1. [BLANK TO FORCE SECTION]

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1. Proposed Action

Under the proposed action, the FAA would issue a license to Kistler to conduct commercial launch and reentry operations at the NTS. These operations would include certain pre-flight activities, launch/flight operations, as well as reentry/landing/recovery operations. The FAA regulates launch and reentry operations consistent with its safety responsibilities and U.S. national security and foreign policy interests. In order to conduct these operations, Kistler proposes to construct a base of operations consisting of a payload processing facility, launch site with vehicle processing facility, and vehicle landing and recovery area.[1]

The proposed payload processing facility would be located on a previously disturbed area at the site of the former Area 18 Control Point (CP-18), and would consist of a building with air-lock/clean rooms, payload work stations, payload integration area and control rooms, access roads, and a parking area.

The proposed launch site would be in a previously undisturbed portion of Area 19. It would include an access road, tank farm, small electrical substation, vehicle processing facility, small parking area, water storage tank, and vehicle launch pad. The affected area of the proposed vehicle processing and launch area is approximately 9.7 hectares (24 acres).

The proposed landing and recovery area would be located about 11 kilometers (seven miles) west of the payload processing facility in a largely undisturbed portion of Area 18. The landing/recovery area would be a circular area 1,828 meters (6,000 feet) in diameter. The area of the landing site would be 269 hectares (665 acres) and all of the soil and vegetation in this area could be affected by preparation of the landing/recovery area. All woody vegetation and rocks over five centimeters (two inches) in diameter would be removed, the ground would be graded to remove areas in excess of two percent slope, and existing natural drainage would be rerouted around the area.

The DOE will provide the necessary land area on which Kistler would construct all of these facilities and conduct its operations through a general use permit issued to the NTSDC by DOE. The NTSDC has, in turn, signed a subpermit agreement with Kistler. (See Appendix B.) Characteristics of the NTS, including remoteness, low population, open range, restricted airspace, security, and elevation, are advantages for launching satellites using the K-1 vehicle.

Kistler intends to operate its launch vehicle service using a fleet of five K-1 vehicles at a maximum rate of 52 launches per year once the system is fully operational.

Kistler would require up to two adjoining 15-minute blocks of range time for launch and up to two 15-minute blocks for recovery of the OV approximately 24 hours after the initial launch. Range times at the Nevada Test and Training Range (also known as the Nellis Air Force Range) are typically scheduled in 15-minute blocks. To address the scheduling use of the

[1] The FAA does not license payload processing and therefore this is included only as an associated activity in this environmental documentation.

affected airspace, a working group called the Range Management Group has been established to coordinate the withdrawn airspace over the NTS and the Nevada Test and Training Range. This group is anticipated to be the airspace coordinator for the Kistler activities.

Since Kistler's launch and recovery operations would be scheduled well in advance, the use of Range airspace by Kistler would be consistent with the current Nevada Test and Training Range scheduling and range time allocation constraints. Based on the flight schedule profile described below, the two 30-minute blocks of range time required for a K-1 launch and recovery equate to less than one-half of one percent of the available range time. In addition, due to the remoteness of Kistler's proposed operations, only a portion of the airspace would be required for launch and landing operations. There will be no interruption of commercial aircraft traffic as the Kistler vehicle will pass over the nearest traffic route at approximately 60,960 meters (200,000 feet) above mean sea level (MSL). Upon reentry, the OV will pass over the nearest commercial jet traffic route at 31,089 meters (102,000 feet) above MSL. The specific arrangements related to airspace use will be addressed in detail during the safety analysis portion of the licensing process.

2.1.1. Alternatives Considered but Not Evaluated

Alternative Sites Considered Outside the NTS

Prior to selecting the NTS as its preferred launch base, Kistler explored alternatives throughout the United States. Kistler considered locating facilities at the California Spaceport® at Vandenberg Air Force Base (AFB), Spaceport Florida at Cape Canaveral Air Force Station, and the proposed Southwest Regional Spaceport in New Mexico.

The coastal sites (Spaceport Florida Launch Complex 46 and the California Spaceport®) were eliminated from consideration due to restrictions in launch azimuths. Kistler's prospective customers require launch to inclinations in two distinct corridors. The first corridor includes inclinations from 45 to 60 degrees. The second corridor includes launch inclinations from 84 to 99 degrees. Current range restrictions would not allow launches to the first corridor from the California Spaceport®, or launches to the second corridor from Spaceport Florida. Selection of either of these two sites would mean that Kistler could only serve a portion of its projected market. Thus, Kistler narrowed the candidate sites to the NTS and the proposed Southwest Regional Spaceport.

The final decision to select the NTS over the proposed Southwest Regional Spaceport was based upon range support considerations. In Kistler's estimation, the NTS offered a more flexible range environment that would be critical to commercial operations. The Kistler K-1 vehicle is intended to be an autonomously controlled system that does not require extensive tracking and communications networks. This innovative approach may offer a significant cost advantage for a commercially operated system. Authorities at the NTS recognized the need for such innovation to facilitate commercial operations and were willing to consider acceptance of such a system pending FAA licensing.[2]

Alternative Locations Considered Within the NTS

The K-1 ground facilities, equipment and operations would be located at the NTS in Nye County, Nevada as shown in Figure 2-1. The entire NTS area totals 3,496 square kilometers (1,350 square miles) and is surrounded by the Nevada Test and Training Range on the north, east, and west sides and by Bureau of Land Management lands on the south and southwest as shown in Figure 2-2. Thus, the NTS is surrounded by thousands of square kilometers of land withdrawn from the public domain for the Nevada Test and Training Range, as well as for use as a protected wildlife range, creating an unpopulated land area of 14,170 square kilometers (5,470 square miles). In addition, the airspace over the NTS and the Nevada Test and Training Range is removed from public access by the designation of an extensive Restricted Area.

Since the NTS is used for numerous other activities by a large number of other users, Kistler identified a preferred site for its operations, not through a process of elimination based upon Kistler's own requirements, but through a dialogue with other NTS users. Kistler proposed an initial site and received comments from the NTS user community. Based upon these comments and recommendations, Kistler developed further options for discussion. As part of this process, Kistler considered several sites within the NTS as candidate basing sites. The sites considered within the NTS were evaluated based on their ability to provide:

- Remote and secure area.
- Least impact on other users of the NTS and Nevada Test and Training Range operations.
- Existing infrastructure of roads, power, and water.
- Highest take-off site elevation possible to give the K-1 an additional performance advantage.
- Relatively level sites that required little grading and preparation.
- Soil characteristics at the landing site that would least stress the landing system.
- Accessibility for suppliers and customers.

[2] A fully autonomous system would not satisfy the existing FAA licensing requirements for reusable launch vehicles. Accordingly, final operational processes involving the K-1 vehicle have not yet been approved by the FAA. Those processes are described generally in the EA as background information for evaluation of the range of environmental impacts.

Figure 2-1. Location of NTS

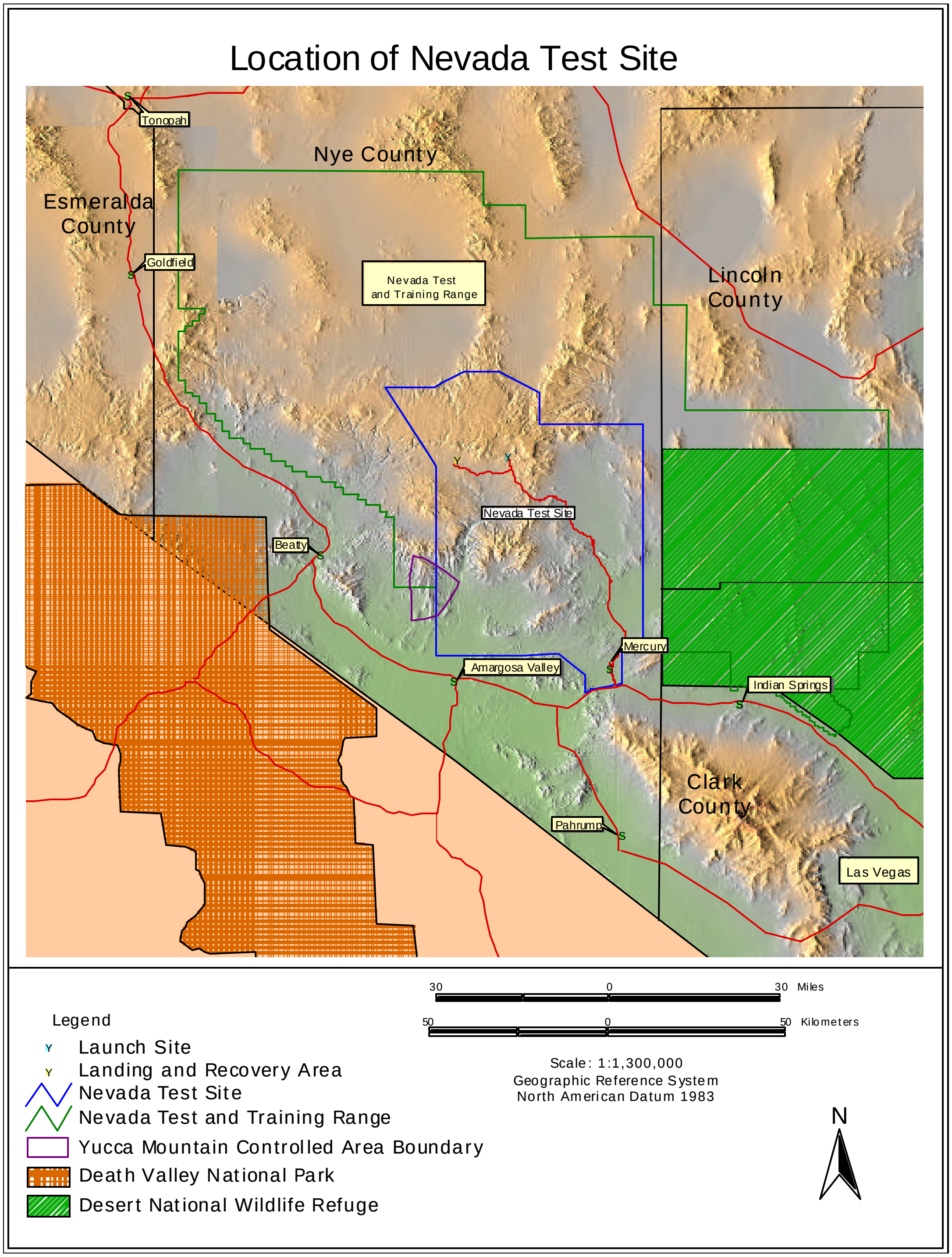
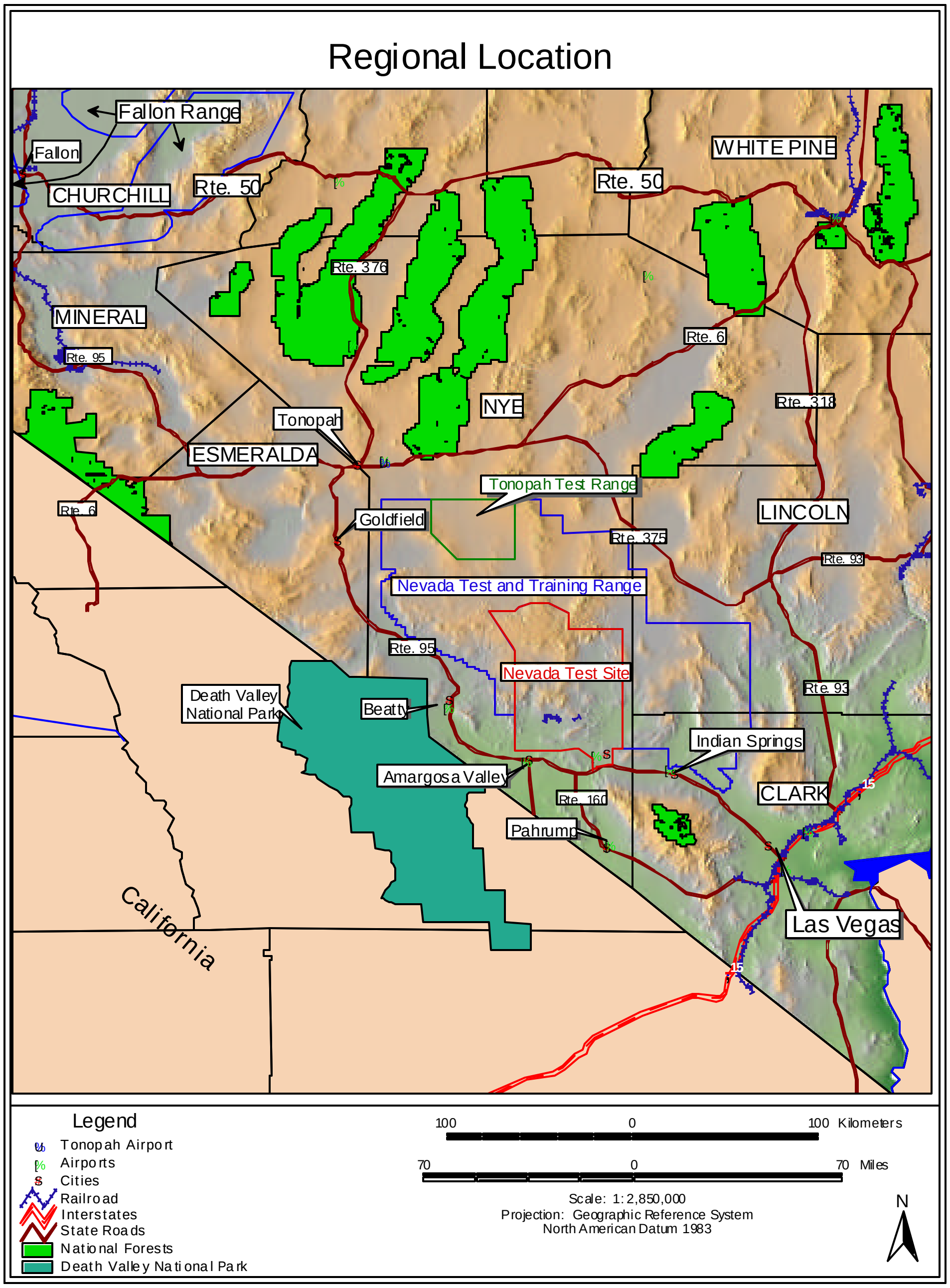


Figure 2-2. Nevada Test Site and Nevada Test and Training Range



Alternative 1

Kistler and DOE collectively considered existing and planned land uses at the NTS when proposing sites for the Kistler facilities. Kistler initially identified an optimal baseline location (Alternative 1) that involved various portions of Area 25 for the proposed activities and facilities. Upon consultation with other NTS users, however, it became apparent that Area 25 is among the most heavily used and developed portions of the NTS. There was significant concern over the possibility of road closures, electromagnetic interference, noise levels, scheduling coordination, and the effects of a vehicle failure on other operations at the NTS.

