	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>1 of 10</b>

## 1 Purpose

- To **plan** and **schedule** the activities related to the Large Hadron Collider project.
- To **track** the time and physical progress throughout the project duration.
- To **report** project control information to the Project Management.

## 2 Scope

This procedure applies to :

- all activities related to the Large Hadron Collider project, performed either at CERN, at Contractors/Suppliers premises or in External Laboratories.
- all phases of the project, from prototyping up to commissioning.

In other words, this manual describes the basic approach and methods to be employed in the management of planning and scheduling for the Large Hadron Collider project. It is prepared specifically for this project, and it is based on state-of-the-art practices used on large-scale projects<sup>[3] [4] [5]</sup>.

All CERN staff, CERN Contractors, External Laboratories concerned with planning and scheduling activities related to the LHC project must implement this procedure.

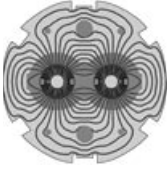
## 3 Responsibilities

The **Head of the Technical Coordination and Planning Unit** is responsible to the Project Management for the **overall scheduling of the project**, including :

- the issuing and the following up of Master Schedule
- the progress/performance monitoring at top level, including the project reporting to the Project Management and the preparation of corrective actions in case of drift
- the initial issue and further updates of the present Planning & Scheduling procedure.

The **Planning Section Leader** is responsible to the Project Management via the Head of the Technical Coordination Planning Unit of:

- the checking of Co-ordination Schedules
- the support to Technical Groups, Contractors/Suppliers and External Labs in the issuing and the following up of Detailed Schedules
- the interface management between Technical Groups, Contractors/Suppliers and/or External Laboratories when required, including the monitoring of Interface Dates
- the monitoring of the centralized Schedule Register and Cut-off Dates.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>2 of 10</b>

The **Planning Co-ordinators** are responsible to the Planning Section Leader for the **co-ordination scheduling of the project**, including :

- the issuing and the following up of Co-ordination Schedules
- the progress/performance monitoring at co-ordination level
- together with the Planning Section Leader, the interface management between Technical Groups, Contractors/Suppliers and/or External Labs when required, including the monitoring of Interface Dates
- the implementation of this Planning and Scheduling procedure.

Each **Technical Group Leader** will nominate a **Planning Officer**. Each **Group Leader** together with his **Planning Officer** is responsible to the Project Management for the **detail scheduling of the Group activities**, including :

- the issuing and the following up of Detailed Schedules
- the progress/performance monitoring and reporting at detailed levels
- the implementation of this Planning and Scheduling procedure.

Also refer to the Planning & Scheduling Organization – Appendix 4 of present procedure.

## 4 Procedure

### 4.1 General

Schedules shall be established in accordance with the hierarchy of schedules, be prepared, checked, approved, numbered, revised, distributed, maintained and up-dated in accordance with the schedule numbering system and the Table of Schedules – Refer to Appendices 2 and 3 of present procedure.

### 4.2 Schedule content

The content of level 1, 2 and 3 schedules shall be as follows :

#### 4.2.1 Level 0 – Summary Schedule

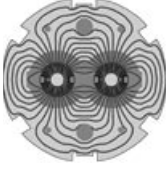
The Summary Schedule shall be in the form of a Gantt chart, consisting of up to 100 tasks. It shall be derived by rolling-up the level 1 Master Schedule.

#### 4.2.2 Level 1 – Project Master Schedule

The project Master Schedule shall be in the form of five Gantt charts<sup>1</sup>, of no more than 150 tasks each ; each Gantt chart shall :

- cover the whole duration of the project, from prototyping up to commissioning

<sup>1</sup> Due to the complexity of the project, for communication purposes the Master Schedule (level 1 network) is split-up into five Gantt charts – see Appendix 1 for details.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>3 of 10</b>

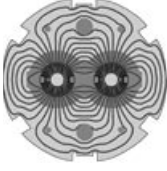
- show the Time Spans and Milestones of the project, i.e. LEP Activities (running and shutdown periods), and LHC Milestones (impact study and DUP issue, 1997 Council Review, 1<sup>st</sup> Beam)
- show the duration of the main tasks down to level 2 of the Product Breakdown and Generic Activity Structures
- highlight critical paths<sup>2</sup>
- be marked-up monthly with Actual/Expected start and finish Dates and be issued as Master Progress Mark-up Schedules
- follow the Gantt chart, symbol, bar color/pattern code – see Appendix 7
- be issued by the Planning Co-ordinators at the early stage of the project, together with a Schedule Note.

#### 4.2.3 Level 2 – Co-ordination Schedules

The Co-ordination Schedules shall be in the form of five Gantt charts, of no more than 300 tasks each ; they shall :

- cover the whole duration of one of the five phases of the project :
  - R&D (prototyping) and Design
  - Tendering and Contracting (purchase orders and construction/installation contracts)
  - Manufacturing : from tooling up to series production and delivery to CERN
  - Construction and Installation
  - Tests and Commissioning
- when adequate, show the Time Spans and Milestones of the project
- show relevant Interface Dates
- be detailed down to Work Units
- highlight critical paths
- utilize early start and early finish dates to identify floats
- be marked-up monthly with Actual/Expected start and finish Dates and be issued as Co-ordination Progress Mark-up Schedules
- conform the Gantt chart, symbol, bar color/pattern code – see Appendix 7
- be issued by the Planning Co-ordinators at the early stage of the considered phase, together with a Schedule Note.

