CNI - Preparatory Phase of the Large Hadron Collider Upgrade

Date of preparation: **2 May 2007**
Project starting date: **1 April 2008**
Duration: **36 months**
Coordinating person: **Lyn Evans (CERN)**

Participant no.	Participant organisation name	Part. short name	Country
1 (Coordinator)	European Organization for Nuclear Research	CERN	Switzerland
2	AGH University of Science and Technology	AGH-UST	Poland
3	Commissariat à l'Energie Atomique	CEA-Saclay	France
4	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	CIEMAT	Spain
5	Centre National de Recherche Scientifique	CNRS-IN2P3	France
6	Czech Technical University	CTU	Czech Republic
7	Deutsches Elektronen-Synchrotron	DESY	Germany
8	Eidgenössische Technische Hochschule Zürich	ETHZ	Switzerland
9	Stichting voor Fundamenteel Onderzoek der Materie	FOM-NIKHEF	The Netherlands
10	Gesellschaft für Schwerionenforschung	GSI	Germany
11	Imperial College London	Imperial	United Kingdom
12	Istituto Nazionale di Fisica Nucleare	INFN	Italy
13	Paul Scherrer Institut	PSI	Switzerland
14	Science and Technology Facilities Council	STFC	United Kingdom
15	Rheinische Friedrich-Wilhelms-Universität Bonn	UBONN	Germany
16	Université de Genève	UNIGE	Switzerland
17	University of Sheffield	USFD	United Kingdom

Proposal Abstract

The Large Hadron Collider upgrade (SLHC) is the project (1 B€ budget expected) with

- highest priority in the European Strategy Roadmap in Particle Physics,
- major upgrade of the accelerator cascade, a new injector complex,
- tenfold increase of the luminosity of the LHC.

The SLHC-PP, co-funded by the EC, will have an important catalytic effect for

- the implementation of the major upgrades, planned for the period 2011-2016.
- with global endeavors, of the 20 CERN Member States, and many other countries from all over the world, among which Russia, USA, Japan, India, and China.

The SLHC-PP project will comprise

- coordinating activities for the organisation of upgrade collaborations,
- negotiations and agreements with new partners and a new structure of the experiments.
- Support activities on safety issues, (radiation protection and radioactive waste disposal).
- key prototypes of Nb-Ti high-field magnets with large aperture, the prototype of a new H- ion source, field stabilization in SC accelerating structures, and novel tracking detector powering systems

SLHC Implementation Phase will be funded by CERN together with important contributions from many CERN non-member states. In this way Europe will continue to serve as a focal point for the world's best particle physicists and will maintain its leading position in the foreseeable future.

*List of **other organisations** involved in the Preparatory Phase*

Organisation Name	**Organisation short name**	**Country**	**Specific role or contribution to the preparatory phase**
Budker Institute of Nuclear Physics	BINP	Russia	Negotiation for participation to the construction of the new injectors
Institute for High Energy Physics	IHEP	Russia	Negotiation for participation to the construction of the new injectors, S-ATLAS project office and Nb-Ti quadrupole
Institute for Nuclear Research	INR	Russia	Negotiation for participation to the construction of the new injectors
The Russian Federal Nuclear Center	VNIIEF	Russia	Negotiation for participation to the construction of the new injectors
All-Russian Scientific Research Institute Of Technical Physics	VNIITF	Russia	Negotiation for participation to the construction of the new injectors
Raja Ramanna Centre for Advanced Technology	CAT	India	Negotiation for participation to the construction of the new injectors
Bhabha Atomic Research Centre	BARC	India	Negotiation for participation to the construction of the new injectors
Institute of High Energy Physics	IHEP	China	Negotiation for participation to the construction of the new injectors
Fermi National Accelerator Laboratory	FNAL	USA	Negotiation for participation to the construction of the NbTi quadrupole
Brookhaven National Laboratory	BNL	USA	Negotiation for participation to the construction of the NbTi quadrupole and S-ATLAS project office participation S-ATLAS R&D projects and coordination
TRI-University Meson Facility	TRIUMF	Canada	Negotiation for participation to NbTi quadrupole
Lawrence Berkeley National Laboratory	LBNL	USA	Development of switched capacitor DC-DC converters for tracking detector power distribution and construction of Nb-Ti quadrupole S-ATLAS R&D projects

