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Texas Comptroller of Public Accounts

Facility Preliminary Energy Assessments and Recommendations

Lost Pines Power Park

Lower Colorado River Authority

3700 Lake Austin Blvd.
Austin, Texas 78703

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SECO
State Energy Conservation Office

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Local Government Energy Management Program

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1.0 EXECUTIVE SUMMARY

The Lower Colorado River Authority, now referred to as LCRA, requested that Texas Energy Engineering Services, Inc. (TEESI) perform a Preliminary Energy Assessment (PEA) of the Lost Pines Power Park (LPPP), where the Sim Gideon Power Plant and Lost Pines-1 Power Project are located. This facility will now be referred to as the PLANT. This report documents that analysis.

This PEA addresses lighting, heating, ventilating and air conditioning systems, plus metering and controls for those systems. Appendix F touches briefly on some preliminary analysis for potential savings on the production side.

This service is provided at no cost to LCRA through the Local Government Energy Management and Technical Assistance Program as administered by the Texas Comptroller of Public Accounts, State Energy Conservation Office (SECO). This program promotes and encourages an active partnership between SECO and Texas local governments for the purpose of planning, funding, and implementing energy saving measures, which will ultimately reduce the PLANT's annual energy consumption.

The annual energy savings and implementation cost estimate for all building energy retrofit projects identified in this preliminary analysis are summarized below. Individual projects are summarized in the Energy Cost Reduction Measures Section of this report.

Implementation Cost Estimate ($):	316,500
Annual Energy Savings (KWh/yr):	761,888
Annual Energy Savings (MWh/yr):	762
Annual CO_2 Reduction (Metric Tons/yr):	379
Annual CO_2 Reduction (ton/yr, US):	417.5

SECO is committed to providing whatever assistance LCRA may require in planning, funding and implementing the recommendations of this report. LCRA is encouraged to direct any questions or concerns to either of the following contact persons:

SECO / Mr. Stephen Ross
(512) 463-1770

TEESI / Saleem Khan
(512) 328-2533

2.0 FACILITY DESCRIPTIONS

This section provides a brief description of the facilities surveyed. The purpose of the onsite survey was to evaluate the major energy consuming equipment in individual buildings. The PLANT covers approximately 60 Acres (excluding the lake) and contains approximately 17 buildings devoted to receiving natural gas, then creating steam which is used to generate electrical power, and operations and maintenance or the equipment. There are a total of 5 units divided between The Lost Pines Facility and the Sim Gideon Facility, that generate approximately 1,115 MW. Below is an image of the entire PLANT.

The focus of this preliminary assessment was to identify energy cost saving opportunities associated with the support buildings and to develop a metering plan that accurately measures the energy consumption of the various buildings and processes. A general description of the specific facilities surveyed is provided below.

Administration Building (Sim Gideon)

Stories:	One story
Area (estimated):	5,500 SF
Bldg. Components:	Concrete building, flat built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts
HVAC:	Package DX with electric heat.
Controls:	Standard non-programmable thermostats

Turbine Building (Sim Gideon)

Stories:	Two – Three story (Not including exterior structure)
Area (estimated):	124,000 SF, not including exterior
Bldg. Components:	Metal building, flat built-up roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with magnetic ballasts, Incandescent fixtures in process equipment areas.
HVAC:	Package DX with electric heat for office areas. Chiller for water treatment system.
Controls:	Standard non-programmable thermostats

Maintenance Building (Sim Gideon)

Stories:	One story
Area (estimated):	10,500 SF
Bldg. Components:	Concrete building, flat built-up roof, slab on grade
Typical Lighting Fixtures:	400W MH, T12 fluorescent fixtures with magnetic ballasts
HVAC:	Package DX with electric heat.
Controls:	Standard non-programmable thermostats

Administration Building (Lost Pines)

Stories:	One story
Area (estimated):	11,250 SF
Bldg. Components:	Concrete building, flat built-up roof, slab on grade
Typical Lighting Fixtures:	T8 fluorescent fixtures with electronic ballasts, T12 fluorescent fixtures with Magnetic ballasts, 400W MH
HVAC:	Package DX with electric heat.
Controls:	Standard non-programmable thermostats

Water Lab, Turbine Equipment Building (Lost Pines)

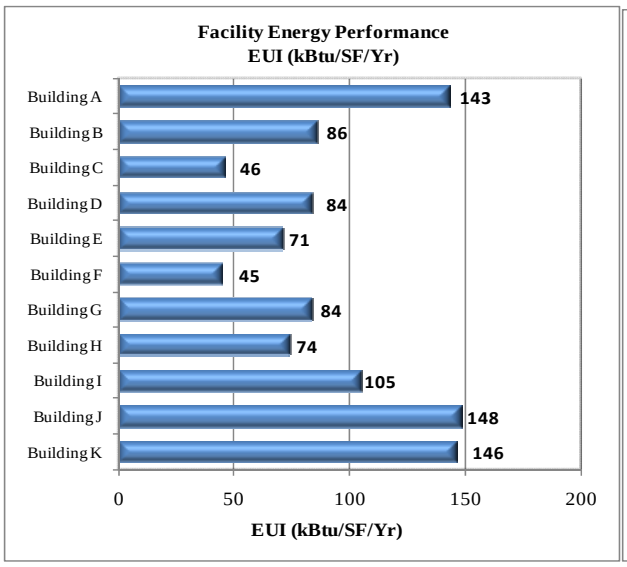
Stories:	One story
Area (estimated):	10,400 SF
Bldg. Components:	Metal building, flat built-up roof, slab on grade
Typical Lighting Fixtures:	T12 fluorescent fixtures with Magnetic ballasts, 400W MH
HVAC:	Package DX with electric heat. Chiller for water treatment system.
Controls:	Standard non-programmable thermostats

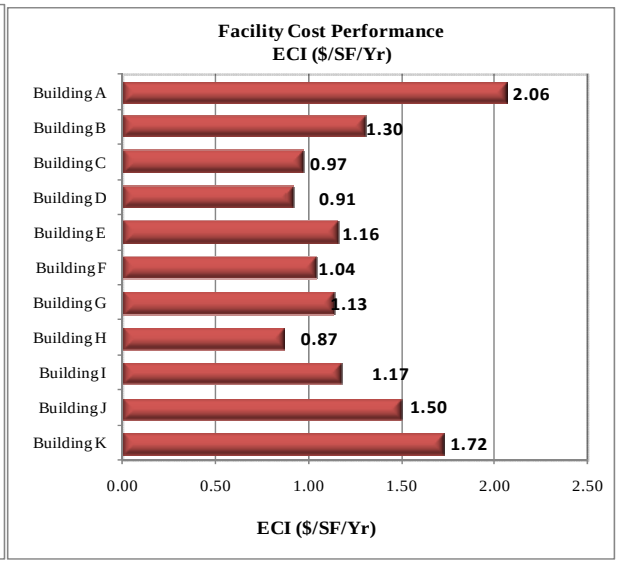
3.0 ENERGY PERFORMANCE

The LCRA currently does not use utility meters to track energy consumption at the individual buildings. This prevents LCRA from being able to identify the amount of energy the buildings are using. Utility tracking and accounting are important in order to develop a baseline for how much energy various buildings at the PLANT consume.

This consumption information can be used to evaluate the overall energy performance of its facilities. The Energy Utilization Index (EUI) is a representation of a facility's annual energy usage per square foot; it is measured as thousand BTU's per square foot per year (kBTU/SF/Year). The Energy Cost Index (ECI) represents a facility's annual energy usage per square foot; it is measured as cost per square foot per year ($/SF/Year). The EUI and ECI of a facility can only be calculated using energy consumption from a utility meter's history. Knowing the EUI and ECI of each facility is useful to help determine the PLANT's overall energy performance.

The following charts depict how EUI and ECI can be compared among separate buildings if energy usage is tracked. This information is useful for comparing building energy performance. The values and building in these charts are provided as examples, and are not related to LCRA's PLANT energy consumption.





