Federal Aviation Administration

Office of Commercial Space Transportation

RECORD OF DECISION

Issuing a Reentry License to Lockheed Martin Corporation for the Reentry of the Orion Multi-Purpose Crew Vehicle

Introduction and Background

The Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) prepared this Record of Decision (ROD) in order to document the FAA's final environmental determination and approval to support the issuance of a reentry license to Lockheed Martin Corporation for the reentry of the Orion Multi-Purpose Crew Vehicle (MPCV) from Earth orbit to a location in the Pacific Ocean. The potential environmental impacts of the Orion MPCV reentering the Earth's atmosphere and landing in the Pacific Ocean were analyzed in the 2008 *Final Constellation Programmatic Environmental Impact Statement* (2008 PEIS) prepared by the National Aeronautics and Space Administration (NASA). Because the FAA was not a cooperating agency on the 2008 PEIS, the FAA adopted in part the 2008 PEIS and recirculated the 2008 PEIS as a Final EIS in accordance with 40 Code of Federal Regulations (CFR) § 1506.3(b). A public notice of FAA's adoption and recirculation of the 2008 PEIS was published in the *Federal Register* on November 30, 2012[1].

The 2008 PEIS evaluated the potential environmental impacts from NASA's proposal to continue preparations for and implement a program previously known as Constellation[2], which involved the development of flight systems and infrastructure required to enable continued access to space and to enable future crewed missions to the International Space Station, the Moon, Mars, and beyond. Specifically, the 2008 PEIS analyzed the production, assembly, and ground and flight testing of the previously named "Orion" spacecraft[3] to transport crew and cargo to and from space. The 2008 PEIS addressed potential environmental impacts associated with the Orion spacecraft being launched atop the Ares I launch vehicle from the John F. Kennedy Space Center and returning to a landing location in the Pacific Ocean. On February 28, 2008, NASA issued a ROD, which presented the agency's decision to implement all aspects of the proposed action analyzed in the 2008 PEIS. However, in the NASA Authorization Act of 2010[4], Congress clarified its direction for NASA's post-Shuttle program for human space flight and exploration, and directed NASA to develop the "Constellation Program" into the "Space Shuttle Launch System (SLS), Multi-Purpose Crew Vehicle (MPCV), and associated programs." As a result, in June 2011, NASA published a *Modified Record of Decision for NASA's Post-*

[1] 77 *Federal Register* 71419 (November 30, 2012).

[2] Certain planned elements and specific objectives of the Constellation Program as described in the 2008 Final Constellation PEIS were revised as a result of the NASA Authorization Act of 2010. These changes were evaluated in NASA's 2011 Modified Record of Decision (ROD) for the Post-Shuttle Human Spaceflight Program and the Constellation Programmatic EIS. The "Constellation" moniker was also discarded in 2011 following the issuance of NASA's modified ROD.

[3] The design for the Orion spacecraft considered in the 2008 PEIS was carried forward as the Orion Multi-Purpose Crew Vehicle (Orion MPCV) as part of NASA's mission to explore beyond low-Earth orbit and into deep space.

[4] Public Law 111-267: National Aeronautics and Space Administration Authorization Act of 2010 (124 STAT. 2805; Date October 11, 2010).

Shuttle Human Spaceflight Program and the Constellation Programmatic Environmental Impact Statement (2011 Modified ROD), which documented NASA's consideration of possible changes in the environmental impacts resulting from directed changes in the agency's proposed human spaceflight program. NASA concluded there were no substantial changes relevant to environmental concerns associated with the evolution of NASA's post-Shuttle human spaceflight program from Constellation – and particularly its Orion and Ares elements – to MPCV, SLS, and associated programs, and thus, the 2008 PEIS remained valid at the programmatic level for analysis of the environmental impacts associated with the major elements of NASA's post-Shuttle human spaceflight program.

The FAA has adopted the 2008 PEIS in part, focusing on those parts of the 2008 PEIS that are relevant to FAA's Proposed Action of issuing a reentry license to Lockheed Martin Corporation for the reentry of its Orion MPCV from Earth orbit to a reentry location in the Pacific Ocean. Specifically, the FAA has adopted those parts related to Orion spacecraft operations, including the discussions of the affected environment and potential environmental impacts associated with the reentry of the Orion spacecraft.

