DRAFT CONTENT OF AN LHC-CNI PROPOSAL – 14.03.07

Capacities - Research Infrastructures

FP7-INFRASTRUCTURES-2007-1

Proposal full title: **Upgrade of the Large Hadron Collider**

Proposal acronym: SLHC

Type of funding scheme: Combination of Collaborative Projects and Coordination and Support Actions

Work programme topics addressed: *INFRA-2007-2.2.1.33*

Name of the coordinating person: Lyn Evans (CERN)

LHC upgrade

*Table 2a - List of Preparatory Phase **Work Packages foreseen under this proposal***

First Part: Management/coordination/support activities

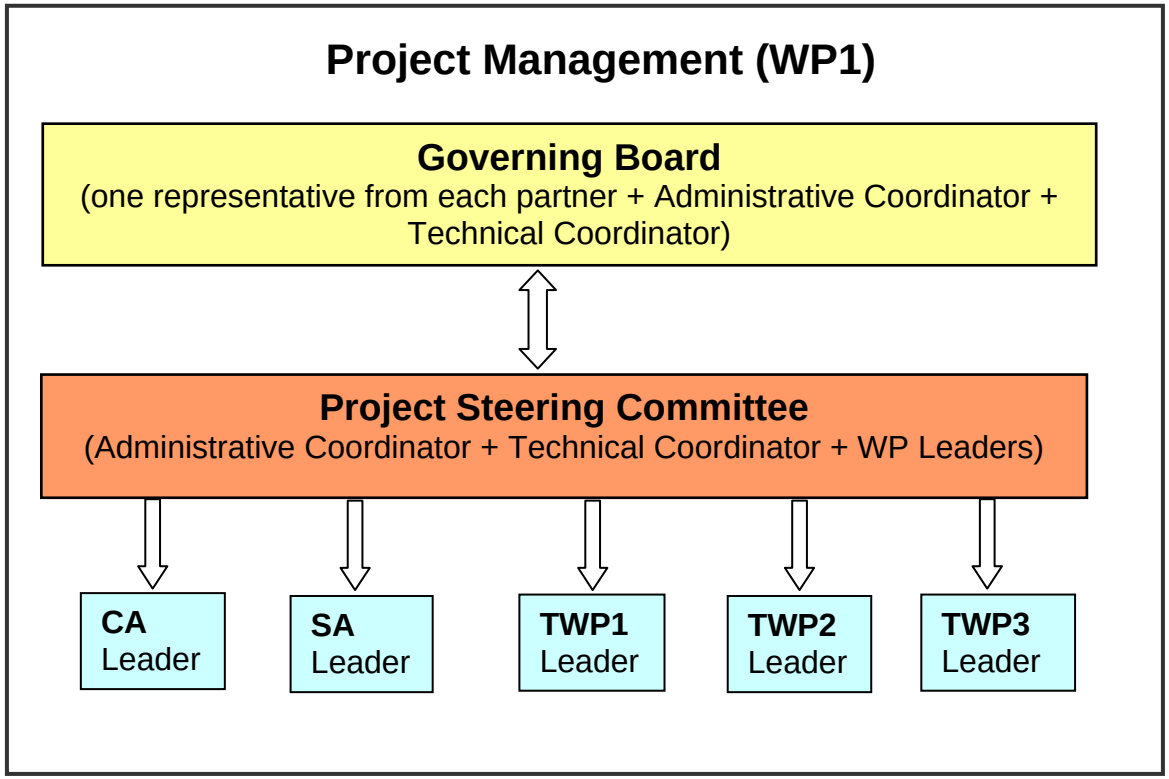
Work Package No	**Descriptive Title**	**Short description and specific objectives of the task**	**Participants**	**Total budget (k€)**	**Requested EC contribution (k€)**	Over-heads (k€)
WP1	**Management of the contract**	Management and coordination of all Work Packages, progress and budget follow-up and reporting	**CERN**	**400**	**200**	120
WP2	Coordination activities: **SLHC coordination**	1. General coordination meetings, networking, dissemination of information, workshops	**CERN** ???	**600**	**600**	65 (total)
		2. Project Office (experiments)		**320**	**320**	
WP3	Support activities: **Radiation and safety**	1. Radiation calculation studies	**CERN**	**200**	**100**	42 (total)
		2. Safety management	???	**160**	**80**	
		3. Beam protection		**140**	**70**	
		4. Radioactive waste disposal (INB)		**700**	**350**	
Totals				**2,520**	**1,720**	227

Second Part: Technical activities

Work Package No	**Descriptive Title**	**Short description and specific objectives of the task**	**Participants**	**Total budget (k€)**	**Requested EC contribution (k€)**	Over-heads (k€)
WP4	Technical Work Package 1: **Nb-Ti magnet prototype**	Design and construction of Nb-Ti quadrupole magnet model of large aperture	**CERN** CEA (FR) INFN (IT) ??? (US)	**2,400**	**800**	480
WP5	Technical Work Package 2: **Injector upgrade**	1. Design and prototyping of an H- source for the SPL 2. Design and prototyping of the low-level RF for the SPL	**CERN,** CEA (FR) DESY (DE)	**2,500**	**1,000**	600
WP6	Technical Work Package 3: **Detector powering systems**		**CERN,** RAL (UK) NIKHEF (NL) ??? (RU) BHNL (US)	**2,100**	**700**	420
Totals				**7,000**	**2,500**	1,500

Grand Totals	**9,520**	**4,220**	1,727

LHC upgrade



Legend:

CA = Coordination Activities

SA = Support Activities

TWP = Technical Work Package

WP2 SLHC Implementation Coordination

1. General Coordination

Organizing meetings gathering the potential participants into the implementation phase to agree upon and define the upgrading plans.

