TECHNICAL SPECIFICATION
for
NSLS-II Steel Beamline Shielding Enclosures

Approvals *Date*

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ESH&Q RISK LEVEL: A-2		
OUTSTANDING ECNs		

VERSION CONTROL SHEET

VERSION	DESCRIPTION OF CHANGE(S)	DATE	AUTHOR	APPROVED BY
1	First Issue	21 Mar 2011	E. Haas	See cover sheet
2	The qty of electrical labyrinths for 10-ID-B (page 28, in Appendix 1) was changed from 1 to 2.	28 June 2011	E. Haas	See ECN LT-ECR-011-322
3	Options included in the tables of Appendix 1 were removed to correspond to the steel hutch procurement contract.	1 July 2011	E. Haas	See ECN LT-ECN-011-324A

Contents

1 INTRODUCTION

The National Synchrotron Light Source II (NSLS-II) is a state-of-the-art synchrotron light source facility presently being built at Brookhaven National Laboratory (BNL), a facility operated by Brookhaven Science Associates (BSA, a consortium of Battelle Laboratories and Stony Brook University). The overall NSLS-II scientific research facility project includes design, construction, installation, and commissioning of accelerator systems and scientific equipment, and civil construction of the central facilities required to produce a new synchrotron light source. NSLS-II will utilize a highly optimized 3GeV electron storage ring (SR), full-energy injector, state-of-the-art experimental beamlines and optics, and appropriate support equipment. When completed in 2014, NSLS-II will be more than a kilometer in circumference externally and it will produce extremely bright short-wavelength light at the specific frequencies needed to enable scientists to clearly resolve molecular scale structures. The beamline shielding enclosures specified herein will protect personnel from synchrotron and bremsstrahlung radiation. These enclosures will be prominently located around the outside of the experimental floor where they will be continuously visible by staff and visitors from all over the world. NSLS-II therefore requires enclosures that BNL can be proud to display.

1.1 Definitions/Acronyms

ADA	Americans with Disabilities Act
ALARA	As Low As Reasonably Achievable
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASHRAE	American Soc. of Heating, Refrigeration & Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BCNYS	Building Code of New York State
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CFR	Code of Federal Regulations
CHX	Coherent Hard X-ray
CMAA	Crane Manufacturers Association of America
CSX	Coherent Soft X-ray (reference only)
FDR	Final Design Review
FOE	First Optical Enclosure
GeV	Giga (billion) electron Volts
IEEE	Institute of Electrical and Electronics Engineers
HXN	Hard X-ray Nanoprobe
IAW	In Accordance With
ID	Insertion Device
IR	Infrared
IXS	Inelastic X-ray Scattering
MSDS	Material Safety Data Sheet
NCRP	National Council on Radiation Protection and Measurement
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association

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NRTL	Nationally Recognized Testing Laboratory
NSLS-II	National Synchrotron Light Source II
PPS	Personnel Protection System
RoHS	Restriction of Hazardous Substances (i.e., no Pb, Hg, Cd, CrVI, PBBs or PBDEs)
SR	Storage Ring
SRX	Submicron Resolution X-ray
OSHA	Occupational Safety and Health Administration
PDR	Preliminary Design Review
VOC	Volatile Organic Compound
QA	Quality Assurance
XPD	X-ray Powder Diffraction (reference only)

1.2 Documentation

Document Number	Document Title
BCNYS-2007	Building Code of New York State (2007)
AISC 360-05	Specification for Structural Steel Buildings
AISI S100-2007	North American Specification for the Design of Cold-Formed Steel Structural Members
ANSI B30.2-2005	ANSI Safety Code for Overhead and Gantry Cranes
ASHRAE F08	Sound and Vibration
ASME B30.16	Overhead Hoists
ASME B30.17	Monorail System for Hoists
CMAA 70	Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes
CMAA 74	Specifications for Top Running Single Girder Electric Overhead Traveling Cranes
IEEE1202	Standard for Flame-Propagation Testing of Wire and Cable
LT-C-XFD-SOW-HU-001	Statement of Work for the NSLS-II Beamline Shielding Enclosures
NCRP Report # 147	Structural Shielding Design for Medical X-Ray Imaging Facilities
NFPA 70 (2008)	National Electrical Code
NFPA 80	Standard for Fire Doors and Other Opening Protectives
NFPA 101	Life Safety Code
NSLS-II Tech Note 0020	Bremsstrahlung Ray Tracing Guidelines for NSLS-II Beamlines and Front Ends
NSLS-II Tech Note 0040	Revised Shielding Estimates for the NSLS-II Beamlines at 3.0 GeV Beam Energy
NSLS-II Tech Note 0048	Guidelines for NSLS-II Enclosure Labyrinth Design
OSHA Standard 1910.22	OSHA Standard for Walking/Working Surfaces
OSHA Standard 1910.23	OSHA Standard for Guarding Floor and Wall Openings and Holes
OSHA Standard 1910.24	OSHA Standard for Fixed Industrial Stairs
OSHA Standard 1910.27	OSHA Standard for Fixed Ladders
OSHA Standard 1910.145	Accident Prevention Signs and Tags
OSHA Standard 1910.179	Overhead and Gantry Cranes

2 SCOPE

2.1 General Information

2.1.1 This Specification specifies the technical requirements for the shielding enclosures (herein referred to as "hutches" or "enclosures"), which are designed to protect personnel from synchrotron and bremsstrahlung radiation.

2.1.2 This document does not cover the unshielded enclosures to be used for infrared (IR) experiments, nor "cabins" erected on the experimental floor for the convenience of users.

2.1.3 The enclosures referred to in these specifications include only the all-steel experimental enclosures that house monochromatic (or "pink") beamline equipment and/or end stations where research will be conducted. Since steel enclosures provide radiation protection from soft x-ray photons, they are therefore subject to the same radiation protection requirements as lead/steel enclosures. These requirements may be found in the lead/steel enclosure specifications, but are repeated herein for convenience.

2.2 Radiation Shielding Calculations Basis (for Information Only)

2.2.1 Shielding calculations for the NSLS-II beamlines were performed using the STAC8 program, written by Asano and Sasamoto [1] and developed from the PHOTON code.

2.2.2 For the monochromatic beam enclosure calculations, five reflections (111, 333, 444, 555, 777) with corresponding bandwidths are considered[2].

2.2.3 The distance of the closest approach from any part of a beamline to the lateral hutch wall was assumed to be 1.0 m, in a worst-case scenario. The shielding thickness was calculated at the ambient dose rate of <0.05 mrem/h to standard human tissue on contact with the shield wall. Thus the shielding is designed to exceed the required regulatory requirements as well as ensure that the radiation doses are As Low As Reasonably Achievable (ALARA).

2.2.4 The distance of closest approach from any part of a beamline to the roof of hutch was assumed to be 1.5 m. The roof shielding thickness was calculated at the ambient dose rate of <0.05 mrem/h to standard human tissue on contact to the shield.

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[1]. Y. Asano and N. Sasamoto (1999): Characteristics of shielding design calculation for the Spring-8 synchrotron radiation beamlines, *Radiation Protection Dosimetry*, **82**, 167.

[2]. P.K. Job and W.R. Casey (2008); Revised Shielding Estimates for NSLS-II Beamlines at 3.0 GeV Beam Energy, NSLS-II Technical Note 0040.

3 TECHNICAL REQUIREMENTS

The synchrotron facility is designed to operate continuously 24 hours per day, 7 days per week (≥5,000 User Beam Hours per year). The design life of the beamline enclosures shall be a minimum of 30 years.

3.1 Materials

3.1.1 General

All materials used to build the enclosures shall be capable of withstanding prolonged exposure to an x-radiation environment.

3.1.2 Steel

3.1.2.1 Steel shall be the structural material. All design, structure, welding, and fabrication shall be in accordance with (IAW) the Building Code of New York State (BCNYS).

3.1.2.2 Steel shall be the radiation attenuating material in the enclosures specified herein. The specified sheet steel thicknesses therefore shall be considered as minimum requirements in all locations. For example, in Appendix 1, where 6 mm thick steel is required for radiation protection, steel plate that is ¼-in. (6.35 mm) thick may be used.

3.1.2.3 Steel shall be of sufficient thickness to permit welding to the steel structure and Unistrut® as needed.

Note 1: Commercial interchangeable equivalents to Unistrut may be used with BSA approval.

Note 2: Plate steel is ≥ .25-in. thick, sheet steel is <.25-in. thick.

3.1.2.4 The steel plate or sheet thickness shall not vary by more than -0.25 mm from the nominal thickness specified. Larger reductions in steel plate or sheet thickness from BSA-specified values due to subsequent manufacturing operations require BSA approval unless additional steel is added to assure adequate radiation protection.

3.1.2.5 The steel plates or sheets shall be free from pits, dents, stretch marks, buckles, waves, scratches, grit, foreign matter, porosity, and other defects affecting the functionality and radiation protection capability of the material.

3.1.2.6 Steel plate or sheet shall be used to ensure radiation-tight joints between enclosure panels (especially at corners), labyrinths, windows, and over bolt penetrations unless it can be demonstrated that the design inherently meets the shielding thickness requirements (e.g., if suitable overlap is provided).

3.1.3 Lead and Adhesives

3.1.3.1 Lead plate or sheet may be used as needed (e.g., for gasket material) to ensure radiation-tight interfaces between steel enclosure surfaces and the concrete experiment floor, and between steel enclosure surfaces and the storage ring tunnel ratchet walls. To ensure that "floor-shine" of radiation does not occur through these interfaces, measures shall be taken (e.g., by hammering the lead into intimate contact with the floor).

3.1.3.2 When lead is used for sealing steel-to-concrete, steel-to-steel interfaces, or for other purposes, all exposed lead surfaces shall either be covered by steel plate or sheet, or shall be coated with epoxy paint per section 3.12.

3.1.3.3 Adhesives (if used with steel materials) shall be selected to provide acceptable bonding and long life in an ionizing radiation environment. BSA review and acceptance of all adhesives used are required. Adhesives shall be specified by the Contractor in the Manufacturing Plan. Material preparation and adhesive application shall be done according to manufacturer's recommendations. Adhesive review and acceptance shall be part of the FDR.

3.2 Radiation Protection of Structures

3.2.1 The Contractor shall ensure that the design, manufacture, and installation of the enclosures is such that the radiation attenuation material is not less than the specified thickness at any location in the structure and that radiation protection is afforded at all positions, and in all directions. This includes all joints and boundaries of the enclosures and all penetrations.

3.2.2 The shielding material (and thickness) is specified for each enclosure in Appendix 1.

3.2.3 The furthest downstream enclosure for each beamline shall have a panel of lead shielding on the downstream wall centered about the beam center line that shall serve as a beam backstop. The lead shall be coated (e.g., painted, or encapsulated in sheet aluminum, stainless steel, or painted sheet steel) to prevent potential lead exposure from personnel contact or dispersion of lead oxide (see Section 3.1.3.2). The dimensions of the lead beam stop (unless otherwise noted on the corresponding NSLS-II drawing) shall be 305 mm (12 in.) square x 25 mm (1 in.) thick with no seams in the lead in any direction other than orthogonal to the photon beam direction.

3.2.4 Doors, guillotines, panels, labyrinths, etc. also provide radiation protection. These items are discussed in paragraphs 3.6, 3.8, and 3.10.

3.3 Personnel Protection System

3.3.1 The Contractor shall provide mountings for the mechanical and electrical interfaces to the Personnel Protection System (PPS) both inside and outside of the enclosures.

3.3.2 The specification for the PPS mechanical and electrical interfaces (e.g., safety switches, magnetic locks, emergency-stop buttons, search buttons, warning lights and warning speakers) shall be provided by BSA at or before the Preliminary Design Review (PDR).

3.4 Structural Design

3.4.1 The Contractor shall document that the enclosure has been designed IAW this Specification and is structurally certified by a Professional Engineer registered in New York State.

3.4.2 The enclosure shall be designed IAW BCNYS-2007, which also references the following codes (and which may be applicable depending on the hutch construction):

- AISC 360-05, "Specification for Structural Steel Buildings"
- AISI "North American Specification for the Design of Cold-Formed Steel Structural Members"

3.4.3 The enclosure structures shall be built to have sufficient safety factors to withstand:

- self-weight
- a 1,000-kg (2,200-lb) capacity manual bridge hoist system (not required on "mini-hutches")
- live weight roof loading of 910 kg (2,000 lb) at any 760 mm x 760 mm (30 in. x 30 in.) area on the roof
- live roof loading of 500 kg/m^2 (100 lb/ft^2) uniformly distributed over the entire roof area

- loads of 730 kg (1,600 lb) per meter of linear cable tray/pipe length at any location on all Unistrut utilities roof-mounting provisions
- any other loads mandated by BCNYS-2007

3.4.4 The doors shall not jam in any loading configuration.

3.4.5 All wall panels shall be of modular design.

3.4.6 The enclosures shall be designed in such a way that installation of the enclosure is possible where one or more walls are directly adjacent to the walls of an existing structure.

