Temporary Light Management Plan for Launch Complex 39

Kennedy Space Center, Florida

Prepared For:

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1.0 INTRODUCTION

1.1 PLAN PURPOSE

The purpose of this plan is to provide site specific guidelines to operate exterior lighting at Launch Complex 39 (LC-39). The purpose of exterior light management is to minimize adverse impacts to threatened and endangered sea turtles nesting/hatching on Kennedy Space Center (KSC) beaches. The adverse effects of exterior light use on sea turtle nesting activity is well documented on nesting beaches near developed areas. Exterior lighting interferes with sea turtle hatchling migration from the nest to the ocean resulting in disorientation of hatchlings toward the light source. Development of this plan is necessary to minimize the incidental take of sea turtle hatchlings and disturbance of adult nesting turtles as mandated under Section 7 of the Endangered Species Act (ESA) of 1973, as amended.

The light management directives and procedures described in this plan are temporary only and will be followed during the 2001 sea turtle nesting season (1 May through 31 October). A more permanent solution which entails lighting system modifications at the Space Shuttle launch pads, light shielding and operational controls is being planned for implementation to be effective at the start of the 2002 nesting season. These details will be described in a separate document to be provided at a later date. Although sea turtle nests typically do not begin hatching until mid June, exterior lighting visible from the beach can also deter female turtles from nesting. Therefore, the effective period of this LMP was extended to May 1, to include early nest site selection and nesting activity.

Implementation of this Light Management Plan (LMP) will assist NASA in fulfilling its obligations under the ESA as stipulated in the “Reasonable and Prudent Measures” and “Terms and Conditions” of the Biological Opinion (BO), issued April 1991 by the U.S. Fish and Wildlife Service (FWS) for exterior light use on KSC.

1.2 PLAN OBJECTIVE

The objective of this plan is to eliminate unnecessary exterior light use at LC-39 and their associated facilities. This action is being taken to reduce adverse impacts on nesting and hatchling sea turtles on KSC beaches. Implementation of this plan will assist NASA in complying with FWS requirements to protect threatened and endangered marine turtle species while maintaining a safe working environment for site personnel.

Research shows that different types of lighting affect sea turtle orientation to varying degrees, with low-pressure sodium (LPS) lighting having the least impact. LPS light is a nearly monochromatic (589-590 nanometers) yellow light. All other light sources are multi-spectral, containing some amount of blue-green wavelength light, which is the most disruptive to marine turtle sea-finding behavior. Of all high intensity discharge (HID) exterior lighting, white light contains the greatest percentage of blue and green wavelengths. Examples of these light fixture types include quartz-halogen, metal halide and mercury vapor. Lighting with a more yellow appearance, such as high pressure sodium (HPS) contains a smaller percentage of light at the blue and green end of the visible light spectrum. However, HPS lights can still disorient sea turtles, particularly at high intensities.

The most effective method of reducing direct and indirect lighting visible to sea turtles on KSC beaches is to eliminate the light source. However, the total elimination of exterior lights is not possible due to safety, security and/or operational requirements. When color rendition and/or explosion-proof fixtures are required, the efficient use of HPS lighting is an acceptable alternative. LPS lighting is the best alternative when elimination of the source is not a viable option.

Due to the lack of time needed to implement a permanent LMP for LC-39, this temporary LMP will be used only for the 2001 sea turtle nesting season. A separate and permanent LMP, including design modifications to the current

electrical system, will be completed and implemented for sea turtle nesting seasons beginning in 2002 and beyond. This temporary LMP will address mitigative actions that can be performed during the 2001 sea turtle nesting season that do not require design changes to the current lighting system. These actions will be limited to turning off lights that are not critical to safe, nighttime operations. All lighting will be restored when an orbiter is present at the launch pads and also during periods of critical or hazardous nightly operations.

2.0 DESCRIPTION

Kennedy Space Center's Launch Complex 39 (LC-39) has two identical launch pads, which, like many Space Shuttle facilities, were originally designed and built for the Apollo lunar landing program. The pads, built in the 1960s, were used for all of the Apollo/Saturn V missions and the Skylab space station program.

Each of the dual launch pads, designated Pads A and B, covers an area of about one-quarter of a square mile. Located not far from the Atlantic Ocean, Pad A is 48 ft. above sea level, while Pad B is 55 ft. above sea level. They are octagonal in shape. To accommodate the Space Shuttle vehicle, major modifications to the pads were implemented after the Apollo program. Initially, Pad A modifications were completed in mid-1978, while Pad B was finished in 1985.

