**GOP EXAMPLE**

The following document (SEAL-SSD-009) is provided as an example of possible layout for a Ground Operations Plan (GOP). Specific details on required content are included in AFSPCMAN 91-710 Volume 6, Attachment 2. The Range User has the flexibility to decide on document layout and format.

As described in Volume 6, Attachment 2, the GOP provides a detailed description of the hazardous and safety critical operations associated with a missile system and its associated ground support equipment. It is the medium from which Missile Systems Prelaunch Safety approval is obtained.

If the Range User chooses to use this template as a deliverable format, it is recommended that the Volume 6, Attachment 2 be used as a checklist for populating the existing sections and subsections, or adding new sections or subsections to the document, as needed. This GOP example is by no means complete; therefore the Range User should use the Volume 6, Attachment 2 as the driver for document completion.

**<Company Name>**

DRAFT

**GROUND OPERATIONS PLAN**

**FOR THE**

**<Title> PROGRAM**

Document Number: XXXXX

Revision X, 15 Sep 2020

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

This document is meant as an example only. Detailed requirements

are included AFPSPCMAN 91-710 Vol 6, Attachment 2

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

<Company Name>

102 Maybury Gardens

Isle of Avalon, FL 32145

Prepared by:

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Approved by:

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Adam Smith Date

<Company Name> Program Manager

**Document Change History**

|  |  |  |  |
| --- | --- | --- | --- |
| Revision **Identification** | RevisionDate | **Pages Affected** | **Change Description** |
| Initial Release | 18 Sep 19 | N/A | N/A |
| A | 21 Feb 20 | Appendix A |  |
|  |  |  |  |
|  |  |  |  |

##### [Guidance: The “change” section contains a summary of all changes to the latest edition of the GOP. All changes shall be highlighted using change bars or similar means of identification.]Preface

This document establishes and defines the <Company Name> Corporation Ground Operations Plan (GOP) and its elements as required by AFSPCMAN 91-710 [T] for the <Title> Program at Vandenberg AFB (VSFB).

<Company Name> Corporation, located at Isle of Avalon, Florida, has contracted with the USAF to launch <Title> launch vehicles from the Western Range. The <Title> launch vehicle consists of two stages. The first and second stage propellants are RP-1 and LOX.

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# Glossary of Acronyms & Definitions

**30th SW** 30th Space Wing

**45th SW** 45th Space Wing

**“A” Basis** The minimum mechanical strength values guaranteed by the **Allowables** material producers or suppliers such that at least 99 percent of the material they produce or supply will meet or exceed the specified values with a 95 percent confidence level.

**“B” Basis** The mechanical strength values specified by the material **Allowables** producers and suppliers such that at least 90 percent of the materials they produce or supply will meet or exceed the specified values with a 95 percent confidence level.

**Acceptable** Determination of the acceptability of any hazard imposed by a **Hazard**  launch vehicle/missile or orbital vehicle launched from or onto the range is solely the responsibility of the Space Wing Commander;

The acceptability varies with operational requirements and/or national need and is determined by the Space Wing Commander on a case-by-case basis.

**Accepted Risk** A residual hazard that has been accepted by the Program Manager and the Space Wing Commander.

**Accumulated Risk** The combined risk to all individuals exposed to a particular hazard through all phases of an operation.

**Allowable Load** The maximum load (stress) that can be allowed in a material for a given operating environment to prevent rupture or collapse or detrimental deformation; allowable load (stress) in these cases are ultimate load(stress), buckling load (stress) or yield load (stress), respectively.

**Allowable Strength** The ratio of material strength to the specified factor of safety.

**Blast Danger Area** A hazardous clear are, clearance prior to establishment of a major explosive hazard such as vehicle fuel/oxidizer load and pressurization; the area subject to fragment and direct overpressure resulting from the explosion of the booster/payload.

**CCAFS** Cape Canaveral Space Force Station

#### Casualty A serious injury or worse, including death, to a human

#### CFR Code of Federal Regulations

**EEAP**  Emergency Evacuation Assembly Point

**GOP** Ground Operations Plan

#### GN2 Gaseous Nitrogen

#### Hangfire A condition that exists when the ignition signal is known to have been sent and reached an initiator but ignition of the propulsion system is not achieved.

