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John C. Stennis Space Center
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COMPLIANCE IS MANDATORY

John C. Stennis Space Center Lighting Design, Operation, and Maintenance Standard for Energy Conservation

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Document History Log

Revision	Date	Originator/ Phone	Description
Basic	10/21/08	Donnie Thompson x8-1641	Initial release. Supersedes SSC STD 50-002.
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1.0 PURPOSE

This Standard establishes the requirements for design, maintenance, and operation of lighting systems at the John C. Stennis Space Center (SSC). The purpose is to provide proper lighting for all personnel at the most energy efficient levels.

The limits given conform to federally mandated energy conservation standards per the National Aeronautics and Space Administration (NASA) Policy Directive (NPD) 8820.2, Design and Construction of Facilities, and to best known local factors. Maintenance and operation sections are included because they are closely associated with the lighting design.

2.0 APPLICABILITY

This Standard is applicable to NASA/SSC personnel, SSC contractors, and resident agencies.

This Standard is applicable to all lighting projects in new construction as well as building and lighting renovations, regardless of size.

3.0 REFERENCED AND APPLICABLE DOCUMENTS

The latest edition of the following shall be utilized unless otherwise indicated:

ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings

Illuminating Engineering Society (I.E.S.) Handbook

NPD 8820.2, Design and Construction of Facilities

NPR 8820.2, Facility Project Requirements

SCWI-8500-0004-ENV, Hazardous Materials, Hazardous Waste, and Solid Waste Plan

SCWI-8500-0017-ENV, Pollution Prevention Plan

SPR 1440.1, Records Management Program Requirements

SSTD-8070-0001, Facilities Engineering Documentation Standard

SSTD-8070-0005-CONFIG, Preparation, Review, Approval and Release of SSC Standards

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4.0 RESPONSIBILITIES

- a. NASA is required to construct new buildings and major renovations that meet or exceed current federal regulations which specify energy efficiency levels. Since lighting is a significant energy user in most buildings, it is imperative that the designer utilize the most efficient lighting systems that are currently available.
- b. The lighting designer shall coordinate with other design disciplines to incorporate design features such as natural lighting into building designs so that the amount of electrical lighting is reduced.
- c. Synergy Achieving Consolidated Operations and Maintenance (SACOM) Facilities Operations and Maintenance Department has various responsibilities for planning, maintenance, documenting and notifying as specified throughout this Standard.
- d. Users of this Standard shall comply with its requirements, ensure use of the correct version of this Standard and the documents it references, and inform the appropriate organization of needed changes in accordance with SSC Standard SSTD-8070-0005-CONFIG.
- e. Responsibilities for the use and control of this Standard and for the review and approval of revisions or cancellation of this Standard shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

5.0 REQUIREMENTS FOR DESIGN, MAINTENANCE AND OPERATIONS

5.1 SUMMARY

The basic requirements of this Standard can be summarized as follows:

- a. Lighting systems are to be designed and maintained to provide proper illumination levels and quality of illumination.
- b. Lighting is to be designed for minimum energy usage.
- c. Lighting fixtures/systems are to be maintained in accordance with an established and current SACOM Maintenance Plan.
- d. Lights are to be operated to utilize the most economical advantage of their design.

5.2 DESIGN ILLUMINATION LEVELS

- a. Lighting at SSC shall provide approved, adequate levels of illumination for each job or area. Adequate illumination is defined by visual difficulty of tasks and by illumination

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requirements for work areas, offices, passageways, restrooms, and other spaces, provided in the Illuminating Engineering Society (I.E.S.) Handbook.

- b. Illumination shall meet intensity requirements aided by reflectance from walls and ceilings but without “veiling” reflection which causes glare. The fixtures and their locations must be wisely selected to do this.
- c. Up-to-date vendor catalogs shall be used to select fixtures with proper Coefficient of Utilization (CU).
- d. Proper ratios of luminance (reflectance) between task and surrounding areas are required in design.

5.3 DESIGN LIGHTING FOR LOW ENERGY USE

- a. Lighting shall be designed to ensure minimum energy cost. Meeting the limit requires that lighting be carefully allocated to appropriate sections and that attention be given to lamp and fixture selection, switching, wall coloring, windows, and area tasks.
- b. Wattage shall be based on input power to the fixtures and includes supplemental lighting power such as desk lamps.
- c. Interior lighting power shall be provided at or below levels specified in the latest revision of ASHRAE 90.1.