4.0 POWER METERING

At present, none of the individual buildings at the PLANT have electric meters in place. This makes it difficult to account for the electrical consumption (kWh) or demand (KW) of the individual buildings. It is possible to perform analysis and/or simulations to develop baseline energy consumption profiles for unmetered buildings, but in order to support long-term energy efficient practices, an Energy Metering Plan should be developed and implemented to support energy conservation and facility planning needs.

The three primary benefits for metering are:

- Identify areas of high energy use.
- Assist with measurement and verification of the implemented energy measures.
- Provide electric load profile data for future planning and renovations.

From an energy management perspective, access to the historical energy consumption data provides for better targeting of buildings for energy cost reduction measures. Where buildings have already undergone energy retrofits, metering helps with the measurement and verification process. In addition, a change in metered energy use can reveal a change in operating parameters, equipment efficiency, or control malfunction that may otherwise remain undetected.

From a facility management perspective, access to the historical peak power load will be available to planning and/or design teams. This will enable them to accurately determine if the existing power distribution equipment can accommodate a planned expansion or renovation or if new or additional equipment will be required.

The first step for a metering plan is to establish the site's overall metering objective and determining what to meter. Some buildings are served from panels that also serve process loads, and some buildings may be served from more than one distribution panel. To separately meter building power, meters must be applied at each point where a significant building load separates from the overall distribution system.

An important part of the metering plant is determining which building loads (or process loads, if included) are significant enough and variable or changeable enough to justify the cost of metering. The purpose of each meter and the use to be made of its data must be established before its value can be determined. Major factors will include the size of the feeder, the uncertainty of the load magnitude or schedule, and what potential that load has for energy reduction or distribution capacity evaluation.

The metering plan implementation must be designed to accommodate 24/7 operation, with downtimes carefully coordinated with PLANT operations. Fortunately, the PLANT has established procedures as to how maintenance work is performed with live equipment. The implementation plan should be detailed enough to give clear direction while flexible enough to handle minor corrections. All persons planning meter installations or installing meters must be well aware of PLANT policies, priorities and protocols to insure that meter installations do not compromise the operation, safety or quality standards of the facility.

For cost estimating purposes, metering locations include majority of all branch panels at the PLANT. This estimate is based on data gathered during preliminary site visit(s) and associated information received by TEESI from LCRA. **The budgetary cost estimate based on preliminary analysis for a comprehensive metering plan is approximately $200,000.** Please note that a detailed assessment & engineering survey should be conducted in conjunction with the scope of the Energy Cost Reduction Measures (ECRMs) to determine the exact scope and associated costs. The budgetary cost may be lessened based on those findings and coordinating construction with associated ECRMs.

This metering and associated costs are based on a Revenue Grade Energy and Demand Meter such as Shark 200 **or equivalent** that has many features attractive for this application, such as data-logging, power quality, and I/O systems. Additionally, a SCADA (Supervisory Control and Data Acquisition) system could be utilized for a variety of tasks. These tasks include tracking energy usage and power demand, performing weather normalization on this data to establish an accurate baseline for the system in question, and attempting to forecast energy usage and power demand based on forecasted weather conditions. Appendix D includes some basic information on the metering system for reference purposes only.

5.0 RECOMMENDED MAINTENANCE & OPERATION PROCEDURES

Sound Maintenance and Operation procedures significantly reduce annual energy use, extend equipment life, and increase occupant comfort. Generally, maintenance and operation procedural improvements can be made with existing staff and budgetary levels. Even though the majority of the LCRA's energy consumption is due to electric generating activities, the following typical maintenance and operations procedures may lead to cost effective energy savings. Some of the recommendations noted below are most likely already being practiced by the LCRA. The following maintenance and operation procedures should be encouraged and/or continued to ensure sustainable energy savings.

PUBLICIZE ENERGY CONSERVATION

Promote energy awareness at regular staff meetings, on bulletin boards, and through organizational publications. Publicize energy cost reports showing uptrends and downtrends.

MANAGE SMALL ELECTRICAL EQUIPMENT LOADS

Small electrical equipment loads consists of small appliances/devices such as portable heaters, microwaves, small refrigerators, coffee makers, stereos, cell phone chargers, desk lamps, etc. The LCRA should establish a goal to reduce the number of small appliances and to limit their usage. Many small devices such as radios, printers, and phone chargers can consume energy while not in use. To limit this "stand-by" power usage these devices should be unplugged or plugged into a power strip that can act as a central "turn off" point while not in use. With an effective energy awareness campaign to encourage participation, managing small electrical loads can achieve considerable energy savings.

ESTABLISH HVAC UNIT SERVICE SCHEDULES

Document schedules and review requirements for replacing filters, cleaning condensers, and cleaning evaporators. Include particulars such as filter sizes, crew scheduling, contract availability if needed, etc.

PRE-IDENTIFY PREMIUM EFFICIENCY MOTOR (PEM) REPLACEMENTS

Pre-identify supply sources and PEM stock numbers for all HVAC fan and pump motors so that as failures occur, replacement with PEM units can take place on a routine basis. As funding allows, pre-stock PEM replacements according to anticipated demand, i.e., motors in service more than 10 years, motors in stressful service, and particular motor types that are in service at several locations.

IMPROVE CONTROL OF INTERIOR & EXTERIOR LIGHTING

Establish procedures to monitor use of lighting at times and places of possible/probable unnecessary use: Offices at lunchtime, maintenance shops, closets, exterior and parking lots during daylight hours, etc. Encouraging staff (i.e. Custodial, maintenance) to participate in the LCRA's efforts to limit unnecessary lighting use would help improve this effort.

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

Effective operation and maintenance of equipment is one of the most cost effective ways to achieve reliability, safety, and efficiency. Failing to maintain equipment can cause significant energy waste and severely decrease the life of equipment. Substantial savings can result from good operation and maintenance procedures. In addition, such procedures require little time and cost to implement. Examples of typical maintenance checklists for common equipment including are provided in **Appendix A**. These checklists from the Federal Energy Management Program (FEMP), a branch of the Department of Energy (DOE), are based on industry standards and should supplement, not replace those provided by the manufacturer.

CONTROL OUTSIDE AIR INFILTRATION

Conduct periodic inspections of door and window weather-stripping, and schedule repairs when needed. Additionally, make sure doors and windows are closed during operation of HVAC systems (heating or cooling). Unintended outside air contributes to higher energy consumption and increases occupant discomfort.

ENERGY STAR POWER MANAGEMENT

ENERGY STAR Power Management Program promotes placing monitors and computers (CPU, hard drive, etc.) into a low-power “sleep mode” after a period of inactivity. The estimated annual savings can range from $25 to $75 per computer. ENERGY STAR recommends setting computers to enter system standby or hibernate after 30 to 60 minutes of inactivity. Simply touching the mouse or keyboard “wakes” the computer and monitor in seconds. Activating sleep features saves energy, money, and helps protect the environment.

INSTALL ENERGY SAVING DEVICES ON VENDING MACHINES

Install energy saving devices on vending machines with non-perishable food items to reduce the equipment power usage. These devices shut the vending machines down during unoccupied periods. There are several commercially available devices that can be easily installed on existing vending machines. These devices typical have a motion sensor which powers down the equipment after periods of inactivity. For example if the motion sensor does not sense activity within 15 minutes the device will shutdown the vending machine and turn on once motion is sensed. These devices range in price from $100 to $250 and have a typical annual savings of $20 to $150 per vending machine.

HAIL GUARDS ON AIR-COOLED CONDENSER COILS

Specify hail guards for all air cooled condensers. The hail guards protect the condensing unit’s heat exchanger coils from hail damage. Damage to the condensing unit heat exchangers reduces the efficiency of the units. If any existing units have damaged condenser coil fins, the fins should be straightened using a fin comb.