Major pad modifications included construction of new hypergolic fuel and oxidizer support areas at the southwest and southeast corners of the pads; construction of new Fixed Service Structures (FSS); addition of a Rotating Service Structures (RSS); addition of 300,000-gallon water towers and associated plumbing; and, finally, replacement of the original flame deflectors with Shuttle-compatible deflectors.

The following sub-sections will describe all buildings, structures, and facilities associated with LC-39 that are fitted with exterior lighting. A site map of Pad A and Pad B are included in this document and are labeled **Figure A** and **Figure B**, respectively.

2.1 PERIMETER FENCE

For the purposes of security, safety, and resource protection, a chain link security fence with pole-mounted perimeter lighting is necessary at both Pad A and Pad B of LC-39. Security fences of this type (single) are used in conjunction with Closed Circuit Television (CCTV) and flood lighting to facilitate remote monitoring. Consequently, approximately 100 perimeter security lights exist at each launch pad area. Typically, the poles/lights are approximately 80 feet apart. The pole mounted perimeter lighting is located immediately inside the security fence. Each pole has been fitted with a single 55 watt LPS light fixture approximately 30 feet above grade. An inventory of all perimeter lighting with reference to a specific light fixture identification (ID) Number (No.) is provided in **Table 1** and **Table 2**. This area is labeled as 'Perimeter Fence' on **Figure A** and **Figure B**.

2.2 GATE HOUSE, OPERATIONS BUILDING, AND PARKING LOT

The Gate House, Operations Building No. 1, and the adjacent parking lot are located at the south entrance area of Pad A and Pad B of LC-39. The Gate House is used by security personnel to control access to the pad area. The Operations Building is used for office space in support of pad operations.

The exterior lighting in this area consists of approximately 10 pole mounted HPS perimeter lights in the parking lot and two (2) 500 watt wall mounted HPS lights illuminating the Gate House area. This area is labeled as 'Gate House, Operations Building No. 1, and Parking Lot Area' on **Figure A** and **Figure B**.

2.3 LOX AND LH2 TANK AREAS

The LC-39 Launch Complex contains large liquid oxygen (LOX) and Liquid Hydrogen (LH2) storage tanks. These are large ball-shaped vacuum-jacketed dewar bottles used to store supercold cryogenic propellants for the shuttle external tank. The LOX tanks, located at the northwest corner of each respective pad store 3,406,500 liters (900,000 gallons) of liquid oxygen. The LH2 tanks are located at the northeast corner of each respective pad and store 3,218,250 liters (850,000 gallons) of liquid hydrogen.

The LOX tank area has 16 wall mounted HPS lights that are used for general area lighting. Most of these lights are 100 watt lamps with the exception of one 300 watt lamp and one 150 watt lamp. There are eight (8) pole mounted HPS lights that are used for both the parking area and for zone safety. These lights range from 400 watts to 1000 watts and there are at least three (3) lamps per pole.

The LH2 tank area has five (5) HPS pole mounted lights that are similar in configuration and wattage to the LOX area pole mounted lights. There is one (1) 100 watt HPS entrance light that is wall mounted. The complete listing of LOX and LH2 area lights is given in **Table 1** and **Table 2**. These areas are labeled as 'LOX Tank Area' and 'LH2 Tank Area' on **Figure A** and **Figure B**.

2.4 HYPERGOL AND OXIDIZER FUEL FACILITIES

The Hypergol Oxidizer Facility is located approximately 1000 ft southeast of the actual launch point on each pad. The main function of this facility is to provide the oxidizer (Nitrogen Tetroxide) for the orbiter's Orbiter Maneuvering System (OMS) pods and Reaction Control System (RCS) via the Hypergolic Umbilical System. The facility consists of several oxidizer tanks covered by a metal roof structure. This facility does not have walls. The Hypergol Fuel Facility is almost identical to the Hypergol Oxidizer Facility in structure. The hypergolic fuel stored in this facility for use in orbiter systems is Monomethyl Hydrazine. This facility was constructed on the southwest side of the pad to provide maximum distance from its oxidizer to reduce explosion potential from inadvertent mixing of the fuel and oxidizer commodities.

Both areas have a similar lighting configuration consisting of approximately eight (8) HPS lights located underneath the metal roof structure. These lights can be turned on and off by a standard switch. Both facilities also have approximately two (2) emergency fluorescent lights that remain on at all times for safety reasons. These areas are labeled as 'Hypergol Oxidizer Facility' and 'Hypergol Fuel Facility' on **Figure A** and **Figure B**.

