Management of the Project

Organization and Management Plan

This document describes the SNAP project organization and management plan. The proposed key management structures are either in place or are to be implemented during this phase as appropriate. The approach that SNAP is implementing is an adaptation of the successful BaBAR experiment, the Solenoidal Tracker at RHIC (STAR) detector project directed by LBNL, and the High Energy Solar Spectroscopic Imager (HESSI) project directed by UCB/SSL. The desired approach and configuration of projects as described in DOE Order 4700.1 and the Project Management Institute (PMI) Standards Committee *A Guide to the Project Management Body of Knowledge* (BMBOK) form the organization and execution background for the SNAP project. The goal is an efficient, focused, flexibly staffed project that will allow scientists to have overall technical control while utilizing the talents of technical managers and their supporting organizations to ensure proper scope execution within cost and schedule. Deliverables and reviews for the conceptual design phase are in accordance with the recently approved DOE Order 413 and forms the basis for the proposed work during the conceptual design phase.

Organization

Organization Chart

The SNAP Project Organization Structure is shown in Figure 1 below. This configuration covers the research and development activities, the construction activities and the operations portion of the project. Clearly, the organization should be viewed in a dynamic context where major activities and emphasis will shift during the course of the project.

Element Function and Responsibility

The functions and responsibilities of each of the elements shown in the Organization Chart are given in the following subsections.

DOE and NSF Organization

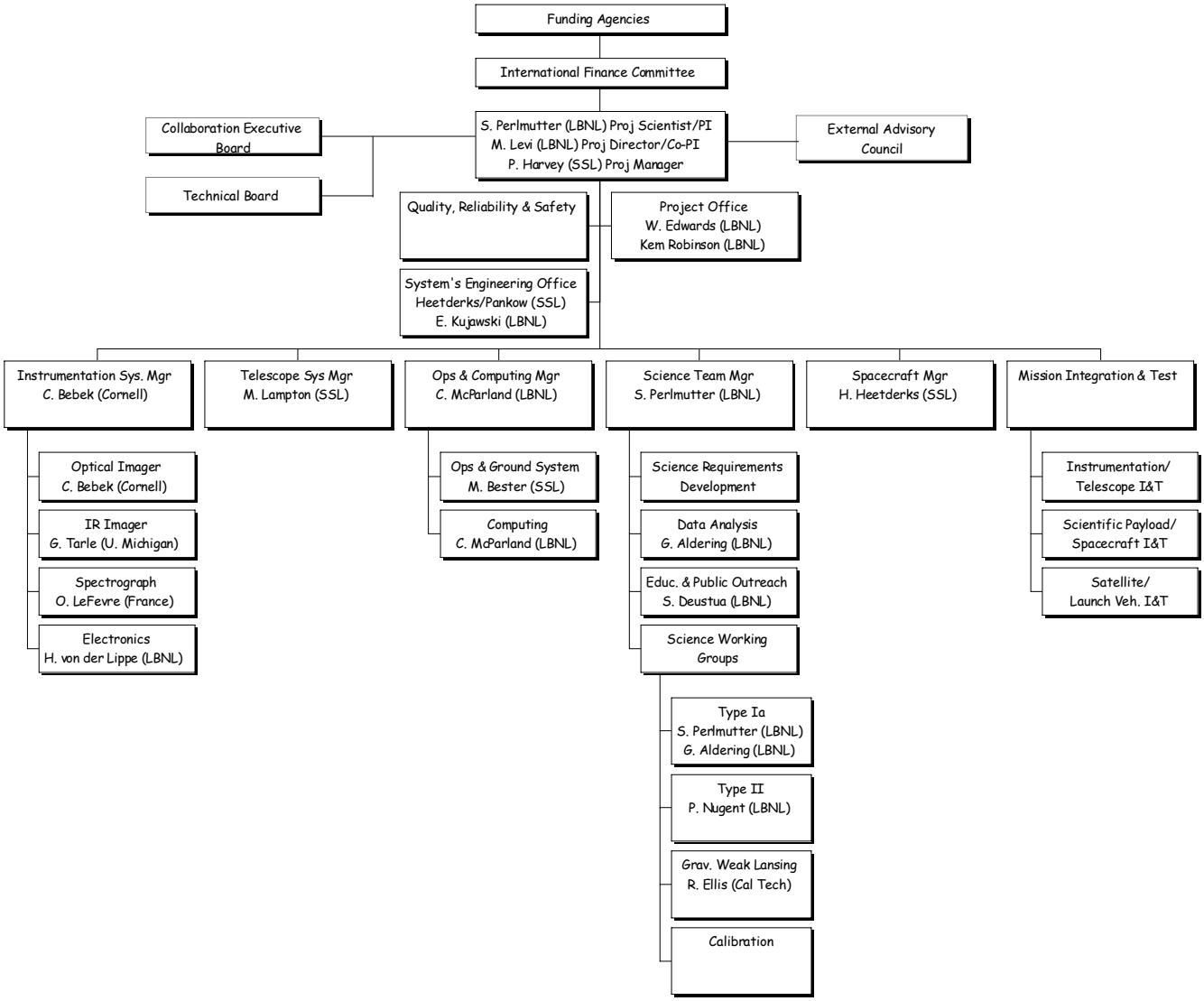
The SNAP project is seen as a joint DOE/HEP, NSF/MPS, and French (CNRS/IN2P3, CNES) project. It is anticipated that these organizations will work together with the SNAP Project Office to organize an International Finance Committee that will be responsible for establishing overall programmatic and financial guidance for the project. There are several recent examples of major U.S. experiments with DOE and NSF participation with successful joint agency authority which we model here.

The International Finance Committee (IFC) will include representatives of each of the U.S. and foreign funding agencies or of the collaborating institutions if duly empowered. The role of the IFC includes approval of modifications to the structures and tasks proposed to the project as a whole. It also includes monitoring common funds and general financial and manpower support, and endorsement of the annual budgets for construction, maintenance and operation of the satellite. The Principal Investigator reports regularly to the IFC on administrative, financial and technical matters.

The Project Directorate

The body responsible for scientific, technical, scope, schedule and cost execution of the project is the Project Directorate. The Project Directorate consists of the Principal Investigator / Project Scientist, the Co-Principal Investigator / Project Director, and the Project Manager. To assist the Project Directorate in this regard it has the services of the Project Office, the Systems Engineering Office, and the Safety, Quality, and Reliability Office. Serving in both advisory and control capacities to the Project Directorate are the Collaboration Executive Board, the Project Technical Committee, and the Project Advisory Council.

