

LIGHTING OPERATIONS PLAN (LOP)

FOR

KENNEDY SPACE CENTER

KSC-PLN-1210

Revision A

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Approved by:

//Original Signed//

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Change Log

Date	Revision	Description
9/28/2018	Basic	Appendix C will be removed once the KNPR 8500.1, Revision E is released. Other references to Appendix C throughout this document require removal.
10/31/2018	A	Appendix B, Central Campus LOM, was removed from this Lighting Operations Plan to be a separate document. Appendix C, Exterior Lighting Requirements therefore changed to Appendix B. The language on Section 5.0 of the Lighting Operations Plan has been updated to reflect new document management procedures for Lighting Operations Manuals. Appendix B will be removed once the KNPR 8500.1, Revision E is released. Other references to Appendix B throughout this document require removal.

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1.0 INTRODUCTION

1.1 Purpose

In support of the National Aeronautics and Space Administration (NASA), Kennedy Space Center (KSC) is responsible for its real property assets and infrastructure in support of the Agency mission of human spaceflight and continued exploration of space. This Lighting Operations Plan (LOP) ensures appropriate lighting is available for nighttime operations at KSC, while also minimizing the impact on protected species. Five federally protected marine turtle species nest along KSC shorelines, a critical habitat for loggerhead sea turtles.

The purpose of this Lighting Operations Plan (LOP) is to describe measures implemented by KSC to ensure compliance with federal regulations that require KSC to address the operation of artificial exterior lighting. This document serves as the overarching lighting plan for KSC. All activities and facilities at the Spaceport are required to minimize artificial lighting. Development and implementation of the LOP is intended to support NASA KSC's compliance with [Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#), issued by the United States Fish and Wildlife Service (USFWS), in accordance with Section 7 of the Endangered Species Act of 1973, as amended. This LOP, and the appended Lighting Operations Manuals (LOMs), in accordance with the directives, are in effect year round, including the annual sea turtle nesting season occurring from March 1 to October 31.

1.2 Need

The proposed action is necessary to ensure the continued ability of NASA KSC to accomplish its mission to ensure access to space from a secure and geographically unique location at KSC. The selection of space flight windows have a variety of variables such as orbit and rotation of planets, and the date and time of launch are directly tied to location and destination of the launch vehicle. Since launch scheduling is mission critical, they may occur at night during nesting and hatching season, with the potential to affect the five species that nest along the KSC coastline.

KSC LOMs ensure proper operation of facility lighting by facility managers (FM) and project managers (PM). The LOMs describe light use operation methodologies directed toward reducing the adverse impact of artificial lighting on all wildlife at KSC and the Merritt Island National Wildlife Refuge (MINWR) while maintaining safe operations to meet mission success.

1.3 Applicable Documents

[KNPR 8500.1, KSC Environmental Requirements](#), Rev. E as planned and documented in Appendix B of this document titled "Exterior Lighting Requirements".

[Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#)

[KDP-P-1727, Environmental Checklist](#)

[Environmental Checklist \(KSC Form 21-608\)](#)

2.0 KSC OPERATIONS AND ENVIRONMENTAL COMPLIANCE

NASA KSC has space launch operations on approximately ten kilometers of beach along the KSC Atlantic coastline. The KSC Master Plan of development and associated center-wide Environmental Impact Statement describe a 20-year transformation from a single, government-user launch complex to a multi-user spaceport. This multi-user spaceport continues to be developed in concert with NASA's programmatic missions and requirements to explore destinations outside of low Earth orbit along with promoting commercial ventures and our country's ability to push the boundaries of our understanding of the universe. Environmentally sound mission success is key, including protection of endangered wildlife species, such as marine sea turtles.

[Appendix B](#) provides the Exterior Lighting Requirements (ELR) developed by KSC as a condition for issuance of the regulatory instrument, [Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#), which is established in Conservation Measure #1.

The [Environmental Checklist \(KDP-P-1727\)](#), required by KNPR 8500.1, is a process that ensures a thorough environmental review of all projects performed at the Spaceport.