<sup>2</sup> At this stage of the planning process, the critical path is identified as much on the basis of knowledge than on a network analysis.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>4 of 10</b>

The level 2 Co-ordination Schedules shall be consistent with the tasks, Time Spans and Milestones dates contained in the level 1 Master Schedule, and with Interface Dates at co-ordination level.

These schedules shall be established using network analysis (precedence method) in a sufficient detail to demonstrate the logic and viability of the schedules.

#### 4.2.4 Level 3 – Detailed Schedules

The Detailed Schedules shall be in the form of Gantt charts, of approximately 100 tasks each ; they shall :

- cover the whole duration of a Work Unit or a group of Work Units (Work Package)
- when adequate, show the Time Spans and Milestones of the project, or Key Dates of the relevant Co-ordination Schedules
- show relevant Interface Dates
- be detailed down to elementary tasks
- utilize early start and early finish dates to identify floats
- be marked-up weekly with Actual/Expected start and finish Dates and be issued as Detailed Progress Mark-up Schedules
- follow the Gantt chart, symbol, bar color/pattern code – see Appendix 7
- be issued by the Technical Group Planners at the early stage of the phase, together with a Schedule Note.

The level 3 Detailed Schedules shall be consistent with the tasks, Time Spans, and Milestones dates contained in the level 2 Co-ordination Schedules, and with Interfaces Dates at detailed level.

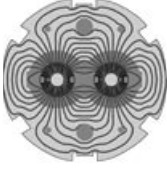
These schedules shall be established using network (precedence method) and resource analysis, in a sufficient detail to demonstrate the logic and viability of the schedules.

#### 4.2.5 Zoom, Group and Communication Schedules

##### 4.2.5.1 Zoom Schedules

Zoom Schedules shall be in the form of Gantt charts, of no more than 200 tasks each, detailing parts of level 1, 2 or 3 schedules ; like these schedules, they shall :

- cover the same duration
- show the same Time Spans and Milestones
- highlight critical paths
- utilize early start and early finish dates to identify floats
- follow the Gantt chart, symbol, bar color/pattern code – see Appendix 7
- be issued together with a Schedule Note.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>5 of 10</b>

#### 4.2.5.2 Group and Communication Schedules

There are no specific requirements for establishing Group or Communication Schedules. However, these schedules shall be numbered in accordance with the schedule numbering system – Refer to Appendix 2 of present procedure.

#### 4.2.6 Task numbering

Tasks shall be numbered in accordance with Appendix 6, by following the project WBS.

#### 4.2.7 Schedule Note

Schedule Notes shall be in the form of A4 printed documents. The typical summary of them shall be the following :

- 1 Overview (Key Dates ; Critical Path(s))
- 2 Schedule and such (Bar coding ; File location ; Plotting parameters)
- 3 Program assumptions
- 4 Interface Dates

*Appendices – List of tasks, resource histograms...*

### 4.3 Schedule Classification

Refer to Appendix 3 of present procedure.

### 4.4 Schedule issuing / up-dating process

#### 4.4.1 Schedule preparation

##### 4.4.1.1 Planning tool

Master Schedule, Co-ordination Schedules, Detail Schedules and Zoom Schedules shall be established using Microsoft Project™, version 4.0 for Windows 3.1<sup>3</sup>, which is the computerized planning system for the LHC project<sup>[2]</sup>.

All users of the computerized planning system shall comply with Everyone concerned with planning and scheduling activities must follow the detailed instructions issued by the Planning Section Leader governing the use of this system. For these instructions, refer to Appendices 7, 8 and 9 of present procedure.

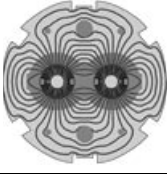
##### 4.4.1.2 Flow Chart

Refer to Appendix 5 of present procedure.

##### 4.4.1.3 Gantt chart plots – printed documents

Refer to Appendix 7 of present procedure.

<sup>3</sup> Microsoft and Windows are registered trademarks of Microsoft Corporation, Microsoft Project and Microsoft Access are trademarks of Microsoft Corporation.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>6 of 10</b>

4.4.1.4 Schedule numbering – centralized Schedule Register

A document number as well as a revision number shall appear on all schedules, issued either for comments, for Project Management approval or approved. The schedule numbering shall comply with the schedule numbering system and the Table of Schedules (when applicable) – Refer to Appendices 2 and 3 of present procedure.

Printed documents attached to schedules such as the Schedule Notes shall have the same document/revision numbers as the schedules they are referring to.

The Planning Section Leader is responsible for the monitoring of the centralized Schedule Register (a Microsoft Access™ database).

4.4.1.5 Frequency of revision

Level 1 Master Schedule shall be revised as decided by the Project Management – theoretically, never.

Level 2 Co-ordination Schedules shall be revised when required by co-ordination – no more than twice a year.

Level 3 Detailed Schedules shall be revised as decided by the Technical Group Planner/ Leader.

**4.4.2 QA associated to schedule issuing**

Refer to Appendix 3 of present procedure.

**4.4.3 Time progress monitoring**

This apply mainly to Master, Co-ordination and Detail Schedules. On a regular basis, the following information shall be recorded :

- the actual start dates of tasks which have started in the Period
- the actual finish dates of tasks which have been completed in the Period
- the expected start dates of the tasks which should be in-progress at the Cut-off Date
- the expected finish dates (i.e. the remaining durations) of tasks which are in progress, or which should be.

