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Soviet Heavy-Lift Launch Vehicle and Space Shuttle Orbiter Facilities, Tyuratam Missile and Space Test Center (S)

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IA 84-10017
March 1984

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Soviet Heavy-Lift Launch Vehicle and Space Shuttle Orbiter Facilities, Tyuratam Missile and Space Test Center (S)

Summary

Information available through 31 October 1983 was used in this report. (U)

A large-scale, integrated facilities construction and modification program is nearing completion at Tyuratam Missile and Space Test Center for the offloading, receipt, assembly, checkout, transport, and launch of a new Soviet heavy-lift-capability space launch vehicle. Several variants of this heavy-lift vehicle probably are being developed, one of which will be used to launch the Soviet space shuttle orbiter. Shuttle orbiter landing and processing facilities also are being built at Tyuratam.

Construction of new facilities and modification of existing ones for the heavy-lift vehicle began in 1978. New booster facilities include a single-pad launch site, two launch control centers, a high-bay vehicle processing building, and miscellaneous support areas. Facilities under modification include a twin-pad launch site, a vehicle assembly and checkout area, a payload and upper stage assembly and checkout area, and several support and housing areas.

Facilities for the space shuttle orbiter include a large airfield, begun in 1979, and a twin-bay orbiter maintenance and checkout building, begun in 1981. Several other facilities, including the new high-bay vehicle processing building, will support both shuttle orbiter and heavy-lift vehicle processing activities.

Initial heavy-lift vehicle/launch pad compatibility testing occurred in October 1983. Completion of the first launch site and most of the launch vehicle and shuttle orbiter support facilities is expected in 1984 or 1985, with nonshuttle launch operations possibly beginning about mid-1985. The first launch with the shuttle orbiter is expected no earlier than late 1985.

The basic heavy-lift vehicle consists of a core booster and four strap-on, thrust-augmentation boosters. The core booster has two or three main propulsion engines and will use high-energy liquid oxygen and liquid hydrogen propellants. The strap-on boosters will use liquid oxygen and probably a hydrocarbon-based fuel such as kerosene. Large payloads, such as the shuttle orbiter, and possibly payloads with attached upper stages will be mounted to the side of the core booster. Future variants of the heavy-lift vehicle may have differing numbers of strap-on boosters, use high-energy-propellant upper stages, and be able to accommodate either side- or top-mounted payloads.

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Successful development of the heavy-lift launch vehicle and its variants will enable the Soviets to orbit up to 150 metric tons. With this launch vehicle, the Soviets will be able to conduct shuttle orbiter missions similar to those flown by the US; launch large payloads such as space station modules; and, with the development of upper stages, conduct flights to the moon and planets.

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Soviet Heavy-Lift Launch Vehicle and Space Shuttle Orbiter Facilities, Tyuratam Missile and Space Test Center (S)

Introduction

The Soviets are in the late stages of a large-scale, high-priority construction project at Tyuratam Missile and Space Test Center to provide support and launch facilities for a new heavy-lift launch vehicle (HLLV). Variants of the HLLV will be used for launching the Soviet space shuttle orbiter and probably numerous other payloads. The facilities under development at Tyuratam include those required for the offloading, receipt, assembly, checkout, transport, and launch of the HLLV and its variants. Landing and processing facilities for the shuttle orbiter and assembly/checkout facilities for other HLLV payloads are also being built or modified. Most of the facilities at Tyuratam for the HLLV have been under construction or modification since 1978 and are expected to be operational in 1985 or 1986. (S [redacted]

The HLLV under development is the successor to the SL-X-15 (formerly the TT-5) booster, which was to have been used in the Soviet manned lunar landing program. After three successive launch failures between 1969 and 1972, the SL-X-15 program was cancelled in early 1974. Most, if not all, of the facilities at Tyuratam originally built for the SL-X-15 booster and payload programs are being extensively modified for the new HLLV program [redacted] since at least 1976 a new three-stage space launch vehicle has been under development by the V. P. Glushko design bureau, which also designed the SL-X-15. The new booster [redacted] being smaller than the SL-X-15 and employing high-energy liquid oxygen (LOX) and liquid hydrogen (LH) propellants. We believe this launch vehicle is the new HLLV. (S [redacted] 25X1

The new HLLV is composed of several large components which are mated together to form the launch vehicle. The basic vehicle consists of a 59-meter-long [redacted] core booster and 25X1 four strap-on thrust-augmentation boosters, each about 40 meters in length and 4.0 meters in diameter (see appendix). The core booster has two or three main propulsion engines and will use LOX and LH propellants. The strap-on boosters are derived from the first stage of the SL-Y, a medium-lift space launch vehicle also under development at Tyuratam, and will use LOX and probably a hydrocarbon-based fuel such as kerosene. (S [redacted] 25X1 25X1

The payload-lift capability to low earth orbit for the HLLV and its variants will probably range from 100 to 150 metric tons. The basic HLLV probably will be able to orbit about 100 metric tons. An HLLV variant employing a high-energy-propellant upper stage should be able to place about 150 metric tons into low earth orbit. These launch capabilities will enable the Soviets to pursue a wide variety of space missions. The launch of their space shuttle orbiter on the basic HLLV will allow them to conduct missions similar to those flown in the US shuttle program. In addition, other heavy, earth-orbital payloads such as large space station modules; heavy, unmanned interplanetary spacecraft; and, eventually, manned missions to the moon and Mars probably will be launched using the HLLV and its variants. (S [redacted] 25X1 25X1 25X1 25X1 25X1

