National Aeronautics and
Space Administration

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HUMAN-CLASS DELIVERY LANDER (HDL) CONCEPT OF OPERATIONS (CONOPS)

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REVISION AND HISTORY PAGE

Revision No.	Change No.	Description	Release Date
-	HLS-C0205	Initial Release (Reference HCB.12.15.2021)	01/05/22
-	HLS-MD-0006	Updated to reflect HLS-IRD-004-01 Sustaining Volume numbering.	02/22/22
A	-	Revision A (Reference OSB HCB.06.27.2022) Updated in support of the response to App P provider feedback.	06/29/22

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1.0 INTRODUCTION

The Human-class Delivery Lander (HDL) Concept of Operations (ConOps) describes the general concepts associated with the delivery of large Cargo that either remains integrated with the HDL on the Lunar surface, or that is offloaded from the HDL. The HDL is not intended to deliver crew. The HDL and Cargo will be launched by the HDL provider's procured launch vehicle(s) (LV), and the HDL will be expected to perform complete delivery to the surface. Providers may choose any approach to launch, aggregation, or staging architecture within the bounds of the HDL's and the Cargo's operational and environmental limits.

1.1 PURPOSE

The primary purpose of this document is to define the HDL ConOps for the NASA Artemis effort to establish a sustained human presence on the Moon. Specifically, this document captures the top-level operational concept for how the HDL provider will be expected to deliver large Cargo to the Lunar surface. These Cargo are crucial to supporting the NASA Artemis Program campaign to establish a sustained human presence on the Moon per Space Policy Directive-1. This document is also used to define HDL mission phases and is intended to feed the functional analysis that helps form the basis of HDL requirements.

The HDL Design Reference Missions (DRMs) are included to describe the current understanding of the mission types to be used in delivering human-class Cargo to the lunar surface. The DRMs establish an operational context, descriptions of situations that may be encountered during currently available mission concepts, and top-level operational sequences.

1.2 SCOPE

This document defines the mission concepts for the delivery of large Cargo that will either remain integrated with the HDL on the Lunar surface, such as a Surface Habitat (SH), or that are offloaded from the HDL, such as a Pressurized Rover (PR) (these examples are non-binding). The providers are responsible for defining their vehicle's ConOps detailing how they will integrate the Cargo for launch, deliver the Cargo to the lunar surface, bring the Cargo into service, if necessary, maintain the Cargo while the HDL prepares to transfer operations to the Cargo operations team, offload the Cargo, if necessary, and perform disposal, if required. The specific architecture and vehicle implementation of this ConOps will be housed in future documentation.

1.3 CHANGE AUTHORITY/RESPONSIBILITY

The HDL is managed by NASA's Human Landing System (HLS) Program. Proposed changes to this document shall be submitted via a Change Request (CR) to the appropriate HLS Program Control Board for consideration and disposition.

All such requests will adhere to the *HLS Configuration and Data Management Plan*, documented in HLS-PLAN-004. The appropriate NASA Office of Primary Responsibility (OPR) identified for this document is HLS Systems Engineering & Integration Office.

1.4 APPLICABLE DOCUMENTS

The following documents include specifications, models, standards, guidelines, handbooks, and other special publications. The documents listed in this paragraph are applicable to the extent specified herein.

Document Number	Document Title
EVA-EXP-0070	HLS - Extra-Vehicular Activity (EVA) Compatibility Interface Requirements Document (IRD)
HLS-PLAN-004	HLS Configuration and Data Management Plan

1.5 REFERENCE DOCUMENTS

The following documents contain supplemental information to guide the user in the application of this document.

Document Number	Document Title
AES-50007	Advanced Exploration Systems (AES) Concept of Operations
HEOMD-007	Human Exploration and Operations Mission Directorate (HEOMD) Scope
HLS-IRD-004-01	HLS Program Integrated Lander to Mission Systems (MS) Interface Requirements Document (IRD) – Sustained Phase
HLS-IRD-010	Human Landing System (HLS) Program Human-class Delivery Lander (HDL) to Cargo Interface Requirements Document (IRD) – Sustained Phase
HLS-PLAN-016	HLS Technical Management Plan
HLS-RQMT-007	Human Landing System (HLS) Program Human-class Delivery Lander (HDL) Requirements Document – Sustained Phase
SPD-1	Space Policy Directive-1 Reinvigorating America's Human Space Exploration Program
NASA-STD-1006	Space System Protection Standard
NPR 2810.1A	Security of Information Technology

2.0 SUMMARY

As lunar surface exploration evolves into the Lunar Sustained Phase, more ambitious Artemis missions are likely to be pursued to further the advancement of surface goals. These missions may require surface assets like an SH or PR to meet these advanced goals and provide the foundation for a sustained human presence at the Lunar base known as the Artemis Base Camp (ABC). The HDL is a vehicular system that supports the transport of critical Artemis Cargo from Earth to the lunar surface, brings its Cargo into service, and ensures a safe environment for crew in the vicinity by remotely safing the vehicle post-landing.