High Energy Accelerator Research Organization	KEK	Japan	Development of advanced superconductor for superconducting quadrupole design
Stanford Linear Accelerator Center	SLAC	USA	Advanced collimator design
University of Tsukuba	U. of Tsukuba	Japan	S-ATLAS R&D projects
The University of Liverpool	U. of Liverpool	United Kingdom	S-ATLAS R&D projects
Lancaster University	Lancaster U.	United Kingdom	S-ATLAS R&D projects
University of Glasgow	U. of Glasgow	United Kingdom	S-ATLAS R&D projects
University of Cambridge	U. of Cambridge	United Kingdom	S-ATLAS R&D projects
Queen Mary University of London	QM London	United Kingdom	S-ATLAS R&D projects
Albert-Ludwigs-Universität Freiburg	U. of Freiburg	Germany	S-ATLAS R&D projects
Max-Planck-Institut für Physik	MPI	Germany	S-ATLAS R&D projects
University of Ljubljana	U. of Ljubljana	Slovenia	S-ATLAS R&D projects
Charles University in Prague	CU	Czech Republic	S-ATLAS R&D projects
Jagiellonian University of Krakow	JU	Poland	S-ATLAS R&D projects
Oxford University	U. of Oxford	United Kingdom	S-ATLAS R&D projects
Hampton University	HU	USA	S-ATLAS R&D projects
New York University	NYU	USA	S-ATLAS R&D projects
Universitat de Barcelona	UB	Spain	S-ATLAS R&D projects
Università degli Studi di Milano	U. of Milano	Italy	S-ATLAS R&D projects
Universitat de València	U. de València	Spain	S-ATLAS R&D projects
University of California Santa Cruz	UCSC	USA	S-ATLAS R&D projects
Department of Energy	DOE	USA	CMS2 R&D Activities
Alikhanov Institute for Theoretical and Experimental Physics	ITEP	Russia	CMS2 R&D Activities
National Science Foundation	NSF	USA	CMS2 R&D Activities
Science and Technology Facilities Council	STFC	United Kingdom	S-ATLAS R&D projects and CMS2 R&D Activities

List of Preparatory Phase ***Work Packages foreseen under this proposal***

Work Package No	**Descriptive Title**	**Short description and specific task objectives**	**Leading Participant** (+ co-participants)	**Total direct costs (k€)**	**Requested EC contribution to the direct costs (k€)**
WP1	**SLHC-PP project management**	Management and coordination of all Work Packages, progress monitoring, budget follow-up, reporting and dissemination	**CERN** STFC-RAL (UK)	**645**	**400**
WP2	Coordination activities: **Coordination for the SLHC accelerator implementation**	Establish the formal structures for the SLHC accelerator upgrade 2.1 Project management preparation 2.2 Networking and communication	**CERN** CEA (FR), STFC-RAL (UK), CIEMAT (ES)	**600**	**600**
WP3	Coordination activities: **Coordination for S-ATLAS experiment implementation**	Upgrade coordination and organization of S-ATLAS 3.1 Coordination and project structures 3.2 Project Office	**CERN** FOM-NIKHEF (NL), STFC-RAL (UK), UNIGE (CH)	**901**	**501**
WP4	Coordination activities: **Coordination for CMS2 experiment implementation**	Upgrade coordination and organization of CMS2 4.1 CMS2 organisational structure 4.2 CMS2 Technical Coordination Unit.	**CERN** DESY (DE), ETHZ (CH), Imperial(UK)	**900**	**500**
WP5	Support activities: **Radiation protection and safety issues**	Optimisation of design options for luminosity increase with respect to radiological impact. 5.1 Detector Activation: 5.2 Accelerator Activation	**CERN** GSI (DE), PSI (CH), CTU (CZ), USFD (UK)	**1,500**	**700**

