NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

LIGHTING SYSTEM IMPROVEMENT

(No.)

CODE 670

DEFINITION

Complete replacement or retrofitting of one or more components of an existing agricultural lighting system.

PURPOSE

This practice may be applied as part of a conservation management system to reduce energy use.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any agricultural facility with an existing lighting system and a completed lighting assessment that complies with the guidelines for a Type 2 on-farm energy audit for the major activity of lighting per ANSI/ASABE S612.

CRITERIA

General Criteria Applicable to All Purposes

Implement recommendations of a Type 2 On-farm Energy audit as they pertain to lighting system improvement. To utilize this practice, the lighting assessment must document the following:

- The baseline – the current energy use of a lighting system
- The replacement or retrofit that will satisfy the minimum energy efficiency requirements established in this practice.
- The expected reduction in energy use over the baseline after the recommended replacement or retrofit is implemented.

Comply with all applicable electrical codes and fire protection standards as well as any local regulations.

Housing, wiring, mounting, and connections shall meet National Electrical Code: Article 547, Agricultural Buildings (NFPA, 2011).

Ensure that the modified lighting system meets the recommended light quality and light levels (illuminance) in foot candles (fc) (lm/ft^2) or lux (lx) (lm/m^2) for the space being lighted and the tasks performed in that space (see Tables 2, 5-7, and 9-11, ASABE EP344.3).

Install lamps with a Color Rendering Index (CRI) of 70 or greater in areas where inspections are occurring such as milk room wash areas, egg inspection, milking parlor pit, etc.

A lighting system may include luminaires (lamps, ballasts and fixtures), controls, and wiring as appropriate.

Where components will be exposed to dust, moisture, or corrosive atmosphere (such as in animal housing operations), use non-corrosive, water resistant light fixtures to protect lamps from environmental exposure in accordance with the National Electric Code (NFPA 2011).

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

Provide light uniformity based on Task Classification and maximum spacing-to-mounting-height ratio (s/Hp) given in Table 3 of ASABE EP344.3. Use manufacturer's uniformity data if available or a commercial light modeling software to ensure level and uniform distribution of light.

Lamps and Ballasts. Select replacement lamps, or lamp/ballast combinations, that have a minimum rated efficiency of 50 lumens per watt (lm/w).

Select lamps and ballasts that meet facility requirements for starting characteristics of the light (warm-up period and start-up temperature).

Ensure ballasts are compatible with the wattage, number and type of lamp they support. Replace magnetic ballasts with electronic ballasts where feasible to improve energy efficiency, extend lamp life and lower starting temperature in some cases.

Dispose of lamps and ballasts in accordance with environmental laws and regulations.

Controls. Use automatic controls to reduce operating time or input power of a lighting system if intermittent use or natural lighting makes continuous artificial lighting unnecessary. Lighting controls include but are not limited to switches, dimmers, photo-sensors, occupancy sensors and timers.

Design and install sensors and controls to meet their intended purpose and to ensure compatibility with the luminaire(s) used.

When automatic controls are used, install an independent manual override.

Safety and Welfare. To ensure worker and animal safety and welfare:

Locate light sources to minimize shadows cast on the work area by workers and obstructions.

Illuminate from more than one direction to minimize the density of shadows and to provide uniform illuminance.

Reduce glare by selecting and installing fixtures with reflectors, refractors, and diffusing shields.

Locate all light fixtures above the horizontal line of sight.

CONSIDERATIONS

In some cases, lighting modifications may impact heating, cooling, or ventilation requirements of a building. These impacts are often minor, but they should be considered when planning for changeover of lamp types.

Protect switches and dimmers from environmental exposure by locating them away from damp or dusty environments, where feasible, or by using corrosion-resistant controls.

In buildings, utilization of reflective, matte finishes on interior surfaces will reduce glare and help create a comfortable visual environment.

The color of a light source can impact the ability to distinguish colors in the lighted area and in some cases affect the mood of people and/or livestock.

Light quality, luminance and photoperiod may be adjusted to enhance plant and animal production.

Utilizing daylight to supplement artificial light may reduce energy requirements of a lighting system and provide higher quality light.

For exterior lighting systems, the direction and intensity of the lights may dramatically affect the impact of light pollution on people and wildlife.

Consider stray voltage when planning improvements to reduce hazards and negative impacts on animal health,

PLANS AND SPECIFICATIONS

Ensure plans and specifications for lighting systems meet the requirements of this standard. Plans and specifications shall:

Identify and describe the existing lighting environment, including lumen output, number and placement of luminaires, number of lamps per fixture, wattage, lamp-type, brand and model of fixture, controls and wiring, and activity for discrete areas.

