Maine Space Complex

Launch Sites and Services

Implementation Plan

Draft Version 6

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Definitions

Term	Definition
SSO	Refers to Sun Synchronous Orbit or an orbital path that passes near the Earth’s poles and over the same area of the earth’s surface each day. Sun-synchronous orbit is useful for imaging, reconnaissance, and weather satellites, because every time that the satellite is overhead, the surface illumination angle on the planet underneath it is nearly the same. This consistent lighting is a useful characteristic for satellites that image the Earth's surface in visible or infrared wavelengths, such as weather and spy satellites, and for other remote-sensing satellites, such as those carrying ocean and atmospheric remote-sensing instruments that require sunlight. For example, a satellite in Sun-synchronous orbit might ascend across the equator twelve times a day, each time at approximately 15:00 mean local time.
LV	Launch vehicle

1 Introduction

The Maine Space Complex is designed to support development across the space value chain – upstream R&D and manufacturing, mid-stream launch services, and downstream satellite data acquisition and analysis - all within the State of Maine. By supporting the in-state growth of the integrated space value chain Maine will offer companies a proximate feedback loop by providing the skills and equipment to design and build space systems, test products and services on the ground and launch spacecraft into space to collect data and iterate accelerating the rate of knowledge acquisition and dissemination within state. Ultimately this will provide our tenants and customers a speed-to-market advantage by offering all services in proximity, engaging tenants throughout the development process and creating a globally competitive knowledge cluster and talent pool.

Underpinning this value proposition is Maine's unique capability to offer a vertical launch site that prioritizes sustainable and Maine-based launch activities. Currently there are only four licensed vertical launch spaceports in the US. Maine has the opportunity to alleviate the increasing bottleneck in launch demand by creating a unique asset to support vertical launch into sun synchronous orbit (SSO)/polar orbit but to create better resiliency in the US launch infrastructure.

1.1 Document Overview

The following document provides an overview of the proposed Launch Sites and Services its core activities, operations and the initial stages of an implementation plan. It is meant to inform and instruct future activities of the Maine Space Corporation as it pertains to the Launch Site and Services arm of the Maine Space Complex. The document seeks to align the Launch Site and Services with the Mission and Vision of the Maine Space Corporation, Legislative Statute, and the State of Maine's Economic Development Strategy 2020-2029. The Mission and Vision of the Maine Launch Site and Services provide the guiding North Star ideal for the strategic **Goals** of the Launch Facility that are attained by carrying out the **Objectives**. **Core Functions** of the envisioned **Launch Site and Services** will be supported by the **Physical Infrastructure and Capabilities** and **Organizational Responsibilities**. Once enabled, the facility and its operations will create a variety of **Revenue Streams**. The document goes on to provide a plan for the successful Phased Implementation of Core Functions and Enabling Infrastructure of the Launch Sites and Services, in order to meet its goals and produce outcomes that are impactful and attainable for the Maine Space Corporation.

1.2 Maine Space Corporation Mission and Vision

The Maine Space Corporation was established by legislative mandate in 2023 to standup the Maine Space Complex and its three respective business units – Launch Site and Services, Innovation Hub and the Space Data and Advanced Analytics Center of Excellence.

Mission: "The Maine Space Complex provides faculty, teachers, students, businesses, partners, and entrepreneurs from within and outside of the state access to a plug-and-play infrastructure where innovations, ground-breaking research and development, problem-solving, spacecraft launch, world-class space data management and analytics capability, and dreaming big are routine occurrences and from which virtual learning is available to teachers, students, and others."

Vision: “By 2030, Maine will be an integral player in the emerging global network of suborbital and orbital transportation to space, providing a significant return on investment as an engine of economic growth and workforce development to the state and the region.”

1.3 Legislative Mandate for Launch Sites and Services Facility

“Maine Launch Sites and Services, which must consist of staging and launch sites for sending small vehicles with nanosatellites into polar orbit. Maine Launch Sites and Services shall allocate the use of its staging and launch sites in a manner that prioritizes Maine-based businesses and businesses that minimize the environmental effects of their space vehicles and launches”[1].

1.4 Launch Site and Services Mission and Vision

Mission: "To be the preferred gateway to space for SSO/Polar launch activities, providing reliably safe, sustainable and efficient polar/SSO launch solutions that empower global access to outer space. We are committed to pioneering the exploration and utilization of outer space for the betterment of humanity and advancing scientific knowledge, fostering innovation, and creating opportunity across the state while inspire the next generation in a uniquely Maine way. We strive to deliver an ease-of-use experience to our customers at our vertically integrated space complex that will foster R&D, testing, launch, and data analytics for rapid iterative development. Offering launch services sets us apart by offering an unparalleled user experience, supporting diverse payloads and data needs that contribute to the sustainable advancement of space exploration, satellite deployment, and scientific discovery. Our mission is grounded in safety, innovation, and customer satisfaction, to support the sustainable evolution of space transportation.

Figure 1: Illustration of Proposed Spaceport

Vision: "We envision a future where humanity seamlessly integrates with the vastness of space, unlocking the boundless potential for scientific discovery, technological advancement, and sustainable development while contributing to the economic development and competitiveness of the Maine economy. We aspire to be a global leader in space launch and exploration, offering state-of-the-art facilities, fostering local, regional, national and international partnerships, and promoting a culture of curiosity, inclusivity, and environmental stewardship. Our vision is to catalyze breakthroughs that transcend borders, inspire wonder, and bring the benefits of space exploration to people in Maine and beyond."

[1] *§13203(C),* 5 M.R.S.A c.393

2 Goals

The **Launch Sites and Services** is central to the Maine Space Complex design that will amplify the utility of the other two business units – R&D/Innovation and Space Data + Advanced Analytics - by offering a unique opportunity to host a vertically integrated commercial SSO/polar launch within the State. Currently only four states can offer this nationally – Alaska, California, Florida and Virginia. Given the dramatic increase in the number of satellites launched over the past ten years demand for launch services is increasing and has currently outstripped demand. Maine's unique geography in northeastern United States makes it particularly well suited to host polar/SSO launch trajectories without overflight thereby limiting liability and risk exposure. The Launch Sites and Services facility of Maine Space Complex is intended to complete such missions in a safe and responsible manner as to limit the amount of risk to the public, environment, and infrastructure.

The following goals support this mission and vision:

Goal 1: Secure a location to develop the launch facility.

Goal 2: Become the preferred gateway for launch provider to polar/SSO. Capture a minimum of 10% of the US small satellite (<300kg) launch market going to SSO/Polar LEO within firsts two years of operations.

Goal 3: Provide customers of the Maine Space Complex an unparalleled customer experience and true to speed to market advantages.

Goal 4: Become a leader in the environmentally friendly space technologies.

2.1 Objectives

The following objectives will support the achievement of the above goals. These objectives are envisioned to be carried out by the core functions and operations of the Maine Launch Site and Services Facility.

Goal	Objective	Measuring Success
Goal 1: Secure a location to develop the launch facility	**1.1** Run an ongoing public relations and awareness campaign in Washington County for the launch facility and proactively manage opposition	
	1.2 Outline Launch Site market opportunities today and forecast market opportunities in future for life of asset	
	1.3 Develop requirements for launch site location (size of LV, # of pads, etc.)	
	1.4 Identify the most feasible launch sites on the coast	
	1.5 Raise funds and option the purchase or lease land for Launch Site	
Goal 2: Become the preferred gateway for launch provider to polar/SSO. Capture a	**2.1** Identify and enter agreements with anchor tenant(s) and recalibrate business plan	
	2.2 Start the FAA license approval process for the launch site and services operating licensing	

minimum of 10% of the US small satellite (<300kg) launch market going to SSO/Polar LEO within firsts two years of operations.	**2.3** Maintain open and continuous communications regarding planning with the citizens and municipalities surrounding the launch site(s)	
	2.4 Hire a design and engineering firm to use requirements to draft facility plans and costs	
	2.5 Secure funding for construction and initial operations	
	2.6 Hire Construction firm and begin construction	
	2.7 Consider interim and alternative launch solutions	
	2.8 Finalize final organization structure and hiring	
	2.9: Monitor ongoing operations operations and seek additional opportunities for launch capabilities to grow including coordination and integration with the other business units of the Maine Space Complex.	
Goal 3: Become a leader in the environmentally friendly space technologies	**3.1** Prioritize companies that focus on development of environmentally sound technologies and/or technologies that allow more effective waste management	

3 Launch Sites and Services Core Functions

3.1 Safety

As with other modes of transportation – aviation, maritime, and land-based – space launch carries risk to human life, infrastructure, and environment. The risks span day-to-day activities, prelaunch preparations, and launch day operations. Ground risk and flight risk are the two basic categories of risk to be managed. **Ground risk** includes risks introduced during general operations, prior to launch, during transport, integration, testing, and prelaunch activities. **Flight risk** refers to the risks occur during launch and once the launch vehicle is in flight along the planned flight path/trajectory. Controls for both types of risk were introduced with the creation of space launch bases. Some ground safety risks are caused by:

- The launch vehicle and payload processing operations that occur inside the processing facilities (e.g., assembly, integration, and tests).
- All activities on the launch pad prior to a launch, during launch chronology, and at the time of liftoff.
- All dedicated ground support equipment for LV and payload activities.
- Storage areas that house liquids, gasses, and pyrotechnics.

Some flight safety risks occur launch day from lift off to the end of mission and are caused by:

- Failure of the LV systems or components during any phase of flight.
- Errant flight of LV.
- Overflight of populated area (inside or outside of define hazard areas.

To mitigate risk, FAA has established requirements for both the Launch Site Operator and the Launch Vehicle Operator to ensure responsibility on both sides. Both Operators will develop, design, test, control hazards per requirements to ensure safety for all parties and protection of the facilities and environment. The focus of FAA requirements will be to ensure public safety and reduce risk to an acceptable level.

If solid-propellant rocket motors are used as main propulsion or boosters, whenever they are in an enclosed workspace such as an assembly building, standard industrial anti-static measures must be enforced. These include requiring all tools in use to be made of non-sparking metals, and requiring all personnel to wear grounding straps, for the entire duration of their presence in the enclosed space.

