

City of Brundidge LED Roadway Luminaires

City of Brundidge Grant Agreement 1ARRA EECBG 52
Specification for LED Roadway Luminaires

PART 1 – GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only. Versions listed shall be superseded by updated versions as they become available.

- A. American National Standards Institute (ANSI)
 - 1. C136.2-2004 (or latest), American National Standard for Roadway and Area Lighting Equipment—Luminaire Voltage Classification
 - 2. C136.10-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing
 - 3. C136.15-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification
 - 4. C136.22-2004 (R2009 or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires
 - 5. C136.25-2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures
 - 6. C136.31-2010 (or latest), American National Standard for Roadway Lighting Equipment – Luminaire Vibration
 - 7. C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment - Solid State Light Sources Used in Roadway and Area Lighting
- B. American Society for Testing and Materials International (ASTM)
 - 1. B117-09 (or latest), Standard Practice for Operating Salt Spray (Fog) Apparatus
 - 2. D1654-08 (or latest), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
 - 3. D523-08 (or latest), Standard Test Method for Specular Gloss
 - 4. G154-06 (or latest), Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
- C. Council of the European Union (EC)
 - 1. RoHS Directive 2002/95/EC, on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- D. Federal Trade Commission (FTC)
 - 1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims
- E. Illuminating Engineering Society of North America (IESNA or IES)
 - 1. DG-4-03 (or latest), Design Guide for Roadway Lighting Maintenance
 - 2. HB-10-11 (or latest), IES Lighting Handbook, 10th Edition
 - 3. LM-50-99 (or latest), IESNA Guide for Photometric Measurement of Roadway Lighting Installations
 - 4. LM-61-06 (or latest), IESNA Approved Guide for Identifying Operating Factors Influencing Measured Vs. Predicted Performance for Installed Outdoor High Intensity Discharge (HID) Luminaires
 - 5. LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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6. LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
 7. RP-8-00 (or latest), ANSI / IESNA American National Standard Practice for Roadway Lighting
 8. RP-16-10 (or latest), ANSI/IES Nomenclature and Definitions for Illuminating Engineering
 9. TM-3-95 (or latest), A Discussion of Appendix E - "Classification of Luminaire Lighting Distribution," from ANSI/IESNA RP-8-83
 10. TM-15-11 (or latest), Luminaire Classification System for Outdoor Luminaires
 11. TM-21-11 (or latest), Projecting Long Term Lumen Maintenance of LED Light Sources
- F. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE C62.41.2-2002 (or latest), IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
 2. ANSI/IEEE C62.45-2002 (or latest), IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- G. National Electrical Manufacturers Association (NEMA)
1. ANSI/NEMA/ANSI C78.377-2008 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products
- H. National Fire Protection Association (NFPA)
1. 70 – National Electrical Code (NEC)
- I. Underwriters Laboratories (UL)
1. 1449, Surge Protective Devices
 2. 1598, Luminaires
 3. 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2. RELATED DOCUMENTS

- A. Contract Drawings and conditions of Contract (including General Conditions, Addendum to the General Conditions, Special Conditions, Division 01 Specifications Sections and all other Contract Documents) apply to the work of this section.
- a. See the separate Specification for Adaptive Control and Remote Monitoring of LED Roadway Luminaires for additional driver performance and interface requirements.

1.3. DEFINITIONS

- A. Lighting terminology used herein is defined in IES RP-16. See referenced documents for additional definitions.
1. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.
 2. Clarification: The term “LED light source(s)” is used herein per IES LM-80 to broadly cover LED package(s), module(s), and array(s).

1.4. QUALITY ASSURANCE

- A. Before approval and purchase, Owner may request luminaire sample(s) identical to product configuration(s) submitted for inspection. Owner may request IES LM-79 testing of luminaire sample(s) to verify performance is within manufacturer-reported tolerances.

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- B. After installation, Owner may perform IES LM-70 field measurements to verify performance requirements outlined in Appendix A, giving consideration to measurement uncertainties outlined in IES LM-61.

1.5. LIGHTING SYSTEM PERFORMANCE

- A. Energy Conservation
 - 1. Connected Load
 - a. Luminaires shall have maximum nominal luminaire input wattage as specified for each luminaire type in Appendix A.
 - 2. Lighting Controls
 - a. See separate controls specification identified in section 1.2 above, if applicable.
 - b. See section 2.1-B below for driver control interface and performance requirements.
 - c. See section 2.1-K below for photocontrol receptacle requirements.
- B. Photometric Requirements
 - 1. Luminaires shall meet the general criteria provided in the body of this specification and the particular criteria for each luminaire type defined in Appendix A.

1.6. REQUIRED SUBMITTALS FOR EACH LUMINAIRE TYPE DEFINED IN APPENDIX A

- A. General submittal content shall include
 - 1. Completed Appendix E submittal form
 - 2. Luminaire cutsheets
 - 3. Cutsheets for LED light sources
 - 4. Cutsheets for LED driver(s)
 - a. If dimmable LED driver is specified, provide diagrams illustrating light output and input power as a function of control signal.
 - 5. Cutsheets for surge protection device, if applicable
 - 6. Instructions for installation and maintenance
 - 7. Summary of luminaire recycled content and recyclability per the FTC Green Guides, expressed by percentage of luminaire weight
- B. LM-79 luminaire photometric report(s) shall be produced by the test laboratory and include
 - 1. Name of test laboratory
 - a. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program. For more information, see <http://ts.nist.gov/standards/scopes/eelit.htm> or www.ssl.energy.gov/test_labs.html.
 - 2. Report number
 - 3. Date
 - 4. Complete luminaire catalog number
 - a. Provide explanation if catalog number in test report(s) does not match catalog number of luminaire submitted
 - i. Clarify whether discrepancy does not affect performance, e.g., in the case of differing luminaire housing color.

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2. LED light source(s)
 - a. Negligible light output from more than 10 percent of the LED packages constitutes luminaire failure.
3. LED driver(s)
- B. Warranty period shall begin 90 days after date of invoice, or as negotiated by owner such as in the case of an auditable asset management system.

PART 2 – PRODUCTS

2.1. LUMINAIRE REQUIREMENTS

- A. General Requirements
 1. Luminaires shall be as specified for each type in Appendix A.
 2. Luminaire shall have an external label per ANSI C136.15
 3. Luminaire shall have an internal label per ANSI C136.22.
 4. Nominal luminaire input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.
 5. Luminaires shall start and operate in -20°C to +40°C ambient.
 6. Luminaire's LED operating junction temperature during normal operation shall not exceed 37°C.
 7. Electrically test fully assembled luminaires before shipment from factory.
 8. Effective Projected Area (EPA) and weight of the luminaire shall not exceed the values indicated in Appendix A.
 9. Luminaires shall be designed for ease of component replacement and end-of-life disassembly.
 10. Luminaires shall be rated for the ANSI C136.31 Vibration Level indicated in Appendix A.
 11. LED light source(s) and driver(s) shall be RoHS compliant.
 12. Transmissive optical components shall be applied in accordance with OEM design guidelines to ensure suitability for the thermal/mechanical/chemical environment.
- B. Driver
 1. Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperatures indicated in section 2.1-A above.
 2. Shall accept the voltage or voltage range indicated in Appendix A at 50/60 Hz, and shall operate normally for input voltage fluctuations of plus or minus 10 percent.
 3. Shall have a minimum Power Factor (PF) of 0.90 at full input power and across specified voltage range.
 4. Control signal interface
 - a. Luminaire types indicated "Required" in Appendix A shall accept a control signal as specified via separate controls specification referenced in section 1.2 above, e.g., for dimming.
 - b. Luminaire types indicated "Not Required" in Appendix A need not accept a control signal.
- C. Electrical immunity
 1. Luminaire shall meet the "Basic" requirements in Appendix D. Manufacturer shall indicate on submittal form (Appendix E) whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.