ESTABLISH SPECIFICATIONS FOR FUTURE MATERIALS AND METHODS

A procedure is needed to feed back equipment weaknesses and quality problems into the equipment specification process. Possible specification upgrades could include:

1. Avoid air cooled condensers where exposed to gritty or corrosive atmospheres.
2. Provide filtration and/or evaporative cooling pads ahead of air-cooled condensers, if this can be determined to be maintainable and effective.
3. Specify copper fins on copper coils, or perhaps micro-channel coils if they can be proven less susceptible to corrosion.
4. Specify minimum fin spacings on condensers, based on the size grit encountered at various locations.
5. Specify proven duct insulation attachment methods, and procedures for the removal and replacement of duct liner.
6. Energy Management Control specifications for HVAC equipment.

On future projects, consideration should be given to organizing the electrical power distribution to accommodate separate metering of key processes and of building systems (e.g. HVAC, lighting, appliances). Reference Section 4.0 for specific advantages.

INSULATE CONDITIONED SPACES AND COOLING DUCTS

Spaces with temperature limitations, even if only heated and/or ventilated, should be reviewed for adequate insulation. The proliferation of electronic devices, rising standards for employee comfort, and the rising cost of comfort control have narrowed the band of acceptable temperatures in many spaces since the original construction of the facility. Where such insulation improvement is practical, increased worker productivity or reduced energy use or both will result.

ESTABLISH SPECIFICATIONS FOR FUTURE MATERIALS AND METHODS

A procedure is needed to feed back these issues from field staff to purchasing, and perhaps others, into the equipment specification process. Possible specification upgrades could include:

1. Indoor and outdoor lighting minimum wattage, color rendering index and life.
2. Avoid air cooled condensers where practical.
3. Provide filtration and/or evaporative cooling pads ahead of air-cooled condensers, if this can be determined to be maintainable and effective.
4. Specify minimum fin spacings on condensers, based on the size grit encountered at various locations.
5. Specify proven duct insulation attachment methods, and procedures for the removal and replacement of duct liner.
6. Specify metering equipment to be included in switchboard purchases.

IMPROVE COMFORT CONDITIONS WHERE FEASIBLE

Adequate cooling is necessary for the health, productivity and retention of employees. Where employees are required to wear protective clothing for chemical or arc flash protection, their high-temperature tolerance is greatly reduced. Where high temperature surfaces, steam leaks or air-cooled motors are abundant, space temperatures can become extreme. Three available grades of cooling for such spaces, ranging from least effective, complex and expensive to most, are as follows:

1. Ventilation with outdoor air, using enough airflow to keep the local temperature within some design goal of the highest outdoor air temperature
2. Evaporative ventilation, using sufficient airflow (substantially less than above) to keep the local temperature within some design goal of the highest outdoor wet bulb temperature.
3. Refrigerated air, supplied at a temperature and rate designed to limit the space conditions to some desired temperature and humidity.

6.0 ENERGY COST REDUCTION MEASURES

Energy retrofit projects identified during the preliminary analysis are detailed below. Project cost estimates include design, construction management, and construction (labor and material).

HVAC & CONTROLS

HVAC systems at the PLANT are in relatively good condition, although facility can benefit from HVAC controls upgrade. The EMS will minimize the run time of the units while maintaining comfort throughout the facility. Additionally, EMS can remotely diagnose and document HVAC maintenance problems. Presently the PLANT's HVAC systems are controlled using independent zone thermostats. While an EMS will generate some energy and maintenance savings, those savings and associated system costs are difficult to assign specifically to the EMS in this initial evaluation phase. As such, no further discussion or analysis of HVAC and controls is included in the report.

LIGHTING RETROFITS

The opportunities suggested below are the findings based on preliminary analysis performed. Different types of retrofits were explored.

INTERIOR LIGHTING RETROFITS

For conversion to 4' T8 lamps, the costs and savings throughout this report are primarily based on a 48" F28T8, extended-life linear fluorescent lamp. This selection balances cost, energy use, lighting output, and lamp life.

LED lights were also researched. The findings from that research were that LED lights are very useful for many outdoor lighting applications and for certain indoor applications requiring close control of lighting distribution or intensity. However, the lighting efficacy (lumens/watt) is presently only about 77 lumens/watt, as opposed to 93 lumens/watt for a linear fluorescent. LED fixtures cost substantially more than other fixtures that are more efficient for general illumination. The other finding is that a ballast/lamp replacement for a fluorescent fixture is a small maintenance item, whereas a failed component in an LED fixture often requires replacing the entire fixture.

There are a number of high wattage incandescent lamps inside the Sim Gideon turbine building. An evaluation entailed reviewing various lamp replacement options, including using Compact Fluorescent or LED lamps. A simple CFL replacement was decided upon due to cost and ease of procurement. The specific scope, costs, and energy savings of the retrofit projects are limited to the buildings indicated, but the findings are applicable to the plant as a whole.

EXTERIOR LIGHTING RETROFITS

The outdoor lighting evaluation entailed reviewing various replacement options, including using Metal Halide, Compact Fluorescent, or LED lamps. The LED was determined as a best fit to replace HID lamps due to the longevity of the "lamp" and because the output decreases with age but does not end abruptly. Other considerations were vibration and heat concerns for the Compact Fluorescent lamps, although heat is also a concern for the LED lamp.

T12 TO T8 FLUORESCENT LIGHTING RETROFIT

The PLANT has a combination of T8 and T12 Fluorescent fixtures. It is recommended LCRA replace the existing T12 fluorescent lamps and magnetic ballasts with high efficiency T-8 fluorescent lamps and electronic ballasts. A typical four-foot, two-lamp (34W) fixture with magnetic ballast requires approximately 75 watts, while two F28T8 lamps with electronic ballast in the same fixture configuration require only 55 watts and produce 95% as much light while consuming 73% as much energy. The table below indicates the facilities where T-12 fluorescent lamps were observed during the preliminary walkthrough. The cost and savings noted below are based on preliminary observations of the facilities. Exact cost, quantities, and lamp types can be identified through a detailed energy audit. In addition, a detailed lighting design calculation will help ensure the appropriate lighting replacement is selected. For example, a detailed design calculation may identify areas that could operate with fewer lamps per fixtures or with low-wattage T8 lamps while still maintaining adequate lighting levels. Lamp and ballast recycling is included in the cost estimates.

T12 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Turbine Building (Sim Gideon)	$1,900	5,676
TOTAL	**$1,900**	**5,676**

T12 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Lost Pines)	$3,100	3,285
Turbine Support Building (Lost Pines)	$2,800	8,515
TOTAL	**$5,900**	**11,800**

REPLACE EXISTING T8 FLUORESCENT LAMPS WITH LOWER WATTAGE LAMPS

Low-wattage T8 fluorescent lamps are available in 30, 28 and 25-watt versions. It is recommended LCRA replace existing 32-watt T8 Fluorescent lamps with lower wattage lamps in most cases. However, lower wattage T8 lamps have reduced lighting levels, so it is important to ensure recommended lighting levels are maintained. Lighting levels should be verified prior to lamp replacement. In addition, compatibility with existing ballasts, local codes and other requirements must be verified prior to retrofitting. Nevertheless, if suitable for the application, switching to lower wattage T8 lamps will have sustainable energy savings with minimal impact. For example, replacing a 32-watt T8 lamp with a 28-watt T8 lamp will approximately have a 12% lighting energy reduction with only a lighting level drop near 4%.

The estimated costs and savings noted below are based on replacement of existing 32-watt T8 lamps and does not account for ballast replacements. Estimates are based on a preliminary walkthrough of the facilities. A detailed lighting analysis will be required to determine exact cost, quantities and configuration to maximize the energy savings and lighting performance. Lamp recycling is included in the cost estimates.

T8 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Sim Gideon)	$800	2,246
TOTAL	**$800**	**2,246**

T8 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Lost Pines)	$300	730
TOTAL	**$300**	**730**

HID TO FLUORESCENT FIXTURE LIGHTING RETROFIT

The PLANT utilizes High Intensity Discharge (HID) fixtures to light the warehouse and maintenance area. It is recommended that LCRA replace the existing HID fixtures with T5HO fluorescent fixtures suitable for high bay applications. Fluorescent fixtures offer improved control, reduce energy consumption and improve lighting levels. In addition, due to the long re-strike times associated with HID fixtures, they cannot be effectively switched on/off during unoccupied periods. This causes the HID lamps to operate longer, which both consumes more energy and affects lamp life. The cost and savings estimates below are based on preliminary observations and analysis, assuming no reduction in operating hours; just efficiency improvement. Lamp and ballast recycling is included in the cost estimates.