3.2 Federal Safety Requirements

3.2.1 Federal Aviation Administration (FAA)

As the leading US regulatory body for launch site and aviation related matters, the FAA licenses all commercial space launch, reentry activity, and sites to ensure safety of the public. Other agencies that establish regulatory requirements are Occupational Safety and Health Agency (OHSA), Environmental Protection Agency (EPA), Federal Communication Commission (FCC), and National Oceanic and Atmospheric Administration (NOAA). The FAA uses the following tools to regulate space related activities:

The most relevant parts that apply to obtaining an FAA License include:

- **Part 414:** Safety approval.
- **Part 417:** Launch safety - (grandfathered launch vehicles: Identifies the requirements for flight and ground safety, and control of hazard areas and safety zones. This set of requirements focuses on the rocket and ground support equipment design, test, operation, hazard analysis and environmental impact. It includes a risk assessment for the flight trajectory to ensure risk level is acceptable.
- **Part 420:** License to operate a launch site - Identifies requirements to establish and operation a launch site to conduct and execute operations. This set of requirements focuses on facility design, explosive siting, environmental, flight safety, ground safety, risk analysis, access control, and overall operations.
- **Part 450:** Launch and Reentry License Requirements - All new launch vehicles are required to meet this new streamlined set of requirement in Title 14 of the Code of Federal Regulations (CFR). Part 450 consolidates multiple regulatory parts (415, 417, 431 and 435) to create a single licensing regime for all types of commercial space flight launch and reentry operations and replaces prescriptive requirements with performance-based criteria. This advisory circular provides guidance to an applicant as they develop a hazard control strategy (or strategies) that must be compliant with article 450. Although the FAA considers this advisory circular to be an accepted means of achieving compliance with the requirements of § 450, the content of this document does not have the force and effect of law, and it is not meant to bind the public in any way. The advisory circular is intended only to provide clarity to the public regarding existing requirements under the law and agency policies. This set of requirements includes scope of license, design, test, operations, hazard analysis, hazard control strategies, ground safety, flight safety, and risk analysis to ensure safety of the public.

3.2.2 National Environmental Protection Agency (NEPA)

NEPA is a U.S. environmental statute signed into law in 1970 requiring all federal agencies to assess the environmental impacts of their proposed action(s) prior to making decisions. Specifically, it requires all federal agencies to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment. These statements are commonly referred to as Environmental Impact Statements (EIS) and Environmental Assessments (EA).

Once all environmental analysis requirements are satisfied, an agency will prepare a NEPA finding or decision document.

An EA defines the purpose and need for the project, analyzes the potential impacts of the project and alternatives; demonstrates compliance with other Executive Orders and environmental laws; and allows for public participation, when applicable. An EA may also contain mitigation measures that avoid, eliminate, or reduce anticipated impacts.

If an EA demonstrates impacts of a proposed action would not be significant or could be mitigated below the level of significance, AST will prepare and issue a Finding of No Significant Impact (FONSI) or a FONSI/Record of Decision (ROD). A FONSI presents AST's findings and provides the rationale for why the project would not have a significant impact on the environment. Alternatively, if an EA demonstrates that the proposed action could result in significant impacts, AST will publish a Notice of Intent (NOI) to prepare an EIS to continue the environmental review.

In the event of a mishap that impacts the environment, MSC will coordinate and require the launch vehicle operator to remediate the impacted areas to an acceptable level directed by MSC and Maine EPA.

3.2.3 Other Requirements

OHSA, FCC, and NOAA will also have requirements that MSC and the LV operator will need to meet.

3.3 Launch Campaign Overview

A launch campaign will begin with the delivery of the launch vehicle (typically broken into sections) and customer's payload(s) to the launch base. Several weeks prior to the launch campaign, a preparation phase must take place. During the preparation phase, all operational documents are issued, and the payload preparation complex is assessed to verify that it is in compliance with the customer's requirements. Each launch whether it be vertical, horizontal or water based will have unique requirements that will need to be addressed that may not be included below.

A launch campaign is usually divided into five major phases as follows:

A. Launch Vehicle Preparation and Assembly

This phase occurs in the LV assembly and integration building and is performed in accordance with the LV operations plan. It is the responsibility of the launch vehicle operations manager and the member of the launch operator team reporting to the launch operator's mission director.

B. Spacecraft Preparation

This phase includes the operations performed from the spacecraft's arrival at the launch facility up to its readiness for integration with the LV. The Spacecraft Operations Plan is prepared by the customer and describes the required support(s) needed for the campaign. It is agreed to by the mission director and the range operations manager.

- Stage 1: spacecraft preparation and check out
- Stage 2: spacecraft hazardous operations

The operations are managed by the customer. Additional support is provided by the range team assigned to the payload preparation complex. The launch mission director from the launch operator team, in charge of the launch campaign, takes care of the operation's global coordination.

C. Combined Operations

In accordance with the Spacecraft Operations Plan, these operations include the spacecraft integration on its adapter and its installation for encapsulation inside the fairing to constitute the LV upper composite (stage). The upper composite will then be assembled on top of the LV. For smaller LVs, this operation is usually achieved horizontally in the LV assembly and integration building. The complete LV will then be transferred to the launch pad for erection on the launch platform and connection to the umbilical links

D. Launch Countdown Preparation

This phase encompasses the final launch preparation sequence. These operations are carried out on the launch pad under the responsibility of the launch vehicle operations manager and in full coordination with the range operation manager for all the launch base support. This phase is followed by the launch chronology up to lift off. Prior to launch day, a launch rehearsal is usually conducted three to four days before launch range systems are activated. LV and payloads are fully implicated.

E. Post Launch

Post launch, the LV will fly along a pre-planned and approved trajectory. It is required to remain in the defined hazard-controlled areas. During the flight, the LV will fly through maxQ (most dynamic pressure on LV), complete stage separation events, fairing separation events, achieve orbit, and deploy payloads. Payloads will then begin their specific missions.

Telemetry/Tracking: The LV will be tracked using different systems (GPS, Skin track, optical) to monitor the flight progression, trajectory, and overall status of the LV. All data will be transmitted through telemetry systems that sends data from the LV to the Launch Site and LV Operator. This will utilize some type of radar and satellite to send/receive data. Payloads will use telemetry to provide overall health and status throughout the lifecycle. The Launch Site and LV will use the data for post flight analysis, mishap investigations, and review of all systems. Therefore, data is recorded to ensure the ability to use and review launch campaign.

Ongoing Maintenance, Repair: Post launch of a mission, the launch site will need to conduct inspections on all pad infrastructure and maintenance. If the pad is not in active testing or launching mode, there will need to be sleep mode procedures executed to control cost and wear and tear on equipment and infrastructure.

3.4 Launch Campaign Staffing

During the time that operations are in progress at the launch facility, the customer team will be in direct communication with the mission director who is in charge of the coordination of all the launch campaign activities. The range control officer communicates with the launch mission director and with the customer for on-site coordination purposes. The range operations manager is in charge of all range activities that are dedicated to supporting the customer and supporting the LV.

The launch day organization consist of the following roles:

- Range Director
- Range Control Officer
- Range Safety Officer
- Ground Safety Officer
- Mission Manager (Operations Director)
- Weather Lead
- Emergency Services
- Launch Pad Lead and technicians,
- Telemetry, Communications, and Video
- Customer – Payload and/or LV
- FAA - TBD

The Range Director is the highest level of leadership for the spaceport. This position monitors and supports the operations and may fulfill other positions, such as liaison between operations and CEO. The Range Control Officer is responsible for the Range Safety and Security for all types of activities including the state's security and safety regulations and for FAA safety regulations.

4 Launch Sites and Services Infrastructure Overview

The requirements for launch sites and services are similar for both vertical and horizontal launch**.** The Maine Space Complex will include the following:

- Launch Site
- Command and Control
- Radar and Telemetry Station
- Observation Deck and VIP and client lounge facilities
- Additional Support Infrastructure

4.1 Launch Site

A launch site will consist of the following facilities and equipment:

- **Office Space** – a building for office space for Spaceport management, conference rooms, customer workspaces, etc.
- **Launch Vehicle and Payload Assembly Building** - large building (estimated size of ~30,000-35,000 sq. ft) for LV and payload assembly and integration to constitute the upper composite (stage) and its mating on the LV
    - Payload Processing - For payload-related work and preparation, two clean rooms conformed to ISO 8 cleanliness level 100,000 standards (estimated size TBD possibly 10,000-12,000 sq. ft) will be located inside the LV assembly building that houses all of the equipment and associated services. Note that equipment and services will be

negotiated and agreed upon with the customer during the launch contract and the launch demand discussions.
  - A laboratory area for conducting physical and chemical testing.
  - A technical support area with workshops, transportation vehicles, garage, and miscellaneous ground support equipment.
- **Vertical launch pads** - composed of a heavy concrete launch platform and configured with combustion hot-gases ejection ducts below the platform at the LV nozzles level as needed, directly covered by a water deluge. Launch pads will have berms reduce damage to other pads or customers. A fence must surround the areas for physical security to ensure access control and overall protection of LV, equipment, and hardware.
- **Lightning Protection System -**
- **Launch Mast** - A launch mast for each launch pad, to be used for umbilical links depending on customer/vehicle requirements.
- **Camera System** - Cameras that are positioned to give a close view of the LV on the launch platform to support integration, testing, and launch operations. As well as Cameras around the launch complex for situational awareness and security
- **Propellant and Gas Storage** - A storage area for the propellant and gas products to be used during LV preparation and chronology (e.g., fueling and tanks pressurization) as well as a dedicated reinforced booth for pyrotechnics (explosives) devices that are used for the LV arming process (estimated size around 800 sq. ft)
- **On-site Power Supply** - system with an emergency substitute system (backup power) to ensure constant power is available to the facility.
- **Secured itineraries** (and procedures) located both inside and outside the launch base that include instructions for performing any type of hazardous operation, such as transferring a LV to the launch pad and transporting propellants and explosive devices to the complex and movement inside the facilities.
- **Security Unit** – with dedicated area and building to store protection equipment, emergency and rescue vehicles and equipment, and a small fire brigade. This building should also have a first aid room and treatment area for providing short-term emergency care. The size and specialized training requirements of the fire and security brigade will be dictated by the LV specifications and FAA regulations.
- **Vehicle fleet Storage** - to support operations, movement of equipment, and customer support.

4.2 Command and Control

The launch base command and control center is the facility where all launch base activities are managed and coordinated from. It must be located outside of the protection radius at a minimum of approximately one point four (1.4) miles, or seventy-three hundred (7,300) feet, away from the launch point. Dependent on the quantity and explosive potential of the propellants used by launchers, the required distance may be greater.

This building will house two (2) main rooms, separated so as to segregate the launch vehicle operations team from the ground and flight safety team. The command and control center may occupy an area of approximately 150,000 sq. ft and include a large building that offers at least 50,000 sq. ft of usable space. Command and Control will also include:

- The launch control center, which will contain multiple consoles for each of the launch vehicles' main and satellites components, large display screens for following the status of systems through flight preparation, launch and ascent. Some customers will bring their own control centers requiring onsite power, fiber, and communications capabilities to host.

The ground and flight safety control room and its separate room dedicated to monitoring flight safety. The safety officer in charge of a flight must function independently of the launch base director for a successful mission to be achieved. This includes:

- The localization/trajectory/telemetry (TM)/TCD control room and command consoles.
- The security command room with its associated consoles (also see separate building below).
- The weather forecast room with associated consoles and requirement equipment near launch pads and weather room. Weather balloons will need to be built up, released, and data collected during missions.

A separate multi-use operations building (around 20,000 sq. ft) with offices to be located beside the launch base control center building to house:

- The launch base power supply command post needed for managing all the launch base electrical sources, including emergency backup units.
- A technical support area with separate laboratories, the security teams' facilities and transportation vehicles, and the rapid intervention teams (i.e., the fire brigade and medical squad) and accessories equipment and garage.

