SNS INSTRUMENTS
NEXT GENERATION – (SING)

SYSTEM REQUIREMENTS
Beamline 14B External Building
Document Number
SING14B-80-SR0001-R00B

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Beamline 14B External Building

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System Requirements for Beamline 14B External Building		Issue Date 01/31/07
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1.0 SCOPE

This document contains the requirements for a building to house the downstream elements of the HYSPEC (Hybrid SPECtrometer) instrument to be located on the SNS beamline 14B.

2.0 RELATED DOCUMENTS

The following drawing is provided to illustrate the end use of the HYSPEC External Building:

SING14B-80-G8U-8714-A001
Spallation Neutron Source
SING Beamline 14B Infrastructure
External Building Planning Layout

The scope of this drawing extends beyond the system requirements of this document and is provided to aid in understanding the HYSPEC External Building and its associated neutron scattering instrumentation, however **only this document shall define the External Building requirements.**

3.0 INTRODUCTION

The Spallation Neutron Source (SNS) is a neutron scattering facility operating in Oak Ridge National Laboratory, in Oak Ridge, TN. At the heart of the SNS is the High Power Target Station which provides pulsed neutron beams to up to 24 different beamlines resulting in a wide range of beam facilities for experimenters to conduct research. Figure 1 shows the Target Building at the SNS site, and additional general information about the SNS can be accessed at: http://www.sns.gov.

HYSPEC (**HY**brid **SPEC**trometer) is a neutron scattering instrument which is located on beamline 14B of the SNS. A schematic view of the beamline is shown in Figure 2. Neutrons from a cryogenic hydrogen moderator, located next to the target, are transported through the primary beamline to focusing crystals located approximately 128 ft. (39 meters) from the moderator.

As shown in Figure 2, the required length of the primary beamline exceeds the width of the Target building, therefore elements at the downstream end of this beamline are housed in a separate building.

A conceptual model of the HYSPEC External Building is shown in Figures 3a, 3b and 3c.

Figure 1 – Aerial view of the SNS site showing the Target Building

4.0 BUILDING REQUIREMENTS

The HYSPEC External Building shall be designed and constructed to provide for flexibility, versatility, durability, and longevity. Construction materials and technology shall be used that will provide structures with a lifetime of thirty years without major renovation.

Sustainable building design principles shall be evaluated and cost effective features applied to the design and construction of the HYSPEC External Building. Standard practices, which include using recycled content products, purchasing energy efficient and water efficient material and equipment (Energy Star) and substituting less hazardous construction materials, shall be used where economically feasible.

All design and construction requirements and activities shall be in compliance with the ORNL Work Smart Standards.