Figure 1. SNAP Project Interim Organization



Principal Investigator / Project Scientist

The Principal Investigator / Project Scientist has principal responsibility for the project with regard to its scientific mission and execution. He is directly responsible to ensure that as specifications and requirements are developed and that the scientific goals are not compromised. The Project Scientist serves as the Principal Investigator (PI). He is the spokesperson for the project and oversees the R&D, scientific planning and subsequent operations efforts. He is directly responsible to the DOE, NSF and the International Finance Committee.

The PI is the executive head of the Collaboration Executive Board. The PI will be in frequent contact with the other members of the Board and obtain from the Board advice on all major collaboration issues. On financial matters, the PI authority will be consistent with the requirements of the funding agencies represented in the International Finance Committee. The PI is responsible for keeping the International Finance Committee informed about the status of the project.

The Project Director / Co-Principal Investigator

The Project Director / Co-Principal Investigator has responsibility for the direction of all SNAP activities. He has full responsibility and authority for all phases of the project. The Project Director coordinates the R&D, design, construction and deployment of the satellite and subsequent operations efforts through systems managers. The Project Director is the Co-Principal Investigator for the project. He assumes the role of the PI whenever the PI is unavailable. He is also a member of the Collaboration Executive Board, and leads the Technical Board.

The Project Manager

The SNAP Project Manager (PM) is responsible to the PI and co-PI for the execution of the project within the schedule, cost and resource constraints available. The PM with support from the Project Engineer, the project office (PO), the Systems Engineering Office (SEO) and the Safety, Quality and Reliability Office (SQRO) will establish tasks, work statements, Memoranda of Understanding (MOU), deliverables, schedules, and changes to those elements.

The PM is responsible for day-to-day project management which includes: project status; risk management; documentation; cost and schedule tracking; major make or buy decisions; subcontract management and procurement; MOU facilitator; coordination with team members; and focal point of communication for project construction.

The PM will be responsible for establishing a baseline project plan. This plan will establish the schedule, cost phasing, and resource needs to carry out the SNAP project consistent with experiment science requirements. This proposal is the first step in defining the project plan. The complete project plan requires the approval of the Project Scientist, Project Director, and the International Finance Committee, before being accepted as the baseline.

The Project Engineer

The SNAP Project Engineer (PE) is responsible to the Project Manager and Project Director for the construction of the project and the organization and management of the engineering resources. The Project Engineer is responsible for the development of cost and schedule, optimization of the project through the Systems Engineering Office (SEO) and will establish specifications, requirements, interfaces, work statements, and is responsible for overseeing configuration tracking.

The PE will be responsible for executing the baseline project plan, maintaining oversight over interfaces, and integration.

Collaboration Executive Board

The SNAP Collaboration Executive Board (CEB) is comprised of a lead scientist from each of the collaborating research institutions. The Collaboration Board along with the Project Scientist and Director establishes scientific goals and objectives of the SNAP project Cost. It advises the Principal Investigator on all scientific, collaboration and collaborating institution matters of the project. It will develop a policy for membership and for publication. The Board will decide on controversial issues within the collaboration by consensus or by voting.

The Project Scientist and the Project Director are members of the Board with the Project Scientist as chair. Official Board meetings will be held on an as needed basis and no less frequently than twice a year. Teleconferencing will be used to resolve urgent issues and minimize travel expenses. The CEB will appoint (with concurrence from the International Finance Committee) an External Project Advisory Council to monitor and review the execution of the SNAP project.

External Project Advisory Council

The External Project Advisory Council (PAC) will be comprised of several external outstanding

individuals from the US, Europe, and elsewhere with expertise in the various facets of the SNAP project. PAC members will be appointed with input and approval of the International Finance Committee to minimum two-year terms. Expertise will be sought in the relevant areas of science, engineering, space flight, operations, education and outreach, and management. Each of these areas will be represented by at least one individual.

The PAC will meet with the SNAP collaboration to review performance and progress of the SNAP project. These reviews will be held in the form of short briefings given by members of the SNAP science, engineering and management teams. The CEB is responsible for organizing briefings to the PAC. The PAC will provide the Collaboration CEB and the Program Directorate with a summary report on their recommendations, suggested plan of action, and observations.

Project Technical Board

The SNAP Project Technical Board (PTB) is responsible for working with and advising the Project Directorate with respect to the execution of the project as a whole. Its membership consists of the Project Manager and Engineer, leads from the Systems Engineering Office, the Project Office, the Safety, Quality, and Reliability Office, the individual systems managers and additional members as determined appropriate by the Project Directorate. The PTB is chaired by the Project Director.

The PTB shall meet on a regular basis to discuss technical, cost and schedule issues and will form the basis of the Change Control Board (CCB). Its main goal is to help ensure that all systems of the project are being adequately integrated and executed toward the scientific and technical goals of the project within the constraints of budget and schedule.

Safety, Reliability and Quality Office

The Safety, Reliability, and Quality Office (SRQ) has primary responsibility to the Project Directorate in ensuring that all aspects of the project are conducted to the appropriate levels of safety, reliability, and quality.

The SRQ will aid the Project Directorate in the definition of the system safety implementation plan (SSIP) by developing and maintaining a detailed system description and by supporting safety working group meetings. SRQ will document in a safety data package all identified hazards to instrumentation and personnel, hazardous procedures, and the methods used to control them. The instrument design will incorporate safety features such as encapsulation of high voltages and cryogenic surfaces (as required). All work will be done in accordance with the requirements of DOE and Laboratory Health and Safety standards, as well as applicable NASA and flight safety standards.

Based on the project quality guidelines most of the instrument and mission level systems will undergo extensive failure modes and effects analysis (FMEA). The SRQ will perform these FMEA in concert with the spacecraft and systems engineers to determine vulnerability. The SRQ will work with the systems managers and engineers to ensure that as the design is developed, cost-effective easily serviceable units are developed for use during assembly, integration and testing. Any part that is replaced as the result of an alert of failure during testing will undergo a new round of testing before integration.

The SRQ will establish the requirements for quality and reliability within the project, and ensure, under the Project Directorate, that all policies, procedures and design approaches are consistent with mission goals and agency requirements.

Systems Engineering Office

The Systems Engineering Office (SEO) is charged with developing and maintaining the system hardware and software requirements and specifications. The SEO reports directly to the Project Engineer within the SNAP Project Directorate. The SEO has responsibility for system level issues. Early in the project the SEO will be primarily concerned with top level requirements flow-down so that design and planning decisions are made with overall systems considerations in mind. The other key role that the SEO has is in the development of interfaces between the various systems. As such, the SEO will be working continuously with system managers to ensure that interfaces are properly defined and that technical issues affecting more than one system are resolved efficiently and effectively.