Space Launch Site W

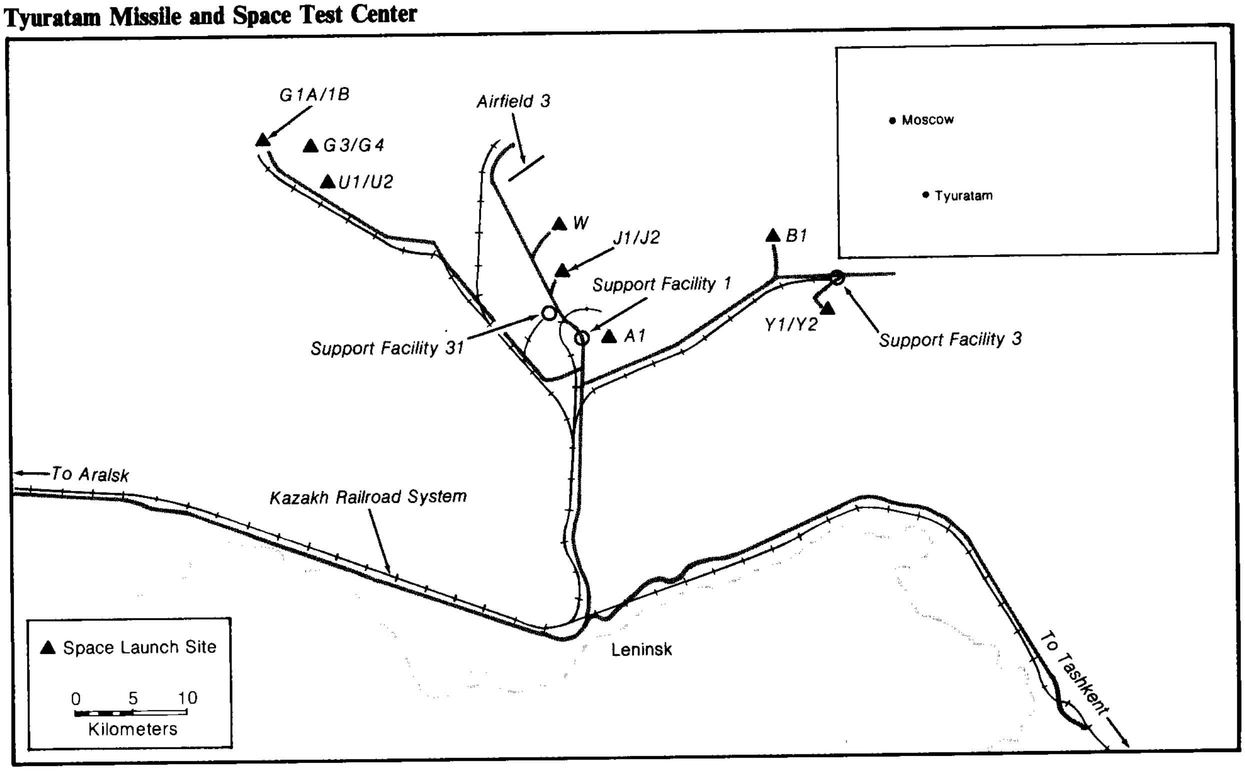
Space Launch Site W, one of two launch areas for the HLLV at Tyuratam, is under construction about midway between Launch Site J and Airfield 3 (figure 1). The launch site is configured to support the launch of an HLLV (designated SL-W by the Intelligence Community) with four strap-on boosters and a side-mounted payload, such as the space shuttle orbiter. This site may also be capable of accommodating side-mounted payloads with upper stages. (S [redacted] 25X1

Ground breaking for Launch Site W occurred in May 1978 and actual launch pad construction began in August 1979. In October 1983, the site was in a late stage of construction and a prototype HLLV (without payload) was brought to the pad for the initial series of launch pad compatibility checkout tests. Based on the current pace of construction, completion of the launch site may occur by late 1984 or early 1985 and initial nonshuttle launches may begin in mid-1985. The first launch of the space shuttle orbiter is expected no earlier than late 1985. (S [redacted] 25X1

The major features of the launch site include the launch pad and its associated booster and payload service structures, flame pit, exhaust chute, lightning arresters, and illumination towers; bunkered propellant-related facilities; propellant storage facilities using spherical tanks; and miscellaneous propellant-related facilities (figure 2). Support facilities constructed in the vicinity of the launch site include a construction worker housing area, a launch control center with two associated probable support buildings, two materials receiving areas, a steam heating plant, and an unidentified building which will provide some form of support. (S [redacted] 25X1 [redacted] 25X1

Figure 1

Tyuratam Missile and Space Test Center



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Launch Area

The launch area consists of a single launch pad and launch vehicle support and service structures located near the launch pad (figure 3). The launch pad and its C-shaped pad substructure, as well as the flame pit, are located at the base of a triangular excavation which was 525 meters long, 220 meters wide, and 45 meters deep at the start of pad construction. Construction of the pad substructure began in August 1979 and the substructure now supports the 84-meter-long by 62-meter-wide steel-reinforced-concrete launch pad. A 30-meter-wide by 40-meter-high curved flame deflector is enclosed on three sides by the pad substructure and is water cooled. An underground building, about 58 meters long and 40 meters wide, was built adjacent to and level with the west side of the launch pad. Propellant, propellant-support, and utility lines run into this building and probably are distributed to facilities at the launch pad for servicing the HLLV. A 14-meter-long, 30-meter-wide, [redacted] launch vehicle support pedestal is located on the launch pad, above the flame deflector. The pedestal is configured for an HLLV with four strap-on boosters, each 4.0 meters in diameter. Besides structural support for the HLLV, the pedestal probably will provide electrical, mechanical, and hydraulic connections to the HLLV. Engine exhaust from the launch vehicle will be directed downward through the pedestal and then deflected into the flame pit and exhaust chute during lift-off. Water spray nozzles for cooling the pedestal and flame deflector and for suppressing launch noise vibrations probably are located in or on the launch pedestal, but they have not yet been identified. (S [redacted]

Once the HLLV has been erected on the pad, it will be serviced by both fixed and mobile service structures (figure 3). The fixed service structure (FSS) is a 10-meter-square by 69-meter-high open steel framework which is located adjacent to the launch vehicle support pedestal and will be used for loading the cryogenic propellants onto the core booster of the HLLV. Two probable propellant-loading umbilicals, one for LH and one for LOX, have been identified on the FSS and each has been seen in extended and retracted positions. The two umbilicals, which are swung into or out of position, are mounted on the FSS at about [redacted] 46 meters above the pad surface. The position of each umbilical relative to that of the erected HLLV's core booster indicates that the lower propellant umbilical probably will be used for LH and the upper umbilical probably will be used for LOX. (S [redacted]

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The mobile service structure (MSS) is a large gantrylike structure mounted on a 34-meter-gauge rail line which will provide access to and around an erected HLLV and payload. The MSS is about 77 meters tall and has a clear span between its side support towers [redacted] Ten service platforms are attached to the MSS support towers at elevations from about [redacted] 64 meters above the pad surface. The platforms are hinged and can be swung into and out of position around an erected HLLV and its side-mounted payload. Furthermore, the platforms are mounted to the MSS in a manner that indicates that the space shuttle orbiter is one of the intended payloads for the HLLV. When hinged in the open position, the lowest four MSS platforms will allow about [redacted] ance for each shuttle wing when the MSS is being moved into or out of position. No platforms for orbiter payload bay or cosmonaut access have been identified on the MSS. (S [redacted]

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Two lightning arresters and four illumination towers are positioned around the launch pad (figure 2). The lightning arresters, each 222 meters tall, are located about 135 meters north and south of the launch point. In addition to the four illumination towers, banks of lights are mounted on the lightning arresters. (S [redacted]

