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# Front-End Schedule Optimization Services

## OVERVIEW

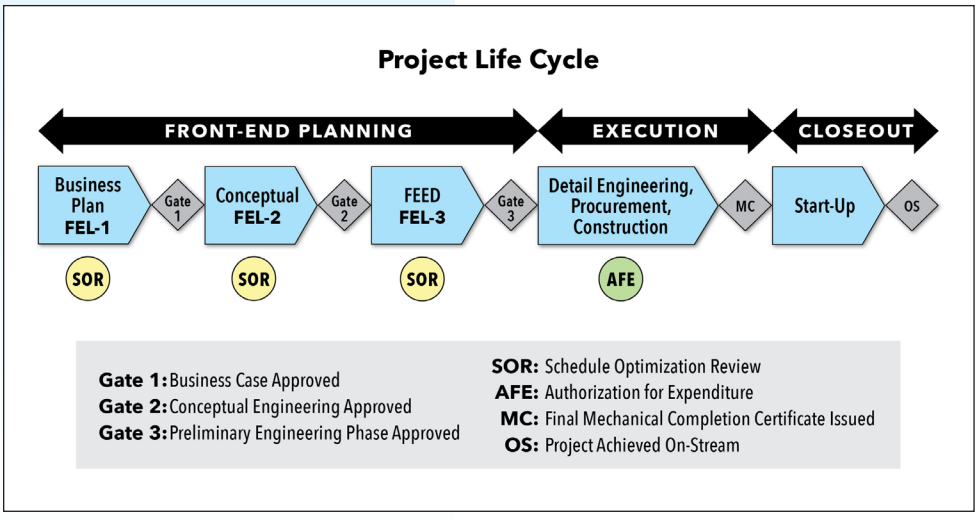
*Poor planning and scheduling during the front-end planning phases, including the critical phase of Front-End Engineering Design (FEED), are significant factors leading to project failure. If a project does not start right, it is unlikely that it will end right. The project milestones, resources, and completion dates established during FEED set the baseline control plan during project execution. Therefore, front-end planning schedule optimization techniques, including using the DCMA 14-point schedule assessment and other quality checks, are recommended to validate that a project baseline schedule is reasonably achievable.*

*Long International and CORE can help you meet your cost, schedule, and quality objectives.*

## 1. Schedule Quality Assurance

Many front-end project schedules are poorly prepared and require extensive re-baselining during project execution to become useful project management tools to correctly measure progress, determine the effect of changes in scope, and forecast the completion of contractual milestones and overall project completion dates. Poorly prepared schedules do not provide reliable tools to quantify and allocate responsibility for delays during project execution to provide a basis for a time extension or assess the need for acceleration to mitigate delays. Long International and CORE International Consulting perform schedule quality assurance checks to identify and rectify these common problems with front-end schedules by: ensuring that the schedule accurately reflects the complete contractual scope of work; evaluating schedule metrics to assess schedule integrity; reviewing schedule logic for reasonableness; and evaluating the reasonableness and completeness of the critical path.

A schedule quality assurance assessment provides valuable and comprehensive project schedule checks to ensure that: the complete scope of work is represented; schedule metrics are within industry norms; schedule logic is reasonable and competitive; and the project critical path is reasonable and achievable. Compiled findings from these examinations serve as a guide for schedule improvement.




## 2. Schedule Quality Checks During the Project Life Cycle

A project life cycle refers to the several phases and stages that a project passes through from initiation to completion. Major capital projects consist of two phases of pre-planning and execution. Each phase consists of stages marked by defined activities that correspond to project scope and deliverables. Approving the deliverables that are normally marked by a gated milestone manifests completion of each stage. Decision gates are critical checkpoints when phase deliverables receive formal review and approval, allowing a project to move to the next stage or phase. This includes the project's financial approval with authorization for expenditure (AFE).

The figure on this page shows a typical capital project's planning and execution roadmap, including the phases and stages of the project life cycle. Each stage has specific objectives, defined activities, deliverables, and decisions. Decision gates may be formal or informal, depending on the organization. The stages of the pre-planning phase are also referred to as Front-End Loading (FEL). FEL is usually formatted into three stages:

1. Business Plan Development,
2. Conceptual Scope Development, and
3. Front End Engineering Design (FEED)

At the end of the FEED phase, project funding is approved, and a project can move forward and be awarded for engineering, procurement, and construction (EPC) execution. The type of execution depends on the contracting strategies established during the pre-planning phase.

## 3. Schedule Optimization During Front-End Planning

The Construction Industry Institute (CII) states that project planning is often synonymous with Front-End Planning (FEP) and FEL. The FEL process organizes the project life cycle into different phases, decision gates, or checkpoints to help management decide if a project is ready to continue to the next phase. Well-performed FEP can reduce cost and project variability and increase chances of a project meeting its objectives. Front-end planning is arguably the single most important process in the facility project life cycle.