The command and control center could also accommodate a third building or an extra room in one of the previous facilities that can be used for hosting VIPs, clients and invitees in a lounge and service and viewing area; this can be in tandem with a media room, complete with the appropriate amenities (including a front desk and reception area, a few offices and a conference room, indoor and outdoor viewing areas, food and beverage services, monitors, comfortable seating, a public announcement system, binoculars, washrooms, and parking).

Depending on the terrain and line of sight options, the third building could also be located elsewhere and constitute a separate location, particularly with a separate entrance not granting access to the rest of the complex, might permit easier access to foreign nationals viewing the launch, such as foreign payload representatives. journalists, or other foreign VIPS, with fewer ITAR issues.

4.3 Radar and Telemetry

Radar and telemetry should be located as close as possible to the launch base control center in order to optimize the different data and communication links. This site should also be integrated in the launch control center area, if visibility is required. If the launch site selected does not guarantee full visibility (line of sight) between different radars and antennas of the localization and TM -TCD Optical Systems from the launch base control center area, a different site should be identified as the location to install these pieces of equipment and facilities. The estimated required size is ~20,000 sq. ft. This site also needs to be secured and protected against intrusion and tampering, in addition to power, fiber and communication to allow for the operation, collection and distribution of data to other locations.

4.4 Observation Deck and VIP client lounge facility

This would be host a building for VIP, clients, students, and invitees lounge, service and viewing area along with a media room with appropriate amenities (including a front desk and welcome area, offices and a conference room, indoor and outdoor viewing area, food and beverage services, monitors, comfortable seating, public announcement system, binoculars, bathroom, car parking and other amenities).

5 Launch Site Infrastructure: Buildings and Control Centers

5.1 Permanent Launch Facility Infrastructure

5.1.1 Launch Vehicle Preparation and Assembly Building

The LV assembly and preparation building must be able to receive the LV and the associated equipment (i.e., assembly racks) for different LV activities. The building must be accessible, with large doors for an assembled LV transfer to the launch pad. It must also be equipped with different support equipment to cover the LV operator requirements, including three (3) phased power and voltages, pressurized air distribution, overhead cranes, specific rooms and amenities for the teams.

The launch vehicle assembly and preparation building must also be equipped to support the installation of the payload on-board the LV and to achieve the LV’s upper composite integration after the S/C is fixed on its adapter or on a LV plate for dispensers’ installation. The encapsulation and the fairing closure need different hoisting equipment. All the LV hazardous operations will be realized on the launch pad.

Note: all explosive device arming and the fueling of propellant operations occur on the launch pad and not in the LV assembly building. A storage hangar of fair size must also be associated to the LV assembly building for the storing of the launch vehicle stages and associated equipment after their arrival on the base and before the assembly process. Some of the buildings, especially the LV assembly building, are contracted for military launches and may need to be EMP (electro-magnetic pulse) protected.

5.1.2 Payload Processing Facility

A payload processing facility is usually composed of different rooms of various sizes or separate buildings. The main facility is dedicated to the payload preparation which may be a satellite or other spacecraft. It should contain a special cleanroom to be qualified ISO 8, class 100,000 and adapted to the potential spacecraft size. It must offer special services for classified payloads under customer requirements (e.g., the non-visibility of some operations, special monitoring camera systems, etc.).

A second room or building dedicated to uniting the spacecraft with its LV adaptation equipment before its transfer to the LV assembly building for final integration and encapsulation. A third room could be necessary to achieve specific operations such as pyrotechnic devices installation or propellant or gas fueling not achievable on the launch pad, but having been agreed to by the launch base safety authorities through the safety submission that is presented prior to a launch campaign execution.

All buildings must provide all the support equipment, supplies and services to the customer: energy supply, pressurized air distribution, fire alarm, air conditioning/heating and various mechanical hardware like ladders, scaffoldings, mobile cranes, etc.).

5.1.3 Spaceport Control Center

The Spaceport Control Center is the heart of the Maine Space. It is the facility from which all operations - both inside and outside the launch base perimeter are coordinated. In order for staff to effectively coordinate launch base operations, the launch base control center must house each piece of equipment that is needed for controlling launch activities, wherever they take place. This will support Range Director, Range Control Officer, Ground Safety Officer, and other mission support personnel, as needed. The launch base center should also house the following systems:

- Communications network with emergency backup capacities for data transmission.
- Power distribution systems during the launch critical phases, specifically when the final launch chronology is engaged (for instance, a combination of gas generators, batteries with an immediate conversion AC/DC system to enable a zero-cut power distribution).
- Television display.
- Weather situation display.
- Capability to display camera views around the launch site and pad to monitor, record, activities.

The GO for launch is given by this center once all the site operational and supporting entities and the LV and payloads have reported a Green situation, particularly the safety status from the safety control center. Today rockets will likely have Automatic Flight Termination systems onboard which means infrastructure, personnel and equipment may be configured differently.

5.1.4 Launch Vehicle Control Center

The LV control center is the facility from which oversees the integrations, testing, and preparation of the rocket and its payload. The control center would support the integration and testing in the LV/payload integration facility or the LV/payload on the launch pad. The final testing on the launch pad will be the testing and preparation of the final stages of readiness before the launch operations start. The location of this control center is dependent on the operations and hazards (typically near the Spaceport Control Center). It will need to be at a safe distance so any failure would not impact the control center or its personnel. The center needs to be properly linked to the launch mast, the LV and payloads interfaces and all the GSE and EGSE equipment.

The launch vehicle control center enables the full and permanent control of the LV's switching from external to internal command and control systems during the operations until lift off. The launch sequence and orders are sent from the launch vehicle control center to the rocket after the GO is delivered by the launch base control center.

5.1.5 Safety Control Center

The safety control center can be jointly located with the spaceport control center. It is the facility from which flight safety is monitored and managed, and it houses the launch operations and supporting flight safety personnel. The command and control center is responsible for the launch countdown and the LV flight until the end of the safety mission. This event usually occurs when the LV is out of the tracking visibility from the launch point, at the time when the commanded or autonomous destruction/thrust termination command order can no longer be transmitted, an event which occurs when the LV is beyond the electromagnetic horizon of the launch base. Note: the human (command) destruction order is a unique responsibility of the spaceport flight safety mission. From this point onward, the flight safety relies upon the on-board autonomous LV Flight Termination System (FTS). The LV localization and telemetry reception is achieved by the down range stations network until the mission end.

5.1.6 Power Supply Control Center

The power supply control center manages all power supply sources for the launch base (private, commercial and an on-site backup system). Due to the extreme operational needs during the most critical part of the launch chronology, a secured dedicated internal system must be installed specifically for the launch chronology. This system should cover, at least without any power interruption, the needs of:

- launch control center.
- launch vehicle control center.
- safety control center.
- launch pad.
- LV localization systems (radar, optics and TM/TCD systems) and all associated communications and data links.

Additionally, a telemetry and communications hub for the launch site personnel and customers may be considered.

5.1.7 Maintenance Support Area and Building

The maintenance support building should be large enough to accommodate the maintenance and parking needs of the LV transportation vehicle and other standard launch base vehicles. The area should include a garage with an associated workshop for maintenance purposes as well as supporting facilities for staff, such as offices, a cafeteria, sleeping quarters and other amenities.

5.1.8 Security and Emergency Services

A security department and emergency services must be created for supporting facilities, including vehicles, arms, booth/checkpoint, and electronic badging system and offices. This unit should be responsible for the protection of facilities (alarms equipped). It is also responsible for all transportation activities of the LV, the spacecraft and movement on site. The access to areas should have an electronic badging system to streamline security, access, and provide accountability.

There should also be an emergency services area including a fire brigade on site during testing activities and launch chronology. One option for a fire brigade could be a specially trained unit within the local fire department. Emergency personnel should be trained to respond to specific hazards presented by launch operations. The security of the mission is under the coordination of the launch control center. The safety team will also coordinate when ground safety activities are required inclusive of the launch base safety regulation.

During the launch countdown, the security team has to secure the interdicted areas around the launch pad and within the launch site perimeter as per the site safety regulation. The control center team will also coordinate with air and marine transportation agencies to notify traffic to avoid the area (through the issuance of a NOTAM) in advance of the planned launch. The overall objective is to prevent human presence in the safety areas. A medical team with an ambulance should be present on the launch base during launch. A small medical area is required in the command and control center. The medical team could be a local unit from the closest hospital/health services provider, again given that they are certified to treat any unique hazards presented by the launch vehicles' propellants and/or payloads.

5.1.9 Storage Areas

Three (3) storage areas should provide for the proposed Maine Space Launch Facility. Storage sites 1 and 2 are to be located near the launch pads so that propellant can be stored prior to its onboarding during the launch chronology.

A third site, to be located closer to the LV assembly building, will be used to store pyrotechnics. This site must include a secure booth to protect personnel. On the same site, propellants, including cryogenic propellants (such as LOX and LH2) and other propellants with the appropriate very low temperature support facilities (such as gas, compressed air, oxygen, helium and nitrogen) will also be stored. This dual-purpose site must be equipped with alarm systems for both specific leak detection and anti-intrusion detection.

5.1.10 Weather Center

Weather forecasting is a key information service for different activities occurring through the entire launch preparation schedule. These activities include all transportations activities and operational processes on launch pads, such as:

- LV transfer from the assembly and integration building to the launch pad.
- LV erection on its launch platform.
- All launch chronology activities.
- LV flight (especially pertaining to lightning risks on ground and in flight, winds in altitude, winds shears gusts at the maximum dynamic pressure passage with risks on the LV structures, and showers at lift off from the launch platform with direct impacts on the optical mission).

Beside its local measurement needs in the form of weather (MTO) sounding balloons and standard MTO ground sensors, and the addition of a LIDAR for local atmospheric sounding, the weather center has to be in touch with the national MTO forecasting sources in order to evaluate weather systems and patterns that could impact the LV during its flights and along its trajectory.

5.1.11 Launch Pad for Vertical Launch

A launch pad is composed of a series of facilities and infrastructure that support launch activities. The main components of a launch pad are:

- A lightning protection system with masts usually installed around and in close proximity to the launch platform.

- A concrete pad designed to withstand the expected loads and allow for securing a launch platform.
- A launch platform with exhaust ducts to deviate the combustion high speed hot-gasses after ignition and lift off. This infrastructure should be associated with a water deluge system to damper the acoustic shock and vibration impact mainly on the payload. This potential impact will be evaluated during the preliminary coupling analysis with the LV operator and the customers (note: the exhaust ducts may or may not be needed).
- A water deluge system, mainly composed of a mast, on top of which a water tank is installed, the water rushing down by gravity at the ignition of the LV's engines (at nozzles level) (Note; a water tank may not be needed based on size of LV).
- A launch mast able to bear the different LVs and payload interfaces that are required up to the end of the launch countdown, including power distribution, data links, LV and payloads internal commands and controls, LV fueling (if necessary), and fairing air conditioning (if required)
- A specific LV hold system on the launch platform to keep the LV in a secured vertical attitude in case of an aborted launch.
- A storage area for the propellants used in LV fueling and the necessary GSE for activities on the launch pad (fuel and oxidizers need to be separated) Usually protected by berms.
- A protected area around the launch pad, free of persons, with a minimum radius of 1.4 miles (7,300 feet) in accordance with the FAA regulation for small launch vehicles or smaller, according to the LV dispersion radius and authorized by FAA – this is required in the event a catastrophic accident occurs blow up of the LV at lift off or during the first seconds of flight. This area must allow for the protection of potential loss of life with an occurrence probability usually stated to be lower than 10^-7 (1/1,000,000) per launch.
- A protected area on the launch site, where only persons involved in the chronology could be present but protected against a catastrophic risk with a usual probability of 10- 6.
- Further away from the launch pad, the overflight of populated areas is authorized only if the risk to the population is usually below 10^-7 (1/1,000,000) per launch.
- An access road to each launch pad, to be used by the vehicle carrying the LV.
- Security perimeter fence.

