SECTION 6

Spacecraft and Launch Facilities

6. SPACECRAFT AND LAUNCH FACILITIES

6.1 FACILITIES OVERVIEW

The Baikonur Cosmodrome is located in the Republic of Kazakhstan in Central Asia, approximately 2,000 km southeast of Moscow. The Cosmodrome is a Russian facility leased from Kazakhstan through the year 2050. The annual temperature averages 13^{o}C, ranging from -40^{o}C in winter to +45^{o}C in summer. The Baikonur Cosmodrome is equipped with spur-railroad service lines that are used for most transportation. Specialized equipment is available for fueling, handling of compressed gases, and for SC integration with the AU and the LV.

The Baikonur Cosmodrome includes several facilities that are used for ILS launch campaigns (see Figure 6.1-1). These facilities include:

a) Yubileiny Airfield - SC arrival, GSE and campaign personnel arrival and departure via chartered aircraft.

b) Building 92A-50 - SC preparation, AU and LV preparation, and final integration of AU to LV.

c) Breeze M Fueling Station - Fueling of the Breeze M as part of Integrated Launch Vehicle (ILV).

d) Launch Complex Areas 81 and 200 - Launch from Pad 24 (Area 81) or Pad 39 (Area 200).

e) Hotel Area (Area 95) - Hotel Fili and Hotel Kometa for use by commercial Customers.

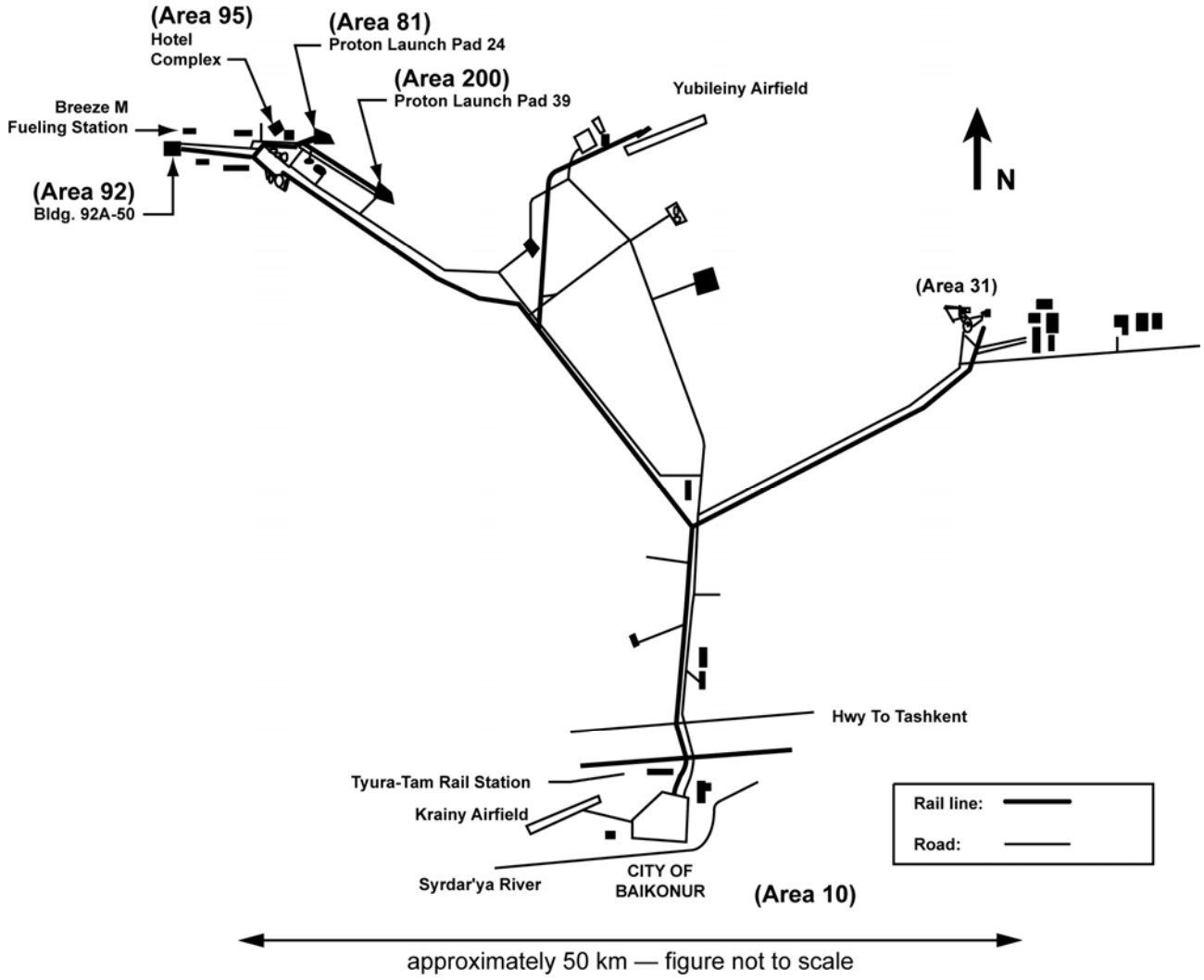
The sub-sections that follow provide brief descriptions of these facilities. More in-depth descriptions of these same facilities are provided later in this section.

6.1.1 Yubileiny Airfield

Yubileiny Airfield is located at the Baikonur Cosmodrome and is used for receiving the charter aircraft carrying the SC and GSE, as well as charter flights with campaign personnel. It is an internationally rated airport with a single 4.5 km long, 84 m wide landing strip oriented 60 degrees/240 degrees relative to North. The airport has an elevation of approximately 100 m above sea level.

A 140 m by 420 m concrete pad is available next to a railhead for unloading aircraft and transferring equipment to rail convoys. Prior to aircraft arrival, this area is cleared and ground-handling equipment is positioned. The pad also is equipped with stationary and portable lighting for use in night operations.

Figure 6.1-1: Baikonur Facilities Map



6.1.2 Building 92A-50

Building 92A-50 contains all facilities necessary for processing a SC from its arrival through its mating with the adapter and Breeze M, and encapsulation. The SC and GSE containers arrive at Hall 102, where they are cleaned. The SC container is transported on a flatbed railcar into Hall 101, where the SC container is off-loaded from the railcar and the SC is normally removed from the container. The SC is then transported into Hall 103A on the SC transporter or manufacturer supplied dolly, where it is installed onto its fueling/test stand. The SC remains in this hall for all subsequent testing and fueling operations. Following fueling, the SC is transported back to Hall 101 where it is mated to the adapter and Breeze M and encapsulated. Following encapsulation, the AU is transported to Hall 111 for integration with the Proton M LV and final electrical verification of the integrated LV.

6.1.3 Breeze M Fueling Station (Area 92)

The ILV will be transported to the Breeze M fueling facility for filling the Breeze M with low pressure propellant components, and from there to the launch complex (Area 81 or 200).

6.1.4 Launch Complexes (Area 81/Area 200)

At the launch complexes, an underground Vault accommodates the SC Customer's support equipment providing power to the SC while on the pad (Rooms 64/76 for Launch Pad 24, and Room 79 for Launch Pad 39).

6.1.5 Hotels

The Hotels Kometa, Fili, and Polyot, which are located in Area 95 near the launch complexes, are used to house personnel during a launch campaign.

6.2 SC PROCESSING FACILITIES - BUILDING 92A-50

This section describes the SC processing facilities, which provide the capability to perform all required operations from receipt of the SC through its encapsulation in preparation for launch on the Proton LV at the Baikonur Cosmodrome. These operations include off-loading in the SC technical zone, testing, fueling, mating to the Breeze M, payload encapsulation, and LV integration.

The main building within the technical complex for integration and testing is Building 92A-50. Stand-alone processing and assembly of the Proton M LV are carried out in Hall 111. SC preparation, testing, and fueling are accomplished in Hall 103A. Integration of the fueled SC with the Breeze M and subsequent encapsulation in the PLF to form the AU are performed in Hall 101. The AU is transferred by rail to the LV side of the building in Hall 111, where it is horizontally mated to the three assembled stages of the Proton to form the integrated LV.

6.2.1 Facility Layout and Area Designations

Building 92A-50 has been expressly modified and outfitted to efficiently complete all SC processing and encapsulation in a single building. The halls/rooms, facility systems, and equipment are sized to accommodate SC of up to approximately 4.5 m diameter, 10.0 m height, and loaded masses of up to 8,700 kilograms.

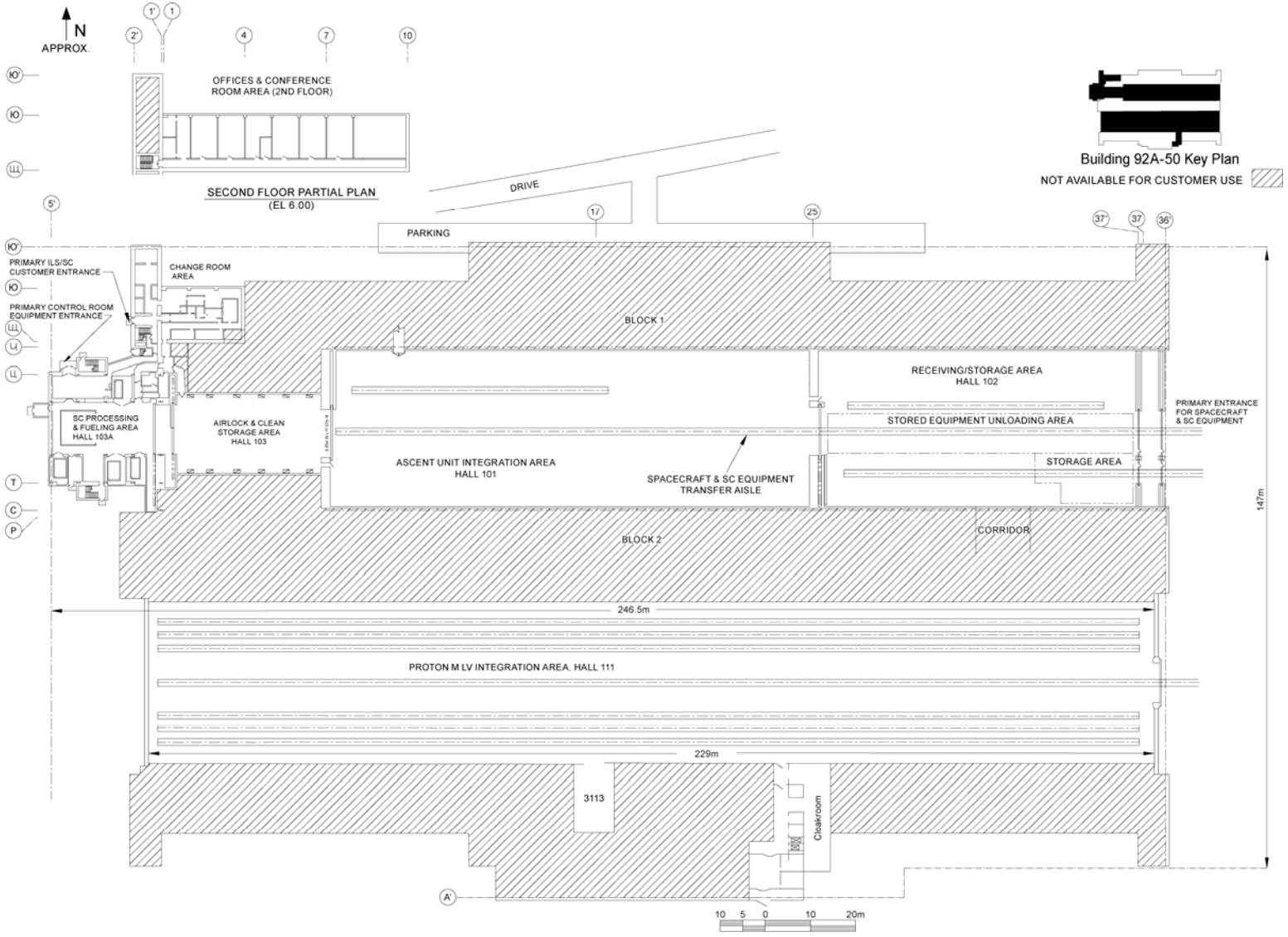
Building 92A-50 is approximately 229 m long and 147 m wide, but only a portion of the building is used for commercial programs. Figure 6.2.1-1 depicts the overall arrangement of the areas within the building that are used for commercial programs.