Requirements, specifications, and Interface Control Documents (ICD) will be entered into

configuration management by the end of the definition and R&D phase. Systems management will be performed through regular reviews of the design activity. All drawings will receive SEO approval prior to initial release to manufacturing and procurement and all Engineering Change Orders (ECOs) will require SEO sign-off. ECOs that do not affect form, fit, or function may be given a preliminary release by the subsystem manager with a courtesy copy to the SEO. Other ECOs will require SEO approval prior to release.

Project Office

The Project Office is responsible for monitoring the technical scope, cost and schedule performance of all portions of the SNAP project and providing timely reports to the International Finance Committee. The Project Office will maintain the SNAP master resource-loaded schedule with a software package (most likely Primavera) capable of determining and monitoring the progress of the project and reporting the status of the project to the International Finance Committee and sponsoring entities in a complete manner.

SNAP Systems and Subsystems Management

As can be seen in the organization chart in figure 1, the SNAP project is divided into its principal systems and subsystems beneath the Project Directorate. Each major system has a designated System Manager who is responsible for the successful development and completion with compliance to system and scientific requirements of the system within budget and schedule constraints. The primary SNAP systems are identified on the Organization Chart as well as their attendant subsystems. The system managers report to the SNAP Project Director and subsystem mangers report to their respective System Manager. Their primary responsibility is to develop the subsystem shown within the cost, schedule, and resources available consistent with the overall project plan. The subsystem managers work as a team with the System Manager. The System Mangers work as a team with the Project Directorate and SEO to ensure that subsystem interfaces are defined and developed that meet project requirements.

As previously stated the Project Technical Committee is comprised of system managers, representatives from the SEO, and SQR, and the Project Directorate. This board will convene on a regular basis (in person, or by teleconference or video-conference) to discuss project progress. The Project Director chairs the technical board and will run meetings and set the agenda.

Management Processes

The Project Director (PD) is responsible to the Principal Investigator, the International Finance Committee, the DOE, and the NSF for day-to-day operations including performance, schedule, and budget tracking. The PD, with the support of the SNAP project office, will assure that clear channels exist for official communication including establishment of tasks, interfaces, requirements, work statements, deliverables, schedules, and changes to those elements. Working level communication, on the other hand, is encouraged among all participants to assure that technical information is freely and efficiently disseminated and thoroughly discussed. The management approach is designed to communicate clearly to all team members the tasks to be done, the requirements for those tasks, and the schedule and resources available, and to track progress so that problems can be identified and resolved at the earliest possible time.

A Work Breakdown Structure (WBS) is the key planning and control document. The WBS is designed to implement the project as defined in project documents. This includes the top-level requirements document from which the lower-level requirements documents are derived by the flow-down process, and the contract requirements, which include the budget and schedule. The detailed work of the SNAP project will be planned in the form of a resource-loaded schedule using the WBS as the basis of the individual tasks. The order of tasks, the relationships between the tasks, and the schedule boundary conditions will be incorporated into the schedule. The groups that will actually perform the tasks provide estimates of time and other resources. This increases their commitment to meeting the schedule and budget and serves as a basis for internal monitoring.

Tracking progress will be accomplished primarily by review of the schedule, particularly the near-term milestones. Any task that is falling behind schedule, is consuming more resources than planned, or is encountering unforeseen difficulties becomes the focus of corrective action. The process of evaluating

progress is constant: estimating what remains to be done, iterating the schedule, budget, and requirements to maintain an optimum balance, and communicating the results to all concerned. Project management software will be used to assimilate, analyze, display, and maintain the key schedule and resource information. Primavera and MSProject have been successfully used on recent projects to maintain schedules, analyze alternative resource-loaded plans, and maintain cost-to-complete estimates. It is anticipated a combined use of Primavera and Excel will provide the basis for the resource loaded schedule and monitoring. The Project Technical Board (PTB) will convene weekly to discuss the current project, plans and issues. The PTB also forms the basis of the Change Control Board.

Financial and schedule control will be exercised via review of monthly earned-value and financial reports detailing all SNAP. The amount of labor charged will be regulated by the PM, before the monthly reports are compiled, by monitoring the actual effort applied as it occurs and comparing it to the plan. In addition, the PM will review a detailed breakdown of all expenses contained in the monthly financial report. Financial control of consultants will be accomplished by means of the subcontract and continuous review of technical and financial progress.

Design, development, technical, and engineering progress will be measured by the schedule milestones, design reviews, testing, informal reviews, and day-to-day communication. System managers report to the PM and keep him informed of progress, problems and potential solutions, operational needs, and weekly status. The single point of contact model is used for aspects of subcontract activity including all official communications. However, day-to-day working-level direct communication on technical matters among the parties directly involved is encouraged.

Change Orders

Changes to baseline technical, schedule, and cost specifications are inevitable. These changes will follow a change control process overseen by the PM. A technical board composed of all system managers, the SEO, the SQR, and others designated by the PM will function as the Change Control Board (CCB). The PD chairs the technical board and the CCB. The PI is a member of the technical board and the CCB to ensure that the scientific requirements of the project are met.

Table 1: Approval levels for changes to SNAP technical, cost, schedule parameters.

	SNAP System Managers	SNAP Project Manager	DOE/NSF
Change in the technical capability of SNAP WBS Level 2 element	X	X	
Addition or deletion of a WBS Level 2 element	X	X	
Revision of estimated cost of SNAP WBS Level 2 Element	X	X	
Revision of estimated cost of SNAP WBS Level 3 Element	X	X	
Change in overall estimated cost of the SNAP project, including allocated contingency	X	X	X
Changes to the SNAP Level 2 milestones	X	X	
Slippage of SNAP project Level 1 milestone by 3 months or more	X	X	X

Proposed changes will require different levels of approval based on severity and impact on the project. At the lowest level, involving a relatively small redistribution of funds within a given subsystem, only approval of the subsystem manager is required. At a much higher level, involving a major change in scope or scientific goals, the change must be brought to the Change Control Board (CCB) and approved by the Collaboration Board and the PI. The PD must be informed of all changes at any level. System managers will bring changes in cost and/or schedule to the CCB. Changes in scientific scope will first be brought to the CCB and in turn taken to the Collaboration Board by the PI for approval. Table 1 below

shows a list of changes that may be requested, and for each type, the level of approval that must be obtained. This is based on the successful STAR Detector Project completed recently. Specific trigger thresholds for levels of the CCB involvement will be established while detailed cost estimating proceeds.