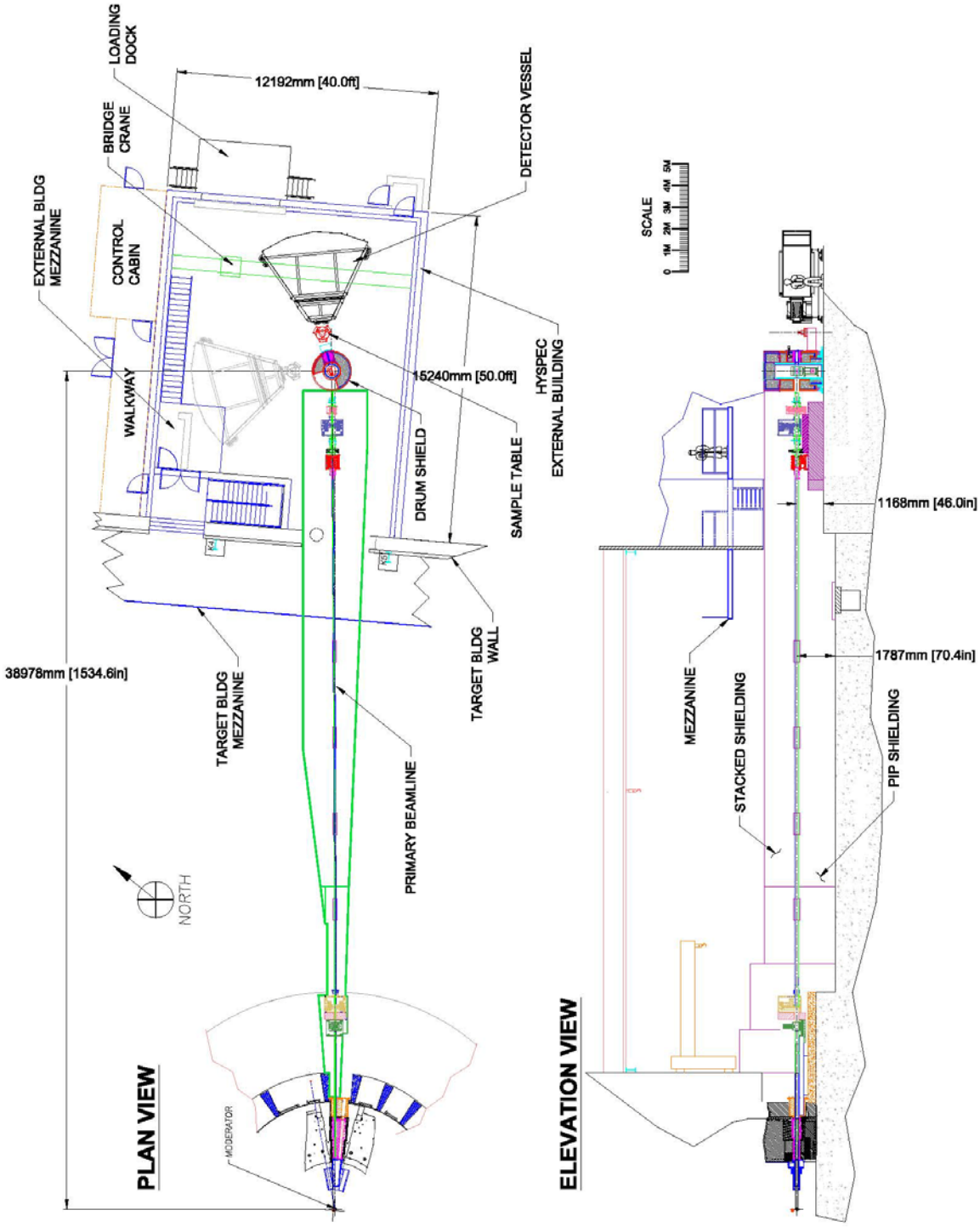

Figure 2 Schematic View of HYSPEC Beamline

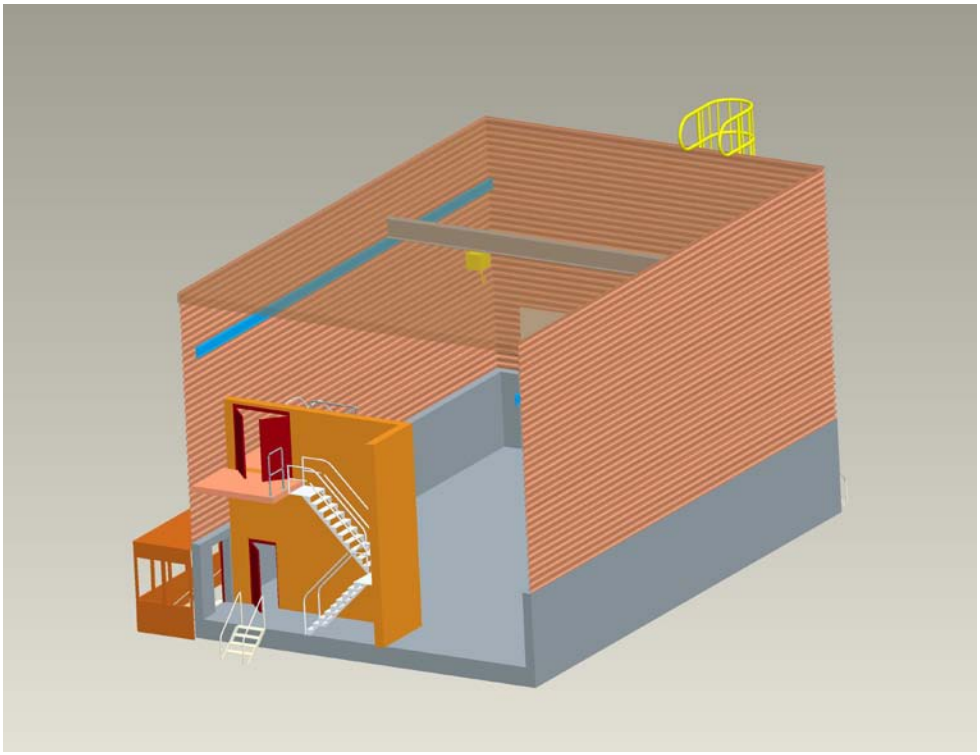

Figure 3a – HYSPEC External Building showing open side that attaches to SNS Target Building

Figure 3b – HYSPEC External Building showing attached Control Cabin and Walkway

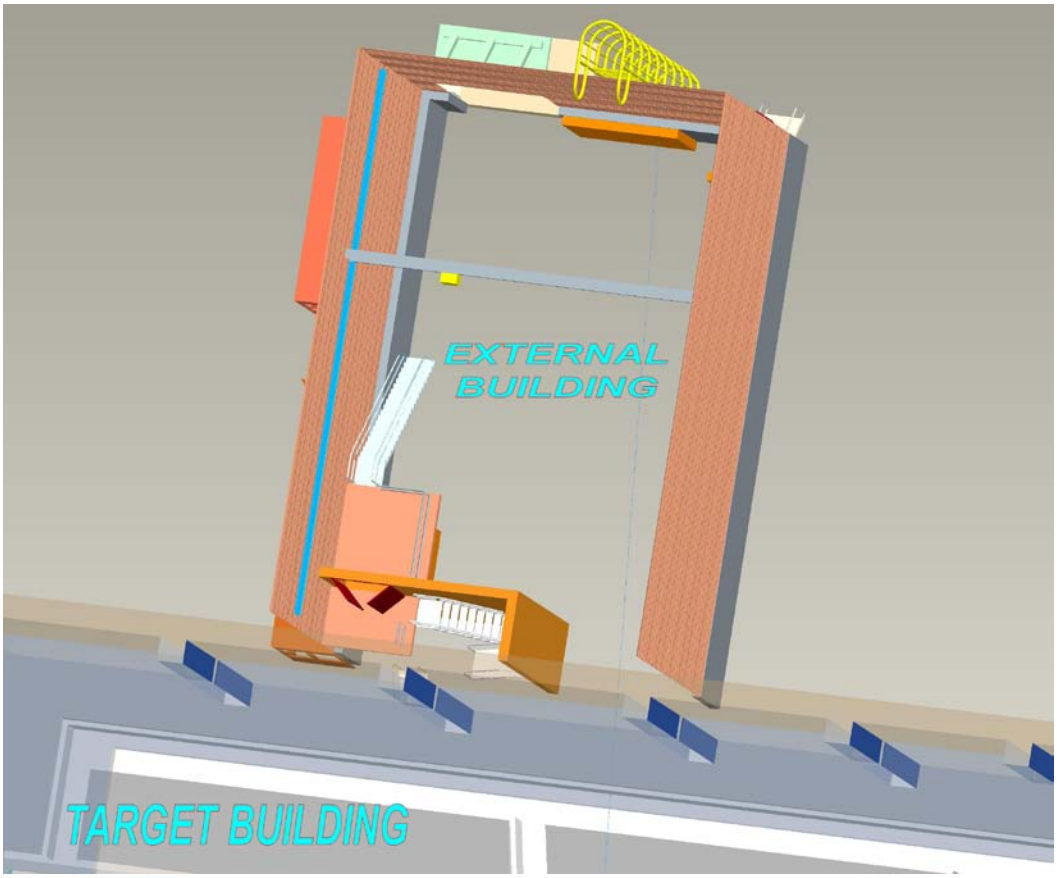

Figure 3c – Plan view of HYSPEC External Building Model

4.1 GENERAL

- The building shall be located adjacent to the SNS Target Building, on its north side as shown in Figure 4. It shall meet the dimensions and other requirements of Figure 5. Exterior siding, glazing and roofing material shall closely match or compliment those of the Target Building. Additionally, the building shall have, where practical, fixed windows to permit natural lighting of the interior.
- Design and construction shall meet all of the requirements of SNS Document 108000000-ST0003, *Conventional Facilities Design and Construction Requirements for Instrument Development Teams (IDTs)*, latest revision, and all standards and requirements documents referenced therein.
- The minimum total square footage shall be 2000 sq. ft.
- The building height is anticipated to be approximately 40 feet. The height shall be the minimum possible while providing the minimum crane hook height as defined in Section 4.4.4 and the necessary roof support structure to support HVAC and other required equipment loads.