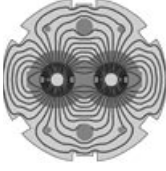
The entering of this information shall be understood as the up-date of a schedule.

4.4.3.1 Project Cut-off Dates

Progress Cut-off Dates are frozen in November for the following year. The monitoring of these dates is under the responsibility of the Planning Section Leader.

4.4.3.2 Progress Mark-up Schedules content

Progress Mark-up Schedules presenting at a Cut-off Date the time progress (Actual and Expected Dates) in addition to the Baseline Schedule, shall be in the form of Gantt charts ; they shall :

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>7 of 10</b>

- refer to a Master, Co-ordination or Detailed Schedule, i.e. feature the same tasks, have the same identification number
- specify the Cut-off Date : a vertical line on the bar chart, the full date in the header
- follow the Gantt chart, symbol, bar color/pattern code – see Appendix 7.

#### 4.4.3.3 Progress Mark-up Schedules issuing

They shall be issued within the week following each Cut-off Date.

Refer to Appendix 3 of present procedure for periodicity and other QA aspects.

### 4.5 Planning co-ordination meetings

On a regular basis(Monday morning of odd weeks) , planning co-ordination meetings shall be held under the sponsorship of the Planning Co-ordinators, in order to :

- review the actual physical and time progress compared to the planned one
- forecast new dates in undertaking the work as necessitated by circumstances
- appreciate the consequences on the Interface Dates and Risk Limitation Floats at the co-ordination level
- report to the Project Management the actual status of the progress of the project.

### 4.6 Interface Management

The principle level for identification and monitoring of schedule interfaces shall be the co-ordination level.

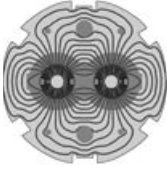
The review and co-ordination of schedule interfaces shall be through formal meetings at a regular nature. Specific schedule interface meetings shall be held as necessary, under the sponsorship of Planning Co-ordinators.

Interface, once established and agreed by the relevant Technical Group Planners/Leaders, shall be documented in Interface Dates List, which shall be followed up through the above meetings. This Interface Dates List shall be maintained under the responsibility of the Planning Section Leader. Any changes shall be agreed by Planning Co-ordinators before incorporation into the Co-ordination Schedules.

The Planning Section Leader shall use the results obtained from the processing of the level 2 networks, to monitor the Interface Dates, and to initiate appropriate actions (convene meetings, advise the Project Management), as necessary.

The Planning Co-ordinators shall advise the acceptability of the interface results, and shall initiate any renegotiation that may be necessary between relevant Technical Groups.

Interface Dates codes shall be allocated by the Planning Co-ordinators in accordance with Appendix 6.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>8 of 10</b>

## 4.7 Performance monitoring and reporting

The main objective for measuring progress is to be able:

- to **evaluate the performance of the project** all along its life cycle, i.e. what has been realized compared to the man-hour and cost expenditure
- to **control the overall advancement of the project**, i.e. the actual state of completeness compared to the planned one.

The performance measurement shall be appropriate to phase of the project : R&D (prototyping) and Design ; Tendering and Contracting (purchase orders and construction/installation contracts) ; Manufacturing ; Construction and Installation ; Tests and Commissioning.

The performance monitoring system shall be consistent with the network level it refers to. The project performance monitoring system shall be consistent with the level 2 co-ordination networks ; The groups' performance monitoring systems shall be consistent with the level 3 detailed schedules.

### 4.7.1 Design phase

The progress shall be calculated or estimated on document production. This can be monitored in different ways, however, most methods are based on the same basic principle of allocating progress values to predefined milestones, in the document development process.

Each document (technical specifications, calculation notes...), or group of documents (drawings, data sheets...) shall be weighed ; these physical weights shall reflect the overall man-hours required to produce these document documents (issues, reviews...). Predifined milestones shall follow the production life cycles of each family of document (*to be define later on with Engineering Co-ordinators*).

The assessment of planned progresses between milestones shall be obtained by assuming linear progress-development between milestones.

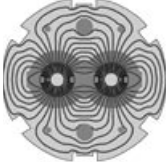
At a Cut-off Date, the consolidation rule shall be the following :

$$\% \text{Complete}_{\text{Design Phase}} = \frac{\sum_{i=1}^n \% \text{Complete}_{\text{Doct } i} \times \text{Weight}_{\text{Doct } i}}{\sum_{i=1}^n \text{Weight}_{\text{Doct } i}}$$

This actual percentage complete is then compared to the planned one.

It is up to the Engineering Co-ordinators to monitor this information using the Engineering Data Management System. Physical progress reports (mainly 'S curves') shall be issued by Planning Co-ordinators. This performance monitoring system's information shall be consistent with the R&D and Design Co-ordination Schedule. At this stage, monitoring the worked time progress is not required.



	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>9 of 10</b>

#### 4.7.2 Tendering and Contracting phase

The progress shall be calculated on tender issues and contract awards. Each contract shall be weighed ; physical weights shall reflect the part of each contract in the project budget. The assessment of planned progresses between milestones shall be obtained by assuming linear progress-development between milestones.

At a Cut-off Date, the consolidation rules are similar to the one defined previously. Two actual progresses are then compared to planned ones.

It is up to the Engineering Co-ordinators to monitor this information. It is then integrated to the Project Progress by the Planning Section Leader. This performance monitoring system's information shall be consistent with the Tendering and Contracting Co-ordination Schedule.