Subsequent to the communication of these concerns, an "all hands" siting meeting was held on November 8, 1996 in the DOE/Nevada (NV) auditorium at 1634 S. Highland St., Las Vegas, where NTS users were asked to provide their input to identify locations and time frames for the proposed Kistler activities that would minimize the effects on their operations and provide clear input in defining criteria for a NTS users safety review of the proposed Kistler operations.

During the NTS user meetings, concern was expressed that the proposed Kistler project would interfere with activities currently being executed at other locations that were being considered for the Kistler project. Subsequently, the conclusion was reached that the most isolated location with the fewest activities was the best place to site the proposed facility.

After consolidating the input received at this meeting, a second meeting was held on November 19, 1996 with representatives of a majority of the users at the NTS. Those organizations represented were Los Alamos National Laboratories, DOE Defense Programs Group, Lawrence Livermore National Laboratories, DOE Yucca Mountain Nevada Operations, the U.S. Air Force, Sandia National Labs, and SRS Technologies. This second meeting was held in Las Vegas at the DOE Atlas Facility, Building A-13 on Lossee Road. Concerns discussed included probabilities of vehicle failure, falling debris, electromagnetic environment interference, noise levels, alternate emergency landing locations, launch and recovery windows, and scheduling coordination.

Areas 18 and 19 of the NTS are very remote locations. Because the sites are remote, availability of utilities was a prime concern when considering a location. For the launch site, the decision to site the project at the currently proposed location was based on the availability of power and water. This location was a previously occupied base camp for other DOE activities, and these utilities had already been installed for other purposes. The currently proposed location is the only location with the utilities available in sufficient quantity in Areas 18 and 19 that meet the decision criteria of the NTS users. Locating the launch site at other locations in Area 18 would require major construction efforts to install power and to route water to another selected site, with possible additional impact to the environment.

The terrain in Areas 18 and 19 is predominantly very rugged, with elevations varying by approximately 305 meters (1,000 feet) or more. This rugged terrain rules out most of the proposed area for the landing site because of the vehicles' requirement for relatively flat landing area. The proposed landing location was selected to minimize the amount of contouring required to create the landing site, with other locations being either too mountainous or criss-crossed with gullies.

No documentation was produced to describe any other siting alternatives in Area 18. Four documents are available that describe the proposed project siting decision process. They are:

1) A Kistler Aerospace Corporation (KAC) Siting Options Assessment document in a presentation format that was presented to the DOE/NV Acting Manager on 10/11/96 by the DOE Kistler Aerospace Project Manager;
2) A memorandum dated 12/11/96 describing the outcome of a Kistler Aerospace Siting Meeting convened by representatives of the NTS users;
3) A Decision Memorandum dated 1/24/97 requesting project siting concurrence of the Acting DOE/NV Manager from the DOE/NV Strategic Initiatives Coordinator and
4) A Decision Memorandum dated 1/24/97 requesting concurrence of the siting decision from the Office of Defense Programs, DOE/Headquarters (HQ) (DP-1), the Assistant Secretary for the Office of Environmental Management, DOE/HQ (EM-1), and Acting Director for the Office of Civilian Radioactive Waste Management, DOE/HQ (RW-2).

The initial request, Alternative 1, involved various portions of Area 25 for the proposed activities and facilities with a caveat that the site could be shifted to another location should a conflict arise at Area 25. The participants felt that once the Kistler project was established as a facility it would be difficult to move and that a permanent siting decision should be made. Therefore, although Alternative 1 may have met all technical assessment criteria, it clearly was not perceived as meeting the need to have the least impact on other users of the NTS and Nevada Test and Training Range. Consequently, Alternative 1 was rejected and will not be evaluated in the remainder of the document.

Alternative 2

NTS users pointed out that Area 25, which encompasses most of the southwest corner of the test site, is among the most heavily used and developed portions of the NTS. They also indicated that the Yucca Lake/Yucca Flats area, which runs through Areas 1, 2, 3, 4, 6, 7, 8, 9, and 10, up the east side of the NTS, is also an area of significant development and activity. The Frenchman Lake/Frenchman Flat portion of Area 5 is equally well utilized by the DOE and other NTS users. The NTS users consequently focused their efforts on identifying sites in the little-used northwest quadrant (i.e., Areas 18, 19, and 20) of the NTS. Specifically, at this second meeting, consensus was reached on Area 18 for the launch site and Area 19 or 20 for the landing/recovery site.

As discussion continued in the weeks after the second meeting, issues raised by the Yucca Mountain Project, Air Force Operations at the Nevada Test and Training Range, and other defense programs at the NTS further limited the operations to Area 18 with the landing/recovery site on an adjacent site in Area 19. Among the concerns raised were security, safety of ground based nuclear activities, the possibility of Kistler recovery activities interfering with defense activities, electromagnetic interference, and increases in on-site traffic. Therefore, although Alternative 2 may have met all technical assessment criteria, it clearly did not meet the need to have the least impact on other users of the NTS and Nevada Test and Training Range. Consequently, Alternative 2 was rejected and will not be evaluated further in the remainder of the EA.

Alternative 3: The Preferred Alternative

The NTS users' agreement resulted in the DOE Nevada Operations Office determination that the DOE could approve the proposed Kistler operations, with the landing/recovery area located in Area 18 and the launch site located in the southern portion of the adjacent Area 19. The topography in Areas 18 and 19 consists of rocky mountains, hills, dry stream beds and gullies. There is little choice of level terrain. Kistler selected the most level sites possible for its launch and landing operations based upon topographic maps. A subsequent site visit to the Areas confirmed the selections.

Consequently, it was decided that K-1 facilities would be located in the upper part of NTS Area 18 and the lower part of NTS Area 19. The proposed launch site is on the southern slopes of Pahute Mesa south of Rattlesnake Ridge and north of Stockade Wash at an elevation of about 1,768 meters (5,800 feet). The facilities would be approximately 177 kilometers (110 miles) from Las Vegas, and approximately 72 kilometers (45 miles) from the on-site town of Mercury in the southeast corner of the NTS.

This alternative is examined in detail along with the no action alternative in the remainder of this document.

2.2. Description of the Proposed Commercial Launch and Reentry Activities

Kistler proposes to develop and operate exclusive-use commercial launch and reentry facilities using the K-1 launch vehicle to put commercial satellites into LEO. The facilities will consist of a payload processing facility, and landing/recovery area in Area 18 and a launch site with a vehicle processing facility and launch pad in Area 19. Kistler's activities would include:

- Construction of a launch facility and clearing of a landing/recovery area,
- Landing and recovery operations, and
- Sustained commercial launch, flight, reentry, landing, and recovery operations.

2.2.1. Kistler K-1 Reusable Aerospace Vehicle

The Kistler K-1 is designed as a two-stage vehicle made up of a LAP and an OV as described in Figure 2-3 and Table 2-1. Each stage would be fully reusable, carry its own avionics, and is intended to operate autonomously under control of on-board computers with no ground control.[3] The design is organized around major subsystems called Line Replaceable

[3] A fully autonomous system would not satisfy the existing FAA licensing requirements for reusable launch vehicles. Accordingly, final operational processes involving the K-1 vehicle have not yet been approved by the FAA. Those processes are described generally in the EA as background information for evaluation of the range of environmental impacts.

Units (LRUs). These are designed to have minimum interfaces with other subsystems to reduce the need to make or break connections during processing. LRUs are modularly designed to allow simple, organizational level processing at the launch site, and to be readily accessible by service personnel. The details of the launch vehicle operations provided in the environmental assessment are based on Kistler's conceptual engineering designs.

To achieve operational goals, the vehicle is being designed to meet operational requirements including:

- The use of simple, organizational level maintenance operations at the site. Removing faulty components from the vehicle and replacing them with an operational unit. Returning the failed unit to the supplier's facility where highly trained, certified technicians carry out a diagnosis and repair of the unit if necessary.

- Using a Health Monitoring System (HMS) to maintain records of the system's components and detect faults in a manner that allows timely replacement. Recording flight anomalies and tracking performance trend lines to predict component failures allowing for preventive replacement as well as scheduled maintenance.

- Minimizing the number of disconnections and reconnections of electronic, hydraulic, and fuel lines between flights. This reduces operational costs, and allows increased confidence in the K-1's integrity with each flight. If unbroken connections worked properly in the last flight, they are more likely to do so in the next.

- Using automated testing for connections that need to be broken for processing after each flight further reducing operations costs, and ensuring that a poor connection is not overlooked due to human error.

Figure 2-3. Kistler K-1 Reusable Aerospace Vehicle

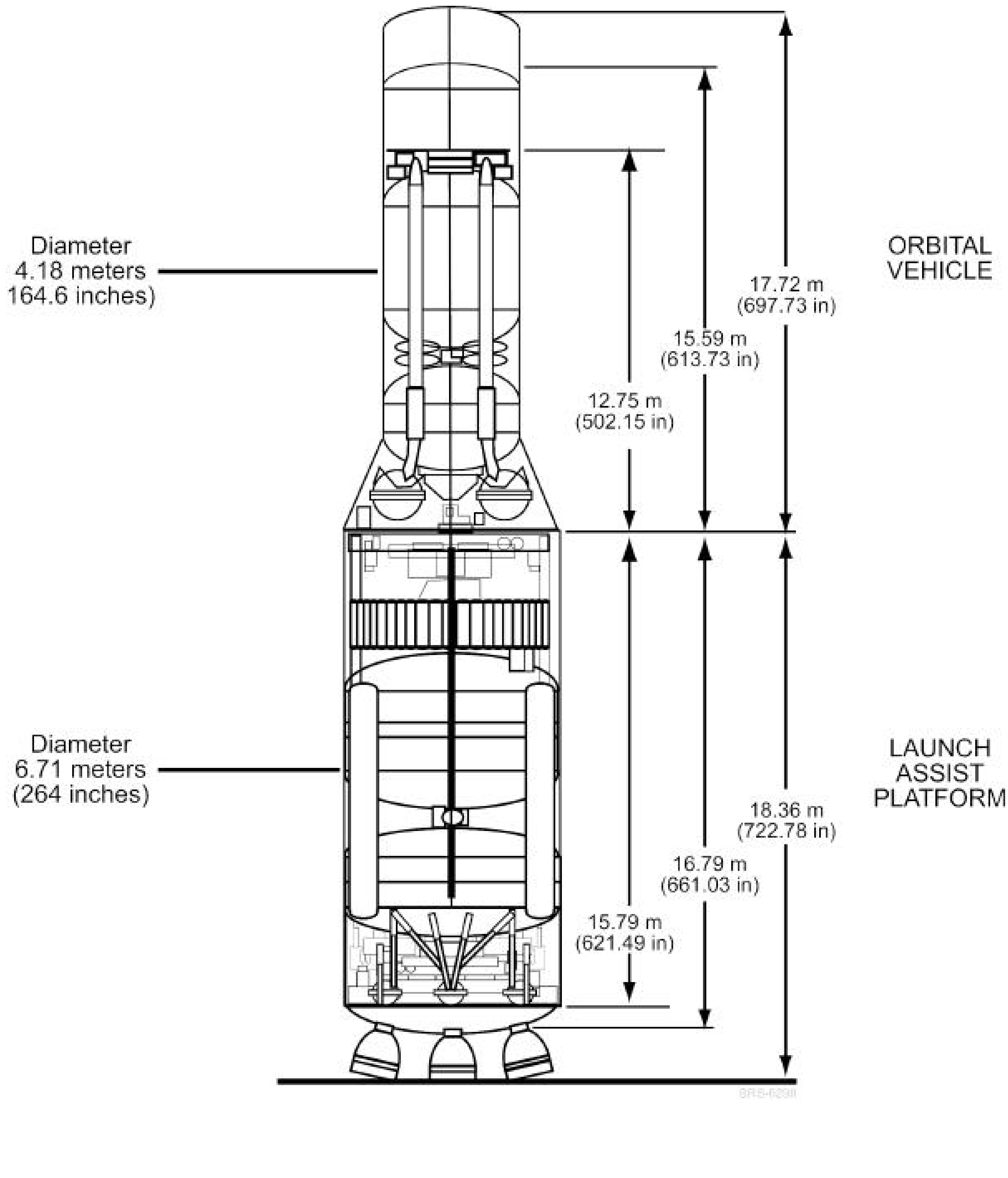


Table 2-1. K-1 Weight Summary

Component	Elements	Weight kg (lb)	Subtotal kg (lb)
Launch Assist Platform	Dry Weight Fluids, Trapped Residuals, etc. LO_X RP-1	18,948 (41,773) 1,347 (2,971) 161,098 (355,154) 62,294 (137,333)	243,687 (537,231)
Orbital Vehicle	Dry Weight Fluids, Trapped Residuals, etc. LO_X RP-1 Orbital Maneuvering System (OMS) Propellants	12,086 (26,645) 1,538 (3,391) 82,213 (181,247) 31,715 (69,919) 2,345 (5,170)	1298,897 (286,372)
Payload	Fittings, Support, etc. Available Payload (varies) *(estimate for a 52° inclination, 900 km altitude mission)*	45 (100) 2,632 (5,803)	2,677 (5,903)
Gross Liftoff Weight			**376,261 (829,506)**

2.2.2. Ground Facilities, Process Operations and Flow Descriptions

The K-1 would require three principal functional areas within the NTS for operations:

- an area for payload processing,
- an area for vehicle processing, propellant loading and launch, and
- an area for reentry, landing, and recovery. Figure 2-4 depicts the general location of proposed facilities. Figure 2-5 depicts the facility site plan.