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Two bunkered possible compressed-air facilities are located about 245 and 208 meters north and south, respectively, of the launch point (figure 2). Both facilities consist of six adjoining arched-roof buildings, each about 14 meters long and 14 meters wide, and are connected by underground conduit to the launch pad area. Small, upright, cylindrical objects, possibly tanks, were observed on palletlike platforms adjacent to the facilities during construction. These possible tanks were subsequently installed in the facilities and may be used for the storage of compressed air, which will be required for the control of pneumatic equipment at the launch pad. (S [redacted]

Propellant-Related Facilities
Storage, conditioning, and pumping facilities for liquid propellants are under construction west of the launch pad area and are connected to the launch pad by underground conduits or elevated pipe galleries. These facilities include four major bunkered facilities, probable LH and LOX storage facilities, and several miscellaneous facilities (figure 2). (S [redacted]

Bunkered Facility A. This possible propellant- or utilities-related facility is located about 220 meters west of the launch point and consists of five adjoining arched-roof buildings, each about 119 meters long and 14 meters wide. The buildings are individually vented and are connected by conduits to the underground launch pad support building. No storage tanks have been associated with the buildings, suggesting that the facility may be used for propellant-related purposes, such as temperature conditioning and pumping, or for utilities, such as housing electrical equipment. (S [redacted]

Bunkered Facility B. This possible propellant temperature-conditioning or pumping facility is adjacent to the south side of Facility A and consists of an 88-meter-long by 14-meter-wide arched-roof building and eight adjoining arched-roof buildings, each about 44 meters long and 14 meters wide. Although the facility layout is similar to that of a bunkered LOX storage facility at site J used during the SL-X-15 program, no storage tanks have been associated with these buildings. The facility is connected by conduits to Bunkered Facility D, which probably is used for kerosene propellant storage, and to the launch pad, suggesting that it may be used for propellant temperature conditioning or pumping. (S [redacted] 25X1

Bunkered Facility C. This water storage and possible air conditioning equipment facility is on the south side of Facility B and consists of two arched-roof equipment buildings, both about 121 meters long and 14 meters wide; a third arched-roof equipment building about 80 meters long and 14 meters wide; and three concrete water storage vaults, each about 36 meters square and 6 meters high. The facility is connected by conduits to the launch pad and is similar to a facility at the former SL-X-15 launch site that was used for water storage and to house air conditioning equipment. Water stored here probably will be used to cool the flame deflector and launch pad surface during launch of the HLLV. (S [redacted] 25X1 25X1 25X1

Bunkered Facility D. This probable kerosene propellant storage facility is located south of Facility C and consists of three arched-roof buildings, two of which are about 63 meters long and 14 meters wide, and a third which is about 98 meters long and 14 meters wide. This facility houses at least six and probably eight [redacted] 3.0-meter-diameter propellant storage tanks, each with a capacity of about 170,000 liters, and is connected by conduits to Facility B and the launch pad. (S [redacted] 25X1 25X1 25X1

Probable LH Storage Facility. A probable LH storage facility is located about 850 meters northwest of the launch point and contains four double-walled spherical tanks, each with a capacity of about 1.43 million liters (figures 2 and 4). The tanks are storage dewars; each consists of a 16-meter outer tank and a 14-meter inner tank and 25X1 25X1

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provides an insulated environment for prolonged storage of the cryogenic fuel.[1] The four tanks are interconnected and have a common rail-served off-loading area. Fuel apparently can be transferred from one tank to another by means of an extensive intertank piping system. The tanks are also connected by pipeline to adjacent banks of upright cylinders, [redacted] These cylinders—a total of 32—possibly are refrigeration units for cooling the stored LH and for recovery of condensed hydrogen vapor, thus minimizing cryogenic liquid losses from boil-off. Two bunkered arched-roof buildings have been built in the vicinity of the spherical tanks, possibly for housing special environmental-control and pumping equipment for the fuel. A hydrogen burn area is located immediately north of the probable LH storage facility and contains several flare stacks. (S [redacted]

[redacted] the new HLLV may use a combination of liquid and solid hydrogen, also known as slush hydrogen, for its high-energy fuel. The higher density of slush hydrogen versus liquid hydrogen would allow the Soviets to store a greater amount of LH in a given volume, thereby reducing the size and weight of the LH tanks required for the launch vehicle. The lower temperature of the slush hydrogen also would result in less hydrogen loss due to venting. (S [redacted]

The LH capacity of this storage facility (about 5.7 million liters) is much greater than the quantity of LH required for tanking a single HLLV (estimated at between 1.5 and 1.8 million liters).[2] Therefore, if slush hydrogen is used in the HLLV, two of the four LH storage tanks may be used primarily for receipt and storage of LH, while the other two could be used for conditioning the LH into a slush state and for maintaining such a condition by means of recirculation. (S [redacted]

[1]A dewar is a twin-walled container which functions as a vacuum bottle. The space between the walls is evacuated of air and usually filled with insulation in order to prevent heat transfer to stored liquids, especially liquified gases. (U)

[2]Estimate based on a calculated approximate volume of LH contained in the HLLV (1.5 million liters) plus up to an additional 300,000 liters for venting and boil-off during tanking activities. (S [redacted]

Probable LOX Storage Facility. A probable LOX storage facility is located about 700 meters northwest of the launch point and consists of two groups of three double-walled spherical storage tank dewars, for a total of six tanks (figures 2 and 4). The tanks are identical in size and capacity to those in the LH storage area. LOX apparently can be transferred by pipeline between spherical tanks within a group or between the two groups by an extensive piping system. Connected to both groups of tanks are 16 cylindrical possible refrigeration units [redacted] which may be used for cooling the stored LOX and for recovery of condensed oxygen vapor, thus minimizing cryogenic liquid losses from boil-off. Colocated with the piping system of the southernmost group are two cylindrical probable cryogen storage tanks, possibly used for storing liquid nitrogen for pressurization or purging of pipelines and tanks. In addition, two bunkered arched-roof buildings have been built between the two groups of spherical tanks, possibly for housing environmental-control and pumping equipment for the oxidizer. (S [redacted]

[redacted] the new HLLV may use LOX which has been subcooled from 25 to 30 degrees Celsius below the boiling point.[3] Since the LOX capacity of this storage facility (about 8.6 million liters) is much greater than the quantity of LOX required for tanking a single HLLV (estimated at between 1.4 and 1.8 million liters), several of the spherical tanks could be used for LOX storage while others could be used for subcooling LOX and for maintaining such a condition by means of recirculation.[4] (S [redacted]

An elevated pipe gallery has been built for the transfer of cryogenic propellants between the tanks at the probable LH and LOX storage facilities and the fixed service structure at the launch pad. Two

[3]For LOX, subcooling involves cooling the liquid to a temperature below that of its boiling point (-183°C) but above that of its freezing point (-220°C). (U)