		5.3 Impact Study 5.4 Radioactive Waste 5.5 Maintenance planning			
WP6	Technical Work Package 1: **Development of Nb-Ti quadruple magnet prototype**	Development of high field Nb-Ti quadrupole magnet prototypes with very large aperture 6.1 Design of the complete quadrupole magnet and ancillary equipments 6.2 Construction and test of 1-m long model 6.3 Construction and test of full-scale prototype quadrupole	**CERN** CEA (FR), STFC-RAL (UK), CIEMAT (ES), CNRS-IN2P3 (FR)	**2,400**	**800**
WP7	Technical Work Package 2: **Critical components for the injectors**	Development of injector chain components. 7.1 RTD towards an H- ion source meeting the required duty factor for the future injection accelerators of the LHC. 7.2 Field stabilization in pulsed superconducting low beta (v/c) accelerating structures	**CERN** CEA (FR), DESY (DE), INFN (IT), STFC-DL (UK)	**2,397**	**799**
WP8	Technical Work Package 3: **Tracking detector power distribution**	Development of radiation-hard and magnetic-field tolerant microelectronic components for tracking detector power distribution systems 8.1 Linear voltage regulation 8.2 DC-DC conversion 8.3 Serial powering	**STFC-RAL (UK)** CERN, AGH-UST (PL), PSI (CH), UBONN (DE)	**1,985**	**600**
Totals:				**11,328**	**4,900**

Note: The **indirect costs** are not included in this table

*List of **other** Preparatory Phase **Work Packages not directly supported by the EC***

Work Package No	**Descriptive Title**	**Short description and specific objectives of the task**	**Organisations involved**	**Approximate budget**
WP9	Improved injection complex	Study of a replacement of the PS, with a final energy of about 50 GeV, and of a new superconducting proton linac, capable of about 5 GeV and large current.	CERN, CEA, IN2P3, INFN, GSI	7 M€
WP10	Front end of the improved injection complex	Replacing the old proton linac 2 with a new one, Linac 4, delivering H^- ions at 160 MeV	CEA, IN2P3, INFN, BINP, ITEP, IHEP, VNIIEF, VNIITF (Russia), BARC, CAT (India), IHEP (China)	66 M€
WP11	High-field SC magnets, based on Nb_3Sn	Development of magnets with about 15T max. field, to be used for the ultimate upgrade of the interaction regions for very high luminosity This work includes advanced collimator design	CERN, CEA, CIEMAT, INFN, STFC, Twente Univ. Wroclaw Univ, LBNL, KEK, FNAL, BNL, SLAC	20 M€
WP12	SC pulsed field magnet	Development of pulsed SC magnets for a possible SC version of the PS and possibly of the SPS	CERN, GSI, BNL, INFN KEK, JINR, Dubna	10 M€
WP13	Cryogenic upgrade	Study of the possible cryogenics improvement for the cooling of the Interaction region new magnets.	CRN, CEA , CERN, CEA, CNRS, Wroclaw Univ, Valadolid Univ.	2 M€
WP14	Common R&D for S-ATLAS and CMS2	Common development work in electronics, detectors, triggering, data acquisition, data analysis, simulation and computing	CERN	12 M€

WP15	S-ATLAS R&D projects	Development and testing of electronics, sensors and modules for an upgraded Inner Detector for ATLAS	KEK, U. of Tsukuba, U. of Liverpool, CERN, Lancaster U., U. of Glasgow, USFD, U. of Cambridge , QM London, U. of Freiburg, MPI, CU, JU, U. of Ljubljana, U. of Oxford, STFC, HU, LBNL, NYU, UB, U. of Milano, FOM-NIKHEF, U. de Valencia, UCSC, BNL.	7 M€
WP16	CMS2 R&D Activities	R&D on technical issues related to the CMS2 inner tracking detector (solid state pixel detector), outer tracking detector, Level 1 Trigger and data acquisition, Calorimeters, and Muon systems.	DESY, DOE, DUBNA, ETHZ, IHEP, INFN, IN2P3, ITEP, NSF, PSI , STFC	12 M€
Total				**136 M€**