The receiving area (Hall 102) is the primary entrance for the SC and associated equipment, and is located on the east side of the building. The SC shipping container is cleaned in the receiving area, Hall 102. The container is then delivered into Hall 101 on a railcar, where it is lifted and placed on the floor. After the railcar exits and the environment is reestablished, the SC is removed from the shipping container and placed on a transporter to be moved into the processing and fueling hall (Hall 103A). Once there, the SC is placed on the fueling stand and requires no further movement in order to complete all necessary standalone assembly, checkout, propellant loading, and pneumatics servicing. When ready, the fueled SC is moved by special transport dolly to the integration hall (Hall 101) for mating to the Breeze M and encapsulation inside the PLF.

The main entry into Building 92A-50 for ILS and SC processing personnel is next to Hall 103A, on the west end of the building. An additional entrance with a vestibule is provided for delivery of equipment into the control room.

To connect Customer's equipment, 60 Hz and 50 Hz Uninterrupted Power Supply (UPS) sockets are available in the rooms and at workstations, providing transient-free, conditioned power. (For a detailed specification, refer to the Proton Launch Campaign Guide.)

Figure 6.2.1-1: Building 92A-50 General Arrangement



6.2.2 Receiving/Storage Area - Hall 102

The receiving area (Hall 102), or the integration area (Hall 101), may be used to off-load the SC container from its transport railcar. Rail access for the SC and GSE is provided through two locally controlled, exterior sliding doors located in the hall's east wall. Hall 102 is used for wash-down of the railcar and container before transfer to Hall 101. It can also be used for container storage. See Figure 6.2.2-1 for a detailed layout of Hall 102.

The overall clear dimensions of Hall 102 are approximately 70.5 m by 36 m. Hall 102 is equipped with two overhead cranes for handling operations. Each of the two cranes is equipped with hooks for 50 MT and 10 MT. The clear ceiling height is 25.85 m, and the heights of the overhead crane hooks are 17.5 m and 18.25 m, respectively (see Figure 6.2.2-2). The SC unloading area is approximately 8.85 m wide and 34.1 m long. An area of approximately 240 square meters is provided for general storage of non-hazardous items (no environmental controls).

When ready, the SC container is moved, via railcar, from Hall 102 to the inside of Hall 101, where the container is opened and the SC is transferred to its own transport dolly, and moved into Hall 103A.

Figure 6.2.2-1: Detailed Layout of Hall 102

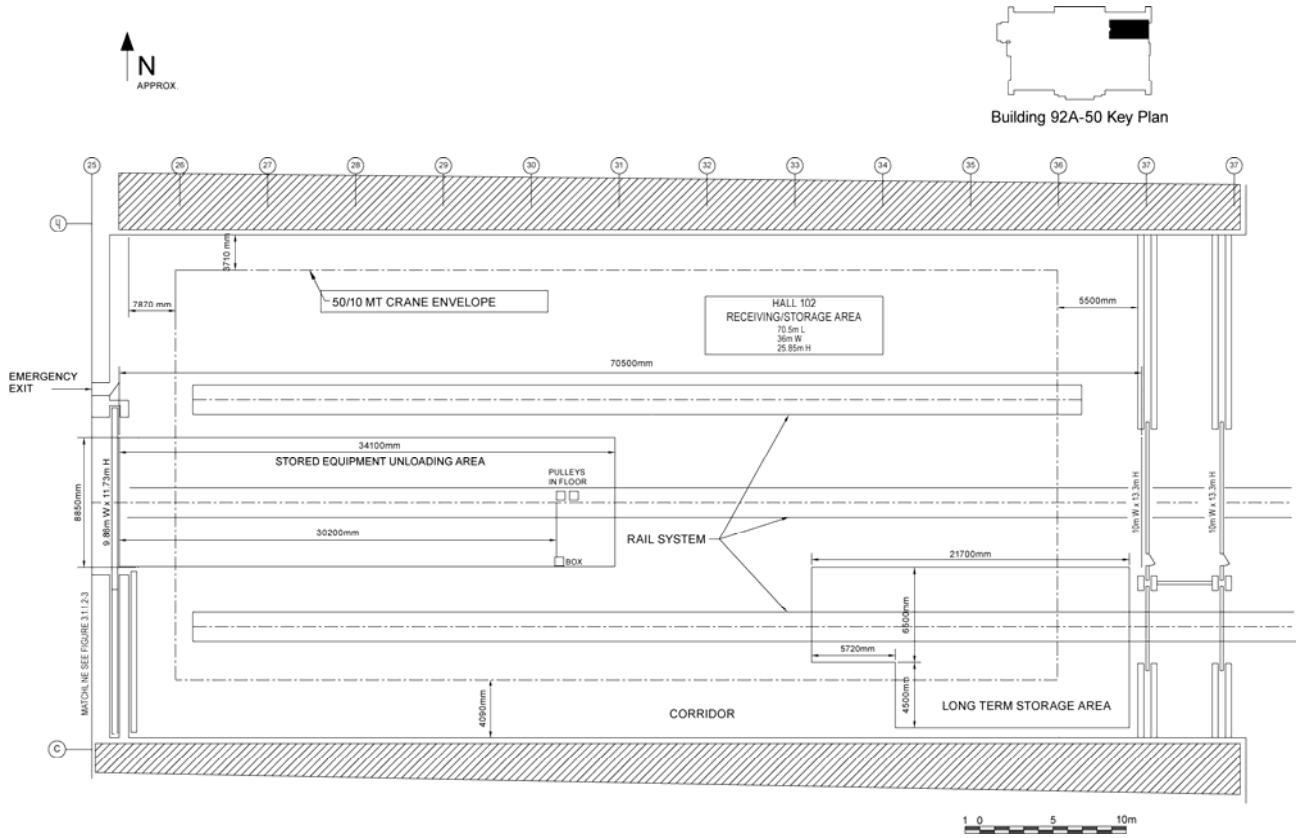


Figure 6.2.2-2: 50-MT and 10-MT Crane Hooks in Hall 102

6.2.3 SC Processing and Fueling Hall - Hall 103A (Room 4101)

Hall 103A, the processing and fueling hall, is used for pre-encapsulation SC processing, including loading propellants and servicing pneumatics (see Figure 6.2.3-1). Equipment access to Hall 103A is provided from Hall 103 through two sliding doors with a clear opening that is 9.5 m wide by 11.95 m high. A 15-MT overhead bridge crane, equipped with a load cell device, is provided.

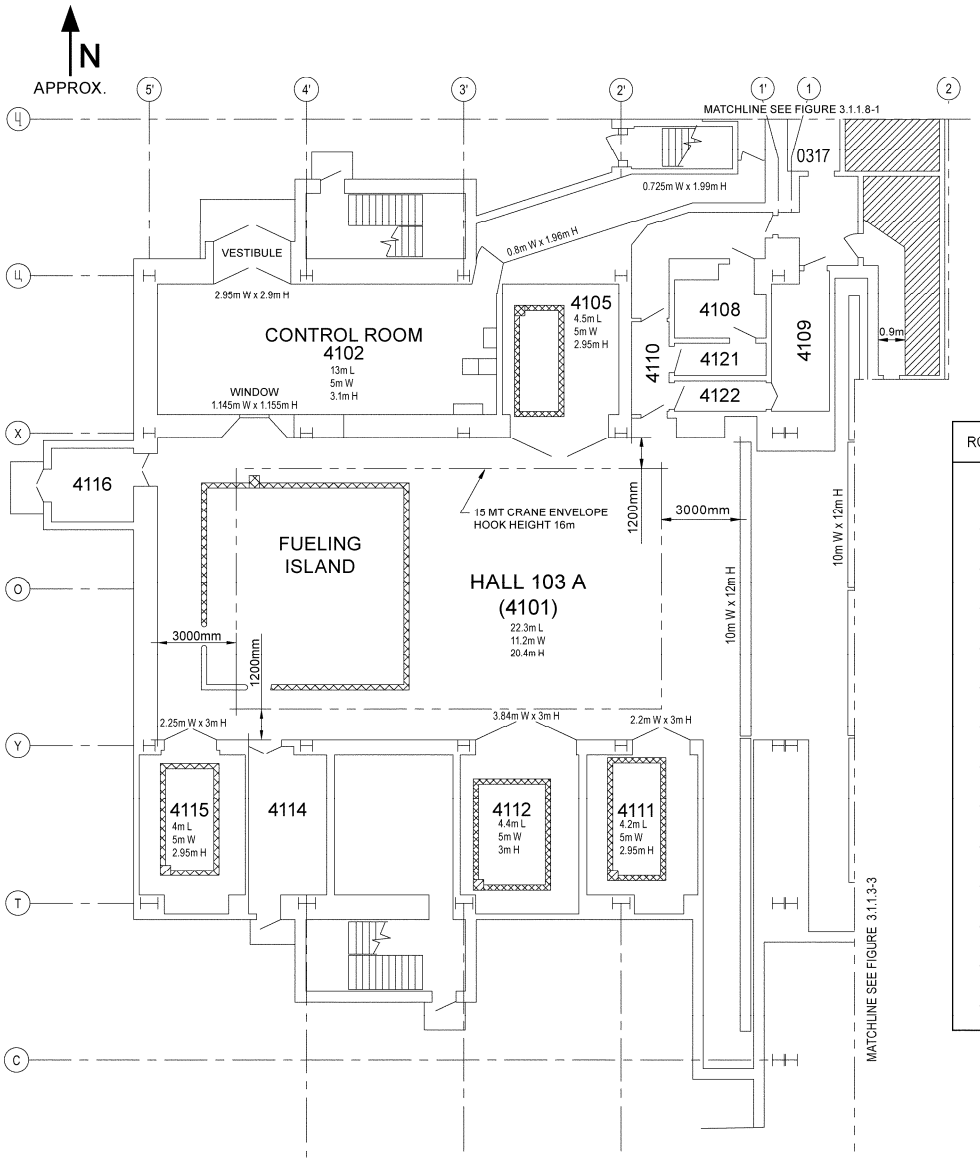
The clear dimensions for Hall 103A are 11.5 m wide by 22 m long. Rooms 4114 and 4116 provide rapid egress routes from Hall 103A, and the pressurization airlock (Room 4110) provides the standard egress route. Rooms 4114 and 4116 each have three emergency showers and eyewashes. The Self-Contained Atmospheric Protective Ensemble (SCAPE) shower areas (Rooms 4121 and 4122) have showers for post-operation clean-up. A parking lot for ambulances and fire trucks is located next to the rapid egress routes. The pressurization airlock (Room 4110) and the space between the double doors between Hall 103 and Hall 103A are pressurized with clean air in order to isolate Hall 103A during propellant loading operations.