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2. Luminaire shall meet the “Elevated” requirements in Appendix D. Manufacturer shall indicate on submittal form (Appendix E) whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.
- D. Electromagnetic interference
1. Shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
 2. Shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- E. Electrical safety testing
1. Luminaire shall be listed for wet locations by an OSHA NRTL.
 2. Luminaires shall have locality-appropriate governing mark and certification.
- F. Electrical surge protection
1. Luminaire shall have a minimum of 10kV of arrester protection separate from the driver protective contributions.
 2. Surge protective devices shall be separable and replaceable.
- G. Painted or finished luminaire components exposed to the environment
1. Shall exceed a rating of six per ASTM D1654 after 1000hrs of testing per ASTM B117.
 2. The coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.
- H. Thermal management
1. Mechanical design of protruding external surfaces (heat sink fins) for shall facilitate hose-down cleaning and discourage debris accumulation.
 2. Liquids or other moving parts shall be clearly indicated in submittals, shall be consistent with product testing, and shall be subject to review by Owner.
- I. IES TM-15 limits for Backlight, Uplight, and Glare (BUG Ratings) shall be as specified for each luminaire type in Appendix A.
1. Calculation of BUG Ratings shall be for initial (worst-case) values, i.e., Light Loss Factor (LLF) = 1.0.
 2. If luminaires are tilted upward for calculations in section 1.6-D, BUG Ratings shall be calculated for the same angle(s) of tilt.
- J. Minimum Color Rendering Index (CRI): 70.
- K. Correlated Color Temperature (CCT)
1. If nominal CCT specified in Appendix A is listed in Table 1 below, measured CCT and Duv shall be as listed in Table 1.

Table 1. Allowable CCT and Duv (adapted from NEMA C78.377)

Manufacturer-Rated Nominal CCT (K)	Allowable LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
2700	2580 to 2870	-0.006 to 0.006
3000	2870 to 3220	-0.006 to 0.006
3500	3220 to 3710	-0.006 to 0.006
4000	3710 to 4260	-0.005 to 0.007
4500	4260 to 4746	-0.005 to 0.007
5000	4745 to 5311	-0.004 to 0.008
5700	5310 to 6020	-0.004 to 0.008
6500	6020 to 7040	-0.003 to 0.009

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2. If nominal CCT specified in Appendix A is not listed in Table 1, measured CCT and Duv shall be as per the criteria for Flexible CCT defined in NEMA C78.377.
- L. The following shall be in accordance with corresponding sections of ANSI C136.37
 1. Wiring and grounding
 - a. All internal components shall be assembled and pre-wired using modular electrical connections.
 2. Mounting provisions
 - a. Specific configurations are indicated in Appendix A
 3. Terminal blocks for incoming AC lines
 4. Photocontrol receptacle
 5. Latching and hinging
 6. Ingress protection

2.2. PRODUCT MANUFACTURERS

- A. Any manufacturer offering products that comply with the required product performance and operation criteria may be considered.

2.3. MANUFACTURER SERVICES

- A. Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email.

END OF SECTION

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Appendix A Application-Based System Specification

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APPENDIX A

APPLICATION-BASED SYSTEM SPECIFICATION
Veterans Blvd. from Armory Dr. to N. Main St. – 19 fixtures, 0.74 miles

SITE PARAMETERS		
ROADWAY DATA:	Lane width	14 ft
	Number of lanes, total on both sides of median	2
	Shoulder width, driveline to edge of pavement	1 ft
	Median width	0 ft
	IES pavement class.	<input type="checkbox"/> R1 <input type="checkbox"/> R2 <input checked="" type="checkbox"/> R3 <input type="checkbox"/> R4
	Posted speed limit	<input type="checkbox"/> ≤ 25 mph <input checked="" type="checkbox"/> > 25 mph
SIDEWALK DATA:	Sidewalk width	NA
	Edge of sidewalk to edge of roadway pavement	NA
LIGHT POLE DATA:	Luminaire mounting height	30 ft
	Arm length, horizontal	14 ft
	Luminaires per pole	1
	Pole set-back from edge of pavement	3 ft
	In-line pole spacing (one pole cycle)	225 ft
	Layout	<input checked="" type="checkbox"/> One side <input type="checkbox"/> Opposite <input type="checkbox"/> Staggered <input type="checkbox"/> Median
PERFORMANCE CRITERIA: APPLICATION		
ROADWAY		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	6.0 lux (0.6 fc)
	Avg:min uniformity ratio	6.0 : 1
PHOTOPIC LUMINANCE:	Maintained average luminance	n/a
	Avg:min uniformity ratio	n/a
	Max:min uniformity ratio	n/a
VEILING LUMINANCE:	Max. veiling luminance ratio	0.4
SIDEWALKS		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	2.0 lux (0.2 fc)
	Avg:min uniformity ratio (horizontal)	4.0 : 1
	Maintained min. vertical illum. at 4.9 ft, in directions of travel	1.0 lux (0.1 fc)
PERFORMANCE CRITERIA: LED LUMINAIRE		
INPUT POWER:	Max. nominal luminaire input power	170 W
NOMINAL CCT:	Rated correlated color temperature	4000 K
BUG¹ RATING:	Max. nominal backlight-uplight-glare ratings	B1-U2-G1
VOLTAGE:	Nominal luminaire input voltage	120 V
FINISH:	Luminaire housing finish color	Gray
WEIGHT:	Maximum luminaire weight	45 lb
EPA:	Maximum effective projected area	0.7 ft ²
MOUNTING:	Mtg. method	<input type="checkbox"/> Post-top <input type="checkbox"/> Side-arm <input checked="" type="checkbox"/> Trunnion/yoke <input type="checkbox"/> Swivel-tenon
	Tenon nominal pipe size (NPS)	2 inches
VIBRATION:	ANSI test level	<input checked="" type="checkbox"/> Level 1 (normal) <input type="checkbox"/> Level 2 (bridge/overpass)
DRIVER:	Control signal interface	<input checked="" type="checkbox"/> Not required <input type="checkbox"/> Required

¹ The deprecated “cutoff” classification system cannot be accurately applied to LED luminaires.