*Summary of **staff effort***

Participant no. / short name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total person months
1. **CERN**	**54**	**45**	**52**	**36**	**94**	**72**	**161**	**90**	**604**
2. AGH-UST								36	36
3. CEA-Saclay		6				42	20		68
4. CIEMAT		6				24			30
5. CTU					8				8
6. DESY				12			2		14
7. ETHZ				12					12
8. GSI					24				24
9. Imperial				12					12
10. INFN							7		7
11. CNRS-IN2P3						18			18
12. FOM-NIKHEF			20						20
13. PSI					24			16	40
14. STFC-RAL	3	6	20			24	1	**58**	112
15. Uni Bonn								60	60
16. UNIGE			10						10
17. USFD					8				8
TOTAL	**57**	**63**	**102**	**72**	**158**	**180**	**191**	**260**	**1083**

1.4 Work packages to be supported by the EC

1.4.1 WP1 – SLHC-PP project management

Work package number	1	**Start date or starting event:**		Month 1		
Work package title	SLHC-PP project management					
Activity Type	MGT					
Participant	CERN	STFC-RAL				
Person-months per participant:	54	3				

Objectives:

- effective management and coordination of all Work Packages and of the whole project, ii) progress monitoring and reporting,
- contractual and financial follow-up of the project,
- dissemination of information inside and outside the consortium

Deliverables	Description	Nature	Delivery date
1.1.1	SHLC-PP web-site operational (intranet + public pages)	O	M3
1.1.2	Periodic Report (progress of work + use of resources + financial statement)	R	M12
1.1.3	Periodic Report (progress of work + use of resources + financial statement)	R	M24
1.1.4	Periodic Report (progress of work + use of resources + financial statement)	R	M36
1.1.5	Final report	R	M36

1.4.2 WP2 – Coordination for the SLHC accelerator implementation

Work package number	WP2	**Start date or starting event:**	Month 1			
Work package title	Coordination for the SLHC accelerator implementation					
Activity Type	COORD					
Participant	CERN	CEA	STFC-RAL	CIEMAT		
Person-months per participant:	45	6	6	6		

Objectives

For the SLHC accelerator, the collaboration management will be more advanced than for the original LHC construction. The objective of this work package is to

- define the project management structure, all collaborators' tasks and work packages for the implementation phase
- set up the project and collaboration management tools.

Responsibilities have to be attributed to the partners. Furthermore, the communication between the participants has to be streamlined in workshops and meetings and the general information dissemination has to be set up.

Deliverables Tasks 1&2	**Description**	**Nature**	**Delivery date**
2.**1** 1	Memoranda of understanding for the implementation phase.	R	M24
2.**1**.2	Cost plan and time planning for the implementation phase	R	M24
2.**1**.3	Common fund, Financial Management System (software) and user requirements and user guide document	O	M30
2.**1**.4	Quality Assurance plan for the implementation phase	R	M30
2.**1**.5	Earned Value management system (software) with user requirements and user guide document	O	M36

2.**2**.1	Functioning collaboration communication structure	O	M12
2.**2**.2	Project web site linked to the technical databases: Machine layout database, hardware baseline database, project notes and reports	O	M12

1.4.3 WP3 – Coordination for S-ATLAS experiment implementation

Work package number	WP3	**Start date or starting event:**	Month 1			
Work package title	Coordination for S-ATLAS experiment implementation					
Activity Type	COORD					
Participant	CERN	FOM-NIKHEF	STFC-RAL	UNIGE		
Person-months per participant:	52	20	20	10		

Objectives

During the FP7 project period of three years the major preparatory goals are:

- Establish the formal structures needed for the ATLAS upgrade construction project, and through Technical Documentation, Cost and Schedule planning, establish an initial MoU with the major FAs taking responsibilities for the Upgrade Construction.
- Establish a Project Office to address the critical technical integration and coordination issues of the new detectors, and the technical and managerial tools needed for the project planning and follow up.