#### Hazard Any real or potential condition that can cause injury, illness, or death to personnel; damage to or loss of a system, equipment or property; or damage to the environment.

**Hazard Analysis** The analysis of systems to determine potential hazards and recommended actions to eliminate or control the hazards.

**Hazardous** Liquids, gases or solids that may be toxic, reactive, or flammable

**Materials** or that may cause oxygen deficiency either by themselves or in combination with other materials.

**Hazardous** Those operations classified as hazardous according to the

**Operations** following criteria: (1) consideration of the potential or kinetic energy involved, (2) changes such as pressure, temperature, and oxygen content in ambient environmental conditions, (3) presence of hazardous materials. Hazardous operations (including storage, transport, and handling) include, but are not limited to, the following: material (launch vehicle, payload, and other critical loads) handling operations; operations with acoustic hazards; operations with ionizing and non-ionizing sources and systems; operations with hazardous materials; pressure system (greater than 150) psig operations; propellant system operations; ordnance operations; and electrical system operations.

**Hazardous** The systems used to store and transfer hazardous fluids such as

**Pressure Systems** cryogens, flammables, combustibles, hypergols; systems with operating pressures that exceed 250 psig; systems with stored energy levels exceeding 14,240 ft lb; systems that are identified by Range Safety as safety critical.

**Hazardous** A designation for a particular type of Range User procedure: a

**Procedure** Document containing specific steps in sequential order to safely process hazardous materials or conduct hazardous operations.

**HRI** Hazard Risk Index: An alphanumeric rating of hazard risk based upon its anticipated frequency of occurrence and the resultant severity of exposure to such risk.

**LN2** Liquid Nitrogen

**LOX**  Liquid Oxygen

#### Life cycle All phases of the system’s life including design, research, development, test and evaluation, production, deployment (inventory), operations and support, and disposal

**Mishap** An unplanned event or series of events resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

**Mishap Risk** An expression of the impact and possibility of a mishap in terms of potential mishap severity and probability of occurrence.

**OSHA** Occupational Safety and Health Administration

**Residual Mishap** The remaining mishap risk that exists after all mitigation

**Risk** techniques have been implemented or exhausted, in accordance with the system safety design order or preference.

**RF** Radio Frequency

**Safety** To have freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment.

**Safety Critical** An operation, process, facility, system, or component that controls or monitors equipment, operations, systems, or components to ensure personnel, launch area, and public safety (for example, Flight Termination System integrity); these operations, processes, facilities, systems, or components may or may not be hazardous in and of themselves.

**SLC-16** Space Launch Complex 16

**Subsystem** A grouping of items satisfying a logical group of functions within a particular system.

**System** An integrated composite of people, products, and processes that provide a capability to satisfy a need or objective.

**System Safety** The application of engineering and management principles, criteria, and techniques to achieve acceptable mishap risk, within the constraints of operational effectiveness and suitability, time and cost, throughout all phases of the system life cycle.

**System Safety** An engineering discipline that employs specialized professional

**Engineering** knowledge and skills in applying scientific and engineering principles, criteria, and techniques to identify and eliminate hazards, in order to reduce the associated mishap risk.

**[T]** Tailored

**USAF** United States Space Force

**VSFB** Vandenberg Space Force Base

# 1.0 INTRODUCTION

## 1.1 Purpose

This document provides a detailed description of the hazardous and safety critical operations associated with the <Title> Launch Vehicle and its associated ground support equipment, including but not limited to, back-out procedures and hazard analyses of the respective hazardous operations. This submittal satisfies the applicable portions of the Volume 3, Attachment 2.

## 1.2 Scope

This GOP applies to the operations and tasks associated with the <Title> Program located at the Western Range at Complex 16 on Vandenberg Space Force Base (VSFB).

Procedures and policies defined herein are binding upon all personnel and will be adhered to by all operating agencies of military or civilian personnel who participate in any Ground Operations.