The 2008 PEIS serves as the primary reference and basis for preparation of this ROD. The PEIS documents the analysis of the potential environmental consequences associated with the above-referenced Proposed Action and a No Action Alternative, and is made part of this ROD. The FAA adopted the 2008 PEIS in part pursuant to the requirements of the National Environmental Policy Act (NEPA) of 1969, 42 United States Code §§ 4321–4347 (as amended), Council on Environmental Quality (CEQ) NEPA implementing regulations (40 CFR Parts 1500–1508), and FAA Order 1050.1E, Change 1.

For more information concerning the contents of this ROD or the 2008 PEIS, please contact:

Mr. Daniel Czelusniak
Environmental Specialist
Office of Commercial Space Transportation
Federal Aviation Administration
800 Independence Avenue SW, Room 325
Washington, DC 20591
Phone: (202) 267-5924
Email: Daniel.Czelusniak@faa.gov

Purpose and Need

The purpose of the FAA's Proposed Action of issuing a reentry license to Lockheed Martin Corporation for the reentry of the Orion MPCV from Earth orbit to a location in the Pacific Ocean is to fulfill the FAA/AST's responsibilities as authorized by Executive Order 12465, *Commercial Expendable Launch Vehicle Activities* (49 *FR* 7099, 3 CFR, 1984 Comp., p. 163), and the Commercial Space Launch Act (51 U.S.C. Subtitle V, ch. 509 §§ 50901-50923) for oversight of commercial space launch activities, including issuing reentry licenses for reentry vehicles.

The need for the Proposed Action results from the statutory direction from Congress under the Commercial Space Launch Act to encourage, facilitate, and promote commercial space launch and reentry activities by the private sector in order to strengthen and expand U.S. space transportation infrastructure. The FAA/AST has received an application for a reentry license

from Lockheed Martin Corporation for the reentry of the Orion MPCV. The FAA/AST must review the application and determine whether to issue the license.

Public and Agency Involvement

Public participation in the NEPA process promotes better decision-making and provides for and encourages open communication between Federal agencies and the public. NASA published a Notice of Intent to prepare a PEIS for the Constellation Program in the *Federal Register* on September 26, 2006[5]. Scoping meetings to solicit public input on significant issues and alternatives to be considered in the PEIS were held on October 18, 2006 in Cocoa, Florida; on October 20, 2006, in Washington D.C.; and on October 24, 2006, in Salt Lake City, Utah. Comments were solicited from Federal, state, and local agencies and other interested parties on the scope of the Constellation Program. A Draft EIS was filed with the Environmental Protection Agency (EPA) on August 17, 2007. The public review and comment period for the Draft PEIS closed on September 30, 2007. The Final PEIS was filed with the EPA in January 2008, and a Notice of Availability was published in the *Federal Register* on January 23, 2008[6].

Because the FAA was not a cooperating agency on the 2008 PEIS, the FAA adopted in part the 2008 PEIS and recirculated the 2008 PEIS as a Final EIS in accordance with 40 CFR § 1506.3(b): "if the actions covered by the original environmental impact statement and the proposed action are substantially the same, the agency adopting another agency's statement is not required to recirculate it except as a final statement." CEQ's 40 most asked questions further clarifies that an agency that was not a cooperating agency on an EIS, but is adopting the EIS, must recirculate it as a final EIS and announce what it is doing. A public notice of FAA's adoption in part and recirculation of the 2008 PEIS was published in the *Federal Register* on November 30, 2012[7]. Additionally, a copy of the Notice of Availability, which contained a website address for accessing the 2008 PEIS, was mailed to persons and agencies that might have an interest in the FAA's Proposed Action.

Overview of the Proposed Action and No Action Alternative

Under the Proposed Action (which is the FAA's Preferred Alternative), the FAA would issue a reentry license to Lockheed Martin Corporation for the reentry of the Orion MPCV from Earth orbit to a reentry location in the Pacific Ocean. The Orion MPCV would be launched atop a Delta IV Heavy launch vehicle from Space Launch Complex-37 (SLC-37) at Cape Canaveral Air Force Station (CCAFS), and upon reentry, the Orion MPCV would land in the Pacific Ocean in international waters approximately 180 miles off the coast of Mexico. Under the Proposed Action, the FAA would authorize one Orion MPCV reentry mission – Exploration Flight Test 1 (EFT-1). Under EFT-1, the Orion MPCV would have the necessary capabilities to achieve a controlled reentry, parachute deployment, and splashdown from the launch vehicle upper stage, but would not support crewed flight operations. Prior to the FAA issuing the reentry license, the project must meet all FAA safety, risk, and financial responsibility requirements per 14 CFR part 400. Authorization for reentry of the Orion MPCV would terminate upon completion of all activities authorized by the reentry license or the expiration date stated in the reentry license, whichever occurs first. Existing facilities and infrastructure would be used for all launch readiness and reentry activities and no new construction would occur.