5.3.1 Product Selection

- a. Products selected for use shall provide the most efficient light source, while still maintaining recommended light levels within the space.
- b. The designer shall be acquainted with the most recent energy efficient products in the lighting industry and utilize these products in all lighting designs.
- c. “Energy Star” products shall be used when available.
- d. Comfort and aesthetic factors of lighting must be known and used judiciously.
- e. Since mercury is considered a toxic chemical and is used in certain types of lighting, the designer shall select only those lamps that have a low mercury content. Where applicable, the mercury content of lamps shall not exceed 90 pico-grams per lumen-hour. Where achievable, the mercury content shall be reduced to 70 pico-grams per lumen-hour.

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5.3.2 Switching Provisions for Operation of Lights

- a. The designer shall be familiar with the requirements of ASHRAE 90.1 concerning lighting control and incorporate these requirements into all lighting designs.
- b. Of particular interest shall be the use of occupancy sensors to control lighting in areas of intermittent occupancy such as restrooms, conference rooms, offices, and break rooms.
- c. The designer shall include an Energy Management and Control System (EMCS) interface that monitors and controls major lighting circuits in their design.

5.3.3 Supplemental Lighting

Since illumination varies with tasks, personnel, daylight, and other factors, requirements for an area may vary with time. To avoid energy wasting designs such as installing 100 fc where 40-60 fc is the norm, desk lamps, wall lamps or other separately switched lights shall be used.

5.3.4 Outdoor Lighting Requirements for Design

- a. Outdoor lighting shall be limited to the minimum needed for safety and security.
- b. Exterior lighting power shall be provided at or below levels specified in the latest version of ASHRAE 90.1.
- c. Exterior lighting shall be controlled by means of photocells.
- d. Remote control/monitoring interface to the site-wide EMCS shall be provided.

5.4 MAINTENANCE OF LIGHTING SYSTEMS

5.4.1 Summary

The SACOM Facilities Operations and Maintenance Department has thorough experience in gauging and maintaining lighting to the limits specified in preceding sections. This is a very important factor in limiting energy for lighting. The frequency of maintenance is a second major factor as covered in the following paragraphs.

5.4.2 Maintenance Frequency on Lighting Systems

This Standard requires that an agreed upon "lighting maintenance plan" be established, reported to users, and followed by maintenance personnel. Since this "plan" may vary with time, economic condition, and other factors, the type of plan is not specified in this Standard. The requirements of this Standard are met when the plan is agreed upon by the Maintenance

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Manager, NASA SSC Energy Manager and followed by users and maintenance. Some obvious choices of lighting maintenance plans are:

- a. Clean fixtures and relamp on specific schedules.
- b. Test illumination periodically. Clean, relamp as required.
- c. Test, relamp, clean only on call.

When a schedule is established for a plan of relamping and cleaning luminaries, use the I.E.S. Handbook to determine frequencies. This reference also gives suitable frequencies for cleaning or repainting wall/ceiling area.

5.4.3 Illumination Surveys

Maintenance is to test areas of illumination on one or more of the following bases:

- a. When new or retrofitted lighting is first turned on.
- b. Periodically, when called out in the “plan”.
- c. When requested by a user manager.

Illumination will be surveyed, corrected, and recorded for all SSC areas annually. The SACOM Facilities Operations and Maintenance Department is required to keep the records and changes made to lighting as they occur.

5.4.4 Component Replacement Specifications

- a. Ballasts: Replacement ballasts shall be as or more efficient than equipment being replaced, compatible with other equipment, and does the job it is intended for.
- b. Diffusers for Fluorescent Fixtures: Diffusers on new fluorescent fixtures or for replacement shall be as efficient or more efficient than those being replaced.
- c. Lamps: All lamps shall be compatible with ballasts installed, and shall be of the “energy-saver type” to provide the greater lumen/watt.

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5.5 USER OPERATION OF LIGHTS

5.5.1 Turning Off General and Special Lighting

This important step requires that everyone turn off his or her personal lights when leaving their location and that specific persons are assigned to turn off other lights. The area user manager is assigned responsibility for light turn-off and for use as designed. Only safety and security lights are to remain on during off-work hours. Continued adherence to energy saving principles may be aided by placing signs at light switches. Scheduling custodial work for normal work hours helps reduce energy consumption.