Deviations from these policies and procedures will not be permitted except by 30th SW approval. All provisions of AFSPSMAN 91-710[T] are applicable except where changed or deleted by this document.

# 2.0 <Title> GENERAL DESCRIPTION

The General Description section shall present an overview of the system and the processing flow as a prologue to the hazardous and safety critical operations descriptions. The following items are included in this section:

a. General Flow of system integration and testing.

b. Facilities to be used.

c. Generic timeline with sufficient granularity to identify the major hazardous operations.

## 2.1 System Integration and Testing

The <Title> Launch Vehicle is designed, developed, and constructed at the <Company Name> facility in Isle of Avalon, FL. System and subsystem integration and testing occurs at this facility as well. Propulsion systems, however, are manufactured in Seattle, WA and delivered to the <Company Name> facility upon completion of qualification and acceptance testing. At the <Company Name> facility, subassemblies are integrated with stage/tank assemblies and undergo acceptance testing. Upon acceptance, final integration and checkout are performed. Launch will follow at SLC-16. The integration and test flow is summarized in Figure 2.1.

NOTE: Launch vehicle qualification tests are carried out once the vehicle is in its final assembly. Typical performance checks include, but are not limited to: leak checks, pressure checks, hydraulics, propellant and propellant tanks, and electrical systems. The final assembly of <Title> is treated as one system. Checkout is performed at this level before launch.

Figure 2.1: General Flow of System Integration <Example>

## 2.2 SLC-16 Facilities

The facilities used by the <Title> program are shown below.

*[Guidance: Include any drawings and/or pictures that help describe facility layout, as well as, a brief descriptive summary for each facility. The below examples use limited details; therefore include as much information as possible to allow the reader to get a clear understanding of the facilities.]*

*[Guidance: Range User can determine how data is presented, i.e. offsite processing first, then onsite processing to follow order of operations.]*

**2.2.1 Payload Assembly Building**

The Payload Assembly Building in Isle of Avalon, FL provides the capability of a clean room environment to potential users and customers if needed for test articles or components prior to installation in the LOX Test Area.

**2.2.2 LOX Test Area**

The LOX Test Area at SLC-16 provides the capability for testing and qualifying LOX tanks, valves, and other components.

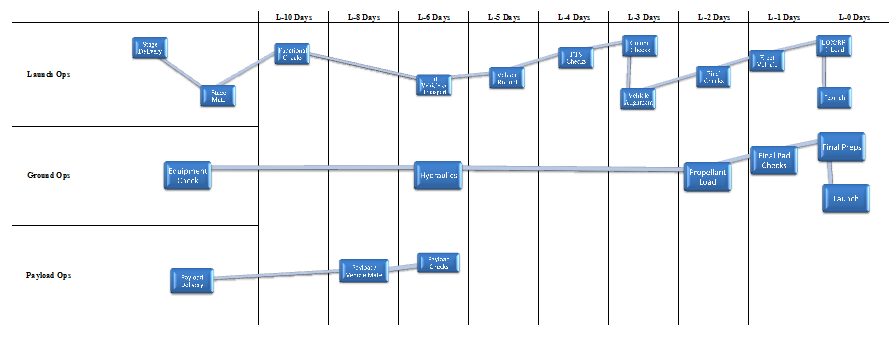
**2.2.3 Storage Facility (Isle of Avalon, FL)**

…

**2.2.4 Propulsion System Facility (Seattle, WA)**

…

## 2.3 Process Flow Timeline



**Figure 2.2: <Title> General Launch, Ground, & Payload Timeline <Example>**

# 3.0 GROUND OPERATIONS

## 3.1 Procedure Listing

Procedures are listed below governing the safe operation, testing, maintenance and installation of components for the <Title> program.