3.5 Unistrut (see Note 1 of paragraph 3.1.2.3)

3.5.1 Unistrut channels shall be used for the mounting of cable trays and utilities on the interior and exterior of the enclosures.

3.5.2 Unistrut shall be flush-mounted to the structure and factory welded into position.

3.5.3 All Unistrut shall have a galvanized type finish to prevent corrosion.

3.5.4 Unistrut shall run vertically from 200 mm (8 in.) above the floor to the top of the wall at intervals of 1 m both inside and outside each enclosure. This requirement applies to all NSLS-II inside concrete walls when the NSLS-II facility walls are located on the inside of the enclosure. In these specific cases, the locations and mountings shall be coordinated with and accepted by BSA at or before the FDR. Unistrut shall also run horizontally above each door on the inside of each enclosure, and where indicated on the design drawing(s).

3.5.5 Unistrut attached to roof exteriors and interiors shall be attached by welding (during factory manufacture of panels) or screwing, and not by gluing. Welds shall be cleaned and painted to prevent corrosion, leaving the Unistrut itself unpainted. If attached by screws, then all penetrations shall be radiation sealed so that minimum shielding thickness requirements are met. Additional Unistrut requirements for utilities pipes and cable trays are specified in Section 3.11.13.

3.6 Doors

3.6.1 The enclosures shall have manually actuated doors as shown on individual enclosure layout drawings unless indicated otherwise on NSLS-II drawings.

- Doors and door hardware shall meet all applicable code requirements including NFPA 80. Designs of doors and hardware shall be subject to review at the PDR.
- Each door shall open fully providing a *minimum* clear opening of 813 mm (32 in.) with hinged doors open at 90° All hinged doors shall open as close to 180° as practical. Door sizes are specified in Appendix 1.
- Door operating devices (handles, pulls, locks, etc.) shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate. Lever-operated mechanisms, push-type mechanisms, and U-shaped handles are acceptable.
- When sliding doors are fully open, operating hardware shall be exposed and usable from both sides.
- Hardware required for door passage shall be mounted no higher than 1,220 mm (48 in.) above the finished floor.

3.6.2 Manual doors shall be able to be operated by one person from either side of the enclosure with no loss in radiation protection at the door handle or latch area. Doors shall operate smoothly and with

minimal effort in all operating conditions, especially in an emergency situation where electrical and fluid (pneumatic, compressed gas, pressurized water, etc.) pressure fails.

3.6.3 Each door shall have door stops incorporating shock absorption at the fully open and fully closed positions. The attachments and locations for these shock absorbers shall be reviewed and approved by BSA at the FDR.

3.6.4 A simple method to secure the door in the open position shall be provided (this is in order to comply with access requirements to the external eyewash/shower when dealing with dangerous chemicals). For example, this may consist of a short steel cable on the door which can be tethered to the door frame when the door is opened, preventing the door from accidentally closing.

3.6.5 Door seals are required to block all lines of sight around each door for radiation shielding purposes.

3.6.6 Recessing of channels into the floor under sliding doors shall be permitted.

3.6.7 For sliding doors either a floor trench or a lead-lined structure with a minimum depth/height of 35 mm (1 3/8 in.) on both sides of the door shall be used to form a trench to block the scattered radiation under the door. Lead may be used as needed (e.g., for gasket material) subject to the requirements of sections 3.1.2.6 and 3.1.2.8.

3.6.8 For swing doors, a steel or lead-lined structure attached to the floor with a minimum height of 35 mm (1 3/8 in.) above the bottom of the door shall be used to block the scattered radiation under the door.

3.6.9 Any door sealing structure above the floor shall be removable for beamline equipment to be wheeled into the enclosure. The door sealing structure (or threshold) shall be attached with tamper-evident bolts or other BSA-approved tamper-resistant provisions to facilitate re-installation after removal. If special tools are needed for threshold removal and installation, a minimum of two sets shall be supplied by the Contractor. The door sealing structure shall protrude from the floor as little as possible into the path of egress, and shall be designed and appropriately marked for visibility so as to minimize any potential trip hazard.

3.6.10 Door sizes for individual enclosures are specified in the hutch drawings referenced in Appendix 1.

3.6.11 Strip doors (e.g., vertical transparent plastic strips which form an air interchange barrier) or other BSA-approved commercial product shall be mounted inside doorways where indicated in Appendix 1. The strip doors shall be clear and shall readily allow passage of people and equipment into and out of the enclosure with minimal effort to move the strips, curtain, slats, or other air dam materials to allow passage. The strip doors shall minimally be mounted across the full height and width of each indicated doorway without gaps when in the undisturbed position so that external air interchange through the doorway is minimized. The strip doors shall be made so that the entire set of strips may be moved fully out of the door opening area as a unit into an unobtrusive location when not in use and removed readily. BSA approval is required for the strip door design.

3.6.12 Door hinges or other supports shall be suitable for the purpose and design life.

3.6.13 Hardware and structural reinforcement, as necessary, for doors and doorways shall be provided that will allow doors to open and close freely and smoothly, with negligible sagging, for the design life of the equipment.

3.7 Hoist

3.7.1 The hoist shall be procured within the USA in order to ensure compliance with national codes.

3.7.2 The hoist system shall be designed, built, installed, inspected, and tested IAW the following codes:

- OSHA 1910.179, Overhead and Gantry Cranes
- ANSI Safety Code for Overhead and Gantry Cranes, ANSI B30.2-2005
- ASME B30.16 (overhead hoists) and ASME B30.17 (monorail system for hoists)
- Crane Manufacturers Association of America (CMAA) specifications; for crane/hoist design and construction the applicable standards are CMAA 70 and 74 of the CMAA specifications. CMAA 74 covers underslung-type cranes/hoists, which are the type that would be the most typical within hutches.
- All BNL SBMS subject area Lifting Safety requirements shall be met by the crane installation.

3.7.3 A bridge crane with manually operated hoist and hook of 1,000 kg (2,200 lb) net load capacity shall be provided in each enclosure where specified, for equipment handling.

3.7.4 Net load is defined as the weight to be lifted excluding hoist self-weight, with vertical and lateral movement.

3.7.5 The hoist runways shall be mounted as high as possible within the enclosure, avoiding interference with cable tray placements, lighting fixtures, ventilation ducting/diffusers, and labyrinths. Crane locations shall be reviewed and approved by BSA at the FDR.

3.7.6 The crane shall maintain a minimum clearance of 76 mm (3 in.) overhead and 51 mm (2 in.) laterally of obstructions.

3.7.7 The hoist runways shall be leveled in both planes with a minimum of 3.0 m clearance to the floor, unless specified otherwise in Appendix 1.

3.7.8 The hook working height shall range up to a minimum 2.6 m above floor level and should lower to within ~0.5 m of the floor level, unless specified otherwise in Appendix 1. A low-profile crane and hoist design should be used that will allow loads to be lifted as high as possible.

3.7.9 Mechanical overload protection shall be provided.

3.7.10 End stops/safety lugs shall be fitted as appropriate.

3.7.11 The hoist system shall be fail-safe.

3.7.12 Each enclosure layout drawing shows the desired hoist coverage area.

3.7.13 An identification plate must be attached to the hoist with all of the required information. Documentation shall be provided according to SOW requirements.

3.7.14 Calculations, test, and inspection documentation shall be provided as required by the BNL SBMS subject area Lifting Safety.

3.8 Labyrinths

3.8.1 Each enclosure shall have labyrinths located on the roof and wall panels as indicated the drawings referenced in Appendix 1.

3.8.2 Each wall labyrinth should be of a design similar to the concept design of Appendix 3.

3.8.3 Each roof labyrinth should be of a design similar to the concept design of Appendix 3.

3.8.4 The Contractor shall provide the specified number of labyrinths for utilities and ventilation, etc. This is defined in the detailed specification for each enclosure.

3.8.5 The labyrinth positions will be finalized during the design process.

3.8.6 All labyrinths shall use hinged structures for the ease of installation of utilities. Roof labyrinths shall hinge upwards, and wall labyrinths shall hinge outwards. If two people are needed to open a labyrinth, then two lifting handles shall be provided.

3.8.7 All labyrinths shall be capable of being fitted with a padlock or tamper evident bolts or seals.

3.8.8 Labyrinths shall be fitted with mounting plates for interlock switches and/or locks.

3.9 Ventilation System and External Exhaust Connections

3.9.1 Roof-mounted ventilation fans with integral filter units shall be fitted to each enclosure unless otherwise specified on NSLS-II drawings. The filters selected shall be approved by BSA and information about the filter and filter housing shall be presented at the PDR.

3.9.2 Individual fans shall be able to blow air into each enclosure at a rate of at least 6 m^3/min (180 cfm). Additional fans shall be added, as required, to allow a minimum of six (6) air changes per hour). Air will leave the enclosures via the air outlet labyrinths (near floor level) as well as through labyrinths and other pathways.

- An internal diffuser (e.g., a fabric "sock") shall be flush-mounted along the internal length in the center of the enclosure such that it distributes incoming air evenly throughout the enclosure.
- The internal diffuser shall protrude minimally inside the enclosure so that it does not reduce internal lighting (i.e., the diffuser and/or internal ducts cast no shadows on internal user equipment) or impede hoist movement.
- The internal diffuser shall muffle all fan and air movement sound so that it is below the level of a whisper (i.e., less than 25 dB) at the average ear height inside each enclosure.

3.9.3 Each fan shall be equipped with variable speed control permitting continuous adjustment from 0% (off) to 100%. It is permissible to have a single speed control for each fan, or a single control for all fans in a hutch.

3.9.4 Electrical connection to the electrical mains will be done by BSA staff.

3.9.5 Incoming air from the SR building shall be ducted into the hutches using roof labyrinths to prevent radiation leakage. Additionally, external exhaust system labyrinths shall also be required for enclosures as indicated in Appendix 1. The external exhaust system labyrinths shall be roof and/or wall mounted, according to the needs of the specific application. In all cases, all labyrinths shall be appropriately shielded by the Contractor. Details of shielding protection for all wall and roof labyrinths and penetrations shall be presented by the Contractor at the PDR and accepted by BSA.

- All labyrinths used for wall and roof surfaces shall minimally use the same thickness of shielding materials that protect the wall or roof where the penetration occurs.
- The required shielding materials shall surround all penetrating tubes, pipes, or ducts for minimally ten (10) diameters, or ten (10) times the longest cross-sectional diagonal for non-circular cross-section ducting, with no interruption or reduction in shielding protection that can allow radiation leakage.
- All labyrinths shall be designed such that scattered radiation rays encounter a minimum of two (2) bounces within fully shielded labyrinths so that they are extinguished before escaping.

3.9.6 All fans are to be mounted with anti-vibration hardware and ventilation shall be per American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards (see ASHRAE Manual F08, "Sound and Vibration").

3.9.7 Enclosures and subsystems associated with them (especially fans) shall adhere to the specified vibration criteria set for the experimental floor. Specifically, the vibration levels transmitted to the experimental floor as a result of the presence or operation of the enclosures shall not exceed either 25 nm of integrated RMS displacement for frequencies > 4 Hz or 3.12 μm/sec velocity for frequencies >1 Hz.

3.9.8 Structural interfaces of the enclosure itself with the experimental floor as well as the interfaces between subsystems (rotating equipment) and the enclosure or the experimental floor shall be evaluated prior to the operation in communication with the vibration analysis/mitigation experts of the NSLS-II project. The concrete experimental floor supporting the beam station enclosures has a thickness of 380 mm (15 in.).

3.9.9 All fans proposed shall be NRTL-approved, RoHS-compliant, and shall have a guaranteed noise level of less than 25 dBA at average ear-height inside the enclosure (and less than 70 dBA on the enclosure roof) and shall be subject to BSA approval at the FDR.

3.10 Beam Entry and Exit Points

3.10.1 Beam transport pipe will pass through holes in the upstream and downstream walls of the enclosures known as the "beam pipe penetrations." The size and shape of the beam pipe will be defined within each drawing in Appendix 4.

3.10.2 The beam pipe centerline will be at approximately 1,400 mm above the experimental floor level unless otherwise specified by BSA.