The K-1 vehicle processing facility located within the launch complex is dedicated to the refurbishment of the vehicle stages after landing and to the integration of the LAP, OV, and Payload Module prior to flight (see Figure 2-6). The stages are delivered to the vehicle processing facility and off-loaded onto railroad type tracks that run through the vehicle processing facility to the launch erector. After flight, for example, the LAP is delivered to the vehicle processing facility and placed on the rails. Twenty-four hours later the OV is recovered, transported to the vehicle processing facility, and placed on the rails behind the LAP. The Payload Module is removed from the OV and transported to the payload processing facility where the customer will load and prepare its payload for the next flight. The loaded Payload Module is then transported back to the vehicle processing facility and off-loaded on the rails behind the OV. The three sections of the K-1 are then in position to be integrated for flight.

The K-1 is processed horizontally using specially designed maintenance stands. The vehicle processing facility will accommodate simultaneous processing of the stages of a second vehicle. After a K-1 is refurbished and integrated for flight, it is rolled out of the facility for fueling of the OMS engine tanks from small alcohol tanks while the vehicle is still horizontal. It is then moved along the rails to the erector for mounting to the launch ring and to the fuel mast. Through a counterbalance and winch system, the K-1 is raised to the take-off position for refueling. As stated in the text, all plans should be considered the general concept of operations. The proposed final technical procedures will be analyzed in detail during safety reviews.

Figure 2-4. General Facility Locations

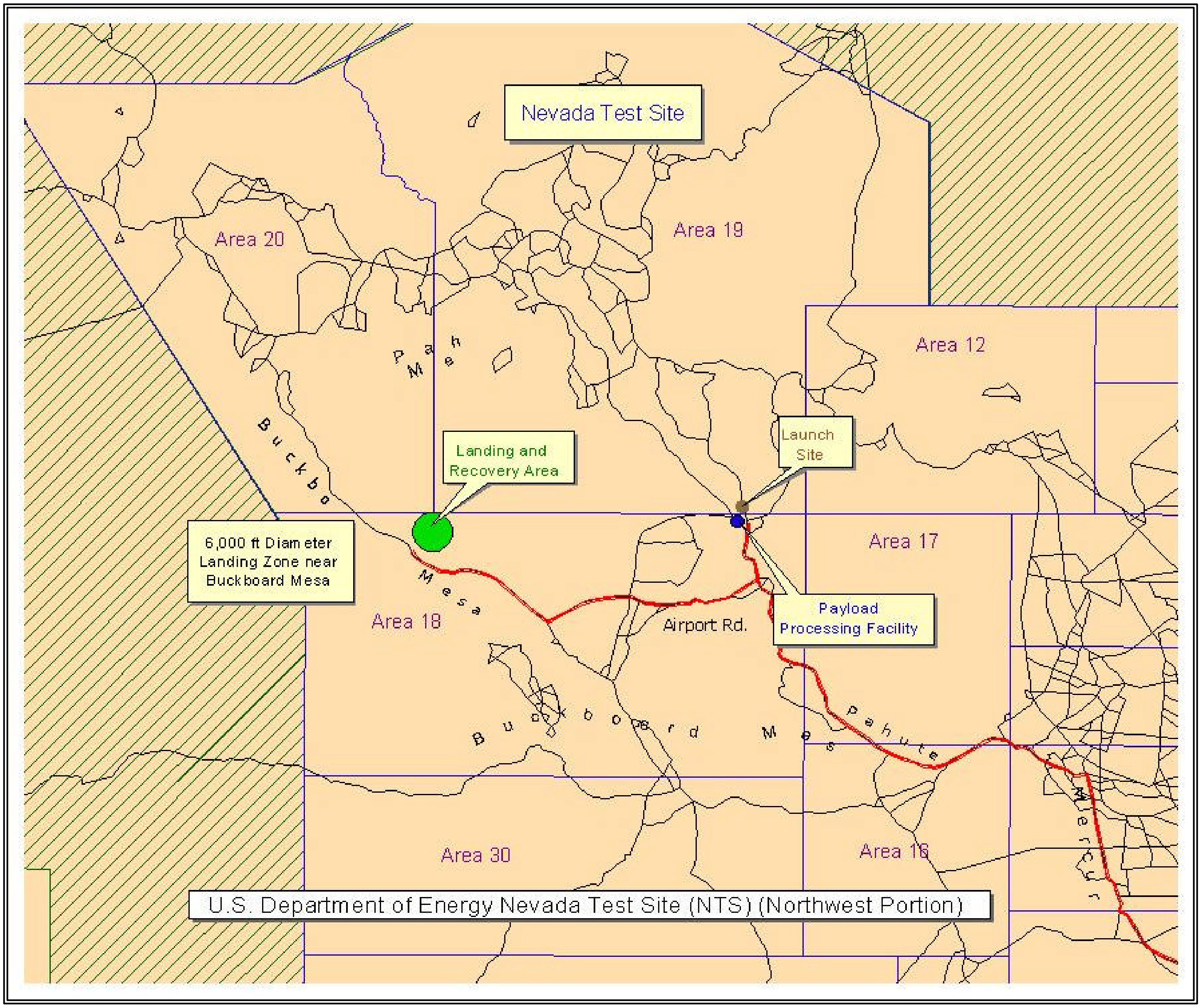


Figure 2-5. K-1 Facilities Site Plan

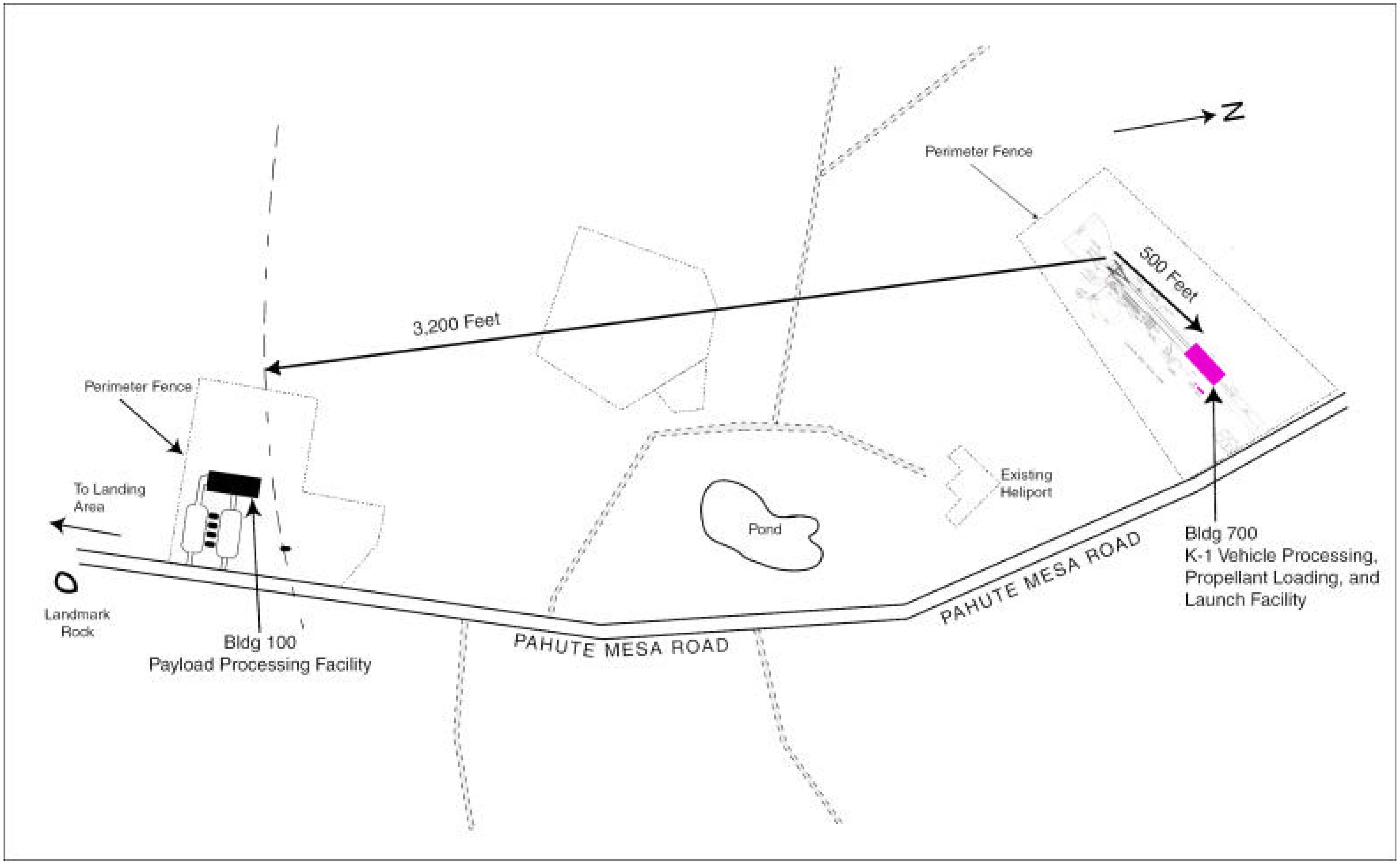
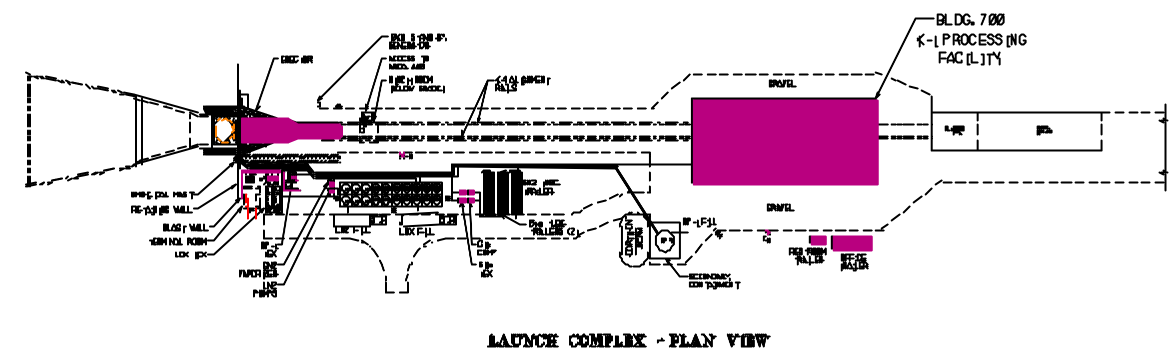


Figure 2-6. Vehicle Processing, Propellant Loading, and Launch Complex Site Plan



Process Operations

The operations flow process is shown in Figure 2-7. The operations process would make use of specialized straddle lifters and other support equipment. Vehicle stages would be transported via road to the vehicle processing facility on a stage transporter vehicle for processing and turn-around.

Processing Flow Description

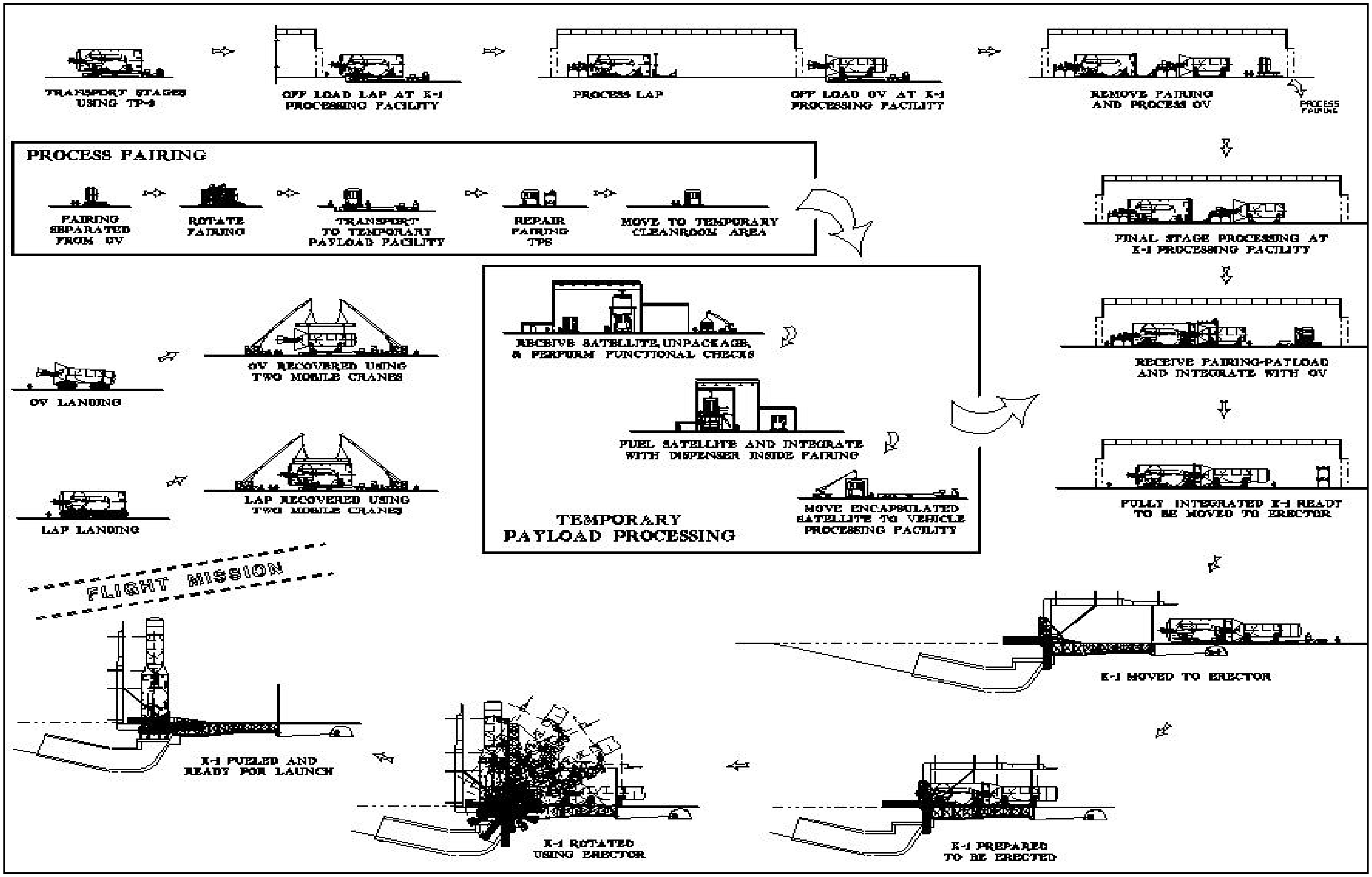
The first step in vehicle processing is the receipt of the stages either from initial shipment or from recovering the vehicle from the reentry site. The stages would be mounted on shipping and handling pallets, and would be transported on a specially built tractor trailer. The LAP stage would be received first, followed by the OV stage and payload module. The payload module would be removed and transported on special support equipment to the payload processing facility.