3.0 DESIGN REFERENCE MISSIONS

The DRMs contained in this section describe the top-level operational sequence that drives HDL system and mission design. Each HDL DRM is a variation on the overall HDL mission architecture, which is generically represented in Figure 3.0, where the variations between HDL DRMs are focused on the type Cargo being delivered. The DRMs also describe the current understanding of the bounding mission types.

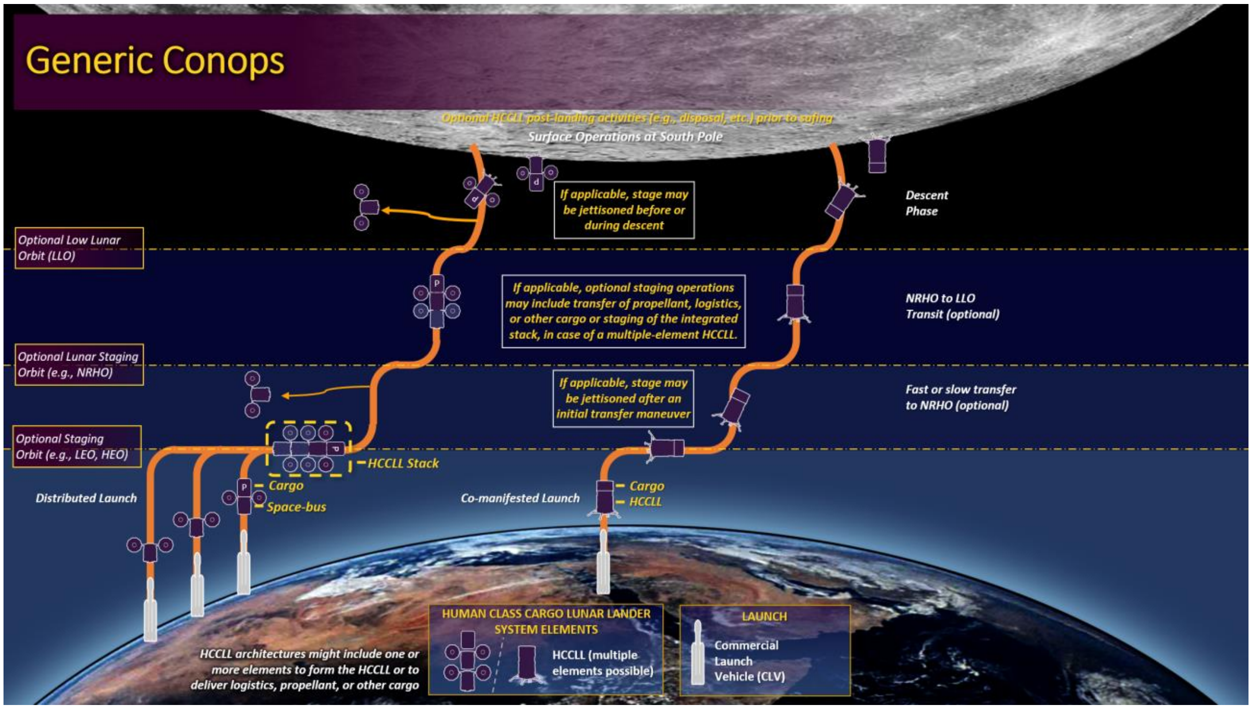

FIGURE 3.0 NOTIONAL HDL MISSION ARCHITECTURE

3.1 DRM-C-001 INTEGRATED CARGO DELIVERY MISSION

DRM-C-001 is a large Cargo delivery mission to the lunar South Pole ABC region with a stationary Cargo that remains integrated with the HDL. As a non-binding example, such an Integrated Cargo (IC) could be an SH. Transit from Earth to the lunar surface will be provider-specific and may or may not involve aggregation of the HLS and Cargo in Earth and/or Lunar orbits. There will be an appropriate number of checkouts to determine the health and status of the HDL and the IC prior to any subsequent crewed mission. The number and sequencing of these checkouts are expected to be HDL and IC design-specific and follow required flight rules. As an example, there could be a checkout performed before descent to the Lunar surface. Another example could be a checkout performed after landing and safing of the vehicle is complete. Once on the lunar surface, the HDL is expected to provide the IC with services until the IC is ready to operate independently. This period may also involve intermittent darkness which will be determined by the mission epoch and landing site. The IC may have protective fairings or other protective material that may need to be removed prior to crew launch. Remote operations to remove any inhibiting hardware must be completed prior to crew launch to ensure that the crew mission timeline is not affected. While it is possible the Cargo may have some of its own fairings or operations required, the HDL provider is intended to be responsible for any fairing or inhibiting hardware removal remotely as stated if it is owned by the HDL provider. Crew interaction is intended to be limited to only the Cargo and HLD, as absolutely necessary, to minimize human-rating requirements. Once the HDL completes its operations to enable bringing the Cargo into service, if necessary, the IC operations will take over responsibility of the IC and the HDL will remain in a safe condition for the duration of the IC operations. The HDL must provide crew access to Cargo and potential ingress to the IC.