1. A Project Proponent must submit an [Environmental Checklist \(KSC Form 21-608\)](#) for all projects including, but not limited to, new construction, leasing, and modifications of facilities.
2. Within seven days of submittal of the Environmental Checklist, the Project Proponent will receive a Record of Environmental Consideration (REC) from the KSC Environmental Management Branch (EMB).
3. If the EMB determines that the construction/leasing/modification project may have an adverse effect on sea turtles, the REC will note that a LOM is required.
4. The EMB will assist the Facility Manager (FM), Project Manager (PM), or equivalent with the development of a LOM. [Appendix A](#) provides the available LOM template. For multi-use complexes, the template will be adapted following template outlines for each individual facility.
5. Once the draft LOM is determined to meet all ELR guidelines, the EMB will submit the LOM to the USFWS for review.
6. The USFWS has 45 days to review the document and provide comments. If they request further information, the EMB will work with the FM/PM to provide this information and resubmit the LOM to USFWS for approval.
7. Once final approval is received, the FM/PM is responsible for ensuring all parties comply with the LOM procedures. The appendices of this document will catalog the final approved plan. EMB and USFWS will vet updates or changes to an individual LOM. The LOP will contain the final approved LOM revisions.

8. FM/PMs are required to review and update their LOMs annually. At the beginning of each calendar year, NASA EMB will send a reminder to the FM/PMs to complete this requirement.

3.0 LIGHTING AND OPERATIONAL GUIDELINES AND MITIGATIVE ACTIONS

As documented in the LOM template, this section is required for all LOMs. It describes lighting operations at a particular facility, including light use guidelines and operational constraints. Information includes a lighting plan and a lighting fixture schedule. The lighting plan will consist of site maps for each facility in which the location of all light fixtures will be identified and tied back to the lighting fixture schedule, which will provide more information on each fixture type. The intent is for the narrative, depiction, and schedule to cross-reference. If applicable, this section will also describe mitigative actions to reduce the effects of heritage lighting and high intensity discharge exterior white lighting. Each LOM submitted will have this section tailored to meet the facility needs.

4.0 COMPLIANCE VERIFICATION

The FM/PM will have responsibility for ensuring compliance with procedures described in each LOM by site personnel, to include NASA civil service, contractor support, and temporary staff/site visitors. The following standard monitoring and enforcement actions will be taken and the organization responsible for the misuse of lighting will be notified.

NASA EMB will provide, at a minimum, annual notices reminding FMs/PMs to ensure conformance with facility-specific LOMs and the KSC ELR.

NASA EMB or their designee may conduct periodic, unannounced nighttime inspections of KSC facilities to verify facility compliance with the facility-specific LOMs and KSC ELR throughout the year with special emphasis during the sea turtle nesting season (March 1–October 31).

Any change to Facility lighting requirements, including light types, light fixture location or orientation, and period of light operations identified in this LOM, must be coordinated with NASA EMB and comply with the KSC ELR prior to implementation. This would include use of lighting currently identified as inactive or left in the default “OFF” position.

5.0 CONCLUSION

This document serves as the overarching lighting plan for KSC. Once facility-specific LOMs receive final approval by EMB and USFWS, they will be uploaded to the NASA/KSC TechDoc System as separate Addendums to this Plan (e.g. KSC-PLN-1210_XYZ).

APPENDIX A

**LIGHTING OPERATIONS MANUAL
(LOM) TEMPLATE**

[INSERT BUILDING NAME HERE]

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1.0 INTRODUCTION

(Use the template paragraphs below and substitute facility specific nomenclature as required).

This Lighting Operations Manual (LOM) describes lighting systems to be operated at the [insert building name], Kennedy Space Center (KSC), Florida. Artificial lighting is known to adversely affect sea turtle nesting and hatchling emergences and interferes with other terrestrial and aquatic wildlife species' ability to survive. This LOM will describe light use operation methodologies directed toward reducing the adverse impact of artificial lighting on all wildlife at KSC and the Merritt Island National Wildlife Refuge (MINWR) with the added benefit of reducing energy consumption and facility operation costs.

1. Purpose

The purpose of this LOM is to provide site-specific guidelines for the operation of artificial lighting at the [insert building name here] to minimize impacts to threatened and endangered sea turtle nesting along KSC beaches as well as other wildlife species sensitive to artificial night lighting. Use of this manual will also help to ensure energy conservation and management by proper light operation at the facility. Development and implementation of this LOM is intended to support National Aeronautics and Space Administration (NASA), Kennedy Space Center (KSC) compliance with the [Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#), issued by the United States Fish and Wildlife Service (USFWS), in accordance with Section 7 of the Endangered Species Act of 1973, as amended. The directives described in this manual will be implemented year-round including the annual sea turtle nesting season occurring from March 1 to October 31.

All NASA personnel and contractors at the [insert building name here] are required to comply with this manual.

2. Applicable Documents

[KNPR 8500.1, KSC Environmental Requirements](#), Rev. E as planned and documented in Appendix B of this document titled "Exterior Lighting Requirements".

[Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#)

[KDP-P-1727, Environmental Checklist](#)

[Environmental Checklist \(KSC Form 21-608\)](#)

2.0 SITE DESCRIPTION

ALL FIELDS MUST BE FILLED OUT COMPLETELY.	
Facility Name	<i>Provide the complete Facility Name as identified in the KSC Facility Search Engine.</i>
Facility Number	<i>Provide the complete Facility Number as identified in the KSC Facility Search Engine.</i>
Facility Location	<i>Provide and attach Facility Map—see Facility Map Sample.</i>
Facility Description	<i>Describe the facility in 3-5 sentences in the space below.</i>
Typical working hours for this facility are from approximately _____ am to _____ pm depending on individual worker schedules. Launch and facility maintenance operations could periodically extend working hours. It is anticipated that a portion of the facility staff will either enter or leave the facility during hours of darkness.	

3.0 LIGHTING AND OPERATIONAL GUIDELINES AND MITIGATIVE ACTIONS

PLEASE ATTACH THE FOLLOWING ITEMS TO [SECTION 5.0](#) OF THIS LOM.

A. [Facility Exterior Lighting Fixture Table](#)

All facilities are required to maintain and update a schedule of the exterior lighting, including the following fixture requirements. Complete the [Lighting Fixture Table](#) and attach it to Section 5.0.

B. [Facility Exterior Lighting Plan Diagram](#)

All facilities are required to maintain and update a [Lighting Plan Diagram](#) of the exterior lighting, including quantity, locations and types, as part of this LOM. Complete the [Lighting Plan Diagram](#) and attach it to Section 5.0.

C. Fixture Manufacturer Data Sheet(s)

All facilities are required to include Manufacturer Data sheets for all exterior lighting fixture types, identified in the [Exterior Lighting Fixture Table](#). Attach Fixture Manufacturer Data sheets to Section 5.0. If unsure of location of these sheets, contact the PM or the lighting design/installation contractor for further guidance.

Facility Light Fixture Description

ALL FIELDS MUST BE FILLED OUT COMPLETELY.

PARKING AND ROADWAY LIGHTING

Describe lighting used for parking, roads or driveways. Provide detail of light operations (photocell/timer combinations, motion sensors/automatic dimming capability or other methods). Provide corresponding detail on [Lighting Plan Diagram](#) and the [Lighting Fixture Table](#).

EGRESS LIGHTING

Describe egress lighting at all access or entry points, and walkways. You must provide a detailed description for minimizing nighttime lighting impacts. Provide corresponding detail on [Lighting Plan Diagram](#) and the [Lighting Fixture Table](#).

FACILITY OPERATIONS TASK LIGHTING

Provide a brief description of nighttime operations requiring artificial light. Describe when and how often these operations will occur. Provide corresponding detail on [Lighting Plan Diagram](#) and the [Lighting Fixture Table](#).

SECURITY LIGHTING

Provide a description of lighting required for site security, including cameras. Provide corresponding detail on [Lighting Plan Diagram](#) and the [Lighting Fixture Table](#).

INTERIOR LIGHTING

NOTE: Interior Lighting is not required to be input on the Lighting Fixture Table. Describe the facilities interior lighting and mechanisms that ensure interior lighting is off when the facility is unoccupied. Also, discuss secondary measures, such as tinted glass and/or window blinds, to prevent light trespass.

OTHER LIGHTING

Describe any other lighting not covered in the above categories (flag lighting, signage, decorative insignias, architectural enhancement, landscaping, etc.) You must provide a detailed description for minimizing nighttime lighting impacts. Provide corresponding detail on [Lighting Plan Diagram](#) and the [Lighting Fixture Table](#).

MITIGATIVE ACTIONS

If applicable, please describe mitigative actions to reduce the effects of heritage lighting and high intensity discharge exterior white lighting.

4.0 COMPLIANCE VERIFICATION

The FM/PM of the *[insert building name here]* will have responsibility for ensuring compliance of these procedures by site personnel to include NASA civil service, contractor support, and temporary staff/site visitors. Compliance will be ensured based on the following:

1. EMB will provide, at a minimum, annual notices reminding FMs/PMs to ensure conformance with the KNPR 8500.1 and facility-specific light operation manuals.
2. EMB or their designee may conduct periodic unannounced nighttime inspections of KSC facilities to verify facility compliance with the [KSC ELR](#) and site-specific LOMs throughout the year with special emphasis during the sea turtle nesting season (March 1–October 31).
3. Any change to Facility lighting requirements, including light types, light fixture location or orientation, and period of light operations identified in this LOM, must be coordinated with NASA EMB and comply with the [KSC ELR](#) document prior to implementation.

5.0 LIGHTING OPERATIONS MANUAL (LOM) ATTACHMENTS

FACILITY MAP

Please attach or insert your Facility Map. Samples provided.



Figure 1--Sample Facility Map 1



Figure 2--Sample Facility Map 2

Insert or Attach Facility Map Below

EXTERIOR LIGHTING FIXTURE TABLE

Exterior Light Fixtures listed must coincide with [Exterior Lighting Plan Diagram](#) (See [Light Fixture Table Sample](#)).

[illegible]

*Fixture ID refers to the quantity of fixtures in a given location. Each fixture is identified by that number

Fixture ID	Quantity	Function	Fixture Type	Power	Housing Style	Location	Hours of Operation	Control Method
P1	43 (Ph 1)/ 30 (Ph 2)	Pole Light	Turtle Friendly Amber LED	137 W (Ph 1)/ 91 W (Ph 2)	Single Head Pole Fixture, Full Cutoff	Parking Lot	Dusk to dawn or dusk to pre- set time	Photocell or Photocell/Timer as noted above
W1	16	Walkway Light	Turtle Friendly Amber LED	35 W	Single Head Pole Fixture, Full Cutoff	Sidewalks	Dusk to pre-set time	Photocell/timer
W2	11	Wall Light	Turtle Friendly Amber LED	36 W	Full Cutoff Wallpack	Service Yard	Dusk to pre-set time	Photocell/timer
D1	22	Downlight	Turtle Friendly Amber LED	27 W	Recessed downlight mounted in canopy	Building exits	Dusk to dawn	Photocell
O1	45	Downlight	Turtle Friendly Amber LED	42 W	Recessed downlight mounted in canopy	Second story canopy around perimeter	Dusk to pre-set time	Photocell/timer
O2	2 (one for each)	Flagpole/ Logo Sign	White LED	12 W/ 60 W	Top of pole/ Behind logo sign letters	Main entry drive	Dusk to dawn	Photocell

Figure 3--Sample Light Fixture Table

EXTERIOR LIGHTING PLAN DIAGRAM

Please attach or insert your Exterior Lighting Plan Diagram. Sample provided.



