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John C. Stennis Space Center
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John C. Stennis Space Center Lightning Warning System

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Responsible Office: NASA QA00/Safety & Mission Assurance Directorate		
SUBJECT: Lightning Warning System		

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Rev C	July 2013	Amy Rice 8-2972	Updated Section 5.3 to include new information from the KSC studies. Added in section for barge operations

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1.0 PURPOSE

The purpose of this work instruction is to establish a notification process for John C. Stennis Space Center (SSC) personnel regarding actual and potential hazardous lightning conditions.

2.0 APPLICABILITY

This work instruction applies to all SSC personnel, including NASA and its contractors, as well as SSC resident agencies and their contractors at SSC, as directed in their applicable agreement documents.

3.0 REFERENCES

All references are assumed to be the latest version unless otherwise specified.

NPR 1400.1, *NASA Directives System Procedural Requirements*
 SPR 8715.1, *John C. Stennis Space Center Safety and Health Procedures and Requirements*
 SSC SSTD-8070-0081-ELEC, *Stennis Space Center Facility Electrical Standard*
 SMI-8830-0055-ES, *John C. Stennis Space Center Maintenance Instruction Ground System Measurements*
 SSP-8715-0001, *John C. Stennis Space Center Safety and Health Handbook*

4.0 RESPONSIBILITIES

Responsibilities are as follows:

Safety and Mission Assurance Directorate (SMA) is responsible for the creation, implementation and verification of policy and procedures to ensure the highest level of warning of potential or actual lightning activity is available to all personnel at SSC.

NASA Center Operations Directorate is responsible for the procurement, maintenance and repair of equipment used to detect potential and actual lightning activity for SSC. Center Operations will also ensure the video feed for the lightning detection system is continuously distributed through the SSC cable television system and the SSC Intranet Portal Web Site.

NASA Security is responsible for the activation of warning systems to alert personnel of potential and/or actual lightning activity that may threaten SSC operations per the guidance in this work instruction.

Each employer shall be responsible for assuring an adequate means for communicating lightning advisories and warnings to all potentially affected personnel. This includes the organization's employees as well as their contractor personnel.

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5.0 PROCEDURES

The SSC Lightning Detection System shall be available twenty-four (24) hours a day, seven (7) days a week at the SSC Security Dispatch Office. When potential or actual lightning activity has been detected within a ten (10) mile radius of SSC, SSC Security will issue an action per the following guidance and chart:

"Lightning Advisory" This notification advises that conditions in the atmosphere are developing or an observable weather system is approaching (within ten (10) miles of SSC) that is expected to produce, or is producing, lightning which may arrive at specified areas within 30 minutes. Advisories are intended to provide personnel conducting hazardous operations sufficient lead-time to secure the operation before the forecasted weather system arrives.

"Lightning Warning" This notification implements the Lightning Warning Policy and is detailed in this section. All lightning notifications issued from the SSC Security will be announced as specified above, by the duty officer, at least every fifteen minutes until the lightning warning policy is terminated. The following criteria are used by the SSC Security to establish the existence of a lightning threat and are provided as a reference:

- a. A Lightning Warning Condition exists when any one of the following is observed:
 1. The SSC Lightning Detection System observes cloud-to-ground discharges within five (5) miles.
 2. Thunderstorm cell producing cloud-to-ground discharge is within five (5) miles, but the observed lightning is outside five (5) miles.
 3. Thunderstorm cell producing in-cloud, cloud-to-cloud, and/or cloud-to-air lightning is within five (5) miles.
 4. Thunder is heard and/or a reliable source and the parent cell observe lightning or cloud is within five (5) miles.
 5. SSC Security determines the threat of lightning is immediate, i.e., explosive growth or rapid movement of a thunderstorm cell.

- b. A Lightning Warning Condition ends when:
 1. Lightning has not been observed within five (5) miles of SSC within the past fifteen (15) minutes.

Condition	Action Level
Lightning within ten (10) miles of SSC, but not within five (5) miles	"Lightning Advisory"
Lightning indicated within five (5) miles of SSC	"Lightning Warning"
Lightning has moved past five (5) miles for at least fifteen (15) minutes, but is still within ten (10) miles of SSC	"Lightning Advisory"
Lightning has moved past ten (10) miles of SSC for fifteen (15) minutes	"All Clear"

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Use of automated system is preferred, and shall include the following notifications. In case of automation failure, the SSC Security Dispatcher shall perform the following actions in fifteen (15) minute increments:

1. Issue proper action level on all radio frequencies.
2. Issue proper action level over the E-Complex paging system. (688-6000)
3. Issue proper action level over the A/B Test Complex paging system. (688-1112)
4. Place a telephone call to the Wellness Center informing them of action level. (688-3950)
5. Place a telephone call to the Child Care Center informing them of action level. (688-3224)
6. Place a telephone call to the Visitors Center informing them of action level. (688-2134)
7. Place a telephone call to the NAVSCIATTS informing them of action level. (813-4050)
8. Place a telephone call to the SBU 22 informing them of action level. (813-4004)
9. Place a notation in the SSC Security Dispatcher Log stating date, time, and action level and indicating a positive or negative response to all phone calls.