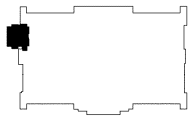
An 8 m by 8 m fueling island, located on the west side of Hall 103A, is used for oxidizer and fuel transfer operations. It is surrounded by a grating-covered trench, which drains any fuel or oxidizer spills into separate waste tanks. The grating permits the passage of wheeled dollies. The hall is equipped with a vapor monitoring system, emergency ventilation, fire-suppression system, demineralized and distilled water, gaseous nitrogen (GN_2) supply systems, breathing air supply systems, fuel and oxidizer vapor intakes, systems for localized removal of fuel component vapors, and a compressed air supply system.

The floor of Hall 103A has an anti-static coating and a load rating of 10-MT (3,000 kg/cm^2) per truck axle. All finishes in Hall 103A use materials that do not react with propellants.

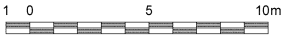
The wall between Hall 103A and Hall 103 includes a pair of large doors designed to withstand a 60 kg/m^2 overpressure load.

Figure 6.2.3-1: Building 92A-50 Spacecraft Processing and Fueling Area





ROOM NO.	DESCRIPTION
0317	Air Shower
4101	Processing & Fueling Hall (103A)
4102	Control Room
4105	Oxidizer Conditioning Room
4108	SCAPE-Doffing Room-Fuel
4109	SCAPE-Doffing Room-Oxidizer
4110	Pressurization Airlock (for propellent loading ops)
4111	Fuel Equipment Decontamination Room
4112	Fuel Conditioning Room
4114	Rapid Egress
4115	Oxidizer Equipment Decontamination Room
4116	Rapid Egress
4121	SCAPE Shower-Fuel
4122	SCAPE Shower-Oxidizer



6.2.4 Integration Area - Hall 101

Once the SC has been processed and fueled in Hall 103A, it is transported to the integration area (Hall 101), which is an ISO Class 8 cleanroom. Hall 101 is used to assemble the Ascent Unit (AU), which involves the following operations:

a) Mating the SC, adapter and Breeze M

b) SC/adapter/Breeze M continuity checks

c) Rollover of the assembled SC, adapter and Breeze M to horizontal

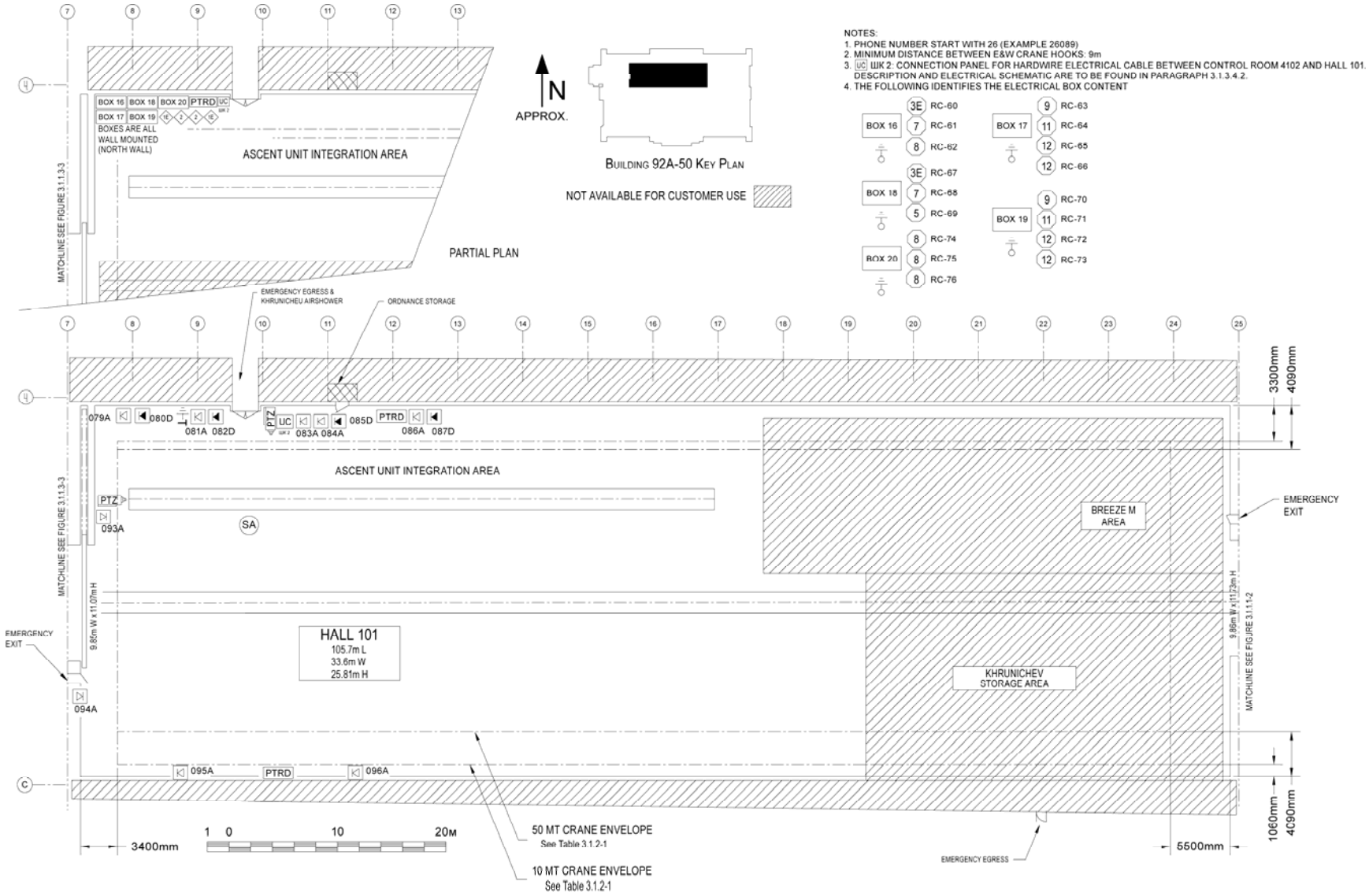
d) Encapsulation within the PLF

Two remotely controlled overhead bridge cranes (50-/10-MT hooks) are used to transfer the SC from the transport dolly to the adapter and to the Breeze M on the rollover fixture, as well as transferring the integrated AU from the rollover fixture to a railcar for delivery to Hall 111, LV integration facility.

This hall is also used for stand-alone processing of the Breeze M prior to integration of the AU.

Hall 101 is 34.5 m wide and 107 m long. It has a full-height wall and ceiling facing, as well as door sealing, thermal insulation, and an anti-static floor coating. See Figure 6.2.4-1 for a detailed layout of Hall 101.

Figure 6.2.4-1: Detailed Layout of Hall 101



6.2.5 Fuel and Oxidizer Conditioning Rooms - Rooms 4112 and 4105

Room 4112, the fuel conditioning room, is used for temporary storage of the SC fuel (e.g., monomethyl hydrazine (MMH)) and thermal conditioning of the fuel before loading. Room 4105, the oxidizer conditioning room, is used for temporary storage of the SC oxidizer (e.g., nitrogen textroxide (NTO)) and thermal conditioning of the oxidizer before loading. Both rooms have grounding points and the capability to collect and dispose of propellant spills. Room 4112 contains no materials that react with fuel, and Room 4105 contains no materials that react with oxidizer. Rooms 4105 and 4112 are equipped with a vapor monitoring system, emergency ventilation, demineralized and distilled water, nitrogen supply systems, breathing air supply systems, fuel and oxidizer vapor aspirators, systems for localized removal of fuel component vapors, and a compressed air supply system.

The floors in both rooms have an anti-static coating and a load rating of 10-MT (3,000 kg/cm^2) per truck axle. The floor elevations are the same as Room 4101.

Rooms 4105 and 4112 are approximately 5.7 m long and 4.4 m wide, and both have clear ceiling heights of 2.9 m.

6.2.6 Fuel and Oxidizer Equipment Decontamination Rooms - Rooms 4111 and 4115

Room 4111, the fuel equipment decontamination room, is used to decontaminate the fuel loading equipment. Room 4115, the oxidizer equipment decontamination room, is used to decontaminate oxidizer loading equipment. Both rooms have the capability to collect and dispose of propellant spills. Room 4111 contains no materials that react with fuel, and Room 4115 incorporates no materials that react with oxidizer. Rooms 4111 and 4115 are equipped with a vapor monitoring system, emergency ventilation, demineralized and distilled water, nitrogen supply systems, breathing air supply systems, grounding points, fuel and oxidizer vapor aspirators, systems for localized removal of fuel component vapors, and a compressed air supply system.

Rooms 4111 and 4115 are both 6.1 m long and 4.1 m wide, and both have clear ceiling heights of 2.95 m.

6.2.7 Control Room - Room 4102

Room 4102, the control room, is used for monitoring and controlling SC processing and fueling activities in Hall 103A, as well as SC integration in Hall 101 with the Breeze M, AU integration with the LV in Hall 111 and SC monitoring of the Breeze M fueling area.

A blast-resistant viewing window is provided between the control room and Hall 103A for monitoring all processing and fueling operations. The wall between Hall 103A and the control room is a welded, reinforced steel structure that provides a hermetic seal.

Ten sealable inlets are provided between the control room and Hall 103A for routing the cables that support processing and fueling of the SC. The inlet design precludes ingress of air contaminated with propellant components from migrating from Hall 103A into the Control Room 4102 area.

The control room is 5.9 m by 12.9 m in overall dimension, with a clear ceiling height of 3.1 m. An equipment entry vestibule, with inner and outer doors 2.9 m wide and 2.9 m high, is provided to facilitate equipment movement into the control room.

The floors of the control room and all associated access corridors are designed for wheeled dollies. Forklifts may be used to bring equipment into the vestibule of the room, but they are not permitted to operate in the control room itself. Temporary ramps are available to aid moving items from the entrance vestibule into the control room.

This room is the primary SC control room for launch operations once the LV reaches the pad. The Customer may alternatively use the Bunker (see Section 6.4) for SC control while at the launch pad.

6.2.8 Entrance/Lobby Area

The entrance/lobby area includes the following rooms and features:

a) A street-level entrance

b) Break room (Room 0301)

c) Medical office (Room 0302)

d) SC Customer security checkpoint with viewing windows and security sensor alarm panel (Room 0318)

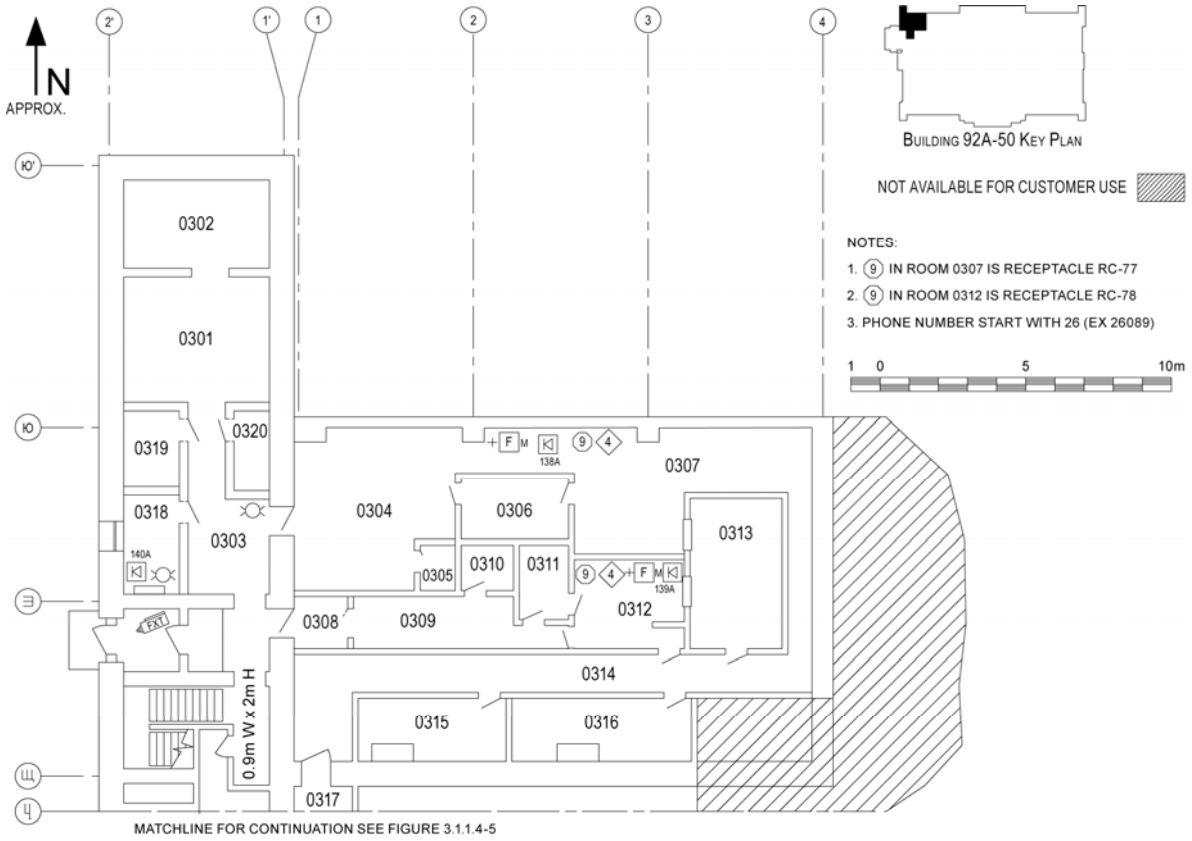
e) Tool storage room (Room 0319)

f) Restroom (Room 0320)

6.2.9 Change Room Area

The change room area consists of several rooms (Rooms 0303 - 0317), including independent men's and women's restrooms, and change areas, a storage and issue room for cleanroom garments, a Personal Protective Equipment (PPE) storage and donning room, and a corridor with an air shower. Clean passage is available from the change rooms to either Hall 103 or Hall 103A. A detailed layout of the change room area is shown in Figure 6.2.9-1.

Figure 6.2.9-1: Detailed Layout of Change Room Area



ROOM NO.	DESCRIPTION
0301	Lobby
0302	Medic Station
0303	Change Area Entry
0304	Locker Room
0305	Restroom
0306	Storage
0307	Cleanroom Garment Change Room
0308	Change Area Entry
0309	Locker Room
0310	Restroom
0311	Storage
0312	Storage
0313	ILS Equipment Storage Room
0314	Access Corridor
0315	ILS Safety Equipment Storage Room
0316	ILS Cleanroom Supplies Storage Roon
0317	Air Shower
0318	Entrance Security Check Point
0319	ILS Security Equipment Storage Room
0320	Restroom

6.2.10 Pressurization Airlock - Room 4110

The pressurization airlock provides clean access between the air shower (Room 0317) and Hall 103A. During propellant loading operations in Hall 103A, the airlock is pressurized slightly more than Hall 103A to prevent vapor migration from Hall 103A. SCAPE-suited personnel use the airlock to access the SCAPE showers and doffing rooms, and the pressurization airlock and corridor to the air shower and change rooms can be used as an emergency egress route from Hall 103A, if necessary.

Room 4110 is 1.4 m by 3.5 m wall-to-wall.

6.2.11 SCAPE Donning/Doffing Rooms and Showers - Rooms 4108, 4109, 4121 and 4122

The SCAPE donning and doffing rooms, Rooms 4108 for fuel and 4109 for oxidizer, are available for donning and doffing PPE for a propellant loading operation. As necessary, SCAPE showers, Rooms 4121 for fuel and 4122 for oxidizer, are available to decontaminate the PPE suits before doffing. The dedicated showers are plumbed to the respective liquid waste tanks.

Room 4108 is approximately 1.65 m by 3.0 m and Room 4109 is approximately 1.9 m by 5.4 m. Room 4121 is 1.2 m by 3.4 m and Room 4122 is 1.2 m by 3.4 m.

6.2.12 Clean Storage Hall - Hall 103

Hall 103, the clean storage hall, provides accessible storage for clean items supporting SC processing. It also provides an ISO Class 8 corridor between Halls 101 and 103A.

Access is via equipment doors leading to/from Hall 101 and 103A.

The wall-to-wall dimensions of the clean storage hall (Hall 103) are 17.5 m by 31.8 m at floor level, and the ceiling height is 15 m. At heights greater than 3 m above the floor, the width of Hall 103 is restricted by Heating, Ventilation and Air Conditioning (HVAC) ducting to about 16 m.

6.2.13 Ordnance Storage

KhSC provides limited storage of ordnance required to support a launch campaign. The ordnance storage room may be accessed through a door located in the north wall of Hall 101.

Ordnance to be stored must meet the following criteria:

a) A maximum Trinitrotoluen (TNT) equivalent quantity of 50 grams, requiring a volume no more than 60 cm by 60 cm by 60 cm, may be stored in accordance with Russian Federation Standards.

b) Only insensitive explosives are permitted, and each item must be individually packaged in U.S. Department of Transportation-approved shipping and storage containers.

c) The SC Customer must provide a certificate of conformance to the Hazard of Electromagnetic Radiation to Ordnance (HERO) Specification (MIL-I-23659).

6.2.14 Offices and Conference Room Area - Rooms 1202 through 1209

An office/conference room area (Rooms 1202 - 1209) is located on the second floor of Building 92A-50. See Figure 6.2.14-1 for a detailed layout. The functions of the eight constituent rooms are:

a) Security office (Room 1202)

b) ILS office (Room 1203)

c) Support/Interpreter office (Room 1204)

d) DTSA office (Room 1204A)

e) SC manufacturer office (Room 1205)

f) SC manufacturer office (Room 1206)

g) Customer office (Room 1207)

h) Conference rooms (Rooms 1208/1209)

The clear dimensions of these rooms are as follows:

a) Offices - Rooms 1202 through 1207, 8.9 m by 5.9 m (each)

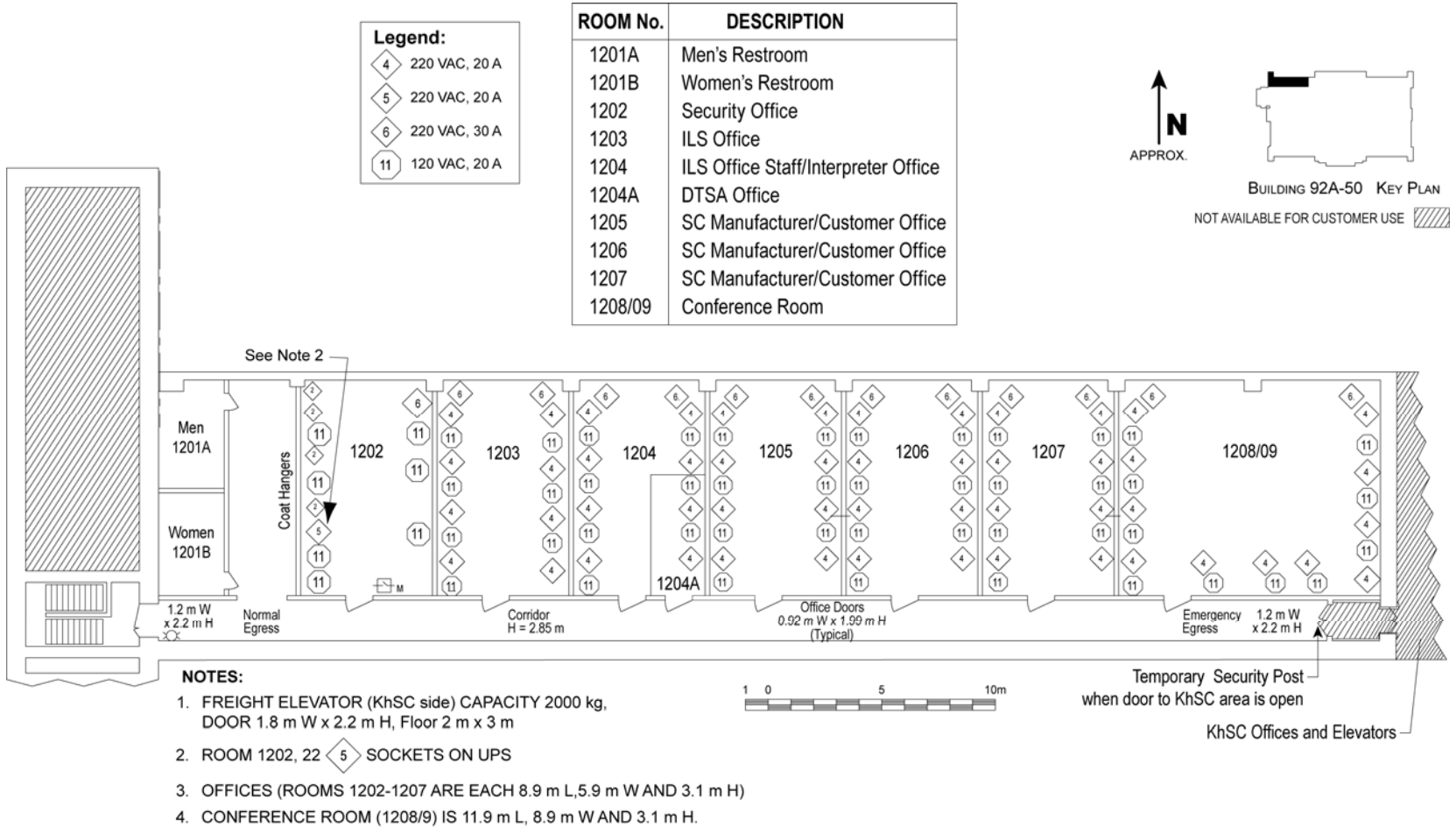
b) Conference Room 1208/1209, 8.9 m by 11.9 m (each)

c) Clear height of all rooms, 3.1 m

Restrooms are accessible from the corridor serving the office/conference room area; general access to the area is via stairs from the "street" entrance to the change room area. As a safety precaution, during SC propellant loading and Breeze M propellant loading, only essential personnel are permitted in Building 92A-50.