Dust and dirt would be removed with a vacuum. The stages would then be placed in the vehicle processing facility where the thermal protection would be inspected and repaired as required. The payload module would then be separated from the OV and transported on special support equipment to the payload processing facility.

While the stages are being prepared for processing, the payload module would be cleaned and checked for damage, and the dispenser would be positioned for receipt of the specific payloads. In addition to cleaning and inspection, the ablative thermal protection would be refurbished as required. The payload contractor would conduct payload processing and propellant loading in parallel. Upon completion of payload processing the payloads would be placed in the payload module and would be ready to be mated to the OV.

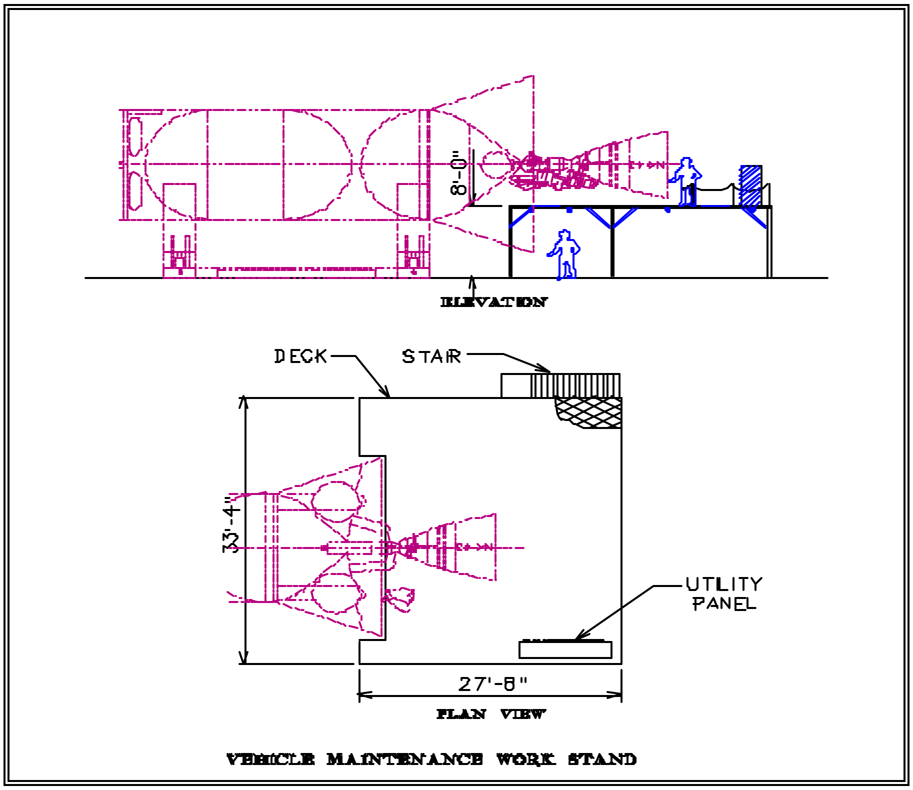
Meanwhile, the stages would be removed from the flatbed truck, but remain affixed to their horizontal pallets. The horizontal pallet can be easily moved into position where work stands would be placed to allow access to all areas of the stage.

Figure 2-7. Operations Process



In the refurbishment bay, each stage would be visually inspected, consumables and expended hardware would be removed and replaced, and various engine components would be cleaned. A workstand supports the engine nozzle while an operator crawls into the nozzle area to inspect and clean it. The stand is shown in Figure 2-8.

Figure 2-8. Engine Nozzle Workstand

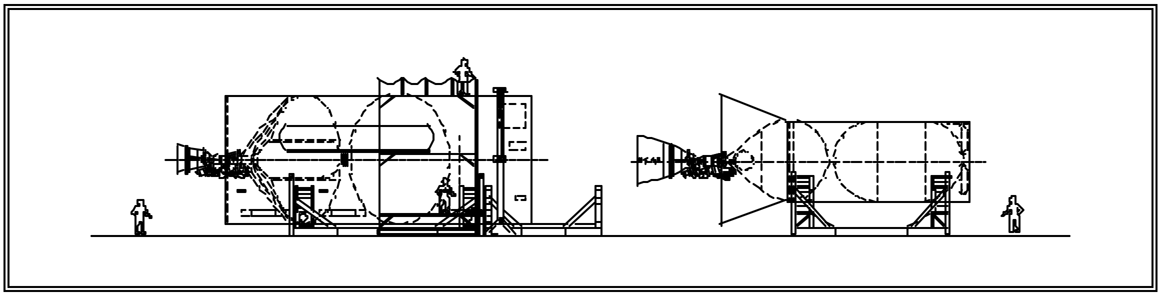


Faulty electrical or other equipment would be removed and returned to the supplier for repair, and the faulty component would be replaced with a spare. Parachutes and airbags would then be installed and final checkout would be performed.

2.2.3. Vehicle Integration, Propellant loading and Launch

Once the stages have been processed, the vehicle must be mated. The LAP horizontal pallet would be aligned to a floor rail. A connecting pallet would be aligned to the forward end of the LAP, then the LAP pallet and connecting pallet would be fastened together. When components are in alignment, the connecting pallet would pull the OV to the LAP for vehicle integration, as depicted in Figure 2-9.

Figure 2-9. OV and LAP Alignment and Integration



The stage separation system would then be secured and the stage interface checked. The final step in the process would be the integration of the payload with the K-1 vehicle.

The mated vehicle would then be moved the 500 feet to the launch pad. Figure 2-10 shows the K-1 as it would appear prior to being erected. At the launch pad, the K-1 would be erected as shown in Figure 2-11, the pallets would be removed, and then the propellants would be loaded. At this point the vehicle would be ready for launch, as shown in Figure 2-12. After propellant loading, an automated countdown sequence would be initiated and the vehicle would be launched.

Figure 2-10. K-1 at Launch Pad

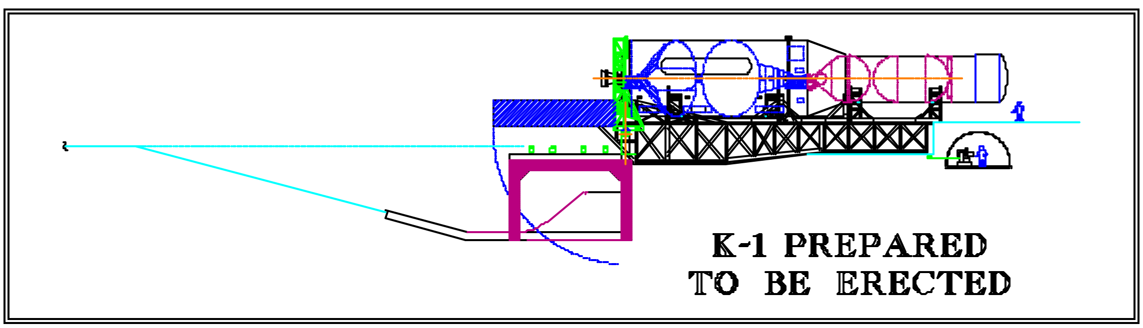


Figure 2-11. K-1 Being Erected

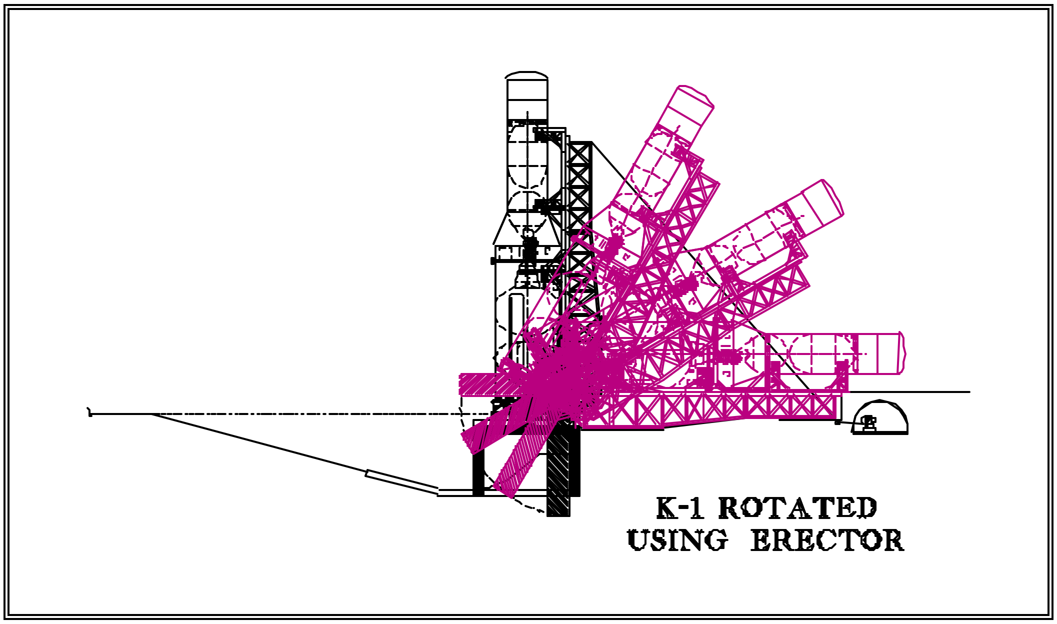
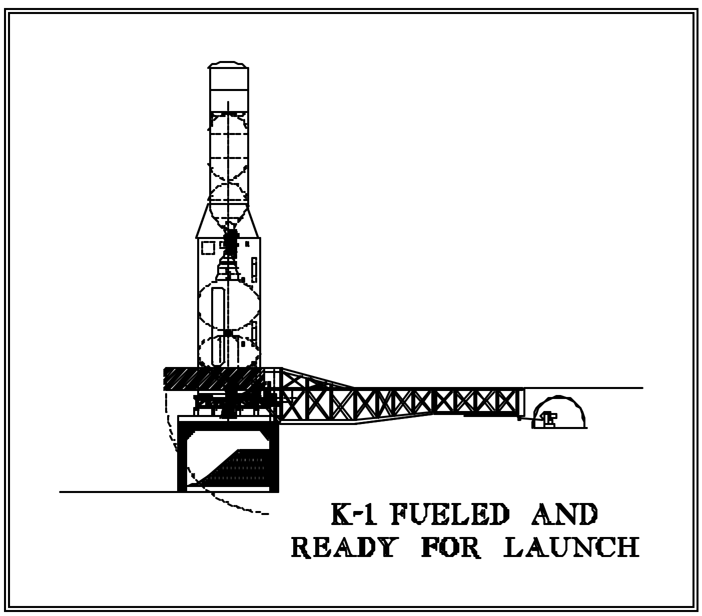


Figure 2-12. K-1 Ready for Launch

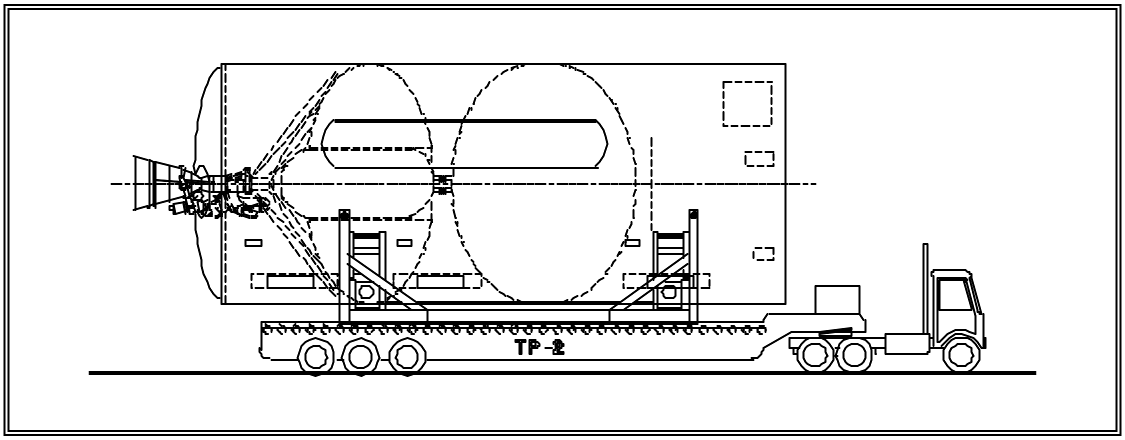


2.2.4. Landing and Recovery

The LAP is designed to land with parachutes and airbags at the landing area approximately 10 minutes after the K-1 takes off. Before approaching the vehicle, the K-1 systems would provide confirmation that they are in a safe configuration. The vehicle would then be approached, and grounded and external power applied. Parachutes, which would be automatically disconnected from the vehicle when it lands, would be rolled-up and transported by truck to the processing facility for shipment back to the vendor. Protective caps would be installed on the main engines, thrusters, and vents to prevent entry of sand and dust.