3.10.3 The beam transport pipe weight will be supported externally. The beam pipe and supports will be supplied by BSA.

3.10.4 Where a beam pipe penetration occurs through a shielded enclosure, a sealing component ("guillotine") shall be designed and installed on the inside of the enclosure by the Contractor. Unless otherwise specified on drawings, each guillotine should be of a proven design whereby the steel (or lead) thickness of the guillotine provides equal or greater additional radiation protection than the enclosure wall to which it is attached (see Appendix 3). Additional guillotines needed for NSLS-II facility monochromatic concrete enclosures (e.g., HXN) shall provide radiation protection equal to or greater than ¼-in. thick steel plate.

3.10.5 The final guillotine design and position will be decided at the design review stage. The components of the guillotine shall be bolted together such that bolts may be replaced by BSA with anti-tamper or locking bolts.

3.10.6 The guillotine around the pipe shall be designed in such a way that a radiation-tight seal is created around the beam pipe.

3.10.7 All radiation sealing components shall be supplied by the Contractor.

3.10.8 For experimental enclosures requiring beam pipe penetrations from adjacent enclosures through a common wall, "doors" shall be fitted to cover these penetrations when required, and shall have the dimensions that are given in the specification tables of Appendix 1. These beam pipe penetration doors may take a similar form to a hinged labyrinth.

3.10.9 Beam pipe penetration doors shall only be opened from the upstream enclosure and shall open inwards, and be equipped with interlock switches. The switches will be mounted by BSA; however, mounting provisions shall be provided by the Contractor. These provisions will be determined by BSA at the PDR.

3.10.10 Where beam pipe penetrations through enclosure walls occur, the opposite side of the enclosure wall from the guillotine shall be finished with a decorative plate or collar that fully covers the opening so that no sharp edges or hazards are present. Finishing requirements for this plate or collar shall be decided at the design review stage.

3.10.11 At any location where the upper and lower blades mate, guillotine blade mismatches shall not allow a gap greater than 2 mm (0.080 in.).

3.10.12 Guillotines shall be designed and installed so that the gap between the faces of the guillotine and steel wall are less than 13 mm (½ in.).

3.10.13 If lead is used for guillotine components, all lead shall be coated with paint or preferably with painted steel to avoid exposed lead surfaces.

3.11 Roof, Guard Rails, and Ladders

3.11.1 Guard rails and toe boards shall be installed on all hutch roofs and on all required stairs and bridges IAW OSHA standards (e.g., 1910.23) and BCNYS-2007. All roof-mounted guard rails shall be made removable (overall) by loosening or removing fasteners only (e.g., without breaking weld, adhesive, or braze joints) and shall be installed according to the manufacturer's instructions. This is in addition to requirements for the removal of individual sections, as indicated in paragraph 3.11.8.

3.11.2 A standard railing (pipe) shall consist of top rail, intermediate rail, posts, and kick-plates, and shall have a vertical height of 1070 mm (42 in.) nominal from upper surface of top rail to floor, platform, runway, or ramp level.

3.11.3 The top rail shall be smooth-surfaced throughout the length of the railing. The intermediate rail shall be approximately halfway between the top rail and the floor, platform, runway, ramp, or stairs.

3.11.4 The ends of the rails shall not overhang the terminal posts except where such overhang does not constitute a projection hazard.

3.11.5 Guard rails shall be fitted less than 100 mm (4 in.) inboard from the edge of the enclosure roof.

3.11.6 The guard rails shall be installed continuously with the galvanized steel guard rails on the storage ring, where the enclosure is in contact with the storage ring tunnel (mezzanine). Where the height difference requires steps these shall be fitted with appropriate guard rails tied to the SR tunnel guard rails.

3.11.7 Any railings adjacent to the stairs shall be of construction similar to a standard railing but the vertical height shall be not more than 860 mm (34 in.) nor less than 760 mm (30 in.) from the upper surface of the top rail to the surface of the tread in line with the face of the riser at the forward edge of the tread. The stairs shall be IAW the OSHA Standard for fixed industrial stairs, 1910.24.

3.11.8 Each enclosure shall have horizontal guard rails that shall be made readily removable for one complete section *minimally* without affecting the required protection supplied by adjacent sections (excluding "special" and/or "mini-hutches" where indicated on NSLS-II drawings). The guard rails shall be made removable by loosening or removing fasteners only (e.g., without breaking weld, adhesive, or braze joints). Unless otherwise specified on drawings provided in Appendix 4, the removable guard rails shall be installed at two locations on each long hutch side (i.e., four locations total on each four-sided, stand-alone hutch). Additionally, removable guard rail sections shall be required for utilities as described in subparagraphs 3.11.8.1 and 3.11.8.2 below. The locations of the removable sections shall be finalized at the PDR.

3.11.8.1 Guard rails shall be constructed with removable sections as needed to allow utilities cable trays and pipes to extend beyond the roof of each enclosure unimpeded (i.e., without utilities interference), and without horizontal gaps between the utilities and guard rails greater than 4 in. (100 mm). These removable sections are **not** shown on individual hutch drawings but are required in all locations where utilities, cable trays, and pipes are intended to extend beyond the roof of each enclosure.

3.11.8.2 All removable guard rails and the guard rail sections on either side of the removed guard rails shall meet all guard rail requirements in all configurations (i.e., both *before* and *after* horizontal section removal), including the load requirements of paragraph 3.11.9.

3.11.9 The anchoring of posts and framing of members for railings of all types shall be of such construction that the completed structure (in all configurations) shall be capable of withstanding a load of at least 200 pounds (0.89 kN) applied in any direction at any point on the top rail and a force of 50 lbs (0.22 kN) applied in any direction to intermediate rails at any location, with a safety factor of at least 3.0.

3.11.10 A standard kick-plate (toe-board; shall be IAW OSHA Standard 1910.23) shall be 100 mm (4 in.) nominal in vertical height from its top edge to the level of the floor, platform, runway, or ramp. It shall be securely fastened in place and with not more than 6 mm (¼ in.) clearance above floor level. It may be made of any substantial material either solid or with openings not over 25 mm (1 in.), greatest dimension.

3.11.11 Ladders to the hutch roof, where specified, shall be installed IAW OSHA Standard for Fixed Ladders, 1910.27, and all applicable state and local building and fire codes.

3.11.11.1 Where ladders are used, self-latching gates are required to prevent accidental falls by personnel on top of the hutch roof. The gates shall be located three feet inside the outer wall so that a minimum platform of 920 mm wide x 920 mm deep (36 in. wide x 36 in. deep) is provided outside of the gate at the top of each ladder for safety. Gates shall open away from the ladder.

3.11.11.2 Where ladders are used, signs shall be placed clearly designating the ladders as for emergency use only. At the lower end of each ladder, one or more signs shall clearly warn personnel using the words "Not an Exit" and "Authorized Personnel Only." At the upper end of each ladder, mounted on the railing/gate for access to the ladder, an additional sign shall be permanently mounted indicating "Emergency Use Only." In all

cases, signs shall meet the requirements of section 4.8 and shall be mounted so as not to inhibit ladder use.

3.11.11.3 Where required, ladders shall be permanently attached to the hutch at both ends.

3.11.11.4 Ladder attachments to hutch shall be made preferably by welding; holes may be drilled into shielded hutches only with BSA approval (i.e., fasteners must be installed into all holes to provide equal or superior radiation protection as the undrilled shielding). Weld spatter shall be removed at all weld locations and the ladder (if not made of corrosion-resistant material) and brackets shall be finished per section 3.12.

3.11.11.5 All ladder design information shall be presented at the PDR.

3.11.12 The hutch external roof surface shall be finished with a non-slip material or coating designed for floor surfaces and for adherence to steel material.

3.11.13 Unistrut attachments shall be welded onto the roof of the hutch to mount brackets for utilities pipes and electrical wiring trays. At all weld locations, weld spatter shall be removed and the welded area shall be finished per section 3.12. Unless otherwise indicated in NSLS-II drawings, Unistrut shall each be 610 mm (24 in.) long, located in a straight parallel row, nominally at 1 m intervals (spacing may be adjusted slightly to avoid panel edges or undesirable conflicts). The design loads are in paragraph 3.4.3.

3.11.14 Emergency egress aisle-ways 710 mm (28 in.) wide shall be designated and clearly marked on top of each connected enclosure where an emergency egress ladder is required for any of the connected enclosures. Hardware protruding into this aisle space shall be subject to review at the PDR stage, but under no circumstances shall the aisle width be restricted to less than 483 mm (19 in.).

3.11.15 Measures shall be taken by the Contractor to avoid protrusions that could constitute a trip hazard on the enclosure roof. (Note: 28 CFR Part 36, the ADA Standards for Accessible Design, specifies a trip hazard as any vertical height of ¼ in. [6.35 mm] or more.) Wherever possible, joint strips to prevent radiation leakage should not be used on top of the enclosure roof due to their potential for warping, bending, and possibly becoming a future trip hazard. Roof joint strips should be placed inside the enclosure, where possible. Where the use of external joint strips on top of the roof cannot be avoided, they must be adequately secured to minimize the possibility of separation and/or warping over the life of the enclosure. The requirements of OHSA part 1910.23(e)7 apply: "Covers projecting not more than 1 inch above the floor level may be used providing all edges are chamfered to an angle with the horizontal of not over 30 degrees. All hinges, handles, bolts, or other parts shall set flush with the floor or cover surface." Labyrinths are excluded from this clause.

3.11.16 At least one sign shall be affixed to the non-removable handrail section of each enclosure to designate the allowable roof loading. The sign shall be double-sided and located in a position that is clearly visible to personnel approaching the roof of the enclosure and to experimenters below. The sign shall meet the requirements of section 4.8 and shall not pose a hazard in any way, nor shall it interfere in any way with use of the handrail onto which it is mounted.

3.12 Enclosure Paint and Finishing

3.12.1 The paint color shall be decided by BSA at, or prior to, the FDR.

3.12.2 MSDS information shall be presented at PDR for all paints and primers to be applied on-site at BNL. The MSDS information shall be reviewed by BSA prior to FDR. Due to potential Health and Safety concerns, BSA reserves the right to reject paints with an unacceptable level of Volatile Organic Compounds (VOC), etc.

3.12.3 The enclosure surfaces shall be adequately prepared prior to painting.

3.12.4 The enclosure components shall be primed in the factory.

3.12.5 The primer undercoat used shall be a two-part epoxy paint and shall be applied IAW the manufacturer's written instructions.

3.12.6 Each enclosure shall be finished-painted after installation; all Unistrut shall be masked and left unpainted.

3.12.7 The final top coat shall be a semi-gloss two-part enamel applied IAW the manufacturer's written instructions.

3.12.8 The exterior surface of wall panels that are directly adjacent to existing structures shall be painted before installation. All exposed lead surfaces shall be painted, including the edges of panels.

3.12.9 Priming and painting on-site at BNL shall be minimized. Where necessary, primer and paint shall be applied by brush and/or roller IAW the manufacturer's recommendations. The application of paint or primer on-site at BNL by spraying is not permitted.

3.13 Windows

3.13.1 Viewing windows shall be fitted, where required in the specifications tables of Appendix 1. All windows shall be protected from accidental breakage with a sheet of polycarbonate plastic laminate on both faces of the window where it interfaces with the window frame.

3.13.2 Where a window is specified, the window and surrounding frame shall provide radiation shielding equivalent to, or better than, that afforded by the wall or door in which the window is placed. The window material should overlap with the wall panel material to assure radiation leak tightness.

3.13.3 Unless otherwise specified in the tables or attached drawings in Appendix 1, windows used in doors shall be horizontally centered in the outermost door panel. All windows shall be centered vertically 1.5 m (60 in.) above the finished experimental floor according to the requirements of NCRP report number 147 unless otherwise specified. Where applicable, window sizes shall be as indicated in Appendix 1.

3.14 Identification

3.14.1 Hutch identification numbering is required for firefighter assistance. Signs shall be provided on each enclosure on the outside downstream and side walls. The identification shall include the enclosure designation only (e.g., 12-ID-A). The manufacturer's corporate logo is not permitted on signs required by BSA, and all other requirements of section 4.8 apply. The hutch identification will be supplied by BSA.

3.14.2 Lettering shall be black, Times New Roman, font size 400 (approximately 100 mm / 4 in. tall) on a white background at least 200 mm (8 in.) tall. Identification may be printed onto self-adhesive plastic sheets and attached after painting is complete, in a position approved by facility staff.

3.15 Fasteners and Suspect/Counterfeit Items

3.15.1 No re-used or suspect/counterfeit fasteners, materials, or hardware may be used, as stipulated in the contract documentation.

3.15.2 Stainless or plated steel fasteners are required. All fasteners shall have adequate strength, fatigue life, and corrosion resistance to last for the full life of the enclosure.