Two egress routes are available from the area: the normal route at the western end of the room block that exits to the "street" entrance to the change room area; and an emergency evacuation route that exits east through the KhSC area of the building. A 2,000 kg capacity freight elevator, with a 1.8-m wide by 2.2-m high door opening and floor measuring 2.0 m by 3.0 m, is also available in the KhSC work area.

Figure 6.2.14-1: Detailed Layout of Offices and Conference Room Area



6.2.15 LV Processing and Integration Hall - Hall 111

The Proton LV processing hall (Hall 111) in Building 92A-50 is used for horizontal mating of the assembled LV stages and strap-on elements, their checkout, and also for mating the LV with the AU.

Hall 111 is the second span of Building 92A-50 and runs parallel with the SC processing halls. A detailed layout is shown in Figure 6.2.15-1.

Hall 111 is 33.5 m wide and 214 m long. It has wall lining over the entire height, ceiling lining, and also door seals, thermal insulation and anti-static floor coating. The hall is an ISO Class 9 clean area, supported by a fire-suppression system, ventilation, and air-conditioning system, complete with High-Efficiency Particulate Air (HEPA) filters.

The hall has a network of rail tracks of which one is central, leading via the building's entrance/exit, with an electrically driven rollout gate 10 m wide and 12 m high, to the Area 92 rail tracks. The rest of the tracks inside the hall are internal ones, intended for assembly and installation work. Personnel access is through the exterior of the building, through KhSC-controlled checkpoints.

Air temperature and relative humidity in the hall are maintained at 22 ± 5°C and 30 - 60% levels, respectively.

Hall 111 has three 100-/20-MT electrical overhead traveling cranes, remotely controlled by radio from a portable control console.

Hall 111 is intended for the following operations:

a) Transferring the AU from the rail transportation unit onto the mating dolly.

b) Mating the AU to the Proton M LV.

c) Leak checks of LV pneumatic and hydraulic tubing after mate.

d) Electrical verification of the LV transit circuits, and checkout of wire communication lines between the AU and LV.

e) Installation of LV flight batteries.

f) Charging SC on-board storage batteries, when required.

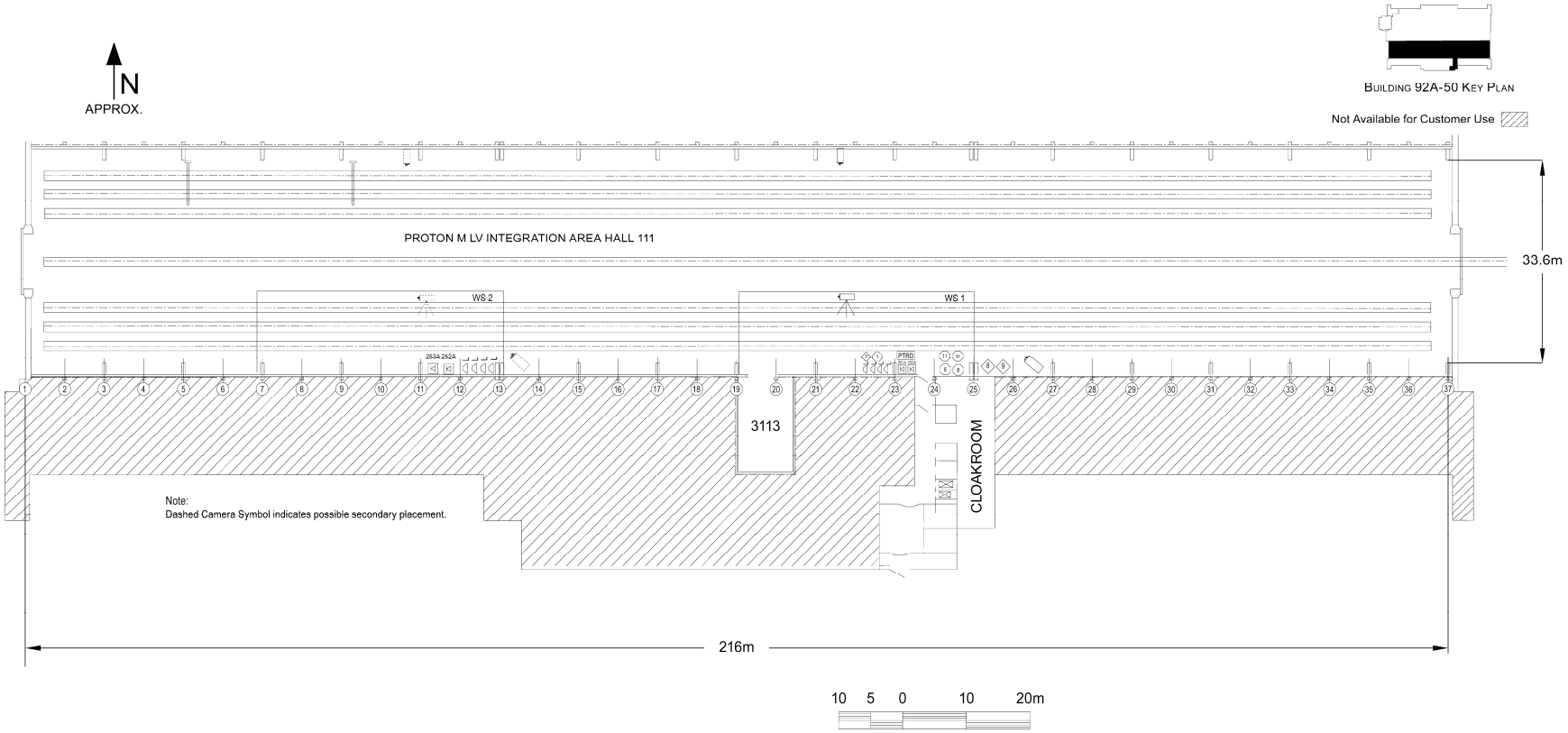
g) Other LV final closeouts.

h) Putting a thermal protection cover onto the AU.

i) Transferring the ILV onto the transportation/erection unit.

j) Preparing the ILV for transportation to the Breeze M fueling facility, and then to the launch complex.

Figure 6.2.15-1: Hall 111 Layout



6.3 BREEZE M FUELING FACILITY

Following final assembly, the ILV is transported from Building 92A-50 to the Breeze M fueling facility. The fueling facility is located in Area 92, directly adjoining Building 92A-50, with some 70 m distance between the building and the facility's external fencing. The fueling facility has been upgraded and reequipped to satisfy the needs of the SC manufacturers and contractors, and is capable of supporting any operation required for SC health checkout and SC on-board storage battery recharging during the ILV stay at the facility.

The fueling facility is used for filling Breeze M tanks with propellant components at low-pressure (high-pressure components are filled earlier at Area 31). The area has a dead siding of the standard rail track and a paved road for motor vehicles. In the filling area, the facility has an awning 66 m long, 12 m wide and 11 m high, built of metal truss structures, with wind protection at the sides. The fueling facility is complete with lightning protection and grounding. The work area has explosion-proof lighting. The fueling facility layout is shown in Figure 6.3-1.

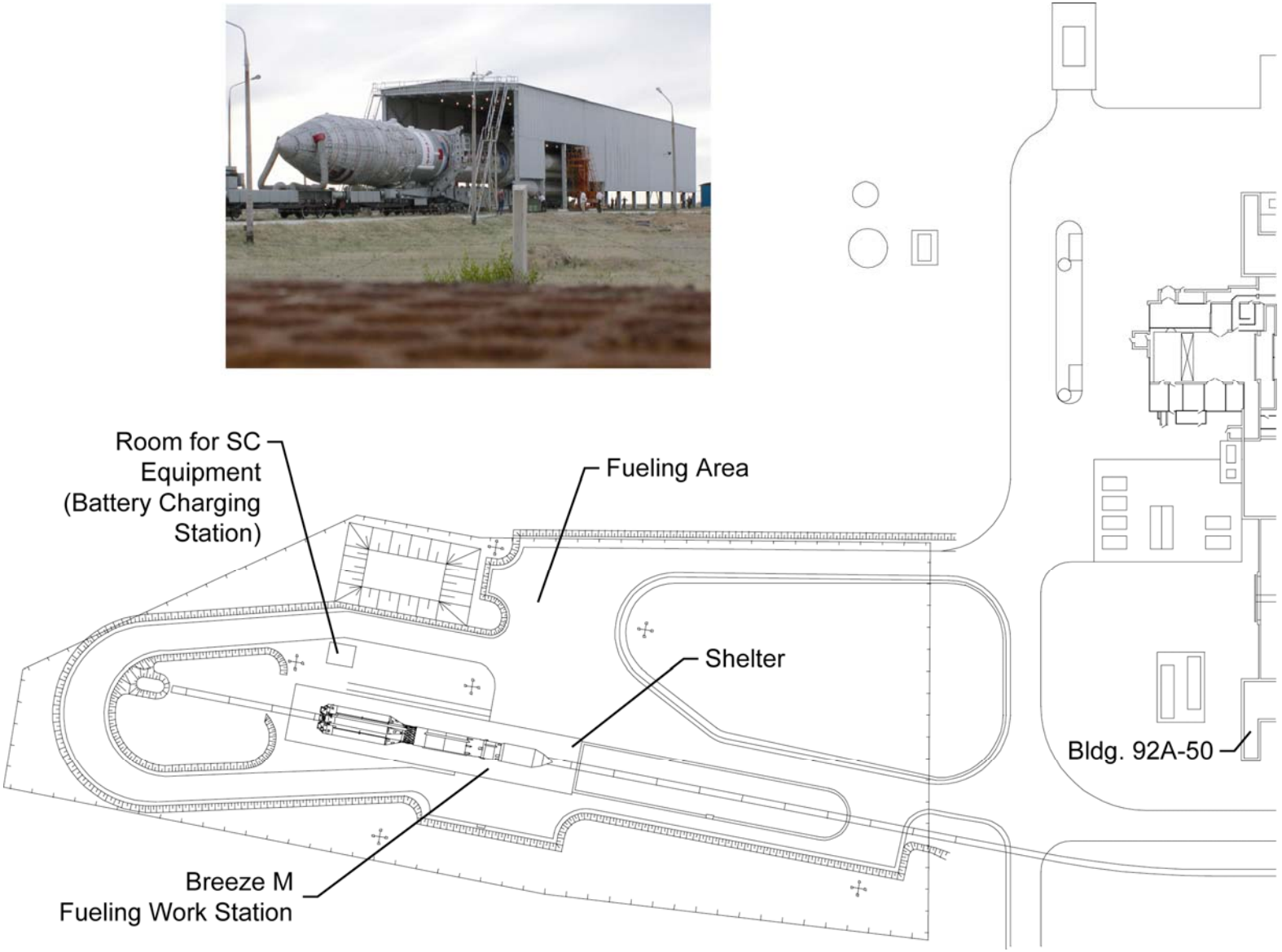
For accommodating the equipment for low-rate charging SC on-board storage batteries and checking the health of SC on-board systems, a special facility 5.9 m long, 4.7 m wide and 2.5 m high (battery charging station) is located about 40 m from the LV tail end. The facility has a hinged gate 2 m wide and 2.3 m high for equipment entry, and a personnel access door. The facility's walls are thermally insulated and soundproof. An air conditioning system supports the required temperature and humidity (see Section 3.1.1) and can be switched over from plenum and exhaust circulation to internal air circulation. The facility offers security and fire alarm signaling, a fire-fighting system, telephone communication, and general and emergency illumination.