Deliverables tasks 1 & 2	**Description**	**Nature**	**Delivery date**
3.**1**.1	Establish a review office	R	M6
3.**1**.2	Establish the initial Memorandum of Understanding for the upgrade, agreed with major partners.	R	M36
3.**1**.3	Develop detailed cost books for the upgrade including the installation phase	R	M36

3.**2**.1	Document the detailed technical scope of the upgrade	R	M24
3.**2**.2	Schedule for the Upgraded Detector parts and for the S-ATLAS installation	R	M24
3.**2**.3	Technical documentation, drawing and CAD information for the existing experiment and upgraded elements	R	M36
3.**2**.4	WEB interface tools and configuration databases for the Upgrade detector project	R	M36

1.4.4 WP4 – Coordination for the CMS2 experiment implementation

Work package number	WP4	**Start date or starting event:**		Month 1		
Work package title	Coordination for the CMS2 experiment implementation					
Activity Type	COORD					
Participant	CERN	DESY	ETHZ	Imperial		
Person-months per participant:	36	12	12	12		

Objectives

- the preparation of the management/organization/scientific structures needed to plan, cost and implement the detector upgrades; including the preparation of agreements defining the sharing of responsibilities among the participating institutes and funding agencies (FA),
- the technical planning and coordination studies needed to allow the changes to be efficiently and safely implemented in large complicated existing experimental facilities

incl. the organization of scientific exchange and dissemination of information to the potential participants in R&D activities targeted to future SLHC implementation,

Deliverables tasks 1&2	**Description**	**Nature**	**Delivery date**
4.**1**.1	Project Structures for construction of systems and sub-systems	R	M12
4.**1**.2	Cost book and MoU for the upgrade and installation phase	R	M36

4.**2.**1	Core of upgrade Technical Coordination unit established	R	M12
4.**2**.2	Schedule and reporting mechanism defined.	R	M18
4.**2**.3	Pilot design and schedule for the upgrade project published.	R	M36

1.4.5 WP5 – Radiation protection and safety issues for accelerator and experiments

Work package number	WP5	**Start date or starting event:**		Month 1		
Work package title	Radiation protection and safety issues for accelerators and experiments					
Activity Type	SUPP					
Participant	CERN	PSI	GSI	USFD	CTU		
Person-months per participant:	94	24	24	8	8		

Objectives

- Assessment of radiological impact on personnel and environment for various design options for radiation exposure.
- Assessment of radiological impact on personnel and environment for the entire accelerator chain as a function of beam intensity increase.
- Optimization of shielding designs and of operative procedures for interventions in high intensity accelerator/ high luminosity regions for maintenance and repair with a view to minimize the radiological impact.
- Investigation of activation of different structural and detector materials and geometries in order to minimize future radioactive waste and to facilitate waste characterization for future elimination.

Deliverables	Description	Nature	Delivery date
5.**1**.1	Estimation of activation and radiation levels for accelerators, detectors and interaction regions	R	M18
5.**3**.1	Environmental Impact Study	R	M24
5.**4**.1	Radioactive waste study incl. waste characterization and disposal pathways	R	M36
5.**0**.1	Documentation of results for the assessment of compliance with relevant regulation (concerning all tasks)	R	M36

1.4.6 WP6 - Development of Nb-Ti prototype quadrupole

Work package number	WP6	**Start date or starting event:**		Month 1		
Work package title	Development of Nb-Ti prototype quadrupole					
Activity Type	RTD					
Participant	CERN	CEA	CIEMAT	STFC-RAL	CNRS-IN2P3		
Person-months per participant:	72	42	24	24	18		

Objectives

- the design,
- the development,
- the manufacture and test, of the NbTi quadrupole for the interaction regions of the SLHC

Each new triplet is made of four quadrupoles all of same cross section with an inner bore of 130 mm and two different lengths: (8 and 9 m). Same operating current, triplet powering in series. Aims at relaxing the question of the collimation aperture.
Forces considerably higher than in the present design and reach limits so far unexplored for NbTi quadrupoles.
This, plus the needs to qualify the procedures and the actual field quality, require at least one short model (1m-long), be manufactured and cold tested before constructing and testing a full scale prototype (complete magnet with cryostat and all necessary equipment like corrector magnets).
This aims to preparing the manufacture of the 16 quadrupoles needed for the 2 high luminosity interaction regions.