#### 4.7.3 Manufacturing phase

The progress shall be calculated equipment and bulk deliveries. Each delivery shall be weighed ; physical weights shall reflect the price of the equipment or bulk delivered. The assessment of planned progresses between milestones shall be obtained by assuming linear progress-development between milestones.

At a Cut-off Date, the consolidation rules are similar to the one defined previously. The actual progress is then compared to the planned one.

It is up to the Manufacturing Inspectors to monitor this information. It is then integrated to the Project Progress by the Planning Section Leader. This performance monitoring system's information shall be consistent with the Manufacturing Co-ordination Schedule.

#### 4.7.4 Construction/Installation Phase

*[hold]*

#### 4.7.5 Test/Commissioning Phase

*[hold]*

#### 4.7.6 Project Progress reporting

##### 4.7.6.1 Project Progress Report content

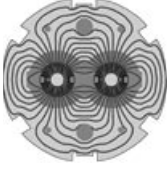
Project Progress Reports shall be in the form of A4 printed documents. The typical summary of them shall be the following :

*(to be defined later on with Project Management).*

##### 4.7.6.2 Project Progress Report issuing

Project Progress Reports shall be issued monthly, within the week following each Cut-off Date, under the responsibility of the Planning Section Leader.

Refer to Appendix 3 of present procedure for periodicity and other QA aspects.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page</i> <b>10 of 10</b>

#### **4.7.7 Group's Progress reporting**

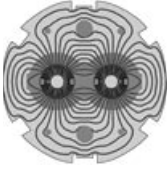
*(to be defined later on with Project Management and Planning Officers).*

#### **4.8 Relationship with other documents**

It shall be the responsibility of everyone involved on the project to be cognizant of the schedule requirements as set out on the appropriate schedules. All documents relating to or containing required dates for action must be consistent with these schedules, e.g. engineering drawing registers, procurement status report, call for tenders...

### **5 Reference documents**

- [1] G. BACHY, A.-P. HAMERY, 'What to be implemented at the early stage of a large scale project', CERN MT/95-02(DI), CERN, March 1995.
- [2] G. BACHY, M. TARRANT, P. BONNAL, 'A Planning & Scheduling System for the LHC Project', CERN MT/95-09(DI), CERN, Sept. 1995.
- [3] *PMBOK : Project management body of knowledge*, Project Management Institute, 1995.
- [4] BS 6046 : Part 1 : 1984, *Use of network techniques in project management – Guide to the use of management, planning, review and reporting procedures*, BSi.
- [5] BS 4335 : 1987, *British standard glossary of Terms used in project network techniques*, BSi.

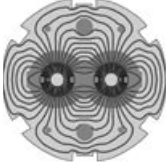
	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>LIST OF APPENDICES</b>

# Appendices

---

1	.....	Definitions
2	.....	Schedule Numbering/Registering System
3	.....	Table of Schedules
4	.....	Planning & Scheduling Organization
5	.....	Planning Process Flow Chart
6	.....	Task and Interface Date Numbering System
7	.....	Gantt chart, Symbol, Bar color/Pattern Code
8	.....	Centralized Planning Databases
9	.....	Addendum to Microsoft Project™ User's Manual
10	.....	List of Generic Activities
11	.....	Co-ordination Schedule Content

All these appendices have been designed with the aim of using Microsoft Project™ as the common planning tool for the project.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 3</i> <b>APPENDIX 1</b>

# Appendix 1

## Definitions

The following definitions apply to this procedure<sup>4</sup> :

**ABS (Assembly Breakdown Structure)** – the structure which is used to determine the adequate LHC machine assembly sequences<sup>[1]</sup>.

**Action Plan** – document containing Time Spans and Milestones, set by the Project Management at the early stage of the project, in order to issue the Master Schedule.

\***Activity** – *see Task*

**Actual Dates** – start/finish dates entered as the project progresses ; dates within which tasks have been carried out ; opposed to Baseline Dates and Expected Dates.

**Baseline Schedule/Dates** – frozen schedule/dates ; standard schedule/dates by which the project performance is measured (~ Planned Schedule/Dates) (*cf.* section ...).

**CBS (Contract/Cost Breakdown Structure)** – the breakdown of cost estimate items down to contracts.

**Communication Schedule** – tasks extracted from schedules (Master, Co-ordination and/or Detailed Schedules), in order to present the project to external parties.

\***Control Schedule** – *see Progress Mark-up Schedule.*

**Co-ordination Schedule** – 2<sup>nd</sup> level in the hierarchy of networks/schedules.

\***Current Dates** – *see Expected Dates.*

**Cut-off Date** – frozen date at which the status of the project is measured ; used for project reporting (~ Time Now).

\***Deliverable** – *see Task.*

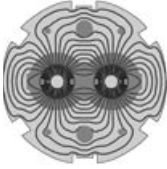
**Detailed Schedule** – 3<sup>rd</sup> level in the hierarchy of schedules.

**Expected Dates** – rescheduled dates of the remaining work, entered as the project progresses ; opposed to Baseline Dates and Actual Dates (~ Target Dates, Forecast Dates) (*cf.* section ...).

\***Forecast Dates** – *see Expected Dates.*

---

<sup>4</sup> In order to avoid the use of synonyms which in some cases can be confusing, terms preceded with an asterisk shall not be used. Refer also to ref. [5] for terms related to network analysis.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 2 of 3</i> <b>APPENDIX 1</b>

**Generic Activity** – item of the gozinto chart which depicts all the activities which can be found in an engineering project, from design activities to tests (*cf.* Appendix ...).