[4]Estimate based on a calculated minimum volume of LOX contained in the HLLV (1.4 million liters) plus up to an additional 400,000 liters for venting and boil-off during tanking activities. (S [redacted]

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arched-roof bunkers are located along and connected to the pipe gallery by underground conduits and may house equipment designed for temperature conditioning and monitoring of the transfer pipelines during propellant loading and unloading operations. The larger of the two bunkers is about 122 meters long and 14 meters wide and also houses two cylindrical cryogen storage tanks, [redacted] and associated equipment. No tankage has been associated with the second bunker, which is about 47 meters long and 14 meters wide. (S [redacted]

Other Propellant-Related Facilities. Several other propellant-related facilities support Launch Site W. A probable POL storage facility is situated between the probable LH and LOX storage facilities and consists of four dark-toned cylindrical storage tanks, [redacted] and a 39-meter-long by 14-meter-wide arched-roof building (figure 2). This facility is bunkered and may store fuel to run on-site generators, compressors, and pumps. (S [redacted]

A probable LOX drainage area is located about 240 meters south of the launch point and contains a probable drainage pond and three possible collection tanks (figure 2). This area is connected to the launch pad fixed service structure by an elevated pipeline and is similar to, but larger than, an area at Tyuratam Space Launch Site Y where probable LOX drainage/venting has been identified. (S [redacted]

A high-pressure gaseous helium storage facility is located about 500 meters west of the launch point and contains 44 cylindrical tanks, each about 25 meters long [redacted] An adjacent, 119-meter-long by 14-meter-wide, arched-roof building probably will regulate the pressurized gas. (S [redacted]

A facility consisting of an induced-draft water cooling building and two support buildings is under construction about 725 meters west of the launch point (figure 2). The induced-draft cooling building is about 78 meters long, 18 meters wide, and 9 meters high and will house six eight-meter-diameter fans. The building is connected by underground pipelines to the bunkered facilities. Two support buildings are located adjacent to the induced-draft cooling building. One of these is about 92 meters long, 12 meters wide, and 9 meters high and the other is about 21 meters long, 12 meters wide, and 25X1
8 meters high. (S [redacted] 25X1

An extensive underground conduit network is under construction throughout Launch Site W for 25X1
propellants, pressurized gases, utilities, and cabling. 25X1
In addition, an underground conduit, which transitions to an aboveground cable and utilities gallery, has been installed between the launch pad and a support area south of the launch area. (S [redacted] 25X1 25X1

Support Facilities 25X1

A large housing area for construction workers and 25X1
a launch site control, storage, and services area are also located at Launch Site W. (S [redacted] 25X1 25X1 25X1

Construction Worker Housing Area. The housing area is about 1 kilometer (km) west of the launch area and extends southward for about 3 km (figure 2). Construction of this area began in 1978, and since 1980 the number of single-story barracks has more than doubled—from about 80 to about 170. The last of the barracks were completed and appeared to be occupied in mid-to-late 1983, indicating that construction manpower probably was at 25X1
or near peak levels during the second half of 25X1
1983. (S [redacted] 25X1

Launch Site Control, Storage, and Services Area. The second Launch Site W support area is located about 3.4 km southwest of the launch area and 25X1
consists of a bunkered launch control center (LCC), two probable LCC-support buildings, a probable liquid nitrogen (LN) storage building, a materials/ 25X1
components receiving and storage area, and a steam heating plant (figure 5). The LCC is about 68 meters long, 43 meters wide, and 18 meters high.

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This facility will support the prelaunch checkout, launch countdown, and launch of the HLLV and payload. The LCC is constructed of reinforced-concrete sections, has three levels, and is connected by an underground conduit to an aboveground cable and utilities gallery that runs to the launch pad area. The two buildings that are adjacent to the LCC probably will provide personnel and technical services, including computer-related support for launch operations. At least one, and probably both, of the buildings are connected by conduit to the LCC. (S [redacted]

A probable LN storage building is under construction near the LCC and is connected by pipeline to the launch site area. The building, about 140 meters long and 60 meters wide, is the largest in this support area and consists of six rectangular sections. The LN is probably stored in four cylindrical tanks, each about 23.0 meters long [redacted] which are housed in one section of the building. Probable cryogenic rail tank cars have been observed on a rail siding adjacent to this section. (S [redacted]

A large materials/components receiving and storage area with a single gantry crane and large concrete aprons is located southwest of the LCC. The facility is rail and road served and has been used to store launch site equipment, including large propellant and pressurized-gas storage tanks. A large, high-bay probable component warehousing facility is under construction along the southwest side of the receiving area. The warehouse is about 96 meters long, 53 meters wide, [redacted] craneway-equipped high-bays. (S [redacted]

A steam heating plant housing four boilers is under construction west of the LCC. A steamline from the plant runs along an overhead gallery to Launch Site W. A rail-served fuel offloading area and a vaulted fuel storage facility have been built adjacent to the plant. (S [redacted]

Other support facilities located in the Launch Site W vicinity include an electric substation and a large construction materials receiving area. The substation is located north of the steam heating plant and serves the launch area and the construction housing area. The construction materials receiving area is located about 4 km south of the launch area and has multiple rail sidings. Five gantry cranes and at least two traveling cranes have been identified in this area. (S [redacted] 25X1

Space Launch Site J

Space Launch Site J was built in the mid-to-late 1960s and was used for launching the SL-X-15 booster. The site consists of two launch pads and support/servicing facilities which are being extensively modified for the launch of the new HLLV. Launch Site J is about 5 km southeast of Launch Site W and about 4 km north of Support Facility 31—the HLLV assembly and checkout area (figure 1). Major alterations to the two launch pads—J1 and J2—include modifications of the rotating service structure (RSS) and launch pad aperture and the construction of new underground support buildings. In addition, new propellant and utilities facilities are being built and others are being modified in the launch area (figure 6). The similarities between the new facilities at Launch Site J and those at Launch Site W indicate that the sites will be capable of supporting launches of the basic HLLV. (S [redacted] 25X1 25X1 25X1 25X1 25X1

Modification of Launch Site J began in 1978 and is continuing. Debris from the site was first noted in August 1978 and was associated with the removal of propellant-related equipment. Dismantlement and alteration of the RSS and aperture components of each launch pad and construction of new propellant-related facilities began in 1979. Although work at launch pad J2 is proceeding ahead of that at pad J1, the sequence of activities at both pads appears to be identical. Based on the current pace of construction, pad J2 may be completed in 1986 or 1987 and launch pad J1 in the late 1980s or early 1990s. (S [redacted] 25X1 25X1 25X1 25X1 25X1