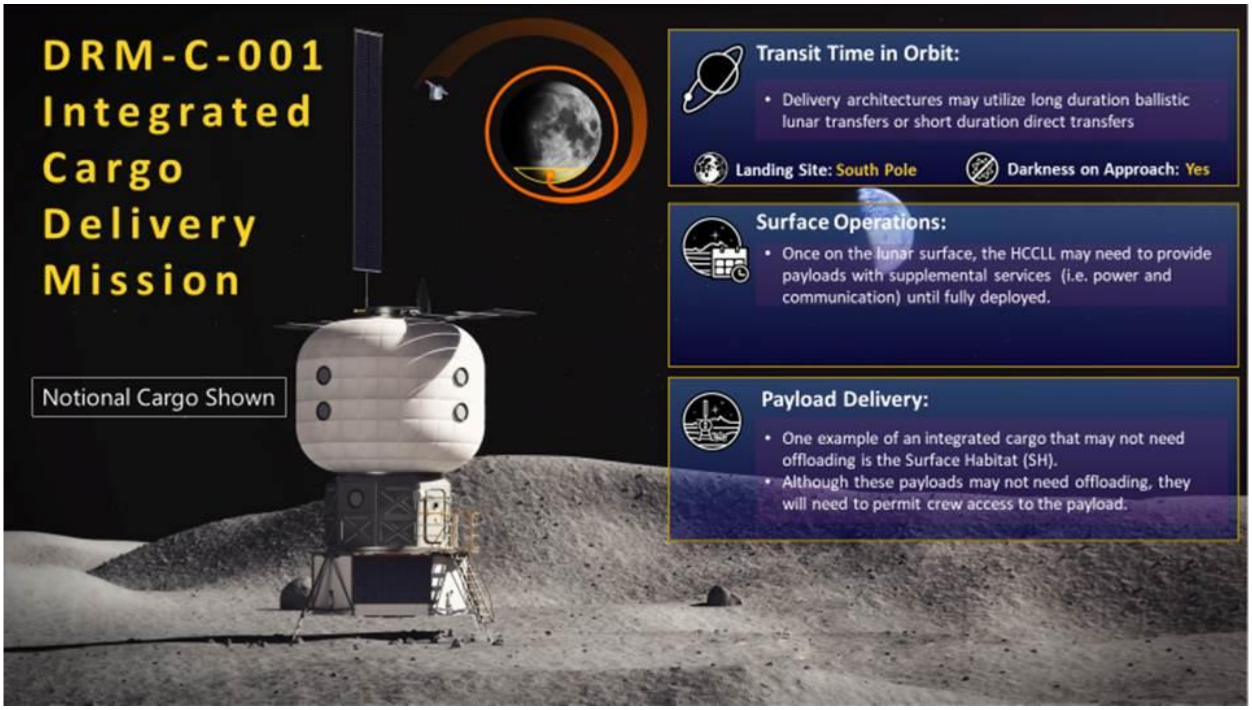

FIGURE 3.1 DRM-C-001 INTEGRATED CARGO DELIVERY MISSION

3.2 DRM-C-002 OFFLOADED CARGO DELIVERY MISSION

DRM-C-002 is a large Cargo delivery mission to the lunar South Pole ABC region with a Cargo that must be offloaded to the Lunar surface. As a non-binding example, such an Offloaded Cargo (OC) could be a PR. Transit from Earth to the lunar surface will be provider-specific and may or may not involve aggregation of the HDL and Cargo in Earth and/or Lunar orbits. There will be an appropriate number of checkouts to determine the health and status of the HDL and the OC prior to any subsequent crewed mission. The number and sequencing of these checkouts are expected to be HDL and OC design-specific and follow required flight rules. As an example, there could be a checkout performed before descent to the Lunar surface. Another example could be a checkout performed after landing and safing of the vehicle is complete. Once on the lunar surface, the HDL is expected to provide the OC with services until the OC is ready to operate independently. This period may also involve intermittent darkness which will be determined by the mission epoch and landing site. The OC may have protective fairings or other protective material that may need to be removed prior to crew launch. Remote operations to remove any inhibiting hardware must be completed prior to crew launch to ensure that the crew mission timeline is not affected. While it is possible the Cargo may have some of its own fairings or operations required, the HDL provider is intended to be responsible for any fairing or inhibiting hardware removal remotely as stated if it is owned by the HDL provider. Crew interaction is intended to be limited to only the Cargo and HLD, as absolutely necessary, to minimize human-rating requirements. The deployment method of the OC will be determined by the HDL and the OC provider and will likely be design specific. Once the HDL completes its operations to enable bringing the Cargo into service, if necessary, the OC operations will take over responsibility of the OC and the HDL will remain in a safe condition.