5.1.12 Runway for Horizontal Launch

Specific runway requirements will be dictated by the specific carrier aircraft or vehicle itself. The working assumption utilizing current horizontal launch vehicles assumes a Boeing 747 or equivalent as a design aircraft for planning purposes.

5.2 Additional Support Facilities

5.2.1 Radar and Tracking Systems

The Radar and tracking systems and the associated down range stations must be continuously computing the LV location. For the safety of the flight, the location/tracking system and the associated TM/TCD capacities must be totally operational to guarantee the flight safety mission with the command destruction capacity up to the end of the launch base electromagnetic visibility. From that point the LV destruction relies on the on-board autonomous Flight Termination System (refer to Chapter 5: Safety).

To achieve these goals, the launch site will require:

- A tracking radar (fixed or mobile) with a potential tracking telescope for the visible spectrum as well as an infrared tracker.
- A fixed optical system (camera system) to cover at least the chosen LV close control critical parts at different levels, from ignition and lift off (when the LV leaves the launch platform) up to the first 20 to 30 meters of its trajectory.
- Real-time images transmission capabilities to the launch base control center, the LV control center and the safety control center.
- A planning and scheduling of events, at a minimum scale of the millisecond.
- A satellite confirmation to be delivered a few minutes after the payload injection on its orbit.
- Security perimeter fence.

To achieve a perfect permanent localization for the LV once it is in flight, tracking radar and ground data (mostly supplemented by the LV's internally computed trajectory by its on-board computer, and informed by inertial platform data) must be attained. Information from on-board GPS signals and all the data transmitted by the TM system are also options that can help achieve in-flight permanent localization.

As an example, Rocket Lab did the following choice for its Electron LV:

- An inertial platform unit
- A GPS receiver
- A telemetry unit transmitter
- A guidance/pilotage control system with the flight program

5.2.2 Communication Hub

To competently manage activities at the Maine Space Complex Launch Site, it is necessary to secure a permanent interconnection between the key systems involved with launch activities. This is to be achieved through an operational network, dedicated exclusively to the Maine Space, that is capable of real time high rate and high-capacity data transmission performance. During a launch chronology and LV flight, all operational data must be dispatched to the appropriate control centers in real time. This communication system must be supported by a power supply emergency system.

6 Horizontal Launch Sites and Services

Horizontal launch is typically operated out of an airport facility. During launch, the carrier aircraft gradually taxis and lifts off the runway and heads to a launch location where it releases a launch vehicle from underneath one of its wings. The launch vehicle is dropped and when the plane is a safe distance away the rocket ignites and lifts into space. The benefit of horizontal launch is that aircraft is able to fly above adverse weather conditions and maneuver safely into the air to a launch point. It also offers flexibility for launch trajectories offering the availability for a more diverse set of orbital insertions including ISS orbit and suborbital operations. Virgin Galactic are currently offering air-launched suborbital human flight operations Although there are benefits, this mechanism for launch does have weight constraints and can only carry small to medium satellites. Currently, the largest limiting factor is the lack of vehicles able to execute horizontal launch. There are several under development including

Aevum, Strat launch, Dawn and others. However, the largest vehicle currently under development – Strat launch – requires an extensive runaway that Loring AFB could accommodate.

7 Sea-based Launch and Services

To be added in future revisions for orbital and suborbital launch services. It will be critical to engage FAA and other regulators i.e. Coast Guard at the earliest possible time to determine the issues and trade offs surrounding sea launch from the coast of Maine.

8 Revenue Streams

Service	Description	Revenue Realization
Anchor Tenancy	Securing an anchor tenant for repeated launch access is a common practice in the financing launch facility construction. This typically includes and upfront sum to finance dedicated infrastructure as well as an ongoing launch fee. Determining a launch tenant will define requirements related to the vehicle such as fueling infrastructure, exclusion zones, etc. but it is also a means of securing investment from a primary customer to offset capital expenses during the building phase and ongoing operational expense once the facility is built. There are a variety of models used in the specific financial agreements. Maine could fund using the below or could create a mechanism where the customer would sign an agreement to fund the development of the pad and needs up front, then MSC could allow recoup over time based on a credit per launch or per usage.	Phase 2
Orbital Fee-for-Launch	Pricing for launch activity in the market today is based on a set fee for launch based on the size of the vehicle and any additional requirements. Each customer will be charged for use of the facility. The price for launch within the market is extremely dynamic as the launch vehicle provider cost/kg pricing is a function of its overall cost and the economies of scale it can provide. The arrival of SpaceX Starship will 10x capacity to space and stands to dramatically lower pricing as it comes online in 2024. This must be taken into consideration as the Corporation determines the best anchor tenant and projection of ongoing revenue generating activities. Launch vehicle operators must consider the associated costs of catering to smaller vehicles is possible at this point in time however due to the shifting market dynamics the costs associated with micro launch vehicles may diminish demand as pricing may become less competitive as new industry developments emerge. Pricing for launch will take into consideration the type of vehicle, ancillary requirements for launch such as fuel type, telecommunications equipment, etc. This should be calculated on what the requirement are from the launch site, range personnel and equipment usage, and profit margin. Need to make sure maintenance cost, power usage, and other cost are included in fee.	Phase 2
Suborbital Fee-for-Launch	Suborbital launch, including sounding rocket, is a growing market. A sounding rocket is a type of suborbital rocket specifically designed for scientific research and experimentation in the upper atmosphere or near space. Unlike orbital rockets that reach orbit around Earth, sounding rockets have a parabolic trajectory, ascending into space and then quickly returning to Earth. These rockets and more recently, winged air-launched horizontal crewed vehicles, are used for various scientific purposes, including atmospheric research, microgravity	Phase 2

	experiments, astronomical observations, ionospheric studies, space weather and technology testing.	
Launch Complex Tenancy	Beyond launch, many space dedicated companies have chosen to have operations nearby the launch facility as companies like SpaceX and Blue Origin among others have established presence on the grounds of the Kennedy Space Center. The Maine Space Corporation must consider facilitating the growth of an industrial park in an area proximate to the launch facilities. Revenues from industrial park leases may ultimately be a larger and more reliable revenue source than range use fees.	Phase 2
Space Tourism (Launch Viewing)	Just as in the early days of aviation, tourism is a critical part of the revenue for a launch facility. With over 36 million visitors currently coming to Maine each year, there will be a subset interested in viewing launch. Designing a launch viewing area and exhibition for tourists, concessions, branded products will create an additional revenue stream. Another concept is to create an integrated offering with the Dark Skies initiative in Maine to provide unique tourism opportunities that incorporate both the ability to familiarize with the galaxy and watch a launch that send payloads into space. The recent low-altitude development launches by bluShift at Loring drew substantial crowds of watchers from all over Maine and New England, despite the fact that it had not been planned primarily as a public event and only minimal promotion had been done.	Phase 2+
Space Tourism (Rocket Rides)	Space tourism is the pay for ride **to space for fun**, adventure, or business.	Phase 2+
Engine Testing	Providing facilities either onsite or nearby for engine testing has proven to be another revenue generator on several launch sites.	Phase 1
Hypersonic Testing Range	This would offer vehicle developers a range at Loring AFB to test vehicles, collect and model data from testing to iterate on vehicle design.	Phase 2
Federal Grants	Launch Site Complex is positioned to apply for grants to enable further growth and expansion	Phase 1
Point-to-Point Transportation	For the first time in spaceflight history the flight of a fully reusable launch system with rocket propulsion appears possible within the next couple of years. Apart from the implications for the orbital launch market, a fully reusable system could also enable an entirely new class of commercial point-to-point transport on Earth. Rocket propelled point-to-point systems promise the ability to transport passengers or cargo to any suitable landing site on Earth with extremely short travel times (typically less than 90 min).	Beyond Phase 2
Intercollegiate Rocket Engineering Competitions	Invite the world's most ambitious collegiate rocketeers to a design-build-fly style competition, with something to offer students, faculty, industry representatives, and amateur aerospace enthusiasts alike	Phase 2+

9 Implementation Schedule

The Launch Facility implementation schedule will begin with a planning phase to determine the optimal mix of operations and tenants to maximize utility and revenue of the Site. These requirements will be translated into the physical site requirements and used to secure the site that most closely fits the needs of the Launch Complex.

9.1 Phase 1 – Minimum Viable Product Outline

9.1.1 Understand the desired requirements informed by the types of vehicles that will be accommodated by the Launch Site (vertical and horizontal)

9.1.2 Site selection

- Identify potential customers/anchor tenants and establish rocket sizes, requirements etc. this is the vehicle that will be used for modeling during the FAA approval process to ensure requirements are appropriate.
- Determine the size of rockets that will be hosted at the launch site.
- Number of pads determine the number of pads and sequential development of the launch site.
- Determine how much land is needed to implement launch operations.

9.1.3 Site definition and requirements

- Identify LV for launch location assessment (FAA)
    - Start basic flight safety analysis.
- Facility, building, infrastructure, and pad layout and sizing.
    - Account for quantity distances and parallel operations/customers.
    - Account for flight safety systems and telemetry.
    - Account for water, fiber, electrical, etc.
- Start FAA licensing.
- Start Environmental Assessment.

9.1.4 Site Development

- Identify design, engineer and construction firms to design and build complex.

9.1.5 Understand infrastructure requirements for transportation of launch vehicles and payloads - roads, bridges, ports, ships, aviation.

9.1.6 Develop cost estimate to address infrastructure upgrades as needs.

9.2 Phase 2

- Finalize design and establish cost parameters for launch site.
- Address and plan for infrastructure upgrades to support the spaceport.
- Fundraise for development.
- Attract anchor tenants and sign agreements.

9.3 Phase 3

- Commence the construction of the Launch Site design.
- Finalize the organization structure.
- Hire the launch facility staff.
- Operationalize.