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Launch Area

Launch pads J1 and J2 both have an RSS, a pad aperture, three exhaust flumes, and ancillary equipment such as lightning arresters and illumination towers. In addition, three adjoining underground probable propellant and utilities distribution buildings for support of HLLV servicing operations are being built at launch pad J2 (figure 7). (S [redacted]

The RSS at each launch pad, formerly 145 meters high, has been partially dismantled and both structures are currently about 100 meters high. In addition, all SL-X-15-associated service platforms, piping, and support equipment were removed from the service structures. Reconfiguration of the RSS at launch pad J2 began in 1983 when a service platform mounting framework was installed on the service structure between 33 and 48 meters above the pad surface. Assembly of at least two booster servicing arms for this framework began in early 1983 at the base of the J2 RSS (figure 7). Both arms have servicing platforms with cutouts for two HLLV strap-on boosters, indicating that an HLLV with at least four strap-ons can be accommodated. The assembly and installation of additional service platforms, as well as propellant-loading umbilicals, is expected. Reconfiguration of the J1 RSS had not begun by late 1983, but it probably will be identical to the one at pad J2. (S [redacted]

Each launch pad has a 20-meter-diameter aperture which is being reconfigured to accommodate the new HLLV. Former SL-X-15 booster-related structures, including a [redacted] cylindrical booster support pedestal, have been removed from the pad aperture. This pedestal was mounted inside the aperture and provided structural support for the launch vehicle; electrical, mechanical, and hydraulic connections to the first stage of the SL-X-15; and engine exhaust channeling during lift-off. A new HLLV support pedestal will have to be constructed over each pad aperture, and these may be similar to the one at Launch Site W. (S [redacted]

In late 1982, assembly of components for a circular probable pad reinforcement structure began on the rail approach to pad J2. The washerlike structure has a 30-meter outer diameter and a 20-meter inner diameter and it appears to be constructed of reinforced-steel segments (figure 7). It probably will be installed around the pad aperture to provide support for an HLLV support pedestal. (S [redacted] 25X1 25X1

The basic Y-shaped layout of each launch pad's exhaust flumes will be retained for the HLLV. However, the pyramidal flame-splitter in the base of the pad J2 aperture appears to have been refurbished and modified to accommodate the HLLV strap-ons. The area around the three sides of the flame-splitter has been deepened and, on at least one of these sides, a wall is being built from the base of the splitter into the exhaust flume, dividing that section of the flume in two. This modification will enable exhaust from two HLLV strap-ons to be effectively channeled through each of the three flumes, suggesting a potential capability for launching not only a four strap-on HLLV from this pad, but also a six strap-on variant of the HLLV. Similar modifications in the pad aperture are expected to take place at pad J1. (S [redacted] 25X1 25X1 25X1 25X1

Construction of three underground buildings around the J2 launch pad aperture has been under way since late 1982. The buildings are being built up to pad level and probably will be used for the distribution, control, and monitoring of propellants, high-pressure gases, electricity, and other utilities for the pad—functions probably like those performed by the underground support building adjacent to the pad at Launch Site W. (S [redacted] 25X1 25X1 25X1

New or modified lightning arresters and illumination towers will be used at both launch pads. The illumination towers around launch pad J2 have been removed and probably will be replaced. In addition, reinforced-concrete hardstands are being built near pad J2 and may be used to support new illumination towers or lightning arresters. (S [redacted] 25X1 25X1

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Propellant-Related Facilities

Existing propellant-related facilities are being renovated and new facilities are being built at Launch Site J for the HLLV. Also, an extensive network of interpad conduits for propellant transfer operations is under construction. The completed propellant facilities will probably be similar, if not identical, in layout and function to the propellant facilities at Launch Site W. (S [redacted]

Extensive renovation is under way on the interpad bunkers which housed LOX storage tanks, water tanks and air conditioning equipment, compressed air tanks, and a site control center for the SL-X-15. By late October 1983, all but the fuel storage and fuel temperature control bunkers had been at least partially unearthed. Six 34-meter-long [redacted] LOX storage tanks were removed from their bunkers, probably in preparation for bunker modification and the installation of new tanks. Old propellant-related piping and debris have also been seen around the interpad bunkers. We have not observed any major modifications other than new conduit connections to several of these bunkers. However, new propellant tanks have been delivered to the site. (S [redacted]

Major new propellant storage and support facilities are under construction both on- and off-site. These include a group of five arched-roof propellant- or utilities-related buildings, probable LH and LOX storage facilities, a probable POL storage facility, a high-pressure gaseous helium storage facility, and an extensive interpad conduit network (figure 6). The five arched-roof buildings are under construction on site between the two transporter/erector rail approaches. Each building is about 14 meters wide and 106 to 113 meters long and will possibly house utility equipment or serve a propellant-support function other than storage, since no tank installation has yet been identified. This group of buildings is similar in design and layout to Bunkered Facility A at Launch Site W, which may be used for propellant- or utilities-related purposes. (S [redacted]

A probable LH storage facility is under construction about 750 meters north of the launch pads at site J. The facility consists of four interconnected, double-walled, spherical tank dewars, each with a 16-meter-diameter outer tank and a 14-meter-diameter inner tank, and bunkers and support equipment. The LH will be pumped through an elevated pipe gallery and underground conduits to the launch area. The layout of the tanks and the associated cylindrical possible refrigeration units is almost identical to that at Launch Site W. (S [redacted] 25X1 25X1

A probable LOX storage facility is located about 750 meters north of the launch pads at site J. The facility consists of two groups of three interconnected, double-walled, spherical tank dewars, each identical in size and capacity to those at the probable LH storage facility. The LOX will be pumped through an elevated pipe gallery and underground conduits to the launch area. The layout of the tanks and the associated cylindrical possible refrigeration units is similar to that at Launch Site W. (S [redacted] 25X1 25X1 25X1

A probable POL storage facility is under construction between the probable LH and LOX storage facilities. Four dark-toned cylindrical storage tanks, [redacted] and a 39-meter-long by 14-meter-wide, arched-roof building probably will be used for storing fuel to run on-site equipment such as compressors, motors, and generators. A nearly identical facility is located at Launch Site W. (S [redacted] 25X1 25X1 25X1 25X1

Other propellant-related facilities under construction at Launch Site J include a high-pressure gaseous helium storage facility which is nearly identical to its counterpart at Launch Site W. The completed storage facility will contain 44 cylindrical gas storage tanks, each about 25 meters long [redacted] An extensive network of interpad and off-site conduits also is being built. The conduits will accommodate propellant, pressurized gas, utility, and cabling lines and will connect with underground support buildings adjacent to the pad aperture. Conduits for probable instrumentation cabling and utility lines also are under construction from the launch area to Support Facilities 31 and 1 (figure 6). (S [redacted] 25X1 25X1 25X1 25X1