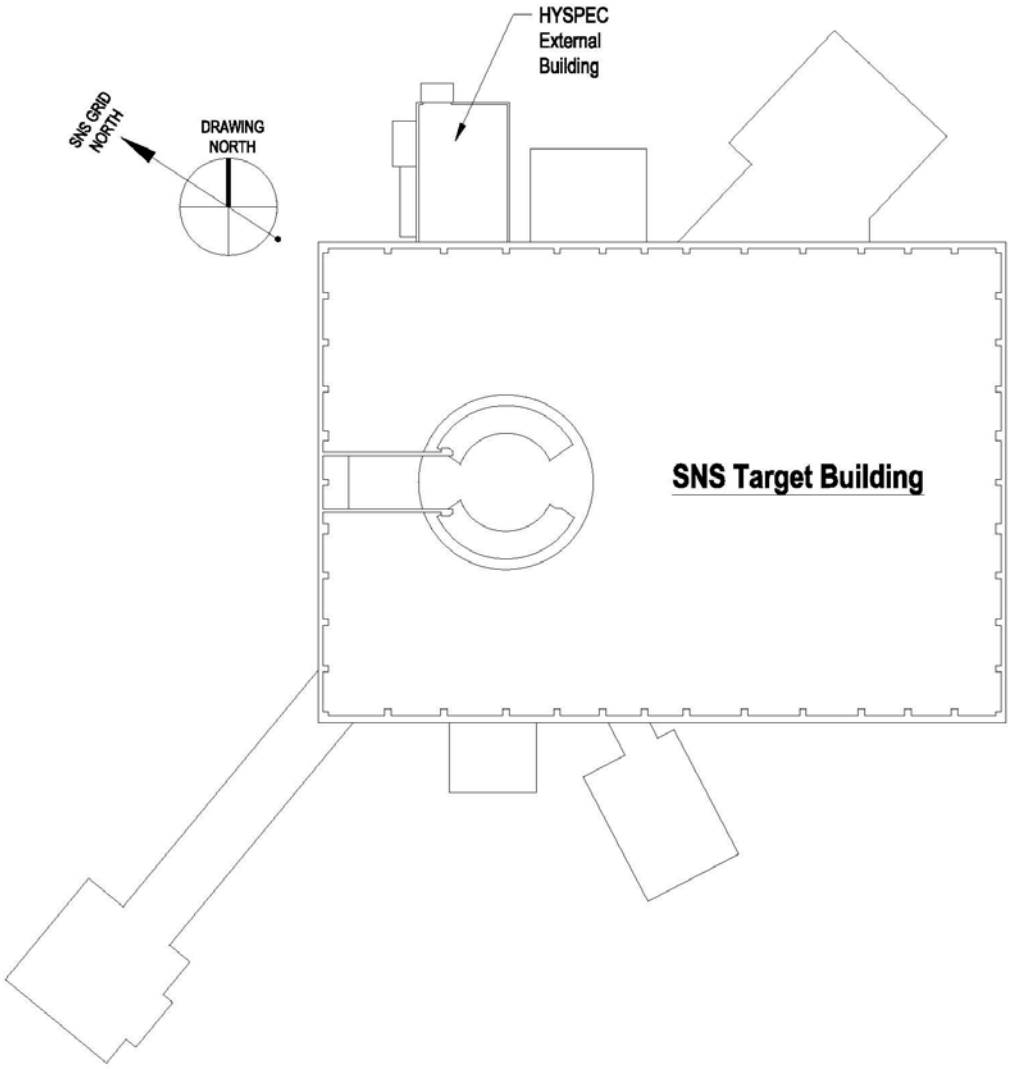

Figure 4 – HYSPEC External Building showing attached Control Cabin and Walkway

- Separate, suitably supported floor sections shall be provided to support:
    1. The neutron guide extension from the Target Building
    2. The drum shield area
    3. The precision floor area
    4. The remaining general floor area

  These areas are shown on the drawing and described in more detail later in this document.
- Doorways shall be provided as shown in Figure 5. All doorways connecting with the sample enclosure area shall be interlocked. The double wide doorway connecting the Target Building mezzanine to the External Building mezzanine shall be a minimum of 96 inches high.

- The building shall have a loading dock on the north wall as shown in Figure 5. Additionally, the building shall have an electrically-operated roll up door, at the loading dock, with minimum dimensions of 12 ft wide by 16 ft high to permit the receipt of material and equipment via fork truck.
- A storage area for six gas cylinders shall be located adjacent to the roll-up door on the loading dock.
- There shall be an access road connecting the external building to the SNS road system. The approximate location of this road is shown in Figure 6. The road shall be gravel and match existing SNS gravel road design requirements.
- There shall be parking for a minimum of six vehicles near the external building.

4.2 FLOOR & FOUNDATION REQUIREMENTS

The use of heavy equipment and concrete shielding around the instrument requires that portions of the building floor be able to support large loads. In particular, HYSPEC will use a device called a *drum shield* that exerts a significant load on the floor. The precise placement of the drum shield is critical to the assembly of the HYSPEC instrument; therefore the location of the drum shield floor area is specified in Figure 7 relative to the target in the SNS Target Building. Other high load floor areas are then shown relative to the drum shield floor area in Figures 8a, 8b and 8c.

Floor/foundation construction shall be concrete slab-on-grade of sufficient thickness, reinforcement and bearing area to eliminate any post-construction settling which is required for successful operation of the experiments. The floor and foundation of this building must operate independently of the Target Building and not interact with it during a seismic event.