5.5.2 Observing Deficiencies/Requesting Correction

In addition to being familiar with lighting design, the user manager must know the plan by which they are maintained. If this is an "On Request" plan, assigned personnel must observe their lighting system for deterioration. If deficient lighting is suspected, maintenance is prepared to measure for proper levels and make corrections.

Observations for deficient lighting shall be guided by the following:

- a. Lamps flickering, discolored or out.
- b. Diffusers discolored or dirty.
- c. Walls and ceilings darkened or dirty.
- d. Complaints from user personnel.

After correction, maintenance will make a final test to ensure the illumination is in range. In special cases, the normal range may need to be exceeded by adding supplementary lighting.

6.0 SAFETY OF LIGHTING SYSTEMS

6.1 Summary

The safety requirements of lighting systems include attention to electrical hazards, glass breakage and toxic materials in fluorescent tubes, illumination affecting vision, and illumination for emergencies egress.

6.2 Electrical Safety Requirements

Work on electrical lights and their components is to be performed in accordance with all pertinent safety and lockout/tagout requirements and procedures.

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6.3 Fluorescent Lamp Hazards and Correction

Approved guards shall be installed to prevent lamps falling from fixtures. Either the plastic diffuser or wire guards supplied from the fixture manufacturer are suitable.

The handling of fluorescent tubes is hazardous from two standpoints: the tubes are under vacuum and they shatter by implosion when broken; also, they contain toxic mercury vapor and mineral phosphors. Safe handling requires eye protection, washing if contacted, proper storage of new tubes, and proper disposal of used lamps.

6.4 Emergency Lighting

- a. Routes of egress shall be illuminated by emergency power.
- b. All building exits shall have lighted exit signs.

6.5 Handling and Disposal of Hazardous Materials

Handling and disposal of hazardous materials, hazardous wastes, universal waste and non-hazardous solid wastes at SSC shall be in accordance with SCWI-8500-0004-ENV.

6.6 Recycling

Pollution prevention and recycling shall be in accordance with SCWI-8500-0017-ENV.

7.0 CONFORMANCE TO LIGHTING STANDARDS

- a. The records obtained by surveys of buildings shall be permanently retained by the SACOM Facilities Operations and Maintenance Department.
- b. All new or repeat surveys shall be included.
- c. A summary of the results shall be reported annually to the NASA SSC Energy Manager and to the SACOM Management.
- d. New surveys and any buildings or areas with light levels as well as power requirements in excess of listed standards shall be listed separately and the reasons for the overage identified.
- e. Energy conservation personnel are to use the survey information in determining needs for changing lighting equipment or changing the "lighting maintenance plan".

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8.0 RECORDS AND FORMS

- a. Records and forms required by the procedures of this Standard shall be maintained in accordance with SPR 1440.1. All records and forms are assumed to be the latest edition unless otherwise indicated. Forms may be obtained from the SSC Electronic Forms repository or from the NASA SSC Forms Management Officer. Quality Records are identified in the SSC Master Records Index.
- b. Records of surveys shall be permanently maintained by SACOM in Central Engineering Files (CEF).

9.0 ACRONYMS

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CEF	Central Engineering Files
CU	Coefficient of Utilization
EMCS	Energy Management Control System
fc	footcandle
I.E.S.	Illuminating Engineering Society
NASA	National Aeronautics and Space Administration
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
SACOM	Synergy-Achieving Consolidated Operations and Maintenance
SPR	Stennis Space Center Procedural Requirement
SSC	John C. Stennis Space Center

10.0 DEFINITIONS

Coefficient of Utilization (CU): The ration of the luminous flux (lumens) form a luminaire received on the work-plane to the lumens emitted by the luminaries lamps alone.

Footcandle (fc): The illumination of a surface one square foot in area on which there is a uniformly distributed flux of one lumen, or the illumination produced on a surface all points of which are at a distance of one foot from a directionally uniform point source of one candela.

Luminance: Incident light measured in foot candles with photometer sensor aimed toward light source.

Veiling: Reduced visual perceptibility caused by light reflected from the surface being absorbed. (Surface glare from printed paper.)

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