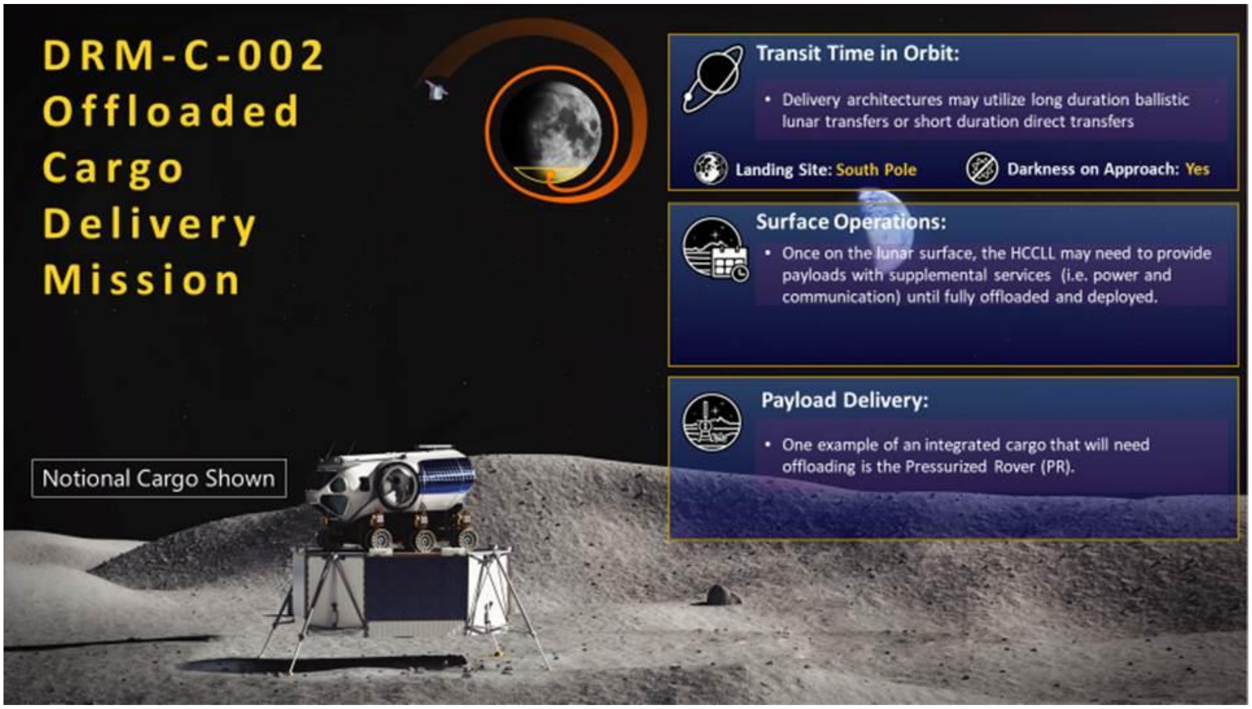

FIGURE 3.2 DRM-C-002 OFFLOADED CARGO DELIVERY MISSION

4.0 MISSION PHASES

This section describes and defines each HDL mission phase and will serve as the program reference for mission phase nomenclature. For simplification, this document will refer to DRM-C-001 and DRM-C-002 when they differ.

4.1 INTEGRATION ACTIVITIES

The HDL provider will be responsible for both the LV procurement and the Cargo integration activities required.

4.1.1 Cargo Integration

There are two main options for Cargo integration depending on the specific HDL design. One scenario has the Cargo integrated with the HDL prior to launch from Earth; the other scenario has Cargo and HDL launched separately and subsequently integrated in space. For both scenarios, the connective structures used to secure the Cargo to any HDL element are the responsibility of the HDL provider. Cargo interfaces for integration with the HDL will be predefined, will likely be Cargo DRM-specific, and will be captured in an appropriate interface requirements document between the Cargo and HDL provider.