2.5 HIGH PRESSURE GAS STORAGE

This area of LC-39 is located on the northeast side of the pad at its base. The facility consists of several concrete corridors that house tall high pressure gas storage canisters.

This area has 24 wall mounted incandescent lights. The lights are single 500 watt lamps that are mounted 30 feet above the ground. This area is labeled as 'Compressed Air Building' on **Figure A** and **Figure B**.

2.6 HIGH PRESSURE HYDROGEN STORAGE

This area, located northeast of the pad near Perimeter Road, consists only of several high pressure hydrogen storage tanks that have no shelter. There are three (3) pole mounted HPS lights that illuminate the area. Each pole has two (2) 400 watt lamps that are 40 feet above the ground. This area is labeled as 'High Pressure Hydrogen Gas Area' on **Figure A** and **Figure B**.

2.7 LAUNCH POINT LOCATIONS

The point on the Launch Pads where the Space Shuttle is positioned and launched consist of two major structures, the FSS and the RSS. The FSS is located on the west side of each pad. It is a square, steel tower which provides access to the orbiter and the RSS. It is an open framework structure about 40 feet square and it is fixed permanently to the launch pad. The FSS tower supports the hinge about which the rotary bridge supporting the RSS pivots as it moves between the orbiter checkout position and the retracted position. A hammerhead crane on the FSS provides hoisting capabilities as needed for pad operations. The FSS is 247 ft. high, and the crane is 265 ft. above the surface of the launch pad. Work platforms on the FSS are located at 20-ft. intervals starting at 27 ft. above the pad surface. The FSS has three service arms. These are the orbiter access arm, the external tank hydrogen vent line and access arm and the external tank gaseous oxygen vent arm.

A complete listing of pad lighting is listed in **Table 1** and **Table 2**. The pad has 392 lights with a total wattage of 92,370. The majority of pad lights are HPS with the remainder being either incandescent or fluorescent. This area is labeled as 'Launch Point Location' on **Figure A** and **Figure B**.

2.8 SOUND SUPPRESSION AREA

The sound suppression area is located directly north of the pad. Its function is to provide a deluge of water during a launch to prevent intense acoustical energy from damaging the orbiter. The system consists of a 290-ft. water tower and a system of large pipes to transport the water from the tank to the pad.

The lighting for this area consists of approximately 12 pole mounted flood lights. This area is labeled as 'Sound Suppression Area' on **Figure A** and **Figure B**.

2.9 SLIDEWIRE TERMINATION FACILITY AREA

The Slidewire Termination Facility serves as an emergency shelter in the event that the slidewire baskets are used. The slidewires run from the FSS of the pad to the Slidewire Termination Facility located west of the pad near Perimeter Road. The area consists of the slidewire system components and the emergency bunker.

The exterior lighting system consists of approximately four (4) pole mounted flood lights, three (3) pole mounted fluorescent lights that illuminate the basket landing area, a single wall mounted 120 watt HPS entrance light on top of the facility, and a single HPS lamp on a concrete pole directly west of the facility. This area is labeled as 'Slidewire Termination Area' on **Figure A** and **Figure B**.

2.10 BOXCAR AREA

This area directly west of the pad consists of several boxcars that serve as office space for operational support. There are several wall mounted HPS lights that illuminate the area. This area is labeled as 'Boxcar Area' on **Figure A** and **Figure**

Figure B.

2.11 PAD TERMINAL CONTROL ROOM (PTCR)

Underneath the launch pad on the west side is the PTCR. This area contains vital components for HVAC and electrical systems at the pad. The interior lights of the PTCR cannot be seen from the outside. The exterior lighting consists of HPS lamps mounted on the wall over the entrance to the PTCR and a high-wattage HPS on the windsock pole directly west of the PTCR. This area is labeled as 'Pad Terminal Control Room' on **Figure A** and **Figure B**.

3.0 MITIGATIVE ACTIONS

As stated in the plan objective, the most effective method of reducing sea turtle disorientation is to eliminate the source. When elimination of a light source is not a viable option, research has shown that there are lighting modifications that can effectively minimize disorientation. Due to the upcoming sea turtle nesting season and the lack of time needed to implement any permanent light design changes, no modifications to current lighting systems are being proposed. What is being proposed is eliminating current light sources by switching circuit breakers within existing electrical panels that control numerous lights and turning off any lights that have individual switches that are not critical to operational safety.