Support Facilities

Two materials receiving areas and a construction worker housing area are associated with Launch Site J. A rail- and road-served materials/components receiving and storage area with 11 buildings, a gantry crane, and concrete aprons has been built on site, west of launch pad J2 (figure 6). Another rail- and road-served construction materials receiving and storage facility with three gantry cranes is located between sites J and W and may be associated with site W also. A large construction worker housing area south of Launch Site J was started in mid-1978 and, although occupied, is still being expanded. (S [redacted]

Airfield 3

A new landing facility, designated Airfield 3, has been built about 5 km northwest of Launch Site W to support shuttle orbiter landings and to receive air-ferried booster components and orbiters (figure 1). This facility includes a concrete runway—the third at Tyuratam and one of the largest in the Soviet Union; a transloading facility; and a large operations control building (figure 8). The runway is 4,500 meters long and 84 meters wide and was constructed along [redacted] The first survey line for the runway was laid between October and December 1977, and in November 1978 housing for construction workers was started about 2 km west of the survey line. Grading for the runway began in March 1979 and concrete paving probably started in May 1979. Paving of the runway was partially completed and the transloading facility was completed in 1982. In late December 1982, a modified Bison carrier aircraft and two support aircraft were parked at Airfield 3, indicating that the runway was capable of supporting booster component deliveries. Runway paving and turnaround apron construction were completed by mid-1983. Runway grooving was under way in 1983 and 400-meter-long unpaved runway overruns were being added in late 1983. Numerous landing aids facilities have been or are being built to the south, north, and adjacent to the runway to provide final approach data to returning orbiters or transport aircraft. Wide-radius-turn roadways have been constructed for the transport of orbiters and booster components between Airfield 3 and Support Facility 31. (S [redacted] 25X1

The runway was constructed using the continuous-strip method, which involved pouring probable high-grade concrete in two layers of overlapping strips over a prepared subsurface. Each strip is 7 meters wide [redacted] indicating 25X1
that the runway has a total thickness of at least 1.0 meter. By comparison, the US shuttle runway at Kennedy Space Center [redacted] The top 25X1
layer of the Soviet runway was reinforced with 25X1
square steel grids, giving the runway a very high load-bearing capability. This high strength will permit the Soviets to land or take off reusable spacecraft and transport aircraft which are much heavier than the shuttle orbiter or modified Bison aircraft. (S [redacted] 25X1

The transloading facility at Airfield 3 is used for the delivery or shipment of the large, air-ferried HLLV core booster components and will be used for the delivery or shipment of space shuttle orbiters. The facility is adjacent to the north side of the runway and consists primarily of two offset, rail-mounted gantry cranes that are about 60 meters 25X1
wide and 20 meters above the ground. The cranes 25X1
are mounted on a 270-meter by 90-meter concrete apron and are built for lifting the booster components and shuttle orbiter off of or onto the top of a modified Bison carrier aircraft when it is positioned beneath them. A similar transloading facility is located at Ramenskoye Flight Test Center, where mated testing of core booster components and the shuttle orbiter with modified Bison aircraft has been conducted. A transloading facility also is located at Kuybyshev Aerospace Production Plant 1, where production and direct air shipment of core booster components originate. (S [redacted] 25X1
25X1

A large probable operations control building is on the north side of the runway, east of the transloading facility. The building consists of a main five-story section about 126 meters long, 19 meters

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wide, and 27 meters high and an attached multi-story wing [redacted] and faces the runway. Atop the roof of the main section are five probable antenna mounting platforms, each about six meters square. The presence of these platforms indicates that the building will probably provide telemetry receipt, tracking, and computer support during shuttle missions and landing operations. The attached wing eventually may house a control tower. (S [redacted]

Other construction at Airfield 3 includes a 380-meter by 141-meter concrete hardstand apron, several buildings to garage runway support vehicles, a steam heating plant, and miscellaneous small support buildings. Road, rail, and utility lines connect Airfield 3 facilities with Launch Sites W and J and Support Facility 31. (S [redacted]

Support Facility 31

Support Facility 31 is 4 km south of Launch Site J and was originally designed to support the SL-X-15 booster. Existing buildings at the facility are being modified for the receipt, assembly, checkout, and transport of the new HLLV and its variants. New buildings for the maintenance and checkout of the shuttle orbiter and for payload propellant loading and mating to the HLLV are under construction. Also, an LCC for Launch Site J is under construction adjacent to the launch control bunker used for the SL-X-15 program. Other areas within Support Facility 31, such as the construction worker and civilian housing complexes, have been refurbished and reoccupied (figure 9). New worker housing, motor pool areas, electric substations, materials receiving areas, a concrete batch plant, and a steam heating plant have been or are being added in the support facility. (S [redacted]

Vehicle Assembly and Checkout Building

A large vehicle assembly and checkout building (VACB) was constructed in the mid-1960s to support SL-X-15 booster processing—component receipt, assembly, integration, and checkout prior to transfer to the launch pad. The building has since been renovated and modified to support similar tasks for the HLLV. The renovation and modification work probably began shortly after the SL-X-15 25X1 program was cancelled. Between 1974 and 1977, we 25X1 observed railcar movements into and out of the VACB and vicinity which were probably related to the removal of tooling and components for the SL-X-15 booster. Six of nine roof-mounted telemetry checkout antennas were removed between early and mid-1974 and the remaining three were removed in mid-1979. Only a small latticework tower has since 25X1 been installed and it may be intended for short- 25X1 range communications. In April 1978, derelict SL-X-15 propellant tank hemispheres were removed from the VACB. Large tooling, jigs, frameworks, and crates formerly used for the SL-X-15 program also were removed from the building beginning in 1978. Three additions to the VACB have been built since mid-1978 and two of these probably were mandated by differences in vehicle design and proc- 25X1 essing flow between the SL-X-15 and the HLLV (figure 10). (See the appendix for a description of vehicle design and processing flow.) The third addition probably will provide technical support or personnel services. (S [redacted] 25X1

A clear-span addition has been built on the east side of the VACB and probably is used for the receipt and inspection of the HLLV core booster components. The addition is 78 meters long, 36 meters wide, and 32 meters high and has a craneway with a usable height of about 16 meters. The size and features of the addition, which is accessed by wide-radius-turn roadways, indicate that it probably is intended for receipt and inspection of the two large components for the HLLV core booster. A road-served door about 13 meters wide and 13 meters high has been installed on the east end of the wing and a rail-served door [redacted] 25X1 is present on the addition's 25X1 south wall. The addition is adjoined on its south side by a 54-meter-long, 12-meter-wide, [redacted] 25X1 administrative-service annex. (S [redacted] 25X1 25X1