4.1.1.1 Co-Manifested Launch: Cargo to HDL Integration

For the option of a co-manifested Cargo / HDL launch, the Cargo integration activities should be documented in the HDL provider's ConOps. Cargo will be delivered to the HDL provider's determined processing/integration facilities per a predefined schedule. The HDL provider, or the HDL provider's chosen vendor, will process, encapsulate (if required), and integrate the Cargo with the HDL.

4.1.1.2 Distributed Launch: In-Space Cargo to HDL Integration

For a multi-launch HDL and Cargo scenario, the in-space Cargo to HDL integration is the responsibility of the HDL provider and will be documented in the HDL provider's ConOps. The Cargo will not be capable of in-space free flight, i.e., no propulsion system or in-space navigation capability, and therefore, delivery of the Cargo to the in-space aggregation point with the HDL will be the responsibility of the HDL provider. Any supporting spacecraft, e.g., an in-space stage or a propulsive bus, will be designed and fielded by the HDL provider and will be considered an element of the overall HDL system.

4.1.2 HDL to LV Integration

The HDL to the LV integration will be performed by the HDL provider and LV provider and documented in corresponding HDL to LV interface requirements documents. The HDL provider will determine the responsible party for HDL to LV integration.

4.2 LAUNCH AND TRANSIT

4.2.1 HDL Launch to a Lunar Orbit or Earth Orbit

If the HDL provider chooses to perform operations in a Lunar or Earth orbit, they will be responsible for the safe delivery of the HDL and Cargo to that orbit. For instance, the HDL may be launched using a distributed launch concept or using a single integrated launch. An optional Lunar Staging Orbit, e.g., Near-Rectilinear Halo Orbit (NRHO), may be part of the HDL mission design. Loitering in a Low Lunar Orbit (LLO) may also be needed for landing site accuracy purposes but will be provider design specific. Definition of specific launch concepts will be documented in the HDL provider's ConOps. The flight profile of transit from Earth to an optional Lunar Staging Orbit (e.g., NRHO) and/or to an LLO will depend on the architecture provided by the HDL provider. The flight profile chosen will not take the HDL within the Keep-Out Sphere of other systems operating in space.

4.2.2 Transit to the Lunar Vicinity

There are multiple trajectory options for delivery to the lunar vicinity. Definition of specific transit concepts will be documented in the HDL provider's ConOps. As an example, ballistic lunar transfers, which may range up to 120 days or longer, reduce the delta-V required for insertion into an NRHO along with a small increase in the Earth departure delta-V. NRHO is not a required orbit but used here as an example of a Lunar Staging Orbit that could optionally be used. Fast transits can reach lunar orbit in a few days but require a higher delta-V insertion to the final orbit. Ultimately, the trajectory selected must balance the design considerations for the HDL and Cargo with the mission requirements and must support the overall Artemis Mission Schedule.

4.2.3 Communications during Launch and Transit

Communications during Launch and Transit are to be performed by the provider in accordance with HLS Program Integrated Lander to Mission Systems IRD – Sustained Phase, HLS-IRD-004-01, and in coordination with the Cargo needs. The HDL may use an Earth ground station, or any combination of Earth Stations and Space Networks (e.g., relay satellites), to provide for uplink and downlink communications during the transit phase. For the Direct-With-Earth (DWE) links, both uplink and downlink encryption are mandatory, but the choice of band and protocols are not prescribed, and the choice of Frequency Band (S-, X-, and/or Ka-Band) must be coordinated with the Federal Communications Commission (FCC), rather than the National Telecommunications Information Administration (NTIA), because commercial companies are requesting the spectrum. Additionally, all lunar spectrum requests will be filtered through the NASA Lunar Spectrum Manager (LSM) prior to Mission Design Review, to enable the necessary spectrum sharing and frequency selection analyses during the project planning phase.

During Transit, the HDL may use the DWE link to provide for command uplink, telemetry downlink, and radiometric tracking/ranging (needed by Guidance, Navigation & Control) from Earth en route to the Moon. The HDL provider should choose link data rates as appropriate to facilitate all anticipated types of data utilization, such as video, file transfer, command uploads, data dumps, etc.

4.2.4 Cargo Services Provided during Transit

During the Transit, the HDL is expected to provide certain services to the Cargo per HLS Program HDL System to Cargo IRD – Sustained Phase, HLS-IRD-010. Services may be Cargo and DRM specific. As an example, such services may include thermal conditioning, communications in the event the Cargo antennas are stowed, power such as keep alive power (e.g., to operate pumps and mechanisms for a PR fluid management), Cargo fairings for protection such as from Micrometeoroid and Orbital Debris (MMOD) during transit and aggregation (particularly in Low Earth Orbit (LEO)), and data recording for information where instantaneous communication is not critical (e.g., periodic data, Cargo health status). Some of these expected services may be required regardless of dormancy status of the Cargo. These services are anticipated to be largely similar for the IC and OC. These examples are intended to give the HDL provider a general idea of the types of Cargo transit needs to be accounted for in the HDL design. For a distributed launch, i.e., the HDL and Cargo are launched separately, the HDL provider must also account for similar services to potentially provide keep alive state and transit protection for the Cargo. The HDL-provided services, and associated induced environments for the Cargo, are expected to be negotiated with the Cargo (i.e., IC or OC) provider, documented in the HDL ConOps, and reflected in appropriate requirements documents.

4.3 DESCENT

The beginning of the mission's Descent Phase will be dependent on the provider's selected flight profile, but it ends with the HDL safely touching down on the lunar surface at a targeted landing site. An example of a descent phase could include a deorbit, descent transit, descent phasing orbit loiter, and final descent. The HDL providers are responsible for determining the descent profile specific to their HDL vehicle and will be documented in the HDL provider's ConOps.

4.3.1 Descent Transit

Transits from a lunar phasing orbit or the initiation of the final descent trajectory vary in both duration and energy required and will be provider specific. They must be designed to accommodate the safety and protection of the Cargo for nominal touchdown.

4.3.2 Descent Phasing Orbit Loiter

A loiter in LLO may be needed for descent and/or navigation state updates to reduce potential errors after the Descent Lunar Orbit Insertion (DLOI) burn. Providers may choose both the profile of and time spent in a phasing orbit based on the needs of their specific HDL architecture.

4.3.3 Final Descent

A Descent Orbit Insertion (DOI) burn will place the HDL in an orbit with a perilune sufficiently low to perform Powered Descent Initiation (PDI). The PDI and Braking phase will slow the HDL into a surface-intercepting trajectory and arrest the HDL to a sufficiently low altitude and velocity to begin the approach phase. The Approach Phase typically consists of a pitch maneuver to prepare for the final phases. The Terminal Descent and Touchdown Phase consists of the final vertical descent to the surface, achieving the desired velocity/attitude state for touchdown. The duration and profile of these phases will vary with descent trajectory design. The HDL will perform precision navigation to achieve a safe landing within a specified radius of the target site, per the HLS Program HDL Requirements Document, HLS-RQMT-007. Throughout the HDL Descent and Landing, crew will not be present on the Lunar surface.

4.3.4 Communication during Final Descent

During Final Descent, the HDL may choose to establish two DWE links: one low-rate, assured link that maintains contact with Earth regardless of HDL attitude, and one attitude-dependent link for high-rate data such as video during the varying attitudes of final descent. If the HDL needs radiometric ranging on either of its communications links during descent, it may choose to range on the DWE Link and/or on the S-Band Lunar Systems Link with the Lunar Gateway Orbiting Platform.

As an alternative to DWE, the HDL could opt to make use of a communications relay satellite (could be a Space Communications and Navigation (SCaN) asset, a commercial asset, or one put in place by the HDL Provider) to enable this link.

4.4 SURFACE OPERATIONS

Immediately following lunar surface touchdown, the HDL provider, in coordination with NASA Mission Control, will determine Authority to Proceed (ATP) with surface operations. Following ATP, the HDL will begin surface stay preparations; if needed, these may start by placing the HDL in an inactive but ready mode, prior to safing, to enable HDL provision of services to the Cargo until the Cargo is ready to be operated independently. Next will be the HDL vehicle safing which is the process that completes the transition of the HDL to a safe condition. The safe condition ensures that the HDL does not present any hazard to Cargo, nearby lunar assets, or any crew that may be performing Extra-Vehicular Activity (EVA) in the vicinity. Subsequent activities following HDL safing may include remote operations for the removal of any Cargo protection hardware that could inhibit Cargo deployment or crew access, possible offloading of Cargo, and any other Cargo-specific processes.

Any HDL safing and disposal activities will consider planetary protection concerns to protect future science and landing sites per HLS-RQMT-007.

4.4.1 Surface Communications

During the surface phase of the mission, the HDL may continue to communicate concurrently (but not necessarily continuously) with Earth and Cargo, as needed. There is an expectation for at least one NASA lunar communication relay asset to be available for use in DWE communication as established in *HLS Program Integrated Lander to Mission Systems IRD – Sustained Phase*, HLS-IRD-004-01. Direct communication between the HDL and suited crew is not intended.

If Gateway is present, the HDL could opt to use the Gateway Lunar System's S- and/or Ka-Band link(s) to Gateway. Or the HDL could opt to use a low-rate S-band Link with Orion, if present. However, the HDL-to-Gateway (or Orion) link may not necessarily have to be direct. Examples of such links could be HDL location determination (e.g., navigation and ranging) or Cargo health status. For this purpose, the HDL could opt to make use of a communications relay satellite (could be a SCaN asset, a commercial asset, or one put in place by the HDL Provider) to enable this link. Surface communication capabilities may also help to precisely determine the location of the HDL on the lunar surface.