5.1 Announcing System Pages and Radio Calls

For Lightning Advisory: “Attention all personnel. A Lightning Advisory has been issued for the Stennis Space Center. A Lightning Advisory means conditions exist that indicate lightning is possible for this location. Personnel should monitor conditions and be prepared to take protective measures if required.” (REPEAT)

For Lightning Warning: “Attention all personnel. A Lightning Warning has been issued for the Stennis Space Center. A Lightning Warning means lightning, or the potential for lightning has been detected within five miles of the Stennis Space Center. All personnel shall immediately secure outside activities and take shelter in a secure location.” (REPEAT)

For All Clear: “Attention all personnel. All Clear. All Lightning Advisories and Lightning Warnings have been cancelled for SSC.” (REPEAT)

The above process will provide notice for any operations requiring advance termination activities and also permit other activities to continue until the policy implementation notice is given.

The Lightning Warning Policy will be implemented upon notification of a Lightning Warning issued by SSC Security. The following restrictions apply, unless specifically identified otherwise:

5.2 All Areas during Lightning Warning

- a. Control of personnel and their activities within that area are the responsibility of supervision and individual self-protection.
- b. Personnel access to roofs or top levels (overhead open areas) of structures is prohibited.

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5.3 Self-Protection from Lightning

When no lightning warning has been announced and personnel observe lightning conditions in their work area, they have the right and obligation to advise their supervision and request that lightning warning actions be initiated. If lightning is within five (5) miles, the individual has the right to remove himself from exposure to lightning or from the effects of lightning.

Working in open areas and on decks exposed (with no overhead protection) to weather is prohibited during Lightning Warnings.

Work can be authorized to remedy an unsafe condition with concurrence of the NASA Safety representative. An Unsafe Condition is defined as the hazards, such as faulty equipment or tools, improper safety procedures, failure to properly guard equipment, etc., that result or have the potential to result in an accident or injury.

A facility is “*lightning protected*” when it implements a properly maintained and fully functional Air Terminal or Catenary Wire Lightning Protection System (SSC employs Air Terminal systems). This applies to buildings and facilities within the test complex areas. Normally occupied office buildings outside of the Test Complex do not always employ a Lightning Protection System. Personnel may remain within these normally occupied office buildings.

All buildings and metal structures, which are daily work areas, are considered, lightning protected shelters for personnel, unless specifically designated to be evacuated during Lightning Warnings.

In areas outside of the test complex, including the guard shacks, personnel shall seek shelter in buildings or metal enclosed vehicles. Persons inside a building shall avoid open exterior doors or windows.

For the Truck Unloading Operations, work shall be permitted as long as the following criteria are met:

When unloading Liquid Hydrogen (LH) and Liquid Oxygen (LOX) trailers and a Lightning warning is issued, technicians will have the drivers close pressure build valve and seek shelter in a nearby building until the warning is over.

For Barge Operations within the SSC Canal System, work shall be permitted as long as the following criteria are met:

1. If M/V Clermont II has departed from a dock and a SSC lightning warning is posted while in route to destination, the Tug Captain will use all available resources to protect crew and equipment from lightning or severe weather as follows:
 - a) Crew will be called back to the interior of the vessel

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- b) If underway, the Tug Captain will seek a location that is deemed safe to hold up until the lightning warning has been cleared. During this time, the Tug Captain will monitor the SSC Marine Operations trunk radio for lightning warning status and maintain the vessel in a safe position.
 - c) If no safe location to hold up is available, the Tug Captain will proceed to dock the barge into the designated stall for safe haven as follows:
 - Barge bow will be placed against the dock
 - Crew will be called back to the interior of the vessel and remain inside until lightning warning has been cancelled
 - Tug Captain will monitor the SSC Marine Operations trunk radio for lightning warning status and maintain barge against the dock with vessel engines
 - Once lightning warning has been cleared, mooring and securing of the barge will be completed.
- b. For Barge Operations outside of the SSC Canal System, work shall be permitted as long as the following criteria are met:
1. If M/V Clermont II is outside of the SSC Canal System and the Captain has lost the ability to utilize the SSC Lightning Detection System for advisory and warning information, he will utilize on-board navigational equipment (radar, wind speed indicator, and Very High Frequency (VHF) weather channel) to make decisions pertaining to the safety of personnel and equipment based on lightning and local weather conditions.
- c. For Barge Connecting or Disconnecting Operations, work shall be permitted as long as the following criteria are met:
1. When connecting or disconnecting barges, technicians will secure the transfer system by closing up any open lines and seek shelter in the nearest building.
 2. After the barge has been docked, technicians will secure the barge by hooking up the Gaseous Nitrogen (GN) supply and Alternating Current (AC) power.
- d. In test stand areas, personnel shall seek shelter in buildings, metal structures identified as "*lightning protected*" areas per 5.3.d, or metal enclosed vehicles. Persons inside a building shall avoid open exterior doors or windows.
- e. For A1 and A2, work shall be permitted as long as the following criteria are met to make them "*lightning protected*" and safe for working during lightning warnings:
1. Personnel are to remain within the lightning protected areas, which have been designated as "*safe working*" with respect to lightning protection. Areas designated as "*protected passage*" are provided for personnel to traverse to a "*safe working*" area. Personnel are NOT to remain in a "*protected passage*" area, they either have to travel to a "*safe working*" area or "*lightning*