The second addition, a probable core booster transfer air lock, is located on the north side of the VACB. It is about 81 meters long, 18 meters wide, and 19 meters high. The addition is rail served and has an access door on the north end which is about

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[redacted] Based on its size and features, this addition probably is used as an air lock for the transfer of the assembled HLLV core booster from its environmentally controlled, final-assembly section to an area in the VACB for integration with the strap-on boosters. An assembled core booster on a rail transporter [redacted] on the north side of the VACB in probable preparation for movement into one of the two HLLV final assembly and checkout high-bays for strap-on attachment. (S [redacted]

A probable technical support or administrative-service annex is located on the south side of the VACB and is about 42 meters long, 10 meters wide, and 10 meters high. The annex probably is an extension of a similar internal annex between the two HLLV final assembly and checkout high-bays (figure 10). (S [redacted]

The strap-on boosters for the HLLV are delivered by railcar to a large subassembly building, originally built in the late 1960s and early 1970s for the SL-X-15 program, which is connected by a covered rail line to the south side of the VACB (figure 10). Delivery of a strap-on booster to this building was first observed in September 1983 and has subsequently been observed several times. The building probably is used for receipt and inspection of the strap-on boosters and their components, as well as other subassembly component storage for the new HLLV. After inspection, the strap-ons probably are transferred to the VACB low-bay section for final assembly and checkout prior to mating with the core booster in one of the two VACB high-bays. (S [redacted]

Once assembled and checked out, the HLLV will be transported horizontally on one of two rail transporter/erectors (TEs) directly to the launch pad or to a new building at the nearby Spacecraft/Upper-Stage Propulsion Facility for probable payload mating. The two former SL-X-15 TEs have been totally reconfigured to transport the HLLV and its payload. The TEs, which are normally parked outside the VACB, are each about 55 meters long, 24 meters wide, and 19 meters high and travel on a 20-meter-gauge rail network (figure 11). One TE was observed undergoing an HLLV weight-simulation test in late December 1982 and was later used to transport the prototype HLLV to site W in October 1983. (S [redacted] 25X1 25X1 25X1

Orbiter Maintenance and Checkout Building 25X1

Soviet space shuttle orbiters will be processed between missions in a large orbiter maintenance and checkout building (OMCB) under construction about 400 meters east of the VACB (figure 12). The building, which is about 232 meters long, 122 meters wide, and 39 meters high, consists of two 34-meter-high high-bay sections, each with a usable space about 193 meters long and 45 meters wide, and 19-meter-high, four-story technical support annexes which have been built along three of the high-bays' four exterior walls. A 41-meter-wide by 22-meter-high doorway is located on the fourth side of the high-bay area and can accommodate the Soviet space shuttle orbiter, which is about 38.0 meters long [redacted] Groundbreaking for the building occurred in November 1981, but actual building construction did not begin until March 1982. The building probably will be completed in 1985. (S [redacted] 25X1 25X1 25X1 25X1 25X1 25X1

The size of the building's high-bay sections indicates that it probably is designed to perform maintenance and checkout work on several shuttle orbiters simultaneously. Each bay has underground conduits probably for utility and servicing equipment that will be required for the refurbishment, maintenance, and checkout of the orbiters between missions. One of the high-bay sections has 24 vent openings in the roof, while no vent openings have yet been observed in the other high-bay section. Other probable support and utilities buildings are under construction adjacent to the OMCB and the building is accessed by wide-radius-turn roadways for probable shuttle orbiter ground transport. (S [redacted] 25X1 25X1

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Spacecraft/Upper-Stage Propulsion Facility
A large, high-bay building (HBB) is under construction in the former SL-X-15 Spacecraft/ Upper-Stage Propulsion Facility at Support Facility 31 (figure 13). This facility was built in the mid-to-late 1960s for the loading of storable propellants and installation of ordnance devices onto the payloads of the SL-X-15 and possibly for the installation of ordnance devices onto the upper stage of the launch vehicle. After propellant loading and ordnance installation were completed, the payload and upper stage were transported to the VACB for integration with the SL-X-15 booster. The HBB probably will be used for loading storable propellants onto the space shuttle orbiter and other HLLV-related payloads. Installation of ordnance devices onto HLLV payloads and possibly onto upper stages of the launch vehicle may also be conducted here. The features and layout of the HBB indicate that the shuttle orbiter probably will be mated to the HLLV in the horizontal position and then transported in that position to the launch pad. (S [redacted]

Groundbreaking for the HBB, which is about 146 meters long, 78 meters wide, and 62 meters high, occurred in April 1981, but actual building construction did not begin until April 1982. The building is constructed of three-meter-wide structural steel support columns which form a 132-meter-long by 42-meter-wide usable high-bay section. A craneway with a usable height of about 45 meters is in the high-bay section and, as indicated by the heavy-duty building construction, it probably is designed to lift very heavy loads, such as the shuttle orbiter. Four-story support annexes, each about 12 meters wide and 17 meters high, flank both long sides of the high-bay. As indicated by floor spacings, the lower two floors of each annex will be used for technical support and the upper two floors will be used for administrative-service functions. Two large, rail-served doorways, one on each end of the high-bay section, are being built. The doorway facing the HLLV launch areas is about 30 meters wide and 42 meters high and will allow passage of a horizontally transported HLLV with payload. The doorway at the opposite end of the building is about 30 meters wide [redacted] The building probably will be completed in 1985. (S [redacted] 25X1 25X1

The transporter/erector rail line has been extended from the existing TE rail network to just outside the larger of the two doorways in the HBB and probably will terminate inside the high-bay section. In addition, a single reinforced-rail spur is being built which probably will allow movement of standard-gauge, heavy-duty payload rail transporters into the center of the HBB for payload propellant-loading or mating to the HLLV. A single standard-gauge rail line accesses the smaller doorway of the HBB (figure 13). (S [redacted] 25X1

The propulsion-related buildings within the facility do not appear to have been altered, suggesting that they may continue to be used for relatively small payloads. A 20-meter-long by 13-meter-wide probable propellant-related support building and a steamline are being constructed within the facility. 25X1 An underground conduit for probable propellant and utility lines is being built inside the facility to connect the HBB with an existing probable propellant storage building. (S [redacted] 25X1 25X1

Launch Control Center
A new LCC is under construction about 600 meters west of the VACB and just north of the former SL-X-15 launch control bunker which supported SL-X-15 launches from site J (figure 14). The LCC appears to be identical to that at Launch Site W and will be used to support the prelaunch checkout, countdown, and launch of the HLLV from Launch Site J. The new LCC is about 3.1 km from the nearest launch pad at site J and is connected by conduits which probably will carry monitoring and control cabling to the site and to a tracking facility located adjacent to the east side of Tyuratam Support Facility 1. The LCC is constructed of reinforced-concrete sections and is about 68 meters

