

4 SUSTAINABLE DESIGN

4.1 Design Criteria

4.1.1 Codes and Standards

The latest edition of the codes, standards, orders, and guides referred to in this section will be followed, with a reference point of August 2008 being the anticipated design completion date. All work will be in accordance with BNL's Implementation Plan for DOE 413.3, "Program and Project Management for the Acquisition of Capital Assets."

4.1.2 DOE and Other Governmental Orders

Executive Order 13423 – Strengthening Federal Environmental, Energy, and Transportation Management
Energy Policy Act of 2005

10 CFR Part 433

DOE O5480.4 – Environmental Protection, Safety and Health Protection Standards

DOE O413.3A – Program and Project Management for the Acquisition of Capital Assets

DOE O414.1C – Quality Assurance

DOE O420.1B – Facility Safety

DOE O420.2B – Safety of Accelerator Facilities

4.1.3 Codes, Standards, and Guides

Building Code of New York State (NYSBC) – 2002 Edition

ASHRAE Standard 90.1-2001 Energy Standards for Buildings Except Low-Rise Residential Buildings

Energy Conservation Code of New York State - 2002 Edition

Leadership in Energy and Environmental Design (LEED) 2.2

LEED for Labs

4.2 Sustainable Design Overview and Approach

Sustainable design is an approach that addresses how design decisions will impact the natural environment, building occupants, and the bottom line. Making sustainable design a priority does not mean losing sight of other program requirements such as schedule and budget. Instead, sustainable design is as an additional set of criteria on which to base design decisions.

4.2.1 Project Goals

The National Synchrotron Light Source II (NSLS-II) Facility will strive to incorporate a wide range of sustainable strategies and objectives throughout the design and construction process, while meeting the functional requirements of advanced technology and creating a workplace that is environmentally friendly, energy-efficient, and both healthy and pleasant to be in. The team was challenged to design the NSLS-II Facility not only to meet the LEED® (The Leadership in Energy and Environmental Design) requirements but also to address the new Executive Order (EO) 13423 and the clarifying guidance dated March 29, 2007. The EO 13423 titled "Strengthening Federal Environmental, Energy, and Transportation Management" was issued

on January 24, 2007 and requires all Federal agencies to lead by example in advancing the nation's energy security and environmental performance by achieving the following goals:

- **VEHICLES:** Increase purchase of alternative fuel, hybrid, and plug-in hybrid electric vehicles when commercially available.
- **PETROLEUM CONSERVATION:** Reduce petroleum consumption in fleet vehicles by 2% annually through 2015.
- **ALTERNATIVE FUEL USE:** Increase alternative fuel consumption at least 10% annually.
- **ENERGY EFFICIENCY:** Reduce energy intensity by 3 % annually through 2015 or by 30% by 2015.
- **GREENHOUSE GASES:** By reducing energy intensity by 3% annually or 30% by 2015, reduce greenhouse gas emissions.
- **RENEWABLE POWER:** At least 50% of current renewable energy purchases must come from new renewable sources (in service after January 1, 1999).
- **BUILDING PERFORMANCE:** Construct or renovate buildings in accordance with sustainability strategies, including resource conservation, reduction, and use; siting; and indoor environmental quality.
- **WATER CONSERVATION:** Reduce water consumption intensity by 2% annually through 2015.
- **PROCUREMENT:** Expand purchases of environmentally-sound goods and services, including biobased products.
- **POLLUTION PREVENTION:** Reduce use of chemicals and toxic materials and purchase lower risk chemicals and toxic materials from top priority list.
- **ELECTRONICS MANAGEMENT:** Annually, 95% of electronic products purchased must meet Electronic Product Environmental Assessment Tool standards where applicable; enable Energy Star® features on 100% of computers and monitors; and reuse, donate, sell, or recycle 100% of electronic products using environmentally sound management practices.
- **ENVIRONMENTAL MANAGEMENT SYSTEMS:** Implement EMS at all appropriate organizational levels to ensure use of EMS as the primary management approach for addressing environmental aspects of internal agency operations and activities.

Our team will evaluate five of the goals listed in the Executive Order that apply directly to new building construction:

- Energy Efficiency
- Greenhouse Gases
- Renewable Power
- Building Performance
- Water Conservation

4.2.2 LEED Point System

The LEED Rating System is a voluntary, consensus-based, national rating system developed by the U.S. Green Building Council. LEED provides a complete framework for assessing building performance and meeting sustainability goals. Its current version: LEED Version 2.2 for New Construction and Major Renovations (NC) is being proposed for this project. With this version, USGBC has launched a series of enhancements including LEED on-line which will aid in the documentation and certification process for this

project. LEED projects can now submit 100% of their documentation on-line, track Credit Interpretation Requests (CIRs), manage key project details, etc.