Identify the replacement brand and model of fixture, number of lamps per fixture, ballast type, lamp wattage, lamp-type, and fixture rating (dust proof, water resistance, wash down, etc.). State the recommended illumination level and if different from the existing level, why the change is recommended.

Describe the specific number and arrangement of fixtures to be replaced and/or installed, along with the power source and controls

Include a plan view showing the location of the lighting system including an electrical wiring diagram.

OPERATION AND MAINTENANCE

The producer/client is responsible for maintaining the lighting system. Provide operation and maintenance instructions that include the following:

Inspect lamps, ballasts, fixtures, wiring, and controls regularly. Replace burned out lamps promptly, and repair or replace other system components as appropriate to ensure the system is functioning properly.

Clean lamps, fixtures, and room surfaces regularly to ensure a high-quality light environment is maintained.

REFERENCES

American Society of Agricultural and Biological Engineers. 2010. Lighting Systems for Agricultural Facilities ASAE EP344.3 JAN2005 (R2010) ASABE, St. Joseph, MI.

American Society of Agricultural and Biological Engineers. 2009. Performing On-farm Energy Audits. ANSI/ASABE S612 JUL2009. St. Joseph, MI.

National Fire Protection Association (NFPA). 2011. Article 547 Agricultural Buildings. NFPA 79. Boston, MA.

National Lighting Product Information Program. 2011. NLPIP Lighting Research Center Glossary. http://www.lrc.rpi.edu/programs/NLPIP/glossary.asp

NATURAL RESOURCES CONSERVATION SERVICE

GEORGIA

OPERATION AND MAINTENANCE REQUIREMENTS

LIGHTING SYSTEM IMPROVEMENT

CODE 670

Land Owner/Operator_____

County_____SWCD_____

Prepared By_____Date_____

Practice Location_____ Farm/Tract No._____
(Latitude/Longitude or UTM Coordinates)

OPERATION AND MAINTENANCE ITEMS

This lighting system improvement was designed and installed to reduce energy used on the farm. The estimated life span of this installation is at least 10 years. The life of this practice can be assured and usually increased by developing and carrying out a systematic operation and maintenance program.

You are required to perform inspections and operation and maintenance activities in order for this practice to achieve the intended function, benefits and design life. Items to inspect, operate and maintain during the estimated design life of this practice include, but are not limited to the following:

- Inspect lamps, ballasts, fixtures, wiring and controls regularly.
- Replace burned out lamps promptly, and repair or replace other system components as appropriate to ensure the system is functioning properly.
- Retain and update records for a minimum of five (5) years from the beginning of operation of measure implementation.
- Clean lamps, fixtures, and room surfaces regularly to ensure a high-quality light environment is maintained.
- Records should include the following:
    - Monthly utility bills, fuel purchases, and yield of agricultural commodities
    - Documentation of maintenance conducted on the replacement, or retrofitted system and related components or devices.

Additional Operation and Maintenance Requirements Specific to this Plan:

_____

_____

_____

_____

_____

CONTACT YOUR LOCAL NRCS OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS O&M PLAN FOR YOUR CONSERVATION PRACTICE.

This O&M Plan was discussed and a copy provided to the landowner/operator.

Signed by the landowner/operator Date

Signed by the Responsible NRCS employee/Conservation Partner Date

United States Department of Agriculture
NRCS Natural Resources Conservation Service

Lighting System Improvement

(Bulb Replacement in Poultry Houses)

Georgia Job Sheet No. GA670

Definition

Poultry houses often use incandescent lights. These bulbs can be replaced with energy saving CCFL (Cold Cathode Florescent Lamp), CFL (Compact Florescent Lamp) or LED (Light Emitting Diode) bulbs to significantly reduce the energy usage associated with lighting.

General Information

The main goal of poultry house lighting is to provide intense, uniform light in the brood chamber, especially over the feed and water lines. After chicks are turned out into the whole house, the lighting should also satisfy the dimming requirements for the remainder of the growout. A cookie-cutter approach to lighting system design is impossible; however, local complexes can usually develop 4 – 5 lighting arrangements to satisfy most of their growers.

CCFL bulbs work very well with the modern type dimmers. CCFL bulbs are typically 8W (45-55W incandescent equivalent) with a typical life of 22,000 – 25,000 hours. However, lumen depreciation (LD) with CCFLs is significant. Additionally, when CCFL bulbs are dimmed to very low levels, as during catch, bulb stress increases LD and may result in a significant reduction in useful bulb life.