HID TO FLUORESCENT LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Lost Pines)	$12,800	3,744
Turbine Support Building (Lost Pines)	$17,000	14,016
TOTAL	**$29,800**	**17,760**

INCANDESCENT TO COMPACT FLUORESCENT CFL LIGHTING RETROFIT

The interior and exterior of the Sim Gideon Turbine Buildings currently utilizes 150W and 200W incandescent lighting for illumination of the walkways and work areas. These locations could be replaced with Compact Fluorescent (CFL) lamps. CFL lamps retrofits are a simple lamp replacement and offer dramatic energy savings for the cost. Some concern was raised due to the temperature, however the lamps considered are rated to 122°F. A test case should be considered for both interior and exterior applications prior to a mass change out. The calculations below assume a simple 1 for 1 replacement from 150W incandescent to 40W CFL lamps

INCANDESCENT TO CFL LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Turbine Building (Sim Gideon)	$13,000	654,810
TOTAL	**$13,000**	**654,810**

REPLACE HID OUTDOOR STRUCTURE LIGHTING WITH LED TYPE

The PLANT has High Pressure Sodium High Intensity Discharge (HID) fixtures for exterior applications. It is recommended that LCRA replace the existing HID fixtures with LED fixtures suitable for this application. LED fixtures offer reduced energy consumption and improved lighting distribution. In addition, LED fixtures are rated approximately 2.5 times the life of a comparable HID lamp and do not fail but dim over time.

The cost and savings estimates below are based on preliminary observations and analysis, assuming no reduction in operating hours or maintenance costs; just efficiency improvement. Fixtures were selected for NFPA 70 Class 1 Division 2 environment at the request of LCRA. LCRA should review this criterion and possibly expand the selection choices, which would reduce fixture costs and possibly fixture wattage, also. The 70W LED wattage was selected because that supplies approximately the same light intensity and is the lowest wattage found in a suitable fixture. Reference **Appendix E** for structure lighting cut sheets. However, a detailed engineering analysis may discover that a lower wattage LED suitable for the application is available. Lamp and ballast recycling is included in the cost estimates.

HID TO LED LIGHTING RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Lost Pines)	$4,300	312
Turbine Support Building (Lost Pines)	$255,000	52,560
TOTAL	**$259,300**	**52,872**

INSTALLATION OF OCCUPANCY SENSORS FOR INDOOR LIGHTING CONTROL

It is recommended the PLANT consider installing occupancy sensors to improve control of non-critical interior lighting. Occupancy sensors will help ensure lights are only on when the space is occupied. The table below provides estimated costs and energy savings for the installation of these sensors. Please note these estimates are based on a preliminary assessment. Exact sensor locations, technology (Infrared, Ultrasonic, and Dual Technology) and quantity can be determined during a detailed energy assessment or design phase. In general, enclosed areas with intermittent use are typically good candidates for occupancy sensors (e.g. offices, break rooms, restrooms, conference rooms). The costs below reflect ceiling mounted occupancy sensors.

MOTION SENSOR RETROFIT		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Sim Gideon)	$2,600	5,733
Turbine Building (Sim Gideon)	$1,100	6,439
TOTAL	**$3,700**	**12,172**

MOTION SENSOR RETROFIT-LP		
Building	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
Admin Building (Lost Pines)	$1,800	3,822
TOTAL	**$1,800**	**3,822**

ENERGY RETROFIT PROJECTS SUMMARY

The following table summarizes the implementation costs and annual energy savings for the projects listed.

SUMMARY OF ENERGY RETROFIT PROJECTS - Sim Gideon		
Project Description	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
T12 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$1,900	5,676
T8 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$800	2,246
MOTION SENSOR RETROFIT	$3,700	12,172
INCANDESCENT TO CFL LIGHTING RETROFIT	$13,000	654,810
TOTAL:	**$19,400**	**674,904**

SUMMARY OF ENERGY RETROFIT PROJECTS - Lost Pines		
Project Description	**Estimated Implementation Cost**	**Estimated Annual Savings (kWH/yr)**
T12 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$5,900	11,800
T8 TO LOW WATTAGE T8 FLUORESCENT LIGHTING RETROFIT	$300	730
HID TO FLUORESCENT LIGHTING RETROFIT	$29,800	17,760
MOTION SENSOR RETROFIT-LP	$1,800	3,822
HID TO LED LIGHTING RETROFIT	$259,300	52,872
TOTAL:	**$297,100**	**86,984**

The above project implementation costs and annual savings are estimated based on a preliminary examination of the facilities. Furthermore, maintenance cost savings are not included in this preliminary energy assessment. Return on investment and/or life-cycle cost analysis should be conducted by LCRA in accordance with their internal standards. Final costs will be determined from detailed building assessments, engineering calculations, and contractor estimates.

Project design (drawings and specifications), if authorized, would normally be accomplished by professional engineers. Project acquisition (competitive bidding) would be in accordance with LCRA requirements, and construction management would be provided by the engineering group who prepared the drawings and specifications.

7.0 ENERGY MANAGEMENT POLICY

At present, the LCRA has not adopted an energy management plan for power plants facilities. LCRA is committed to improving their energy performance and this is evident by the request to perform a Preliminary Energy Assessment. However, in order to ensure and sustain long-term energy efficient practices a comprehensive Energy Management Policy should be adopted by LCRA.

An energy management plan adopted by the governing board sends a strong signal that energy management is an institutional priority. At a minimum, the energy management plan should address the following:

- Establish an energy steering committee to review energy cost and consumption on a regular basis.
- Outline energy cost reduction measures and implementation strategies.
- Assign energy manager duties to existing staff positions, with defined roles and responsibilities.
- Establish acceptable equipment operating parameters and schedules, such as HVAC space heating and cooling set points, availability and duration of overrides, etc.
- Establishment of a tracking method for utility cost and consumption.
- Promote awareness of energy conservation by publishing goals and progress of energy conservation measures.

8.0 FUNDING OPTIONS FOR CAPITAL ENERGY PROJECTS

Institutional organizations have traditionally tapped bond money, maintenance dollars, or federal grants to fund energy-efficient equipment change outs or additions such as energy-efficient lighting systems, high efficiency air conditioning units, and computerized energy management control systems. Today, a broader range of funding options are available. A number of these are listed below.

Texas LoanSTAR Program

The LoanSTAR (Saving Taxes and Resources) Program, which is administered by the State Energy Conservation Office, finances energy-efficient building retrofits at a low interest rate (typically 3 percent). The program's revolving loan mechanism allows borrowers to repay loans through the stream of cost savings realized from the projects. Projects financed by LoanSTAR must have an average simple payback of ten years or less and must be analyzed in an Energy Assessment Report by a Professional Engineer. Upon final loan execution, LCRA proceeds to implement funded projects through the traditional bid/specification process. Contact: Eddy Trevino (512/463-1876).

Internal Financing

Improvements can be paid for by direct allocations of revenues from an organization's currently available operating or capital funds (bond programs). The use of internal financing normally requires the inclusion and approval of energy-efficiency projects within an organization's annual operating and capital budget-setting process. Often, small projects with high rate of return can be scheduled for implementation during the budget year for which they are approved. Large projects can be scheduled for implementation over the full time period during which the capital budget is in place. Budget constraints, competition among alternative investments, and the need for higher rates of return can significantly limit the number of internally financed energy-efficiency improvements.

Performance Contracting with an Energy Service Company

Through this arrangement, an energy service company (ESCO) uses third party financing to implement a comprehensive package of energy management retrofits for a facility. This turnkey service includes an initial assessment by the contractor to determine the energy-saving potential for a facility, design work for identified projects, purchase and installation of equipment, and overall project management. The ESCO guarantees that the cost savings generated by the projects will, at a minimum, cover the annual payment due to the ESCO over the term of the contract.