An inventory of LC-39 lights has been performed and an assessment has been made as to which lights can be turned off during non-critical operational periods. An examination of the circuitry of LC-39 lights has also been performed to determine which circuit breakers within individual panels can be turned off to achieve the desired result. The following is a description, by area, of what actions are proposed to be taken for the 2001 sea turtle nesting season.

3.1 PAD A

While Pad A and Pad B have very similar components, their electrical systems are not identical. The current presence of an orbiter on Pad A prohibits an in

depth examination of the circuitry and also prevents night-time proofing tests of proposed options to determine effective mitigative actions. An assessment, similar to one performed for Pad B, will begin after the orbiter is launched. The results will be presented in an amended version of this document. The Space Shuttle currently located on LC-39A is scheduled for launch on April 19, 2001.

3.2 PAD B

The specific information that follows only applies at times when a Space Shuttle is not located on the launch pad. The Space Shuttle is formally designated as a "national resource" by the federal government via congressional delegation. As such, NASA is required to implement various procedures to protect the national asset. When a Space Shuttle is on the launch pad, full lighting may be needed to provide adequate security and safety for the launch vehicle.

3.2.1 PERIMETER FENCE

Due to security and safety regulations, no mitigative actions can be recommended for the perimeter fence lighting. The launch pad lights must remain on during the dusk to dawn period to assist KSC security personnel in performing routine security checks of the pad as an adequate protection. As indicated above, these units are LPS type fixtures which have the least impact on sea turtle hatchling disorientation.

3.2.2 SECURITY BUILDING, OPERATIONS BUILDING NO.1, AND PARKING LOT

Similarly, due to security and safety regulations, no mitigative actions can be recommended for this area. The lights at the Gate House are needed for security purposes and the parking lot lights are needed for safety and security reasons since employees need to park there at all times. Operations Building No. 1 does not have exterior lighting since the Gate House and parking lot lights illuminate its perimeter. These lights must remain on during the dusk to dawn period.

3.2.3 LOX AND LH2 TANK AREAS

All exterior lights in these areas can be turned off during non-critical periods. Operations at these areas are infrequent and occur only during specific fuel loading procedures prior to launch operations and for system maintenance. In order for these lights to be turned off, appropriate personnel are required to open the circuit breaker panel and throw the breaker that controls these lights. For the 2001 nesting season it is proposed that the lights in these areas be in the "off" mode until such time as they are needed. Additional instructions to this effect need to be added to all Operational Maintenance Instructions (OMIs) applicable to Facilities J7-182 (LOX Facility) and J7-192 (LH2 Facility). The OMI should require appropriate personnel to energize required exterior lights one day prior to any scheduled nighttime operation. OMI revisions should also instruct the appropriate personnel to de-energize the exterior lights after the operation is complete.

- For the LOX Facility, the exterior lights can be turned on or off from Panel PB, Circuit Switch 15 and 16 located in J7-231 (Electrical Equipment Building No. 2 LOX).

- For the LH2 Facility, the exterior lights can be turned on or off from Panel PA, Circuit Switch 46 located in J7-241 (Electrical Equipment Building No. 1 LH2).

3.2.4 HYPERGOL AND OXIDIZER FUEL FACILITIES

All non-emergency lights used to illuminate these facilities can be turned off during non-critical periods. The non-emergency lights consist of approximately eight (8) HPS lights located underneath the metal roof structure. There are emergency lights, approximately two (2) emergency fluorescent bulb lights, that are on at all times that cannot be turned off due to safety regulations. Explosion proof light switches operate the non-emergency lights that can be used to de-energize these non-critical lights. It is recommended that steps be added to all OMIs applicable to this facility to turn the lights on before an operation and turn the lights off after the operation is complete. It is also recommended that sea turtle awareness placards be affixed near the light switches to advise of the lighting policy.

3.2.5 HIGH PRESSURE GAS STORAGE

All exterior lights in this area can be turned off during non-critical periods. In order for these lights to be turned off, appropriate personnel are required to open the circuit breaker panel and de-energize the specific circuits that power the lights. Additional instructions to this effect need to be added to all OMIs applicable to Facility J7-338 (Compressed Air Building). For the 2001 nesting season it is proposed that the lights in these areas be in the "off" mode until such time as they are needed. The OMI should require appropriate personnel to energize required exterior lights one day prior to any scheduled nighttime operation. OMI revisions should also instruct the appropriate personnel to de-energize the exterior lights after the operation is complete.

- For J7-338, the exterior lights can be turned on or off from Panel FL 2 by using the switch that disables the automatic photocell sensor (flood light contactor).