10 Cost Schedule

			Estimated Size Requirements (SqFt)		Cost Estimate	
#	**Asset**	**Description**	**LOW**	**HIGH**	**LOW (MVP)**	**HIGH (Full Build)**
Planning Phase					**$ 3,450,000**	**$ 18,675,000**
	Site Location Survey	Ensuring the site can support the required utiltiies and access for intended usage.	N/A	N/A	$ 200,000	$ 500,000
	Land Acquisition and Fees	Fee to take possession of the raw land/launch area.	N/A	N/A	$ 1,000,000	$ 7,000,000
	Environmental Impact Assessment/Envirnmental Assessment	Completing the environmental analysis required for FAA licensure.	N/A	N/A	$ 500,000	$ 3,000,000
	FAA Approval Process (Consultant)	Consultant to navigate the process effectively.	N/A	N/A	$ 150,000	$ 400,000
	Local Project Navigation	Working with local municipalities and state goverenment to draw up regulations and appropriate oversgiht.	N/A	N/A	$ 50,000	$ 150,000
	DOT Feasibility Analysis	Ensure that roads, highways and bridges can support the weight of incoming launch vehicles.	N/A	N/A	$ 500,000	$ 2,000,000
	Architect	Design and engineering team to develop site plans.	N/A	N/A	$ 500,000	$ 4,000,000
	Full Time PR/Local Communications Staff	Ongoing community outreach and open communications between citizens and project staff, including PR.	N/A	N/A	$ 150,000	$ 400,000
	Legal Fees	In the case that MSC is sued.	N/A	N/A	$ 250,000	$ 1,000,000
	Insurance	General Liability and Operating	N/A	N/A	$ 150,000	$ 225,000

			Estimated Size Requirements (SqFt)		Cost Estimate	
#	**Asset**	**Description**	**LOW**	**HIGH**	**LOW (MVP)**	**HIGH (Full Build)**
Building + Infrastructure					**$ 81,840,000**	**$ 133,800,000**
A	Office and Meeting Space	Spaceport management offices and meeting rooms, conference rooms, customer workspaces, etc.	3,000	8,000	$ 1,470,000	$ 3,920,000
B	Launch Vehicle Preparation + Assembly Building	The LV assembly and preparation building must be able to receive the LV and the associated equipment (i.e., assembly racks) for different LV activities. The building must be accessible, with large doors for an assembled LV transfer to the launch pad. It must also be equipped with different support equipment to cover the LV operator requirements, including three (3) phased power and voltages, pressurized air distribution, overhead cranes, specific rooms and amenities for the teams. The launch vehicle	30,000	40,000	$ 14,700,000	$ 19,600,000

		assembly and preparation building must also be equipped to support the installation of the payload on-board the LV and to achieve the LV's upper composite integration after the S/C is fixed on its adapter or on a LV plate for dispensers' installation. The encapsulation and the fairing closure need different hoisting equipment. All the LV hazardous operations will be realized on the launch pad.				
C	Payload Processing Facility	A payload processing facility is usually composed of different rooms of various sizes or separate buildings. The main facility is dedicated to the payload preparation which may be a satellite or other spacecraft. It should contain a special cleanroom to be qualified ISO 8, class 100,000 and adapted to the potential spacecraft size. It must offer special services for classified payloads under customer requirements (e.g., the non-visibility of some operations, special monitoring camera systems, etc.) A second room or building dedicated to uniting the spacecraft with its LV adaptation equipment before its transfer to the LV assembly building for final integration and encapsulation. A third room could be necessary to achieve specific operations such as pyrotechnic devices installation or propellant or gas fueling not achievable on the launch pad, but having been agreed to by the launch base safety authorities through the safety submission that is presented prior to a launch campaign execution All buildings must provide all the support equipment, supplies and services to the customer: energy supply, pressurized air distribution, fire alarm, air conditioning/heating and various mechanical hardware like ladders, scaffoldings, mobile cranes, etc.)	10,000	12,000	$ 4,900,000	$ 5,880,000
D.	Spaceport Control Center	It is the facility from which all operations - both inside and outside the launch base perimeter are coordinated. In order for staff to effectively coordinate launch base operations, the launch base control center must house each piece of equipment that is needed for controlling launch activities, wherever they take place.	100,000	150,000	$ 49,000,000	$ 73,500,000
E	Launch Vehicle Control Center	The LV control center is the facility from which oversees the integrations, testing, and preparation of the rocket and its payload. The control center would support the integration and testing in the LV/payload integration facility or the LV/payload on the launch pad. The final testing on the launch pad will be the testing and preparation of the final stages of readiness before the launch operations start. The location of this control center is dependent on the operations and hazards (typically near the Spaceport Control Center). It will need to be at a safe distance so any failure would not impact the control center or its personnel. The center needs to be properly linked to the launch mast, the LV and payloads interfaces and all the GSE and EGSE equipment. The launch vehicle control center enables the full and permanent control of the LV's switching	Included in SCC	Included in SCC		

		from external to internal command and control systems during the operations until lift off. The launch sequence and orders are sent from the launch vehicle control center to the rocket after the GO is delivered by the launch base control center.				
F.	Safety Control Center	The safety control center can be jointly located with the spaceport control center. It is the facility from which flight safety is monitored and managed, and it houses the launch operations and supporting flight safety personnel. The command and control center is responsible for the launch countdown and the LV flight until the end of the safety mission. This event usually occurs when the LV is out of the tracking visibility from the launch point, at the time when the commanded or autonomous destruction/thrust termination command order can no longer be transmitted, an event which occurs when the LV is beyond the electromagnetic horizon of the launch base. Note: the human (command) destruction order is a unique responsibility of the spaceport flight safety mission. From this point onward, the flight safety relies upon the on-board autonomous LV Flight Termination System (FTS). The LV localization and telemetry reception is achieved by the down range stations network until the mission end.	Included in SCC	Included in SCC		
G	Maintenance Support Area and Building	The maintenance support building should be large enough to accommodate the maintenance and parking needs of the LV transportation vehicle and other standard launch base vehicles. The area should include a garage with an associated workshop for maintenance purposes as well as supporting facilities for staff, such as offices, a cafeteria, sleeping quarters and other amenities.	Included in SCC	Included in SCC		
H	Security and Emergency Services	Responsible for both the phyical security and badging system of the site, but also houses the fire brigade and medical emergency response team.	10,000	20,000	$ 4,900,000	$ 9,800,000
I.	Power Supply Control Center	Wtih offices to be located beside the launch base control center building to house launch base power supply command and technical support areas with separate laboratories, security team facilities, transportation vehicles and rapid response team				
J.	Storage Area	Three (3) storage areas should provide for the required needs of the proposed Maine Spaceport. Storage sites 1 and 2 are to be located near the launch pads so that propellant can be stored prior to its onboarding during the launch chronology.A third site, to be located closer to the L/V assembly building, will be used to store pyrotechnics. This site must include a secured booth to protect personnel.	5,000	10,000	$ 2,450,000	$ 4,900,000
K.	Weather Center	Weather forecasting is a key information service for different activities occurring through the entire launch preparation schedule.			TBD	TBD
L	Observation Deck	This would be host a building for VIP, clients, students, and invitees lounge, service and viewing area along with a media room with appropriate amenities	5,000	20,000	$ 2,450,000	$ 9,800,000

J.	Vertical Launch Pad(s)	Multi ultiuse vertical launch pads composed of a heavy concrete launch platform and configured with combustion hot-gases ejection ducts below the platform at the LV nozzles level as needed, directly covered by a water deluge. Launch pads will have berms reduce damage to other pads or customers. A fence must surround the areas for physical security to ensure access control and overall protection of LV, equipment, and hardware.			$ 1,800,000	$ 4,000,000
K	Ligthning Protection System	Masts around each launch pad and supporting earth grounding connectors.A vertical holding system for each launch pad, connecting the launch platform and the LV to keep the LV in a vertical and safe position, in case of an aborted launch			TBD	TBD
Utilities and Other Infrastructure						
L	Road	Length will vary based on site.			TBD	TBD
M	Fiber Communciations /WiFi	Length will vary based on site.			TBD	TBD
N	Water Systems /Hydrants	Length will vary based on site.			TBD	TBD
O	Electricity (3 Phase Power)	Length will vary based on site.			TBD	TBD
P	Gas	Length will vary based on site.			TBD	TBD
Q	Sanitation System	Length will vary based on site.			TBD	TBD
R	Generators	Length will vary based on site.			TBD	TBD
S	Docking Facility (if sea based or island location)	Need TBD			TBD	TBD
T	Ships	Need TBD			TBD	TBD
Systems + Equipment						
U	Telemetry and Tracking Systems	The launch base localization/tracking systems and the associated down range stations must be continuously computing the L/V localization. For the safety of the flight, the localization/tracking system and the associated TM/TCD capacities must be totally operational to guarantee the flight safety mission with the command destruction capacity up to the end of the launch base electromagnetic visibility. From that point the L/V destruction relies on the on-board autonomous Flight Termination System			$ 120,000	$1,700,000
V	Communication and Transmission Launch Base System	To competently manage activities at the Maine Spaceport, it is necessary to secure a permanent interconnection between the key systems involved with launch activities. This is to be achieved through an operational network, dedicated exclusively to the Maine Spaceport, that is capable of real time high rate and high-capacity data transmission performance. During a launch chronology and L/V flight, all operational data must be dispatched to the			TBD	TBD

		appropriate control centers in real time. This communication system must be supported by a power supply emergency system.				
W	Launch Rail System	Used to support LV in upright position on launch pad			$ 50,000	$ 700,000
	Personnel Expenses				**$ 1,500,000**	**$ 2,850,000**
		Range Director	N/A	N/A	$ 180,000	$ 250,000
	Operations Dept	Operations Dept. Range Operations Mgr.	N/A	N/A	$ 120,000	$ 200,000
		Launch Vehicle Faciltiy Asst.	N/A	N/A	$ 100,000	$ 200,000
		Payload Prepration Asst.	N/A	N/A	$ 100,000	$ 200,000
		Quality Asst.	N/A	N/A	$ 100,000	$ 200,000
		Safety Asst.	N/A	N/A	$ 100,000	$ 200,000
	Technical Support	LV Facility	N/A	N/A	$ 100,000	$ 200,000
		Launch Pad Section	N/A	N/A	$ 100,000	$ 200,000
		Location, TM + TCD Systems	N/A	N/A	$ 100,000	$ 200,000
		Energy	N/A	N/A	$ 100,000	$ 200,000
		Transportation	N/A	N/A	$ 100,000	$ 200,000
		Lab/Workshop	N/A	N/A	$ 100,000	$ 200,000
	Safety	Ground Safety	N/A	N/A	$ 100,000	$ 200,000
		Flight Safety	N/A	N/A	$ 100,000	$ 200,000
TOTAL COST ESTIMATE					**$ 86,790,000**	**$ 155,325,000**

APPENDIX

A. Horizontal Launch Site Requirements

1. Location:
   - Accessibility to transportation infrastructure, such as commercial passenger service, roads, railroads, and ports, for personnel access and delivering / receiving launch equipment and payloads.
   - Remote location to minimize potential hazards to populated areas.
2. Safety Zones:
   - Adequate safety zones around the launch site to protect people and property in case of accidents or failures during launch.
   - Sufficient distance from populated areas to ensure public safety.
   - For horizontal launch, a transit corridor to the ocean conforming to FAA standards.
3. Environmental Considerations:
   - An Environmental Impact Assessment (EIA) to evaluate and minimize the impact of launch operations on local ecosystems and wildlife. Loring would likely require a less complex level of assessment than a green–field Vertical Launch Facility, given that it is "disturbed earth" already built on, and has hosted similar activities for decades. It has already hosted rocket launches under a Part 101 exemption.
   - Compliance with environmental regulations and permits.
4. Infrastructure:
   - Sufficient runway to host horizontal launch vehicles including a minimum of 8,000 ft runway (this is dependent on the specific aircraft being utilized)
   - Hangers for vehicle storage, including a horizontal assembly facility for air-launched launch vehicles and a mate-demate facility for mating them with their carrier aircraft. Unlike a vertical assembly facility, a horizontal assembly facility would not require a high bay.
   - Ground support equipment tailored to the specific needs of the launch vehicles.
   - Payload integration facilities.
   - Launch control center for monitoring and managing launch operations.
5. Launch Vehicle Compatibility:
   - Compatibility with the size, weight, and operational requirements of the launch vehicles.
   - Facilities for vehicle integration, payload integration, and vehicle fueling.
6. Range Safety:
   - Implementation of a range safety system to track and destroy the launch vehicle if it veers off course or poses a threat to populated areas.
7. Regulatory Compliance:
   - Compliance with local, national, and international regulations governing space launch activities.
   - Licensing and permitting from relevant government agencies.
8. Communication and Tracking:
   - Ground-based tracking and telemetry equipment to monitor the launch vehicle during flight.