Private Lending Institutions or Leasing Corporations

Banks, leasing corporations, and other private lenders have become increasingly interested in the energy efficiency market. The financing vehicle frequently used by these entities is a municipal lease. Structured like a simple loan, a municipal leasing agreement is usually a lease-purchase arrangement. Ownership of the financed equipment passes to LCRA at the beginning of the lease, and the lessor retains a security interest in the purchase until the loan is paid off. A typical lease covers the total cost of the equipment and may include installation costs. At the end of the contract period, the lessee pays a nominal amount, usually a dollar, for title to the equipment.

9.0 ANALYST(S) IDENTIFICATION

Texas Energy Engineering Services, Inc.
Capital View Center, Suite B-325
1301 Capital of Texas Highway
Austin, Texas 78746
(512) 328-2533

M. Saleem Khan, P.E., CxA
Tom Glass, P.E.
Jeremy Taylor, E.I.T.

APPENDICES

APPENDIX A

TYPICAL EQUIPMENT MAINTENANCE CHECKLISTS

Fans Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
System use/sequencing	Turn off/sequence unnecessary equipment	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Observe belts	Verify proper belt tension and alignment			X	
Inspect pulley wheels	Clean and lubricate where required			X	
Inspect dampers	Confirm proper and complete closure control; outside air dampers should be airtight when closed			X	
Observe actuator/linkage control	Verify operation, clean, lubricate, adjust as needed			X	
Check fan blades	Validate proper rotation and clean when necessary			X	
Filters	Check for gaps, replace when dirty - monthly			X	
Check for air quality anomalies	Inspect for moisture/growth on walls, ceilings, carpets, and in/outside of duct-work. Check for musty smells and listen to complaints.			X	
Check wiring	Verify all electrical connections are tight				X
Inspect ductwork	Check and refasten loose connections, repair all leaks				X
Coils	Confirm that filters have kept clean, clean as necessary				X
Insulation	Inspect, repair, replace all compromised duct insulation				X

Electric Motors Checklist

Description	Comments	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Motor use/sequencing	Turn off/sequence unnecessary motors	X			
Overall visual inspection	Complete overall visual inspection to be sure all equipment is operating and safety systems are in place	X			
Motor condition	Check the condition of the motor through temperature or vibration analysis and compare to baseline values		X		
Check lubrication	Assure that all bearings are lubricated per the manufacture's recommendation			X	
Check packing	Check packing for wear and repack as necessary. Consider replacing packing with mechanical seals.			X	
Motor alignment	Aligning the motor coupling allows for efficient torque transfer to the pump			X	
Check mountings	Check and secure all motor mountings			X	
Check terminal tightness	Tighten connection terminals as necessary			X	
Cleaning	Remove dust and dirt from motor to facilitate cooling			X	
Check bearings	Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary.				X
Motor condition	Checking the condition of the motor through temperature or vibration analysis assures long life				X
Check for balanced three-phase power	Unbalanced power can shorten the motor life through excessive heat build up				X
Check for over-voltage or under-voltage conditions	Over- or under-voltage situations can shorten the motor life through excessive heat build up				X

APPENDIX B

LOANSTAR INFORMATION

Texas LoanSTAR Program

FACTS ABOUT LoanSTAR

The State of Texas LoanSTAR (Saving Taxes and Resources) Program finances energy efficient facility up-grades for state agencies, public schools, institutions of higher education, local governments, municipalities, and hospitals. The program's revolving loan mechanism allows participants to borrow money and repay all project costs through the stream of **cost savings** produced.

ELIGIBLE PROJECTS

Up-grades financed through the program include, but are not limited to, (1) energy efficient lighting systems; (2) high efficiency heating, ventilation and air conditioning systems; (3) energy management systems; (4) boiler efficiency improvements; (5) energy recovery systems; (6) building shell improvements; and (7) load management projects. The prospective borrower hires a Professional Engineer to analyze the potential energy efficient projects that will be submitted for funding through the Loan STAR Program. All engineering costs are covered under the program.

PROGRAM REQUIREMENTS

Once the projects are analyzed and the prospective borrower agrees with the recommended projects, the engineer prepares an Energy Assessment Report (EAR) with the project descriptions and calculations. The EAR must be prepared according to the LoanSTAR Technical Guidelines. The EAR is reviewed and approved by the State Energy Conservation Office (SECO) technical staff before project financing is authorized. Projects financed by LoanSTAR must have an average simple payback of ten years or less. Borrowers do, however, have the option of buying down paybacks to meet the composite ten-year limit.

To ensure up-grade projects are designed and constructed according to the EAR, SECO performs a review of the design documents at the 50% and 100% completion phases. On-site construction monitoring is also performed at the 50% and 100% completion phases.

SAVINGS VERIFICATION

To ensure that the Borrower is achieving the estimated energy savings, monitoring and verification is required for all LoanSTAR funded projects. The level of monitoring and verifications may range from utility bill analysis to individual system or whole building metering depending on the size and type of retrofit projects. If whole building metering is required, metering and monitoring cost can be rolled into the loan.

For additional information regarding the
LoanSTAR program, please contact:

Eddy Trevino
SECO, LoanSTAR Program Manager
(512) 463-1876

APPENDIX C

REQUEST FOR ENERGY ASSISTANCE

State Energy Conservation Office

Local Governments and Municipalities

Preliminary Energy Assessment Service Agreement

Investing in our communities through improved energy efficiency in public buildings is a win-win opportunity for our communities and the state. Energy-efficient buildings reduce energy costs, increase available capital, spur economic growth, and improve working and living environments. The Preliminary Energy Assessment Service provides a viable strategy to achieve these goals.

Description of the Service

The State Energy Conservation Office (SECO) will analyze electric, gas and other utility data and work with **Lower Colorado River Authority** _____ , hereinafter referred to as Partner, to identify energy cost-savings potential. To achieve this potential, SECO and Partner have agreed to work together to complete an energy assessment of mutually selected facilities.

SECO agrees to provide this service at no cost to the Partner with the understanding that the Partner is ready and willing to consider implementing the energy savings recommendations

Principles of the Agreement

Specific responsibilities of the Partner and SECO in this agreement are listed below.

- Partner will select a contact person to work with SECO and its designated contractor to establish an Energy Policy and set realistic energy efficiency goals.
- SECO's contractor will go on site to provide walk through assessments of selected facilities. SECO will provide a report which identifies no cost/low cost recommendations, Capital Retrofit Projects, and potential sources of funding. Portions of this report may be posted on the SECO website.
- Partner will schedule a time for SECO's contractor to make a presentation of the assessment findings key decision makers.

Acceptance of Agreement

This agreement should be signed by your organization's chief executive officer or other upper management staff.

Signature: _____ Date: 6/22/10

Name (Mr./Ms./Dr.) Mr. Christopher Kennedy _____ Title: Executive Manager and Chief Admin. Officer

Organization: Lower Colorado River Authority _____ Phone: 512 473-3333 x 3293

Street Address: 3700 Lake Austin Blvd, Austin, Texas _____ Fax: 512 473-3274

Mailing Address: P.O. Box 220, Austin, Texas 78767 _____ E-Mail: Christopher.Kennedy@lcra.org

County: Travis

Contact Information

Name (Mr./Ms./Dr.): Ms. Nancy Overesch _____ Title: Corporate Environmental Advisor

Phone: 512 473-3333 x 2939 / cell 512 468-0046 _____ Fax: 512 473-3274

E-Mail: Nancy.Overesch@LCRA.org County: Travis

Please sign and mail or fax to: Stephen Ross, **Local Governments and Municipalities** Program Administrator, State Energy Conservation Office, 111 E. 17th Street, Austin, Texas 78774. Phone: 512-463-1770. **Fax 512-475-2569.**

