1 EXECUTIVE SUMMARY

1.1 Introduction

Brookhaven National Laboratory has prepared a conceptual design for a world class user facility for scientific research using synchrotron radiation. This facility, called the "National Synchrotron Light Source II" (NSLS-II), will provide ultra high brightness and flux and exceptional beam stability. It will also provide advanced insertion devices, optics, detectors, and robotics, and a suite of scientific instruments designed to maximize the scientific output of the facility. Together these will enable the study of material properties and functions with a spatial resolution of ~1 nm, an energy resolution of ~0.1 meV, and the ultra high sensitivity required to perform spectroscopy on a single atom.

The overall objective of the NSLS-II project is to deliver a research facility to advance fundamental science and have the capability to characterize and understand physical properties at the nanoscale, the processes by which nanomaterials can be manipulated and assembled into more complex hierarchical structures, and the new phenomena resulting from such assemblages. It will also be a user facility made available to researchers engaged in a broad spectrum of disciplines from universities, industries, and other laboratories.

1.2 Scope

The project scope includes the design, construction, installation, and commissioning of the accelerator hardware, civil construction, and central facilities required to produce a new synchrotron light source. It includes a highly optimized electron storage ring, full energy injector, experimental beamlines and optics, and appropriate support equipment, all housed in a new building. Specifically, the main scope elements include:

- an electron gun and a short linac, where an electron beam is generated and accelerated to 200 meV
- the transport system to the booster
- the booster storage ring, where the electrons from the linac are accelerated to 3 GeV for injection into the main storage ring
- the transport system to the main storage ring
- the main storage ring, where a 500 mA current of electrons are stored at an energy of 3 GeV and sent through insertion devices and bend magnets to produce synchrotron radiation
- a suite of initial beamlines and supporting instrumentation
- the ring building, central lab office building, auxiliary lab office buildings, and mechanical equipment rooms, comprising the conventional facilities and supporting utility infrastructure

1.3 Capabilities

NSLS-II is a synchrotron with a highly optimized design that will produce world leading levels of brightness and flux and small beams, over a very broad energy range, extending from the far IR to the very hard x-ray region. The main performance characteristics are given in Table 1.1.

Table 1.1 Main Performance Characteristics of the NSLS-II Storage Ring.

Electron energy [GeV]	3.0
Stored current [mA]	500
Stability of average current [%]	<1
Horizontal emittance [nm-rad]	0.55
Vertical emittance [nm-rad]	0.008
Average brightness [ph/s/0.1%bw/mm^2/mrad^2] in the 2 keV to 10 keV photon energy range	>10^{21}
Average flux [ph/s/0.1%bw] in the 2 keV to 10 keV photon energy range	>10^{16}
Horizontal electron beam size [μm]	38.5
Horizontal electron beam divergence [μrad]	14.2
Vertical electron beam size [μm]	3.05
Vertical electron beam divergence [μrad]	3.22
Stability of electron beam in position and direction [%]	<10
Number of straight sections for insertion devices	27
Number of bend magnet sources	30

1.4 Cost and Schedule

The Total Estimated Cost (TEC) of NSLS-II is $678.2M. The Total Project Cost (TPC) is $775.2M. The schedule for construction will lead to start of operations in FY2014.

1.5 Acquisition Strategy

The acquisition strategy relies on Brookhaven Science Associates (BSA), the Department of Energy Managing and Operating (M&O) contractor for Brookhaven National Laboratory, to directly manage the NSLS-II acquisition. The design, fabrication, assembly, installation, testing, and commissioning for the NSLS-II project will be largely performed by the BNL/NSLS-II scientific and technical staff. Much of the subcontracted work to be performed for NSLS-II consists of hardware fabrication and conventional facilities construction.