---

[5] 71 *Federal Register* 56183 (September 26, 2006).
[6] 73 *Federal Register* 4013 (January 23, 2008).
[7] 77 *Federal Register* 71419 (November 30, 2012).

The open ocean landing and recovery location for the Orion MPCV is consistent with the nominal mission profile discussed in the 2008 PEIS. In addition, the launch abort scenario off the east coast of the United States is consistent with the 2008 PEIS. The reentry of the Orion MPCV under the FAA reentry license is preliminarily scheduled for mid to late 2014.

The only alternative to the Proposed Action is the No Action Alternative. Under the No Action Alternative, the FAA would not issue a reentry license to Lockheed Martin Corporation for the reentry of the Orion MPCV from Earth orbit to a reentry location in the Pacific Ocean.

Orion Multi-Purpose Crew Vehicle

The Orion MPCV design is consistent with the Orion spacecraft design that was analyzed in the 2008 PEIS. The Orion MPCV consists of a Crew Module (CM), Service Module (SM), and Launch Abort System (LAS). The CM is the transportation capsule and is the only major component of the Orion MPCV that would be recovered. The SM is designed to support the CM from launch through separation upon return to Earth and is roughly cylindrical in shape and constructed of alloy. It is expected that components of the SM that survive atmospheric entry would sink in the Pacific Ocean, although some components may survive sufficiently intact to remain afloat. The LAS is positioned on top of the CM and is designed to propel the CM to safety in the event of an emergency during ascent. In addition, the LAS is designed to protect the CM from extreme atmospheric loads and heating during ascent to orbit. The LAS is expected to sink in the Atlantic Ocean. For the purpose of the EFT-1 mission under the FAA license, the SM and LAS would not contain propellant and act as dummy components of the Orion MPCV. In the 2008 PEIS, the SM was assumed to burn propellant and land in the ocean, and the LAS was assumed to carry propellants and land in the ocean where the propellants would disperse.

The CM is 16 feet 5.5 inches in diameter and 10 feet 11 inches in length, with a pressurized volume of 690.6 cubic-feet, gross liftoff weight of approximately 21,650 pounds, and landing weight of approximately 19,463 pounds. The CM propulsion system comprises hydrazine propellant tanks with about 404 pound-mass of liquid hydrazine at launch, Reaction Control System thrusters, and helium pressurant tanks. The propellant is intended to navigate the CM in orbit. At launch, the CM also contains 88 pound-mass of liquid ammonia as coolant. The landing recovery system of the CM includes two drogue chutes, three pilot chutes, three main parachutes, and five helium pressurant tanks for the CM Up-righting System bag inflation after splashdown.

Environmental Impacts under the Proposed Action

The 2008 PEIS considered potential environmental impacts associated with the Orion spacecraft being launched atop the Ares I launch vehicle and the atmospheric entry of the Orion spacecraft, with the return of its CM to a landing location in the Pacific Ocean. Under the FAA's Proposed Action, the Orion MPCV would be launched atop a different launch vehicle – the Delta IV Heavy launch vehicle. However, it would reenter from Earth orbit to a reentry location in the Pacific Ocean as stated in the 2008 PEIS. Further, an environmental review under NEPA of potential environmental impacts of the FAA licensing the launch operations of the Delta IV Heavy launch vehicle from SLC-37 at CCAFS in Florida was completed in 1998 and 2000[8].

[8] Potential environmental impacts from launch operations of the Delta IV Heavy launch vehicle at SLC-37 at CCAFS were analyzed in the U.S. Air Force April 1998 *Final Environmental Impact Statement for the Evolved Expendable Launch Vehicle (EELV) Program* and the March 2000

Thus, this section focuses solely on those potential impacts that could result from the Orion MPCV reentry operations, including the ocean landing of the Orion MPCV's components.

As stated in the 2008 PEIS, the environmental impacts associated with return of the LAS, SM, and CM include the immediate impacts of the entry sonic booms; the potential for components and debris striking people, ships, or wildlife; and the potential longer-term impacts of the components and debris on the ocean environment. The sonic boom footprints associated with atmospheric entry of all components of the Orion MPCV would occur over the open ocean near no major land boundaries and be expected to result in a negligible impact, including impacts to marine species. The physical impact footprints for falling components and debris would be predetermined to minimize potential risks to aircraft and ships, and Notices to Mariners and Notices to Airmen would be issued for the return corridor to reduce the risk to aircraft and surface vessels. Although surviving components and debris could cause damage to ships if they have sufficient kinetic energy, the probability of hitting ships is low. Similarly, intact components and debris that strike a marine organism on or near the surface could be lethal; however, the potential for direct impact on sea life is also low. Furthermore, the potential environmental impacts of falling components and debris are expected to be small.