Requirements and Specifications Development and Control

A top-level project scientific requirements document will be developed during the initial phase of the program by the science team and the Collaboration Executive Board. Systems requirements and definition is the responsibility of the Project Engineer and the SEO. The SEO will lead the definition of lower level system and subsystem requirements using a documented flow down process. All hardware and software elements of the SNAP system will be defined in these specifications. At the appropriate point in the program, the specifications will be placed under configuration control, after which changes are made by means of formally controlled Engineering Change Orders (ECO) which assure proper review by all affected project elements. Updated documentation will be made available to all affected parties and a straightforward system of verification of the latest current version of any project document is continuously maintained and is readily accessible by all. The SRQ has responsibility for planning and oversight of the configuration control process in order to ensure efficient and successful implementation.

Manage and Conduct Systems Engineering

The SNAP Project Engineer and the SEO has primary responsibility for all systems level issues. It is critical in this process to view all elements of the SNAP project as a single entity and properly allocate requirements and design approaches across the entire system. As part of the Phase A study, the Project Engineer will develop a Systems Engineering Management Plan that will serve as the framework and control for all subsequent work and trades. The evaluation criteria for examining the trades will be developed during this same phase, very early in the design process. Additionally, the SEO will be primarily concerned about the development and analysis top-level requirements and their flow-down. Systems models will be developed and the initial trade studies will be performed. System operation will be considered so that design decisions are made with the end user in mind. The other key role that the SEO has is in the development of interfaces between subsystems. As such, the SEO will be working continuously with system and subsystem managers to ensure that interfaces are properly defined and that technical issues affecting more than one system are resolved efficiently and effectively. An important product of the initial phase (Phase A) is the establishment of initial system architecture and initial subsystem interface definition.

Manage, Control, and Allocate Contingency

Contingency requirements are developed as part of the risk assessment and cost estimating cycle. These form part of the initial risk assessment. Development of an overall contingency consistent with DOE and NSF guidelines is part of this estimation process and within the total, contingency is reserved for the various systems and subsystems based on their perceived risk. During the preliminary phase of the project, a contingency depletion schedule will be established. Schedule and budget depletion will have established time-phased benchmarks. The amount of reserve needed depends on the level of maturity and heritage of the particular item. An existing subsystem requires less reserve than one in the early stages of development. As the subsystem develops, the reserves may be expended to resolve problems, meet unanticipated needs, or simply to accommodate the as-built actual parameter.

Contingency is controlled in the central project office and any call by a system or subsystem on contingency must be made through the CCB. This permits the PD and PM to have the ability to manage the technical progress, resources and funds by the effective management of contingency. The management of resources by the PM will balance the reserve available against its use as appropriate to preserve performance, budget, and schedule.

Manage Collaboration Agreements

Memoranda of Understanding (MOU) will be written between the members of the SNAP collaboration. These agreements will cover the cost, schedule, and technical scope of elements to be

provided by respective collaborators. The MOUs specify inter-institutional conduct within the collaboration as well as the scope of efforts, the resources, and the schedule for the respective collaborators. The MOUs will be reviewed along with progress each year as part of the yearly financial planning cycle.

The members of the SNAP collaboration will subcontract to UCB or LBNL. The subcontract will be established by means of a proposal that contains a statement of work, technical requirements, specification where appropriate, schedule, and cost of elements to be provided. A subcontract manager from the SNAP project office will monitor progress and be the point of contact for contractual matters between the project office and collaboration institutions. The subcontract manager reports to the PM.

Progress Reports

Monthly financial and project (earned-value) reports will be submitted to the DOE, NSF and the Joint Oversight Group. Technical progress reports will be submitted to summarize progress, concerns, problems, changes, and plans for the next period. In addition, frequent contact with the DOE and NSF technical monitor would be standard practice.

Risk Management

The basic approach to risk management is to minimize risks by using proven designs, existing hardware, and conventional fabrication methods to the maximum extent possible. However, it is not possible that in a project the size and scope of SNAP that all elements of it can be of a fully developed technology and maturity. Nor is it possible that, at this stage of a project, all of the risks are even known. Consequently, the allocation of contingency to cover both known and unknown risks is very important and should not be compromised. It is to be anticipated that unexpected events or developments during the various phases of the project will influence the resources, cost and schedule of the final configuration. It is in recognition of the inherent uncertainty within the general scope of project execution and more specifically R&D projects that will drive the adoption of an aggressive, global and proven approach to the management of risk.

The approach that would be followed is in recognition that risk may impact any or all of the dependent project variables (scope, schedule, and cost). Typically, there are two general types of risks, insurable (those that can only result in a loss) and leveraged (those with a positive outcome will benefit the project). Developing contingencies for all the dependent project variables provides for the mitigation of risk.

The first step in the management of risk is its assessment. This is done initially in conjunction with the estimation and determination of the work to be done. Each element used in costing is assessed and scored as to its stage of development and potential impact on the project. Specifically, each element is rated for design/approach maturity, complexity, dependency, technical development, cost uncertainty, and potential schedule variance.

The data thus obtained are then scored following procedures adapted from previous large H.E.P. project and NASA approaches. Calculations are then done on the assessed risk score to determine an appropriate level of cost and schedule contingency. In parallel, possible scope contingencies are identified with decision points established where technical trade-off choices must be made.

Once the project is underway, issues identified with risk to the project are monitored and contingency is allocated where necessary. In addition, reliability assessments and trade-off studies directed by the SRQ also seek to minimize incidental as well as project risk. It should be stressed that risk management is not merely the initial allocation of funding contingency to various tasks and subtasks. Complete risk management is an ongoing effort throughout the life of the project and involves the development of not only funding contingency, but schedule and technical contingencies as well.

Schedule and Critical Decisions

Figure 2. shows the project acquisition process and critical decisions as defined by the recent DOE order 413. SNAP is currently exiting the preconceptual design phase. A CD-0 (critical decision zero) determination by DOE is required in order to enter the conceptual design phase. This phase is essential in order to determine an accurate cost range and schedule range for a project of this size. In addition, key technical risks and R&D maybe performed during this phase.

During the proposed conceptual design phase (Phase A), several critical activities must occur. The SEO management plan must be developed. The requirements development and analysis as well as the appropriate evaluation criteria must be identified and started. Several important trade studies must be performed and analyzed, as they will determine several basic aspects of the system. The risk management plan with ties to the R&D plan needs to be developed and implemented. The initial system architecture and interface definitions must be established.