3.2.6 HIGH PRESSURE HYDROGEN STORAGE

All exterior lights in this area can be turned off during non-critical periods. In order for these lights to be turned off, appropriate personnel are required to open the circuit breaker panel and de-energize the specific circuits that power the lights. Additional instructions to this effect need to be added to all OMIs applicable to Facility J7-140 (High Pressure GH2 Facility). For the 2001 nesting season it is proposed that the lights in these areas be in the "off" mode until such time as they are needed. The OMI should require appropriate personnel to energize required exterior lights one day prior to any scheduled nighttime operation. OMI revisions should also instruct the appropriate personnel to de-energize the exterior lights after the operation is complete.

- For J7-140, the exterior lights can be turned on or off from Panel PA, Circuit Switch 27 using the switch to disable the automatic photocell sensor (pole light contactor).

3.2.7 LAUNCH POINT LOCATION

It has been determined that all lights not related to the emergency egress lighting system on the FSS and RSS can be turned off during non-critical periods. The lights that must remain on at all times for safety purposes include the emergency egress lights and the slidewire basket lights when the baskets are not tagged out. In order for the non-emergency lights to be turned off, appropriate personnel are required to open the circuit breaker panel and de-energize the specific circuits that power the lights. Additional instructions to this effect need to be added to all OMIs applicable to Facility J7-337 (Launch Pad 39B). For the 2001 nesting season it is proposed that the lights in these areas be in the "off" mode until such time as they are needed. The OMI should require appropriate personnel to energize required exterior lights one day prior to any scheduled nighttime operation. OMI revisions should also instruct the appropriate personnel to de-energize the exterior lights after the operation is complete.

- For J7-337 (FSS), the exterior lights can be turned on or off from Panel D1, Circuit Switch 15 located in the PTCR Room 103.

- For J7-337 (RSS), the exterior lights can be turned on or off from Panel L33A, Circuit Switch 5.

- For J7-337 (Slide baskets), the exterior lights can be turned on or off from Panel L14B, Circuit Switch 4.

3.2.8 SOUND SUPPRESSION AREA

All exterior lights in this area can be turned off during non-critical periods. In order for these lights to be turned off, appropriate personnel are required to open the circuit breaker panel and de-energize the specific circuits that power the lights. Additional instructions to this effect need to be added to all OMIs applicable to Facility J7-288 (Water Tank). For the 2001 nesting season it is proposed that the lights in these areas be in the "off" mode until such time as they are needed. The OMI should require appropriate personnel to energize required exterior lights one day prior to any scheduled nighttime operation. OMI revisions should also

revisions should also instruct the appropriate personnel to de-energize the exterior lights after the operation is complete.

- For J7-288, the exterior lights can be turned on or off from Panel L60, Circuit Switch 7 by using the switch that disables the automatic photocell sensor (photocell contactor). The panel is located at the base of the water tank.

3.2.9 SLIDEWIRE TERMINATION FACILITY AREA

All exterior lights in this area can be turned off during non-critical periods. However, anytime the slidewire baskets are not locked out these lights need to remain on in case of an emergency. In order for these lights to be turned off, appropriate personnel are required to open the circuit breaker panel and de-energize the specific circuits that power the lights. Additional instructions to this effect need to be added to all OMIs applicable to Facility J7-331 (Slidewire Termination Facility). For the 2001 nesting season it is proposed that the lights in these areas be in the "off" mode until such time as they are needed. The OMI should require appropriate personnel to energize required exterior lights one day prior to any scheduled nighttime operation. OMI revisions should also instruct the appropriate personnel to de-energize the exterior lights after the operation is complete.

- For J7-331 (flood lights), the lights can be turned on or off from Panel PB, Circuit Switch 22.

- For J7-331 (path lights), the lights can be turned on or off from Panel LB, Circuit Switch 2.

- For J7-331 (light mounted on concrete pole directly west of facility), this light can be turned on or off from Panel LB, Circuit Switch 9.

- There is a switch at the entrance of J7-331 that controls the contactor for the light on top of the facility.

3.2.10 BOXCAR AREA

Due to security and safety regulations, no mitigative actions can be recommended for the boxcar area exterior lighting. This area is manned 24 hours a day so the use of perimeter lighting is necessary during the dusk to dawn period for safety purposes.

3.2.11 PAD TERMINAL CONTROL ROOM (PTCR)

Due to security and safety regulations, no mitigative actions can be recommended for the PTCR exterior lighting. This area is in close proximity to the boxcar area and the exterior lighting from the PTCR area is necessary to illuminate both a segment of the boxcar area and the windsock for the launch pad.