Similarly, the potential longer-term impacts of the components and debris on the ocean environment are small. As noted above, the SM and LAS would not contain propellant as discussed in the 2008 PEIS. Most components and remaining debris are expected to sink and corrode on the ocean floor, with the large volume of ocean water diluting any potential toxic concentrations. Thus, the ocean disposal of the LAS and SM under the Proposed Action is not expected to have significant impacts.

Upon reentry and landing of the CM in the Pacific Ocean, it would be recovered in partnership with NASA and U.S. Navy using a ship, capable of using radar to track the CM and other hardware. Any residual liquid hydrazine propellant in the CM would be off-loaded and stored during recovery operations. Similar to the LAS and SM, the CM landing may pose some potential impacts to marine life through direct impact but the chances of hitting marine life is very low given the relatively low density of species within surface waters of the open ocean. All non-recoverable items, including any parachutes, are non-toxic in composition and are expected to sink, limiting impacts to marine life and ocean vessels.

Recovery vessels would carry fuel and potentially other hazardous materials. However, all maritime protocols would be followed to prevent collisions and protect the cargo like for any other seagoing vessel carrying hazardous materials. As stated in the 2008 PEIS, because the landing location of the CM would be in the open ocean, the potential for ecological damage and transit impact is minimal. Also, the potential for accidents would be minimized by the issuance of Notices to Mariners and Notices to Airmen prior to scheduled recovery operations.

All applicable safety protocols for the protection of personnel will be followed during recovery operations. Monitoring would occur for any potential release of hydrazine and ammonia. The CM and any recoverable hardware would then be secured on the ship for transport to a deservicing facility in Long Beach, California. Furthermore, reentry of the CM to a landing location in the Pacific Ocean is expected to have negligible impacts. Thus, the ocean landing of the CM under the Proposed Action are not expected to have significant impacts.

Final Supplemental Environmental Impact Statement for the EELV Program, both of which the FAA adopted and issued a Record of Decision in 2011.

If the Orion MPCV were to incur a catastrophic failure during ascent or reentry, hazardous materials could be released, and, depending upon the extent of the altitude of the release, these materials could combust and/or contact the ocean. Associated environmental impacts from these materials would be temporary due to the isolated location of the landing area, neutralization of the propellant by seawater, and dilution of other commodities. The likelihood of a land impact of the Orion MPCV and any associated hazardous commodities would be low.

Decision and Order

Based on the potential environmental impacts identified in the 2008 PEIS, applicable regulatory requirements, public and agency comments, and the FAA's responsibilities to support the continued growth and expansion of the U.S. space industry, the FAA has decided to implement the Proposed Action as presented in this ROD. The FAA believes the Proposed Action best fulfills the purpose and need identified in this ROD. In contrast, the No Action Alternative fails to meet the purpose and need identified in this ROD. For reasons summarized earlier in this ROD, the FAA has determined that the Proposed Action is a reasonable, feasible, practicable, and prudent alternative for a Federal decision in light of the established goals and objectives. The FAA decision to take the required actions and approvals is consistent with its statutory mission and policies supported by the findings and conclusions reflected in the environmental documentation and this ROD.

The FAA has independently evaluated the information contained in the 2008 PEIS and has verified the continued validity of the analysis. The FAA has determined there is no new information or analysis that would require preparation of a new or supplemental EIS according to the CEQ Regulations (40 CFR § 1502.9 (c)(l)). Therefore, the FAA is using the 2008 PEIS to support its decision on the Proposed Action.

After careful and thorough consideration of the facts contained herein and following consideration of the view of those Federal agencies having jurisdiction by law or special expertise with respect to the environmental impacts described, the undersigned finds that the proposed Federal action is consistent with existing national environmental policies and objectives as set forth in Section 101(a) of NEPA. This ROD represents the FAA's final environmental determination and approval to support the actions identified, including those taken under the provisions of the Commercial Space Launch Act.

Based upon the record of this proposed Federal action, and under the authority delegated to me by the Administrator of the FAA, I find that this Record of Decision is reasonably supported.

Responsible FAA Official:

Dr. George C. Nield
Associate Administrator for
Commercial Space Transportation

5/1/2013
Date