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APPLICATION-BASED SYSTEM SPECIFICATION
S. Main St. from Clayton St. to US Hwy. 231 – 9 fixtures, 0.36 miles

SITE PARAMETERS		
ROADWAY DATA:	Lane width	13.5 ft
	Number of lanes, total on both sides of median	3
	Shoulder width, driveline to edge of pavement	2 ft
	Median width	0 ft
	IES pavement class.	<input type="checkbox"/> R1 <input type="checkbox"/> R2 <input checked="" type="checkbox"/> R3 <input type="checkbox"/> R4
	Posted speed limit	<input type="checkbox"/> ≤ 25 mph <input checked="" type="checkbox"/> > 25 mph
SIDEWALK DATA:	Sidewalk width	NA
	Edge of sidewalk to edge of roadway pavement	NA
LIGHT POLE DATA:	Luminaire mounting height	27 ft
	Arm length, horizontal	6 ft
	Luminaires per pole	1
	Pole set-back from edge of pavement	2 ft
	In-line pole spacing (one pole cycle)	210 ft
	Layout	<input checked="" type="checkbox"/> One side <input type="checkbox"/> Opposite <input type="checkbox"/> Staggered <input type="checkbox"/> Median
PERFORMANCE CRITERIA: APPLICATION		
ROADWAY		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	6.0 lux (0.6 fc)
	Avg:min uniformity ratio	6.0 : 1
PHOTOPIC LUMINANCE:	Maintained average luminance	n/a
	Avg:min uniformity ratio	n/a
	Max:min uniformity ratio	n/a
VEILING LUMINANCE:	Max. veiling luminance ratio	0.4
SIDEWALKS		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	2.0 lux (0.2 fc)
	Avg:min uniformity ratio (horizontal)	4.0 : 1
	Maintained min. vertical illum. at 4.9 ft, in directions of travel	1.0 lux (0.1 fc)
PERFORMANCE CRITERIA: LED LUMINAIRE		
INPUT POWER:	Max. nominal luminaire input power	170 W
NOMINAL CCT:	Rated correlated color temperature	4000 K
BUG¹ RATING:	Max. nominal backlight-uplight-glare ratings	B1-U2-G1
VOLTAGE:	Nominal luminaire input voltage	120 V
FINISH:	Luminaire housing finish color	Gray
WEIGHT:	Maximum luminaire weight	45 lb
EPA:	Maximum effective projected area	0.7 ft ²
MOUNTING:	Mtg. method	<input type="checkbox"/> Post-top <input type="checkbox"/> Side-arm <input checked="" type="checkbox"/> Trunnion/yoke <input type="checkbox"/> Swivel-tenon
	Tenon nominal pipe size (NPS)	2 inches
VIBRATION:	ANSI test level	<input checked="" type="checkbox"/> Level 1 (normal) <input type="checkbox"/> Level 2 (bridge/overpass)
DRIVER:	Control signal interface	<input checked="" type="checkbox"/> Not required <input type="checkbox"/> Required

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APPLICATION-BASED SYSTEM SPECIFICATION
SA Graham Blvd. from US Hwy. 231 to Main St. – 35 fixtures, 0.36 miles

SITE PARAMETERS		
ROADWAY DATA:	Lane width	10 ft
	Number of lanes, total on both sides of median	4
	Shoulder width, driveline to edge of pavement	0 ft
	Median width	0 ft
	IES pavement class.	<input type="checkbox"/> R1 <input type="checkbox"/> R2 <input checked="" type="checkbox"/> R3 <input type="checkbox"/> R4
	Posted speed limit	<input type="checkbox"/> ≤ 25 mph <input checked="" type="checkbox"/> > 25 mph
SIDEWALK DATA:	Sidewalk width	NA
	Edge of sidewalk to edge of roadway pavement	NA
LIGHT POLE DATA:	Luminaire mounting height	27 ft
	Arm length, horizontal	12 ft
	Luminaires per pole	1
	Pole set-back from edge of pavement	6 ft
	In-line pole spacing (one pole cycle)	230 ft
	Layout	<input checked="" type="checkbox"/> One side <input type="checkbox"/> Opposite <input type="checkbox"/> Staggered <input type="checkbox"/> Median
PERFORMANCE CRITERIA: APPLICATION		
ROADWAY		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	6.0 lux (0.6 fc)
	Avg:min uniformity ratio	6.0 : 1
PHOTOPIC LUMINANCE:	Maintained average luminance	n/a
	Avg:min uniformity ratio	n/a
	Max:min uniformity ratio	n/a
VEILING LUMINANCE:	Max. veiling luminance ratio	0.5
SIDEWALKS		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	2.0 lux (0.2 fc)
	Avg:min uniformity ratio (horizontal)	4.0 : 1
	Maintained min. vertical illum. at 4.9 ft, in directions of travel	1.0 lux (0.1 fc)
PERFORMANCE CRITERIA: LED LUMINAIRE		
INPUT POWER:	Max. nominal luminaire input power	170 W
NOMINAL CCT:	Rated correlated color temperature	4000 K
BUG¹ RATING:	Max. nominal backlight-uplight-glare ratings	B1-U2-G1
VOLTAGE:	Nominal luminaire input voltage	120 V
FINISH:	Luminaire housing finish color	Gray
WEIGHT:	Maximum luminaire weight	45 lb
EPA:	Maximum effective projected area	0.7 ft ²
MOUNTING:	Mtg. method	<input type="checkbox"/> Post-top <input type="checkbox"/> Side-arm <input checked="" type="checkbox"/> Trunnion/yoke <input type="checkbox"/> Swivel-tenon
	Tenon nominal pipe size (NPS)	2 inches
VIBRATION:	ANSI test level	<input checked="" type="checkbox"/> Level 1 (normal) <input type="checkbox"/> Level 2 (bridge/overpass)
DRIVER:	Control signal interface	<input checked="" type="checkbox"/> Not required <input type="checkbox"/> Required

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APPLICATION-BASED SYSTEM SPECIFICATION
Galloway Rd. from Veterans Blvd. to 7th Ave. – 22 fixtures, 0.76 miles

SITE PARAMETERS		
ROADWAY DATA:	Lane width	9.5 ft
	Number of lanes, total on both sides of median	2
	Shoulder width, driveline to edge of pavement	0 ft
	Median width	0 ft
	IES pavement class.	<input type="checkbox"/> R1 <input type="checkbox"/> R2 <input checked="" type="checkbox"/> R3 <input type="checkbox"/> R4
	Posted speed limit	<input type="checkbox"/> ≤ 25 mph <input checked="" type="checkbox"/> > 25 mph
SIDEWALK DATA:	Sidewalk width	NA
	Edge of sidewalk to edge of roadway pavement	NA
LIGHT POLE DATA:	Luminaire mounting height	27 ft
	Arm length, horizontal	6 ft
	Luminaires per pole	1
	Pole set-back from edge of pavement	4 ft
	In-line pole spacing (one pole cycle)	150 ft
	Layout	<input checked="" type="checkbox"/> One side <input type="checkbox"/> Opposite <input type="checkbox"/> Staggered <input type="checkbox"/> Median
PERFORMANCE CRITERIA: APPLICATION		
ROADWAY		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	5.0 lux (0.5 fc)
	Avg:min uniformity ratio	6.0 : 1
PHOTOPIC LUMINANCE:	Maintained average luminance	n/a
	Avg:min uniformity ratio	n/a
	Max:min uniformity ratio	n/a
VEILING LUMINANCE:	Max. veiling luminance ratio	0.3
SIDEWALKS		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	2.0 lux (0.2 fc)
	Avg:min uniformity ratio (horizontal)	4.0 : 1
	Maintained min. vertical illum. at 4.9 ft, in directions of travel	1.0 lux (0.1 fc)
PERFORMANCE CRITERIA: LED LUMINAIRE		
INPUT POWER:	Max. nominal luminaire input power	110 W
NOMINAL CCT:	Rated correlated color temperature	4000 K
BUG¹ RATING:	Max. nominal backlight-uplight-glare ratings	B1-U2-G1
VOLTAGE:	Nominal luminaire input voltage	120 V
FINISH:	Luminaire housing finish color	Gray
WEIGHT:	Maximum luminaire weight	45 lb
EPA:	Maximum effective projected area	0.7 ft ²
MOUNTING:	Mtg. method	<input type="checkbox"/> Post-top <input type="checkbox"/> Side-arm <input checked="" type="checkbox"/> Trunnion/yoke <input type="checkbox"/> Swivel-tenon
	Tenon nominal pipe size (NPS)	2 inches
VIBRATION:	ANSI test level	<input checked="" type="checkbox"/> Level 1 (normal) <input type="checkbox"/> Level 2 (bridge/overpass)
DRIVER:	Control signal interface	<input checked="" type="checkbox"/> Not required <input type="checkbox"/> Required