Also during the conceptual design phase, the initial R&D and technology plans must be developed including the necessary prototyping efforts and associated test plans. The engineering concepts must be developed as well as prototype development and tests occur. Also crucial during the is the development of the detailed R&D plans that extend beyond into the preliminary design phase.

Additionally, the SNAP Project office will develop the management and staffing plans, initial MOUs between collaborators for the preliminary design phase as well as development of the complete Work Breakdown Structure (WBS), cost estimates and the preliminary overall integrated project schedule.

With the movement into Conceptual Design activities shift from a definition and exploratory phase to one of concerted systems, project, and technology design and development. The conceptual design of all subsystems is completed and a Conceptual Design Report is reviewed. The final technology and development plans with milestones and decision points is completed.

Within the SEO, PO, and SRQ areas the system architecture is finalized. The subsystem requirements are assigned. The subsystem interface definitions and formal risk analysis are completed. The configuration management and change control plans are finalized and implemented. The final project planning, system safety, reliability and quality assurance plans are completed. The cost estimate (cost bracket), contingency analysis, master resource loaded project schedule, and WBS are completed and prepared for review. These activities take place in accordance with the requirements of DOE Order 413 for the development of the conceptual design phase. The conceptual design phase is considered complete upon a DOE critical decision-1 (CD-1) determination. The CD-1 determination is a very key transition for a project, prior to then no design or procurements can occur. With the approval of the Conceptual Design Report and the release to proceed with the project the execution of the project with complete configuration control begins. Prior to the establishment of the DOE order 413 CD-1 would have been the first decision point.

The major milestones, management deliverables, and key decision points are shown in the large fold-out marked Figure 3. This is a detailed description of the DOE methodology for project development and the manner in which projects move from project planning into project execution. Currently, SNAP is moving from the preconceptual planning phase to the conceptual design phase. This transition occurs with a CD-0 determination. This is an important step in allowing the development of key technologies and developing a project cost range.

Passage though CD-0 requires a justification for the project and development of a “mission need”. Preparation of the justification of mission need document constitutes the first step in the acquisition process and initiates conceptual planning activities. These activities continue with the preparation of the acquisition strategy, which is normally developed by DOE Federal officials. This strategy sets forth the management approach that will be used to ensure that the project contract or system of project contracts satisfies the approved mission need. The acquisition strategy can be part of the mission need document, a separate document, or a part of the Acquisition Plan. The DOE is responsible for performing a Mission Validation Independent Project Review (IPR). This is a limited review of the project prior to CD-0. It validates the mission need and the funding request. An Independent Project Review may be conducted as appropriate to assist in the CD-0.

Figure 2. DOE Order 413 Project Execution Phases

PROJECT ACQUISITION PROCESS AND CRITICAL DECISIONS					
Project Planning Phase		Project Execution Phase			Mission
Preconceptual Planning	Conceptual Design	Preliminary Design	Final Design	Construction	Operations
CD-0 Approve Mission Need	**CD-1** Approve Preliminary Baseline Range	**CD-2** Approve Performance Baseline	**CD-3** Approve Start of Construction	**CD-4** Approve Start of Operations or Project Closeout	

CD-0	CD-1	CD-2	CD-3	CD-4
Actions Authorized by Critical Decision Approval				
• Proceed with conceptual design using program funds • Request PED funding	• Allow expenditure of PED funds for design	• Establish baseline budget for construction • Continue design • Request construction funding	• Approve expenditure of funds for construction	• Allow start of operations or project closeout
Critical Decision Prerequisites				
• Justification of mission need document • Acquisition Strategy • Preconceptual planning • Mission Need Independent Project Review	• Acquisition Plan • Conceptual Design Report • Preliminary Project Execution Plan and baseline range • Project Data Sheet for design • Verification of mission need • Preliminary Hazard Analysis Report	• Preliminary design • Review of contractor project management system • Final Project Execution Plan and performance baseline • Independent cost estimate • National Environmental Policy Act documentation • Project Data Sheet for construction • Draft Preliminary Safety Analysis Report • Performance Baseline External Independent Review	• Update Project Execution Plan and performance baseline • Final design and procurement packages **(**)** • Verification of mission need • Budget and congressional authorization and appropriation enacted • Approval of Safety documentation • Execution Readiness Independent Review	• Operational Readiness Review and acceptance report • Project transition to operations report • Final Safety Analysis Report **After CD-4** **Closeout** • Project closeout report

(**) To the degree appropriate to initiate construction as scheduled.

Figure 3.

PROJECT OVERVIEW

PHASES

PROJECT PLANNING: Pre-Project; PRECONCEPTUAL PLANNING; CONCEPTUAL DESIGN

PROJECT EXECUTION: PRELIMINARY DESIGN; FINAL DESIGN; CONSTRUCTION

MISSION: ACCEPTANCE; OPERATIONS

LONG-LEAD PROCUREMENT

REMAINING PROCUREMENT

CRITICAL DECISIONS

- APPROVE MISSION NEED CD-0
- APPROVE PRELIMINARY BASELINE RANGE CD-1
- APPROVE PERFORMANCE BASELINE RANGE CD-2
- APPROVE START OF CONSTRUCTION CD-3
- APPROVE START OF OPERATIONS OR PROJECT CLOSEOUT CD-4

FUNDING

TOTAL PROJECT COST (TPC)

- OPERATIONS COST (Non - Total Project Cost)
- OTHER PROJECT COSTS
- TOTAL ESTIMATED COSTS (TEC - WITH MINOR OPC)
  - PROJECT ENGINEERING & DESIGN FUNDS (PED)
- OTHER PROJECT COSTS (WITH MINOR TEC)
- OPERATIONS COST (NON - TPC)

MAJOR INPUT ITEMS

- *Problem/Need Definition*
- *Document Proposed Project*
- *Decision Estimate & Budgets*
- *Preliminary Tech Dev Input*
- *Readiness Assessment*
- *Approval of Preliminary Baseline Range*
- *Project Authorization*
- *TPC & Schedule Range*
- *Approved Baselines*
- *Source Documents*
- *Technology Development Output*
- *Issued for Construction Design Documents*
- *Material and Equipment*
- *Construction Permits*
- *Completed Systems*

MAJOR MILESTONES

- *Establish Project Team*
- *Establish Program/Project Planning Budget*
- *Develop Project Scope*
- *Identify Customer Expectations*
- *Identify Key Schedule Drivers*
- *Identify Funding Constraints*
- *Identify High-Level Functions and Requirements*
- *Identify Project-Level Interfaces*
- *Identify Capital & Life Cycle Cost Drivers*
- *Develop Conceptual Design Schedule Range*
- *Develop Up-Front Conceptual Design Business Decision Estimate & Budgets*
- *Develop Pre-Conceptual Design Budget*
- *Develop Pre-Conceptual Design Schedule*
- *Establish Placeholder in Out-Year Budget*
- *Initiate Pre-Conceptual Planning & Design*
- *Assess Technology Maturity Phase Plan*
- *Submit CD-0 Package*
- *Develop Project-Level Functions & Responsibilities*
- *Identify Pre-Conceptual Risks*
- *Perform Alternative Studies*
- *Establish Conceptual Design Budget & Schedule*
- *Identify Current & Next 2 FY Funding Requirements*
- *Initiate Project Data Sheet for Design*
- *Perform Project & Detail Design Phase Technical and Programmatic Risk Analysis*
- *Develop System-Level Functions and Requirements*
- *Identify Long-Lead Procurements*
- *Develop Project Execution Plan for Preliminary Design*
- *Set Project Execution Strategy*
- *Site Investigation & Alternatives*
- *Review Design Alternatives*
- *Identify Project Codes, Standards and Procedures*
- *Develop Preliminary Design Phase Budget & Schedule*
- *Total Project Cost & Schedule Range*
- *Perform Safety & Operability Review*
- *Identify Current & 2 FYs Funding Requirements*
- *Define Special Procurement*
- *Develop, Validate, & Issue Phased Package, if Necessary*
- *Finalize Team Execution Plan*
- *Commit Critical Equipment*
- *Perform Process Hazards Review*
- *Update Project Execution Plan*
- *Update Technical and Programmatic Risk Analysis*
- *Develop Baselines*
- *Develop CD-2 Package*
- *Define CD-3 Deliverables & Completion Criteria*
- *Update Annual/Outyear BA*
- *Prepare Construction Project Data Sheet*
- *Conduct External Independent Review*
- *Conduct Independent Cost Estimate*
- *Receive Critical Vendor Data*
- *Finalize 3D Computer Aided Drafting and Design Set-Up*
- *Complete Design Model*
- *Conduct Technical Innovations Evaluation*
- *Finalize Planning Drawings*
- *Finalize Field Support Plan*
- *Review Safety Action Plan*
- *Perform Final Design Review*
- *Complete Procurement of Materials and Equipment*
- *Start Systems Completion*
- *Initiate Document Closeout Process*
- *Work off Punch Lists*
- *Startup Commissioning Testing*
- *Verification of Performance Criteria*
- *Lessons Learned*
- *Financial Closeout*
- *Satisfaction Meeting*

MAJOR DELIVERABLES

- *Conceptual Design Business Decision Estimate & Budgets*
- *High-Level Functions & Requirements*
- *Conceptual Design Schedule Range*
- *Pre-Conceptual Design Budget*
- *Pre-Conceptual Design Schedule*
- *Statement of Mission Need*
- *Minimum Technical and Functional Requirements*
- *Technology Dev Issues*
- *Program Plan*
- *Conceptual Design Budget & Schedule*
- *Mission Need Independent Project Review*
- *Acquisition Plan*
- *Project Expectations Summary*
- *Statement of Work*
- *NEPA Documentation*
- *Systems Engineering Mgmt Plan*
- *Conceptual Design Package*
- *Preliminary Project Execution Plan*
- *Preliminary Hazard Analysis Report*
- *Preliminary Team Execution Plan*
- *Risk Management Plan*
- *Preliminary Design Phase Budget & Schedule*
- *Verification of Mission Need*
- *CD-1 Package*
- *Total Project Cost & Schedule Range*
- *Review of Contractor Project Management System*
- *Preliminary Design Detailed Schedules*
- *Issued for Design Source Documents*
- *Division of Responsibilities Matrix*
- *Performance Metrics*
- *Staffing Plans*
- *Tech Risk Analysis Report*
- *Technology Dev Output*
- *Prelim Safety Analysis Report*
- *Final Project Execution Plan*
- *CD-2 Package*
- *TPC Estimate*
- *Independent Cost Estimate*
- *NEPA Documentation*
- *Project Data Sheet for Construction*
- *Performance Baseline Independent Review*
- *Equipment and Material Requisitions*
- *Issued for Construction Design Documents*
- *100% Definitive Estimate*
- *Integrated Project Schedule and Subtier Schedules*
- *Updated PEP & Performance Baseline*
- *Final Design & Procurement Packages***
- *Verification of Mission Need*
- *Budget & Congressional Authorization*
- *Approved Safety Documentation*
- *Execution Readiness Independent Review*
- *Updated Construction Project Data Sheet*
- *Turnover & Startup Plan*
- *Operating and Maintenance Manuals*
- *Construction Completion*
- *Startup Commissioning Test Plan*
- *Final Safety Analysis Report*
- *Annual Updated Construction Project Data Sheet*
- *Operational Readiness Review & Acceptance Report*
- *Approval for Acceptance*
- *As-Built Drawings*
- *Final Safety Analysis Report*
- *Project Completion Report*

Note: Deliverables from each phase are input to subsequent phases

*** To the degree appropriate for construction*

Once CD-0 is obtained, the DOE initiates development of the conceptual design, which results in a Conceptual Design Report, an Acquisition Plan, a preliminary hazard analysis, a preliminary Project Execution Plan, and preliminary baseline range. The preliminary baseline range at the design stage consists of a cost, schedule, and scope for the design phase, and a range for the cost, schedule, and scope for the remainder of the project. A project and engineering design (PED) funding pool for all projects for FY2002 and beyond will be available for preliminary and final design. Where long lead procurement is required, a phased CD-3 may be used, subject to prior budget approval and funding availability.