Specific floor requirements are as follows:

- All floor areas shall have their surface 46.0 inches below the Beamline 14 horizontal beamline elevation. These floor areas then shall be approximately 24.4 inches above the target Building floor. General floor loading for these areas shall be 500 psf, except under the drum shield (Fig 8a) which shall be 3600 psf and under the beamline shielding (Fig. 8b) which shall be 1500 psf. **The drum shield and beamline shielding are NOT part of this requirements document.**
- There will be a precision floor in the area marked in Figure 8c. **The precision floor is NOT part of this requirements document.** There shall be a sub-floor under the precision floor that shall be level (no drain slope) and free of any floor drains. **This sub-floor IS part of this requirements document.**

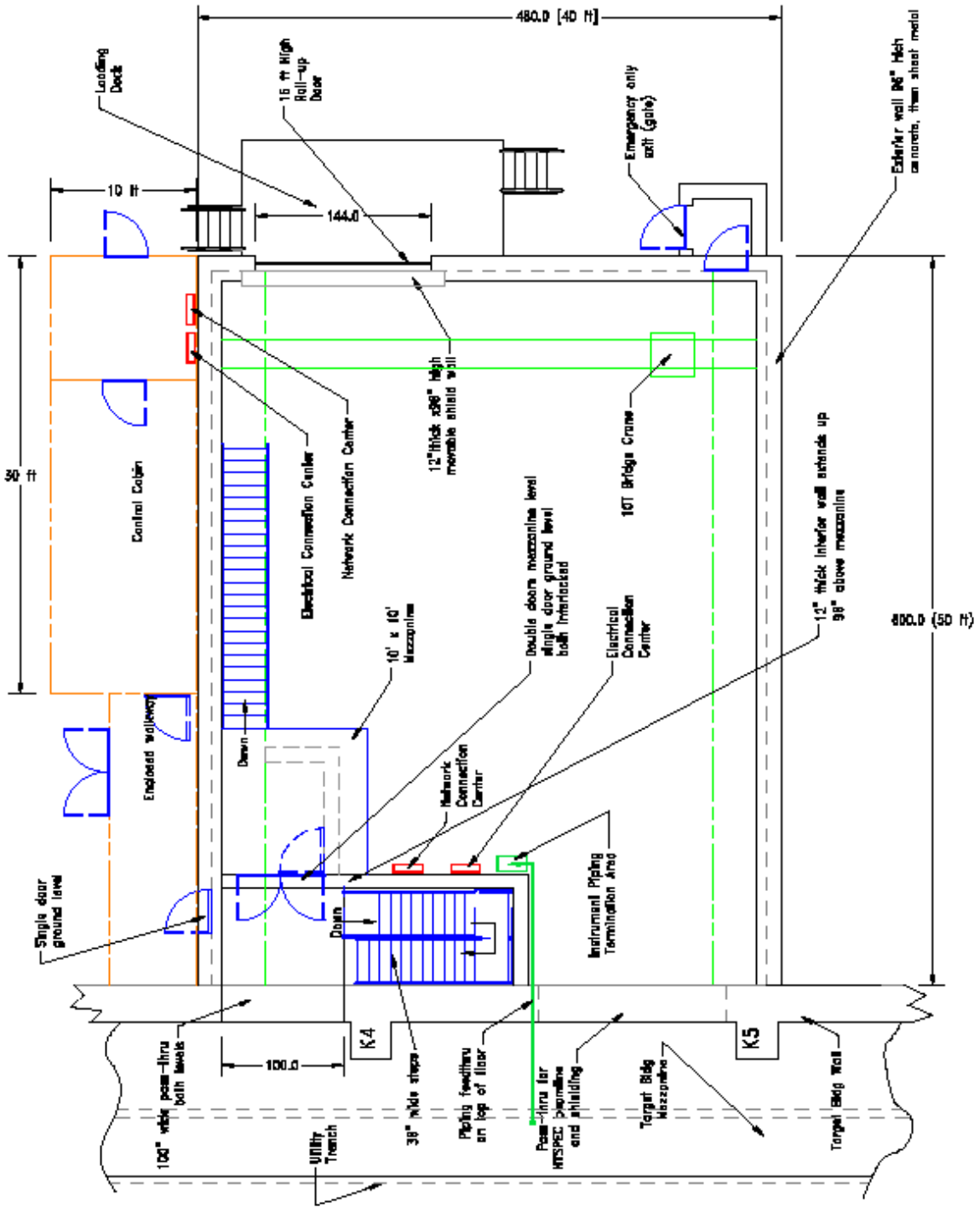