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APPLICATION-BASED SYSTEM SPECIFICATION
N. Main St. from 6th Ave. to Southern Classic Foods Group – 18 fixtures, 0.78 miles

SITE PARAMETERS		
ROADWAY DATA:	Lane width	13.5 ft
	Number of lanes, total on both sides of median	2
	Shoulder width, driveline to edge of pavement	1 ft
	Median width	0 ft
	IES pavement class.	<input type="checkbox"/> R1 <input type="checkbox"/> R2 <input checked="" type="checkbox"/> R3 <input type="checkbox"/> R4
	Posted speed limit	<input type="checkbox"/> ≤ 25 mph <input checked="" type="checkbox"/> > 25 mph
SIDEWALK DATA:	Sidewalk width	NA
	Edge of sidewalk to edge of roadway pavement	NA
LIGHT POLE DATA:	Luminaire mounting height	27 ft
	Arm length, horizontal	6 ft
	Luminaires per pole	1
	Pole set-back from edge of pavement	4 ft
	In-line pole spacing (one pole cycle)	300 ft
	Layout	<input checked="" type="checkbox"/> One side <input type="checkbox"/> Opposite <input type="checkbox"/> Staggered <input type="checkbox"/> Median
PERFORMANCE CRITERIA: APPLICATION		
ROADWAY		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	6.0 lux (0.6 fc)
	Avg:min uniformity ratio	6.0 : 1
PHOTOPIC LUMINANCE:	Maintained average luminance	n/a
	Avg:min uniformity ratio	n/a
	Max:min uniformity ratio	n/a
VEILING LUMINANCE:	Max. veiling luminance ratio	0.5
SIDEWALKS		
PHOTOPIC ILLUMINANCE:	Maintained average horizontal at pavement	2.0 lux (0.2 fc)
	Avg:min uniformity ratio (horizontal)	4.0 : 1
	Maintained min. vertical illum. at 4.9 ft, in directions of travel	1.0 lux (0.1 fc)
PERFORMANCE CRITERIA: LED LUMINAIRE		
INPUT POWER:	Max. nominal luminaire input power	200 W
NOMINAL CCT:	Rated correlated color temperature	4000 K
BUG¹ RATING:	Max. nominal backlight-uplight-glare ratings	B1-U2-G1
VOLTAGE:	Nominal luminaire input voltage	120 V
FINISH:	Luminaire housing finish color	Gray
WEIGHT:	Maximum luminaire weight	45 lb
EPA:	Maximum effective projected area	0.7 ft ²
MOUNTING:	Mtg. method	<input type="checkbox"/> Post-top <input type="checkbox"/> Side-arm <input checked="" type="checkbox"/> Trunnion/yoke <input type="checkbox"/> Swivel-tenon
	Tenon nominal pipe size (NPS)	2 inches
VIBRATION:	ANSI test level	<input checked="" type="checkbox"/> Level 1 (normal) <input type="checkbox"/> Level 2 (bridge/overpass)
DRIVER:	Control signal interface	<input checked="" type="checkbox"/> Not required <input type="checkbox"/> Required

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Appendix B

Estimating LED Lumen Maintenance

IES TM-21 allows for extrapolation of expected lumen maintenance from available test data. The extent of such extrapolation is limited by the duration of testing completed and the number of samples used in the testing. The TM-21 methodology shall be used by the manufacturer to determine lamp lumen depreciation (LLD) at end of lumen maintenance life per section 1.6-C.

The applicant may estimate lumen maintenance in one of two ways:

Option 1: Component Performance

Under this compliance path, the applicant must submit calculations per TM-21 predicting lumen maintenance at the luminaire level using In Situ Temperature Measurement Testing (ISTMT) and LM-80 data. To be eligible for the Component Performance option, ALL of the conditions below must be met. If ANY of the conditions is not met, the component performance option may not be used and the applicant must use Option 2 for compliance.

1. The LED light source(s) have been tested according to LM-80.
2. The LED drive current specified by the luminaire manufacturer is less than or equal to the drive current specified in the LM-80 test report.
3. The LED light source(s) manufacturer prescribes/indicates a temperature measurement point (T_S) on the light source(s).
4. The T_S is accessible to allow temporary attachment of a thermocouple for measurement of in situ temperature. Access via a temporary hole in the housing, tightly resealed during testing with putty or other flexible sealant is allowable.
5. For the hottest LED light source in the luminaire, the temperature measured at the T_S during ISTMT is less than or equal to the temperature specified in the LM-80 test report for the corresponding drive current or higher, within the manufacturer's specified operating current range.
 - a. The ISTMT laboratory must be approved by OSHA as a Nationally Recognized Testing Lab (NRTL), must be qualified, verified, and recognized through DOE's CALiPER program, or must be recognized through UL's Data Acceptance Program.
 - b. The ISTMT must be conducted with the luminaire installed in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires), with bird-fouling appropriately simulated (and documented by photograph) as determined by the manufacturer.

Option 2: Luminaire Performance

Under this compliance path, the applicant must submit TM-21 calculations based on LM-79 photometric test data for no less than three samples of the entire luminaire. Duration of operation and interval between photometric tests shall conform to the TM-21 criteria for LED light sources. For example, testing solely at 0 and 6000 hours of operation would not be adequate for the purposes of extrapolation.

Between LM-79 tests, the luminaire test samples must be operated long-term in the appropriate application as defined by ANSI/UL 1598 (hardwired luminaires). The test laboratory must hold

NVLAP accreditation for the LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy (DOE)'s CALiPER program. The extent of allowable extrapolation (either 5.5 or 6 times the test duration) depends on the total number of LED light sources (no less than 10 and preferably more than 19) installed in the luminaire samples, as per TM-21.

This compliance path poses a greater testing burden to luminaire manufacturers but incorporates long-term testing of other components in the system, such as drivers.

Under either compliance path, values used for extrapolation shall be summarized per TM-21 Tables 1 and 2. Submitted values for lumen maintenance lifetime and the associated percentage lumen maintenance shall be "reported" rather than "projected" as defined by TM-21. Supporting diagrams are requested to facilitate interpretation by Owner.

**APPENDIX C
PRODUCT FAMILY TESTING
LM-79 AND ISTMT**

It is recognized that due to the time and cost required for product testing, it would not be realistic to expect manufacturers offering a multitude of unique luminaire configurations to test every possible configuration. Therefore, the “product families” method may be utilized for LM-79 and ISTMT, whereby manufacturers identify a set of representative products for which test data can be used to demonstrate the accuracy of interpolated or extrapolated performance of product configurations lacking test data. Precedent for this approach can be found in LM-80.

If the particular luminaire configuration submitted has not been tested, the performance may be conservatively represented by test data for another luminaire configuration having:

- The same intensity distribution (typically only applies to LM-79)
- The same or lower nominal CCT
- The same or higher nominal drive current
- The same or greater number of LED light source(s)
- The same or lower percentage driver loading and efficiency
- The same or smaller size luminaire housing.

A more accurate estimate of performance can be obtained by linear interpolation between two or more tests differing in terms of the six parameters listed above. For example, consider a hypothetical luminaire offered in a single size housing, and having the following parameters:

- Three intensity distributions: IES Type II, III, or IV
- Three CCTs: 4000, 5000, and 6000K
- Three drive currents: 350, 525, and 700 mA
- Four LED quantities: 20, 40, 60, or 80 LEDs.

Table C.1 illustrates a set of tests which could allow for accurate interpolation between tested configurations, given a single luminaire housing size and essentially constant driver efficiency; these 10 tests may provide representative data for the 108 possible product configurations. Note that normalized intensity distribution must not be affected by the other three parameters.

Table C.1. Representative testing of a single luminaire housing size

Tests	Intensity distribution (IES Type)	CCT (K)	Drive current (mA)	# of LEDs
1, 2, 3	II, III, IV	4000	700	80
4, 5	IV	5000, 6000	700	80
6, 7	IV	4000	325, 525	80
8, 9, 10	IV	4000	700	20, 40, 60

For example, the manufacturer could detail interpolation as shown in Table C.2, applying the following multipliers to the base test #2 to model a configuration with Type III intensity distribution, 5000K CCT, 525 mA drive current, and 40 LEDs:

- Ratio of test #4 lumens to test #3 lumens
- Ratio of test #7 lumens to test #3 lumens
- Ratio of test #9 lumens to test #3 lumens.

Table C.2. Multipliers for Test #2 to yield: Type III , 5000K, 525mA, 40 LEDs

Test #	Intensity distribution (IES Type)	CCT (K)	Drive current (mA)	# of LEDs	Multiplier (lumens ratio)
2	III	4000	700	80	n/a
3	IV	4000	700	80	n/a
4	IV	5000	700	80	#4 / #3
7	IV	4000	525	80	#7 / #3
9	IV	4000	700	40	#9 / #3

Interpolation between minimal LM-79 and ISTMT data is more difficult if housing size increases with increasing wattage; it may not be clear whether the lowest-wattage configuration would be expected to “run cooler” than the highest-wattage configuration. In these circumstances, the adequacy of submitted data is subject to Owner approval.

At this time, the “successor” method cannot be used; luminaires tested must utilize the LED light source(s) characterized by the submitted LM-80 report.

APPENDIX D ELECTRICAL IMMUNITY

Test Procedure

- Electrical Immunity Tests 1, 2 and 3, as defined by their Test Specifications, shall be performed on an entire powered and connected luminaire, including any control modules housed within the luminaire, but excluding any control modules mounted externally, such as a NEMA socket connected photo-control. A shorting cap should be placed across any such exterior connector.
- The luminaire shall be connected to an AC power source with a configuration appropriate for nominal operation. The AC power source shall have a minimum available short-circuit current of 200A. The luminaire shall be tested at the nominal input voltage specified in Appendix A, or at the highest input voltage in the input voltage range specified in Appendix A.
- Electrical Immunity test waveforms shall be superimposed on the input AC power line at a point within 6 inches (15cm) of entry into the luminaire using appropriate high-voltage probes and a series coupler/decoupler network (CDN) appropriate for each coupling mode, as defined by ANSI/IEEE C62.45-2002. The test area for all tests shall be set up according to ANSI/IEEE C62.45-2002, as appropriate.
- Prior to electrical immunity testing a set of diagnostic measurements shall be performed, and the results recorded to note the pre-test function of the luminaire after it has reached thermal equilibrium. These measurements should include at a minimum:
 - a) For all luminaires, Real Power, Input RMS Current, Power Factor and THD at full power/light output
 - b) For luminaires specified as dimmable, Real Power, Input RMS Current, Power Factor and THD at a minimum of 4 additional dimmed levels, including the rated minimum dimmed level
- Tests shall be applied in sequential order (Test 1, followed by Test 2, followed by Test 3). If a failure occurs during Test 3, then Test 3 shall be re-applied to a secondary luminaire of identical construction.
- Following the completion of Tests 1, 2, and 3, the same set of diagnostic measurements performed pre-test should be repeated for all tested luminaires, and the results recorded to note the post-test function of the luminaire(s).
- A luminaire must function normally and show no evidence of failure following the completion of Test 1 + Test 2 + Test 3 (for a single tested luminaire), or the completion of Test 1 + Test 2 on a primary luminaire and Test 3 on a secondary luminaire. Abnormal behavior during testing is acceptable.
- A luminaire failure will be deemed to have occurred if any of the following conditions exists following the completion of testing:
 - a) A hard power reset is required to return to normal operation
 - b) A noticeable reduction in full light output (e.g. one or more LEDs fail to produce light, or become unstable) is observed
 - c) Any of the post-test diagnostic measurements exceeds by $\pm 5\%$ the corresponding pre-test diagnostic measurement.
 - d) The luminaire, or any component in the luminaire (including but not limited to an electrical connector, a driver, a protection component or module) has ignited or shows evidence of melting or other heat-induced damage. Evidence of cracking, splitting, rupturing, or smoke damage on any component is acceptable.

Test Specifications

NOTE: L1 is typically “HOT”, L2 is typically “NEUTRAL” and PE = Protective Earth.

Test 1) Ring Wave: The luminaire shall be subjected to repetitive strikes of a “C Low Ring Wave” as defined in IEEE C62.41.2-2002, Scenario 1, Location Category C. The test strikes shall be applied as specified by Table D.1. Prior to testing, the ring wave generator shall be calibrated to simultaneously meet BOTH the specified short circuit current peak and open circuit voltage peak MINIMUM requirements. Note that this may require that the generator charging voltage be raised above the specified level to obtain the specified current peak. Calibrated current probes/transformers designed for measuring high-frequency currents shall be used to measure test waveform currents.

Test waveform current shapes and peaks for all strikes shall be compared to ensure uniformity throughout each set (coupling mode + polarity/phase angle) of test strikes, and the average peak current shall be calculated and recorded. If any individual peak current in a set exceeds by $\pm 10\%$ the average, the test setup shall be checked, and the test strikes repeated.

Table D.1: 0.5 μ S – 100Hz Ring Wave Specification

Parameter	Test Level/Configuration
Short Circuit Current Peak	0.5 kA
Open Circuit Voltage Peak	6 kV
Source Impedance	12 Ω
Coupling Modes	L1 to PE, L2 to PE, L1 to L2
Polarity and Phase Angle	Positive at 90° and Negative at 270°
Test Strikes	5 for each Coupling Mode and Polarity/Phase Angle combination
Time between Strikes	1 minute
Total Number of Strikes	= 5 strikes x 4 coupling modes x 2 polarity/phase angles = 40 total strikes

Test 2) Combination Wave: The luminaire shall be subjected to repetitive strikes of a “C High Combination Wave” or “C Low Combination Wave”, as defined in IEEE C62.41.2-2002, Scenario 1, Location Category C. The test strikes shall be applied as specified by Table D.2. The “Low” test level shall be used for luminaires with **Basic** Electrical Immunity requirements, while the “High” test level shall be used for luminaires with **Elevated** Electrical Immunity requirements. (Elevated Electrical Immunity is required for the quoted luminaires.) Prior to testing, the combination wave generator shall be calibrated to simultaneously meet BOTH the specified short circuit current peak and open circuit voltage peak MINIMUM requirements. Note that this may require that the generator charging voltage be raised above the specified level to obtain the specified current peak. Calibrated current probes/transformers designed for measuring high-frequency currents shall be used to measure test waveform currents.

