CDI Beamline Cost and Schedule Estimate Summary

Conceptual Design Review

October 25-26, 2018

In 2016, cost, labor, and schedule estimates were initially developed for the CDI beamline by a task force, based on the design of the beamline described in the CDI beamline development proposal which was submitted in 2015.

Since then, the beamline design became more complicated, embracing additional optical elements, and has lengthened as well, such that the endstation is located in a satellite building instead of in the main experimental hall. This has had a significant impact on the cost and schedule estimates, especially as it's necessary to construct a satellite building in conjunction with construction of the beamline.

Factored into consideration in development of the estimates for the beamline, are various lessons learned from earlier construction of NSLS-II beamlines. Notably, owing to that endstations tend to be unique at these beamlines whereas photon delivery systems aren't, design effort for the endstation for CDI has been shifted forward in the schedule as compared with the standard practice adopted for earlier NSLS-II beamlines which involved pursuing this serially following design of the photon delivery system. In addition, provisions for experimental applications have been included in estimates pertaining to controls and software, not just basic instrument control which was typically all that was in the makeup of these aspects during construction of earlier NSLS-II beamlines. Finally, dedicated staffing for the CDI beamline is being implemented earlier as compared with the general practice in construction of earlier NSLS-II beamlines, for which temporary staffing typically led the effort through at least the conceptual design stage and sometimes beyond.

In Figure 1 is shown a high level construction schedule. The scope pertaining to components inside the shield wall (insertion device and front end) proceeds in parallel with the scope outside the shield wall.

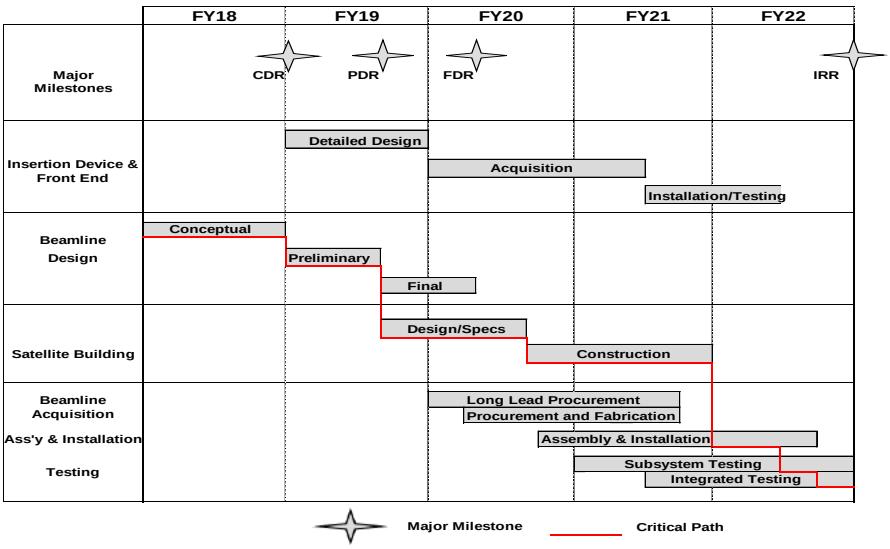

Figure 1: High level construction schedule.

Certain boundary conditions have been imposed which have constrained elements of the schedule. Importantly, funds which could be applied toward procurement of major equipment as well as construction of the satellite building will not be available until the beginning of FY2020 (i.e. October 2019) at the soonest. Until then, available funds could be applied strictly to BNL labor and travel costs.

Construction of the satellite building involves a year-long initial effort to design the building, and then develop its specifications to initiate and pursue the procurement effort to award a construction contract, culminating in award of a contract. Some of the needed design effort may fall beyond the province of BNL labor to pursue, for which suitable funds to sponsor might not become available until the beginning of FY2020. Nevertheless the schedule indicates commencement of the design effort in FY2019 (in June 2019).

The critical path is indicated in Figure 1. Design and construction of the satellite building fall on the critical path. The aspects of installation and testing associated with the endstation (including its supporting utilities and protection systems) cannot commence until construction of the satellite building is completed at the end of FY2021. These particular aspects of the beamline installation and testing activities, shown in Figure 1, also fall on the critical path.

Major review milestones are also indicated in the schedule, consisting of the conceptual, preliminary, and final design reviews, culminating in the so-called instrument readiness review or IRR. Intermediate status reviews during the course of construction will also be scheduled.

A work breakdown structure for construction has been prepared, in which discrete technical activities describing the different facets of construction have been defined and for which required resources have been identified, including materials and labor. BNL operating funds overhead rates have been applied and are being used, at least until an alternative source of funds has been identified having different overhead rates. Escalation has been applied to the rates for the years following FY2019. In Table 1 are summarized the work breakdown structure at the highest level and associated burdened cost estimates, spanning materials and labor. The photon delivery system and endstation alike fall under the Beamline Construction WBS area. Beamline Infrastructure consists of hutches, utilities, and protection systems, while Accelerator Infrastructure consists of the scope inside the shield wall including the insertion device and front end. The satellite building is captured under Conventional Facilities.

WBS	Burdened Cost Estimate (K$)
CDI.01 Management	1,216
CDI.02 Design	1,362
CDI.03 Beamline Construction	14,708
CDI.04 Beamline Infrastructure	2,555
CDI.05 Accelerator Infrastructure	4,313
CDI.06 Controls	1,654
CDI.07 Conventional Facilities	6,822
Total	32,630

Table 1: Work breakdown structure at the highest level and associated burdened cost estimates.

In Table 2 are summarized the direct costs of major items including their cost estimate basis.

Component	Direct Cost (K$)	Basis of Estimate
Undulator (3 m long IVU20)	1,700	Hitachi quotation
First Optics Enclosure (FOE)	490	Existing NSLS-II FOEs
Photon Delivery System	4,140	RI quotation
Multiple Circle Kappa Diffractometer	800	CHX diffractometer scaled
Confocal Microscope	135	Olympus quotation
Two Eiger 4M Detectors	2,390	Dectris quotation
Detectors Positioning System	605	Bestec quotation
Satellite Building	5,000	HEX satellite building estimate scaled

Table 2: Direct costs of major items including basis of estimate.

Labor estimates have also been made and have been built into the cost estimates shown in Table 1.

The principal risk faced, from the perspective of cost and schedule issues, concerns the availability of funds to execute the construction according to the timetable shown in Figure 1. As we proceed, we will investigate cost savings measures, including searches for alternate suppliers of equipment which have already begun.