Deliverables Tasks 1,2&3	**Description**	**Nature**	**Delivery date**
6.**1.**1	Basic design of the triplet	R	M12
6.**1**.2	Complete IR design	R	M36
6.**2**.1	Construction of the model	D	M18
6.**2**.2	Assessment of the design	R	M24
6.**3**.1	Construction Corrector magnet package	P	M26
6.**3**.2	Prototype quadrupole magnet	P	M32
6.**3**.3	Test of complete quadrupole prototype	R	M34
6.**3**.4	Assessment of the design	R	M36

1.4.7 WP7 - Development of critical components for the injectors

Work package number	WP7	**Start date or starting event:**			Month 1		
Work package title	Development of critical components for the injectors						
Activity Type	RTD						
Participant	CERN	CEA	DESY	INFN	STFC-DL		
Person-months per participant:	161	20	2	7	1		

Objectives

- To experimentally demonstrate that the required duty factor for the plasma generator of an H^- ion source of the SPL can be achieved and to guide the design of the operational source.
- To elaborate the architecture, to specify the components and to demonstrate the performance of an RF system that will properly stabilize the accelerating field in the SPL and achieve the characteristics required for LHC in the following synchrotron ("PS2").

Deliverables tasks 1&2	**Description**	**Nature**	**Delivery date**
7.**1.**1	Finite element thermal study of the Linac 4 design source at the final duty factor.	R	M12
7.**1**.2	Design of the plasma generator to operate at 3.6% duty cycle.	R	M18
7.**1**.3	Construction of the plasma generator and sub-systems (e.g. 2Hz RF generator, hydrogen gas injection and pumping).	D	M30
7.**1**.4	Plasma generation and testing during working hours over a total period of 1 month.	R	M36

7.**2**.1	In depth characterisation of the two tuners plus cavities developed in the frame of the "HIPPI" JRA , FP6 (tuner/cavity characteristics)	R	M12
7.**2**.2	Design of RF system architecture including modelling of RF components, simulation of the RF system and simulation of beam dynamics of the full LINAC. RF system and high power modulator specifications.	R	M18
7.**2**.3	Production of a prototype electronic system and other elements for a full system demonstration. Definition of demonstration procedure.	P	M30
7.**2**.4	Full test and validation of RF system. Final report.	D	M36

1.4.8 WP8 – Tracking Detector Power Distribution

Work package number	WP8	**Start date or starting event:**	Month 1			
Work package title	Tracking Detector Power Distribution					
Activity Type	RTD					
Participant	STFC-RAL	AGH-UST	CERN	PSI	UBONN		
Person-months per participant:	58[1]	36	90	16	60		

Objectives

- various *linear voltage regulation* and
- *DC-DC conversion* options
- *serial powering schemes,* to select the most suitable schemes for integration into dedicated ASICs and test them in full-scale S-ATLAS and CMS2 detector module prototypes.

At the end of the PP, a fully qualified technical solution, ready for use in the implementation phase will be available.

Deliverables tasks 1,2&3	**Description**	**Nature**	**Delivery date**
8.**1**.1	Specifications of the components to be developed within the partnership	R	M6
8.**1**.2	Performance report on the prototypes	P,R	M24
8.**1**.3	Fully characterized regulators ready for series production	D	M36
8.**2**.1	Evaluation report on DC-DC conversion technologies	R	M12
8.**2**.2	Prototypes and viability report	P, R	M24
8.**2**.3	Integration in full-scale detector modules	D	M36
8.**3**.1	Evaluation report on generic serial powering studies	R	M12
8.**3**.2	Specification of serial powering components	R	M15
8.**3**.3	Custom serial powering circuitry and evaluation of generic high-current serial powering chip	P,R	M24
8.**3**.4	Full-scale super-module with custom serial powering circuitry	D	M36

2.3 Resources

Overview of the SLHC-PP budget

Table 3.1 gives the budget breakdown of the SLHC-PP direct costs (in €) per Work Package.