The LAP would be lifted, the air bags removed, and then the LAP would be lowered onto a horizontal pallet on the tractor trailer recovery vehicle, as shown in Figure 2-13, to be transported to the vehicle processing facility, depending upon the program phase. The OV and fairing assembly would be recovered in a similar manner, approximately 24 hours after the launch.

Figure 2-13. LAP Loaded on Tractor Trailer Recovery Vehicle



2.3. Vehicle Operations

The Kistler K-1 will be compared in this EA to the vehicles evaluated in the PEA ELV to aid in the evaluation of potential impacts to the environment caused by its launches. The PEA ELV evaluated the Atlas, Atlas/Centaur, Delta 2000, Delta 3920, Scout D, Titan, and Titan/Centaur. Characteristics of each of these vehicles are compared to those of the K-1 in Table 2-2, and a visual comparison is provided in Figure 2-14.

The K-1 vehicle is designed to carry commercial payloads, such as satellites, into LEO, which is generally 200 to 1,000 kilometers (110 to 540 nautical miles) above the earth. See Figure 2-15 for the K-1 payload capability. The altitude reached would be determined by the weight of the payload: lighter payloads can be carried into higher orbits. Another factor in payload capability is the orbital inclination. Lower orbital inclinations (i.e., 45 to 60 degrees) would allow heavier payloads to reach the same altitude as higher orbital inclinations (i.e., 84 to 99 degrees).

In the subsections that follow, the design considerations for the major systems of the proposed K-1 vehicle are discussed.

Table 2-2. Comparison of K-1 with Other Launch Vehicles

Vehicle	Length m (ft)	Weight kg (lb.)	Stage	Propellants	Payload Capacity kg (lb.)	Payload Orbit
Kistler K-1	*33.5 (110)*	*376,139 (827,506)*	*1 2*	*LO_X/ RP-1 LO_X/ RP-1*	*3181-5227 (7000-11500) **	*LEO, 200-1800 km (110 - 1000 mi)**
Atlas F	25.9 (85)	119,050 (262,500)	0 1 2	LO_X/ RP-1 LO_X/ RP-1 Solid	1500 (3307)	550 km (342 mi)
Atlas Centaur	39.9 (131)	149,215 (329,017)	0 1 2	LO_X/ RP-1 LO_X/ RP-1 LO_X/LOH		
Delta 2000	35.35 (116)	132,925 (293,100)	0 1 2 3	Solid LO_X/ RP-1 N_2O_4/Aerozine 50 Solid	703 (1550)	geostationary transfer orbit
Delta 3920/PAM	35.35 (116)	193,200 (426,000)	0 1 2 3	Solid LO_X/ RP-1 N_2O_4/Aerozine 50 Solid	1247 (2750)	geostationary transfer orbit
Scout D	23 (75.46)	21,315 (47,000)	1 2 3 4	Solid Solid Solid Solid	177 (390)	483 km (300 mi) circular orbit
Titan 34D	49 (160.7)	782,100 (1,724,530)	0 1 2 3 4	Solid N_2O_4/Aerozine 50 N_2O_4/Aerozine 50 Solid Solid	12,470 (27,500) 1905 (4200)	161 km (100 mi) earth orbit Geostationary orbit
Titan III E/Centaur	48.76 (160)	640,000 (1,411,200)	0 1 2 3	Solid N_2O_4/Aerozine 50 N_2O_4/Aerozine 50 LO_X/LOH	3356 (7400)	Geostationary orbit

(AST, 1986) *See Figure -2-15 for clarification

Figure 2-14. Comparison of K-1 to other U.S. launch vehicles

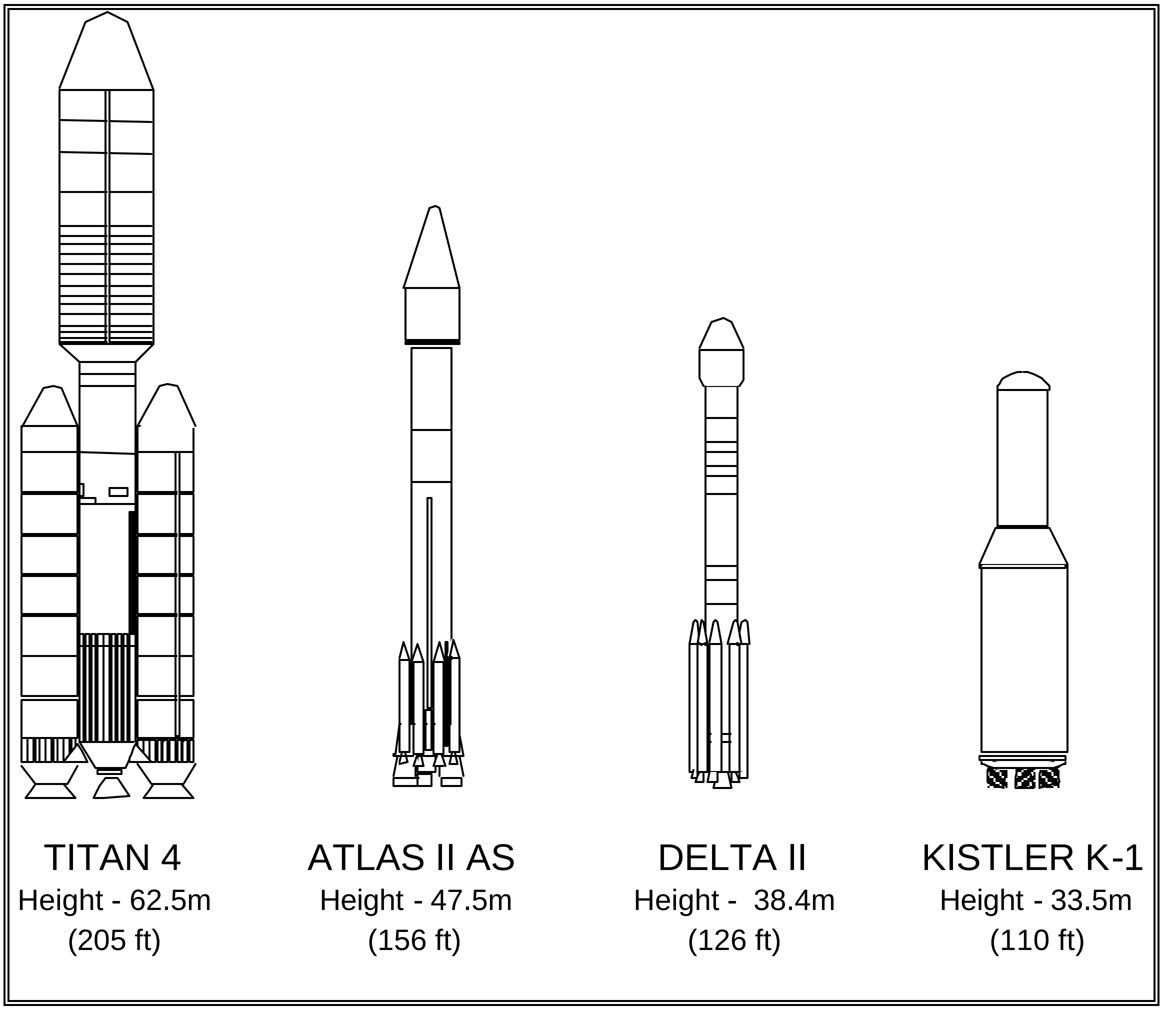
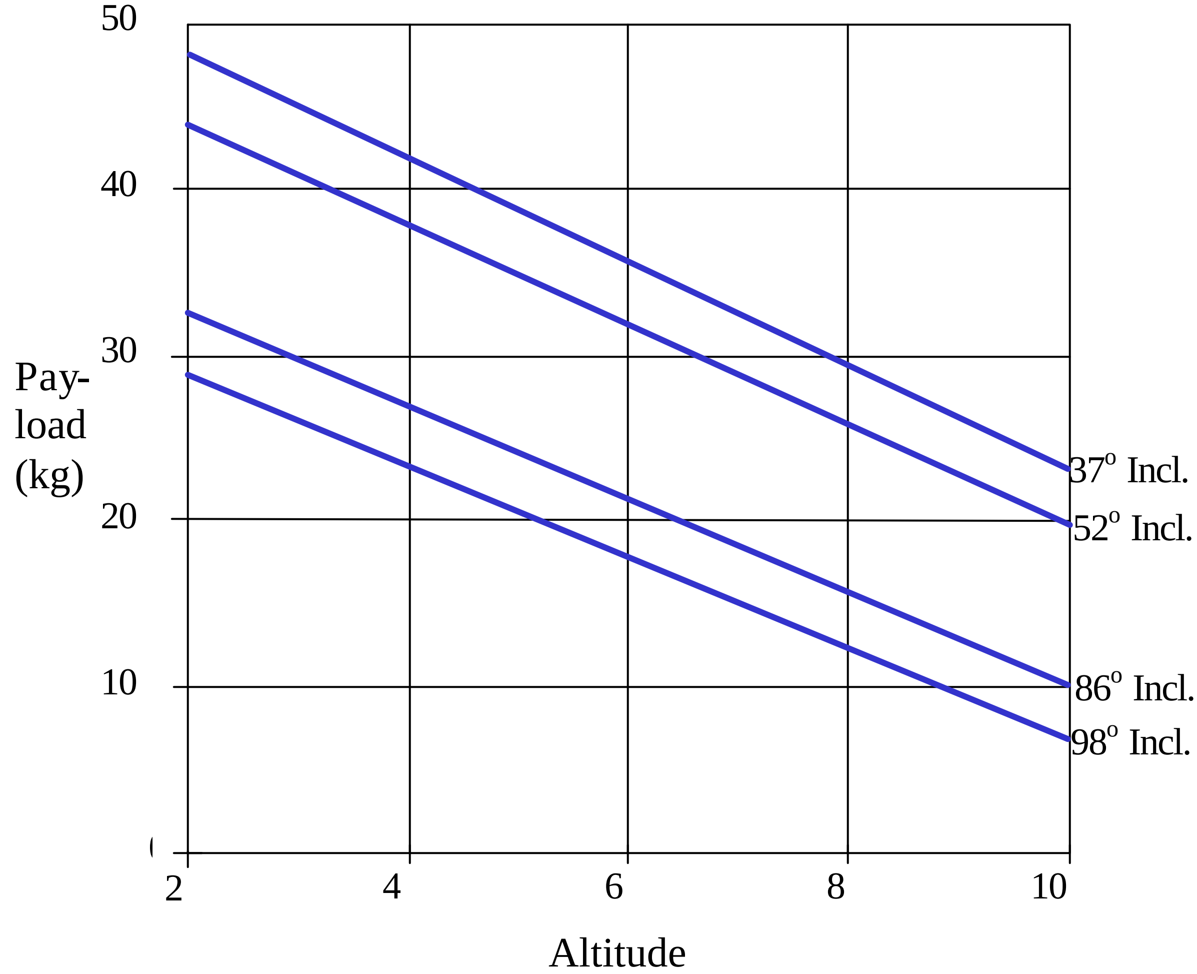


Figure 2-15. K-1 payload capacity



Structures LRU. The Structures LRU includes the primary vehicle aeroshell structure, propellant tanks, payload fairing and support deck, stage and payload separation systems, and associated interfaces with other vehicle LRUs. The LO_X propellant tanks are made of aluminum, while the kerosene tanks are made of composite materials. The vehicle fuselage is designed of lightweight composites similar to those used for the main wing structure, tail section, and control surfaces on the Boeing 777 airliner. For the K-1 vehicle, the Structures LRU also would include external thermal protection systems and internal thermal control systems (primarily insulation) for both the OV and LAP stages. These thermal control systems are merged with the Structures LRU because of the strong interactive weight and performance relationships between the structural and thermal elements of the vehicle.

Propulsion LRU. The Propulsion LRUs include the vehicle's NK-33 or NK-43 main engines, OMS, Attitude Control System, Electronic Engine Controllers, and Propellant Feed/Tank Pressurization Systems.

The NK-33 engine, of which the LAP would have three, delivers 154,224 kilograms (340,000 pounds) of thrust at sea level. It is fueled by LO_X and kerosene, and was built for the Russian moon program. More than 450 engines were tested during the development programs leading to this design. The NK-43 is the upper stage version of the NK-33 engine and would be used in the OV. The NK-33 and NK-43 engines are similar in design and specifications. Differences between the two systems are an increased nozzle expansion ratio on the NK-43 for improved performance at high altitudes.

Electronics LRU. The Electronics LRU is composed of the sensor, power and computing components that are intended to control and guide the LAP and OV in flight. These components have been designed and would be configured to create a multiple fault tolerant system. Fault tolerant, in this instance, means that the system or vehicle performance would not degrade with the loss of any single component. The system is designed to be multiple fault tolerant in that it can sustain multiple failures of different components without any loss in operational capability. For example, due to built-in redundancies a flight computer and the Inertial Measurement Units (used for navigation) could fail during the mission without any degradation in the expected vehicle performance.

Landing LRU. Each Landing LRU would bring the specified stage to a soft landing from an unpowered reentry. Parachute and airbag landing subsystems are intended to give the K-1 a reliable and flexible recovery. The current system design does not include active guidance for landing. High margins in system strength and opening altitudes are designed to accommodate dispersions in parachute opening conditions. The landing area could be any predominantly flat and open area. The Landing LRU is designed such that all sequencing and control functions, both electrical and mechanical, are single fault tolerant. The parachutes and airbags are of conventional design, as flown on other vehicles. Kevlar is used throughout the system as primary structure for added strength and superior performance under varying environments. Risers and harnesses are made up of multiple plys of webbing, and protective sleeves are added where abrasion or other adverse conditions may exist. In addition to standard safety factors, the design contains additional margin to provide tolerance for temperature, fatigue, unequal loading, and other dispersed conditions. Figure 2-16 depicts the OV parachute sequence.