There are two very different types of CFL bulbs, dimmable and non-dimmable. These bulbs should have a life span of 8,000 – 12,000 hours. Dimmable CFL bulbs are available in 15W (70W incandescent equivalent) and a 23W (100W incandescent equivalent). Non-dimmable CFL bulbs can range in wattage from 15W to 65W and are typically used as supplemental lighting to satisfy integrator lighting requirements during brood. Non- dimmable CFL bulbs in the 15W to 26W range are the least expensive and most cost effective bulbs if they can be used in the lighting system.

Dimmable CFL bulbs can be used as grow out bulbs, just like CCFL bulbs. They also have a significant LD rate and can suffer similar bulb damage at low level dimmer settings.

Changes in LED bulb technology are making these bulbs better adapted to the poultry house. The cone-shaped light pattern of some LED bulbs can sometimes makes lighting uniformity in the poultry house a challenge.

Farmers cannot receive federal funds from two sources to pay for bulb replacement.

Installation

Lighting systems must be designed by a professional, and comply with the integrator's requirements. Any new electrical wiring must be certified by the contractor performing the installation.

Older keyless sockets are highly susceptible to corrosion that could lead to premature bulb failures and dimming problems. In almost all cases, these older sockets should be replaced with nickel- plated brass screw shell keyless sockets fixtures for new bulbs.

Some older open ceiling poultry houses may require additional bulb receptacles or circuitry in order to provide any level of reasonable lighting, or they may require a higher wattage (greater lumen output) LED bulb to provide the required level of light.

Operation and Maintenance

High wattage dimmers designed to work with incandescent light bulbs typically do not operate in the same manner with CCFL and dimmable CFL bulbs. Exact target dimming levels depend on the integrator and should be determined by using a good light meter at the bird level. Proper steps must be used to calibrate dimmers (See Poultry House Light Dimming Issues, Newsletter no. 68 of the National Poultry Technology Center, Auburn University).

CCFL and CFL bulbs contain mercury, which is a toxic element. Local and state laws should be followed for proper disposal of these bulbs. In the event of bulb breakage, the affected area should be thoroughly cleaned. Spent and broken bulbs should be double bagged and taken to a recycling center.

The finned heat sinks on some LED bulbs collect dirt and debris and need regular cleaning to ensure the bulbs don't prematurely fail.

Spiral bulbs without globes collect dust and should be cleaned between every flock. All bulbs need periodic external cleaning.

References

NRCS GA Conservation Practice Standard, Lighting System Improvement, Code 670.

Energy Efficient Lighting, Newsletter no. 59, National Poultry Technology Center, Auburn University, May 2009.
Broiler House Lighting Development, Newsletter no. 64, National Poultry Technology Center, Auburn University, February 2010.

Poultry house Light Dimming Issues, Newsletter no. 68, National Poultry Technology Center, Auburn University, October 2010.

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Bulb Replacement

Poultry Farmer:_____**County:**_____**Date:** _____
Integrator:_____**Number of houses:**_____
Farm No.:_____**Tract No.:** _____ **Location:**_____
Designed:_____**Checked:**_____**Approved:**_____**JAA:**_____
House(s): (Design must be attached)

Number of bulbs to be replaced:_____ incandescent _____ non-dimmable CFL/CCFL

_____ metal halide _____ other (_____)

Total CCFL Bulbs to be used:_____

Total dimmable CFL Bulbs to be used:_____

Total non-dimmable CFL (brood) Bulbs to be used:_____

Total LED Bulbs to be used:_____

Are all houses the same ( ) yes ( ) no. If no, make same calculations for each house.
Total bulbs (all houses):
CCFL Bulbs:_____ Dimmable CFL Bulbs:_____

Non-Dimmable CFL Bulbs: _____ LED Bulbs: _____

Farmer Certification:
I certify that I am not receiving other federal funds for bulb replacement (TVA rebate program for LED bulbs or the USDA RD Rural Energy for America Program) for these poultry houses.

_____

Signature Date

Installation Certification:

I certify that the installation for the new lighting system in the poultry houses on this farm was completed: All light bulbs were replaced by Producer in accordance to approved design.

_____

Signature Date

Electrical wiring, replacement of socket fixtures, additional installation of bulb receptacles or circuitry, if required to meet the Accredited Farm Energy Audit, has been installed by certified electrician according to local electrical requirements.