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Totals
Activity type	MGT	COORD	COORD	COORD	SUPP	RTD	RTD	RTD	
Man-months	57	63	102	72	158	180	191	260	**1083**
Personnel costs	565,000	525,000	816,000	720,000	1,224,000	1,500,000	1,538,000	1,455,000	**8,343,000**
Material and equipment	10,000	0	11,000	50,000	76,000	762,000	826,000	440,000	**2,175,000**
Travel costs	70,000	75,000	54,000	100,000	160,000	138,000	33,000	90,000	**720,000**
Other direct costs	0	0	20,000	30,000	40,000	0	0	0	**90,000**
Sub-contracting	0	0	0	0	0	0	0	0	**0**
Total direct costs	**645,000**	**600,000**	**901,000**	**900,000**	**1,500,000**	**2,400,000**	**2,397,000**	**1,985,000**	**11,328,000**
Requested EU contribution	**400,000**	**600,000**	**501,000**	**500,000**	**700,000**	**800,000**	**799,000**	**600,000**	**4,900,000**

Table 3.1. Breakdown of the SLHC-PP direct costs (€) budget per Work Package

The **indirect costs** are not included in this table. The indirect costs depend on the activity type and the accounting principles of each participant, and are indicated on the

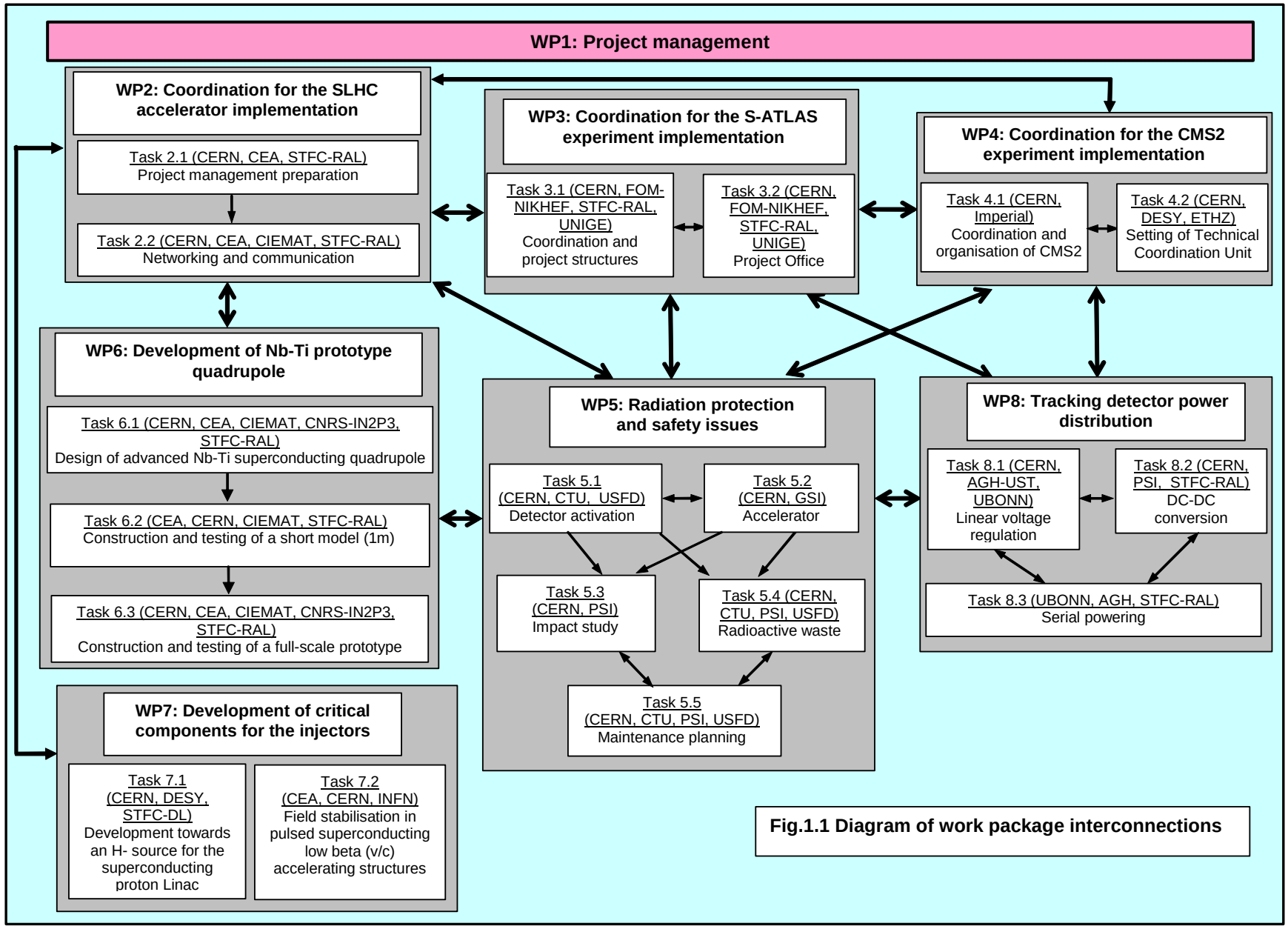

Fig.1.1 Diagram of work package interconnections

SLHC Preparatory Phase	1st YEAR				2nd YEAR				3rd YEAR			
WORK PACKAGE DESCRIPTIONS	Q1 (3)	Q2 (6)	Q3 (9)	Q4 (12)	Q5 (15)	Q6 (18)	Q7 (21)	Q8 (24)	Q9 (27)	Q10 (30)	Q11 (33)	Q12 (36)
WP1. SLHC-PP Project Management												
Task 1.1 Coordination, progress monitoring, reporting and dissemination of information	!D			!D				!D				!D
WP2. Coordination for the SHLC accelerator implementation												
Task 2.1 SHLC project management preparation						!		!D		D		D
Task 2.2 Networking and communication				D								
WP3. Coordination for the S-ATLAS experiment implementation												
Task 3.1 Coordination and project structures		!D				!		!				D
