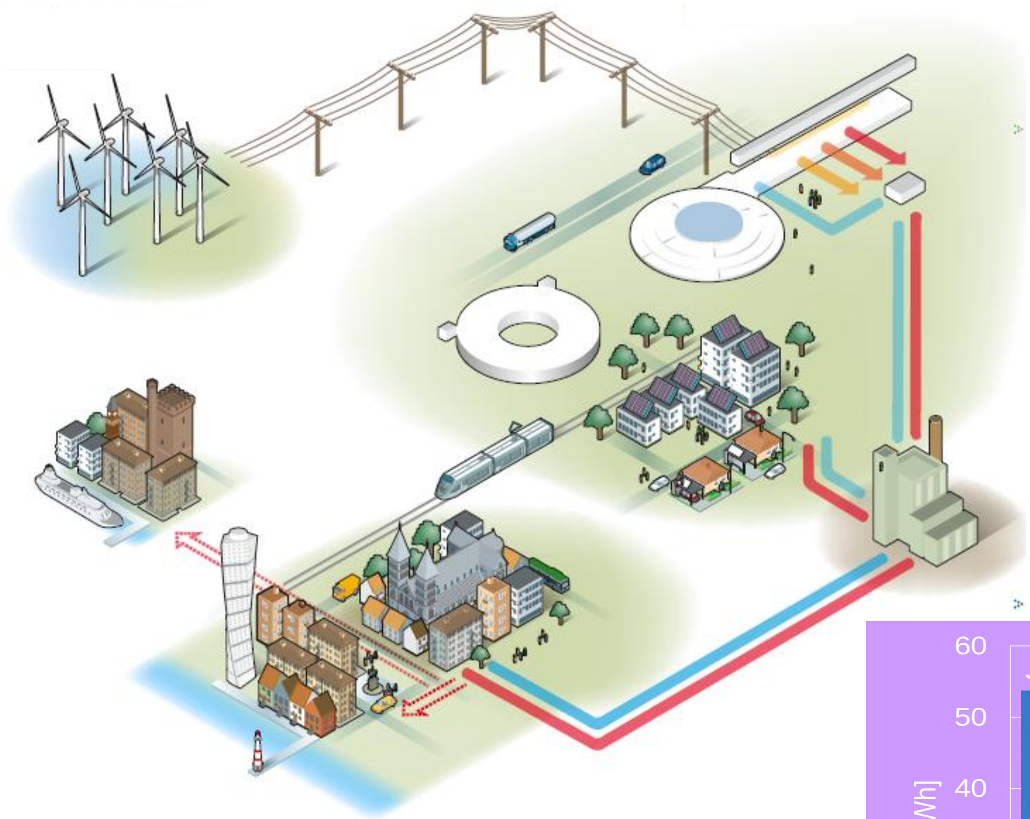
1 Wroclaw University of Technology, 50-370 Wroclaw, Poland
2 CERN, LHC Division, 1211 Geneva, Switzerland

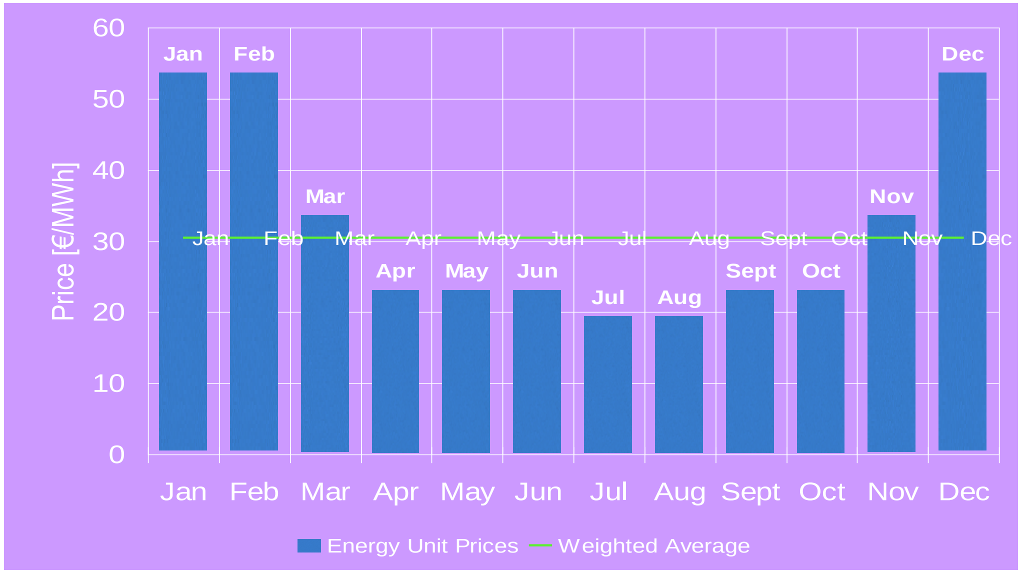
Presented at the 1999 Cryogenic Engineering and International Cryogenic Materials Conference (CEC-ICMC'99), 12-16 July 1999, Montreal, Canada

Administrative Secretariat
LHC Division
CERN
CH - 1211 Geneva 23
Switzerland

Geneva, 1 December 1999

Energy and power studies
Energy efficiency, load shedding, peak shaving, heat recovery





Conclusions

- Implementation studies are to be conducted in the Project Preparation Phase (2012-2016) in order to get ready for the Project Implementation Phase (>2016)
- Two work-packages defined, each with a variety of tasks, concerning Civil Engineering & Services, and Project Implementation Plan
- Some of these tasks are strongly site-specific, and therefore to be handled preferentially by the (potential) host laboratory
- Others of more general nature can be handled through collaborative work with institutes having the specific competencies and interests
- The CLIC study team is seeking partners for such collaborations in the domains of mutual interest