**Interface Management** – the monitoring, co-ordination and negotiation of interface dates between Technical Groups, Contractors/Suppliers and/or External Labs.

**Interface Dates** – dates shared by two networks at a same level (level 2 or 3).

**Key Dates** – significant dates corresponding to the achievement of significant events ; these dates result from network calculations.

**Master Schedule** – 1<sup>st</sup> level in the hierarchy of schedules (*cf.* section ...).

**Milestones** – dates set by the Project Management at the early stage of the project in order to achieve the project in an acceptable duration.

**OBS (Organizational Breakdown Structure)** – the project organigram ; this applies to tasks performed at CERN, under CERN's responsibility<sup>5</sup>

**PBS (Product Breakdown Structure)** – hierarchical chart (*gozinto* chart) of all components which constitute the LHC machine<sup>[1]</sup>, from cryodipole parts to building facilities.

**Period** – time span between two Cut-off Dates : the previous and the current ones.

**\*Planned Schedule/Dates** – *see Baseline Schedule/Dates.*

**Progress Mark-up Schedule** – fixed revision of any schedule, used for time progress monitoring and reporting (~ Control Schedule).

**Risk Limitation Floats** – floats placed all along the project in order to reduce propagation of delays<sup>[2]</sup> ; this applies to level 1 and 2 schedules (~ Time Contingencies).

**Schedule Note** – note issued together with every schedule, abstracting the Key Dates and critical paths, detailing the assumptions, listing Interface Dates.

**Summary Task** – the time envelope of a set of tasks (shall follow the WBS).

**\*Target Dates** – *see Expected Dates.*

**Task** – *elementary line* of any schedule ; smallest discrete block of time and resource handled by the planning software (~ Activity, Deliverable).

**\*Time Contingencies** – *see Risk Limitation Floats.*

**\*Time Now** – *see Cut-off Date.*

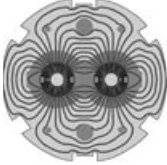
**\*Time Slots** – *see Time Spans.*

**Time Spans** – periods set by the Project Management at the early stage of the project in order to achieve the project in an acceptable duration (~ Time Slots).

**WBS (Work Breakdown Structure)** – a **matrix** constituted of data from the several structures of the project.

**What-if Analyses/Schedules** – Gantt charts issued in order to provide the Project Management/Group Leaders with thorough elements for decision making.

<sup>5</sup> Within the OBS, collaborating institutions are assimilated to technical groups.

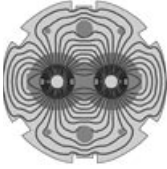
	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 3 of 3</i> <b>APPENDIX 1</b>

**Work Package** – group of Work Units (shall follow the WBS).

**Work Unit** – elementary task of a Co-ordination Schedule (*cf.* section ...).

**ZBS (Zone Breakdown Structure)** – the structure which is used to identify where tasks related to construction take place ; this structure is used in the construction/installation phase mainly.

**Zoom Schedule** – tasks extracted from level 1, 2 or 3 schedules, and sometimes detailed, in order to highlight critical sequences of tasks.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 2</i> <b>APPENDIX 2</b>

## Appendix 2

### Schedule Numbering/Registering System

#### 1 General concept

All schedules related to the Large Hadron Collider project shall be numbered using the following numbering system. The Planning Section Leader is responsible for the monitoring of the centralized Schedule Register (a Microsoft Access database).

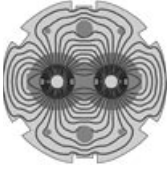
#### 2 Structure of the numbering system

LHC / □□□ □ □□□ rev. □ . □  
 (1) (2) (3) (4) (5) (6)

Field (1) : **Project ID**, (LHC for the Large Hadron Collider project).

Field (2) : **Schedule issuer** (Technical Group / Section) :

- CE – Civil Engineering group (ST/CE)
- ACR – Cryogenics for Accelerators group (LHC/ACR)
- CRI – Cryostats and Integration group (LHC/CRI)
- CV – Cooling and Ventilation group (ST/CV)
- ECR – Cryogenics for Exp'ts and Testing Areas group (LHC/ECR)
- EI – Electrical Installations group (ST/EI)
- [hold] – Engineering Support group (EST/ [hold] )
- IAS – Industrial Automation and Supervision group (LHC/IAS)
- ICP – Insertions, Correctors and Protection group (LHC/ICP)
- IN – Installation group (EST/IN)
- MMS – Main Magnets and Superconductors group (LHC/MMS)
- MF – Manufacturing Facilities group (EST/MF)
- MTA – Magnets Tests and Analyses group (LHC/MTA)
- PL – Planning section (AC/DI/PL) + Miscellaneous
- SM – Surfaces and Materials group (EST/SM)
- SU – Applied Geodesy group (EST/SU)
- VAC – Vacuum group (LHC/VAC)

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 2 of 2</i> <b>APPENDIX 2</b>

Field (3) :    **Schedule level** (kind of schedule) :

- M    –    Master Schedule<sup>6</sup>
- C    –    Co-ordination Schedule
- D    –    Detailed Schedule
- Z    –    Zoom Schedule
- G    –    Group Schedule
- X    –    Miscellaneous

Field (4) :    **Schedule sequential number** (within its category, fields (1) to (3))

- e.g. :
- LHC/PL M002    Main Ring – Master Schedule
  - LHC/PL M003    Transfer Lines – Master Schedule
  - LHC/PL M004    Injectors (PS Modification) – Master Schedule
  - LHC/PL M005    Injectors (SPS Modification) – Master Schedule
  - LHC/PL M006    Common LHC Systems - Conventional Facilities – Master Schedule
  - LHC/PL C001    R&D and Design Co-ordination Schedule
  - ...