Additionally, with the HDL operating near the lunar pole, the apparent local elevation of the Earth will lie between approximately 0˚- 8˚ above the local lunar horizon. Because of these very low angles, directional antennas aboard the HDL will need to be pointed nearly horizontally and could therefore be subject to blockages from local lunar terrain features, as well as degradation from multi-path interference. Note that because of the potential for multi-path degradation, DWE links should be designed with an allocation for multi-path fading loss.

4.4.2 Surface Offloading

Once the vehicle has been safed, Cargo may or may not need to be offloaded from the HDL to the lunar surface. The HDL is expected to be responsible for Cargo offloading that requires it. Cargo offloading methods are HDL provider-specific and should be documented in the HDL provider's ConOps. OC will need to utilize pertinent predefined Cargo interfaces that will likely be Cargo DRM specific and should be documented in HLS-IRD-010. For Cargo that is planned to be integrated with the HDL, and therefore not offloaded, the HDL will be responsible for enabling any Cargo initiation required and maintaining a safe HDL condition for the duration of the Cargo operations.

4.4.3 Services Provided to Cargo on the Lunar Surface

On the lunar surface, the HDL is expected to provide certain services to the Cargo per HLS-IRD-010. Services may be Cargo and DRM specific for a period until the Cargo is in an operational state where these services from the HDL are no longer needed. Operational state is achieved once the Cargo can keep itself alive and operate without the HDL provided services. A potential exception could be for IC that is intended to remain integrated with the HDL depending on the design agreement between HDL provider and Cargo team.

As an example, services may include thermal conditioning, communications while Cargo antennas remain stowed, power such as keep alive power until solar arrays are deployed or for initial lunar night survival before Cargo batteries are sufficiently charged, data recording for information where instantaneous communication is not critical (e.g., periodic data, Cargo health status). These services are anticipated to be largely similar for the IC and OC. One notable difference, however, could be the need for HDL provided back up services in the event of OC offloading anomalies, e.g., accounting for a delay in OC solar array deployment post-offloading from the HDL. These examples are intended to give the HDL provider a general idea of the types of Cargo needs on the lunar surface to be accounted for in the HDL design. The HDL provided services are expected to be negotiated with the Cargo (i.e., IC or OC) provider.

Additional considerations for the HDL provider include those regarding HDL safing activities. As previously stated, HDL safing ensures that the HDL does not present any hazard to Cargo, nearby lunar surface assets or any crew that may be performing EVA in the vicinity. Of specific consideration is the transition of the Cargo from HDL provided services to its own internal ones. One example is the transition to the Cargo's internal power. While Cargo power could technically be available in a relatively short period following landing on the Lunar surface, there may be operational constraints, such as HDL venting and lunar dust settling before safe deployment of the Cargo's solar arrays prompting a sustained period of need for HDL services. In general, the HDL provider should consider the specific drivers for the switchover to internal Cargo services before HDL safing can take place. The HDL provider should have an expectation that the Cargo will be consuming some minimum number of resources (e.g., power, thermal, data interfaces) before it is independently operational and therefore should incorporate these needs for services into its HDL design. HDL services provided and associated induced environments for the Cargo on the lunar surface will be Cargo and DRM specific, should be captured in the HDL provider's ConOps, and reflected in appropriate interface documents.

4.5 POST-LANDING HDL ACTIVITY

After handoff of Cargo operations, the HDL provider may opt to perform some form of post-landing activity, e.g., HDL disposal, HDL relocation. Post-landing HDL activities can only commence after an agreed upon decision with the Cargo operations team to ensure the Cargo and any pre-placed lunar surface assets are not adversely affected by the HDL post-landing operations. The details of such an activity are subject to negotiation and to be documented as part of the HDL provider's ConOps. The HDL may provide passive routing interfaces for IC such as a power and data interface to connect a potentially integrated SH to a Lunar Asset as a pass through.

If EVA crew will need to access Cargo and Cargo systems, such as with an IC SH, the HDL will provide crew access to the relevant Cargo locations for integrated operations per HLS-IRD-010. This will include translation paths and interfaces following EVA-EXP-0070 to ensure EVA compatibility. That document sets the requirements for many parameters, such as translation corridors and sharp edges, so that EVA access does not pose a hazard to crew. Due to the nature of crew proximity and interaction with the HDL on the lunar surface, HDL will meet a tailored set of Human Rating requirements, as represented in HLS-RQMT-007. The HDL will remain in a safe condition throughout the life of the Cargo and will not become a hazard to the Cargo or crew.