Task 3.2 Project Office			!			!		D			!	D
WP4. Coordination for the CMS2 experiment implementation												
Task 4.1 Coordination and organisational structure of CMS2				D		!						D
Task 4.2 Setting of Technical Coordination Unit				D		!D						D
WP5. Radiation protection and safety issues												
Task 5.1 Detector activation				!		D						
Task 5.2 Accelerator activation						!D						
Task 5.3 Impact study								!D				
Task 5.4 Radioactive waste												D
Task 5.4 Maintenance planning										!		D
WP6. Development of Nb-Ti prototype quadrupole												
Task 6.1 Design of advanced Nb-Ti superconducting quadrupole				! D		!		!				D
Task 6.2 Construction and testing of 1-m short model			!			D		! D				
Task 6.3 Construction and testing of full-scale prototype									D	!	D	D D D
WP7. Development of critical components for the injectors												
Task 7.1 Development toward an H- source for the SPL												
7.1.1 Finite element thermal study of Linac 4 RF source				D	!							
7.1.2 Design of a plasma generator for 3.6% duty factor						D						
7.1.3 Construction of plasma generator and sub systems										D		
7.1.4 System testing and plasma generation												D
Task 7.2 Field stabilization in superconducting accelerating structures												
7.2.1 Characterization of tuners				D								
7.2.2 Design and specification of RF system architecture						!D						
7.2.3 Production of system and definition of demonstration										D		
7.2.4 Test and validation of RF system												D
WP8. Tracking detector power distribution												
Task 8.1 Linear voltage regulation		D						!D				D
Task 8.2 DC-DC convertion				D				!D				D
Task 8.3 Serial powering				D	D			!D				D

Figure 1.2 SLHC Work Package Task-chart

! = MILESTONE
D = DELIVERABLE