The Acquisition Plan required for CD-1 includes,

- background and objectives, including the mission need statement description of the program of which the project(s) is a part
- cost, budget, funding, and life cycle considerations
- plan of action, including—
  - possible sources
  - a performance-based contractor incentive process
  - methods of competition
  - options for source selection procedures
  - justification for non-competitive acquisitions if this is recommended
  - contracting options and milestones for the acquisition, and
  - a statement as to whether the Government or a prime contractor will conduct the competition
- risk analysis, and mitigation strategies
- schedules, including milestones
- business considerations, including—
  - Government roles
  - contractor roles
  - interrelationships between contractors
  - interagency cooperation
  - Government-furnished property
  - security
  - international cooperation and considerations
  - make-or-buy considerations
  - warranty
  - licensing considerations
  - safety
- logistics considerations, including contractor and agency support

The Preliminary Project Execution Plan required for CD-1 includes,

- mission need justification/project objectives
- project description
- organizational structure; roles, responsibilities, and authorities; and accountability, including decision authority for Headquarters and Field Element, program and project management and support functions, Environment, Safety and Health, etc.
- resource requirements
- technical considerations, including—
  - extent of research and development and its relationship to the project
  - value engineering
  - test and evaluation
  - Environment, Safety and Health
  - Integrated Safety Management
  - sustainable building design
  - configuration management
  - system engineering, and
  - reliability, maintainability, and quality assurance

  project cost, schedule, and scope baselines (or preliminary baseline ranges for a preliminary Project Execution Plan), including separately

identified contingencies, and descriptions of Levels 0, 1, 2, and 3 baseline change control thresholds

- life-cycle cost
- alternatives, trade-offs
- Risk Management Plan
- Integrated Safety Management Plan
- project controls system and reporting system

Important to the development of a project and mapping this methodology onto an action plan with schedules and milestones requires an understanding of the budgetary mechanisms and the process by which large projects obtain funding through the federal budget cycle. This mapping to the federal budget cycle is shown in Figure 4. The process allows long-lead procurements to occur prior to federal construction authorization. The key to receiving construction authorization is the CD-3 determination. For long-lead items a partial CD-3 authorizes acquisition of these items. Providing a timeline for these items brings the procurement planning for these items all the way back into the conceptual design phase. In order to receive CD-3 approvals for the project as a whole the CD-2 determination must occur approximately 18 months prior to the full construction start authorized by CD-3.

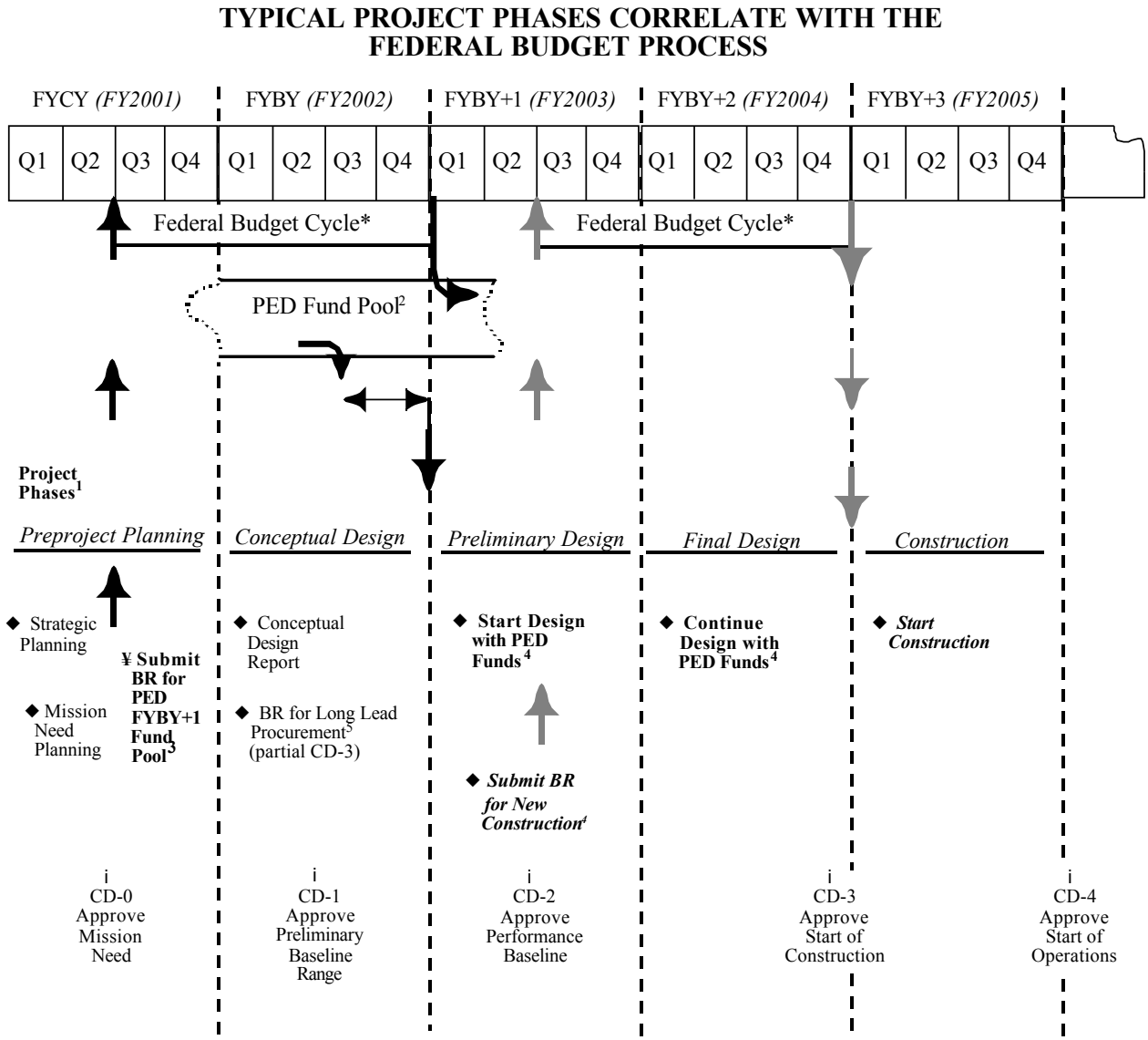
SNAP Schedule

A list of the projected milestones for the project is shown in Table 2. The current SNAP schedule with these milestones shown is given in Figure 5.

Table 2: Major milestone list.