Figure 5 – HYSPEC External Building configuration with key dimensions

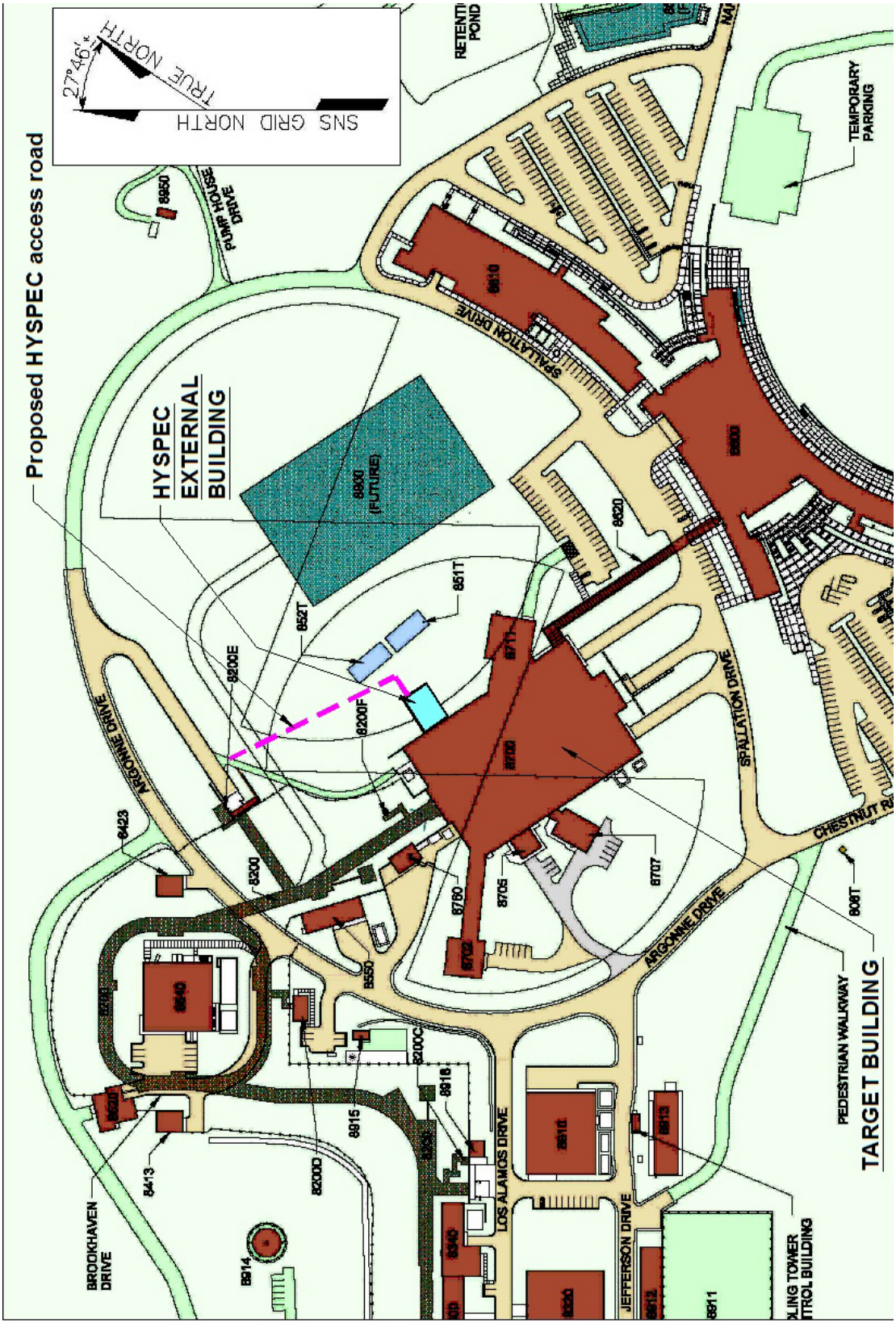

Figure 6 – HYSPEC External Building Access Road Location

- There shall be a mezzanine connecting with and at the same absolute elevation as the mezzanine in the Target Building. The allowable floor loading of the mezzanine shall be a minimum of 150 psf. This mezzanine shall have safety railing as required to protect personnel. The railing shall be easily removable to facilitate rigging activities on and off the mezzanine. There shall be stairs connecting this mezzanine to the External Building ground floor.
- Exterior wall footings shall be provided as required to support the additional building wall requirements defined in section 4.3.

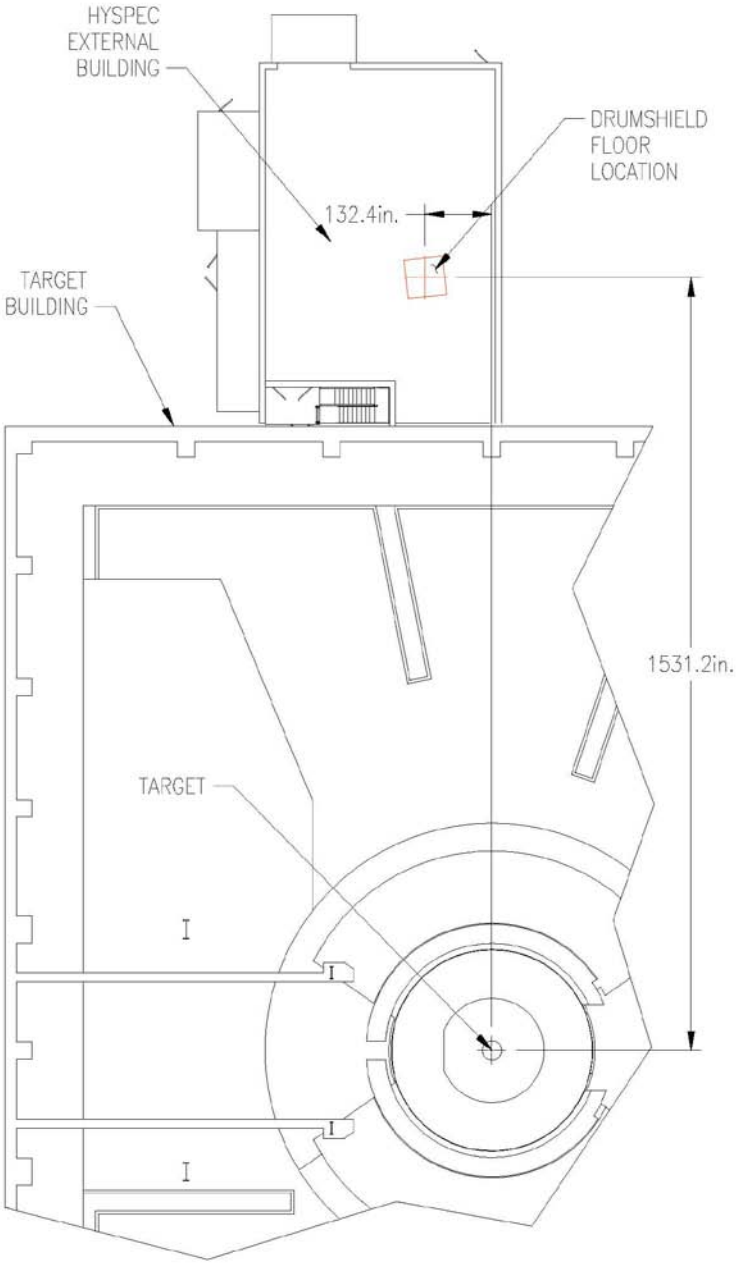

Figure 7 – HYSPEC External Building showing location of drum shield floor area relative to SNS Target