Consistent with the USGBC LEED program and the Executive Order the team identified five key principles that define and guide our sustainable approach. These principles will continue to be monitored throughout the design and construction and include the following:

- Site: Sustainable Site Design
- Water: Protecting and Conserving Water
- Energy: Designing for Energy Efficiency and Considering Alternative Energy Sources
- Materials: Optimizing the Environmental Life Cycle of Materials
- IEQ: Enhance Indoor Environmental Quality

The project is evaluated per each LEED criteria which is either a 'Prerequisite' or 'Credit' which results in a point score for certification:

Prerequisites: This category is based on minimum requirements and must be met. No further points will be awarded unless the minimum is achieved. There are a total of seven Prerequisites.

Credits: Credits are evaluated and result in a point score. Under LEED-NC v.2.2 there are 69 total points available.

The certifications levels are available as follows:

LEED Certified	26-32 Points
LEED Silver	33-38 Points
LEED Gold	39-51 Points
LEED Platinum	52-69 Points

4.3 Sustainable Site

- Maximizing the benefit of the existing site can be accomplished though a number of sustainable measures, one of which is stormwater management. The volume of stormwater generated on the site depends on the area of impervious surfaces and it could potentially have a negative Impact on the New York Sound Water Quality.
- To control the quantity of stormwater run-off detention ponds have been designed to capture excess and reduce the impact on the municipal system.
- The possibility of utilizing bio-retention ponds or pervious pavement to treat stormwater runoffs is proposed, in addition to controlling quantity. These strategies help to promote infiltration, and capture and treat the stormwater runoff.
- Our team identified other life Cycle Cost Savings Strategies that can reduce stormwater runoffs and provide significant savings in potable water use for the building. Rainwater Collection System if implemented could in fact contribute to achieving eight LEED Credits and reduce annual potable water usage for the building by up to 7.5 million gallons. Annual Rainwater Collection for the NSLS-II calculated based on 48" annual average rainfall (see Table 4.1 below) from 310,000 sf roof area equals 7,827,000 gal per year. The LEED Credits affected by this approach are as follows:
Potable Water Usage Reduction: For 500 Occupants = 778,800 gal/yr (64,900 gal/month) = 3 Credits
- Potable Water Usage Reduction for Process Cooling = 7,050,000 gal/yr (587,500 gal/month) = 1 Innovation Credit

- Stormwater Runoffs Reduction = 2 Credits
- Irrigation = 2 Credits

Table 4.1 - BNL Monthly Average Rainwater Collection

Month	Ave. rainfall inches	Collection area sq. ft.	gal per in. sf	Recovered water %	Collected gallons
Jan	3.75	310,000	0.62	85	612,600
Feb	3.42	310,000	0.62	85	558,700
Mar	4.17	310,000	0.62	85	681,300
Apr	4.01	310,000	0.62	85	655,100
May	3.93	310,000	0.62	85	642,000
Jun	3.93	310,000	0.62	85	642,000
Jul	4.44	310,000	0.62	85	725,400
Aug	4.49	310,000	0.62	85	733,500
Sep	4.14	310,000	0.62	85	676,400
Oct	3.83	310,000	0.62	85	625,700
Nov	3.95	310,000	0.62	85	645,300
Dec	3.85	3100,000	0.62	85	629,000
Totals	48				7,827,000

Table 4.2 - Rainwater Harvesting System Design Based On One Storage Tank Per Each LOB Building.

Quantity	Description	Unit cost	Total cost
5	Storage tanks, above ground, 40,000 gal each (200,000 gal total storage)	\$1.00 per gal	200,000
2500 lf	Aluminum or galvalume gutters and downspouts	\$6.00 per lf	15,000
5	"First wash" equipment (piping, strainers, valves, tanks)	\$800 each	4,000
5	Distribution equipment (piping, pumps, pressure tanks)	\$1200 each	6,000
5	Misc. piping, valves, etc. per tank	\$1000 each	5,000
1	Contingency	10%	13,000
1	Design and engineering fees	15%	21,000
TOTAL			\$264,000

(Cost based on other projects.)

4.4 Water: Protecting and Conserving Water

Implementing water efficiency measures can reduce potable water withdraws, and often save building owners money. In addition, sustainable water use protects natural water bodies from contamination. To reduce potable water consumption, no permanent irrigation will be provided for the site, the plantings will be native to the region and will require little or no additional water after new growth has been established.

In addition to rain water usage, we will specify water conserving fixtures to provide savings of 20-30 percent less water than the water usage requirements under the Energy Policy Act 1992. Appropriate water treatment will be required prior to water re-use.

4.5 Energy: Designing for Energy Efficiency and Considering Alternative Sources of Energy

The impact that energy use has on the environment is broad and long-lived. Almost every aspect of conventional energy use poses some threat to the natural environment. To create energy requires fuel. Harvesting these fuel resources from the Earth, whether they are coal, natural gas, oil or wood, is destructive to natural habitats. Federal Energy Management Program (FEMP) at the US Department of Energy (DOE) released an interim final rule for new federal building energy efficiency standard that requires new buildings to achieve an energy consumption level that is at least 30% below the level achieved under the standard (ASHRAE 90.1-2004).