Milestone / Task	Milestone or Start Date
Prelim. Science Review	1-Dec-99
Preconceptual Design Start	2-Dec-99
Proposal Submission	1-Feb-00
Sagenap Review - I	29-Mar-00
Independent Project Review	29-Jan-01
Conceptual Design Start	1-Mar-01
Sagenap Review - II	1-Apr-01
ZDR / Draft Requirements Rev	2-Jul-01
Sagenap Review - III	1-Apr-02
S/C Phase A Study	1-Apr-02
OTA Phase A Study	1-Apr-02
System Requirements Review	3-Aug-02
Conceptual Design Report/Review	15-Sep-02
START Construction Phase	1-Oct-02
Lehman T/C/S Review	1-July-03
PDR & Configuration Baseline	14-Aug-03
FDR (Final Dsgn Rev)	15-Sep-04
Instrument I&T	1-Jul-06
Instrument & S/C Delivery	1-Mar-07
Telescope Delivery	1-Jul-07
Integration & Test	1-Jul-07
NASA SAR (Sys Accept Rev)	1-Sep-07
NASA FRR (Flight Ready Rev)	1-May-08
Launch Integration	1-May-08
Launch window	1-Aug-08
Mission Ops & Data Analysis	1-Aug-08

Figure 4. DOE Order 413 Project Budget Processes



1. The chart is a guide to show how the project phases might typically fit into the annual budget cycle. Actual projects will have different time frames and should be mapped against the budget cycle accordingly.

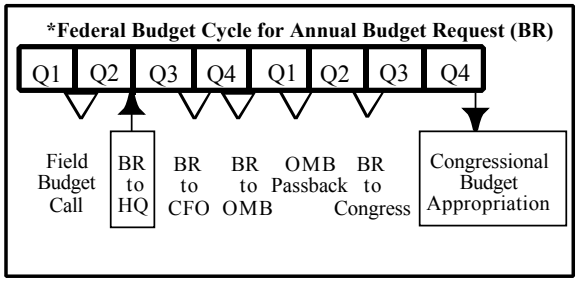
2. The PED Fund Pool is a rolling funding source for capital design that Congress appropriates money to each year.

3. PSOs perform strategic planning to build an FYBY+1 Priority Project List. The BR for PED funds for these projects is based on parametric comparisons and historical project data. In the next fiscal year, the Budget Year becomes the Current Year and the planning process starts again for the new FYBY+1 project.

4. PSOs may authorize PED funds any time after CD-1 approval. This provides a window of opportunity to complete preliminary design earlier so the BR for new construction can be submitted in time for the next fiscal budget cycle.

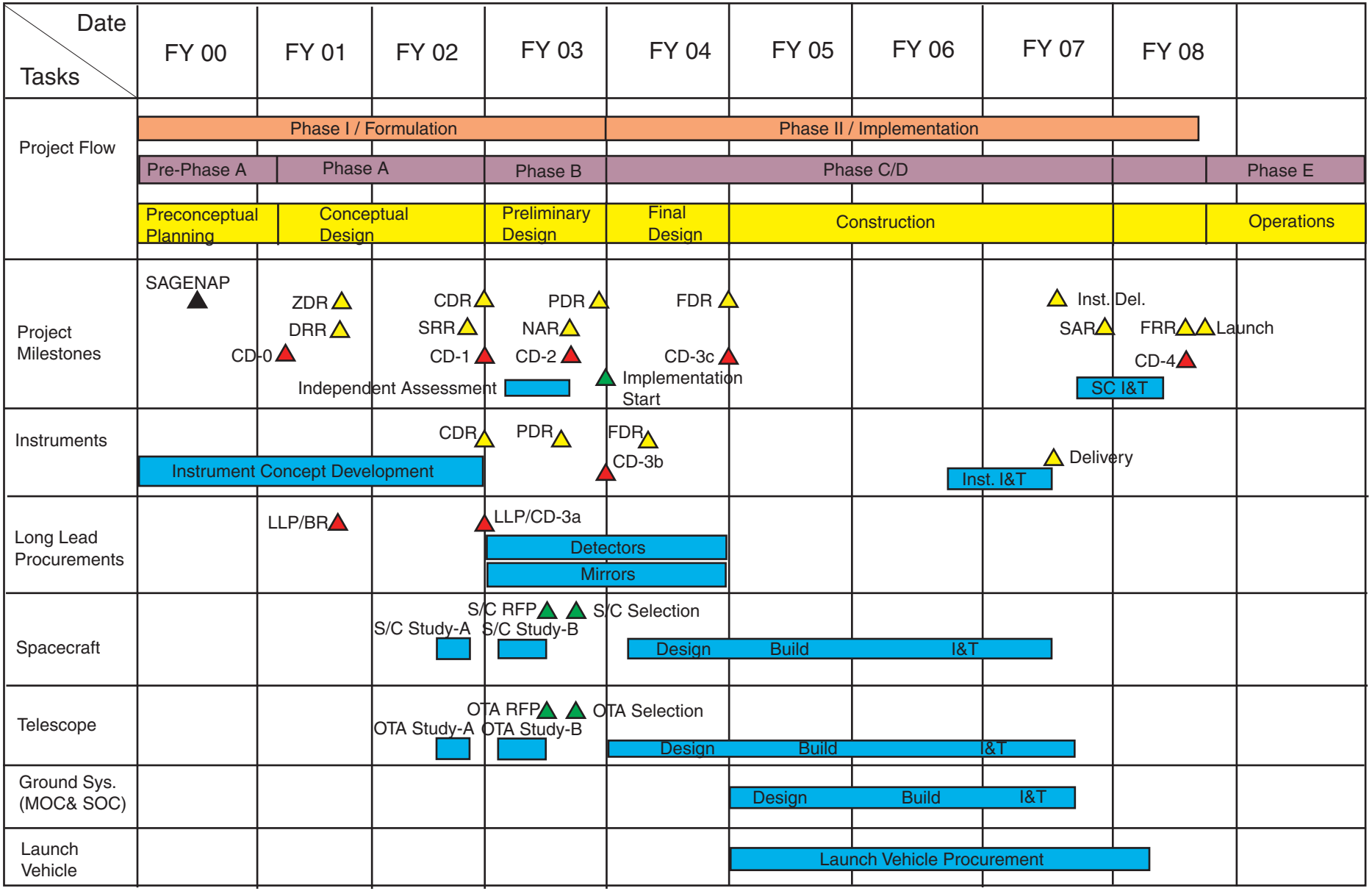
5. If long lead procurement (LLP) is required, a BR for LLP funding should be approved as a partial CD-3 during the conceptual design phase and submitted into the budget cycle to ensure timely receipt of LLP funds.

PED - Project and Engineering Design
BR - Budget Request
CD - Critical Decision



SNAP Top-Level Schedule

draft 1/16/2000



CDR - Conceptual Design Report
FDR - Final/Critical Design Review
FRR - Flight Readiness Review
DRR - Draft Requirements Review
NAR - Non-Advocate Review
PDR - Preliminary Design Review
SAR - System Acceptance Review
SRR - Systems Requirement Review
ZDR - Zeroth Order Design Report
LLP/BR - Long Lead Procurement Budget Req.