Field (5) :    **Major revision index**

Field (6) :    **Minor revision index**

### 3    **Revision tracking**

The first issue of a schedule has the following revision index : 0.1

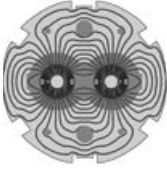
Minor modifications, with few consequences (which do not need to be approved) increment the minor index (field (6), e.g. 0.1 → 0.2 ; 1.5 → 1.6...) while major updates, which must be approved by the Project Management or Technical Group Leaders (according to the schedule level) increment the major index (field (5), e.g. 0.5 → 1.0 ; 2.12 → 3.0...).

In several cases, a major update of a Master Schedule might requires major updates of related Co-ordination and Detailed Schedules.

---

<sup>6</sup> Except schedule no. LHC/PL M001 : Cryodipoles and Short Straight Sections – Zoom Schedule.



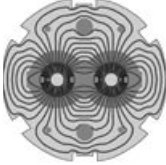
	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>APPENDIX 3</b>

## Appendix 3

### Table of Schedules

Schedule No. Schedule Title	Type Format	Issued by	Checked by	Approved by	Period covered	Monitoring Period	Revision Period	Distrib.	Purpose
<b>→ Master Level</b>									
<b>LHC/PL M001 – ZOOM Cryodipoles and SSS</b>	Bar Chart (hold)	Planning Co-ord.	(hold)	PM <sup>7</sup>	whole Project	monthly	as decided by PM	(hold)	• To highlight the Master Schedule critical path
<b>LHC/PL M002 Main Ring</b>	Bar Chart (hold)	Planning Co-ord.	(hold)	PM	whole Project	monthly	as decided by PM	(hold)	• Master Sched. for the Project
<b>LHC/PL M003 Transfer Lines</b>	Bar Chart (hold)	Planning Co-ord.	(hold)	PM	whole Project	monthly	as decided by PM	(hold)	• Overall progress monitoring
<b>LHC/PL M004 Injectors (PS Modif.)</b>	Bar Chart (hold)	Planning Co-ord.	(hold)	PM	whole Project	monthly	as decided by PM	(hold)	• To identify main Interface Dates
<b>LHC/PL M005 Injectors (SPS Modif.)</b>	Bar Chart (hold)	Planning Co-ord.	(hold)	PM	whole Project	monthly	as decided by PM	(hold)	
<b>LHC/PL M006 Common LHC Systems Conventional Facilities</b>	Bar Chart (hold)	Planning Co-ord.	(hold)	PM	whole Project	monthly	as decided by PM	(hold)	
<b>→ Co-ordination Level</b>									
<b>LHC/PL C001 R&amp;D and Design</b>	Bar Chart (hold)	Planning Co-ord.	Technical Groups	(hold)	Phase Period	monthly	twice a year max.	(hold)	• To meet overall project objectives
<b>LHC/PL C002 Tendering/Contracting</b>	Bar Chart (hold)	Planning Co-ord.	Technical Groups	(hold)		monthly	twice a year max.	(hold)	• To demonstrate logic and viability
<b>LHC/PL C003 Manufacturing</b>	Bar Chart (hold)	Planning Co-ord.	Technical Groups	(hold)		monthly	twice a year max.	(hold)	• Precise progress monitoring
<b>LHC/PL C004 Construction/Installation</b>	Bar Chart (hold)	Planning Co-ord.	Technical Groups	(hold)		monthly	twice a year max.	(hold)	• To monitor tech. group's interfaces
<b>LHC/PL C005 Tests/Commissioning</b>	Bar Chart (hold)	Planning Co-ord.	Technical Groups	(hold)		monthly	twice a year max.	(hold)	
<b>→ Detailed Level</b>									
<b>LHC/◆◆ D◆◆◆ Work Unit .....</b>	Bar Chart (hold)	Group's Planners	Planning Co-ord.	Technical Groups	WU Period	weekly	as required	(hold)	

<sup>7</sup> PM = Project Management.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>APPENDIX 4</b>

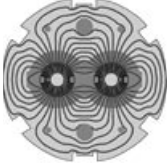
# Appendix 4

---

## **Planning & Scheduling Organization**

---

*[hold]*

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>APPENDIX 5</b>

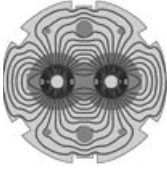
# Appendix 5

---

## Planning Process Flow Chart

---

*[hold]*

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 2</i> <b>APPENDIX 6</b>

# Appendix 6

## Task and Interface Date Numbering System

### 1 General concept

At all levels of scheduling, Schedule tasks and Interface Dates shall be numbered using the following numbering system.

This applies specifically to Master, Co-ordination and Detailed Schedules, and by the way to Progress Mark-up Schedules. This numbering system does not affect Zoom, Communication nor Groups Schedules, for which no specific rules apply.

The intention is to provide a structure for allocating id. numbers to schedule elementary and rolled-up tasks, and Interface Dates, in order to ensure that :

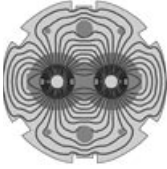
- comparisons can be made between networks, and between schedule revisions
- an audit trail can be established for all schedules.