The facility supports electrical and fiber-optic communication with the SC control room in Building 92A-50, and 380/220 V, 50 Hz or 208/120 V, 60 Hz power supply for the SC equipment. Appropriate monitoring and measuring instruments are available for propellant component vapor detection.

To safeguard against unauthorized access to the PLF doors, the fueling facility has a close-circuit security TV system.

A thermal control car supports the required temperature, humidity and environment for the encapsulated SC at the fueling facility.

Figure 6.3-1: Breeze M Fueling Area Layout



6.4 LAUNCH COMPLEX FACILITIES

Following fueling of the low-pressure tanks of the Breeze M, the ILV is transported to the Proton launch complex for erection, checkout and launch. There are two complexes with two launch pads available for commercial users:

- Area 81, Launch Pad 24
- Area 200, Launch Pad 39

6.4.1 Area 81 Launch Complex

6.4.1.1 Launch Pad 24 - General Description

Following integration, the ILV is transported to the launch complex, Pad 24, in Area 81 for erection and launch. Figure 6.4.1.1-1 shows a layout of the launch complex. The launch area includes the following physical facilities, units, and systems that support processing and launching of the Proton ILV:

a) Launch structure with launch pad (including underground Vault)

b) Mobile Service Tower (MST)

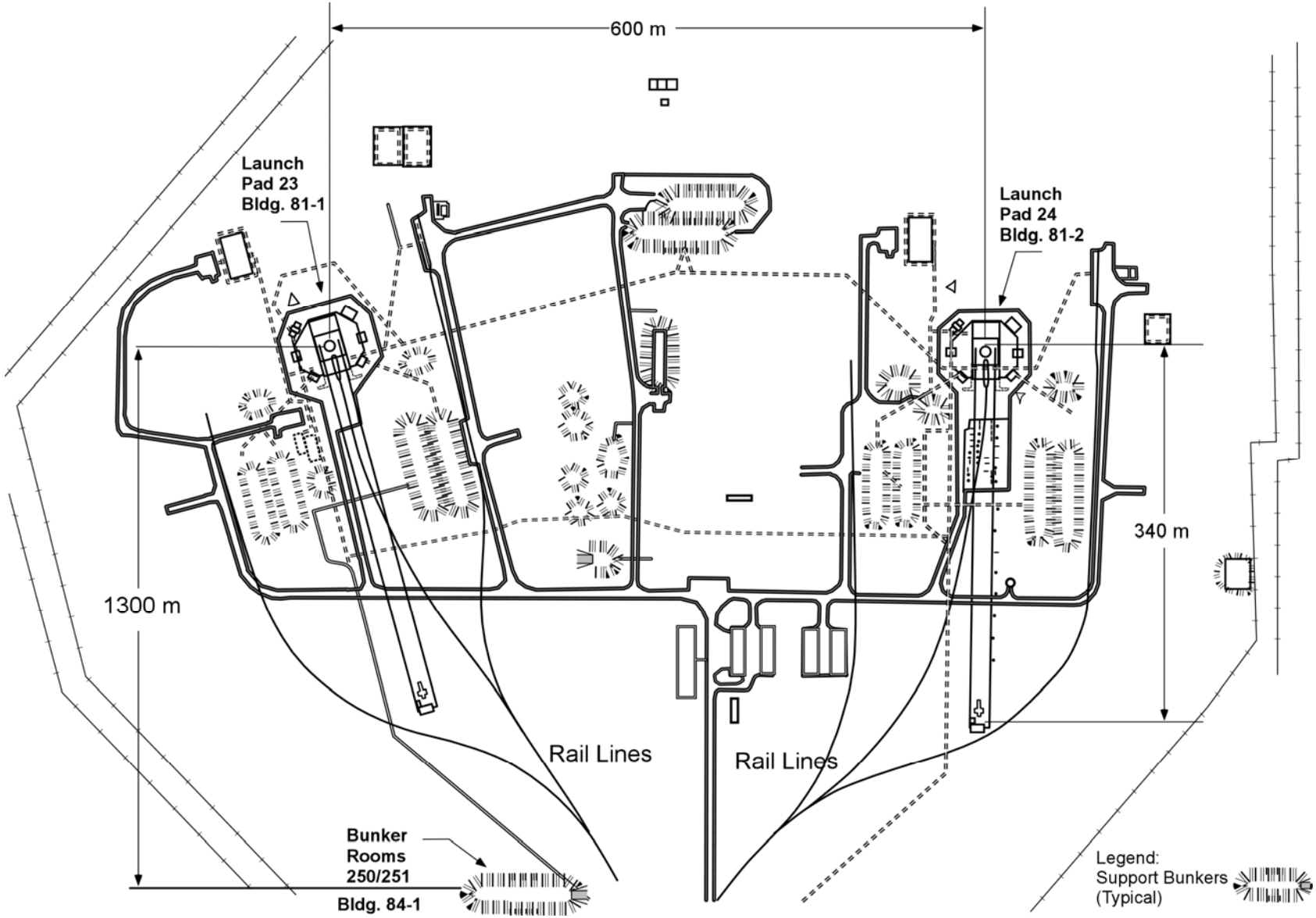
c) Bunker (Rooms 250 and 251)

d) Facilities for support systems

UPS 208/120 V, 60 Hz and 380/220 V, 50 Hz power supplies at the launch complex will be provided from an independent special power supply system. (Refer to the Proton Launch Campaign Guide for details.)

The launch complex facilities have electrical sockets for connecting Customer's equipment.

Figure 6.4.1.1-1: Proton Launch Complex, Area 81



6.4.1.2 Facility Layout and Area Designations

6.4.1.2.1 Launch Structure with Launch Pad (Including Underground Vault)

The launch structure and Vault house equipment that supports the pre-launch processing of the ILV. They provide electrical, pneumatic, and hydraulic links between the ground system testing equipment and on-board hardware via transit cables and pipes. The launch structure is designed to withstand the first-stage engine plume impingement. The launch pad is intended for ILV installation, erection, and securing in a vertical position.

6.4.1.2.2 Room 64 - Vault

Room 64 can be used to house the SC Customer's GSE. Room 64 measures approximately 5.1 m by 5.6 m and is equipped with 50/60 Hz electrical power, grounding, and communications services. All launch campaign operations requiring the presence of personnel in the Vault must be completed prior to the start of LV fueling, which occurs approximately seven hours prior to launch. All personnel are required to leave the Vault by this time, and from then on, all Vault equipment must be controlled remotely.

6.4.1.2.3 Room 76 - Vault

Room 76 can be used to house the SC Customer's GSE. Room 76 measures approximately 5.4 m by 10.8 m and is equipped with 50/60 Hz electrical power, grounding, and communications services. All launch campaign operations requiring the presence of personnel in the Vault must be completed prior to the start of LV fueling, which occurs approximately seven hours prior to launch. All personnel are required to leave the Vault by this time, and from then on, all Vault equipment must be controlled remotely.

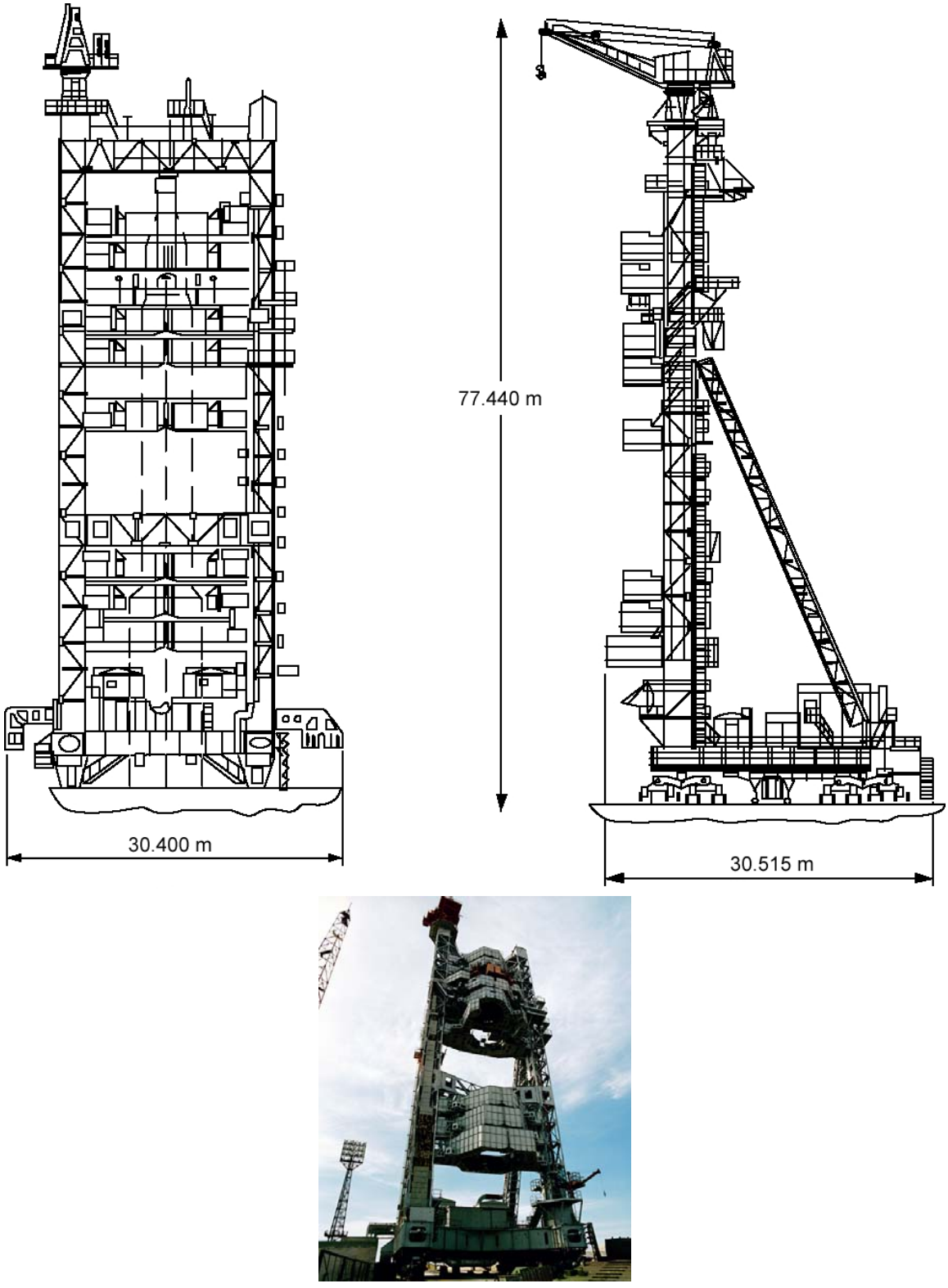
6.4.1.2.4 Mobile Service Tower

The MST provides access to the SC and ILV and houses equipment to support SC and ILV pre-launch processing and launch. The MST includes service platforms, a gallery, service fixtures, two cargo/passenger elevators (500 kg rated load capacity each), and two cranes (rated load capacity 500 kg and 5,000 kg, respectively). An overall view of the MST is provided in Figure 6.4.1.2.4-1.