APPENDIX D

METERING SYSTEM TECHNICAL SUPPORT DATA

SHARK®200

UPGRADABLE FULLY FEATURED POWER & ENERGY METER

Revenue Grade with Advanced I/O and Power Quality

www.electroind.com

From Simple to Sophisticated

- Simple Multifunction Meter: V-Switch™ Key 1
- Historical Data-logging: V-Switch™ Key 2
- Advanced Power Quality Waveform Recorder: V-Switch™ Keys 5 or 6

Industry Leading Performance

- Highly Accurate Metering Technology
- Expandable I/O with 100BaseT Ethernet
- V-Switch™ Technology Upgrade
- Extensive Data Logging
- Power Quality Recording
- Up to 512 Samples/Cycle

Electro Industries/GaugeTech
The Leader in Power Monitoring and Control

HIGH PERFORMANCE WAVEFORM RECORDING

Basic Features Summary

- **0.2% Class Revenue Certifiable Energy and Demand Metering**
- **Meets ANSI C12.20 and IEC 687 (0.2% Class)**
- **Multifunction Measurement**
- **3 Line .56" LED display**
- **% of Load Bar for Analog Perception**
- **Standard RS485 (Modbus and DNP 3.0)**
- **IrDA Port for PDA Read**
- **Ultra-Compact**
- **Fits both ANSI and DIN Cutouts**

Advanced Features Summary

- **High Performance Waveform Recorder**
- **Up to 4 Megabytes Flash for Historical Data Logging & PQ Recording**
- **Extremely Configurable Field Upgradable I/O**
- **100BaseT Ethernet – Rapid Response™ Technology**
- **V-Switch™ Technology**

APPLICATIONS

- **Utility Metering**
- **Substations**
- **Power Generation**
- **Submetering**
- **Power Quality Studies**
- **Load Studies**
- **Commercial Metering**
- **Industrial Metering**
- **Campus Metering**
- **Analog Meter Replacement**
- **Disturbance Recording**
- **Voltage Recording**

ACCURACY AND UPGRADE SWITCHES

Electro Industries introduces a new standard in panel mounted power metering. The Shark® 200 metering system is an ultra-compact power metering device providing industry leading revenue metering functionality combined with advanced data-logging, power quality, communication and I/O traditionally found only in high performance and high cost systems. This product is designed to incorporate advanced features in a cost effective, small package for large scale, low cost deployment within an electrical distribution system.

V-Switch™ Technology

The Shark® 200 meter is equipped with EIG's exclusive V-Switch™ technology. This technology allows users to upgrade and add features by using communication commands as needed, even after the meter is installed.

V-Switches Include the Following Features:

Feature	V1	V2	V3	V4	V5	V6
Multifunction Measurement with I/O Expansion	✓	✓	✓	✓	✓	✓
2 Megabytes Data-Logging		✓	✓	✓		
3 Megabytes Data-Logging					✓	
4 Megabytes Data-Logging						✓
Harmonic Analysis			✓	✓	✓	✓
Limit and Control Functions				✓	✓	✓
64 Samples per Cycle Waveform Recorder					✓	
512 Samples per Cycle Waveform Recorder						✓

ACCURACY

Measured Parameters	Accuracy %	Display Range
Voltage L-N	0.1%	0-9999 Scalable V or kV
Voltage L-L	0.2%	0-9999 V or kV Scalable
Current	0.1%	0-9999 Amps or kAmps
+/- Watts	0.2%	0-9999 Watts, kWatts, MWatts
+/-Wh	0.2%	5 to 8 Digits Programmable
+/-VARs	0.2%	0-9999 VARs, kVARs, MVARs
+/-VARh	0.2%	5 to 8 Digits Programmable
VA	0.2%	0-9999 VA, kVA, MVA
VAh	0.2%	5 to 8 Digits Programmable
PF	0.2%	+/- 0.5 to 1.0
Frequency	+/- 0.03 Hz	45 to 65 Hz
%THD	+/- 2.0%	1 to 99.99%
% Load Bar	+/- 1 Segment	(0.005 to 6) A

Note: *Applies to 3 element WYE and 2 element Delta connections. See full accuracy specifications in Shark® 200 Meter User Manual. Neutral current 2% accuracy.*

Traceable Watt-Hour Test Pulse for Accuracy Verification

The Shark® 200 device is a traceable revenue meter. It contains a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy. This is an essential feature required of all billing grade meters.

- **Utility Block and Rolling Average Demand**
- **Historical Load Profiling**

EXTENSIVE DATA-LOGGING CAPABILITY (V2 and Higher)

The Shark®200 meter offers the capability of having 2 Megabytes of data-logging to be used for historical trends, limit alarms, I/O changes and sequence of events. The unit has a real-time clock that allows for time stamping of all the data in the instrument when log events are created.

Historical Logs

- 3 Assignable Historical Logs
- Independently Program Trending Profiles
- Up to 64 Parameters per Log

System Events Log

To protect critical billing information, the meter records and logs the following with a time stamp:

- Demand Resets
- Password Requests
- System Startup
- Energy Resets
- Log Resets
- Log Reads
- Programmable Settings Changes

Historical Trending

I/O Change Log

- Provides a Time Stamped Log of any Relay Output
- Provides a Time Stamped Log of Input Status Changes
- 2048 Events Available

Limit/Alarm Log

- Provides Magnitude and Duration of an Event
- Includes Time Stamps and Alarm Value
- 2048 Events Available

Alarm Log

Limits Alarms and Control Capability (V4 Option)

Limit Events

- Any measured parameter
- Up to 16 Limits
- Voltage Imbalance
- Current Imbalance
- Based on % of full scale settings

Limit Set Up

HIGH PERFORMANCE POWER QUALITY ANALYSIS (V5 AND V6)

Simultaneous Voltage and Current Waveform Recorder

The unit records up to 512 samples per cycle for a voltage sag or swell or a current fault event. The unit provides the following pre-event and post-event recording capability. Waveform records are programmable to the desired sampling rate. V5 provides up to 3 Megabytes storage and V6 provides a total of 4 Megabytes.

The meter's advanced DSP design allows Power Quality triggers to be based on a 1 cycle updated RMS. Up to 170 events can be stored until the memory fills. The meter stores waveform data in a first-in/first-out circular buffer to insure data is always recording.

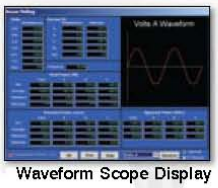
Optional Waveform Recorder

	Samples per Cycle	Pre Event Cycles	Post Event Cycles	Max Waveform per Event	Number of Stored
V5	16	32	96	256	85
	32	16	48	128	85
	64	8	24	64	85
V6	128	4	12	32	170
	256	2	6	16	170
	512	1	3	8	170

Note: *Sampling rate based on 60Hz. 50Hz systems, divide sample rate by 0.83.*

Waveform Scope

The unit uniquely offers a waveform scope to view the real time waveform for voltage and current. Waveform scope allows the meter to be used as a basic oscilloscope throughout a power system.



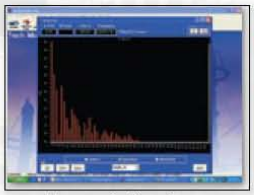
Waveform Scope Display

Independent CBEMA Log Plotting

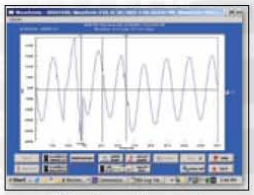
The meter stores an independent CBEMA log for magnitude and duration of voltage events. This allows a user to quickly view total surges, total sags and duration without retrieving waveform data.

Harmonic Recording to the 40th Order

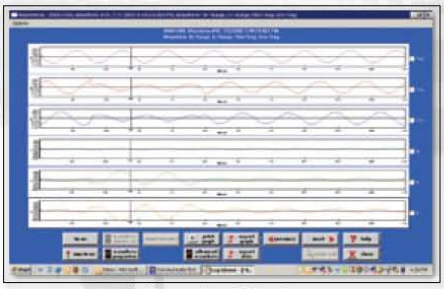
The Shark® 200 meter provides advanced harmonic analysis to the 40th order for each voltage and current channel in real time. Using the stored waveforms, harmonic analysis is available to the 255th order.