**Table 3.1 <Title> Procedures List <Example>**

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Date** | **Procedure Number** | **Procedure Title** | **Hazard** |
| L-30 Days | 1A.105 | Stage/Engine Delivery | **Hazardous** |
| L-27 Days | 1A.157 | Avionics Check | **Hazardous** |
| L-20 Days | 1A.097 | FTS OI Installation | **Safety Critical** |
| L-14 Days | 1A.209 | 1st & 2nd Stage Mate | **Hazardous** |
| L-10 Days | 1A.200 | FTS LSC Installation | **Safety Critical** |
| L-6 Days | 1A.199 | Tank Purge | **Non-Hazardous** |
| L-5 Days | 1A.054 | Vehicle Leak Check | **Hazardous** |
| L-4 Days | 1A.331 | Payload Fairing Detonation Cord Installation | **Safety Critical** |
| L-2 Days | 1A.254 | Final FTS Connect & Checkout | **Safety Critical** |

**Figure 3.1: Flow Chart Task Summary**

## 3.2 Procedure Descriptions & Task Summaries

*[Guidance: Repeat for each procedure. Reference specific requirements of Volume 6, Attachment 2.]*

**3.2.1 Procedure 1A.200: FTS Linear Shaped Charge Installation (Hazardous, Safety Critical)**

**3.2.1.1 Responsibility**

<Company Name> Corp.

* Hangar facility crew
* Ordnance installation crew
* Safety engineer

**3.2.1.2 Objective**

* Mechanical installation of six LSCs and FCDC on the 1st stage tank
* LSCs and FCDC are part of the FTS which are responsible for the destruction of an errant flight vehicle

**3.2.1.3 Initial & Final Configuration**

**Table 3.2 Procedure 1A.200 Initial/Final Configuration**

|  |  |  |
| --- | --- | --- |
| **Agency** | **Initial Configuration** | **Final Configuration** |
| <Company Name> | LSCs not installed on vehicle | LSCs are installed on vehicle |
| <Company Name> | FCDC not connected to LSCs | FCDC is connected to LSCs |

**3.2.1.4 Equipment and Support Required**

* Personnel trained and certified in explosive handling & operations
* Integration facility grounding system
* OSM support required
* Fire & Medical notified

**3.2.1.5 Description**

This procedure completes the mechanical installation of the Linear Shaped Charges and Flexible Confined Detonating Cord on the 1st stage tank of <Title>. There are a total of six LSCs; four on the 1st stage fuel tank and two on the 1st stage LOX tank. FCDC connects the LSCs and is responsible for transferring the detonating charge to the LSCs. This hazardous procedure is expected to take no longer than 8 hours.

**Summary of Main Tasks**

1. Confirm environmental conditions are acceptable for ordnance operations
2. Clear integration facility of all non-critical personnel
3. Commence procedure
4. Verify all personnel and vehicle are grounded
5. Inspect Linear Shaped Charges prior to installation
6. Install two LSCs on bottom of 1st stage fuel tank 180° apart
7. Install two LSCs on top of 1st stage fuel tank 180° apart
8. Install two LSCs on top of 1st stage LOX tank 180° apart
9. Connect Flexible Confined Detonating Cord to LSCs
10. Final inspection & closeout
11. End hazardous operation

**3.2.1.6 Hazards and Precautions**

**Table 3.3 Procedure 1A.200 Hazards**

|  |  |  |
| --- | --- | --- |
| **Hazard Condition** | **Effect if not Controlled** | **Preventative Action** |
| Explosive Hazard (explosive class 1.1D) | Personnel injury or death upon ordnance initiation | -Operation will be conducted in favorable weather conditions  -Area clear of non-essential personnel  -Vehicle grounded and powered off  -Personnel grounded  -Explosives trained personnel  -Safety briefing |

**3.2.1.7 Approved PPE & Detection Equipment**

* Proper protective clothing/equipment (i.e. anti-static, flame-retardant)
* RF sensors

**3.2.1.8 Emergency & Abort/Back-out Actions**

The installation procedure will be terminated and the launch vehicle will be safed in case of unfavorable conditions. LSCs and FCDC which have not been installed will be put back in its packaging. LSCs and FCDC which have already been installed will be shielded with a protective covering. Uninstalled ordnance will then be put in secure storage.