Once an activity number has been allocated, it shall not be changed, under any circumstances.

### 2 Structure of task numbering system

The following Microsoft Project's free text fields, shall be used as follows :

Microsoft Project's free field no.	Usage	Format
<b>Text1</b>	task responsible	<i>(to be define later on with Project Management).</i>
<b>Text2</b>	schedule level	□□□□ Co-ordination Schedule number (cf. appendix 2 – fields (3) and (4)).
<b>Text3</b>	generic activity code	as per appendix 10.
<b>Text4</b>	P.B.S. code	<i>(to be define later on with Project Management).</i>
<b>Text5</b>	A.B.S. code	<i>(to be define later on with Project Management).</i>
<b>Text6</b>	C.B.S code	<i>(to be define later on with Project Management).</i>
<b>Text7</b>	Z.B.S. code	<i>(to be define later on with Project Management).</i>
<b>Text8</b>	sequential no.	□□□ Task sequential number.
<b>Text9</b>	Interface Date no.	as per appendix 6 – § 3 here after.
<b>Text10</b>	<i>(available)</i>	<i>(might be used in a near future).</i>

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 2 of 2</i> <b>APPENDIX 6</b>

Microsoft Project's free field no.	Usage	Comments
<b>Flag1</b>	External event/milestone	Yes if the task is an <b>external event/milestone</b> . No otherwise.
<b>Flag2</b>	Task related to Design	<b>Engineering tasks + Surveys + Permitting.</b>
<b>Flag3</b>	Task related to Procurement	<b>Markets surveys + Tendering + Contracting.</b>
<b>Flag4</b>	Task related to Construction	<b>Manufacturing + Construction + Installation.</b>
<b>Flag5</b>	Task related to Tests	<b>Tests + Commissioning.</b>
<b>Flag6</b>	<i>(available)</i>	<i>(might be used in a near future).</i>
<b>Flag7</b>	<i>(available)</i>	<i>(might be used in a near future).</i>
<b>Flag8</b>	<i>(available)</i>	<i>(might be used in a near future).</i>
<b>Flag9</b>	Location of the work	No (default) if the major part of the work related to the task is performed at Cern. Yes if the work is done at Suppliers/Contractors premises or in External Labs.
<b>Flag10</b>	Task identifier	Yes if the task shall appear in the Task List. No otherwise.
<b>Marked</b>	<i>(available)</i>	<i>(will stay available all project long).</i>

### 3 Structure of Interface Dates numbering system

#### 3.1 Inter-Group Interface Dates

**IG - □□ - □□ - □□□□ - □□□**  
 (0) (1) (2) (3) (4)

Field (1) : **Preceding Technical Group.**

Field (2) : **Succeeding Technical Group.**

Field (3) : **Co-ordination Schedule number** (*cf.* Appendix 2 – fields (3) and (4)).

Field (4) : **Inter-Group Interface Date sequential number** (within its category, i.e. fields (1) to (3))

This identification number shall be entered in Microsoft Project™'s free text fields **Text9**. Each set shall be separated by a dash ('-').

#### 3.2 Inter-Schedule Interface Dates

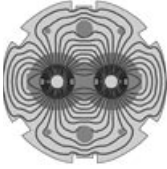
**IS - □□□□ - □□□□ - □□□**  
 (0) (1) (2) (3)

Field (1) : **Foregoing Schedule.**

Field (2) : **Following Schedule.**

Field (4) : **Inter-Schedule Interface Date sequential number** (within its category, i.e. fields (1) and (2))

This identification number shall be entered in Microsoft Project's free text fields **Text9**. Each set shall be separated by a dash ('-').

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>APPENDIX 7</b>

## Appendix 7

### Gantt chart, Symbol, Bar color/Pattern Code


















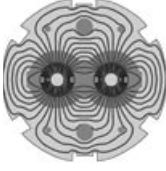
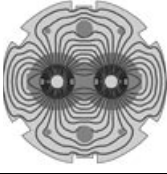
	color	task	milestone
<i>the pattern depicts where a task is performed :</i>			
tasks performed at CERN			
tasks performed by contractors/supplier			
tasks performed by collaborating institutions			
<i>the color depicts the criticality or the project phase :</i>			
external events – action plan’s milestones	<i>dark green</i>		
<u>all critical</u> tasks	<i>red</i>		
tasks related to <b>design</b> activities	<i>magenta</i>		
tasks related to <b>tendering/contracting</b> activities:	<i>dark cyan</i>		
Call for Tender			 CfT
Finance Committee			 FC
Contract Signature			 SC
tasks related to <b>production/construction</b> activities	<i>blue</i>		
tasks related to <b>tests/commissioning</b> activities	<i>dark yellow</i>		

Table 1 – Bar Chart Legend

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>APPENDIX 8</b>

**Appendix 8**  
—  
**Centralized Planning Databases  
and Access to them**  
—

*[hold]*

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 2</i> <b>APPENDIX 9</b>

# Appendix 9

## Addendum to Microsoft Project™ User's Manual

### 1 Purpose

There many different ways to use Microsoft Project. In order to standardize a practice of this software, the several rules shall be respected for issuing Master, Co-ordination and Detailed schedules. In addition to Microsoft Project User's Manual, *fuzzy topics* are highlighted, for a better implementation of this software.