3.15.3 Where possible, fasteners that retain radiation shielding shall be designed so as not to be accessible externally. When this cannot be avoided, externally-accessible fasteners must have tamper-resistant retention provisions that are accepted by BSA, such as cross-drilled holes for lockable safety wiring.

3.16 Electrical

3.16.1 Lighting

3.16.1.1 Lighting shall be ceiling mounted.

3.16.1.2 The lighting shall be of the fluorescent tube type with a T5 efficiency rating.

3.16.1.3 The lighting shall provide a consistent illumination level of 80 foot-candles (~800 Lux) at a height of 1.4 m (~55 in.) from the floor at all places within the enclosure (enclosure empty).

3.16.1.4 The lighting shall be connected to 110 VAC, 60 Hz electrical main supply by BSA.

3.16.1.5 One light in each enclosure shall be designated as an emergency light and fitted with battery backup for automatic use in the event of power failure.

3.16.1.6 The lighting fixtures selected shall be NRTL-approved and subject to approval by BSA at, or before, the FDR.

3.16.2 Electrical Continuity

3.16.2.1 Electrical continuity ("ground" or "earth") shall exist between all panels of each enclosure. A single grounding point shall be provided inside each enclosure; connection to the common earth shall be performed by BSA. The location and method shall be approved by BSA at the FDR.

3.17 Bridges

3.17.1 Structural

3.17.1.1 Bridges that meet all applicable state, local, and federal requirements including OSHA 1920.22 and BCNYS-2007, section 1004.1.2 shall be designed, fabricated, and installed where indicated. The structural design requirements included in paragraphs 3.4.1, 3.4.2, and 3.4.3 of this Specification also apply to the bridges.

3.17.1.2 The minimum live load that the elevated bridge platforms must support is the greater of the loads indicated in section 3.17.1.1 above, or 1,000 lbs, and the minimum Factor of Safety for design is 5. Dead loads shall include the weight of utilities pipes and hangars, as indicated in paragraph 3.17.4.

3.17.1.3 Bridges shall have a clear, unobstructed width (and the clear distance between guard rails shall be) at least 1120 mm (44 in.) and the total bridge width shall be no more than 1220 mm (48 in.). A sketch of a typical bridge is shown in Appendix 4; the minimum allowable clear-path dimensions directly below each bridge are shown in Appendix 4.

3.17.1.4 Bridges shall be designed so they are self-supporting and provide maximum free travel (height and width) underneath. That is, column supports shall be used at either end of the bridge and may be attached to the adjacent hutches, but the structural load of the bridge shall be carried by the columns, not by the hutch structure. The columns may be attached to the hutch preferably by welded-on brackets. Holes may not be drilled into lead/steel enclosure panels. Holes may be drilled into steel shielded hutches only with BSA approval (i.e., fasteners must be installed into all holes to provide equal or superior radiation protection as the undrilled shielding). Weld spatter shall be removed at all weld locations and brackets shall be finished per section 3.12.

3.17.1.5 Clear passage under each bridge and between structures (e.g., between columns or enclosure walls, whichever is most restrictive) for equipment to pass underneath prior to beampipe installation shall minimally be 1.22 m (48 in.) wide by 3.0 m (118 in.) high (measured from floor to lowest point on underside of bridge). BSA approval is required for all column installations to assure that no interference occurs with beamline equipment.

3.17.1.6 Bridge surfaces at either end shall transition smoothly to the hutch roofs at either end so that equipment may be rolled with minimal effort between hutches. BCNYS-2007 specifies minimum ramp angles. The mismatch height between the ramp and the hutch roof surface shall minimally be as indicated for building doorway thresholds.

3.17.1.7 Bridges shall be adequately stiffened and supported so that minimal side-sway occurs when moving loads traverse the bridge.

3.17.1.8 Guard rails and toe boards shall be installed per section 3.11 of this Specification.

3.17.2 Materials and Finish

3.17.2.1 The bridge materials shall be appropriately finished (e.g., galvanized, or primed and painted per section 3.12 of this Specification) to prevent rust or corrosion for the life of the bridge. This includes all brackets for stairs, bridges, and utilities as required.

3.17.2.2 The bridge floor surface shall be steel grating, diamond plate steel, or other fireproof, BSA-approved, non-slip material designed for the application that meets all applicable codes and requirements.

3.17.2.3 External paint or finish colors shall be determined by BSA at the FDR.

3.17.2.4 Unless gratings are used, the upper external bridge floor surface shall be finished with a non-slip coating designed for floor surfaces and for adherence and long life.

3.17.3 Signage

At least one sign shall be placed on each completed bridge in a conspicuous location whereby the sign is viewable by persons entering from either end of the bridge. The sign (or signs) shall indicate the maximum capacity of the bridge in both live loading (i.e., concentrated load) and human occupancy. Signs shall not interfere with access to hand rails, and shall conform to the requirements of section 4.8.

3.17.4 Provision for Utilities

3.17.4.1 Unistrut attachments shall be welded onto the roof of the hutch to mount L-brackets for utilities pipes and electrical wiring trays as indicated in paragraph 3.11.13. Paragraph 3.4.3 indicates the loads for these pipes, hangars, and wiring per meter of cable tray/utilities pipe span.

3.17.4.2 Where bridges between enclosures are required, provisions to support the utilities pipes, wire trays, and cables shall also be provided. Brackets on the walls of each enclosure shall be included so that free-standing support columns may be attached to the facing FOE and enclosure walls, as applicable. The details for mounting the utilities shall be determined during the design review process.

3.18 Stairs

3.18.1 Structural

3.18.1.1 Stairs that meet all applicable state, local, and federal requirements, including OSHA 1920.22 and BCNYS-2007, section 1004.1.2, shall be designed, fabricated, and installed where indicated. The structural design requirements included in paragraphs 3.4.1, 3.4.2, and 3.4.3 of this Specification also apply to the stairs.

3.18.1.2 The minimum live load that the stairs must support is the greater of the loads indicated in paragraph 3.18.1.1 above or 1,000 lbs, and the minimum Factor of Safety for design is 5.

3.18.1.3 Stairs shall have a clear, unobstructed width and the clear distance between guard rails shall be not less than 1120 mm (44 in.).

3.18.1.4 If the stairs are permanently attached to the enclosure, the shielded-panel attachments shall preferably be welded on. Holes may be drilled into hutch shielding materials only with BSA approval (i.e., fasteners must be installed into all holes such that they provide equal or superior radiation protection as the undrilled shielding material). Weld spatter shall be removed at all weld locations and brackets shall be finished per section 3.12. Attachments to the x-ray ring must be approved by BSA.

3.18.1.5 Guard rails shall be installed according to the requirements of section 3.11.7 of this Specification.

3.18.1.6 The enclosure roof height is indicated in Appendix 1. Due to minor differences in as-built dimensions, the Contractor shall take any and all measurements necessary to assure proper fit of stairs and conformance to all applicable codes.

3.18.1.7 Where stairs from the top of individual enclosures to the experimental floor are required (e.g., SRX), gates shall be provided at the top and bottom of each set of stairs. These gates shall have latches that are operable from both sides.

- At the top of stairs, the stair rails shall connect to the guard rails on the enclosure stairs without gaps and there shall be a landing area protected on all sides by guard rails with minimum dimensions of 910 mm x 910 mm (36 in. x 36 in.).
- A minimum of one sign clearly visible by personnel on the experimental floor with the individual NSLS-II beamline identification and the words "Authorized Personnel Only" and "Not An Exit" shall be attached to the bottom gate. The sign shall conform to the requirements of section 4.8.

3.18.2 Materials and Finish

3.18.2.1 The stair rungs shall be made of steel grating or other BSA-approved, fireproof, non-slip material designed for the application that meets all applicable codes and requirements.

3.18.2.2 Only fireproof materials may be used for the stairs and for their supporting structure. These materials may either be corrosion resistant or they shall be appropriately finished (e.g., primed and painted) per section 3.12 of this Specification to prevent rust or corrosion for the life of the stairs.

3.18.2.3 External paint or finish colors shall be determined by BSA at the FDR.

3.18.2.4 If gratings are not used, the upper external stair surfaces shall be finished with a non-slip material or coating designed for the application (i.e., it must have superior material adherence and long life properties).

4 GENERAL FABRICATION REQUIREMENTS

4.1 The Contractor shall endeavor to design, manufacture, and install completed enclosures that are "visibly appealing." and are the best examples of the highest quality workmanship that can be produced. Attention to detail and long-lasting, aesthetically pleasing results are required in all aspects of design, manufacturing, and installation.

4.2 All parts shall be free of burrs and sharp edges, dents, gouges, and scratches.

4.3 The parts shall be clean and free of dirt, corrosion, oil, and grease, with the exception of the appropriate lubrication on moving bearing surfaces.

4.4 Bearing surfaces (e.g., door hinges and slides) shall be lubricated as required, preferably with molybdenum disulfide or other stable lubricant that is compatible both with the materials used, and for use in an ionizing radiation environment.

4.5 All assembly requirements for alignment marks, keying, or pinning specified on the appropriate assembly or sub-tier drawing shall be done after verification that the assembly meets the dimensional requirements of the drawing.

4.6 All fasteners on moving devices shall be locked by means of wires, jam nuts, set screws, spring washers, or similar locking devices to prevent loosening.

4.7 Panels and other components may be labeled or marked to aid assembly and installation as long as marking or labeling is done unobtrusively, preferably in a location that is not readily visible after installation, or by using tags or labels which are removed during assembly or installation.

4.8 Every sign required by BSA shall comply with all applicable codes and standards (including the applicable sections of BCNYS-2007 and OSHA 1910.145) and shall be mounted so as to neither pose a hazard in any way nor inhibit or interfere with the use of handrails, ladders, installed equipment or hardware, etc. Sign format, mounting, and placement shall be approved by BSA for all signs. Manufacturer or corporate logos are not permitted on any signs required by BSA. The location and size of manufacturer or corporate logos must be approved by BSA before installation.

4.9 No holes may be drilled into lead-shielded hutches.

APPENDIX 1TABULATED SPECIFICATIONS FOR HUTCHES

Specification Sheet for Enclosure 3-ID-B

Enclosure designation		3-ID-B
Enclosure type		IVU20 Monochromatic Beam
Enclosure description		HXN Second Optics Enclosure
Shielding material		Steel
BNL Drawing reference		PD-HXN-HU-1210
Dimensions (m)	Height max	3.5 m
	Width max	3.2 m
	Length max	5.8 m
Shielding	Side (lateral) panels	6 mm steel
	Upstream panels	6 mm steel
	Downstream wall panels	6 mm steel
	Roof panels	3 mm steel
	Guillotine	2 places, 1 each on downstream wall & upstream walls
	Beam pipe penetration door	Not required
Entry 1	Position	Outboard side (see PD-HXN-HU-1210)
	Size (m)	2.4 H x 2.0 W
	Type	Sliding single
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip Curtain (internal)	Yes
Hoist		Not required
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 1
	Electrical labyrinth	(on roof): Qty 2
	Air inlet labyrinth, with fan and filter	(on roof): Qty 1
	Air outlet labyrinth	(base of sidewall): Qty 1
	Exhaust labyrinth	Not required
	User access labyrinth	(on sidewall): Qty 4 (with interlock switch provisions)
	Liquid nitrogen labyrinth	(on roof): Not required
Bridges		Not required
Other		Attachment points for adjacent enclosures: Not required
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

Specification Sheet for Enclosure 3-ID-C

Note: Enclosure 3-ID-C is a concrete structure that is part of the HXN Satellite Building construction. It has already been fabricated and is not part of this package. The associated hardware: 36 user labyrinths, 1 guillotine, 1 removable cover plate, 1 beam stop, and 2 entry doors (a 2.4 m wide double and a 1.0 m wide single) are part of this package and are listed below.