2.3.1. Construction and Site Preparation

Figure 2-17 shows a map of the Kistler facilities proposed for Area 18 and Area 19. The site of former CP-18 on Pahute Mesa Road was once an administrative and support center for activities in Area 18. CP-18 is the proposed site for the payload processing facility and is located just south of the proposed launch complex. Power and other utilities already extend to CP-18. It is estimated that approximately 660 kilovolt-ampere [one kilovolt-ampere generally equals 0.8 kilowatt hours]will be needed for the proposed Kistler facilities on a monthly basis. About 0.9 kilometers (0.5 mile) north of CP-18 is a small flat knoll that crosses over into Area 19. The launch complex, which includes the vehicle processing facility, would be located on this knoll with the launch stand built at the edge of the knoll where the ground falls down steeply to a dry bead of a stream at the base of the knoll. The dry streambed would serve as an outlet for engine flame during K-1 launches.

Figure 2-16. Orbital Vehicle Parachute Sequence

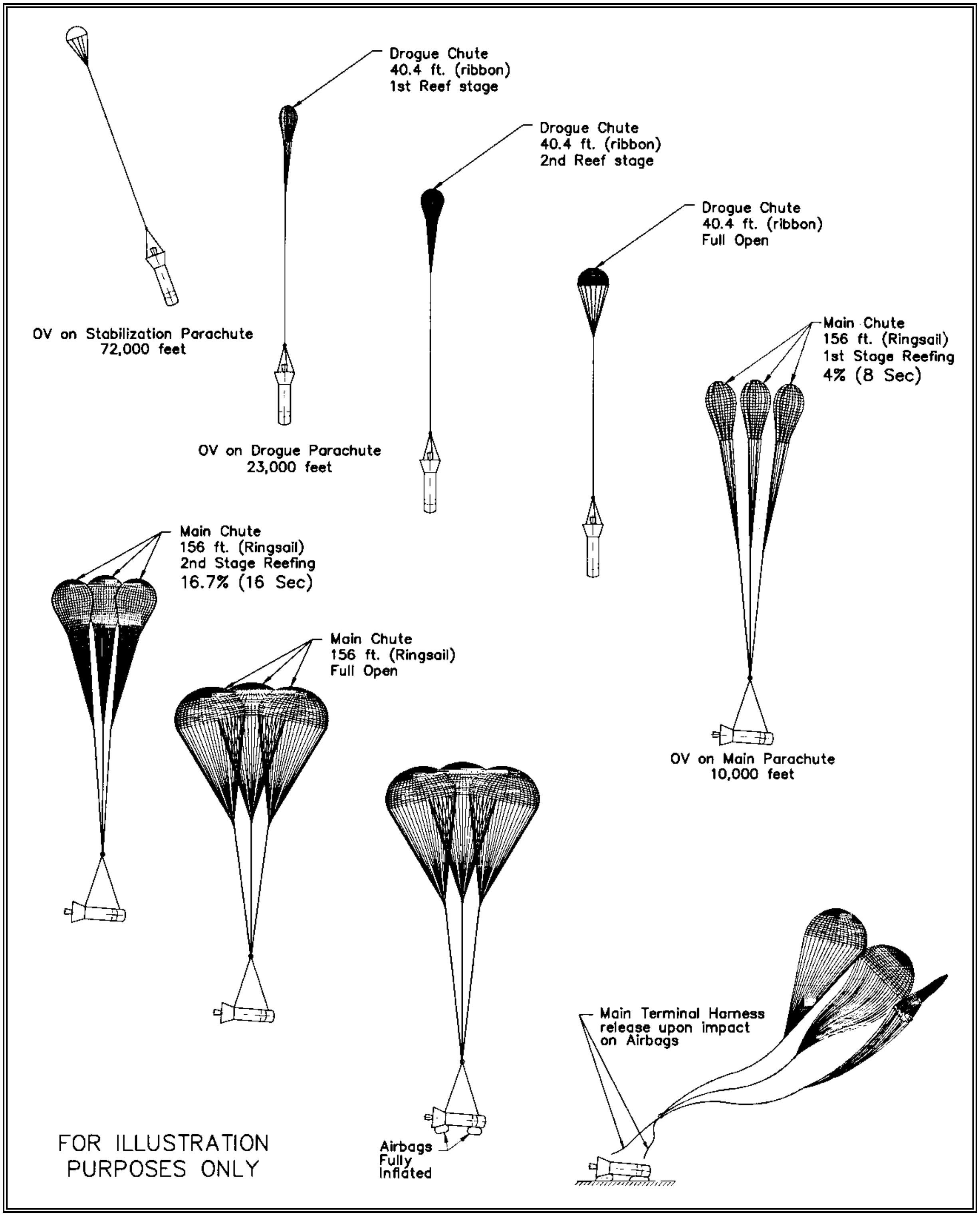
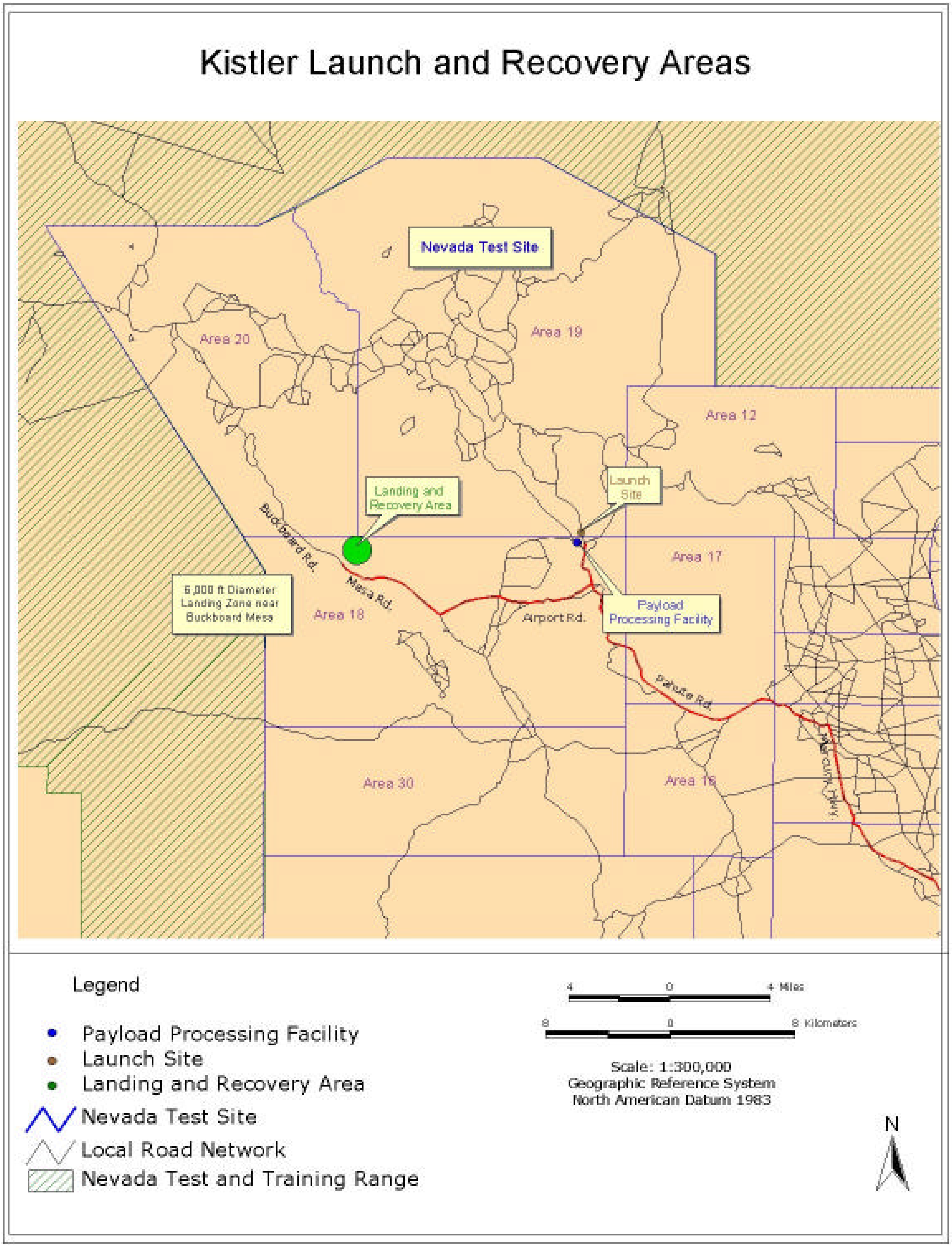


Figure 2-17. Map of Launch and Recovery Areas



A total of 279 hectares (689 acres) would be disturbed for the landing/recovery, processing, and launch areas. Construction personnel requirements are to be 80-90 persons. Alterations to utilities would include power from an existing sub-station to the processing and launch areas, water lines to the launch area (existing in processing area), communications to launch, processing, and landing/recovery areas, and waste/septic system at processing and launch areas. All roadway work would be contained within the construction areas, and no modifications are expected to existing roads at the NTS.

An estimated 2,722 kilograms (6,000 pounds) of solid waste are expected to be generated per month. Kistler will obtain consent from the Nevada Department of Environmental Protection to place solid waste into the solid waste units located on the NTS. The solid waste will be disposed of in a permitted nonhazardous solid waste landfill on the NTS. An alternative solid waste disposal solution is hiring a solid waste contractor to dispose of the solid waste in a permitted landfill outside of the NTS.

The intended landing site is located approximately 11 kilometers (seven miles) west of the launch site on a piedmont slope just north of Buckboard Mesa and Scrugham Peak in an area consisting of low rolling hills. The landing area would consist of a 1,829-meter (6,000-foot) diameter circle that would be cleared and leveled. Drainage would be installed as needed around the perimeter, and a dust suppression system would be put in place if needed.

2.3.2. Test Operations

Kistler plans to conduct a flight test program from its Australian launch site before operations in Nevada commence. This flight test program would consist of a number of test flights under varying flight conditions. The flight test program would demonstrate that the vehicle could operate in the environment for which it was designed, that the vehicle functions as designed, and that the operational support it receives between flights is sufficient to maintain system integrity and reliability.

Kistler would also conduct operational missions from its Australian launch site. These missions could take place over the year between the first flight in Australia and the start of operations in Nevada. These missions would serve as further validation of the design and further assurance of system safety and reliability.

2.3.3. Ground Operations

As discussed earlier in detail in section 2.2.2, ground operations for the K-1 vehicle occur in several stages, including: (1) receiving and final processing of the LAP and OV; (2) integration at the K-1 processing facility; (3) payload preparation and fueling operations; (4) launch operations, including erecting the K-1 and final system review; and (5) reentry, landing, and recovery. After launch operations (less than 15 minutes later) the LAP would return to the landing site. Upon landing the stage would be grounded, checked, made safe for further handling, and secured and moved back to the vehicle processing facility. After flight mission operations (approximately 24 hours later), the OV would return to the landing and recovery site. Upon landing, this stage would be grounded, visually checked for damage or leakage, made safe for further handling, and secured and moved to the vehicle processing facility.

If, during the system check at 55 percent throttle, an engine problem were indicated, the LAP NK-33 engines would be shut down. All fuels and gases would be off-loaded from the K-1 vehicle, transferred to storage tanks, and the erector would return the vehicle to horizontal. The K-1 would then be moved back to the vehicle processing facility for separation. The Payload Module would be removed from the OV, and returned to the payload processing facility.

2.3.4. Launch, Flight, and Recovery Operations

Parachute Sub-System. The OV stabilization chute mortar is fired at 24,380 meters (80,000 feet) altitude. The mortar cover is textile and is attached to the riser. The mortar sabot and deployment bag (attached together to the crown of the stabilization chute) separate from the stabilization chute once it is fully deployed, and descend together. They are not intended to be recovered.

Stabilization chute deployment occurs at approximately nine kilometers (five nautical miles) uprange from the landing site. The sabot/deployment bag landing point will vary depending primarily upon the inclination from which the vehicle is returning and wind conditions. Over the operational life of the K-1 fleet, sabots/deployment bags will land within a quarter circle centered on the vehicle landing site, nine kilometers (five nautical miles) in radius, and arcing from due south to due west. Buckboard Mesa largely occupies this area.

The stabilization chute is released at 6,100 meters (20,000 feet) altitude when the OV drogue chute is deployed. The stabilization chute will drift across the landing zone at approximately the velocity of the wind until it collapses on the ground.

On the LAP, two drogue mortar covers, consisting of lightweight aluminum disks, 41 centimeters (16 inches) in diameter, are jettisoned at drogue deployment. The mortar covers have streamers attached to further slow rates of descent. They will land in the designated landing zone along the flight track and be recovered.

The OV and LAP drogue chutes will be disconnected from the stages at 3,962 meters (13,000 feet) when the main chutes are deployed, and will drift down to the landing zone where they will be recovered.

The OV main chute compartment doors are structural and are hinged and retained with the stage. The LAP main parachute compartment covers are textile and will descend with the

LAP drogues. The OV and LAP main parachutes land attached to the stage, and are disconnected upon impact.

The normal operations sequence for the parachutes during landing phase of a K-1 stage is shown in Figure 2-16. The operations sequence described is based on common sequences for many existing parachute systems, and is flight proven in hundreds of flights. This design approach is the same as that employed by manned systems, such as Apollo and the B-1 and F-111 escape capsules, and unmanned systems, such as the Space Shuttle solid rocket booster recovery system. The Space Shuttle solid rocket booster recovery parachutes in particular have had nearly 200 deployments without a catastrophic failure.