### 2 General

Following LHC Note 355 conclusions, Microsoft Project is the selected tool for planning LHC. In other words, everyone involved in issuing Master, Co-ordination and/or Detailed Schedules on this project (Planning Co-ordinators, Group Planners, Suppliers/Contractors and External Lab's Project Controllers/Managers...) shall use this software.

MPP (Microsoft Project proprietary format) is the preferred format for scheduling data transmitting.

#### 2.1 Hardware requirements

To run correctly, the following hardware configuration is required :

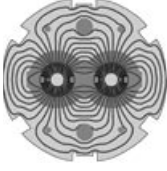
- Processor ..... 486 DX2 66 MHz minimum (Pentium 90 MHz preferred)
- RAM ..... 16 MB minimum (32 MB preferred)
- Screen ..... 17 in. SVGA 1200×1024 80 MHz refresh (20 in. preferred)
- Printer(s)/Plotter(s) ..... [hold]

#### 2.2 Hardware requirements

To run correctly, the following hardware configuration is required :

- Operating system ..... MS/DOS + Microsoft Windows 3.x
- Planning ..... Microsoft Project version 4.0
- Microsoft Project add-on(s) ..... [hold]



	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 2 of 2</i> <b>APPENDIX 9</b>

### 2.3 RESUME.MPW and GLOBAL.MPT files

Standardized workspace (RESUME.MPW) and template (GLOBAL.MPT) files shall be used. For this very reason, these two files located at G:\HOME\BONNAL on SRV3 (also available upon request) shall be copied in the Microsoft Project directory<sup>8</sup> on your local disk (C:\WINPROJ).

An *empty ready-to-work* Project file : EMPTY.MPP, also located at G:\HOME\BONNAL, can be used as a base to build a new schedule.

## 3 User's Manual

### 3.1 Addendum no. 1 – Workspace

Two views (Dates→Cern and Gantt→Cern) and three tables (Codes→Cern; Dates→Cern and Flags→Cern) have been added to the default Microsoft Project environment.

- Gantt→Cern view together with Codes→Cern table complies with standardized Gantt chart printouts.
- Dates→Cern view is compliant with standardized task lists (appended to Schedule Notes).
- Gantt→Cern view together with Flags→Cern table can be usefull for data entry.

### 3.2 Addendum no. 2 – Printouts

#### 3.2.1 Gantt charts

##### 3.2.1.1 Paper Format

*[hold]*

##### 3.2.1.2 Header and Footer

*[hold]*

##### 3.2.1.3 Spreadsheet

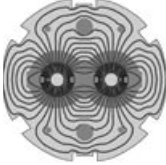
*[hold]*

##### 3.2.1.4 Gantt Chart

*[hold]*

---

<sup>8</sup> When using a network release of Microsoft project, this directory does not exist and need to be created.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 1</i> <b>APPENDIX 10</b>

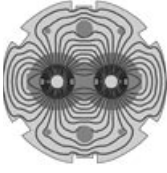
# Appendix 10

---

## List of Generic Activities

---

*[hold]*

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 1 of 2</i> <b>APPENDIX 11</b>

# Appendix 11

## Co-ordination Schedule Content

### 1 R&D and Design Co-ordination Schedule

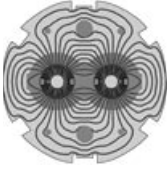
Level 2 R&D and Design Co-ordination Schedule shall identify, for every significant PBS component, as applicable :

- tasks related to prototypes :
  - test benches realization
  - manufacturing of prototype components
  - deliveries of components to CERN
  - assembly
  - tests and measurements
- surveys / geotechnical studies
- impact studies / permitting
- engineering tasks (drawings and documents preparation, issue and approval)
- tendering and contracting of significant engineering sub-contracts
- Interface Dates with tendering, contracting, manufacturing, construction, installation.

### 2 Tendering and Contracting Co-ordination Schedule

Level 2 Tendering and Contracting Co-ordination Schedule shall be established identifying each purchase order over CHF..... for equipment and significant bulk items, each construction or installation contract over CHF....., and shall identify as appropriate :

- Interface Dates with engineering, manufacturing, construction, installation
- market surveys and firm preselections
- preparation of technical specifications
- tendering, from call for tenders issue to bid evaluation
- finance committees and contracting.

	<b>LHC PROJECT</b>	<b>PLANNING &amp; SCHEDULING</b>	
<i>Doc. No.</i> <b>LHC-QAP-402</b>	<i>Rev. No.</i> <b>1.0</b>	<i>Date</i> <b>1996-02-08</b>	<i>Page 2 of 2</i> <b>APPENDIX 11</b>

### **3 Manufacturing Co-ordination Schedule**

Level 2 Manufacturing Co-ordination Schedule shall identify as applicable :

- Interface Dates with engineering, contracting, tests, site requirements
- tooling, mobilization/demobilization of major equipment
- preseries (including evaluation)
- series production, up to site deliveries.

### **4 Construction and Installation Co-ordination Schedule**

Level 2 Construction and Installation Co-ordination Schedule shall identify as applicable :

- Interface Dates with engineering, contracting, deliveries, tests and commissioning
- design/procurement/installation of site facilities and temporary works
- mobilization/demobilization of major equipment
- construction and installation tasks.

### **5 Tests and Commissioning Co-ordination Schedule**

- Interface Dates with manufacturing, construction and installation
- tasks related to tests and measurements : planning, testing and reporting
- tasks related to pre-commissioning and commissioning.