Test waveform current shapes and peaks for all strikes shall be compared to ensure uniformity throughout each set (coupling mode + polarity/phase angle) of test strikes, and the average peak

current shall be calculated and recorded. If any individual peak current in a set exceeds by $\pm 10\%$ the average, the test setup shall be checked, and the test strikes repeated.

Table D.2: 1.2/50 μ S – 8/20 μ S Combination Wave Specification

Parameter	Test Level/ Configuration	
1.2/50 μ S Open Circuit Voltage Peak	Low: 6 kV	High: 10kV
8/20 μ S Short Circuit Current Peak	Low: 3 kA	High: 10kA
Source Impedance	2 Ω	
Coupling Modes	L1 to PE, L2 to PE, L1 to L2	
Polarity and Phase Angle	Positive at 90° and Negative at 270°	
Test Strikes	5 for each Coupling Mode and Polarity/Phase Angle combination	
Time Between Strikes	1 minute	
Total Number of Strikes	= 5 strikes x 4 coupling modes x 2 polarity/phase angles = 40 total strikes	

Test 3) Electrical Fast Transient (EFT): The luminaire shall be subjected to “Electrical Fast Transient Bursts”, as defined in IEEE C62.41.2 -2002. The test area shall be set up according to IEEE C62.45-2002. The bursts shall be applied as specified by Table D.3. Direct coupling is required; the use of a coupling clamp is not allowed.

Table D.3: Electrical Fast Transient (EFT) Specification

Parameter	Test Level/ Configuration
Open Circuit Voltage Peak	3 kV
Burst Repetition Rate	2.5 kHz
Burst Duration	15 mS
Burst Period	300 mS
Coupling Modes	L1 to PE, L2 to PE, L1 to L2
Polarity	Positive and Negative
Test Duration	1 minute for each Coupling Mode and Polarity combination
Total Test Duration	= 1 minute x 7 coupling modes x 2 polarities = 14 minutes

**APPENDIX E
PRODUCT SUBMITTAL FORM**

Luminaire Type ¹		
Manufacturer		
Model number		
Housing finish color		
Tenon nominal pipe size (inches)		
Nominal luminaire weight (lb)		
Nominal luminaire EPA (ft ²)		
Nominal input voltage (V)		
ANSI vibration test level	<input checked="" type="checkbox"/> Level 1 (Normal)	<input type="checkbox"/> Level 2 (bridge/overpass)
Nominal BUG Ratings		
Make/model of LED light source(s)		
Make/model of LED driver(s)		
Dimmability	<input type="checkbox"/> Dimmable	<input type="checkbox"/> Not dimmable
Control signal interface		
Upon electrical immunity system failure	<input type="checkbox"/> Possible disconnect	<input type="checkbox"/> No possible disconnect
Thermal management	<input type="checkbox"/> Moving parts	<input checked="" type="checkbox"/> No moving parts
Lumen maintenance testing duration (hr)		
Reported lumen maintenance life (hr) ²		
Warranty period (yr)		
Parameter	Nominal value	Tolerance (%)
Initial photopic output (lm)		
Maintained photopic output (lm)		
Lamp lumen depreciation		
Initial input power (W)		
Maintained input power (W)		
Initial LED drive current (mA)		
Maintained LED drive current (mA)		
Drive current used		
In-situ LED T _c (°C)		
CCT (K)		
S/P ratio		
Additional product description		

¹ See Appendix A, and attach supporting documentation as required.

² Value shall be no less than as specified in section 1.6-C, and shall not exceed six times the testing duration indicated in the row above. Value shall be consistent with values submitted in the rows below for maintained light output, maintained input power, and maintained drive current.

ENERGY EFFICIENCY AND CONSERVATION BLOCK GRANT (EECBG) CONTRACT FLOWDOWN PROVISIONS

Contractor agrees to comply with all of the following provisions and require any and all subawards and contracts awarded by the Contractor, including small purchases, to contain the following provisions as applicable:

- 1. RESOLUTION OF CONFLICTING CONDITIONS:** Any apparent inconsistency between Federal statutes and regulations and the terms and conditions contained in this award must be referred to the ADECA Energy Division Program Manager for guidance.
- 2. USE OF PROGRAM INCOME:** If you earn program income during the project period as a result of this award, you may add the program income to the funds committed to the award and used to further eligible project objectives.
- 3. STATEMENT OF FEDERAL STEWARDSHIP:** The Energy Division will exercise normal stewardship in overseeing the project activities performed under this award. Stewardship activities include, but are not limited to, conducting site visits; reviewing performance and financial reports; providing technical assistance and/or temporary intervention in unusual circumstances to correct deficiencies which develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the award objectives have been accomplished.
- 4. SITE VISITS:** The Energy Division has the right to make site visits at reasonable times to review project accomplishments and management control systems and to provide technical assistance, if required. You must provide, and must require your subawardees to provide, reasonable access to facilities, office space, resources, and assistance for the safety and convenience of the government representatives in the performance of their duties. All site visits and evaluations must be performed in a manner that does not unduly interfere with or delay the work.
- 5. REPORTING REQUIREMENTS:** The reporting requirements for this award are identified in the Subgrant Agreement. Failure to comply with these reporting requirements is considered a material noncompliance with the terms of the award. Noncompliance may result in withholding of future payments, suspension or termination of the current award, and withholding of future awards. A willful failure to perform, a history of failure to perform, or unsatisfactory performance of this and/or other financial assistance awards, may also result in a debarment action to preclude future awards by Federal agencies.
- 6. PUBLICATIONS:** You are encouraged to publish or otherwise make publicly available the results of the work conducted under the award. An acknowledgment of DOE support and a disclaimer must appear in the publication of any material, whether copyrighted or not, based on or developed under this project, as follows:
 - a) *Acknowledgment:* "This material is based upon work supported by the U.S. Department of Energy under Award Number DE-EE0000831."
 - b) *Disclaimer:* "This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency

thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.”

An application may contain technical data and other data, including trade secrets and/or privileged or confidential information, which the applicant does not want disclosed to the public or used by the Government for any purpose other than the application. To protect such data, the applicant should specifically identify each page including each line or paragraph thereof containing the data to be protected and mark the cover sheet of the application.