Airbag Sub-System. The airbag landing attenuation system consists of a set of airbag canisters that each contain a multi-compartmented airbag, as well as the pressurization system for that airbag. The pressurization system uses the onboard nitrogen source gas generator to produce inflation gas, and an aspirator that mixes air into the inflation gas. The OV and LAP each contain four airbags. The parachute and airbag components of the Landing LRU are designed to work in tandem to yield a four-acceleration of gravity touchdown deceleration at a given elevation (the elevation of the landing site in Area 18 of the NTS, 1,645 meters (5,400 feet) MSL). At higher elevations, the touchdown deceleration will be higher, and at lower elevations, the touchdown deceleration will be lower. In addition, the airbags require a grade of no more than two percent, and no obstructions greater than five centimeters (two inches) in diameter, to ensure that the vehicle is not damaged during touchdown.

To the extent that the LAP or OV is forced to land at conditions other than these design conditions, the vehicle will sustain increasing amounts of damage. Winds increase the touchdown energy, and, consequently, decrease the elevation at which an undamaged landing can be anticipated. Terrain other than the design terrain, leads to the increased likelihood of vehicle rollover and/or puncture damage.

Kistler K-1 Launch and Recovery Concept. The K-1 launch and recovery timeline is summarized in Table 2-3. The Kistler K-1 vehicle would begin its ignition sequence at 55 percent thrust, and then increase to 100 percent thrust for liftoff at two seconds after ignition. At approximately 132 seconds after ignition, the LAP engines would throttle back to 45 percent thrust and then five seconds later shut down. Staging would occur at 137.3 seconds after ignition at an altitude of approximately 43,280 meters (142,000 feet). At 143.4 seconds after ignition, the OV main engine would ignite after separation and fire for approximately 200 seconds until main engine cut-off. The OV would then coast to apogee, when the small LO_X/ethanol maneuvering engines fire to circularize the orbit. The payload would then be deployed. Figure 2-18 shows a typical launch and recovery operation. (Note: The times presented in this paragraph are representative values and actual times and precise distances would vary depending on the particular mission.)

Table 2-3. K-1 Mission Timeline Summary

Time (sec.)	Event
0.0	• Begin ignition sequence at 55 percent thrust • Initiate engine status check
2.0	• Status check complete • Increase to 100 percent thrust • **Liftoff**
12.0	• Begin pitch maneuver
61.5	• Vehicle achieves Mach 1, altitude = 8,320 meters (27,300 feet) MSL
74.5	• Maximum dynamic pressure, q = 2,365 kilograms per square meter (484.5 pounds per square foot)
132.3	• LAP engines decrease to 45 percent thrust
137.3	• **Staging -** LAP engines shutdown • OV separates from LAP at 43,300 meters (142,000 feet) altitude MSL, 48.0 kilometers (25.9 nautical miles) downrange
141.3	• **Restart LAP center engine for flyback** • Initiate close loop guidance • **Ignite OV engine**
172.5	• **Shutdown LAP center engine**
370.1	• **OV main engine cut-off**
394.3	• LAP goes subsonic, altitude = 14,096 meters (46,247 feet) MSL
430.3	• Initiate LAP parachute sequence, altitude = 6,096 meters (20,000 feet) MSL
~ 620	• **LAP touchdown in recovery area**

(Kistler, 1997)

Figure 2-18. K-1 Launch and Recovery Concept

After staging, at 141.3 seconds after ignition, the LAP would begin its return to the recovery area. The LAP center engine would be fired to stop and reverse its horizontal velocity so that the LAP can return to the landing site. Before gravity reverses its vertical velocity, the LAP's new vertical velocity would cause it to coast to an altitude of 89,000 meters (292,000 feet). The LAP would fly back, deploy a drogue parachute, and then deploy larger parachutes and airbags to land at the recovery area approximately 620 seconds after ignition. During normal operations, the LAP is designed to stay within the restricted airspace of NTS and the Nevada Test and Training Range, but for certain launch trajectories the LAP will fly outside of these restricted airspace areas, but also above FAA controlled airspace. On these missions, the LAP would traverse airspace not used by general or commercial aviation at altitudes greater than 45,000 meters (150,000 feet).

The OV would orbit the earth approximately 14 revolutions after deploying the payload. After approximately 24 hours in orbit, the OV would then fire its small LO_X/ethanol maneuvering engines to de-orbit. The OV would return to the landing site in a steep trajectory. It is designed to return to the landing site in an autonomous precision-landing maneuver using parachute and airbag components similar to those used on the LAP. The OV would enter the NTS restricted airspace at an altitude of 32,000 meters (110,000 feet).

Kistler K-1 Flight Profile. The typical K-1 vehicle flight profile is shown in Figure 2-19. Staging occurs within NTS and Nevada Test and Training Range Restricted Airspace, and the LAP would never enter FAA commercial or general use airspace during its nominal flight. With its steep ascent profile, the OV would leave NTS and Nevada Test and Training Range Restricted Airspace at between 45,000 and 60,000 meters (150,000 and 200,000 feet), which is well above the FAA controlled airspace ceiling of 18,288 meters (60,000 feet).

As shown in Figure 2-20, the LAP maximum downrange location would occur when the center engine is shut down for the second time at 173 seconds, approximately 70.4 kilometers (38 nautical miles) downrange of the recovery area.

Figure 2-19. Ascent Altitude Profile

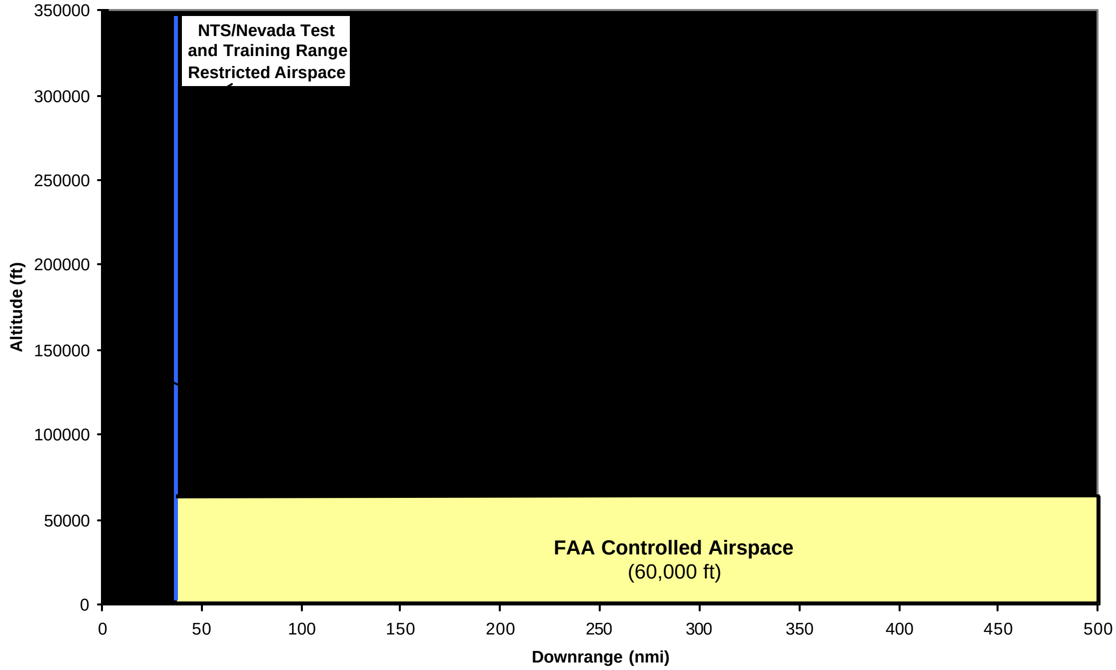


Figure 2-20. Launch Assist Platform Flyback Altitude Profile

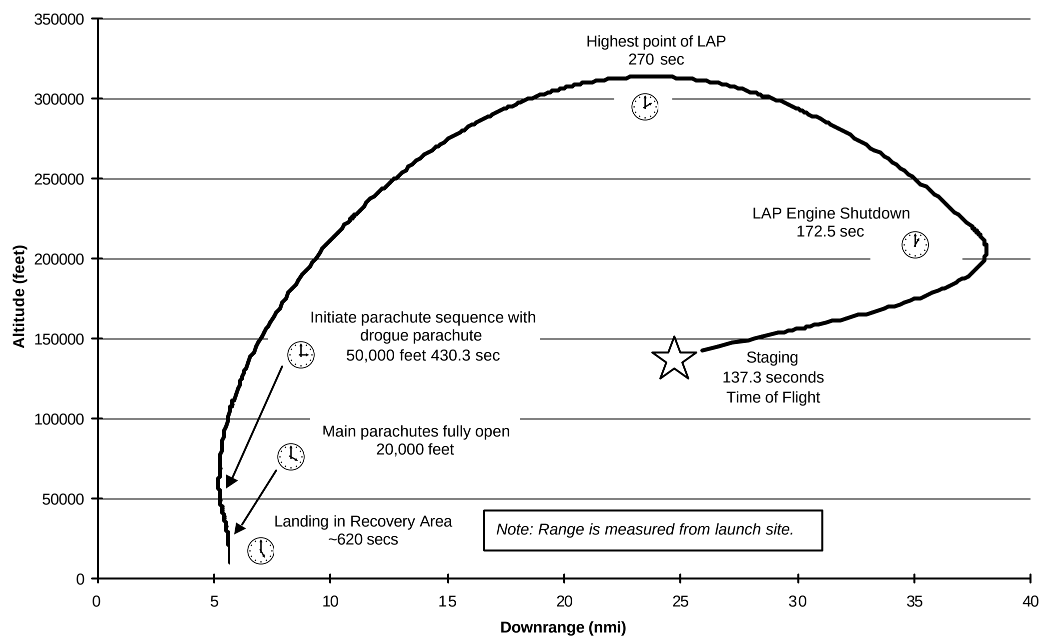


Figure 2-21 and Figure 2-22 depict a detailed view of the terminal phase of descent. The OV would cross into NTS restricted airspace at an altitude of 33,500 meters (110,000 feet), above FAA controlled airspace and thus never enter FAA controlled airspace during a nominal mission. The stabilizing drogue parachutes would be deployed approximately 20 kilometers (11 nautical miles) from the recovery area, and the main parachutes would be deployed within three kilometers (1.5 nautical miles) downrange of the recovery area.

Figure 2-21. Orbital Vehicle Reentry Altitude Profile

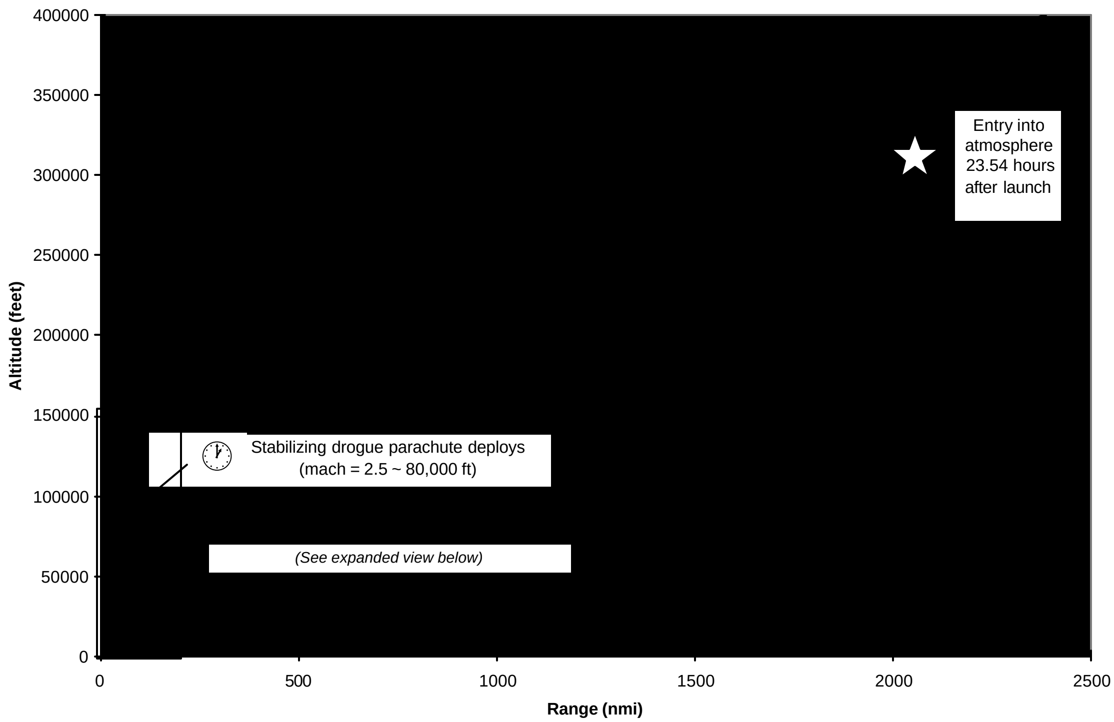
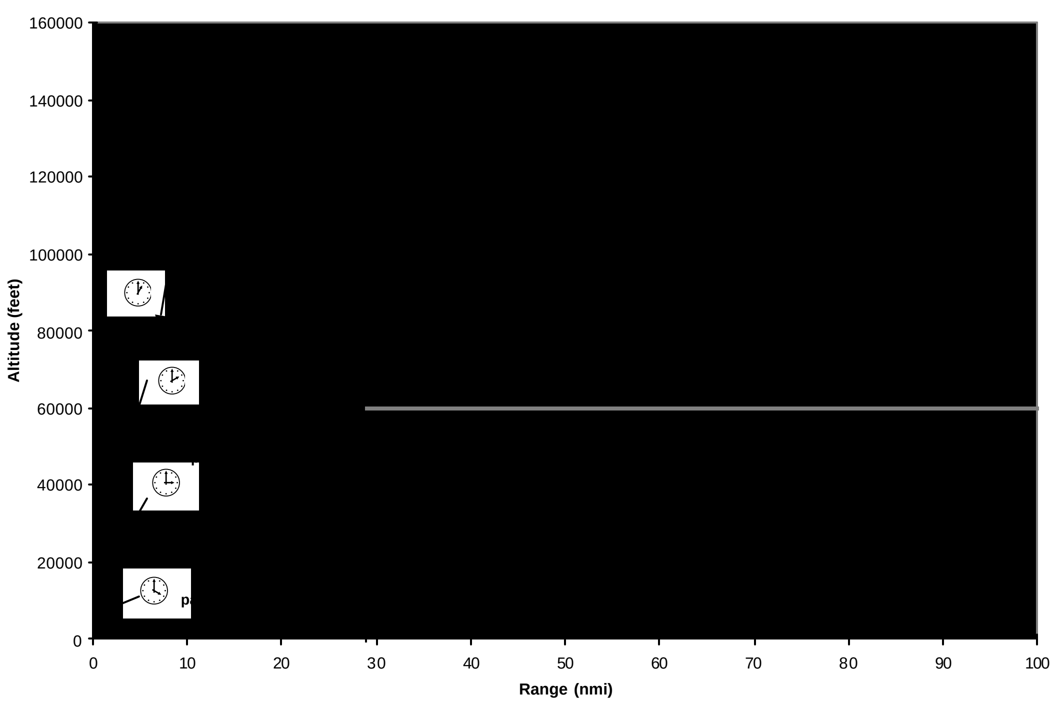


Figure 2-22. Orbital Vehicle Reentry Altitude Profile – Detail



Kistler K-1 Flight Corridors. K-1 operational missions will be flown at inclinations driven by customer requirements. These requirements generally fall in two inclination corridors, from 45 to 60 degrees inclination, and from 84 to 99 degrees inclination.