- Communication systems for real-time data exchange with the launch vehicle.

9. Weather Considerations:
   - Meteorological monitoring and forecasting systems to assess weather conditions and make launch decisions.
   - Lightning protection systems.
10. Emergency Response:
    - Emergency response and firefighting capabilities in case of accidents or fires during launch, with substance-specific training for propellants and payloads..
    - Medical facilities for on-site personnel, similarly trained..
11. Security:
    - Security measures to protect against unauthorized access and to safeguard sensitive launch technology and data.
12. Infrastructure for Payload Handling:
    - Facilities for payload integration and testing.
    - Secure storage areas for payloads before launch.
13. Environmental Control:
    - Facilities to manage and store hazardous materials, including rocket propellants and fuels.
14. Space Traffic Management:
    - Integration with space traffic management systems to coordinate launches and avoid collisions with other objects in space.
15. Public Relations and Outreach:
    - Plans for public relations and community outreach to inform and educate the local community about launch operations and potential impacts

B. Licensing Process

It's essential to engage with the regulatory authority early in the process to ensure an understanding of specific requirements and expectations for obtaining a horizontal launch license. The process can be complex and time-consuming, so careful planning and compliance with all regulatory requirements are crucial to a successful license application and launch operation.

1. **Preliminary Assessment**:
   - Identify the regulatory authority responsible for space launch licensing in your country. In the United States, for example, this is the Federal Aviation Administration (FAA).
2. **Consultation and Pre-Application Discussions**:
   - Contact the relevant regulatory authority to initiate discussions and gather information about the licensing process.
   - Discuss your launch plans and determine the specific requirements and regulations applicable to your operation.
3. **Preparation of License Application**:
   - Gather all necessary documentation and information required for the license application.
   - This may include detailed plans for the launch vehicle, launch site, safety procedures, environmental impact assessments, and financial responsibility requirements.
4. **Submit License Application**:

- Submit a comprehensive license application to the regulatory authority.
- Ensure that your application includes all required forms, reports, and supporting documentation.

5. **Application Review**:
    - The regulatory authority will review your application, conduct technical assessments, and evaluate the proposed launch operation's safety and environmental impact.
6. **Environmental Review and Assessment**:
    - If applicable, undergo an environmental review and assessment to evaluate the potential impact of the launch operation on the environment.
7. **Public Notice and Comment Period**:
    - In some cases, there may be a public notice and comment period where members of the public can provide feedback and express concerns about the proposed launch.
8. **Safety Analysis**:
    - Conduct a safety analysis, including risk assessments, safety protocols, and contingency plans to ensure the safety of the launch operation.
9. **License Conditions and Mitigations**:
    - Work with the regulatory authority to address any concerns or conditions they may impose on the license.
    - Develop and implement mitigations for identified risks and environmental impacts.
10. **License Issuance**:
    - Once the regulatory authority is satisfied with your application and has addressed any outstanding issues, they will issue the horizontal launch license.
11. **Compliance and Reporting**:
    - Maintain compliance with all license conditions, safety protocols, and reporting requirements specified in the license.
12. **Launch Operations**:
    - Carry out your launch operations in accordance with the approved plans and license conditions.
13. **Post-Launch Reporting and Assessment**:
    - Submit post-launch reports and assessments to the regulatory authority as required by the license.
14. **Renewal and Amendments**:
    - If you plan to conduct additional launches or make significant changes to your operations, you may need to apply for license renewals or amendments.
15. **Ongoing Communication**:
    - Maintain open communication with the regulatory authority throughout the duration of your launch operations.

C. Anchor Tenancy

TBD as there is leading horizontal launch vehicle commercialized yet

D. Loring Aero-Space Complex

Compared to many other states with ambitions to be a player in the arena of commercial space, Maine is particularly advantaged by, but also dependent upon dependent on the strengths of complementarity among the various components of the Maine Space Complex. The good science, engineering, and business strengths of its universities have the potential to fuel the Innovation Hub and Data and Analytics Center. Maine's strong geographic advantage make the State an excellent place for polar and sun-synchronous orbit launches in both vertical and horizontal, land and ocean-based modes. The development of the Maine Space Complex has an opportunity to build on Maine's existing strengths in satellite downlinks and tracking.

The complex of capabilities at the former Loring Air Force Base near Limestone have the potential to host a wide variety of space-related capabilities that can strongly complement the other components of the Maine Space Complex. To date attention has been focused primarily on the potential to base horizontal launch activity on the long 12,101 foot long, 300 foot wide runway originally built to base B-52 bombers during Loring's Air Force base days. This remains a unique asset as few runways of this length and width remain that are not rendered problematic by dense civilian passenger traffic.

However, Loring has the ability to offer much more than a runway, it has the ability to support launch site and services infrastructure as described above.

- Capabilities to support both horizontal and vertical launch sites
- Facilities to support Command and Control
- Facilities to support Radar and telemetry station
- Facilities to support Observation Deck and VIP and client lounge facilities
- Facilities to support additional support facilities such as Electrical vault, ARFF, static engine testing
- Access to commercial passenger service 15 minutes away at Presque Isle.
- Available resources in the community to accommodate increasing labor force or increased tourism.

Loring is currently conducting an Airport Master Plan aimed at gaining acceptance into the National Plan of Integrated Airport Systems (NPIAS). With this inclusion into the NPIAS, Loring will be eligible to receive federal and state funding for infrastructure rehabilitation and improvements.

With Loring's portfolio of existing infrastructure, it is well suited for space-related operations in the short term period. Given the low population densities; Aroostook County is currently offering non-trivial vertical suborbital operations. For example, it is important to note that Loring has been host to Blueshift suborbital amateur vertical launches in the past highlighting its ability to support vertical capabilities. By hosting launches at both Loring (horizontal) and the Washington County facility (vertical), Maine can offer users a wide choice of launch conditions.

Rocket development requires many test operations, including many static engine test firings (in which motors are fixed to a ground test stand and fired, with elaborate instrumentation). Loring is equipped with jet engine testing facility and engine repair shop that would be ideal for these types of operations. Loring also includes substantial open space that can accommodate new test stands up to very large sizes, which are coming into short supply nationally as new developers go to propellant combinations that are requiring greater separation distances than crowded legacy sites can offer. Other operations include low-level “hopping” tests (such as were done at Boca Chica, TX, by SpaceX and currently at Moses Lake, WA by Stoke Space) and low-altitude test launches (including bluShift’s recent and currently planned tests at Loring). All of these types of testing require many elements of infrastructure in common with orbital launch, including propellant tank farms with proper separation and safeguards, emergency personnel trained in the specific techniques required for fighting and handling various propellant types, and high-speed, high-capacity data channels for conveying the large amount of data generated by such tests back to the home base of such tenants in real time. All of these are opportunities associated with existing infrastructure at Loring.

New entrepreneurial companies have begun to move to new propellant mixes which are only now being tested to establish their precise explosive equivalence. It is very possible that many existing test stands at Federal facilities such as NASA Stennis Space Center and Edwards Air Force Base will be found to be situated too close together to be used for such propellants, making new facilities in more spacious surroundings such as those found at Loring will be in high demand. Loring can say that it has the space, and separation from civilian activity, to safely locate such facilities immediately.

Similarly, other types of space-related activity are emerging that should be considered as candidates for basing at Loring within the short-term planning period. Suborbital air launch, of which Virgin Galactic’s air-dropped crewed aircraft are the best-known example, would be well-suited to Loring’s runway, which is somewhat longer than Spaceport America’s 12,000-foot facility. Loring’s use for such flights might be seasonal, perhaps flying on clear days in New England’s fall, where leaf colors across the entire region could be seen at once and could be quite spectacular. Or perhaps the winter landscape on a clear day, a sight that can’t be seen readily in southern New Mexico, would be attractive.

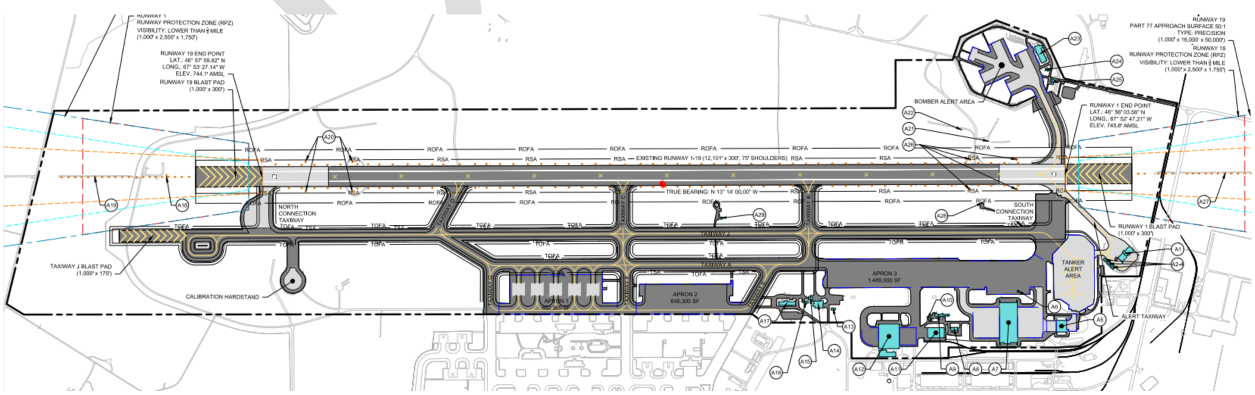
Finally, there is an active demand for re-entry landing sites, in excess of capacity, for both runway-using winged spacecraft, like the Space Force’s X-37B, the crewed Sierra Space DreamChaser, or the Blackstar space drone; and unmanned space capsules that descend by parachute, such as the Varda capsule that were denied permission to land at the Utah Test and Training Range, and which finally landed in Australia. Loring would be well-suited for such activity, which requires a separate FAA license. Such returned capsules often need specially trained personnel to greet them on landing, a task that Loring’s emergency services could be readily cross-trained to provide.