6.4.1.2.5 Rooms 250/251 - Bunker

The Bunker (Rooms 250/251) is used to support a Proton launch. It is located 1.3 km from the launch pad and provides protection for personnel and equipment during the launch. The Bunker houses the ILV System Test Equipment (STE). If required, it can also house the SC STE and GSE required for pre-launch operations and monitoring of SC readiness. Air temperature and humidity inside the Bunker are controlled by an air conditioning unit. While the Bunker can be used to house GSE for pre-launch operations, it is not recommended due to its close proximity to the launch pad.

Figure 6.4.1.2.4-1: Proton Mobile Service Tower



6.4.2 Area 200 Launch Complex

6.4.2.1 Launch Pad 39 - General Description

Pad 39 is located 5 km to the southeast of Pad 24. Figure 6.4.2.1-1 shows a layout of the launch complex. The launch area includes the following physical facilities, units, and systems that support processing and launching of the Proton ILV:

a) Launch structure with launch pad (including underground Vault)

b) MST

c) Bunker (Room 246)

d) Facilities for support systems

UPS 208/120 V, 60 Hz and 380/220 V, 50 Hz power supplies are provided at the launch complex from an independent special power supply system.

The launch complex facilities have electrical sockets for connecting Customer's equipment.

6.4.2.2 Facility Layout and Area Designations

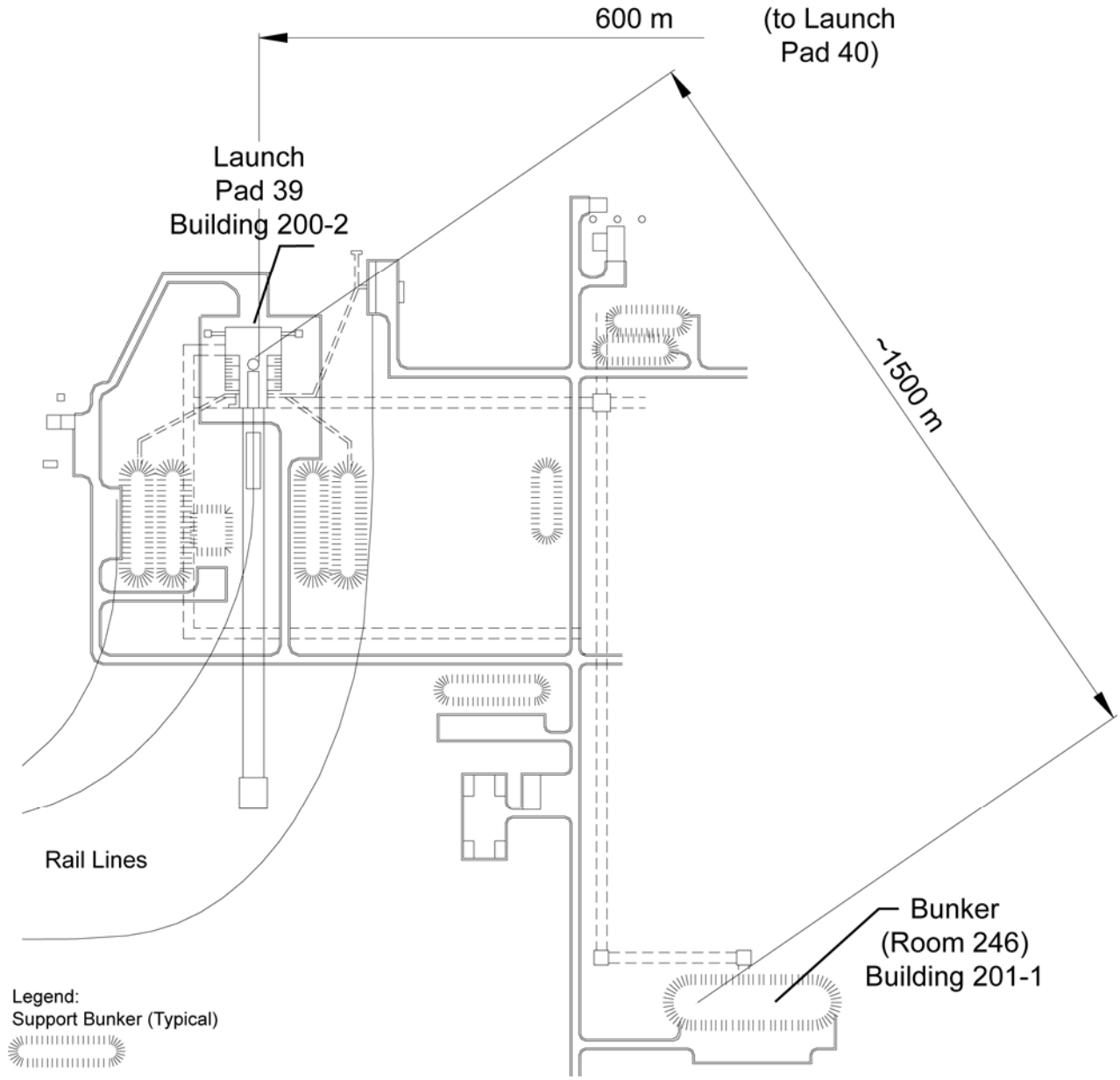
6.4.2.2.1 Launch Structure with Launch Pad (Including Underground Vault)

The launch structure and Vault house equipment that supports the pre-launch processing of the ILV. They provide electrical, pneumatic, and hydraulic links between the ground system testing equipment and on-board ILV hardware via transit cables and pipes. The launch structure is designed to withstand the first-stage engine plume impingement. The launch pad is intended for ILV installation, erection, and securing the ILV in a vertical position.

6.4.2.2.2 Room 79 - Vault

Room 79 can be used to house the SC Customer's GSE. Room 79 measures approximately 8.75 m by 5.7 m and is equipped with 50 Hz and 60 Hz electrical power supplies, grounding, and communications services. All launch campaign operations requiring the presence of personnel in the Vault must be completed prior to the start of LV fueling, which occurs approximately seven hours prior to launch. All personnel are required to leave the Vault by this time, and from then on, all Vault equipment must be controlled remotely.

Figure 6.4.2.1-1: Proton Launch Complex, Area 200



6.4.2.2.3 Mobile Service Tower

The MST provides access to the SC and integrated LV and houses equipment to support SC and ILV pre-launch processing and launch. The MST includes service platforms, a gallery, service fixtures, two cargo-passenger elevators (500 kg rated load capacity each), and two cranes (rated load capacity 500 kg and 5,000 kg, respectively). An overall view of the MST is provided in Figure 6.4.1.2.4-1.

6.4.2.2.4 Room 246 - Bunker

The Bunker (Room 246) is used to support a Proton launch. It is located 1.5 km from the launch pad and provides protection for personnel and equipment during the launch. The Bunker houses the ILV STE. If required, it can house the SC STE and GSE required for pre-launch operations and monitoring of SC readiness. Air temperature and humidity inside the Bunker are controlled by an air-conditioning unit. While the Bunker can be used to house GSE for pre-launch operations, it is not recommended due to its close proximity to the launch pad.

6.4.3 Time Countdown

A time countdown system is available for displaying the countdown information and Universal Time (GMT) at various locations in the launch complex:

In operations at Pad 24, the time countdown system is accommodated in Building 84-1 (Bunker).

In operations at Pad 39, the time countdown system is accommodated in Building 201-1 (Bunker).

For information readout, digital displays are situated as follows:

- Technical Complex:
  - Building 92A-50, in Room 4102
- Launch Complex 81 (Pad 24):
  - Building 84-1, in Room 251
  - Buildings 81-1, 81-2, in Rooms 76
- Launch Complex 200 (Pad 39):
  - Building 201-1, in Room 246
  - Building 200-2, in Room 79

The time countdown system will be activated no earlier than ten days ahead of the launch time, and will supply information (time) on a digital display at 1-minute increments.

At 45 minutes prior to launch time, the time countdown system will switch over to display time at 1-second increments.

6.5 COMMUNICATIONS SERVICES

This section describes the telecommunications support that KhSC provides for commercial launch campaigns at the Baikonur Cosmodrome. In general, KhSC has overall technical responsibility for configuring and maintaining these services at the Cosmodrome. For details on hardware locations at individual facilities, refer to the facility-specific sections of the Proton Launch Campaign Guide (PLCG).

Specific telecommunications requirements for any given launch campaign are provided by the SC Customer in the mission-specific ICD. The final Launch Campaign Service Order communications inputs defined in the ICD shall be provided by the Customer 90 days prior to the start of the Launch Campaign. Nominally, all communications support is in place no later than one week prior to the start of a campaign and remains fully operational until three days following launch.

6.5.1 International Voice/Data Transmission

Voice/data transmission capacity from the KhSC earth station at Baikonur Cosmodrome to the U.S. and other international locations is procured by ILS by direct subcontract with the long distance service provider. The task order with the long distance service provider shall be completed by ILS no later than two months prior to the first use of the service for domestic (United States) Customers, and no later than three months prior to first use of service for international Customers. Upon ILS request, KhSC provides the long distance service provider with the necessary technical information regarding the interface and test support for link checkouts prior to handing the links over to the SC Customer. Testing of ILS-procured long distance lines shall be completed no later than one week prior to the first use of the service.

A SC Customer telecommunications specialist must be available at Baikonur during SC telecommunications equipment installation and communications link testing and commissioning. The Baikonur-London satellite link time slot numbers for the lines listed in Table 6.5.1.1-1 shall be specified in the ICD.

6.5.1.1 Types of Lines (Termination Other Than Moscow)

Table 6.5.1.1-1 summarizes the typical telecommunication lines that can be provided for international voice/data transmission during any given launch campaign. Additional types of communication lines are available. Specific support requirements are detailed in the mission-specific ICD.

Table 6.5.1.1-1: Typical International Voice/Data Transmission Lines Available to Launch Campaigns

Type of Line	Usage
64 kbps channel	E-mail or secure FAX or voice
64 kbps channel	4 x 16 kbps compressed voice/FAX channels
64 kbps clear channel	Data transmission

Links are established from the KhSC ground station at the Baikonur Cosmodrome through a Russian satellite (Express AM1) to London, and then by fiber optics from London to the long-distance service provider at a European or domestic Point Of Presence (POP). From the POP, the lines are routed via a dedicated line to a location defined by the SC Customer. ILS also leases several 64 kbps lines from Baikonur to Reston, Virginia. These lines are provided by the long-distance service provider, as described above, and reconfigured for 4 x 16 kbps voice channels. Additional lines in Reston, VA may be made available for Customer lease.