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long, 43 meters wide, and 18 meters high and has three levels with a personnel accessway located on the south side of the middle level. Like at Site W, the LCC probably will be bunkered. (S [redacted]

The LCC will be connected by conduits to the old launch control bunker, and at least two support buildings are under construction adjacent to the LCC. One of the support buildings is on the west side of the LCC and probably will provide personnel and technical services, including computer-related support for launch operations. The layout of the building appears identical to that of its counterpart adjacent to the site W LCC. Early construction features of the second support building, located south of the LCC, indicate that it will be similar to the probable LN storage building located near the site W LCC. (S [redacted]

Support Facility 1

Support Facility 1, located east of Support Facility 31, was expanded in the mid-to-late 1960s for the final assembly, integration, and checkout of the fourth stage and payload for the SL-X-15 (figure 15). Most, if not all, of the former SL-X-15 program-associated buildings are being renovated and construction of several small support buildings is under way adjacent to the SL-3/4/6 booster and payload assembly/checkout area. The renovation and construction activities, under way since 1978, indicate that this facility will be used for similar purposes for the new HLLV and probably also for spacecraft to be launched on the shuttle orbiter. (S [redacted] 25X1

Refurbishment of the former SL-X-15-associated assembly/checkout building in Support Facility 1 began in January 1978. At that time, what was probably SL-X-15 upper stage/payload-associated debris was seen outside the building. In mid-1978, two derelict SL-X-15 upper stages were moved outside the building and later disassembled. Two [redacted] parabolic dish antennas were installed atop pedestals on the roof of the western side of the building in late 1979. These antennas may be used to receive and transmit on-pad payload checkout telemetry during prelaunch operations. (S [redacted] 25X1 25X1 25X1 25X1 25X1

Five support buildings, one of which is connected to a new induced-draft water cooling tower, have been or are being built near the assembly/checkout building. In addition, an underground conduit about 2 meters wide [redacted] has been constructed between the largest of the new support buildings and the SL-3/4/6 booster and payload assembly/checkout area. The conduit may be used as a personnel passageway or for cable and utility lines. (S [redacted] 25X1 25X1 25X1

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Appendix

Soviet Heavy-Lift Launch Vehicle

A prototype of the Soviets' new heavy-lift launch vehicle (without payload) was seen for the first time [redacted] at Launch Site W, Tyuratam Missile and Space Test Center. The HLLV consisted of a core booster and four strap-on, thrust-augmentation boosters. The launch vehicle was erected on the pad and probably was undergoing the initial series of compatibility checks with the pad facilities. The HLLV was removed from the pad by a transporter/erector and returned to the VACB [redacted] (S [redacted]

Vehicle Components

The HLLV core booster is about 59 meters long [redacted] and has two or three main propulsion engines that will use LOX and LH propellants (figure 16). The core booster serves as the structural backbone of the HLLV configuration, in that the strap-on boosters and payloads are mounted to it for launch. (S [redacted]

The core booster consists of two major components which are manufactured at Kuybyshev Aerospace Plant 1 and are individually air-transported atop modified Bison aircraft to Tyuratam. The larger component [redacted] contains the LH tank. The smaller component [redacted] contains the LOX tank and intertank section. Upon delivery to the VACB, aerodynamic covers are removed from the two components and they probably are checked out before being mated. At some point during core booster processing, two or three [redacted] "podded" engines are attached to the base of the LH tank and constitute the propulsion system for the core booster. The pods could also house a recovery system for the engines if they are reusable. (S [redacted]

The strap-on, thrust-augmentation boosters are assembled at Dnepropetrovsk Missile Development Production Center and are shipped to Tyuratam by flatbed railcar. 25X1 Each strap-on booster is about 40 meters long and 4.0 meters in diameter and is derived from the [redacted] 4.0-meter-diameter first stage of the SL-Y, a medium-lift space launch vehicle also under development at Tyuratam (figure 17). 25X1 The additional length of the strap-on is for an asymmetric nosecone which is attached to the intertank of the core booster and which could house a recovery parachute system if the strap-on is to be reused. 25X1 25X1 The liquid-propellant strap-on boosters will use LOX and probably a hydrocarbon-based fuel such as kerosene. Analysis of the base of the first stage of the SL-Y suggests that its propulsion system will use a single nozzle. 25X1 Also, a ring appears to encircle the end of the nozzle and apparently is connected to three or four possible actuators on the booster. The ring could be pivoted into the exhaust flow from the nozzle and provide thrust vector control for the booster during launch. 25X1 25X1 (S [redacted] 25X1

Vehicle Configuration

The prototype HLLV observed at Launch Site W in October 1983 was about 59 meters long [redacted] 25X1 and its strap-on boosters were 25X1 mounted offset on the core booster. 25X1 The positioning of these strap-ons toward one side is designed 25X1 to accommodate the attachment of large payloads, 25X1 such as the shuttle orbiter, on the opposite side of the core and to counter the center-of-gravity shift caused by side-mounted payloads. The Soviet shuttle orbiter will be attached to the core booster in a manner similar to that used in the US shuttle 25X1 launch system (figure 18). Variants of the HLLV may be developed which will use differing numbers of strap-ons, high-energy-propellant upper stages, and be capable of launching either side- or top- 25X1 mounted payloads. Although up to eight strap-ons 25X1

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could physically be accommodated around the core, it is unlikely such an HLLV variant will be developed. Based on launch pad configurations, HLLVs launched from site W apparently will be limited to four strap-ons. Those launched from site J will have at least four and possibly six strap-ons, depending on the final pad configuration, the capabilities of the TE, and the mounting position for the payload. (S [redacted]

Vehicle Final Assembly and Processing

The final assembly and processing procedures for the HLLV components at Tyuratam are significantly different from those employed during the SL-X-15 program. During the SL-X-15 program, the thousands of pieces and subassemblies required for each booster were shipped by rail to the VACB at Support Facility 31, where both the final fabrication and assembly of the booster occurred. [redacted] indicated that poor design and quality control of the SL-X-15 booster were major contributors to the launch failures and ultimately the cancellation of the program. In contrast, the major components of the HLLV are fabricated, assembled, and tested at the manufacturing plant before shipment to Tyuratam, thus ensuring better factory control over component quality. Little, if any, final fabrication of the HLLV at Tyuratam is necessary. The final assembly of the HLLV essentially involves the checkout of a few large components and their integration into one unit. Total vehicle processing time has thereby been significantly reduced from that of the SL-X-15 booster. Thus, the HLLV processing facilities at Tyuratam should be able to support a much higher launch rate than that believed attainable during the SL-X-15 program. (S [redacted]

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25X1

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