_____

Signature (Certified Electrician/License No.) Date

Designer Certification:	**As Built Certification:**
I certify that this project was designed according to the applicable NRCS standards.	I certify that this project was constructed according to the design.

Signature Date Signature Date

Quality Assurance Plan (QAP)

Landowner/Project: _____ **Engineering Job Class[1/]:** ____

Service Center: _____ **County** _____

Conservation Practice(s) & Engineering Job Class Included in this Job: Lighting System Improvement, 670

QAP Prepared By: _____ **Job Approved By** _____

Est. Construction Start Date: _____ **Est. # Site Visits:** ____ **Est. # QA Hours:** _____

[1/] The engineering job class for a given job will is based on the most restrictive element or conservation practice included in the job.

Certification Statements

I certify that the items, intensity, and inspection requirements listed in Table 1 is adequate quality assurance (QA) for this project.

_____ _____

Approver of Engineering Plans (Signature) *Date*

I certify that _____ has the experience necessary to perform the construction inspection for the items shown in Table 1 and has the qualifications as shown in Table 2 for this project. I support this individual as the construction inspector and will allow the individual adequate staff time to perform the QA inspection for this project.

_____ _____

Line Supervisor (Signature) *Date*

I certify that I have reviewed the engineering plans and specifications and fully understand the QA requirements of the subject project. I will contact the Project Approver if I have any questions or concerns regarding the QA activities and will notify and obtain approval from the Project Approver if there is need to make any changes to the plans and/or specification during construction.

_____ _____

QA Inspector (Signature) *Date*

Quality Assurance Plan (QAP)

Table 1 - Items to be Inspected and Verified

Items [2/]	Intensity [3/]	Inspection Requirements [4/]
Preconstruction Meeting	NA	Meet with landowner and contractor, discuss project, sign and date documents; provide all applicable documents including drawings and specifications.
Permits	NA	Verify that the landowner has obtained all required permits prior to construction.
Pollution Control	P/F	Inspect to verify construction debris has been disposed of properly.
Quantity Computation	P/F	Perform quantity computations for payment purposes as per the payment schedule and specifications. Quantity computations shall be recorded on standard NRCS forms or NRCS-ENG-523A and checked and initialed by a second person.
Photographs	P	Take photographs of the site, before, during and after construction.
As-built Drawings	P	Keep drawings current during construction and prepare as-built drawings within 14 days of final construction.
Survey Notes	P	All construction checks taken including periodic measurements shall be recorded on loose leaf survey notes (form ENG 28, 29) or in a bound survey field book.

[2/] Include items that require quality assurance.
[3/] Intensity of inspection: NA – Not Applicable, C – Continuous, P – Periodic, F– Final. The inspector shall immediately notify the approver of the job if continuous inspection is required and cannot be performed with available staff.
[4/] Inspection requirements shall be to the degree necessary to certify that the project is installed in accordance with the plans and specifications.

Table 2 – Required QA Qualifications for Construction Inspector

QA Qualifications
1. Appropriate EJAA for the engineering job class for construction of the conservation practices to be installed.
2. Knowledgeable of the following references: a) National Engineering Manual (NEM) Part 512 – Construction b) National Engineering Handbook, Part 645, Construction Inspection

STATEMENT OF WORK
Lighting System Improvement (670)
NRCS, GA

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

Licensure

Georgia Code Title 43, Professions and Businesses, Chapter 15, Professional Engineers and Land Surveyors, regulates the practice of engineering in Georgia and provides the definition of engineering in Chapter 15 §2(11). Technical assistance for this engineering conservation practice may be considered the practice of engineering and subject to licensure requirements of Georgia Code Chapter 15. It is the responsibility of the individual providing technical assistance to determine and verify whether this practice is subject to Georgia Code Chapter 15.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in NRCS practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client and regulations to be met
    c. List of facilitating practices
    d. Practice standard criteria-related computations and analyses to develop plans and specifications including but not limited to:
        i. The baseline
        ii. Energy efficiency requirements
        iii. Reduction calculations, analysis, etc.
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Operation and maintenance plan
4. Certification that the design meets practice standard criteria and complies with applicable laws and regulations
5. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client
2. Verification that client has obtained required permits
3. Installation guidance as needed
4. Facilitate and implement required design modifications with client and original designer
5. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
6. Certification that the installation process and materials meets design and permit requirements

CHECK OUT

Deliverables

1. Records of application
    a. Extent of practice units applied
    b. Actual materials used
2. Certification that the application meets NRCS standards and specifications and is in compliance with permits
3. Progress reporting

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard Lighting System Improvement - 670
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook