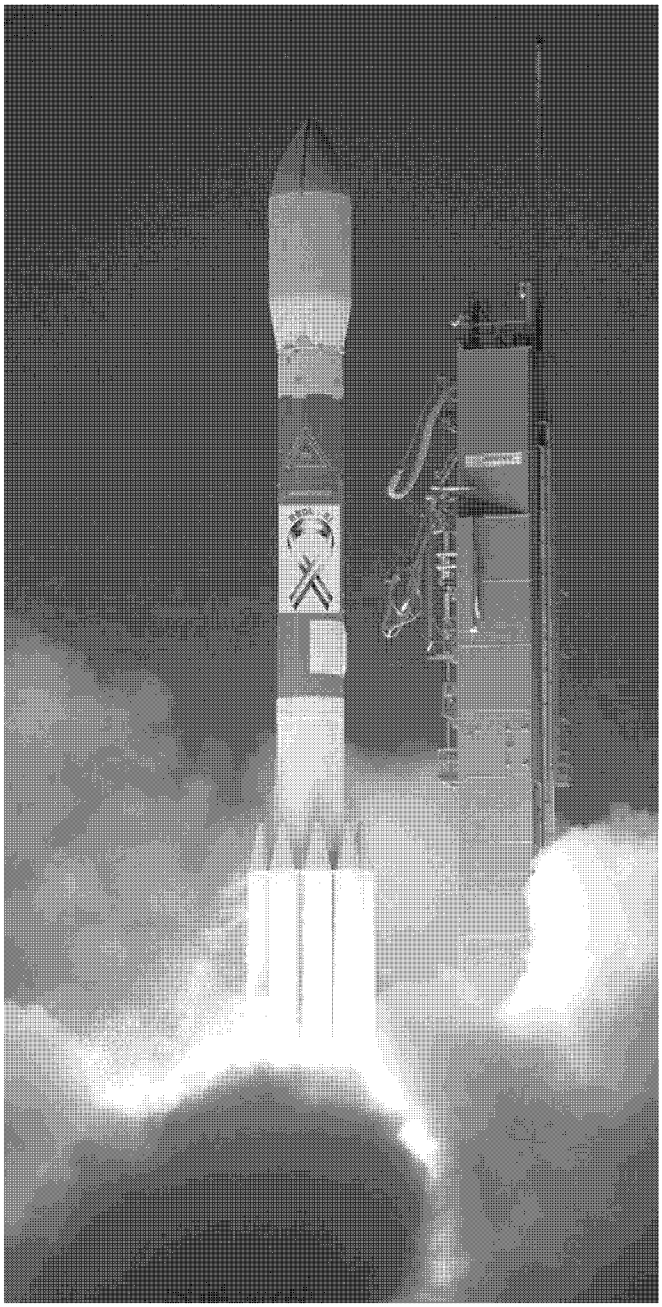
NROL-21
Launch Operations Plan (LOP)



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LAUNCH OPERATIONS PLAN
FOR
NROL-21
DELTA II 7920-10 LAUNCH VEHICLE

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1 INTRODUCTION

1.1 SCOPE

This document defines the composition of the Delta II / NROL-21 Mission Control Team and its support of the following mission activities: countdown, launch, early-orbit flight, and mission quick-look reporting. Mission rules and top-level Go/No Go criteria for launch operations are also defined herein.

Illustrations and supporting materials are included in Appendix B: Console Notebook. The final revision of the Console Notebook will be made available on launch day. Although the LOP is reviewed and signed at L-30 days, the contents of the console notebook are meant to serve as an up-to-date reference for the mission management team on launch day and are subject to minor changes that do not conflict with the LOP. Any change in Boeing processes, policies, or roles and responsibilities occurring after the review and signature cycle will result in a subsequent release of an approved and numbered revision of the Launch Operations Plan. It is important to note, the data that is extracted from the referenced documents is configuration controlled within those documents and provided in the LOP as reference only.

1.2 LAUNCH REQUIREMENTS

The NROL-21 mission will utilize a Delta II 7920-10 launch vehicle. The launch vehicle performance identified in Reference VII is the source document for the trajectory data in section 1.3.

1.3 MISSION DESCRIPTION

The NROL-21 mission trajectory is based on a launch from the Western Range (WR) Space Launch Complex 2-West (SLC-2W) at Vandenberg Air Force Base (VAFB) down a 196-degree flight azimuth.

The trajectory begins at liftoff when the main engine is ignited. Six GEM solid motors are ignited on the launch pad once the RS-27A main engine thrust has reached the required level. The vehicle flies directly down the desired 196 degrees flight azimuth by rotating about an axis perpendicular to the flight azimuth plane[1] between 7 and 90 seconds of flight. The vehicle maintains a near zero angle-of-attack profile from 20 to 90 seconds to reduce aerodynamic loading. The six air-lit GEM solid motors burn for approximately 64.0 seconds. The remaining three air-lit GEM solid motors are ignited at 65.5 seconds. Three of the ground-ignited motors are jettisoned at 86 seconds while the other three are jettisoned one second later at 87 seconds.