Harmonic Spectrum (40th Order)



Waveform Zoomed



6 Channels of Waveforms

STANDARD COMMUNICATION CAPABILITY

The Shark® 200 meter provides two independent communication ports with advanced features.

Rear Mounted Serial Port with KYZ Pulse

- RS485 - This port allows RS485 communication using Modbus or DNP 3.0 Protocols. Baud rates are from 9600 to 57.6k.
- KYZ Pulse - In addition to the RS485, the meter also includes Pulse Outputs mapped to absolute energy.

Front Mounted IrDA Communication

Uniquely, the Shark® meter also has an optical IrDA port, allowing the unit to be set up and programmed using a PDA or remote laptop without need for a communication cable. Just point at the meter with an IrDA-equipped PC or PDA and configure it. COPILOT EXT is a Windows CE software package that allows you configure the meter and poll readings.

FIELD EXPANDABLE I/O AND COMMUNICATION CAPABILITIES

The Shark® 200 meter offers unequaled I/O expandability. Using the two universal option slots, the unit can easily be configured to accept new I/O cards even after installation. The unit auto-detects installed I/O option cards. Up to 2 cards of any type can be used per meter.

1. INP100S: 100BaseT Ethernet Capability
The meter can provide 100BaseT Ethernet functionality. Using this card, a user can connect to 12 simultaneous Modbus TCP/IP connections.

2. 1mAOS: Four Channel Bi-directional 0-1mA Outputs

- Assignable to any parameter
- 0.1% of full scale
- 0 to 10K Ohms, no accuracy losses
- Range +/- 1.20mA

3. 20mAOS: Four Channel 4-20mA Outputs

- Assignable to any parameter
- 0.1% of full scale
- 0 – 500 Ohms, no accuracy losses
- Loop Powered using up to 24 Volts DC

4. RO1S: Two Relay Outputs / Two Status Inputs

- 250VAC/30VDC - 5A Relays, Form C
- Trigger on user set alarms
- Set delays and reset delays
- Status Inputs – Wet / Dry Auto Detect (Up to 150 VDC)
- Must be used with V4 or higher V-Switch™ option for limit based alarms and control

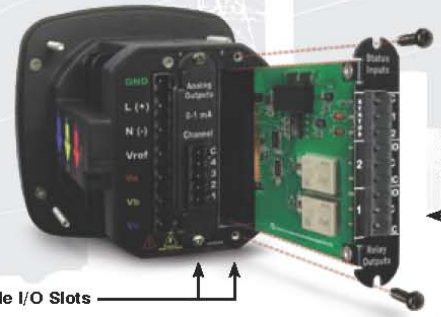
5. PO1S: Four Pulse Outputs / Four Status Inputs

- Programmable to any energy parameter and pulse value
- Form A: Normally open contacts
- Also used for End of Interval pulse
- Can function for manual relay control and limit based control (V4-V6 Options)
- 120mA continuous load current
- Status Inputs - Wet/Dry Auto Detect (Up to 150 VDC)

6. FOVPS or FOSTS: Fiber Optic Card

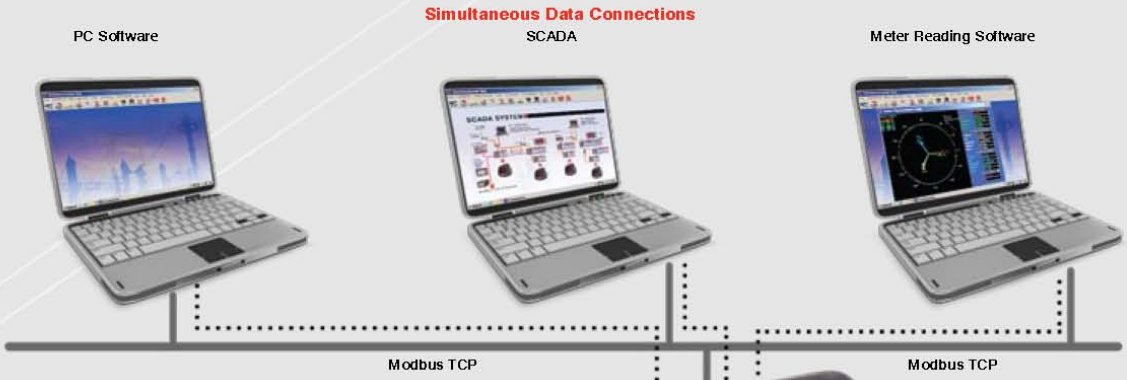
- EIG's exclusive Fiber Optic Daisy Chain switchable built-in logic mimics RS485 half duplex bus, allowing you to daisy chain meters for lower installation costs. Full duplex is also assignable.
- ST Terminated Option (-FOST)
- Versatile Link Terminated Option (-FOVP)
- Modbus and DNP 3.0 protocols available

Meter Auto Detects I/O Card Type



Note: I/O cards can be ordered separately - see last page.

100BASE T ETHERNET (INP100S)



Rapid Response™ 100BaseT Ethernet

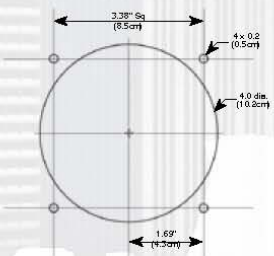
Electro Industries Rapid Response™ Ethernet card allows for high speed Ethernet communication utilizing a 100BaseT protocol communicating with up to 12 connections with Modbus TCP. The card supports a static IP address and is treated like a node on the network. Using Rapid Response™ technology insures that the Shark® 200 meter provides fast and reliable updates to HMI packages, SCADA and COM EXT download software.

Simultaneous Connections to Multiple Software Systems

SHARK® 200 METER ANSI AND DIN MOUNTING

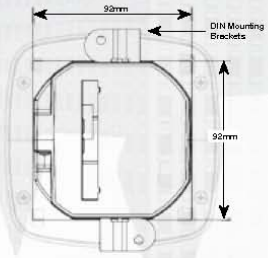
The unit mounts directly in an ANSI C39.1 (4" Round form) or an IEC 92 mm DIN square form. This is perfect for new installations and for existing panels. In new installations, simply use DIN or ANSI punches. For existing panels, pull out old analog meters and replace them with the Shark® 200 meter. The meter uses standard voltage and current inputs so that CT and PT wiring does not need to be replaced.

ANSI Mounting



American

DIN Mounting

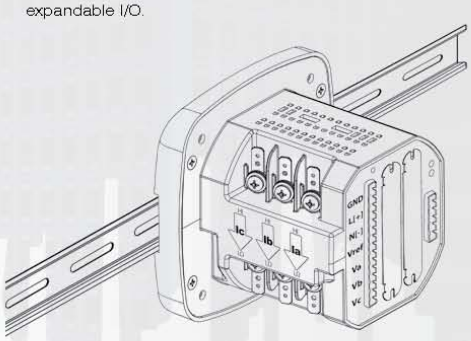


European

(One meter fits both standards)

SHARK® 200T TRANSDUCER

This transducer version of the Shark® 200 meter does not include a display. The unit mounts directly to a DIN rail and provides an RS485 Modbus or DNP 3.0 output and the expandable I/O.



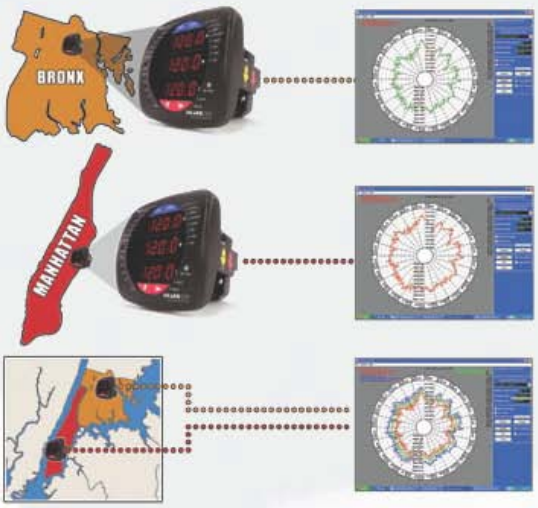
Shark® 200T - DIN Rail Mounted Transducer

Typical Substation Solutions

SUBSTATION VOLTAGE RECORDING

Traditionally, voltage recording meters were relegated to high cost metering or monitoring solutions. The Shark® 200 meter can be placed throughout an electrical distribution network. The meter provides one of the industry's lowest cost methods of collecting voltage information within a Utility power distribution grid.