Perhaps not all markets may develop for Loring over the period of the Plan. However, hosting even a few such activities might logically be expanded over time to a wider variety of space activities. An idea picture of the Maine Space Complex in operation might see a new launch vehicle be designed at the Innovation Hub by a Maine company, tested at Loring, and then launch either at Loring or Washington County, or over time, at both, tracked by a facility in Maine, downloading its data at a Maine ground station, and having the data analyzed by the Data and Analytic Center. Maine is stronger by having as many options as possible within its borders.

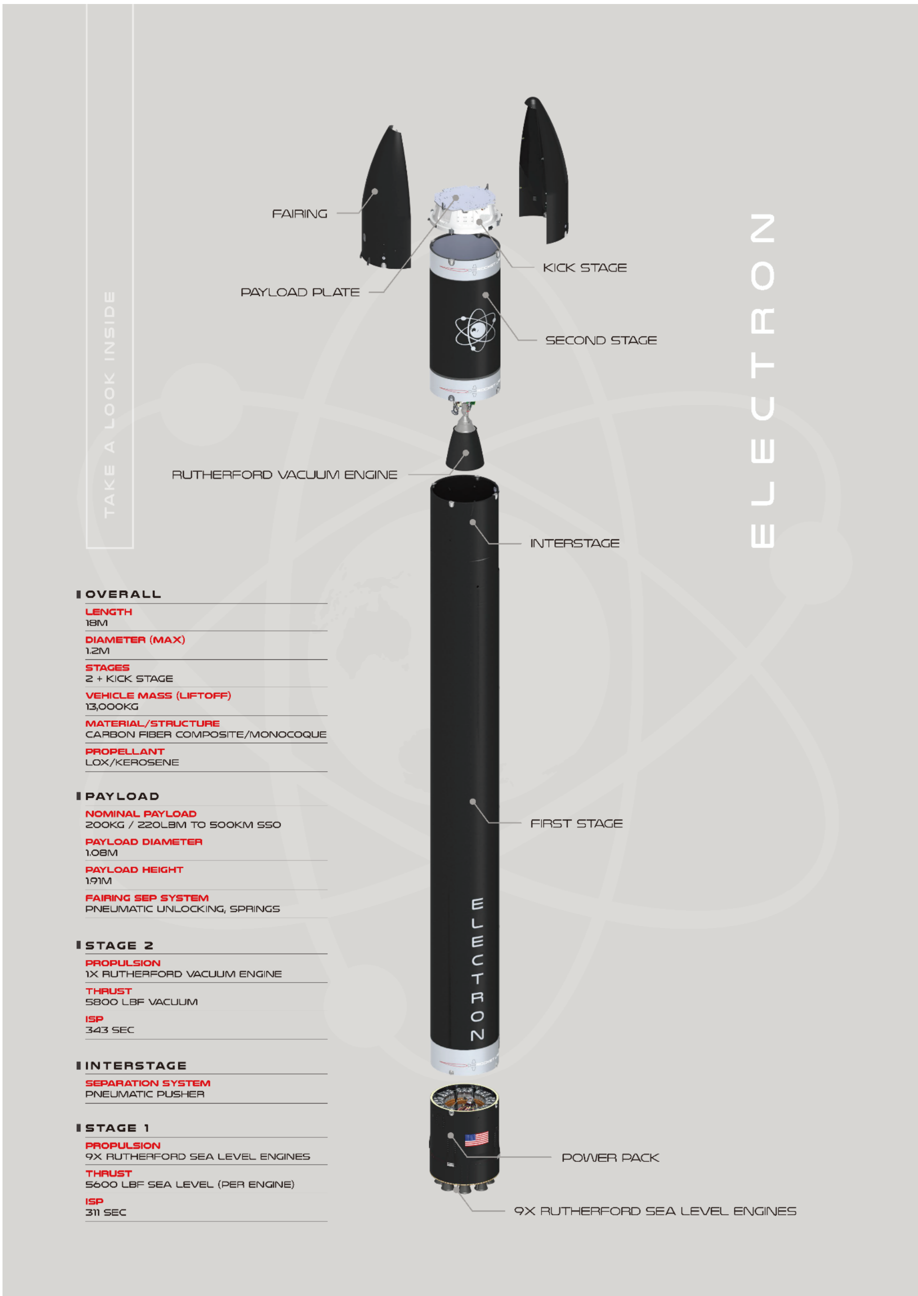
Pros of Loring:

- State entities own land
- Large amounts of land
- Separation from highly populated areas
- Existing infrastructure
- A history of Launches/existing launch history

- Loring could begin the licensing process sooner than alternative sites
- Can accommodate horizontal and suborbital vertical operations



E. Small Launch Vehicle Characteristics Example (RocketLab Electron)



Electron Launch Vehicle:

Kick Stage Height	405 mm
Diameter	1.2 m
Dry mass	40 kg / 88 lbs (dry)
Material	Carbon composite
Engine	Curie (built in house)
Propellant	Liquid bi-propellant (not disclosed)
Propellant storage	Carbon composite tanks
Number of thrusters	6 reaction control thrusters (RCS) (in 2 pods)
Thrust	120 N

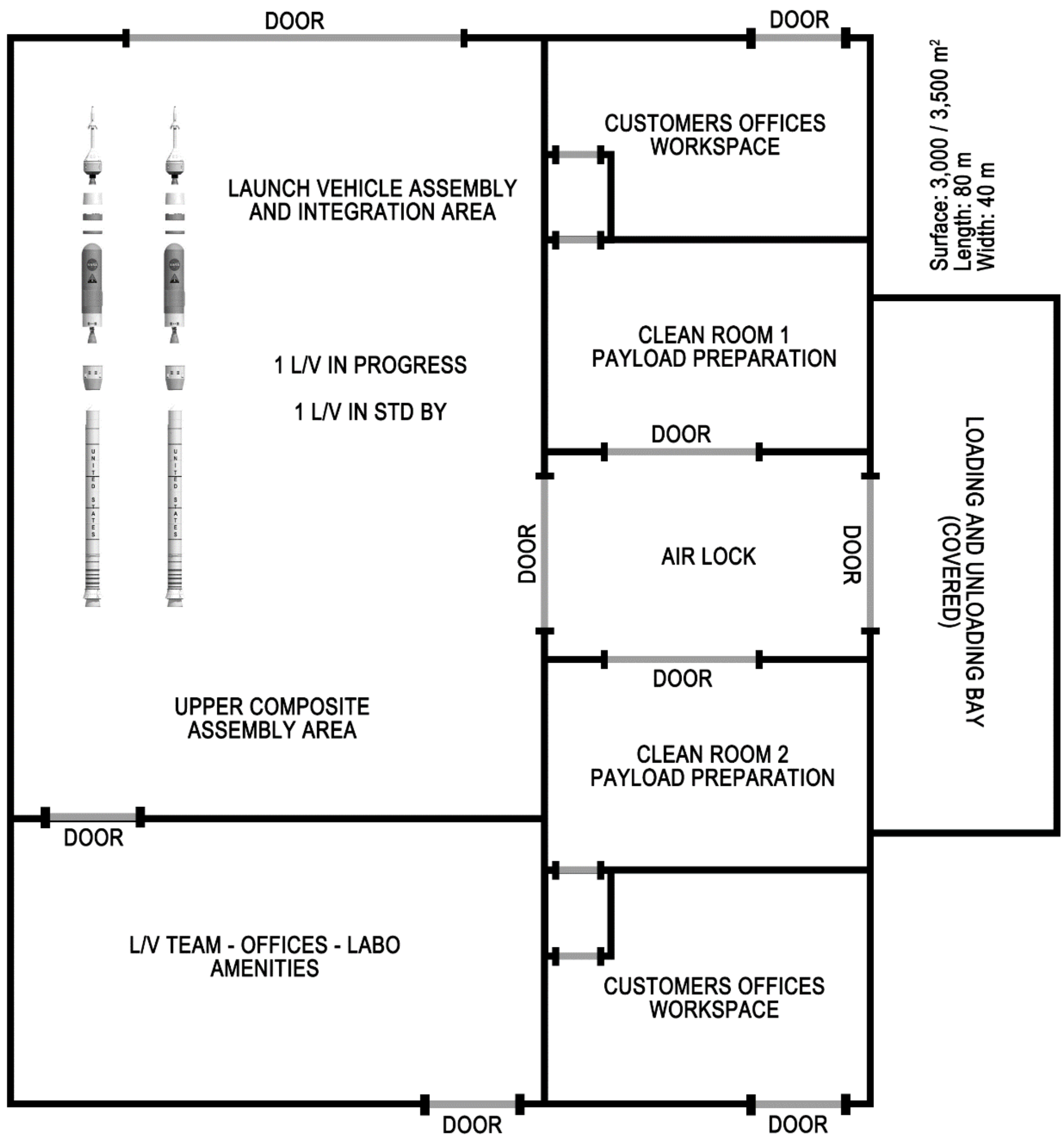
The Rocket Lab Kick Stage is designed to deliver small satellites to precise and unique orbits, whether flying as dedicated or rideshare on Electron.

The Kick Stage enables missions that require:

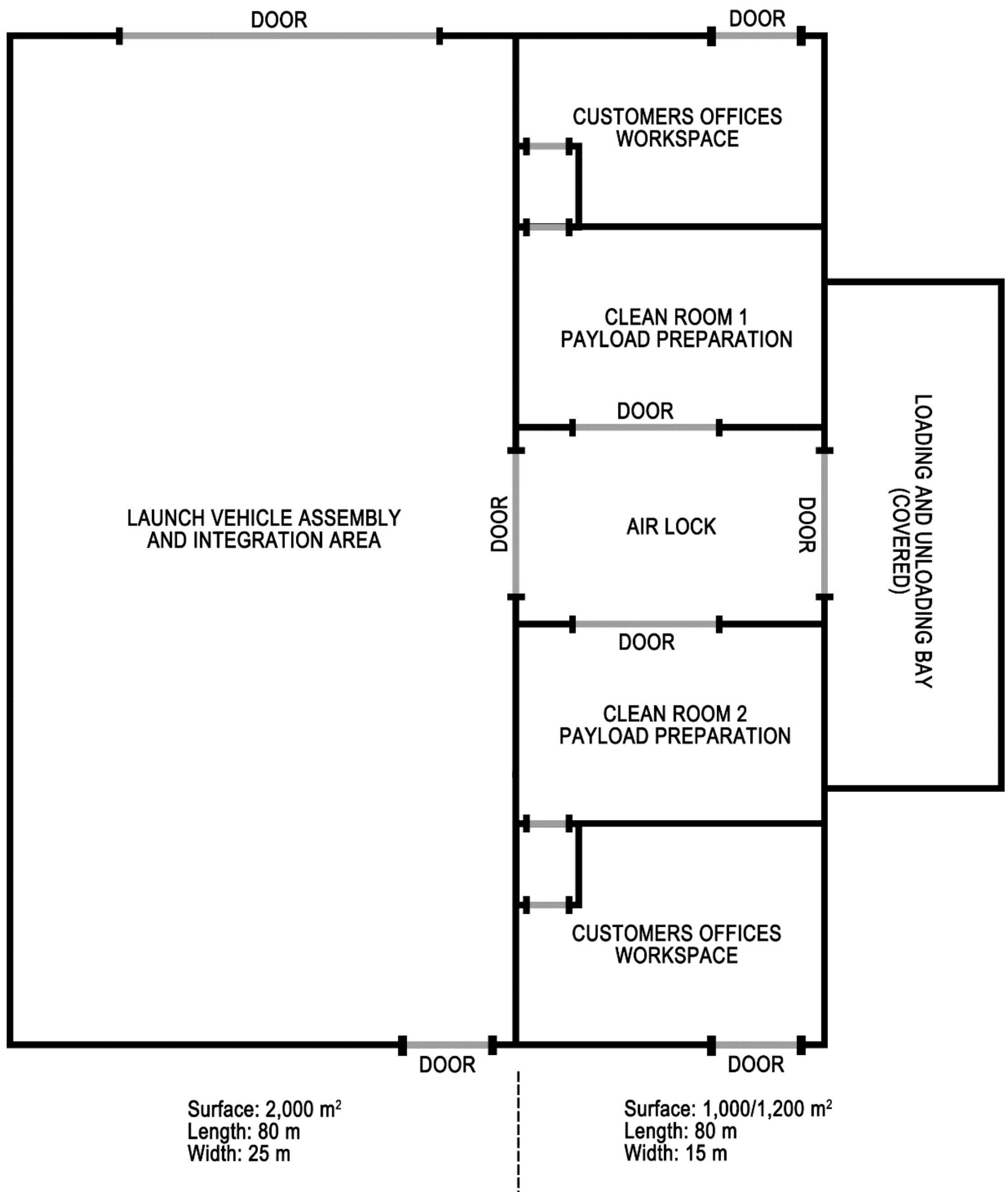
- Deployment of payloads at multiple planes/inclinations, including constellations
- Higher altitude deployment
- Inclinations out of range of the launch vehicle
- Hosted payload support
- Multiple trajectory changes
- Sustained low altitude orbits
- Deorbiting

The Kick Stage is powered by the in-house designed and manufactured Curie engine, a high-energy additively manufactured engine powered with a green bi-propellant. The Kick Stage also employs a cold gas reaction control system to precisely point itself and deploy satellites to independent yet highly precise orbits, and eliminate the risk of recontact with other spacecraft during deployment.

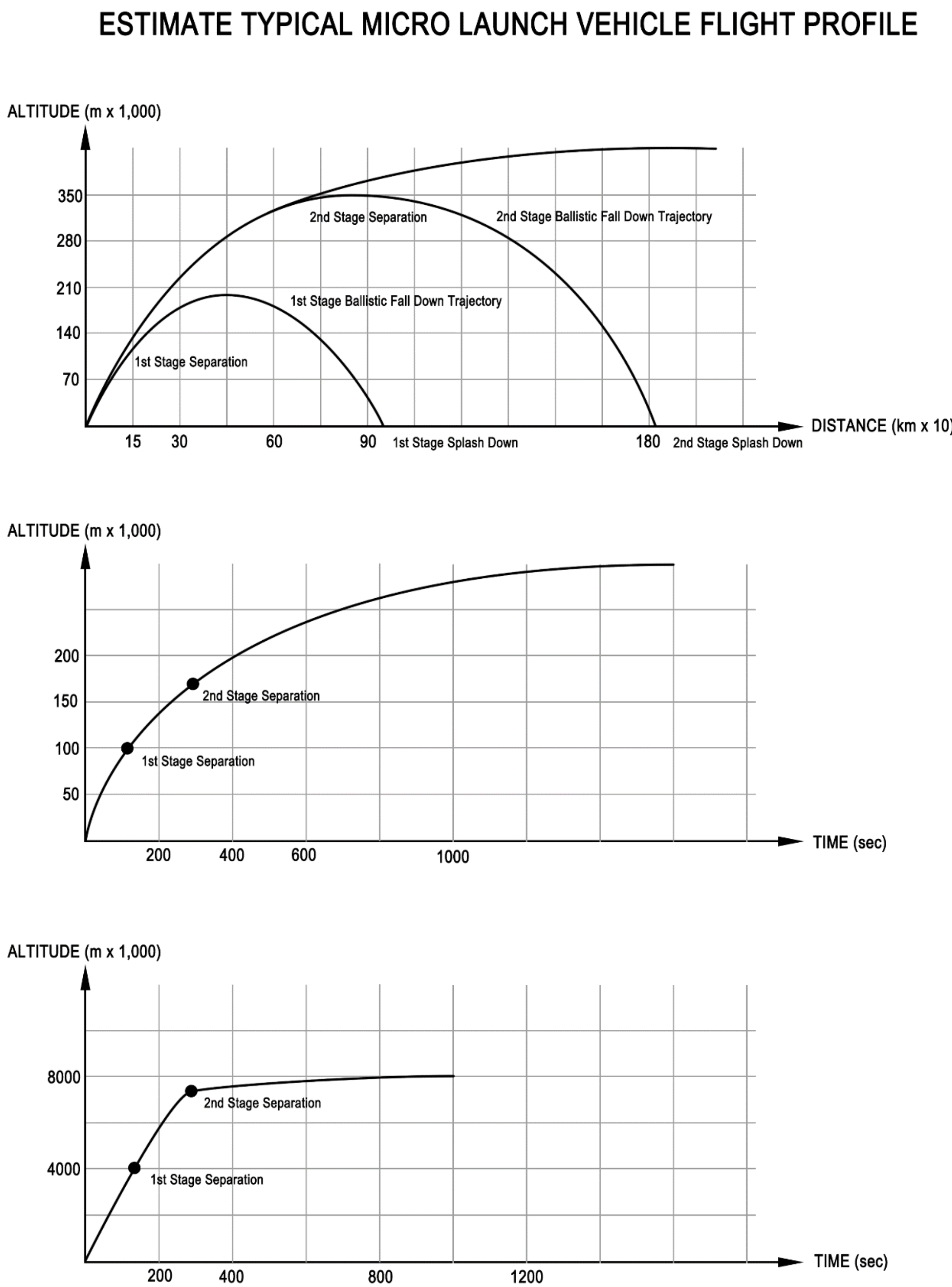
F. Launch Vehicle and Payloads Assembly Building



G. Payload Processing Building



H. Launch Vehicle Trajectory Example (Electron)



I. Standard and Non-standard Services to Customers by Launch Operator (Rocket Lab-Electron - Typical Example)

STANDARD SERVICES

As a part of the standard launch service, Rocket Lab offers the following services. Note that these services will be included in the mission-specific Statement of Work.

- Commercial mission assurance and risk management
- Dedicated Mission Manager
- Mission integration analyses including coupled load analysis and nominal trajectory
- Creation and management of the interface control documentation and associated verification planning and deliverables
- Securing of launch licensing from the Federal Aviation Administration (FAA) with customer inputs, including detailed flight safety analyses
- Electrical interface design and definition from spacecraft separation system to launch vehicle interface
- Facilitation of the Range safety review process
- Temperature, humidity, and cleanliness control in the fairing leading up to launch
- ISO 8 equivalent processing facilities with temperature and humidity control
- Installment of customer logo on payload fairing (dedicated missions only)
- Option to include video (up to 2 minutes) in the Rocket Lab live launch webcast (dedicated missions only)
- Mission operations support during launch and deployment
- Provision of required signals for payload deployment
- Confirmation of separation and provision of state vector
- Post-flight summary or report
- Top level technical design reviews (e.g., mission design review)
- Launch/Range readiness and hardware pre-ship reviews
- Ground operations and day-of-launch working groups
- Detailed mission/launch campaign integrated master schedule (IMS)
- Weekly integration meetings
- Umbilical capability enhancement
- Fit check (options)
  - Separation systems to spacecraft (Rocket Lab provided separation system)
  - Separation system to launch vehicle adapter
  - CubeSat into dispenser
  - CubeSat dispenser to launch vehicle adapter
  - Launch vehicle adapter electrical wire harness checks
- Tracking of meeting minutes and actions items

NON-STANDARD SERVICES

- Provision of spacecraft deployment systems and associated testing hardware (including Maxwell CubeSat dispensers)
- Fit checks at customer facilities
- Payload fueling services and hardware
- Additional analyses (e.g., integrated thermal analysis)
- Mission concept and preliminary integration studies
- Provision of spacecraft servicing electrical harnesses and connectors
- External spacecraft umbilical connection to external ground support equipment in cleanroom, hangar, or at the pad
- Enhanced cleanliness controls (ISO 7, GN_2 purge)
- Arrangement of payload transportation to launch site
- International traffic in Arms Regulations (ITAR) – Export compliance support
- Late payload integration (post-wet dress rehearsal)
- Formal technical design reviews (e.g. Critical Design Review & Qualification Design Review)
- Delivery of additional documents such as qualification/acceptance test plans and/or test reports, analysis inputs/outputs
- Mission assurance reviews: critical design review, test readiness review, qualification design review, pedigree review (utilizing Rocket Lab's proprietary Pedigree Portal), recurring program management reviews, launch vehicle readiness review, mission readiness review, flight readiness review)
- Provide insight into quality and range safety programs
- Insight into production activities, including observation of major launch vehicle integration and test milestones
- Requirements analysis, including decomposition, traceability, and validation
- Independent verification and validation (IV&V) and other additional mission assurance
- Qualification matrix
- Change history and first-flight items
- Customer insight on all hardware and mission-specific risks
- Mission-specific day of launch requirements
  - On console
- Participation in go/no-go polling
- Classified reviews/communications and payload processing in Sensitive
- Compartmented Information Facilities (SCIF)

J. Standard Services and Equipment Available at the Payload Processing Facilities and Additional Non-standard Services (Rocket Lab-Electron Typical Example

STANDARD SERVICES AND EQUIPMENT AVAILABLE AT THE PAYLOAD PROCESSING FACILITIES INCLUDE:

- Certified ISO 8 cleanliness level (Class 100K)
  - Relative Humidity: 40-60%
  - Temperature: 63-77°F
- Pass-through between the customer control room and the cleanroom for electrical cables
- Power provided for customer electrical ground support equipment at Standard 110VAC @60Hz (RLHQ) and 230VAC @ 50 Hz (LC-1) Power
- Overhead crane for payload integration operations
- Compressed air, helium, and nitrogen
- Consumables including isopropyl alcohol, lint free wipes, gloves, gowns, hair nets
- Security is tailored to customer and mission requirements. Available measures include electronic access control, 24-hour facility security guards, closed-circuit video monitoring
- Rocket Lab integration support personnel
- Comfortable lounge style offices and conference rooms with wi-fi, printer, copier, and coffee facilities

ADDITIONAL NON-STANDARD SERVICES AVAILABLE

- Live video feed into the cleanrooms for remote monitoring of payload integration activities
- Fueling carts and procurement of "green" propellants
- Payload EGSE Room Adjacent to Launch Pad
- Customer Range Control Center