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protected” area. SSC Safety shall be responsible for determining the proper demarcation for delineation of the lightning protected areas. Areas designated as "*protected passage*" or "*safe working*" for lightning protection shall be identified on drawings for each test stand and shall be determined by the following criteria:

- a) "Protected passage" and "Safe working"
 - i. For metal items within six (6) feet of the perimeter that are not directly bonded to the facility ground system, a clearance distance of six (6) feet minimum shall be maintained from the item.
 - ii. All metal objects projecting from the Test Stand perimeter (handrails) shall be properly bonded to facility ground system at or near the point-of-entry and periodically tested per the requirements identified in 5.3.1.2.
 - b) "Safe working"
 - i. The criteria in 5.3.1.1 (a) is met, and in addition, provides overhead cover, such as a roof.
2. The facility or test complex stand meets the Lightning Protection Requirements for bonding, grounding, and testing of the resistance-to-counterpoise values of all lightning protection system components and grounded equipment as specified in SSC Facility Electrical Standard, SSC SSTD-8070-0081-ELEC and SSC Maintenance Instruction Ground System Measurements, SMI-8830-0055-ES.
 3. Electrical system maintenance and repair: Defined as worker in physical contact with electrical conductors [AC power, telephone lines, operational intercom communications, operational television cables, radio frequency and microwave transmission cables, hardwire safing systems, Data Acquisition System (DAS) and Control System trunk cables from the hardcore and/or Signal Conditioning Buildings (SCBs) to the exterior Receptacle Boxes (RBs) or Terminal Equipment Boxes (TEBs)].
 - a) Outside all facilities and inside non-lightning protected facilities, electrical systems maintenance and repair is prohibited.
 - b) All inside electrical maintenance and repair work on systems that are connected to outside conductive sources will terminate upon notification of a Lightning Warning.
 - c) Personnel shall not be allowed to work with electrical conduit, panels, and exposed communication or power conductors anywhere inside or outside the lightning protected area.
 - d) Power tools, welders, and portable electrical equipment can be used as long as there is a dedicated grounding conductor that grounds the equipment to the facility power outlet.
 - e) If extension cords are used, they shall not cross facility levels and they shall be confined within the lightning protected area at all times.

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- f) If the “*lightning protected*” facilities have underground electrical utilities, and all above ground electrically connected conductive sources are in the zone of the lightning protection system, a one (1) inch gap disconnect is sufficient to protect work inside against induced voltage caused by a lightning strike. The one (1) inch gap disconnect may be satisfied by opening a circuit breaker, then electrical maintenance and repair work may continue.
- f. No specific protective zone can be ascribed with complete confidence to a vertical lightning rod, pole, or tree. A person near a light pole, mast, tree, or fence is in danger from the lightning side flash effects. Side flashes occur when lightning strikes a tall object and jumps to a nearby object, which may be an individual if they are standing closer than six (6) feet.
- g. If caught in the open, without protective shelter, personnel should avoid being the highest point. Standing erect makes a person extremely vulnerable. Assume a crouched position with both feet close together, knees under chin, arms around knees and head down. Avoid lying flat on the ground as lightning ground currents may cause a voltage potential across the body sufficient to cause death.

6.0 RECORDS AND FORMS

All Records shall be retained in accordance with latest version of the NASA Records Retention Schedule, NPR 1441.1.

All records and forms are assumed to be the latest version unless otherwise indicated. Quality Records are identified in the SSC Master Records Index.

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7.0 DEFINITIONS/ACRONYMS

AC	Alternating Current
DAS	Data Acquisition System
GN	Gaseous Nitrogen
LH	Liquid Hydrogen
LOX	Liquid Oxygen
NASA	National Aeronautics and Space Administration
NPR	NASA Procedural Requirements
RB	Receptacle Box
SCB	Signal Conditioning Building
SMA	Safety and Mission Assurance Directorate
SPR	Stennis Procedural Requirements
SSC	John C. Stennis Space Center
SWI	John C. Stennis Space Center Work Instruction
TEB	Terminal Equipment Box
VHF	Very High Frequency