Figure 2-23 shows the K-1 ground tracks over the NTS from the Area 19 launch facility. Figure 2-24 shows the vehicle Instantaneous Impact Point (IIP) trace. The IIP is the point on the surface of the Earth where an airborne mass would strike, absent atmospheric (e.g., wind) or continuing propulsive effects; the area containing impact points is described by impact limit lines. At main engine cutoff, the vehicle would have achieved orbital velocity. Main engine cutoff would occur approximately 800 kilometers (430 nautical miles) downrange of the launch site. In the 85 degree trajectory, this is about 255 kilometers (137.6 nautical miles) north of the Nevada state line, and in the 56 degree trajectory this occurs about 147 kilometers (79 nautical miles) northeast of the Wyoming and Utah state line.

The reentry flight corridors ground tracks are found on Figure 2-25. Along the 56-degree trajectory, the OV would cross over the U.S. mainland approximately 420 kilometers (227 nautical miles) southwest of the landing area at a height of approximately 57.9 kilometers (190,000 feet). The OV would cross over the California-Nevada border approximately 62.5 kilometers (33.7 nautical miles) from the landing site at a height of 34.3 kilometers (112,400 feet). Along the 85-degree trajectory, the OV would cross over the U.S. mainland approximately 513 kilometers (277 nautical miles) south of the landing area at a height of approximately 61.0 kilometers (200,000 feet). The OV would cross over the California-Nevada border approximately 86.5 kilometers (46.7 nautical miles) from the landing site at a height of 37.1 kilometers (121,800 feet). The OV will fly over the Yucca Mountain operations site during reentry for one of its polar trajectory flights (approximately 88 degree inclination). The OV will pass over the Yucca Mountain operations site at an altitude of between 95,000 and 101,500 feet MSL. The LAP however, will never fly over the Yucca Mountain operations site. When the OV descends to 18,288 meters (60,000 feet), the height for FAA controlled airspace, it would be within 3.7 kilometers (two nautical miles) of the landing site, having already flown more than 46 kilometers (25 nautical miles) through NTS restricted airspace.

Main engine cutoff occurs over the U.S. as shown in Figure 2-23. The K-1 under normal operating conditions would be over 99 kilometers (325,000 feet) in altitude at main engine cutoff. The FAA's controlled airspace ceiling is 18,288 meters (60,000 feet), which is exceeded shortly after launch.

Kistler Proposed Launch Schedule. Kistler anticipates conducting commercial launches from the NTS beginning no earlier than 2002 and building to a capability to support a maximum flight rate of 52 launches per year.

Potential K-1 Payloads and Inclinations. Kistler intends to service primarily the emerging LEO communications satellite market of private and government payloads and provide other on-orbit servicing operations. Possible payloads for the K-1 are listed in Table 2-4 along with their size, altitude and orbital inclination.

Table 2-4. Potential K-1 Payloads, Altitudes, and Inclinations

Company/ Organization	Name	Est. Mass (Each) Kg (lb.)	Final Altitude km (mi)	Inclination (degrees)
NASA	SMEX, UNEX, Discovery, Etc.	Varies	Varies	Varies Est. 45-60, 84-99
Teledesic	Teledesic	2000-2500 (4,400 – 5,500)	1400 (875)	Est. 48 or 87
LEO One Corp	LEO One USA	125 (275)	950 (594)	50
Final Analysis	FAISat	100 (220)	1000 (625)	51 and 83
Space Systems/Loral	Globalstar	450 (990)	1414 (880)	52
Alcatel Espace	SkyBridge	1000 (2200)	1457 (910)	55
Department of Defense	Discoverer 2	1000-2000 (2200-4400)	770 (480)	Est. 52-55
NASA	ESSP	Less than 500 kg (1100 lb)	400 (250)	65
NASA	ESSP	Less than 500 kg (1100 lb)	450 (280)	90
NASA	ICESAT	700 (1,540)	600 (375)	94
STDC / NRL	NEMO	572 (1,260)	606 (380)	97.8
DoD	DMSP	640 (1400)	830 (520)	98.2

[Sources: Teal Group World Space Systems Briefing, NASA, Published data]

2.3.5. Decommissioning

Kistler's agreement with the NTSDC stipulates that, should Kistler cease operations at the NTS, Kistler is required to remove all equipment and facilities, with the exception of those that the Development Corporation considers an improvement, and return the site to its pre-construction state. Launch site facilities are being designed for indefinite service with proper maintenance. Kistler's intentions are to continue to use these facilities well into the future.

2.4. No Action

Under the no action alternative, Kistler would not propose to conduct launch/reentry operations at the NTS, and the FAA would not issue a license for Kistler to conduct launch and reentry operations. The general use permit between DOE and the NTSDC would continue to exist but the subpermit between NTSDC and Kistler would be void. Kistler would not construct its launch and recovery facilities.

Figure 2-23. Operational Launch Corridors

Figure 2-24. Operational Flight Corridors IIP Traces

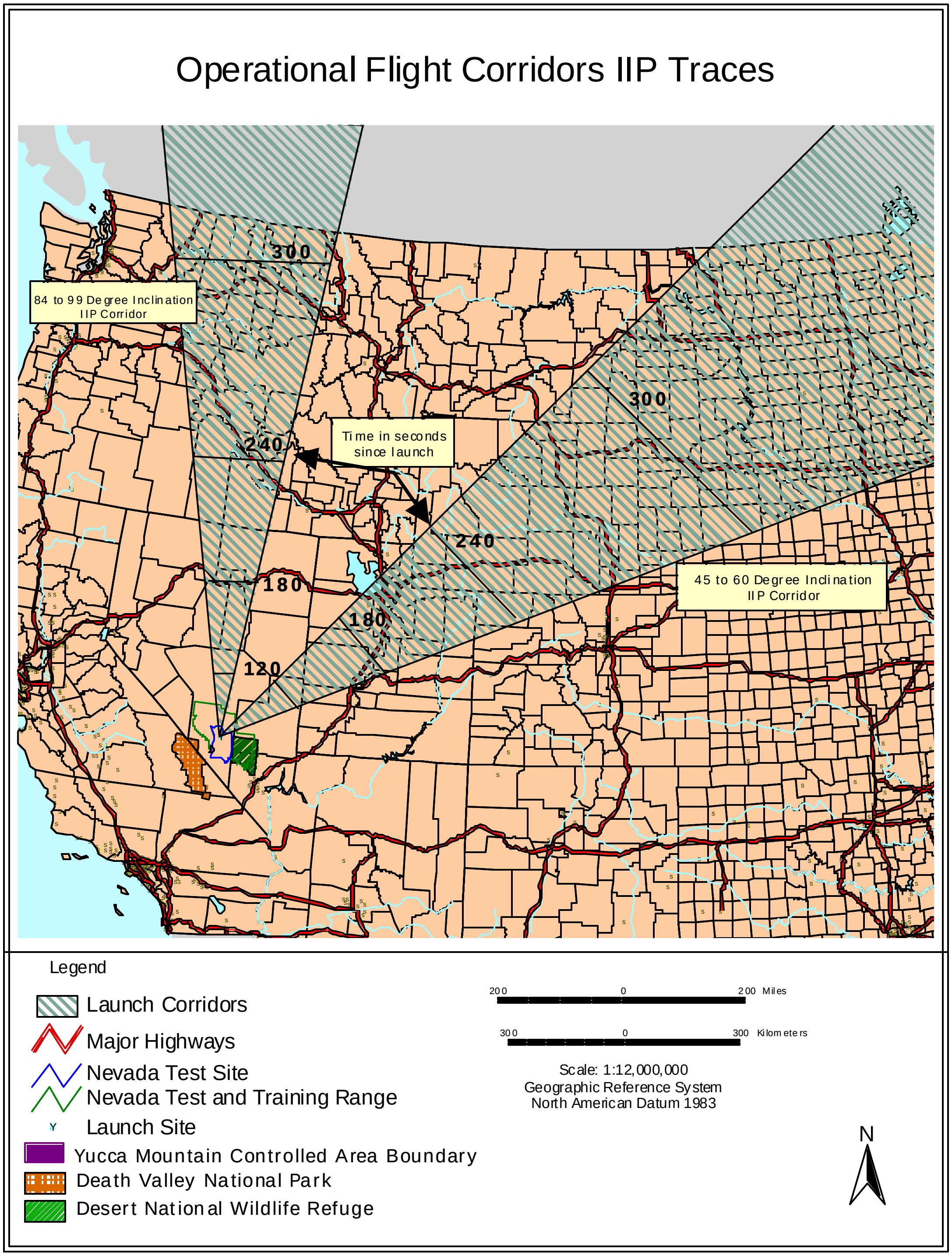
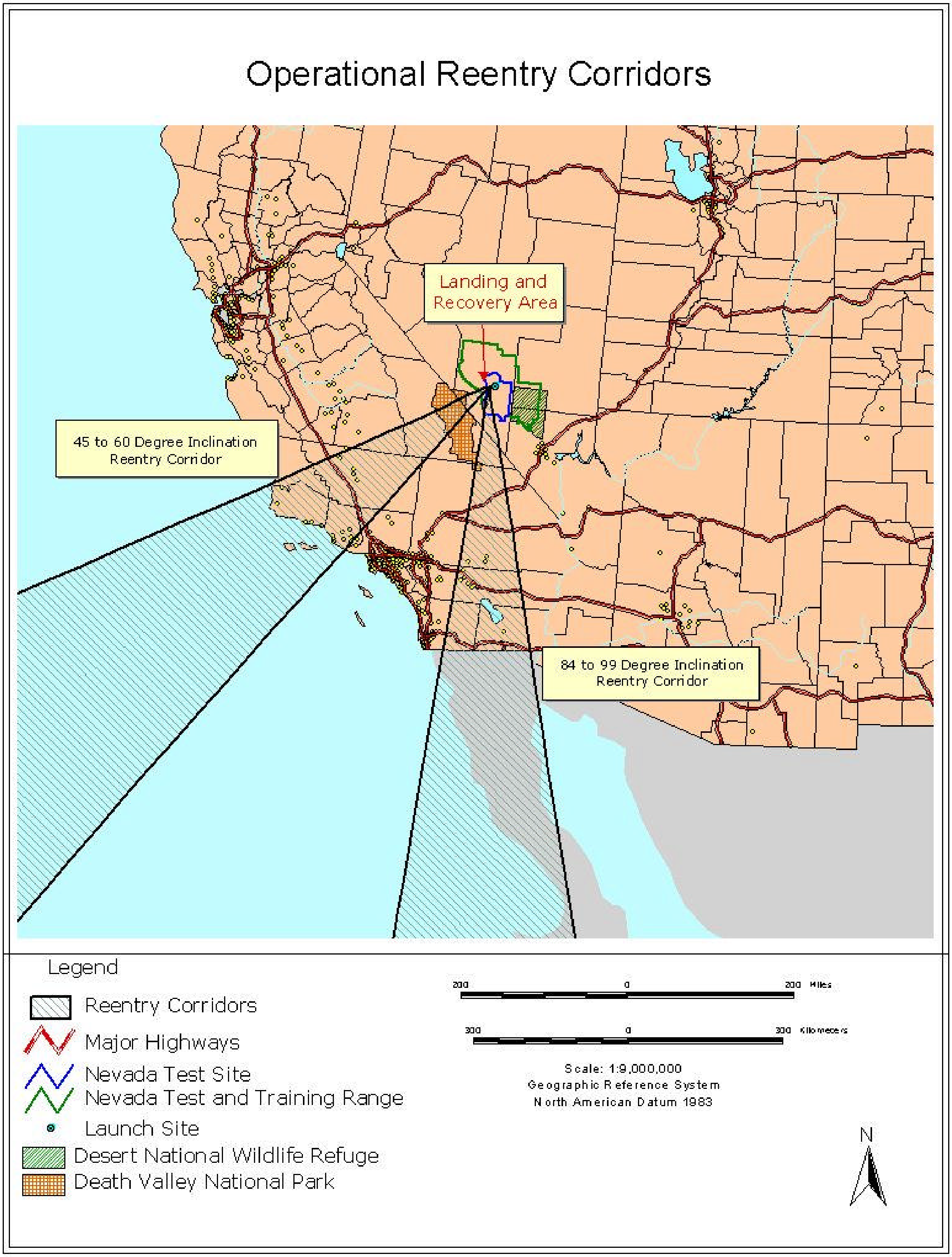


Figure 2-25. Operational Reentry Corridors



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