Implementing energy efficient strategies will include daylighting, high energy efficiency equipment, EMS optimization, ENERGY STAR roof, and commissioning. These will all contribute to a reduction off the baseline- creating a building which will perform at a higher level, ultimately reducing overall energy consumption and reducing operating and maintenance costs.

Some of the Life Cycle Cost Saving Strategy proposed to reach highest possible Energy Efficiency for this project follows:

- Solar shading
- Energy Efficient Building Envelope and Roofing System
- Daylight Harvesting and Occupancy Sensors
- Energy Efficient Lighting System
- Designed to economically turn waste heat into useful heat for loads such as space heating and domestic hot water
- Process load recovery
- Exhaust air heat recovery to be used on 100% outside air handling units.
- On-Site renewable energy sources

Design and construction project's costs associated with the above energy efficiency strategies can be defined further as the project's design progresses and LEED Certification Level is approved by the Client.

4.6 Materials: Optimizing the Environmental Life Cycle of Materials

Almost 70 percent of all energy invested in a building's construction is embodied in the materials themselves. Embodied energy is the energy required to extract, transport, process, install, recycle or dispose of these materials. Our team will evaluate the environmental impact, resource efficiency and performance of the proposed building materials. We will consider non-toxic materials from local and renewable sources.

The material selection process will focus on life-cycle issues rather than solely on aesthetic or first cost. The team is committed to maximize use of recycled content materials and those that are manufactured regionally.

Material recycling will be facilitated to reduce waste and conserve resources. The design team will provide for an area dedicated to the separation, collection, and storage of materials for recycling by the building occupants.

Construction Waste Management Plan will be required for this project. A minimum of 75% of construction, demolition and land clearing waste will be recycled and/or salvaged to meet LEED requirements.

The team is committed to specifying locally manufactured materials and recycled content materials that are durable and esthetically pleasing.

4.7 IEQ: Enhance Indoor Environmental Quality

The quality of the indoor environment has a significant impact on human health, productivity and quality of life. Sustainable indoor environments promote daylighting, natural ventilation, and interiors that are free of toxins. The result is an interior environment that safeguards occupant health, and reduces operating costs. These can include strategies such as CO2 monitoring System, low VOC and non-toxic materials, air monitoring systems.

A large contributor to the quality of the indoor environment is the indoor air quality; the development and implementation of an Indoor Air Quality (IAQ) Management Plan during construction and pre-occupancy can positively impact both the occupant and the maintenance budget.

In addition to industry standard sustainable initiatives, NSLS-II team will propose specific innovations in sustainability pertaining to IEQ and human comfort. These innovations include using furniture systems which use post-consumer recycled content and reduce harmful VOCs into the working environment. This in conjuncture with the development and utilization of simulated daylight will add to the quality of the indoor working environment providing signification benefits to human health, productivity and quality of life.

4.8 LEED Status

In order to keep track of LEED prerequisite and credit point status of the project a tracking spreadsheet has been developed and attached to this report.

A description of the columns included in the spreadsheets is as follows:

- LEED Prerequisite/ Credit. Title and Intent of each prerequisite/credit taken directly from LEED. What the credit/prerequisite is meant to achieve.
- LEED Points Available. Notes the number of points available for each LEED credit if an REQ'D appears in the column, this indicates a prerequisite for which there are no associated points).
- “Yes” / “Maybe” / “No” Status
 - “Yes” The credit can be achieved
 - “Maybe” The credit will be pursued although there is not enough information at this time to assume it will be earned
 - “No” The credit is not achievable.

To meet LEED Certified Level it is required to have a minimum of 26 points. Current design shows that we can achieve 28 Yes and 18 Maybe points. The feasibility of achieving LEED Certified is shown in the LEED Point Summary below and it is also in line with the new Federal mandates. There are minimal cost implications associated with this strategy. These costs can be defined further as the project’s design progresses.

Table 4.3 - LEED NC 2.2 TOTAL POINT SUMMARY

Certified Level	
Yes	28 points
Maybe	18 points
No	23 points
Total Possible	69 points
SUSTAINABLE SITES	
Yes	5 points
Maybe	7 points
No	2 points
Total Possible	14 points
WATER EFFICIENCY	
Yes	3 points
Maybe	2 points
No	0 points
Total Possible	5 points
ENERGY & ATMOSPHERE	
Yes	3 points
Maybe	1 points
No	13 points
Total Possible	17 points
MATERIALS & RESOURCES	
Yes	7 points
Maybe	0 points
No	6 points
Total Possible	13 points
INDOOR ENVIRONMENTAL QUALITY	
Yes	6 points
Maybe	7 points
No	2 points
Total Possible	15 points
LEED AP AND INNOVATION CREDITS	
Yes	4 points
Maybe	1 points
No	0 points
Total Possible	5 points

4.9 LEED Project Checklist

LEED-NC Version 2.2 Registered Project Checklist is included below for Certified Level.