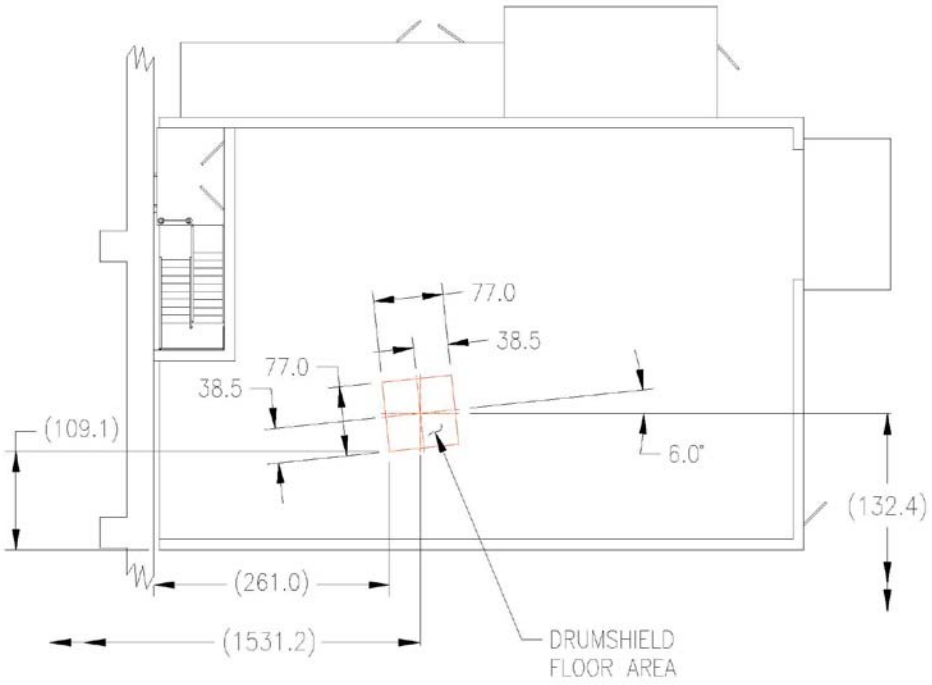

Figure 8a – Drum Shield Floor Area

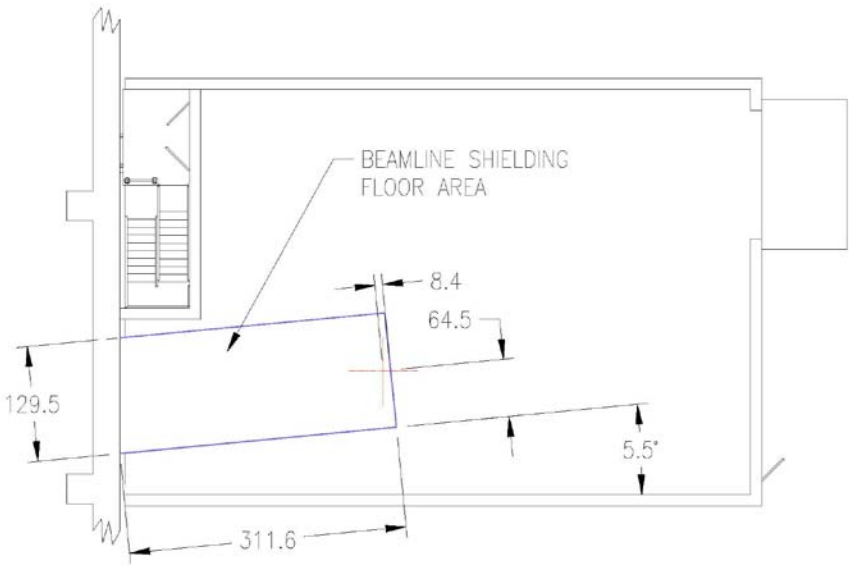

Figure 8b – Beamline Shielding Floor Area

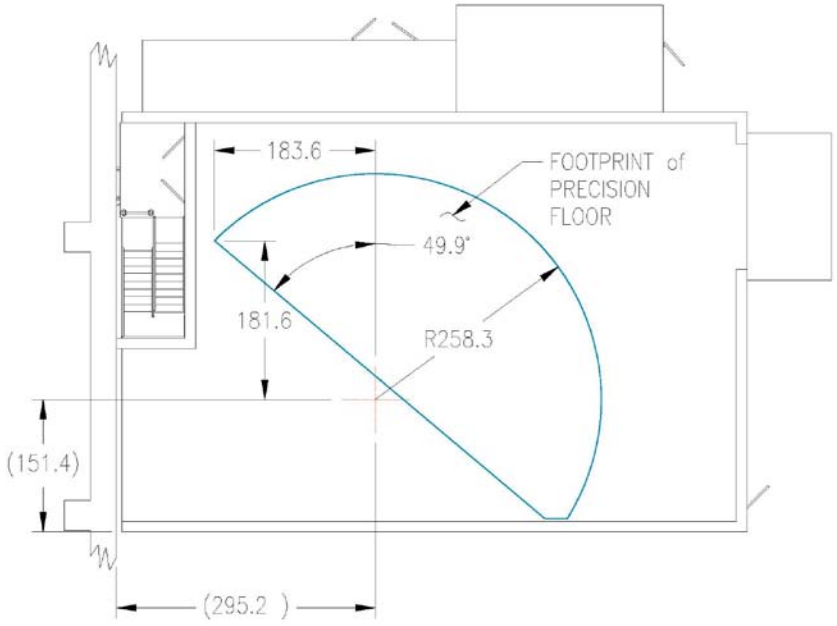

Figure 8c – Precision Floor Area

4.3 ADDITIONAL BUILDING WALL REQUIREMENTS

The instrument to be located in the HYSPEC External Building will be enclosed by, and interlocked inside, the building itself. As part of this enclosure of the instrument, it is required that there be a 12” thick concrete wall, 8ft tall (measured from the floor of the external building) that follows the internal perimeter of the building. Around the stairwell this wall should extend upwards for the height of the stairwell (as illustrated in Figure 3a). At the ground floor level the two doorways that penetrate through this concrete wall should have a labyrinth wall to block “line-of-sight” access to the sample area (as illustrated in Figure 5). At the position of the roll-up door in the external building the concrete wall should have a movable section to allow access through the roll-up door. This section shall be movable either by sliding to the side or by being lifted above the roll-up door opening. Apart from extending around the stairwell this concrete wall should not cover the face of the building that attaches to the target building (as illustrated in Figures 3a and 3c).

It is preferable that where practical this perimeter/enclosure wall should be incorporated in the external building wall. If this is not possible then the appropriate flooring loading and attachment points for the concrete perimeter wall must be made to the external building wall.