Enclosure designation		3-ID-C
Enclosure type		IVU20 Monochromatic Beam
Enclosure description		HXN Experimental End Station Enclosure
Shielding material		Concrete / Steel
BNL Drawing reference		PD-HXN-HU-1310
Dimensions (m)	Height max	3.7 m (reference only)
	Width max	5.5 m (reference only)
	Length max	20.5 m (reference only)
Shielding	Steel hardware to be attached to existing concrete enclosure	6 mm thick minimum (~¼ in.) steel
	Guillotine	Upstream wall (may be attached directly to concrete hutch wall)
	Beam pipe penetration door	Not required
	Beam stop	Qty 1 (required even though it is NOT SHOWN on drawing PD-HXN-HU-1310)
Entry 1	Position	Inboard side – upstream (see drawing PD-HXN-HU-1310 for notes)
	Size (m)	2.4 H x 2.4 W
	Type	Swinging double
	Floor groove	No
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Not required
Entry 2	Position	Inboard side – downstream (see drawing PD-HXN-HU-1310 for notes)
	Size (m)	2.2 H x 1.0 W
	Type	Swinging single
	Floor groove	No
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Not required
Hoist		Not required
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 0
	Electrical labyrinth	(on roof): Qty 0
	Air inlet labyrinth, with fan and filter	(on roof): Qty 0
	Air outlet labyrinth	(at base of sidewall): Qty 0
	Exhaust labyrinth	Qty 0
	User access labyrinth	(on sidewall): Qty 36 (with interlock switch provisions)
	Liquid nitrogen labyrinth	(on roof): Qty 0
Bridges		Not required
Other	Removable Cover Plate	Qty 1 (For a 38 in. x 14 in. wall opening; must extend a minimum of 2 in. beyond the opening on all sides. **See drawing PD-HXN-HU-1310 for details.**)
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

APPENDIX 1 TABULATED SPECIFICATIONS FOR HUTCHES *(cont.)*

Specification Sheet for Enclosure 5-ID-B

Enclosure designation		5-ID-B
Enclosure type		IVU21 Monochromatic Beam
Enclosure description		SRX Mini-hutch for Secondary Source Optics
Shielding material		Steel
BNL Drawing reference		PD-SRX-HU-1210
Dimensions (m)	Height max	2.1 m
	Width max	1.8 m
	Length max	2.1 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Upstream wall panels	6 mm steel
	Downstream wall panels	Share 5-ID-C upstream wall
	Guillotine	1 required, upstream wall for double beam pipe penetration
	Beam pipe penetration door	(alignment window) Not required
Entry 1	Position	Inboard side (see drawing PD-SRX-HU-1210)
	Size (m)	2.1 H x 2.1 W (full width/height)
	Type	Dual full-size swinging doors.
	Floor groove	No
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Not required
Entry 2	Position	Inboard side on entry 1 (see drawing PD-SRX-HU-1210)
	Size (m)	0.7 H x 1.0 W access panel (within entry 1 removable door panel)
	Type	Hinged or sliding
	Floor groove	No
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Not required
Hoist		Not required
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 0
	Electrical labyrinth	(on roof): Qty 0
	Air inlet labyrinth, with fan and filter	(on roof): Qty 0
	Air outlet labyrinth	(at base of sidewall): Qty 0
	Exhaust labyrinth	Qty 0
	User access labyrinth	(on sidewall): Qty 1 (with interlock switch provisions)
	Liquid nitrogen labyrinth	(on roof): Qty 0
Bridges		Not required
Other		Attachment points for adjacent enclosures: downstream side attach to 5-ID-C, **see drawing PD-SRX-HU-1310**
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

APPENDIX 1 TABULATED SPECIFICATIONS FOR HUTCHES *(cont.)*

Specification Sheet for Enclosure 5-ID-C

Enclosure designation		5-ID-C
Enclosure type		IVU21 (TBD) Monochromatic Beam
Enclosure description		SRX ZP branch Experimental End Station Enclosure
Shielding material		Steel
BNL Drawing reference		PD-SRX-HU-1310
Dimensions (m)	Height max	3.5 m
	Width max	3.88 m
	Length max	7 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Upstream wall panels	6 mm steel
	Downstream wall panels	6 mm steel
	Guillotine	2 Required, 1 double beam pipe penetration upstream, 1 single beam pipe penetration downstream, see drawing PD-SRX-HU-1310
	Beam pipe penetration door	(alignment window) Not required
	Beam stop	Qty 1
Entry 1	Position	Outboard side (see drawing PD-SRX-HU-1310)
	Size (m)	2.4 H x 2.0 W (full width)
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Yes
Hoist		Manual 1,000 kg (double sliding rail)
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 1
	Electrical labyrinth	(on roof): Qty 1
	Air inlet labyrinth, with fan and filter	(on roof): Qty 1
	Air outlet labyrinth	(at base of sidewall): Qty 4
	Exhaust labyrinth	Qty 1 (approximate location shown on drawing PD-SRX-HU-1310)
	User access labyrinth	(on sidewall): Qty 2 (with interlock switch provisions)
	Liquid nitrogen labyrinth	(on roof): Qty 1
Bridges		Not required
Other		Attachment points for adjacent enclosures: Upstream wall attach to 5-ID-B (**see drawing PD-SRX-HU-1210**). Downstream wall attach to 5-ID-D (**see drawing PD-SRX-HU-1410**). Stairs as required by drawing PD-SRX-HU-1310.
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

Specification Sheet for Enclosure 5-ID-D

Enclosure designation		5-ID-D
Enclosure type		IVU21 Monochromatic Beam
Enclosure description		SRX KB branch Experimental End Station Enclosure
Shielding material		Steel
BNL Drawing reference		PD-SRX-HU-1410
Dimensions (m)	Height max	3.5 m
	Width max	3.88 m
	Length max	10.2 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Upstream wall panels	Share 5-ID-C downstream wall
	Downstream wall panels	6 mm steel
	Guillotine	Not required
	Beam pipe penetration door	Not required
	Beam stop	Qty 1
Entry 1	Position	Outboard side
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Yes
Hoist		Manual 1,000 kg (double sliding rail)
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 1
	Electrical labyrinth	(on roof): Qty 2
	Air inlet labyrinth, with fan and filter	(on roof): Qty 2
	Air outlet labyrinth	(base of sidewall): Qty 4
	Exhaust labyrinth	Qty 1 (approximate location shown on drawing PD-SRX-HU-1410)
	User access labyrinth	(on sidewall): Qty 2 (with interlock switch provisions)
	Liquid nitrogen labyrinth	(on roof): Qty 1
Bridges		Not required
Other		Attachment points for adjacent enclosures: Upstream wall to 5-ID-C (**see drawing PD-SRX-HU-1310**)
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

APPENDIX 1 TABULATED SPECIFICATIONS FOR HUTCHES *(cont.)*

Specification Sheet for Enclosure 10-ID-B

Enclosure designation		10-ID-B
Enclosure type		IVU22 Monochromatic Beam
Enclosure description		IXS High Resolution Monochromator Optics Enclosure
Shielding material		Steel
BNL Drawing reference		PD-IXS-HU-1210
Dimensions (m)	Height max	3.5 m
	Width max	2.8 m
	Length max	5.0 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Downstream wall panels	6 mm steel
	Guillotine	Yes, (downstream wall)
	Beam pipe penetration door	(alignment window): Not required
Entry 1	Position	Outboard side
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Yes
Hoist		Manual 1,000 kg (double sliding rail)
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 1
	Electrical labyrinth	(on roof): Qty 2
	Air inlet labyrinth, with fan and filter	(on roof): Qty 1
	Air outlet labyrinth	(base of sidewall): Qty 2
	User access labyrinth	(on sidewall): Qty 1 (with interlock switch provisions)
	Exhaust labyrinth	Not required
	Liquid nitrogen labyrinth	(on roof): Qty 0
Bridges		One required between 10-ID-B & 10-ID-C, ~1.2 m wide (**see drawing PD-IXS-HU-1000**)
Other		Attachment points for adjacent enclosure 10-ID-A
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

APPENDIX 1 TABULATED SPECIFICATIONS FOR HUTCHES *(cont.)*

Specification Sheet for Enclosure 10-ID-C

Enclosure designation		10-ID-C
Enclosure type		IVU22 Monochromatic Beam
Enclosure description		IXS Secondary Optics Development Enclosure
Shielding material		Steel
BNL Drawing reference		PD-IXS-HU-1310
Dimensions (m)	Height max	3.5 m
	Width max	2.7 m
	Length max	6.25 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Upstream wall panels	6 mm steel
	Guillotine	2 required; 1 on upstream wall, 1 on downstream wall
	Beam pipe penetration door	Not required
Entry 1	Position	Inboard side
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Yes
Entry 2	Position	Outboard side
	Size (m)	2.4 H x 1.0 W
	Type	Sliding or hinged single
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	300 mm (12 in.) square
	Strip curtain (internal)	Yes
Hoist		Manual 1,000 kg (double sliding rail)
Labyrinths		Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
	Fluids labyrinth	(on roof): Qty 1
	Electrical labyrinth	(on roof): Qty 1
	Air inlet labyrinth, with fan and filter	(on roof): Qty 1
	Air outlet labyrinth	(base of sidewall): Qty 2
	User access labyrinth	(on sidewall): Qty 1 (with interlock switch provisions)
	Exhaust labyrinth	Not required
	Liquid nitrogen labyrinth	(on roof): Qty 0
Bridges		See 10-ID-B table (**and see drawing PD-IXS-HU-1000**)
Other		Attachment points for adjacent enclosures: 10-ID-D
Drawings		Number of full-sized prints required of all drawings: Qty 3
Manuals		Number of copies required of all manuals: Qty 3

APPENDIX 1 TABULATED SPECIFICATIONS FOR HUTCHES *(cont.)*

Specification Sheet for Enclosure 10-ID-D

Enclosure designation		10-ID-D
Enclosure type		IVU22 Monochromatic Beam
Enclosure description		IXS Experimental End Station Enclosure
Shielding material		Steel
BNL Drawing reference		PD-IXS-HU-1410
Dimensions (m)	Height max	3.5 m
	Width max	8.0 m
	Length max	16.0 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Upstream & Downstream wall panels	6 mm steel
	Guillotine	Not required
	Beam pipe penetration door	(alignment window): Not required
	Beam stop	Qty 1
Entry 1	Position	Outboard side
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	300 mm (12 in.) square on one door only
	Strip curtain (internal)	Yes
Entry 2	Position	Inboard side
	Size (m)	2.4 H x 1.0 W
	Type	Sliding single
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	300 mm (12 in.) square
	Strip curtain (internal)	Yes
Entry 3	Position	Upstream side
	Size (m)	2.4 H x 1.0 W
	Type	Sliding or hinged single
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	300 mm (12 in.) square
	Strip Curtain (internal)	Yes
Hoist		Manual 1,000 kg (double sliding rail)

Continued...

Specification Sheet for Enclosure 10-ID-D *(continued)*

Labyrinths	Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
Fluids labyrinth	(on roof): Qty 1
Electrical labyrinth	(on roof): Qty 3
Air inlet labyrinth, with fan and filter	(on roof): Qty 2
Air outlet labyrinth	(base of sidewall): Qty 4
User access labyrinth	(on sidewall): Qty 2 (with interlock switch provisions)
Exhaust labyrinth	Not required
Liquid nitrogen labyrinth	(on roof): Qty 0
Bridges	Not required
Other	Attachment points for adjacent enclosures: 10-ID-C
Drawings	Number of full-sized prints required of all drawings: Qty 3
Manuals	Number of copies required of all manuals: Qty 3

APPENDIX 1 TABULATED SPECIFICATIONS FOR HUTCHES *(cont.)*

Specification Sheet for Enclosure 11-ID-B

Enclosure designation		11-ID-B
Enclosure type		IVU20 Pink Beam
Enclosure description		CHX Experimental End Station Enclosure
Shielding material		Steel
BNL Drawing reference		PD-CHX-HU-1210
Dimensions (m)	Height max	TBD (adjust ceiling height to accommodate 3.0 m min crane clearance per PD-CHX-HU-1210)
	Width max	4.6 m
	Length max	27.0 m
Shielding	Side (lateral) panels	6 mm steel
	Roof panels	3 mm steel
	Upstream & Downstream wall panels	6 mm steel
	Guillotine	Upstream wall
	Beam pipe penetration door	(alignment window): Not required
	Beam stop	Qty 1
Entry 1	Position	Outboard side, upstream—see drawing PD-CHX-HU-1210
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Yes
Entry 2	Position	Outboard side, downstream—see drawing PD-CHX-HU-1210
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip curtain (internal)	Yes
Entry 3	Position	Inboard side, upstream—see drawing PD-CHX-HU-1210
	Size (m)	2.4 H x 2.0 W
	Type	Sliding double
	Floor groove	Yes
	PPS Interfaces	Mounting plates for magnetic lock and dual position switches.
	Window	Not required
	Strip Curtain (internal)	No
Wall window(s)	Location	Upstream of entry 2, closest full panel to corner—see drawing PD-CHX-HU-1210
	Size	460 mm (18 in) x 380 mm (15 in)
Hoist		Manual 1,000 kg (double sliding rail)

Continued...