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The table to the right shows the three stages of FEP, cost/schedule deliverables, expected outcome, and decision gates at each stage. FEL presents an excellent opportunity to apply robust planning early in a project's life cycle, when the ability to influence changes in design is relatively high and the cost to make those changes is relatively low. It typically applies to industries with highly capital-intensive projects with long life cycles.

The following sections recommend schedule quality checks at each stage of FEP. It is encouraged that schedule reviewers be included as part of gate reviews and score each phase relative to schedule quality and schedule optimization with a grading scale that includes "pass," "fail," or "needs improvement" on the project schedule. If there are any failed items, the schedule should not be accepted until all concerns, errors, or problems have been corrected, cleared, or considered.

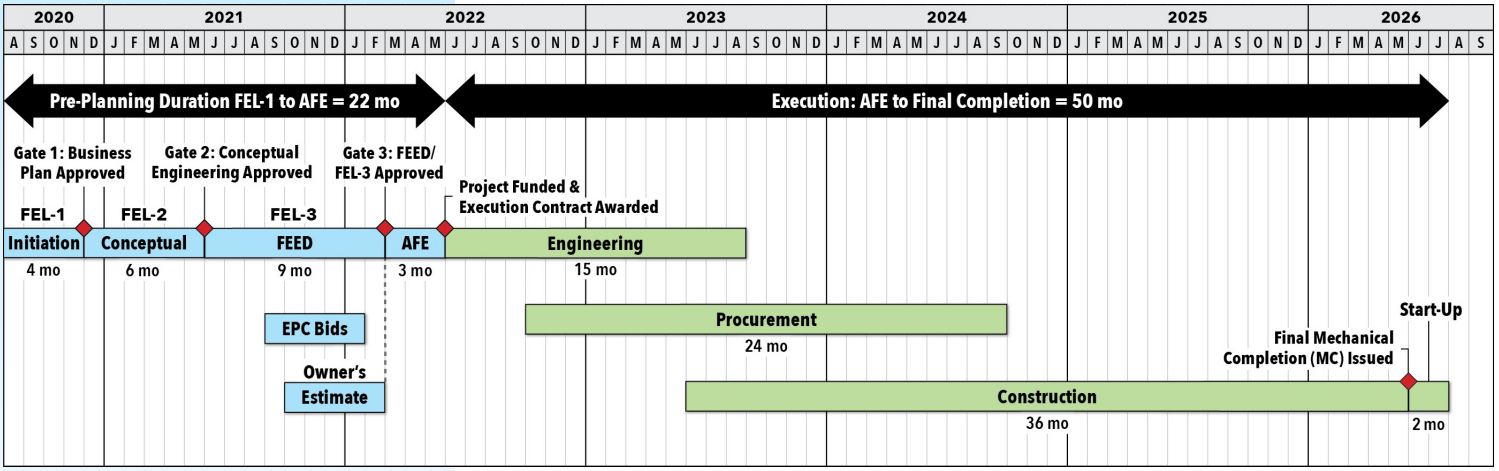
| Business Plan (FEL-1) | Conceptual Plan (FEL-2) | FEED (FEL-3) |
|---|---|---|
| ± 50% estimate | ± 30% estimate | ± 10% definitive estimate |
| Level I master schedule | Level II milestone schedule | Level III project schedule |
| Project initiation into business plan | Basis of design | Tender documents |
| **Gate 1: Approved for business plan** | **Gate 2: Design basis approved** | **Gate 3: AFE** |

## 4. Business Plan Level I Master Schedule (FEL-1)

The business plan stage is often referred to as the project initiation stage. Major activities include conducting a business case, preliminary conceptual studies, scope definition, stakeholders' identification, and benchmarking against similar internal or external projects. A business plan project schedule reflects the business plan milestones usually in bar chart format. It is developed mainly based on a brief scope of work and historical data including preliminary durations benchmarked against similar projects. The graphic below is an example of a business plan schedule for a large process plant project.

The following quality checks identify the minimum quality measures to include with a Level I project master and business plan schedule:

1. Brief scope of work or project scoping document
2. List of key interfaces within the project or with other projects
3. Initial project charter
4. Schedule data used as benchmarks from similar projects



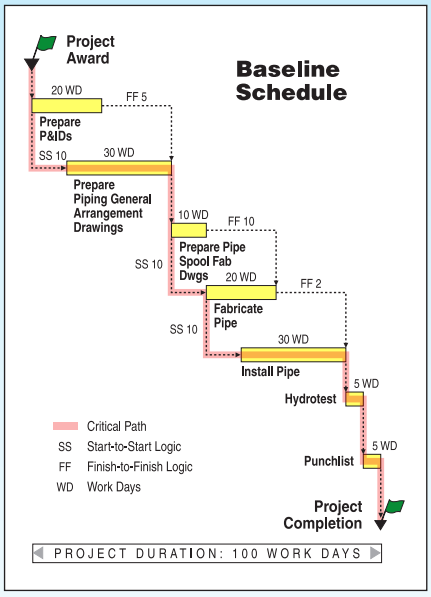
5. Initial contracting strategy
6. Conceptual drawings of the facility, including site plan
7. Preliminary list of major equipment, including long-lead equipment
8. Preliminary vendor quotations if available
9. Estimated preliminary major installation quantities
10. Shutdown and startup requirements and/or sequences

## 5. Conceptual Plan Level II Project Milestone Schedule (FEL-2)

The conceptual stage (FEL-2) should include a complete scope of the capital project to economically achieve the stated business objective(s). This stage is also known as the facility plan as it defines the design basis prior to initiating FEED development. FEL-2 should define the major design aspects of the project and detail the impact on existing or future facilities. It also serves to document agreement among major stakeholders, including senior management representing the operating owner (project proponent) and project management team organization (execution agency). FEL-2 also includes the facilities planning consultants or the department that helps the proponent define and streamline scope, prepare the project justifications and feasibility study, and develop the major design basis, cost, and schedule for the capital project under consideration.

# Front-End Schedule Optimization Services

| Activity ID | Activity Name | Start | Finish |
|---|---|---|---|
| **FEL 3.1.3.1.2 Process Simulations** | | 06-Jul-20 | 12-Apr-21 |
| FB8GNPR1010 | Process Simulations – Maintain & Update for FEL 3 | 06-Jul-20 | 28-Sep-20 |
| FB8GNPR1020 | Process Simulations – Maintain & Update | 01-Oct-20 | 12-Apr-21 |
| **FEL 3.1.3.1.3 Heat & Material Balance (H&MB)** | | 06-Jul-20 | 16-Apr-21 |
| FB8GNPR1130 | H&MB – Incorp ASC Comments/Issue for HAZOP | 24-Sep-20 | 05-Nov-20 |
| FB8GNPR1140 | H&MB – Incorp HAZOP Comments & Issue | 14-Dec-20 | 29-Jan-21 |
| FB8GNPR1150 | H&MB – Incorp E-Review Comments & Issue | 18-Feb-21 | 16-Apr-21 |
| FB8GNPR1120 | H&MB – ASC Review | 10-Sep-20 | 21-Sep-20 |
| FB8GNPR1110 | H&MB – Update for FEL 3 (UTMN) | 06-Jul-20 | 19-Jul-20 |
| **FEL 3.1.3.1.4 Process Flow Diagrams PFD & UFD** | | 20-Jul-20 | 11-Apr-21 |
| FB8GNPR1210 | PFDs – Update for FEL 3 | 20-Jul-20 | 02-Aug-20 |
| FB8GNPR1230 | PFDs – Incorp Comments/Issue for HAZOP | 17-Aug-20 | 05-Nov-20 |
| FB8GNPR1220 | PFDs – Client Review | 03-Aug-20 | 16-Aug-20 |
| FB8GNPR1240 | PFDs – Incorp HAZOP Comments & Issue for E-Review | 14-Dec-20 | 29-Jan-21 |
| FB8GNPR1250 | PFDs – Incorp E-Review Comments & Issue for FEED Pkg | 28-Feb-21 | 11-Apr-21 |
| **FEL 3.1.3.1.7 P&IDs** | | 16-Jul-20 | 18-Apr-21 |
| FB8GNPR1360 | FEL 3 HAZOP Mtg (Including SIL) | 21-Nov-20 | 13-Dec-20 |
| FB8GNPR1350 | P&IDs – Facilitator – Review & Prep for HAZOP | 16-Nov-20 | 20-Nov-20 |
| FB8GNPR1390 | P&IDs – Incorp E-Review Comments/Issue for PP Pkg | 28-Feb-21 | 18-Apr-21 |




Major activities during conceptual engineering include preparing the basis of design, performing a project feasibility study, issuing a preliminary Project Execution Plan (PEP), developing the Work Breakdown Structure (WBS), conducting value improvement practices including project and schedule risks, validating all viable alternatives, and identifying long-lead procurement items. Major deliverables during this phase include a design basis package, preliminary PEP, WBS, Level II project milestone schedule, Schedule Risk Analysis (SRA) report, and ±30% budget estimate.

During FEL-2, a detailed project milestone schedule is developed to plan and control the detailed activities required to produce all FEL-2 deliverables and ensure they meet milestone deadlines. The FEL-2 project milestone schedule should be a Critical Path Method (CPM) schedule. Interactive planning sessions are typically held during the development to determine activity durations and logic to ensure stakeholders alignment. Schedule development is usually based on activities defined in discipline man-hour estimates. The above bar chart is an example FEL-2 schedule of engineering deliverables for process flow diagrams (PFDs) and utility flow diagrams (UFDs), as well as preliminary piping and instrumentation diagrams (P&IDs).

The ultimate objective is to prepare a well-developed FEL-2 target schedule that provides a tool to measure the schedule/performance. The following list provides the minimum quality measures to include and consider for the Level II project milestone schedule:

1. The basis and assumptions used to prepare the Level II project milestone schedule
2. Complete "Design Basis" documents
3. Updated project charter
4. Project Execution Plan (PEP) including list of key interfaces
5. Updated contracting strategy
6. Updated project risk management or risk register
7. Schedule Risk Assessment (SRA) report showing schedule confidence level
8. Updated constructability review report
9. Preliminary P&ID and other drawings, plot plans, and diagrams
10. Procurement duration(s) based upon actual vendor quotations
11. Process and utility sized equipment list
12. Sized electrical equipment
13. Bulk construction quantities
14. Procurement strategy and material procurement plan
15. Memorandum of understanding for execution
16. Commissioning, start-up, and shutdown requirements
17. Change log documenting project changes since start of FEL-2
18. Benchmarking study or report
19. Value assurance reports




*We can help you provide transparency and accountability for all project stakeholders.*

# Front-End Schedule Optimization Services

### 6. FEED Plan Level III Project Summary Schedule (FEL-3)

The FEL-3 stage is project pre-planning, usually referred to as FEED. It focuses on technical project requirements with a definitive cost estimate of ±10% accuracy. All required FEED documents should be complete, such that the contracting strategy is final, bidding and award of the project execution are complete or in final stages, long-lead equipment vendors are selected or finalized, and all known potential risks are identified. It also includes special studies such as environmental studies and the hazard and operability study (HAZOP), Electrical Transient Analyzer Program (ETAP), energy optimization report, interface management, etc. Major deliverables include the final tender documents, Level III Project Summary Schedule (PSS), and detailed PEP. The FEED package as a deliverable of FEL-3 is usually of sufficient detail to prepare a ±10% accuracy estimate used to secure authorization for permanent funding expenditure (AFE). FEED provides the baseline from which all subsequently considered scope changes are measured.

*We can help you avoid, minimize, or resolve disputes during the entire project life cycle.*

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The Level III Project Summary Schedule (PSS) is a CPM-based schedule using information from FEL-2. The PSS is a fully resource-loaded schedule, and the activities for each phase are logically linked to produce a project's overall duration and resource requirements. The Level III PSS establishes the baseline for project durations and represents the basis for project approval and total AFE funding. This schedule is used for generating project baseline progress "S" curves. The Level III PSS is an actual deliverable of FEL-3 and is rigorously reviewed at 60% development during the schedule optimization workshop(s). A key deliverable is the Schedule Basis and Assumptions Memorandum that provides a detailed explanation of how the Level III PSS has been prepared.

The FEL-3 stage also includes schedule optimization workshops that will achieve alignment by all project stakeholders on the overall schedule, establish priorities, understand manpower requirements, identify the basis for schedule activity durations, finalize the contracting and procurement strategies, identify internal and external constraints, etc. The following checklist identifies the minimum document quality assessments that should be included with a Level III PSS submittal:

1. Level III PSS with supporting Schedule Basis and Assumptions Memorandum
2. Final project charter, final PEP, and final contracting strategy
3. Updated project risk management document and risk register
4. Final constructability review report
5. Updated SRA report clearly showing schedule confidence level
6. Process, utility, and electrical sized equipment lists
7. Vendor quotations on long-lead equipment delivery times
8. Quantities and man-hours by discipline for engineering and construction
9. Updated procurement plan and commissioning and start-up requirements
10. Benchmarking report and final agreed-upon value assurance reports
11. Critical milestones issue for-bid package

The Level III PSS will also include a quality assessment using the guidelines established by the United States Defense Contract Management Agency (DCMA). The DCMA 14-point CPM schedule assessment check is a helpful best-practice guide to assess the quality of a CPM schedule's technical aspects, which include the following:

1. Missing logic checks
2. Negative lag (leads) checks
3. Excessive positive lag checks
4. Logic type checks (*i.e.,* FS, SS, FF, and SF)
5. Hard constraint checks
6. High (total) float checks
7. Negative float checks
8. Long duration checks
9. Invalid date checks
10. Resource loading checks
11. Late activity checks
12. Critical path test
13. Critical Path Length Index (CPLI) check
14. Baseline Execution Index (BEI) check

### 7. Project Advisory Services

Long International and CORE's project advisory services assist with the implementation of project monitoring techniques to maintain cost, schedule, and quality objectives; provide transparency and accountability for all project stakeholders; and avoid, minimize, or resolve disputes during the entire project life cycle, including the important front-end design phase.