Figure 4--Sample Lighting Plan Diagram

Insert or Attach Lighting Plan Diagram Below

APPENDIX B

EXTERIOR LIGHTING REQUIREMENTS

All NASA personnel and Contractors shall comply with the most recent version of these requirements.

1.0 PURPOSE

The purpose of this section is to provide clear guidance to project and/or facility managers (FM/PM) responsible for exterior lighting requirements and to demonstrate compliance with the federal regulations referenced below.

National Aeronautics and Space Administration (NASA) Kennedy Space Center (KSC) is required to protect marine turtle nesting habitat by the National Environment Policy Act (NEPA) and the U.S. Fish and Wildlife Service (USFWS) through the Endangered Species Act (ESA). The NEPA of 1969, as amended (42 U.S.C. 4321-4347), and according to the procedures of implementation of NEPA for NASA (Title 14, Code of Federal Regulations, Part 1216, subpart 1216.3), requires federal agencies to assess how programs and associated actions may affect the environment. As part of this assessment, KSC has coordinated with USFWS on the effects of exterior lighting on protected species. USFWS issued the [Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#), in accordance with Section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.)(USFWS Log No. 04EF1000-2016-F-0083), and based on their review of historical and anticipated future light management activities by KSC, and the associated effects on the following sea turtles:

- loggerhead (*Caretta caretta*)
- green (*Chelonia mydas*)
- leatherback (*Dermochelys coriacea*)
- hawksbill (*Eretmochelys imbricata*)
- Kemp's ridley (*Lepidochelys kempii*)

This Exterior Lighting Requirements (ELR) is a mandatory component of the [Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#).

Currently, hatchling or adult sea turtle disorientation rates shall not exceed three percent as described in the [Sea Turtle Biological Opinion \(BO\) \(USFWS Log No. 04EF1000-2016-F-0083\)](#). If that occurs, USFWS requires that NASA KSC reinitiate consultation and USFWS shall review the reasonable and prudent measures NASA KSC has taken to remedy the situation. Any changes that result from the consultation must be incorporated into this requirement to ensure regulatory compliance which will affect existing and future projects. FM/PM shall ensure compliance with the requirements below.

2.0 DESIGN REQUIREMENTS

2.1 Light Fixture Design

The project design shall include, but not be limited to, the following: details of each type of fixture to be used, lamp type, wattage, installation height, orientation, and operational procedures. If required, the [Lighting Operations Manual \(LOM\)](#) will identify locations of all exterior lighting fixtures and interior fixtures visible from the outside, facility lighting controls, proposed operation schedule, and procedures for ensuring proper light use.

2.2 Light Fixture Operations

KSC prohibits the use of facility exterior lighting between 9:00 p.m. and dawn except where essential to support facility and personnel safety/security activities.

These activities include: space launch-related activities at launch complexes and/or processing facilities with essential operations occurring during hours of darkness with specific lighting requirements. Operation of existing lighting at facilities currently not covered by a [LOM](#) and not meeting the current design criteria below must apply for a waiver.

2.3 Light Fixture Criteria

Lighting using lamps with long wavelengths (560 nanometers [nm] or greater) and lowest wattage possible shall be used for all exterior lighting applications.

Low-pressure sodium and red, amber, or orange light emitting diode (LED) lamps meet this criteria.

Lighting with wavelengths less than 560nm, including but not limited to phosphor-converted amber LED, metal halide, and mercury vapor lamps are not authorized for use in exterior lighting applications.

In cases where there are specific requirements calling for the discernment of colors, the justification will be addressed in the LOM or, for smaller projects, FM/PM may apply for a waiver.

2.4 Energy Conservation

KSC energy conservation standards will be incorporated into all lighting designs.

2.5 Lighting Installation Guidelines

All exterior light fixtures will be designed/installed so that:

- 2.5.1 The point source of light shall not be visible from the beach.
- 2.5.2 Light fixtures will be mounted as low as possible, directed at the target of illumination, and will not be visible from the beach. Maximum mounting height of light fixtures is 20 feet above grade at facilities/infrastructure visible from the beach. Maximum mounting height of luminaires is 25 feet above grade at all other facilities/infrastructure locations.
- 2.5.3 All light fixtures will be full cut-off fixtures, shielded and/or recessed or equivalent.
- 2.5.4 Photocells will only be used to support security or other mission-specific requirements that occur on a regular schedule each night. Parking lots will not use photocells unless used in conjunction with programmable timers and/or manual switching. Timers and remote switching can also be used for lighting operation at locations where personnel are not readily available to manually extinguish lights. Where unplanned security monitoring is required, motion detector switches programmed to turn lights on for the minimum duration practicable will be used.

2.6 Portable Light Fixtures

Portable task lighting rather than permanent light fixtures will be used for temporary operational activities. Task lighting must conform to the same restrictions as permanent lighting and must have the capability to be turned off immediately following work completion.

2.7 Exceptions

Exceptions to these design guidelines will be evaluated by the KSC Environmental Management Branch (EMB) on a case-by-case basis through the variance process. If approved, a waiver will be issued.

3.0 LIGHTING IMPLEMENTATION

3.1 Evaluation

All projects that include installing, upgrading, or retrofitting exterior lighting or lighting that is visible from outside the building shall be evaluated through submittal of an [Environmental Checklist, KSC Form 21-608](#) and review by the EMB. The checklist will be submitted by FM/PM.

3.2 Response

Within seven days of submittal of the checklist, the FM/PM will receive either a request for further information or a REC from EMB.

3.3 LOM Requirement

At a minimum, new facilities, major modifications, and existing and proposed launch complexes will require a [LOM](#). Other activities that may require a LOM will be identified through the Environmental Checklist process.

- 3.3.1 FM/PM will be responsible for the development of a [LOM](#) that meets the criteria described in the LOM template provided by KSC EMB. The EMB will have a subject matter expert available to assist the FM/PM with the plan.
- 3.3.2 FM/PM will submit the proposed LOM to EMB for review and comment.
- 3.3.3 The final approved LOM will be uploaded to the NASA/KSC TechDoc System as a separate Addendum to the KSC Lighting Operations Plan (KSC-PLN-1210). The FM/PM will retain a copy for future reference.

3.4 Requirements Met

If EMB determines that the LOM is in compliance, no further action will be required.

3.5 Requirements Not Met

If EMB determines that the LOM does not meet the requirements, then a waiver/variance will be required. The process is as follows.

- 3.5.1 In these cases, the discrepancy shall be identified in the waiver request which includes a justification, with a focus on the specific lighting requirements needed to conduct the project.
- 3.5.2 Notification of approval and acceptance of the variance will be sent to FM/PM by the EMB.
- 3.5.3 The final approved waiver shall be cataloged by the EMB and a copy retained by FM/PM for future reference.

- 3.5.4 Any modifications to the project site/structure(s) that result in exterior lighting changes must go through the process again, as outlined above.

4.0 COMPLIANCE COORDINATION

4.1 Sea Turtle Lighting Workshop

Once every two years, personnel from facility in question, including, but not limited to, engineers, facility managers, and any other representatives that design and/or enforce lighting at KSC, will attend a USFWS-approved sea turtle lighting workshop.

4.2 Posting Notices and Information

These same personnel will allow EMB and/or agents of EMB to post educational data and notices related to sea turtle nesting season at their facilities.

4.3 Inspections

FM/PM will allow the EMB to conduct periodic compliance inspections of facility light operation and report all findings to USFWS on an annual basis.

4.4 LOM Template Submittal

[LOM template](#) is available through KSC EMB. The LOM is a KSC plan with a specific format that must be followed. A draft LOM shall be submitted to EMB for review and approval. Once approved, EMB will forward to USFWS for final review and approval. EMB staff are available to support preparation of this document.