Specification Sheet for Enclosure 11-ID-B *(continued)*

Labyrinths	Positioned as on drawing, sealed with anti-tamper screws except where locks/interlocks specified.
Fluids labyrinth	(on roof): Qty 1 (with one middle partition)
Electrical labyrinth	(on roof): Qty 9 (with two internal partitions)
Air inlet labyrinth, with fan and filter	(on roof): Qty 2
Air outlet labyrinth	(base of sidewall): Qty 3
Exhaust labyrinth	Qty 1 (see drawing PD-CHX-HU-1210)
User access labyrinth	(on sidewall): Qty 4 (with interlock switch provisions)
Liquid nitrogen labyrinth	(on roof): Qty 0 (without internal partitions)
Bridges	1 required between 11-ID-A & 11-ID-B enclosures
Other	Attachment points for adjacent enclosures: NA
Drawings	Number of full-sized prints required of all drawings: Qty 3
Manuals	Number of copies required of all manuals: Qty 3

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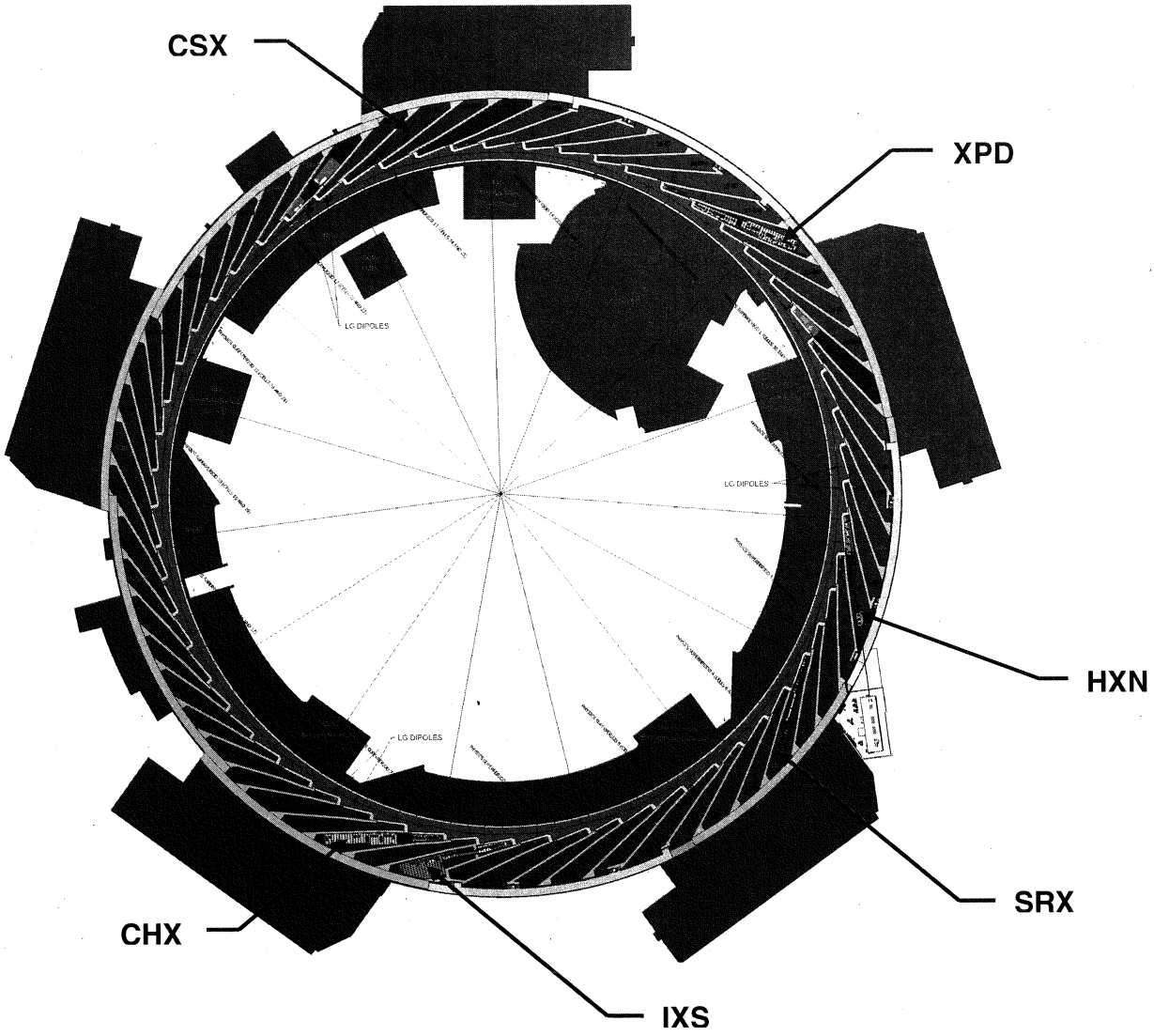
APPENDIX 2 FLOOR PLAN OF FACILITY SHOWING BEAMLINE LOCATIONS



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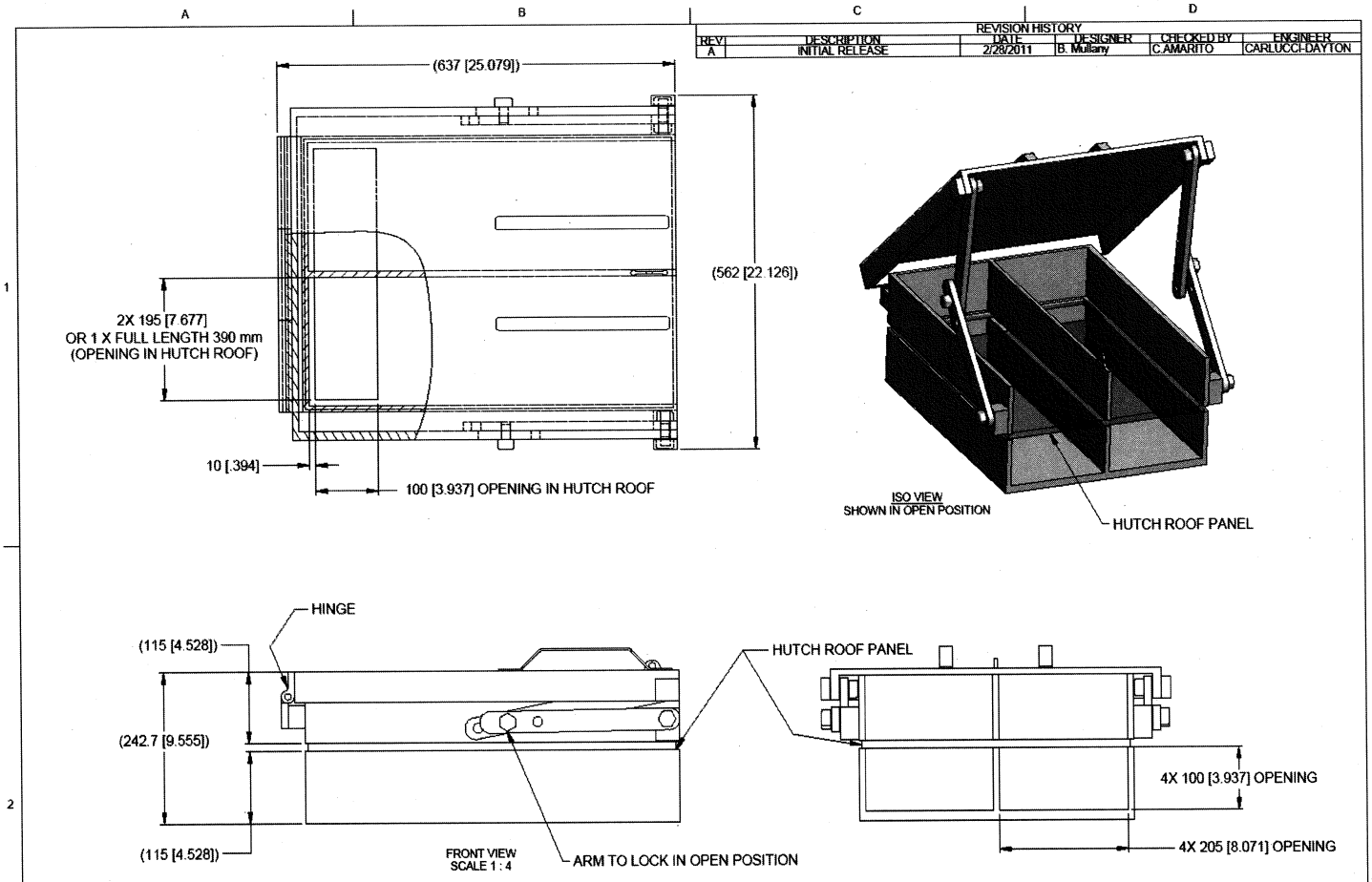
APPENDIX 3 CONCEPTUAL LABYRINTH AND GUILLOTINE DESIGNS

Conceptual Roof Labyrinth Design, Drawing PD-COM-HU-1100



NOTES:

1. THIS DRAWING SHOWS A CONCEPTUAL DESIGN OF A COMPACT ROOF LABYRINTH ASSY.
2. MATERIAL TYPE (STEEL OR LEAD/STEEL) AND THICKNESS TO BE IDENTICAL TO THE SPECIFICATIONS FOR THE PANEL ON WHICH IT IS ATTACHED.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN BRACKETS [no. of DECIMAL PRESENT] ARE INCHES AND ARE FOR REFERENCE ONLY
INTERPRET DRAWING AS PER ASME Y14.5-1994 OR Y32.3-1975
DIMENSIONAL TOLERANCES: X. ± 1.500, X.X ± 0.750, XX ± 0.400, XXX ± 0.120
ANGULAR TOLERANCE: ± .5°
Finish 3.2
BREAK EDGES & SHARP CORNERS 0.120 MIN TO 0.750 MAX
THIRD ANGLE PROJECTION
SCALE: SEE DWG VIEW

BROOKHAVEN NATIONAL LABORATORY, BROOKHAVEN SCIENCE ASSOCIATES, UPTON, NEW YORK 11973
NSLSII NATIONAL SYNCHROTRON LIGHT SOURCE II

DRAWN BY	B. MULLANY	1/21/2011
CHECKED BY	C.AMARITO	2/28/2011
RADIATION SAFETY ENGINEER APPROVAL	PK.JOB	2/28/2011
ALARA ENGINEER APPROVAL	M.GARLUCCI-DAYTON	2/28/2011
SUPERVISOR APPROVAL	A.BROADBENT	2/28/2011
HUTCH ENGINEER APPROVAL	E.HAAS	2/28/2011
QA APPROVAL (BAM APPROVAL)	J.SPENCER B.HOEY	2/28/2011 2/28/2011

PHOTON DIVISION
COMMON, HUTCHES
ROOF LABYRINTH, COMPACT

C (SHEET SIZE)	PD-COM-HU-1100 (DRAWING/PART NUMBER)	A (REVISION)

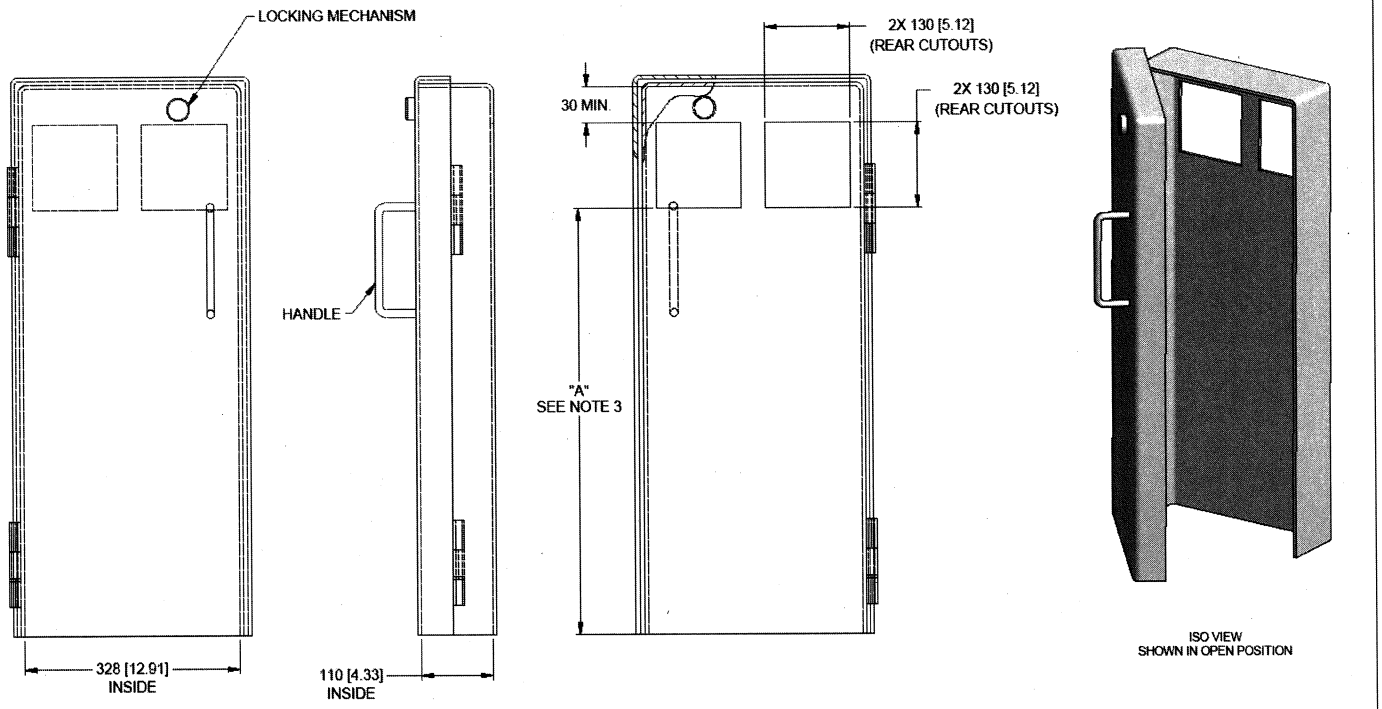
NEXT ASSY: MULTIPLE USAGE
PROJECT: NSLSII HUTCHES
WBS# 1.04.05
ESH&Q RISK LEVEL A-2
SHEET 1 OF 1

C:\MECH-Eng\LTYPDCOM\HU\PD-COM-HU-1100.idw

Conceptual Wall Labyrinth Design, Drawing PD-COM-HU-1003

(may be used as a "User labyrinth" & for LN_2, etc.)

REVISION HISTORY					
REV	DESCRIPTION	DATE	DESIGNER	CHECKED BY	ENGINEER
A	INITIAL RELEASE	2/28/2011	B. MULLANY	C.AMARITO	CARLUCCI-DAYTON



NOTES:

1. THIS DRAWING SHOWS A CONCEPTUAL DESIGN OF A WALL LABYRINTH.
2. MATERIAL TYPE (STEEL OR LEAD/STEEL) AND THICKNESS TO BE IDENTICAL TO THE SPECIFICATIONS FOR THE PANEL ON WHICH IT IS ATTACHED.
3. DIMENSION "A" TO BE 390 mm IF LABYRINTH IS INSTALLED ON BOTH SIDES OF HUTCH PANEL, OR 650mm IF INSTALLED ON THE OUTSIDE OF HUTCH PANEL.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN BRACKETS [xx.xx] ARE INCHES AND ARE FOR REFERENCE ONLY
INTERPRET DRAWING AS PER ASME Y14.5-1994 OR Y12.3-1975
DIMENSIONAL TOLERANCES: X. ± 1.500; .X ± 0.750; .XX ± 0.400; .XXX ± 0.120
ANGULAR TOLERANCE: ± .5°
FINISH: 3.2
BREAK EDGES & SHARP CORNERS 0.135 MIN. TO 0.750 MAX

BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES
UPTON, NEW YORK 11973
Exploring Life's Mysteries, Protecting Its Future

NSLSII NATIONAL SYNCHROTRON LIGHT SOURCE II

DRAWN BY	B. MULLANY	2/1/2011
CHECKED BY	C.AMARITO	2/28/2011
RADIATION SAFETY	PK JOB	2/28/2011
ENGINEER	M.CARLUCCI-DAYTON	2/28/2011
INTERFACE & MECHANICAL MGR.	A.BROADBENT	2/28/2011
HUTCH	E.HAAS	2/28/2011
CAD APPROVAL	J.SPENCER	2/28/2011
ESH&Q APPROVAL	E.HOEY	2/28/2011

PHOTON DIVISION
COMMON, HUTCHES
LABYRINTH, WALL

SHEET SIZE: C	DRAWING/PART NUMBER: PD-COM-HU-1003	REVISION: A
ESH&Q RISK LEVEL: A-2	SHEET 1 OF 1	

NEXT ASSY: MULTIPLE USAGE
PROJECT: NSLSII HUTCHES
THIRD ANGLE PROJECTION
SCALE: SEE DWG VIEW
WBS# 1.04.05

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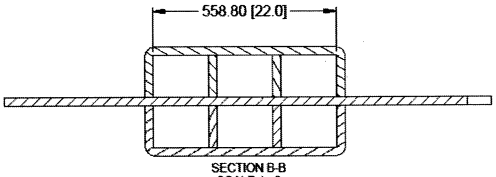
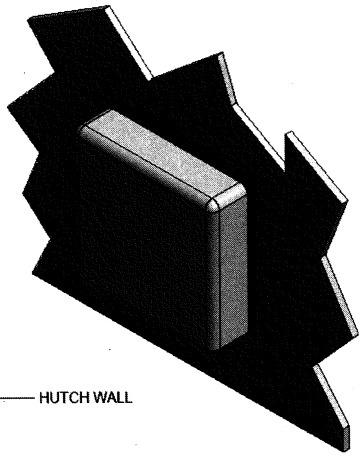
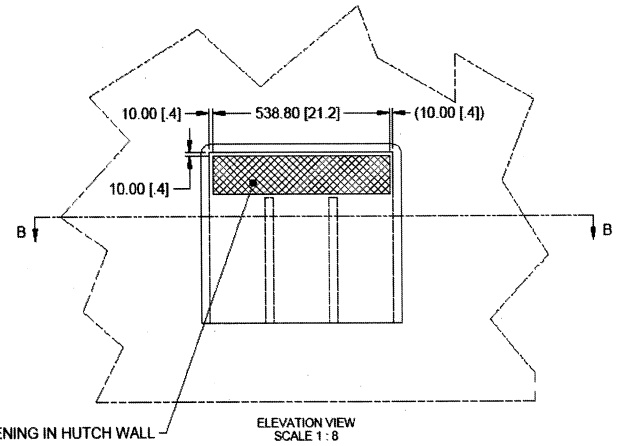
Conceptual Air Outlet Labyrinth Design, Drawing PD-COM-HU-1200

REVISION HISTORY					
REV	DESCRIPTION	DATE	DESIGNER	CHECKED B	ENGINEER
A	INITIAL RELEASE	03/01/11	A.DeSantis	C.AMARITO	M.CARLUCCI-DAYTON

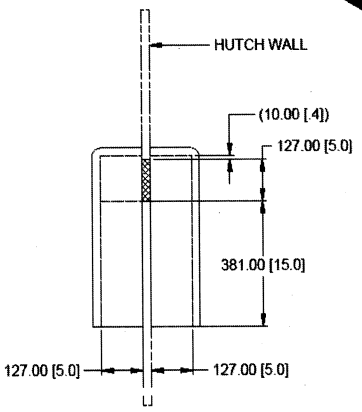


SECTION B-B
SCALE 1 : 8





ELEVATION VIEW
SCALE 1 : 8



NOTES:

1. THIS DRAWING SHOWS A CONCEPTUAL DESIGN OF AN AIR OUTLET LABYRINTH
2. MATERIAL TYPE (STEEL OR LEAD/STEEL) AND THICKNESS TO BE IDENTICAL TO THE SPECIFICATIONS FOR THE PANEL ON WHICH IT IS ATTACHED.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN BRACKETS [xx.x] ARE PRESENT) ARE INCHES AND ARE FOR REFERENCE ONLY
INTERPRET DRAWING AS PER ASME Y14.5-1994 OR Y32.3-1975
DIMENSIONAL TOLERANCES: X ± 1.500, .X ± 0.750, .XX ± 0.400, .XXX ± 0.120
ANGULAR TOLERANCE: ± .5°
FINISH: 3.2
BREAK EDGES & SHARP CORNERS 0.120 MIN. TO 0.760 MAX.

BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES LLC
UPTON, NEW YORK 11973
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Benefiting Its Future

NSLS II
NATIONAL SYNCHROTRON LIGHT SOURCE II

DRAWN BY	A.DeSantis	2/11/2011
CHECKED BY	C.AMARITO	02/16/11
ESH&Q COMPLIANCE	P.K. JOB	02/15/11
Engineer APPROVAL	M.CARLUCCI-DAYTON	02/15/11
INTERFACE & BEAMLINE MGR.	A.BROADBENT	02/16/11
HUTCH MECH APPROVAL	E.HAAS	02/28/11
ESH&Q APPROVAL	T.KOSY	02/28/11
QA APPROVAL	J.DYER	03/01/11

PHOTON DIVISION
COMMON, HUTCHES
AIR OUTLET LABYRINTH

C | PD-COM-HU-1200 | A
SHEET SIZE | DRAWING/PART NUMBER | REVISION

NEXT ASSY:
PROJECT: NSLS II
THIRD ANGLE PROJECTION
SCALE: SEE DWG VIEW
WBS# 1.04.05
ESH&Q RISK LEVEL A2
SHEET 1 OF 1

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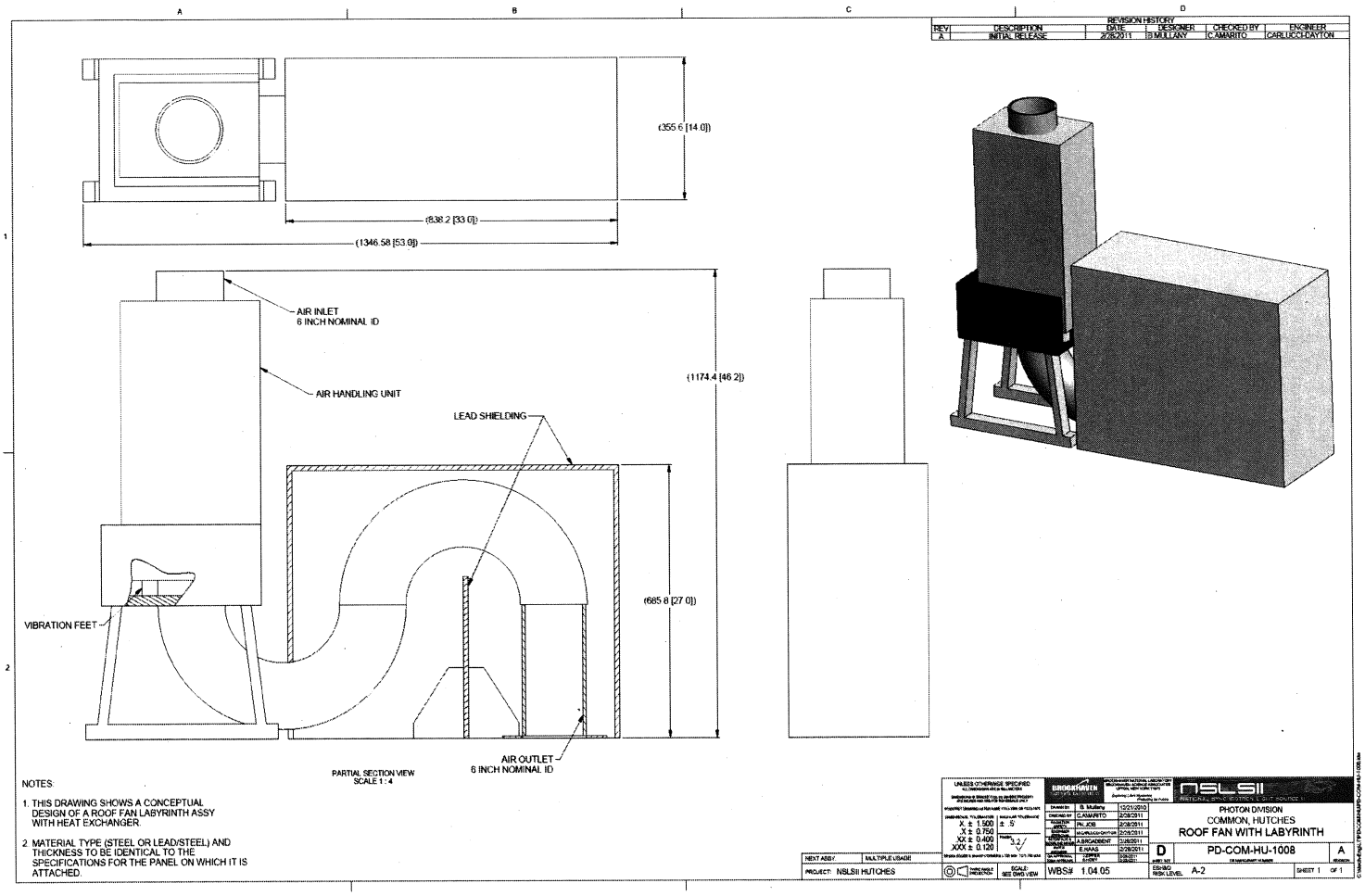
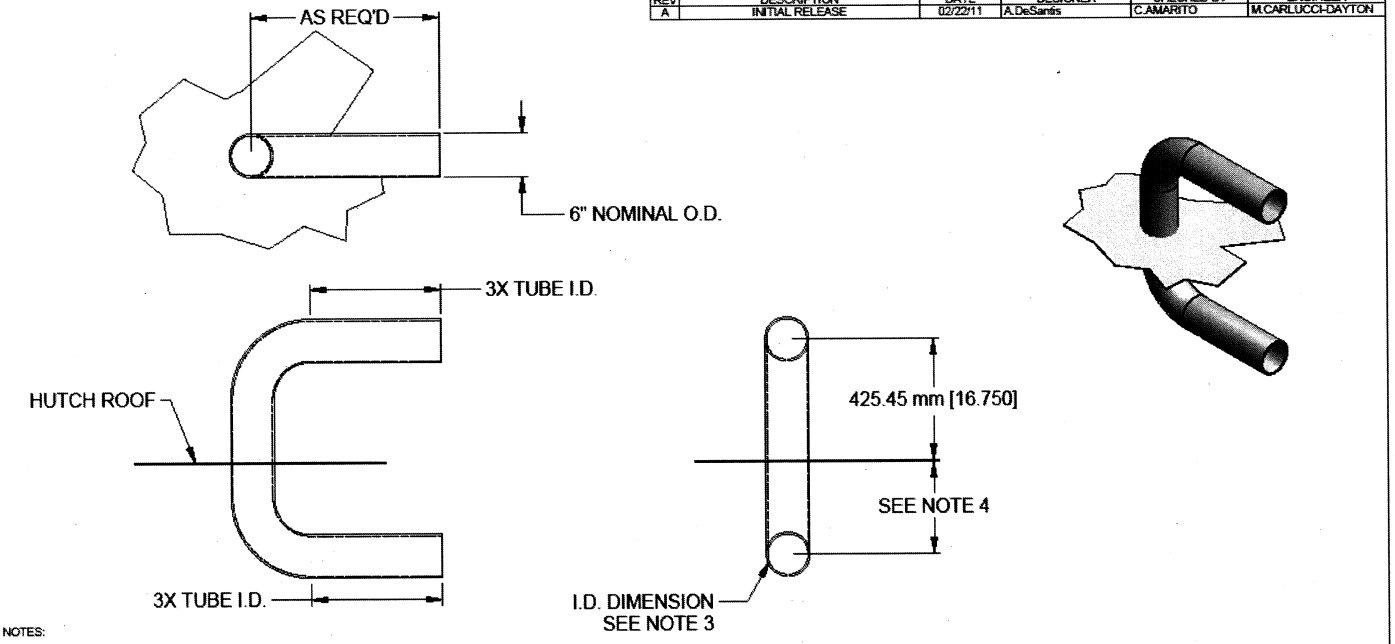
Conceptual Air Inlet Labyrinth Design, Drawing PD-COM-HU-1008



Conceptual Roof Exhaust Labyrinth Design, Drawing PD-COM-HU-1009

REVISION HISTORY					
REV	DESCRIPTION	DATE	DESIGNER	CHECKED BY	ENGINEER
A	INITIAL RELEASE	02/22/11	A.DeSantis	C.AMARITO	M.CARLUCCI-DAYTON



NOTES:

1. THIS DRAWING SHOWS A CONCEPTUAL DESIGN OF A ROOF EXHAUST LABYRINTH .
2. MATERIAL TYPE (STEEL OR LEAD/STEEL, AND THICKNESS TO BE IDENTICAL TO THE SPECIFICATIONS FOR THE PANEL WHICH IT IS ATTACHED.
3. TUBE WALL THICKNESS TO BE ≥ HUTCH ROOF THICKNESS
4. MINIMUM LENGTH COMMENSURATE WITH SMOOTH PIPE BEND RADIUS DEPENDENT ON MANUFACTURING TECHNIQUE.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS IN BRACKETS [xx.xx] (WHERE PRESENT) ARE MILLIMETERS AND ARE FOR REFERENCE ONLY
INTERPRET DRAWING AS PER ASME Y14.5-1994 OR Y32.2-1975
DIMENSIONAL TOLERANCES: X. ± 0.060, .X ± 0.030, .XX ± 0.015, .XXX ± 0.005
ANGULAR TOLERANCE: ± .5°
FINISH: 125
BREAK EDGES & SHARP CORNERS 0.005 MIN. TO 0.030 MAX.

BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES
UPTON, NEW YORK 11973
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NSLS II NATIONAL SYNCHROTRON LIGHT SOURCE II

DRAWN BY	A.DeSantis	1/21/2011
CHECKED BY	C.AMARITO	02/10/11
ESH&Q CONST/RAD	P.K. JOB	02/15/11
ENGINEER APPROVAL	M.CARLUCCI-DAYTON	02/04/11
INTERFACE & BEAMLINE MGR.	A.BROADBENT	02/11/11
HUTCH MECH APPROVAL	E.HAAS	02/14/11
ESH+ APPROVAL	S.HOBY	02/22/11
QA APPROVAL	J. ZIPPER	02/17/11

PHOTON DIVISION
COMMON,HUTCHES
ROOF EXHAUST LABYRINTH

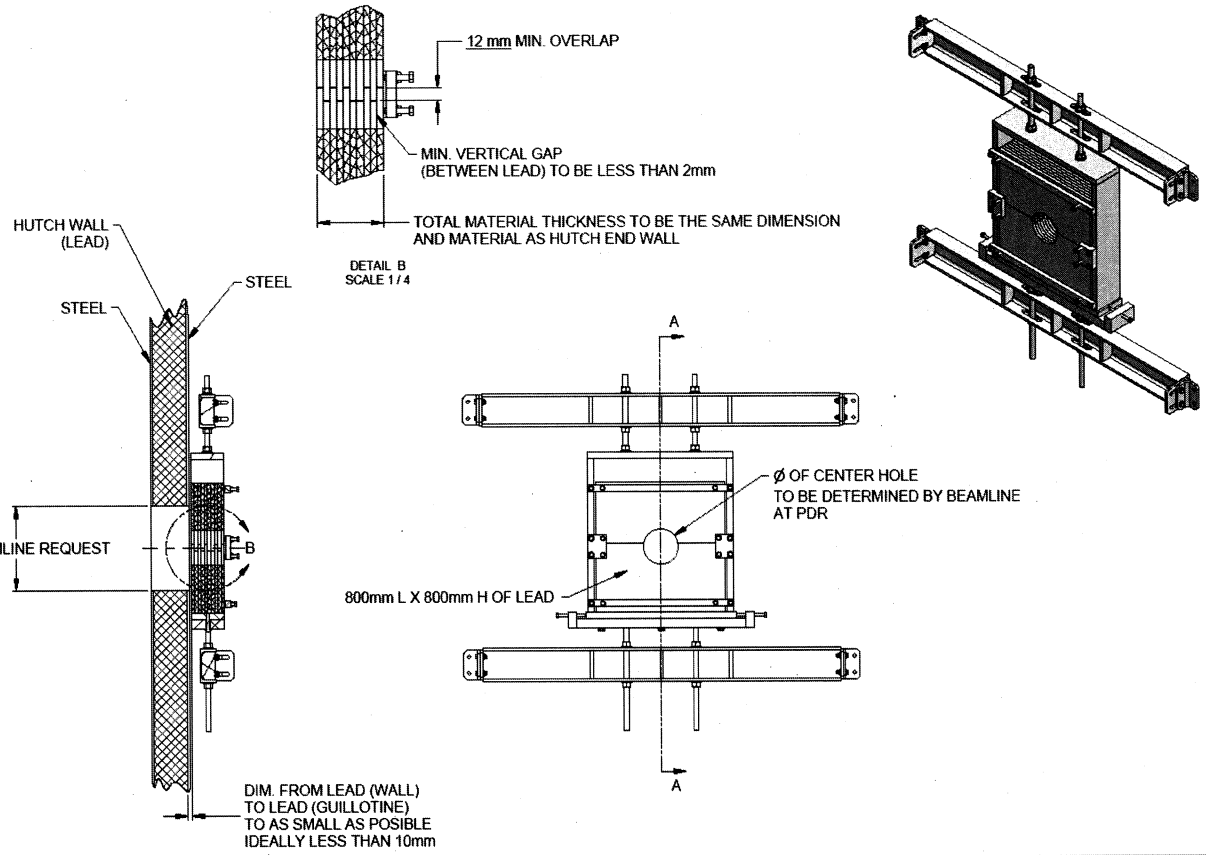
B (SHEET SIZE) | PD-COM-HU-1009 (DRAWING/PART NUMBER) | A (REVISION)

NEXT ASSY:
PROJECT: NSLS II
THIRD ANGLE PROJECTION
SCALE: SEE DWG VIEW
WBS# 1.04.05
ESH&Q RISK LEVEL A-2
SHEET 1 OF 1

C:\Mech-Engr\LTPD\COM\HU\PD-COM-HU-1009.idw

Conceptual Guillotine Design, Drawing PD-HU-COM-1300

REVISION HISTORY					
REV	DESCRIPTION	DATE	DESIGNER	CHECKED BY	ENGINEER
A	INITIAL RELEASE	2/28/2011	B. Mullany	C.AMARITO	CARLUCCI-DAYTON



NOTES:

1. THIS DRAWING SHOWS A CONCEPTUAL DESIGN OF A GUILLOTINE.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN BRACKETS [xx.xx] ARE FOR REFERENCE ONLY
INTERPRET DRAWING AS PER ASME Y14.5-1994 OR Y32.3-1975
DIMENSIONAL TOLERANCES: X. ± 1.500, .X ± 0.750, .XX ± 0.400, .XXX ± 0.120
ANGULAR TOLERANCE: ± .5°
Finish: 3.2
BREAK EDGES & SHARP CORNERS 0.120 MIN. TO 0.750 MAX.

BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES UPTON, NEW YORK 11973
Exploring Life's Mysteries, Protecting Its Future

DRAWN BY	B. Mullany	2/2/2011
CHECKED BY	C.AMARITO	2/28/2011
RADIATION SAFETY	PK.JOB	2/28/2011
ENGINEER RESPONSIBLE	M.CARLUCCI-DAYTON	2/28/2011
INTERFACE & BEAMLINE MNGR.	A.BROADBENT	2/28/2011
PROJECT MANAGER	E.HAAS	2/28/2011
QA APPROVAL	J.SIPPER	2/28/2011
ESH APPROVAL	E.HOEY	2/28/2011

NSLSII NATIONAL SYNCHROTRON LIGHT SOURCE II

PHOTON DIVISION
COMMON, HUTCHES
GUILLOTINE

C | PD-COM-HU-1300 | A
SHEET SIZE | DRAWING/PART NUMBER | REVISION

ES&H&Q RISK LEVEL: A-2
SHEET 1 OF 1

NEXT ASSY: | MULTIPLE USAGE
PROJECT: NSLSII HUTCHES
THIRD ANGLE PROJECTION
SCALE: SEE DWG VIEW
WBS# 1.04.05

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APPENDIX 4 NSLS-II DRAWINGS AND INTERFACE REQUIREMENTS

[See fold-out drawings]

Drawing Number	Drawing Title
PD-HXN-HU-1000	HXN BEAMLINE; HUTCH LAYOUT
PD-HXN-HU-1210	HXN BEAMLINE; HUTCH 3-ID-B PROCUREMENT ASSY
PD-HXN-HU-1310	HXN BEAMLINE; HUTCH 3-ID-C PROCUREMENT ASSY
PD-SRX-HU-1000	SRX BEAMLINE; HUTCH LAYOUT
PD-SRX-HU-1210	SRX BEAMLINE; HUTCH 5-ID-B PROCUREMENT ASSY
PD-SRX-HU-1310	SRX BEAMLINE; HUTCH 5-ID-C PROCUREMENT ASSY
PD-SRX-HU-1410	SRX BEAMLINE; HUTCH 5-ID-D PROCUREMENT ASSY
PD-IXS-HU-1000	IXS BEAMLINE; HUTCH LAYOUT
PD-IXS-HU-1210	IXS BEAMLINE; HUTCH 10-ID-B PROCUREMENT ASSY
PD-IXS-HU-1310	IXS BEAMLINE; HUTCH 10-ID-C PROCUREMENT ASSY
PD-IXS-HU-1410	IXS BEAMLINE; HUTCH 10-ID-D PROCUREMENT ASSY
PD-CHX-HU-1000	CHX BEAMLINE; HUTCH LAYOUT
PD-CHX-HU-1210	CHX BEAMLINE; HUTCH 11-ID-B PROCUREMENT ASSY
PD-COM-HU-2100	COMMON, HUTCHES; GUILLOTINE, DOUBLE