6.5.1.2 Multiplexing

KhSC multiplexes the above lines using an Alcatel 3600 Mainstreet Multiplexer (MUX), equipped with an echo suppression function for each line. Should the SC manufacturer require the use of special MUX equipment, they must provide KhSC with detailed information about the Definity Private Branch Exchange (PBX) interface, signaling protocol, dialing connection procedures, and provide all necessary adapting equipment to ensure compatibility with the Definity PBX. The list of adapting equipment needs to be agreed upon with KhSC not later than 3 months prior to the start of the launch campaign. KhSC will assist the Customer in installing such equipment.

6.5.1.3 Access to Baikonur PBX

All commutated lines mentioned above have access to the Baikonur PBX and a Baikonur Cosmodrome dial tone, which allows automatic switching to/from any SC Customer phone jack location or to/from any mobile radio. No operator assistance is required for international calls. The exact locations of all phone jacks are specified in the facilities section of the PLCG.

6.5.2 On-Site Mobile and PBX Phone Network Communications

Table 6.5.2.1-1 summarizes the telecommunications equipment that KhSC and ILS provide for a launch campaign.

At each Area 95 hotel, one analog voice circuit is provided in each room, each recreation area, and each bar/eating area. Two (2) analog voice/FAX circuits are provided in the reception area of each hotel.

In work areas, a minimum of 20 digital handsets and 50 analog handsets can be provided for ILS and Customer use, and can be distributed to the jacks designated in the facilities section of the PLCG.

The specific phone jacks to be used by the SC Customer are identified in the mission-specific ICD. Final agreement on telecommunications requirements shall be reached with KhSC no later than 45 days prior to the launch campaign.

6.5.2.1 Voice/FAX

Table 6.5.2.1-1 summarizes the quantities and types of equipment provided by KhSC for voice communications.

Table 6.5.2.1-1: KhSC/ILS-Provided Communications Equipment

Equipment	Model	Provider	Quantity Used By		
			Customer	ILS	Total
Portable radios	Motorola 838 Model B4	KhSC	6*	11*	17*
Portable radio with telephone keyboard	Motorola 838 Model B7	KhSC	7*	16*	23*
Analog telephone (work areas)	AT&T	KhSC	36*	14*	50*
Digital telephone with speaker	AT&T	KhSC	14*	6*	20*
Analog telephone (hotel rooms)	AT&T	KhSC			Each room
SCAPE radios	QB-3R/TR/IS	KhSC	4	-	4

Note: *Additional quantities may be negotiated on a mission-specific basis.

6.5.2.2 Teleconference Networks

ILS and the Customer have access to two dial-in voice networks functioning as intercom networks for each campaign. One dial-in network can support a maximum of seven callers, while the second can be configured to support a maximum of 14 callers. SC Customers are advised to notify ILS/KhSC a minimum of two days in advance of establishing an intercom network. These networks are accessible from any of the phone jacks and mobile phones, as well as from offsite (international) lines.

6.5.2.3 Mobile Radios

Motorola MTX838 B7 portable radios (with keypads) operate through a Motorola SmartWorks trunking system and have access to international lines (access is limited by number of digits in number dialed), as well as phone jacks used by the SC Customer and ILS. Their operational range includes all areas where Customer/ILS personnel are located, including the airfield. The Motorola MTX838 B4 radios (without keypads) can send calls only to other radios in the same area, but can receive from B7 radios and telephones in other areas. During SC fueling operations in Building 92A-50, Hall 103A, Customer personnel are provided with explosion-proof portable radios, ensuring two-way communication during work in SCAPE.

Nominally, each mobile radio is programmed for the two channels for SC Customer/ILS use. Table 6.5.2.1-1 identifies the numbers of mobile radios supplied by KhSC for a launch campaign.

6.5.2.4 Data

Data transfer within the Baikonur facility, as well as to Customer offsite facilities, can be made via a digital network. The use of the following data interfaces is possible: V.35 (64 kbps) and Integrated Services Digital Network (ISDN) BRI S/T (2B+D). RJ45 jacks installed at the launch sites facilities are used to form these interfaces. The Customer is required to supply the appropriate interface equipment to adapt to these digital standards, or the Customer may elect to use analog modems. The Customer will specify termination points required for each digital link in the mission-specific ICD.

Up to four pairs of hardline connections may be provided between the Vault and the Bunker to support modem links to Customer electrical test equipment in the Vault. An ISDN termination is not available in the Vault.

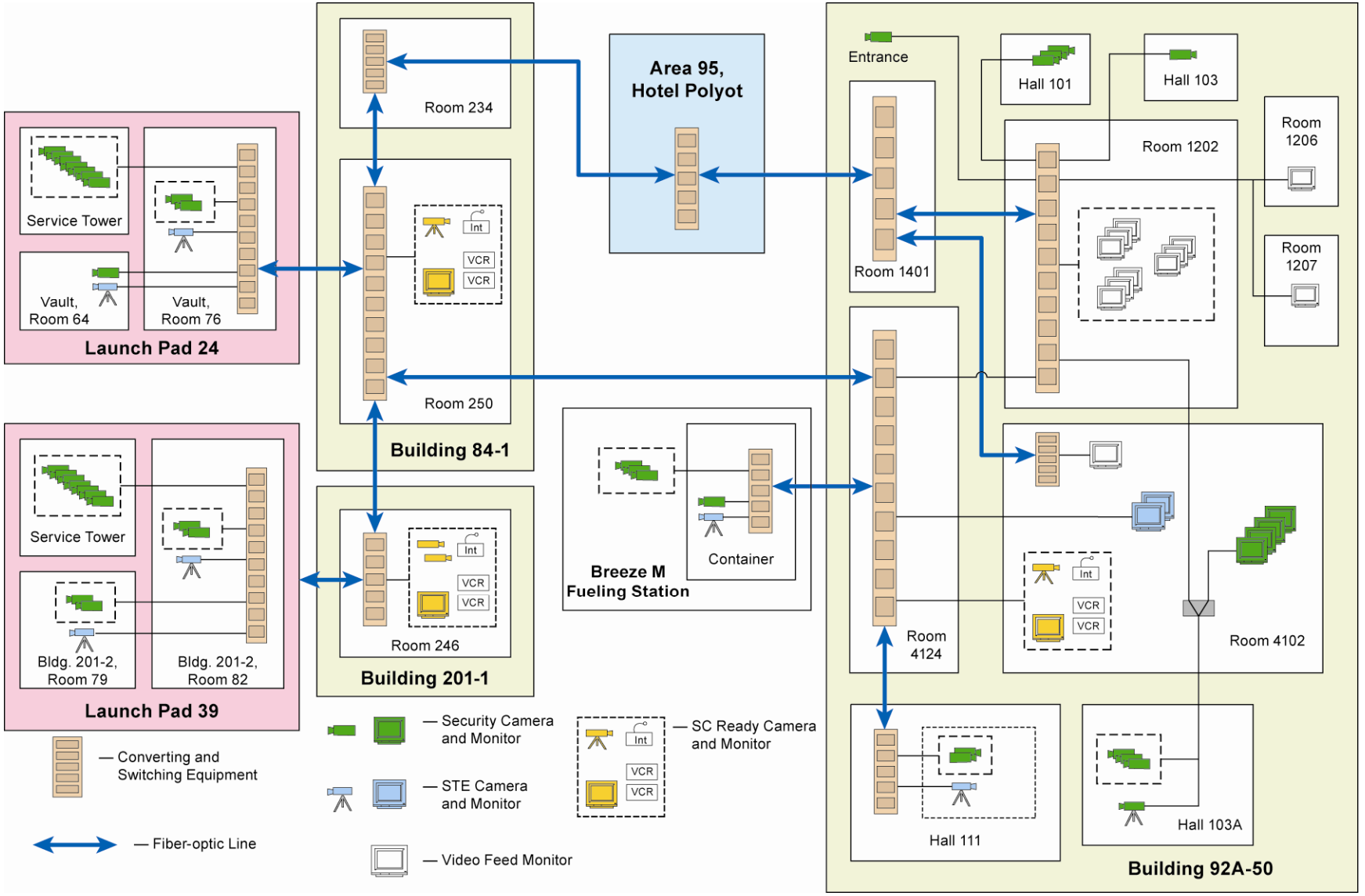
In Building 92A-50, a hardline distribution network is provided between the office areas, control room, and Hall 103A to provide the SC Customer with the option of creating a computer network among these areas.

Access to the Internet is provided through a Moscow Internet Service Provider (ISP) to the hotel areas and Building 92A-50.

6.5.3 Baikonur CCTV Network

Figure 6.5.3-1 provides a schematic diagram of the Closed-Circuit Television (CCTV) network.

Figure 6.5.3-1: General System Block Diagram of Baikonur Cosmodrome CCTV Network



6.5.4 On-Site SC and STE Hardline and Fiber Optic Data Networks

6.5.4.1 Hardline Links

Facility cables are available in Building 92A-50 to provide a copper wire umbilical link between the SC equipment in Hall 101 and Control Room 4102. Electrical characteristics of the cables are provided in Table 6.5.4.1-1.

Table 6.5.4.1-1: Electric Circuit Characteristics of KhSC Permanent Cables

	Quantity of Circuits	Circuit Resistance (Ohm)	Max Voltage (V)	Max Current (A)	Insulation Resistance (Megohm)
Single wire	50	0.63	120	10	≥ 10
Single shielded wire	50	3.15	120	10	≥ 10
Twisted shielded pairs	48 (24 pairs)	3.15	120	10	≥ 10
	48 (24 pairs)	1.05	120	10	≥ 10

6.5.4.2 Fiber Optic Data Network

The locations and characteristics of the fiber optic network are provided in Table 6.5.4.2-1. Descriptions of the fiber optic system interfaces and panels are provided in the facility sections of the PLCG.

6.5.5 RF Links

RF telemetry and command links are provided between the SC on the launch pad and the SC STE in the Building 92A-50 Control Room (Room 4102) from the time of ILV erection until lift-off (see Section 4.2.3 for details).

Table 6.5.4.2-1: Fiber Optic Data Links

From		Number of Lines	To		Notes
Building (Room)	**Interface**		**Building (Room)**	**Interface**	
92A-50 (4102)	ST Fiber Optic Coupler	6	Breeze M Fueling Station	ST Fiber Optic Coupler	Flexible switching (n x 2 lines to any destination)
92A-50 (4102)	ST Fiber Optic Coupler	8	Bunker (Room 250, Area 81)/ Bunker (Room 246, Area 200)/ 92A-50 (101, Work Site 1)/ 92A-50 (101, Work Site 2)/ 92A-50 (111, Work Site 1)/ 92A-50 (111, Work Site 2)/ Pad 24, Vault (Rooms 64 or 76)/ Pad 39, Vault (Room 79)	ST Fiber Optic Coupler	Flexible switching (n x 2 lines to any destination)
92A-50 (4102)	TCP/IP (RJ45 Connector)	2	Breeze M Fueling Station 92A-50 (111, Work Site 1)/ 92A-50 (111, Work Site 2)/ Pad 24, Vault (Rooms 64 or 76)/ Pad 39, Vault (Room 79)	TCP/IP (RJ45 Connector)	Data transmission lines "Control room - Vault (LP 24, LP 39)" and "Control Room - Breeze M Fueling Station" cannot be supported simultaneously.

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