- 7. FEDERAL, STATE, AND MUNICIPAL REQUIREMENTS:** You must obtain any required permits, ensure the safety and structural integrity of any repair, replacement, construction and/or alteration, and comply with applicable federal, state, and municipal laws, codes, and regulations for work performed under this award.
- 8. LOBBYING RESTRICTIONS:** By accepting funds under this award, you agree that none of the funds obligated on the award shall be expended, directly or indirectly, to influence congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. 1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.
- 9. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REQUIREMENTS:** You are restricted from taking any action using Federal funds, which would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to DOE providing either a NEPA clearance or a final NEPA decision regarding this project.
- 10. NATIONAL HISTORIC PRESERVATION ACT (NHPA) REQUIREMENTS:** Prior to the expenditure of Project funds to alter any historic structure or site, the Recipient or subrecipient shall ensure that it is compliant with Section 106 of the National Historic Preservation Act (NHPA), consistent with DOE’s 2009 letter of delegation of authority regarding the NHPA.
- 11. WASTE STREAM:** The Recipient assures that it will create or obtain a waste management plan addressing waste generated by a proposed Project prior to the Project generating waste. This waste management plan will describe the Recipient's or subrecipient's plan to dispose of any sanitary or hazardous waste (e.g., construction and demolition debris, old light bulbs, lead ballasts, piping, roofing material, discarded equipment, debris, and asbestos) generated as a result of the proposed Project. The Recipient shall ensure that the Project is in compliance with all Federal, state and local regulations for waste disposal. The Recipient shall make the waste management plan and related documentation available to DOE on DOE's request (for example, during a post-award audit).
- 12. DECONTAMINATION AND/OR DECOMMISSIONING (D&D) COSTS:** Notwithstanding any other provisions of this Agreement, the Government shall not be responsible for or have any obligation to the Recipient for (i) Decontamination and/or Decommissioning (D&D) of any of the Recipient’s facilities, or (ii) any costs which may be incurred by the Recipient in connection with the D&D of any of its facilities due to the performance of the work under this Agreement, whether said work was performed prior to or subsequent to the effective date of the Agreement.
- 13. ADVANCE UNDERSTANDING CONCERNING PUBLICLY FINANCED ENERGY IMPROVEMENT PROGRAMS:** The parties recognize that the Recipient may use funds under this award for Property-Assessed Clean Energy (PACE) loans, Sustainable Energy Municipal Financing, Clean Energy Assessment Districts, Energy Loan Tax Assessment Programs (ELTAPS), or any other form or derivation of Special Taxing District whereby taxing entities collect payments through increased tax assessments for energy efficiency and renewable energy building improvements made by their constituents. The

Department of Energy intends to publish "Best Practices" or other guidelines pertaining to the use of funds made available to the Recipient under this award pertaining to the programs identified herein. By accepting this award, the Recipient agrees to incorporate, to the maximum extent practicable, those Best Practices and other guidelines into any such program(s) within a reasonable time after notification by DOE that the Best Practices or guidelines have been made available. The Recipient also agrees, by its acceptance of this award, to require its sub-recipients to incorporate to the maximum extent practicable the best practices and other guideline into any such program used by the sub-recipient.

14.SEGREGATION OF COSTS: Recipients must segregate the obligations and expenditures related to funding under the Recovery Act. Financial and accounting systems should be revised as necessary to segregate, track and maintain these funds apart and separate from other revenue streams. No part of the funds from the Recovery Act shall be commingled with any other funds or used for a purpose other than that of making payments for costs allowable for Recovery Act projects.

15.PROHIBITION ON USE OF FUNDS: None of the funds provided under this agreement derived from the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, may be used by any State or local government, or any private entity, for any casino or other gambling establishment, aquarium, zoo, golf course, or swimming pool.

16.ACCESS TO RECORDS: With respect to each financial assistance agreement awarded utilizing at least some of the funds appropriated or otherwise made available by the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, any representative of an appropriate inspector general appointed under section 3 or 8G of the Inspector General Act of 1988 (5 U.S.C. App.) or of the Comptroller General is authorized – (1) to examine any records of the contractor or grantee, any of its subcontractors or subgrantees, or any State or local agency administering such contract that pertain to, and involve transactions that relate to, the subcontract, subcontract, grant, or subgrant; and (2) to interview any officer or employee of the contractor, grantee, subgrantee, or agency regarding such transactions.

17.PROTECTING STATE AND LOCAL GOVERNMENT AND CONTRACTOR WHISTLEBLOWERS: An employee of any non-Federal employer receiving covered funds under the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, may not be discharged, demoted, or otherwise discriminated against as a reprisal for disclosing, including a disclosure made in the ordinary course of an employee's duties, to the Accountability and Transparency Board, an inspector general, the Comptroller General, a member of Congress, a State or Federal regulatory or law enforcement agency, a person with supervisory authority over the employee (or other person working for the employer who has the authority to investigate, discover or terminate misconduct), a court or grant jury, the head of a Federal agency, or their representatives information that the employee believes is evidence of:

- a) gross management of an agency contract or grant relating to covered funds;
- b) a gross waste of covered funds;
- c) a substantial and specific danger to public health or safety related to the implementation or use of covered funds;
- d) an abuse of authority related to the implementation or use of covered funds; or
- e) as violation of law, rule, or regulation related to an agency contract (including the competition for or negotiation of a contract) or grant, awarded or issued relating to covered funds.

Requirement to Post Notice of Rights and Remedies: Any employer receiving covered funds under the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, shall post notice of the rights and remedies as required therein. (Refer to section 1553 of the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, www.Recovery.gov, for specific requirements of this section and prescribed language for the notices.)

18.FALSE CLAIMS ACT: Recipient and sub-recipients shall promptly refer to the DOE or other appropriate Inspector General any credible evidence that a principal, employee, agent, contractor, sub-grantee, subcontractor or other person has submitted a false claim under the False Claims Act or has committed a criminal or civil violation of laws pertaining to fraud, conflict of interest, bribery, gratuity or similar misconduct involving those funds.

19.INFORMATION IN SUPPORT OF RECOVERY ACT REPORTING: Recipient may be required to submit backup documentation for expenditures of funds under the Recovery Act including such items as timecards and invoices. Recipient shall provide copies of backup documentation at the request of the Energy Division Program Manager, DOE Contracting Officer or designee.

20.AVAILABILITY OF FUNDS: Any commitment of funds shall be contingent upon the receipt and availability of funds under the program for which this Agreement is made. Payments made by the Department under the terms of this Agreement shall not constitute final approval of documents submitted by the Contractor. Funds appropriated under the Recovery Act and obligated to this award are available for reimbursement of costs until the end of the performance period set forth in the Subgrant Agreement.

21.CERTIFICATIONS: With respect to funds made available to State or local governments for infrastructure investments under the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, the Governor, mayor, or other chief executive, as appropriate, certified by acceptance of this award that the infrastructure investment has received the full review and vetting required by law and that the chief executive accepts responsibility that the infrastructure investment is an appropriate use of taxpayer dollars. Recipient shall provide an additional certification that includes a description of the investment, the estimated total cost, and the amount of covered funds to be used for posting on the Internet. A State or local agency may not receive infrastructure investment funding from funds made available by the Act unless this certification is made and posted.

22.REPORTING AND REGISTRATION UNDER ARRA SECTION 1512: The reporting requirements for this award are identified in the Subgrant Agreement. This award requires the recipient to complete projects or activities which are funded under the American Recovery and Reinvestment Act of 2009 (Recovery Act) and to report on use of Recovery Act funds provided through this award. Information in these reports will be provided to the public. Failure to comply with these reporting requirements is considered a material noncompliance with the terms of the award. Noncompliance may result in withholding of future payments, suspension, or termination of the current award, and withholding of future awards. A willful failure to perform, a history of failure to perform, or unsatisfactory performance of this and/or other financial assistance awards, may also result in a debarment action to preclude future awards by Federal agencies.