4.4 UTILITIES

4.4.1 Electrical Power and Communication Systems

The requirements for electrical power and communication systems are as follows:

Electric Power

- Power shall be supplied to the Beamline 14B External Building from existing 480 volt, 3 phase, 4 wire Power Distribution Panels located on the mezzanine of the Target Building, just west of column K5.
- The electric service shall be connected to electric connection centers as shown in Figure 5.
- Building electrical power distribution systems shall be provided to receive electrical power from the target building electrical distribution panels and supply the maximum design facility electrical load. The following electrical distribution equipment is anticipated:
    - 480Y/277 Volt, 3 phase, 4 wire, 100 amp Power Distribution Panel
    - 75 kVA 480-208Y/120 volt 3 phase transformer
    - 208Y/120 volt 3 phase, 4 wire, 250 amp Power Distribution Panel
    - 30 kVA 480-208Y/120 volt, 3 phase transformer (clean power)
    - 208Y/120 volt 3 phase, 4 wire, 100 amp Power Distribution Panel (clean power)
- 120VAC convenience outlets shall be located all around the building inside wall no more than 6 ft. on center and 4 ft. above the building floor.

Lighting

- Provide the necessary illumination of facility components, facilities, and control locations of a quantity and quality adequate to permit satisfactory performance of the required visual tasks. The lighting levels in each area shall be in accordance with IESNA Lighting Handbook.
- Provide emergency lighting systems and exit signs for egress lighting during building power outages. The emergency lights and the exit signs shall be connected to an existing emergency lighting circuit in the Target Building. This circuit is backed up by a generator; therefore, no battery back up is required for the light fixtures or signs.
- Provide outside lighting adequate for safe visual nighttime egress from building exits and in parking areas.
- Metal Halide HID light fixtures shall be utilized for general lighting inside the building and on the exterior. Fluorescent light fixtures shall be used in office areas and for task lighting.

Grounding and Electrical Protection

- A lightning protection system shall be provided for the building and shall comply with NFPA 780.

- Effective grounding of systems and equipment shall be provided to ensure personnel safety and equipment protection.

Raceway System

- Provide for routing of feeders to all facility loads through cable tray and/or conduit.
- Provide separated raceways for signal and power wiring.

Fire Alarm System

- Provide a fire detection and alarm system for the facility that is compatible with SNS systems and requirements.

Electrical Power, Control, Instrumentation and Communications Systems Cabling Requirements

- Provide wiring for all conventional facility power loads and control devices.

Telecommunications Systems

- Provide the necessary equipment and cabling to support basic telephone communication throughout the building. Three phone connections are required, one each next to each pedestrian door.
- Provide a connection with the ORNL emergency public address system and install speakers to allow adequate coverage of the entire external building and control cabin.
- Provide two network connection centers with the option of connecting individual network cable connections as needed. The locations are shown in Figure 5. Conduit shall be installed to allow future installation of network cables. The network cable installation is not part of this requirements document. The conduit shall run from network connection centers to the Target Building Ethernet system located on the Target Building mezzanine just east of the K4 column.

4.4.2 Mechanical/Piping Systems

- All piping connections shall be made to the appropriate piping system “stub-offs” located in the utility trench parallel to and approximately 10 feet from the Target Building’s north wall. Piping for the instrument utilities shall terminate in the External Building “instrument piping termination area” as shown in Figure 5.
- A chilled water system shall be supplied from the Target Building system and shall provide chilled water at sufficient flow, pressure, and temperature to service the building HVAC system and the experiment chilled water cooled equipment. The instrument chilled water heat load is expected to be below 5 kW as shown in Table 1.

- A compressed air system shall be supplied from the Target Building system and provide pressurized, clean, dry, oil-free air at a minimum of 100 psig at the building utility station. It is anticipate that the air pad system will be supplied by this compressed air system. Air pad requirements are expected to be less than 2.0 scfm @ 60 psig.
- Floor drains shall be routed to the building sump.
- A sprinkler system shall be provided for fire safety.
- An argon recovery line shall be provided to capture vented argon from the beamline's detector vessel and discharge it through the secondary off-gas system.

4.4.3 Environmental Control Systems

- HVAC shall be provided using chilled and heated water from the Target Building. The inside temperature in the External Building shall be maintained between 65ºF and 75ºF.
- Ancillary equipment, such as pumps, blowers, motors, compressors, gear trains, and controls shall be located to minimize noise and vibration transmission. The external building roof is available for HVAC equipment installation.
- Outside air shall be introduced as necessary to meet the minimum requirements for acceptable air quality per ASHRAE Standard 62 or as required to meet exhaust requirements, whichever is greater.
- Energy conserving design practices shall be used to the extent allowed by the environmental control tolerances required.

4.4.4 Bridge Crane

The building shall have an overhead bridge crane with a 10 ton capacity. The bridge shall travel north-south in the building and the crane travel limits shall afford access to the secondary shutter (located 114 ft. [34.7m] from the moderator), equipment brought to the external building mezzanine and equipment brought into the building through the roll-up door. The crane hook height shall be a minimum of 30 ft. above the external building floor.

The crane shall include electrical power distribution for movement of crane (i.e., bus rail, festoon, etc.). The crane shall also include control pendant or wireless controls for operation of the crane.

4.5 SEISMIC REQUIREMENTS

The HYSPEC External Building shall be seismically designed per IBC 2003 and shall be rated as a PC-2 SSC for structural design purposes. Components (SSCs) of the HYSPEC External Building shall be reviewed and categorized according to DOE 1020-02. The building will join the Target Building with only a flexible "weather' connection and

the design shall ensure that failure of an External Building SSC during a PC-3 event does not adversely impact a Target Building PC-3 SSC (PC-2/PC-3 review).

5.0 CONTROL CABIN

A control cabin shall be located immediately adjacent to the HYSPEC External Building. It is envisioned that this shall be a one story, modular portable building installed on a suitable foundation at ground level and connected to the External and Target Buildings via an enclosed walkway. A schematic of the control cabin is shown in Figure 9.

Control cabin requirements are:

- Minimum area of 10 ft. X 30 ft, including an office area of 10 ft. X 20 ft. and a closable electronic rack room 10 ft. X 10 ft.
- 120 VAC power to run lights and office machines (computers, printers, etc.).
- Heating and cooling for personnel comfort.
- Telecommunications and network connections with the HYSPEC External Building and Target Building.

6.0 INTERFACES

HYSPEC External Building interfaces are as follows:

- Structural – The external building will be structurally a “stand alone” building. Although, its open side will attach to the Target Building, there shall just be a “weather” closure only and the external building will get no structural support from the Target Building, nor impact it in a seismic event.

- All utilities for the external will tie into the existing utility stub-offs assigned to Beamline 14 in the Target Building.