The vehicle executes two first stage dog-leg maneuvers in order to achieve the desired 58.519 degree orbit inclination. The first dog-leg maneuver, which begins at 90 seconds after liftoff, consists of

[1] The plane defined by the flight azimuth direction and the radius vector from the center of the earth to the vehicle.

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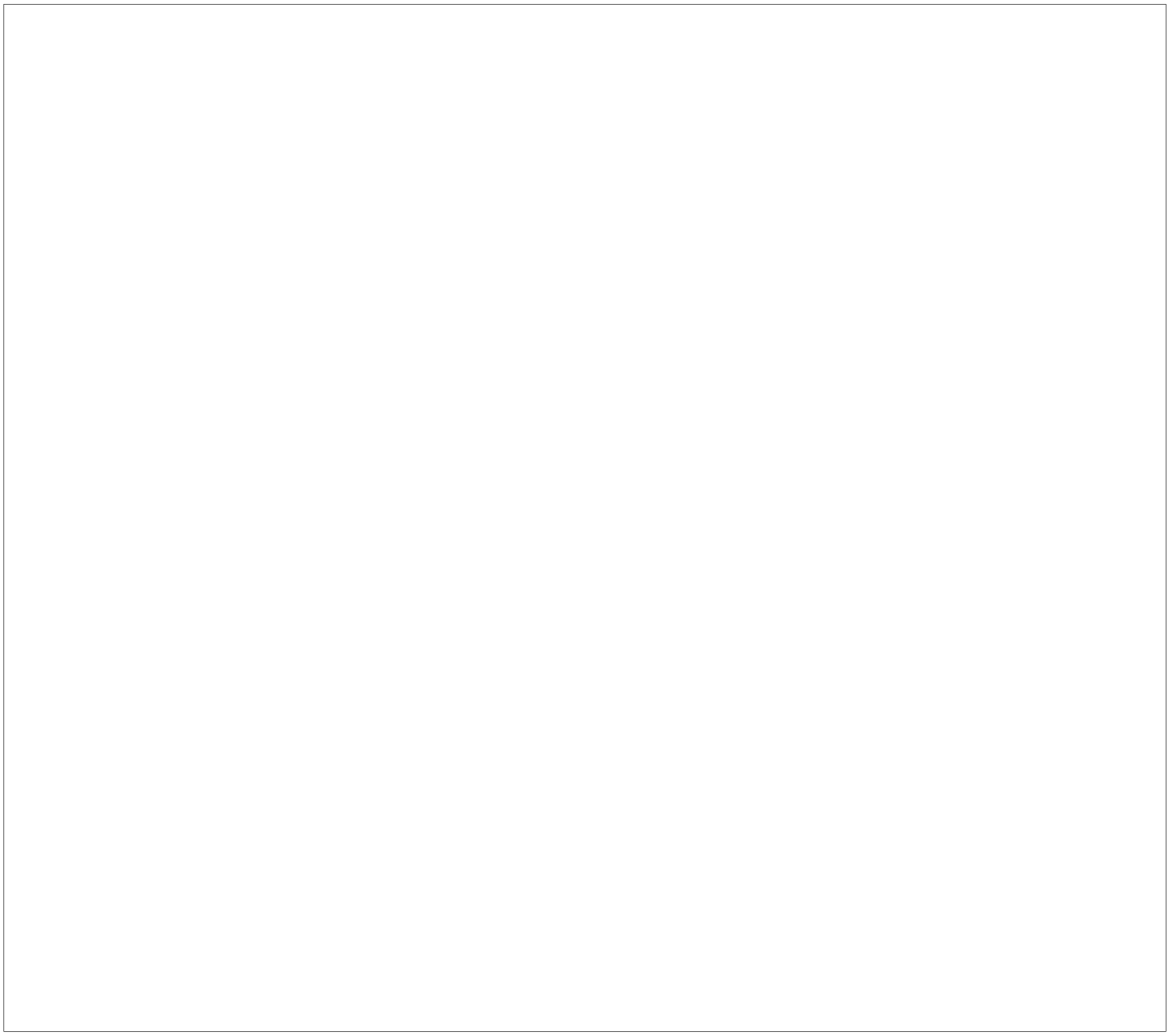
combined pitch-yaw-roll rates between 90 and 115 seconds and results in a maximum product of total angle-of-attack and dynamic pressure (Max Q) during this time period. A second combined pitch-yaw-roll maneuver is performed between 115 and 132 seconds to achieve the required zero angle-of-attack for the jettison of the air-ignited GEMs. The air-ignited GEMs burnout at 129.7 seconds and are jettisoned at 131.5 seconds. The second dog-leg maneuver consisting of a combined pitch-yaw-roll maneuver is performed between 132 and 142 seconds. The roll rate during the dog-leg maneuvers is designed to align the pitch plane with the local vertical plane. After the first stage dog-leg maneuvers, the vehicle initiates a slow pitch rate that is terminated at 261 seconds. Main Engine Cutoff (MECO) occurs at 263.4 seconds after liftoff when booster propellants are depleted. Stage I-II separation follows 8 seconds later (271.4 seconds) with second stage ignition occurring at 276.9 seconds.



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APPENDIX A FLIGHT CERTIFICATION DOCUMENT

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APPENDIX B CONSOLE NOTEBOOK