**3.2.1.9 Personnel Training, Certification, and Experience Requirements**

Personnel will be trained and certified in explosive handling & operations in accordance with AFMAN 91-201 and OSHA CFR 29.

[*Guidance: Include details on any other specific training being implanted.*]

# 4.0 OFF-SITE PROCESSING

*[Guidance: This section shall have a detailed description of the off-site build-up and transport configuration of the launch vehicle and payload that will be transported to the Range]*

*[Guidance: This section shall also have a description of the tests performed on hazardous and safety critical systems such as rotation of S&A devices, no voltage checks on ordnance systems, pressure checks of pressure and propellant vessels, RF radiation measurements, and preliminary FTS checks]*

## 4.1 Major Assembly Transportation

*[Guidance: Include any relevant drawings, diagrams, computer models, etc of transportation fixtures and setup]*

### 4.1.1 1st and 2nd Stage, Payload Transportation

The aft and fore ends of the 1st and 2nd stages will rest on pedestal fixtures and secured along the circumference of the stage with transportation rings. The 1st and 2nd stages will be in the horizontal position on a flatbed trailer. The trailer features an independent suspension system and remote steering capabilities. Meanwhile, the payload will also be secured on pedestal fixtures in the upright position and caged in a metallic box. The payload will also be wrapped for protection. 1st and 2nd stages and the payload will be transported separately from <Company Name> facility in Isle of Avalon, FL to the launch site. NOTE: the propulsion system will be transported in the same manner from Seattle, WA to Isle of Avalon, FL for integration to the 1st stage prior to transport to the launch site.

<Title> will be wrapped in a protective plastic to prevent environmental damage during transport and will further be covered by a tarp. The propulsion system will be encapsulated with a metal box cover that is secured to the bed of the trailer.

An up-to-date DOT permit and route survey will be obtained for the oversized load. DOT exemptions are not needed and will therefore not be pursued. All hazardous materials including FTS ordnance will not be aboard the transport. These hazardous components will be installed at the launch site upon arrival.

## 4.2 Tests Performed on Hazardous & Safety Critical Systems

### 4.2.1 Pressure Vessels

### 4.2.1.1 1st & 2nd Stage Tanks

The 1st and 2nd stage tanks undergo an acceptance test procedure prior to validation. This procedure checks for any leaks and assures the integrity of the tanks by validating the welds and joints. During acceptance testing, the tanks are filled with an inert fluid and pressurized to slightly above MEOP and held for ten minutes. A visual inspection will check for any leaks.

### 4.2.1.2 COPVs

The 1st and 2nd stage COPVs undergo an acceptance test procedure prior to validation. This procedure checks for any leaks and assures the integrity of the COPVs by validating liner and composite overwrap. During acceptance testing, the COPVs are filled with an inert fluid and pressurized to slightly above MEOP and held for ten minutes. A visual inspection will check for any leaks.

### 4.2.2 Ordnance

All ordnance items are checked prior to installation on ADONIS through no voltage checks. A visual inspection is also performed just prior to installation; however, no other checks are performed on vehicle ordnance.

### 4.2.3 FTS Checks

*[Guidance: Can either discuss FTS system checks in this section or refer to the FTSR (if required), with the exception of the FTS End-to-End testing that is required.]*

# 5.0 OPERATING AND SUPPORT HAZARD ANALYSIS

*[Guidance: The O&SHA shall be performed for each procedure and the results summarized in the GOP]*

*[Guidance: The O&SHA shall identify and evaluate the safety considerations associated with environments, personnel, procedures, and equipment involved throughout the operational phase of the program and shall meet the intent of Volume 1, Attachment 2, O&SHA requirements]*

*[Guidance: O&SHAs shall be conducted for activities such as testing, installation, maintenance, support, transportation, storage, operations, and training]*

*[Guidance: O&SHAs shall coincide with the flow chart task summaries in A2.2.2.4 of Volume 6 in AFSPCMAN 91-710]*

*[Guidance: O&SHAs shall incorporate a worksheet associated with each specific flow block in the flow chart and shall include, at a minimum, the following information: Refer to SEAL-SSD-014]*

1. *Reference to the Flow Block Task Number*
2. *General Hazard Group*
3. *Specific Hazard Condition*
4. *Effect if Hazard is not Controlled*
5. *Hazard Risk Index, Initial*
6. *Hazard Control Measures*
   1. *Hardware*
   2. *Procedure*
   3. *Personnel*
7. *Hazard Risk Index, Final*
8. *Comments and Reference Documents*

# APPENDIX

## A. Accident Notification Plan

[Guidance: An accident notification plan shall be developed by the Range User and coordinated with Range Safety to ensure proper and timely notification of mishaps.]