23.NOTICE REGARDING THE PURCHASE OF AMERICAN-MADE EQUIPMENT AND PRODUCTS -- SENSE OF CONGRESS: It is the sense of the Congress that, to the greatest extent practicable, all equipment and products purchased with funds made available under this award should be American-made.

24.REQUIRED USE OF AMERICAN IRON, STEEL, AND MANUFACTURED GOODS – SECTION 1605 OF THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009: Sec. 1605. Use of American Iron, Steel, and Manufactured Goods.

- a) None of the funds appropriated or otherwise made available by this Act may be used for a project for the construction, alteration, maintenance, or repair of a public building or public work unless all of the iron, steel, and manufactured goods used in the project are produced in the United States.

- b) Subsection (a) shall not apply in any case or category of cases in which the head of the Federal department or agency involved finds that—
 - 1. applying subsection (a) would be inconsistent with the public interest;
 - 2. iron, steel, and the relevant manufactured goods are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
 - 3. inclusion of iron, steel, and manufactured goods produced in the United States will increase the cost of the overall project by more than 25 percent.
- c) If the head of a Federal department or agency determines that it is necessary to waive the application of subsection (a) based on a finding under subsection (b), the head of the department or agency shall publish in the Federal Register a detailed written justification as to why the provision is being waived.
- d) This section shall be applied in a manner consistent with United States obligations under international agreements.

25. RECOVERY ACT TRANSACTIONS:

- a) To maximize the transparency and accountability of funds authorized under the American Recovery and Reinvestment Act of 2009 (Pub. L. 111-5) (Recovery Act) as required by Congress and in accordance with 2 CFR 215.21 "Uniform Administrative Requirements for Grants and Agreements" and OMB Circular A-102 Common Rules provisions, recipients agree to maintain records that identify adequately the source and application of Recovery Act funds.
- b) For recipients covered by the Single Audit Act Amendments of 1996 and OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations," recipients agree to separately identify the expenditures for Federal awards under the Recovery Act on the Schedule of Expenditures of Federal Awards (SEFA) and the Data Collection Form (SF-SAC) required by OMB Circular A-133.
- c) Recipients agree to separately identify to each subrecipient, and document at the time of subaward and at the time of disbursement of funds, the Federal award number, CFDA number, and amount of Recovery Act funds. When a recipient awards Recovery Act funds for an existing program, the information furnished to subrecipients shall distinguish the subawards of incremental Recovery Act funds from regular subawards under the existing program.
- d) Recipients agree to require their subrecipients to include on their SEFA information to specifically identify Recovery Act funding similar to the requirements for the recipient SEFA described above. This information is needed to allow the recipient to properly monitor subrecipient expenditure of ARRA funds as well as oversight by the Federal awarding agencies, Offices of Inspector General and the Government Accountability Office.

26. DAVIS-BACON ACT: When required by Federal program legislation, all construction contracts awarded by the recipients and subrecipients of more than \$2,000 shall include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 276a to a-7) and as supplemented by Department of Labor regulations (29 CFR part 5, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction"). Under this Act, contractors shall be required to pay wages to laborers and mechanics at a rate not less than the minimum wages specified in a wage determination made by the Secretary of Labor. In addition, contractors shall be required to pay wages not less than once a week. The recipient shall place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation and the award of a contract shall be conditioned upon the acceptance of the wage determination. The recipient shall report all suspected or reported violations to the Federal awarding agency. Current wage determinations for the appropriate county can be found at <http://www.wdol.gov/dba.aspx#0>.

27. WAGE RATE REQUIREMENTS UNDER ARRA SECTION 1606: Section 1606 of the Recovery Act (ARRA) requires that all laborers and mechanics employed by contractors and subcontractors on projects funded directly or assisted in whole or in part by and through the Federal Government

pursuant to the ARRA shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code.

28.CONTRACT WORK HOURS AND SAFETY STANDARDS ACT: Where applicable, all contracts awarded by recipients in excess of \$2000 for construction contracts and in excess of \$2,500 for other contracts that involve the employment of mechanics or laborers shall include a provision for compliance with Sections 102 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-333), as supplemented by Department of Labor regulations (29 CFR part 5). Under Section 102 of the Act, each contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than 1 ½ times the basic rate of pay for all hours worked in excess of 40 hours in the work week. Section 107 of the Act is applicable to construction work and provides that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

29.COPELAND "ANTI-KICKBACK" ACT: All contracts and subgrants in excess of \$2,000 for construction or repair awarded by recipients and subrecipients shall include a provision for compliance with the Copeland "Anti-Kickback" Act (18 U.S.C. 874), as supplemented by Department of Labor regulations (29 CFR part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he is otherwise entitled. The recipient shall report all suspected or reported violations to the Federal awarding agency.

30.DEBARMENT AND SUSPENSION: No contract shall be made to parties listed on the General Services Administration's List of Parties Excluded from Federal Procurement or Nonprocurement Programs in accordance with E.O.s 12549 and 12689, "Debarment and Suspension." This list contains the names of parties debarred, suspended, or otherwise excluded by agencies, and contractors declared ineligible under statutory or regulatory authority other than E.O. 12549. Contractors with awards that exceed the small purchase threshold shall provide the required certification regarding its exclusion status and that of its principal employees.

31.PRESERVATION OF OPEN COMPETITION AND GOVERNMENT NEUTRALITY TOWARDS CONTRACTORS' LABOR RELATIONS ON FEDERALLY FUNDED CONSTRUCTION PROJECTS: s

- a) Unless in conflict with State or local laws, you must ensure that bid specifications, project agreement, or other controlling documents in construction contracts awarded pursuant to this agreement, or pursuant to a subaward to this agreement, do not:
 - 1. Require or prohibit bidders, offerors, contractors, or subcontractors to enter into or adhere to agreements with one or more labor organizations, on the same or other related construction project(s); or
 - 2. Otherwise discriminate against bidders, offerors, contractors, or subcontractors for becoming or refusing to become or remain signatories or otherwise to adhere to agreements with one or more labor organizations, on the same or other related construction project(s).
- b) The term "construction contract" as used in this provision means any contract for the construction, rehabilitation, alteration, conversion, extension, or repair of buildings, highways, or other improvements to real property.

- c) Nothing in this provision prohibits bidders, offerors, contractors, or subcontractors from voluntarily entering into agreements with labor organizations.

32. RIGHTS TO INVENTIONS MADE UNDER A CONTRACT OR AGREEMENT: Contracts or agreements for the performance of experimental, developmental, or research work shall provide for the rights of the Federal Government and the recipient in any resulting invention in accordance with 10 CFR part 600.325, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

33. INTELLECTUAL PROPERTY PROVISIONS AND CONTACT INFORMATION: Nonprofit organizations are subject to the intellectual property requirements at 10 CFR 600.136(a), (c) and (d). All other organizations are subject to the intellectual property requirements at 10 CFR 600.136(a) and (c). A list of all intellectual property provisions may be found at http://www.gc.doe.gov/financial_assistance_awards.htm. Questions regarding intellectual property matters should be referred to the Energy Division Program Manager assigned to this project who will forward them to the DOE Award Administrator and the Patent Counsel designated as the service provider for the DOE office that issued the award. The IP Service Providers List is found at [http://www.gc.doe.gov/documents/Intellectual_Property_\(IP\)_Service_Providers_for_Acquisition.pdf](http://www.gc.doe.gov/documents/Intellectual_Property_(IP)_Service_Providers_for_Acquisition.pdf).