EXTERNAL BUILDING INSTRUMENT HEAT AND POWER LOADS

BEAMLINE 14b (HYSPEC) Hybrid Spectrometer						AIR COOLED EQUIPMENT	CHILLED WATER COOLED EQUIPMENT
Item Description	Quantity	Power Requirement per Unit (KW)	Total Peak Power Requirement (KW)	Duty Cycle (%)	Air Cooled? Yes or no	Average Heat Rejection = Total Power requirement X Duty Cycle (KW)	Average Heat Rejection = Total Power requirement X Duty Cycle (KW)
Chillers	1	2	2	100%	yes	2.0	0.0
Computers & DAS **	3	1	3	100%	yes	3.0	0.0
Crane #1	1	5	5	5%	yes	0.3	0.0
Cave Crane	0		0		yes	0.0	0.0
Detectors (160 tubes, ~ 8HV supplies)	8	0.5	4	100%	yes	4.0	0.0
Disk Chopper (1 disk + 1 Fermi)	2	2	4	100%	yes	4.0	0.0
Furnace or Close Cycle Refrigeration * (Cryomagnet is biggest S.E power drain)	1	3	3	100%	no	0.0	3.0
Lighting	40	0.1	4	100%	yes	4.0	0.0
Secondary Shutter	1	0.5	0.5	5%	yes	0.0	0.0
T0 Chopper	0	2	0	100%	yes	0.0	0.0
Vacuum pump	3	0.5	1.5	100%	yes	1.5	0.0
Hydraulic pump			0		yes	0.0	0.0
Motors for shielding drum/ monochromator hoist	3	0.5	1.5	15%	yes	0.2	0.0
Motors for sample & monochromator goniometers	21	0.2	4.2	15%	yes	0.6	0.0
Air Pad Compressor	1	10	10	15%	yes	1.5	0.0
Other			0		yes	0.0	0.0
Other			0		yes	0.0	0.0
Other			0		yes	0.0	0.0
Other			0		yes	0.0	0.0
TOTAL			**42.7 KW**			**21.1 KW**	**3.0 KW**
* Enter values for equipment requiring the largest loads unless they are used simultaneous							

Approved by : **Bill Leonhardt** Date: **08-23-2007**

Comments: 1 KW = 3414 Btu/hr. 1 hp = 0.746 kw.

** Items located in Control Cabin

Table 1 – Beamline 14B Instrument Heat and Power Loads

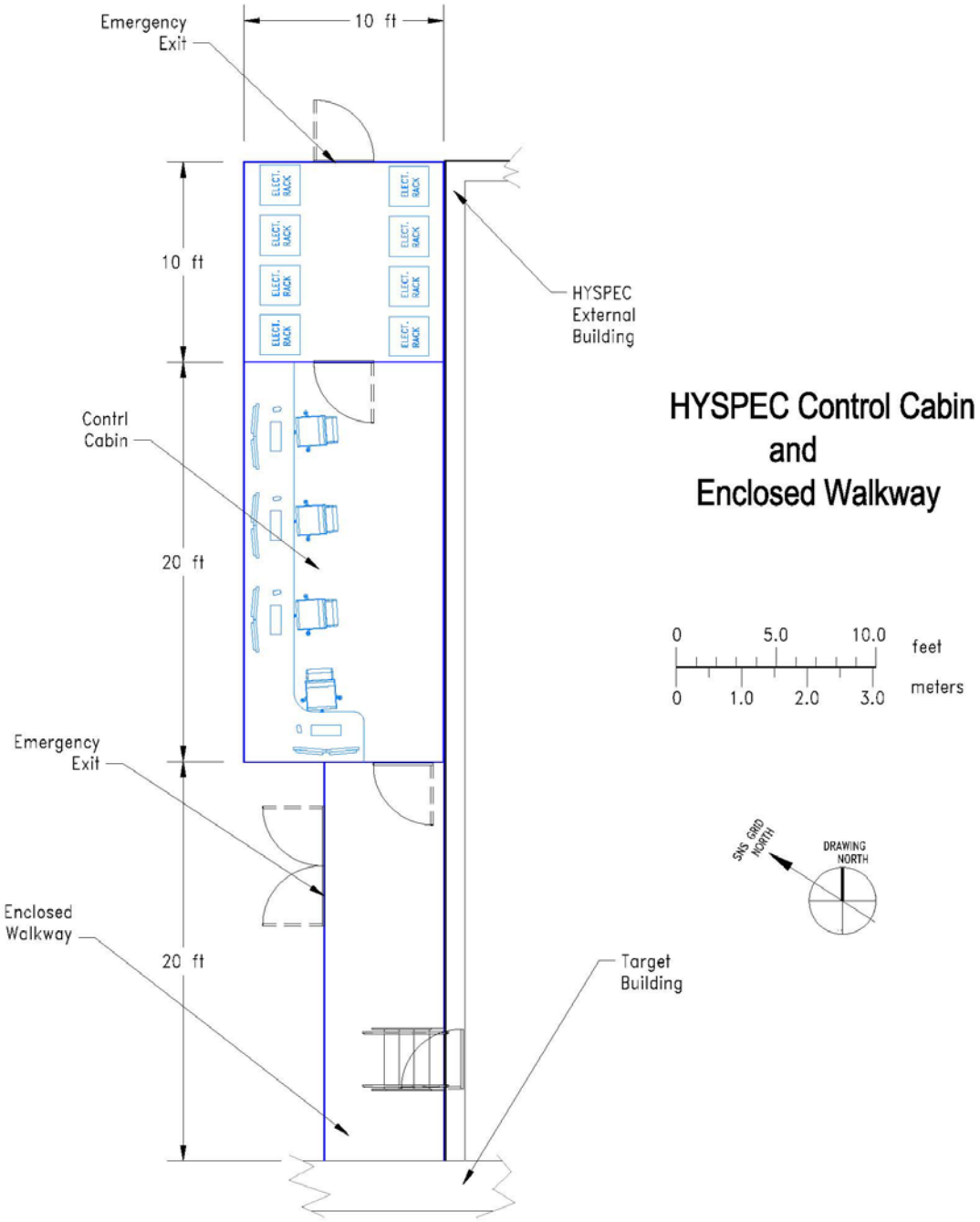

Figure 9 – Schematic of HYSPEC Control Cabin