## B. Fire or Explosion

Personnel will evacuate area immediately via established evacuation routes to the designated EEAP, dial 911 (on cell phone request call routing to VSFB), and report any personnel injuries sustained and existing conditions. Personnel will also notify *[insert here]*, who will immediately *[insert here]*.

An announcement shall be made informing personnel of the potentially hazardous area, existing conditions, and the designated EEAP.

Area warning lights shall be switched to flashing red, when appropriate.

All personnel shall be accounted for.

Notify range safety of *[insert here]*

Explosive ordnance disposal team shall be summoned, when appropriate.

Personnel will not return to work areas until area is declared safe and entry is authorized by the OSM and NASA ESH engineer.

## C. Weather Delay (crane ops)

If inclement weather advisory (i.e. Phase I lightning advisory, winds, etc) is announced during actual lifting operation and operations are expected to take 30 minutes or longer to complete:

1. Continue with lift until load can be secured and safed (next safest step).
2. Once load is secured, power down the crane at the control console.

If lightning occurs within 5 nautical miles (Phase II) during lifting operation:

1. Secure the load and power down the crane at the control console.

## D. <Company Name> Personnel Training Plan

[Guidance: A training plan listing all courses used for personnel involved with hazardous or safety critical operations and procedures shall be submitted to Range Safety as part of the GOP]

< Title > personnel receive job safety, fire prevention, and occupational health training. This training includes, but is not limited, to the following:

1. Hazards of the job tasks they will perform, including:
   1. Crane Operations
   2. Ordnance Handling & Transportation
   3. Forklift Operations
2. Hazards of the work area
   1. <Title> personnel shall complete OSHA Hazards Communications training annually. Additionally, technicians, inspectors, safety personnel, and their supervisors shall also complete Hazardous Waste training annually.
3. Range requirements, safety standards, and other guidance that applies to the job and workplace
4. Personnel required to use PPE in the performance of their duties shall attend PPE training covering PPE requirements, use, and care; including but not limited to:
   1. Hard Hats
   2. Respirators
   3. Clothing
   4. Fall Protection
   5. Splash Suits & Gloves
   6. Eye Protection
5. Location and use of emergency and fire protection equipment
6. How to report emergencies and fires to proper authorities
7. Emergency procedures applicable to the job and workplace
8. How to identify and report hazards
9. How to report work-related injuries and illnesses
10. Hazardous waste handling training
11. Material handling
12. Maximum work time policy & restrictions

Rosters are kept for each individual’s training and records are kept on each individual working on the <Title> program and are available for audit by the appropriate agency(s). Records are kept on file with the company for a period no less than five years.

## E. Emergency Response Plan for Graphite Epoxy Composite Overwrapped Pressure Vessels

The following is the planned emergency response plan for the GE COPVs following an event:

1. Initially, personnel involved in the GE cleanup will wear the following PPE:
   1. Leather Gloves
   2. Rubber/Leather Boots
   3. Tyvek suit with hood and full-face particulate filter
2. Air sampling will also initially occur to determine if personnel exposure exceeds six fibers per cubic centimeter. This will determine if and what PPE requirements should be maintained or could be downgraded
3. Typically, the GE is handled similar to fiberglass and is an injection hazard. The potential for an inhalation hazard is minimal but lacks data at high heat temperatures
4. If power shut downs occur prior to start up, an evaluation to determine if inspection of electrical circuit breaker panels, etc, should be checked since GE is conductive

## F. Hazardous Procedures Drawings