APPENDIX A
ACRONYMS AND ABBREVIATIONS
AND GLOSSARY OF TERMS

A1.0 ACRONYMS AND ABBREVIATIONS

TABLE A1-1 ACRONYMS AND ABBREVIATIONS

ABC	Artemis Base Camp
AES	Advanced Exploration System
ATP	Authority to Proceed
ConOps	Concept of Operations
CR	Change Request
DLOI	Descent Lunar Orbit Insertion
DOI	Descent Orbit Insertion
DRM	Design Reference Mission
DWE	Direct-With-Earth
EVA	Extra-Vehicular Activity
FCC	Federal Communications Commission
HDL	Human-class Delivery Lander
HEOMD	Human Explorations and Operations Mission Directorate
HLS	Human Landing System
IC	Integrated Cargo
IRD	Interface Requirements Document
LEO	Low Earth Orbit
LLO	Low Lunar Orbit
LSM	Lunar Spectrum Manager
LV	Launch Vehicle
MMOD	Micrometeoroid and Orbital Debris
NASA	National Aeronautics and Space Administration
NPR	NASA Procedural Requirement
NRHO	Near-Rectilinear Halo Orbit
NTIA	National Telecommunications Information Administration
OC	Offloaded Cargo
OPR	Office of Primary Responsibility
PDI	Powered Descent Initiation
PR	Pressurized Rover
RF	Radio Frequency
SCaN	Space Communications and Navigation
SH	Surface Habitat
SPD	Space Policy Directive

TABLE A1-1 ACRONYMS AND ABBREVIATIONS

SRD	System Requirements Document
STD	Standard

A2.0 GLOSSARY OF TERMS

TABLE A2-1 GLOSSARY OF TERMS

Term	Description
Autonomous (operation)	The capability of HDL to manage its mission operations with minimal reliance on Earth-based mission control.
Cargo	A human-class system for delivery that is critical to Artemis missions (e.g., a PR or SH). The “critical” qualifier means that loss of the Cargo could result in loss of future missions or mission capabilities.
Direct to Earth Link	An RF link with geometric line-of-sight capability with Earth. Can be uni- or bi-directional (should always be specified). Direct-with-Earth is sometimes used interchangeably.
Human-class	Classification of a large, high-investment cargo that supports both crewed deep space systems and the longer-term sustainable crewed exploration of the lunar surface.
Human-class Delivery Lander (HDL)	A single HDL Element or collection of HDL Elements that, when integrated: (1) provide transportation for Human-class Cargo from the Earth to the lunar surface; but (2) do not provide transportation to crew.
Human-class Delivery Lander (HDL) Element	A spacecraft capable of operating independently of other spacecraft and that is also either: (1) used to transport Human-class Cargo to the lunar surface during uncrewed missions; or (2) connected to other spacecraft at any time when those spacecraft are used to transport Human-class Cargo to the lunar surface during uncrewed missions.
Keep-Out Sphere	A sphere of a specified radius around an object’s center of mass that requires ATP prior to performing any maneuver to enter the Keep-Out Spere (whether automated, onboard crew, or ground command).
Mission	A sequence of activities or operations that are required to achieve one (or more) Agency goal(s). A mission can be broken down into "Mission Phases" (which group the sequence of activities or operations based on major mission milestones) for the purposes of communicating aspects of the operations, timeline, or performance. Each mission or mission phase can have its own set of elements and modules that are used to pursue the Agency goal(s). The duration of a mission or mission phase is defined by the activities or operations within it; additionally, the duration of a mission segment can be indirectly defined by the adjacent mission segments.
Mission phase*	A distinct period or stage in a series of events that comprise a DRM.

TABLE A2-1 GLOSSARY OF TERMS

Term	Description
Mission segment*	Each of the parts into which a DRM or one of its mission phases is or may be divided. The role title “Mission Segment Lead” has been formally adopted by the Program, as described within HLS-PLAN-016 *Technical Management Plan* §5.2.3 Mission Segment Leads and Discipline Leads.
Remote (operation)	The capability of HDL to be managed for its mission operations from Earth-based mission control.
Safe Condition	A nominal system condition that ensures the HDL does not present any hazard to Cargo, nearby lunar assets or any crew that may be performing EVA in the vicinity.
Safing	A process that transitions the HDL into a safe condition.

* *Disambiguation note: The terms mission phase and mission segment co-exist within the HLS Program*.

[a] Mission phase refers to what is operationally happening during a mission. The ConOps suite of data products has opted to use the term “mission phase”.

[b] Mission segments reflect divisions of the mission for other purposes by the Program itself (e.g., the role title “Mission Segment Lead” within HLS-PLAN-016 Technical Management Plan). Mission segments do not necessarily align with mission phases and may include one or more mission phases.