Common data bases, sites for the upgrade of the machine and of the detectors.

Preparation of participation of Institutes and of future MoU in view of organizing and distributing the tasks.

300 k€ accelerator and 300 k€ experiments (incl. 3+3 p.y ?)

2. Project Office for the Experiments

Ensure a consistent information structure for the existing detectors and their upgrade projects, covering web interfaces, databases, drawings, CAD and technical documentation, …
aiming at good control of the changes to be done.

Define Installation Scenario and scheduling

Launch realistic plans for the final detector construction.

320 k€ experiments (incl. 3 p.y)

WP3 Radiation and Safety support

1. Radiation calculation studies

Activation calculation related to increased particle flux and modified layout near IP.
200 k€ (incl. ~2 p.y)

2. Safety management

Ensure safe operation of accelerator and detectors, define running scenarios, shielding, …
Plan underground safety in the presence of various material, fluids, gases, …
160 k€ (incl. ~1.5 p.y)

3. Beam protection

Optimize the design to minimize losses and activation, define collimation, masks, etc…
140 k€ (incl. ~1.5 p.y)

4. Radioactive waste disposal

Define scenarios to comply with safety rules and to fit into the legal framework of the regulations. Concerns the radioactive waste disposals and the compliance to the rules applicable in France to an "Installation Nucléaire de Base".
700 k€ (incl. ~5-6 p.y)

WP4 Nb-Ti quadrupole prototyping

Design of a large-aperture quadrupole for the insertion triplets required because of
increased crossing angle at IP
smaller than nominal β^* at collision point
collimator positions not too close to the beam (prevent instability)

Aperture needed to remove limitations at high luminosity is at least 130 mm.

Development of large-aperture quadrupole with conventional Nb-Ti superconductor as for the main dipoles:

- Construction and testing of a short model
- Launch the construction and testing of a full-length quadrupole prototype
- Validating the design for the production of a small series of 16 quads by the industry.

Full upgrade of luminosity to 10^{35} $cm^{-2}s^{-1}$ will require long-term development of advanced superconductor (Nb_3Sn) quadrupoles with higher peak-field.

~2,400 k€

WP5 Injector Upgrade technical work

1. Activity on the H^- source for the SPL

Design and prototyping of an H^- source based on the source foreseen for the new 160 MeV H^- linac.
Specifications: 80 mA of H^-, at 50 Hz, pulse length of 0.4 ms. 95 keV extraction, $\varepsilon = 0.25\ 10^{-6}$ radm
Tasks envisaged:

- Optimization and tests of the source.
- Design, construction and commissioning of a single stage 95 KeV extraction
- Pre-chopper design, construction and test.
- Instrumentation design for measurements of source parameters and beam-energy spread.
- Design and test of an active beam compensation
- Upgrade of the low-energy beam transport (solenoids)
- Beam transport measurement with gas injection

~1,600 k€ (incl. ~7-8 p.y)

2. Activities on the low-level RF for the SPL

Design and prototyping of the low level RF for SPL and Linac4 to minimize ampl. and phase errors.
Specifications: field stabilisation with an accuracy of 0.5% in amplitude and 0.5^o in phase.
Tasks envisaged:

- define parameters and algorithm for feed forward system (from beam pulse to RF wave form)
- study hardware solutions (digital solution, circuit design)
- production and testing of prototype electronic cards, then of pre-series models

~900 k€ (incl. ~9 p.y)

WP6 Detector Powering Systems

Improve power distribution in the SLHC detectors, reduce the power needs per channel by improving powering efficiency and changing from parallel to serial powering schemes.

Work on the use of advanced silicon technologies for the front-end electronics (more efficient),

Design radiation hard DC-DC converters and voltage regulators.

- specification and design of these components

- prototyping high-current radiation-tolerant linear voltage regulator (collaboration with industry)

- prototyping serial powering schemes, in particular for the trackers, feeding a chain of modules

2,100 k€

Impact

- Critical questions:

i) Bring the project to level of legal, organizational and financial maturity required to implement it. Involve the stakeholders necessary to drive the project, take decisions and make financial commitment before construction can start. Set-up participation and financial rules
ii) Address the technical topics critical for the luminosity upgrade.
iii) Address the safety issue and the compliance to host-countries regulations.

-Attractiveness of the European Research Area

Large impact on the HEP research opening the possibility of new discoveries or of better statistics.
Reinforce the EU capacity of producing high-energy and high-intensity proton beams and in addition intense neutrino and muon beams (at particle physics and nuclear physics).
Technical work proposed aims at mastering (SC) technologies with impact on other infrastructures.

- Catalytic Effect

Efficient use of the LHC infrastructure at a moderate additional cost, large parts being reused.
EC involvement in pp is vital to progress on this path in order to be ready on reasonable time.
EC support will contribute to define a consistent work-plan and to reinforce interaction with or attract partners for the LHC upgrade.
The proposal lays the foundation of the future upgraded LHC and EU involvement will boost multilateral efforts and the effectiveness of the collaboration extending beyond CERN.