- Voltage reliability analysis insuring proper voltage to customers
- Compare voltage reliability throughout transmission or distribution networks
- Monitor the output of substation transformers or line regulators
- Initiate conservation voltage reduction, reducing system demand



LOAD PROFILING

The Shark® 200 meter allows you to log substation data over time with regard to electrical usage, demand, voltage, current, PF and many other parameters. This enables a complete analysis of the power system over time.

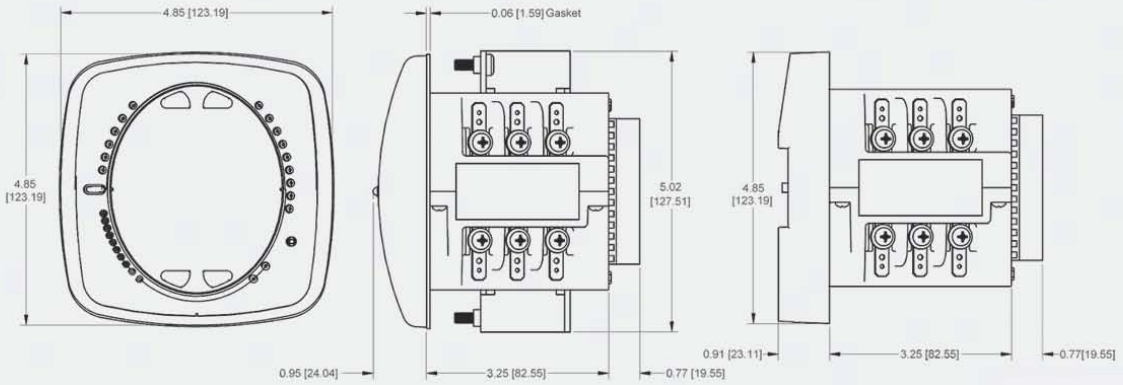
- Provide revenue accurate load profiling
- Determine substation usage
- Analyze feeder capacity and utilization
- Provide time based load profile for planning one estimation
- Data trend PF distribution and imbalances for system efficiency analysis

LOW COST SUBSTATION TELEMETRY

The Shark® 200 meter's advanced output capability brings back data using many different communication mediums such as RS485, Ethernet and analog outputs. This insures that one meter can be used for almost every substation application no matter what communication infrastructure is needed.

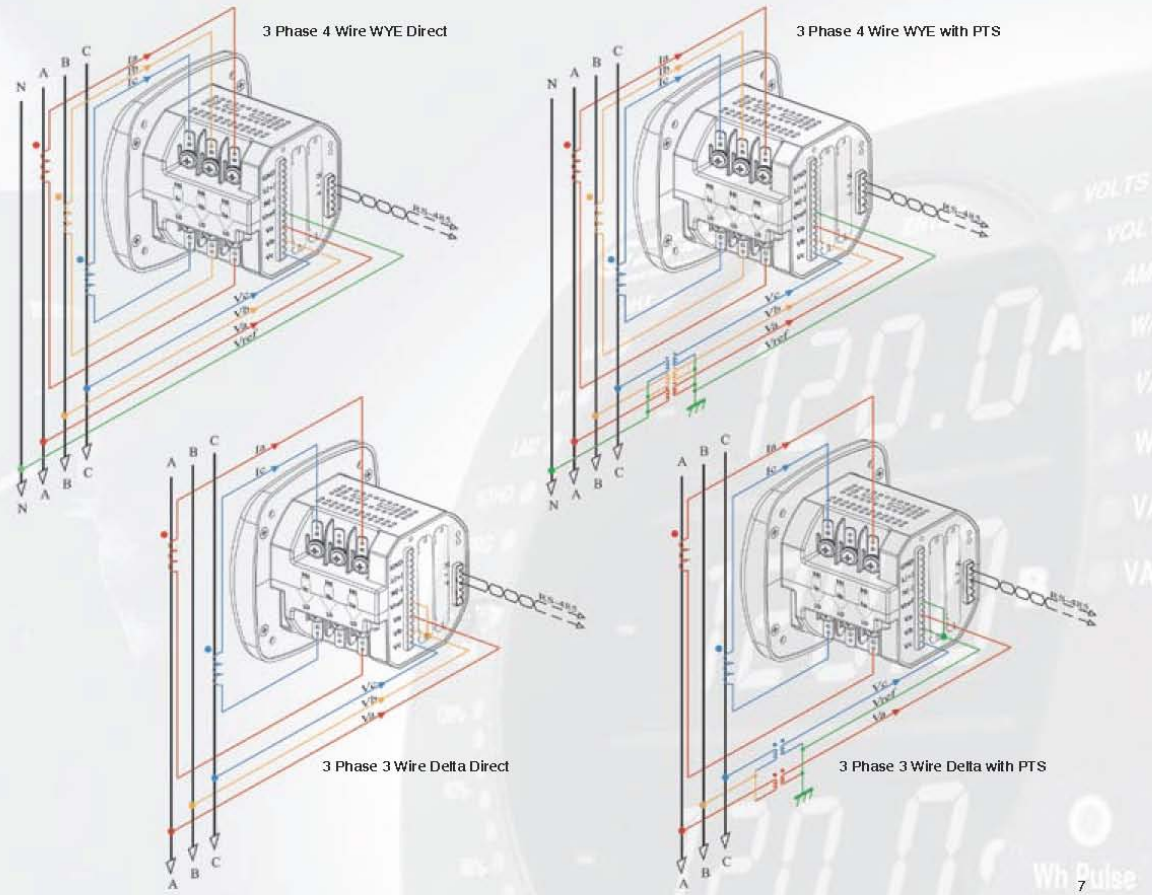
- Perfect for new or retrofit applications
- Multiple Com paths
- One meter provides outputs for every application
- Multiple systems and/or user accessing data simultaneously

DIMENSIONAL DRAWINGS



Shark® 200 Meter Face | Shark® 200 Meter Side | Shark® 200T Transducer Side

WIRING DIAGRAMS



Specifications

Voltage Inputs

- 20-576 Volts Line To Neutral, 0-721 Volts Line to Line
- Universal Voltage Input
- Input Withstand Capability – Meets IEEE C37.90.1 (Surge Withstand Capability)
- Programmable Voltage Range to Any PT ratio
- Supports: 3 Element WYE, 2.5 Element WYE, 2 Element Delta, 4 Wire Delta Systems
- Burden: Input Impedance 1 Mega Ohms. Burden 0.014W at 120Volts
- Input wire gauge max (AWG 12 / 2.5mm^2)

Current Inputs

- Class 10: (0.005 to 11) A, 5 Amp Nominal
- Class 2: (0.001 to 2) A, 1A Nominal Secondary
- Fault Current Withstand: 100 Amps for 10 Seconds, 300 Amps for 3 Seconds, 500 Amps for 1 Second
- Continuous current withstand: 20 Amps for Screw Terminated or Pass Through Connections
- Programmable Current to Any CT Ratio
- Burden 0.005VA per phase Max at 11Amps
- Pickup Current: 0.1% of Nominal Class 10: 5mA Class 2: 1mA
- Pass through wire diameter: 0.177" / 4.5mm

Isolation

All Inputs and Outputs are galvanically isolated to 2500 Volts

Environmental Rating

Storage: (-20 to + 70)° C
Operating: (-20 to + 70)° C
Humidity: to 95% RH Non-Condensing
Faceplate Rating:
NEMA 1 2
(Water Resistant)
Mounting Gasket Included

Sensing Method

- True RMS
- Sampling at over 400 samples / cycle on all channels of measured readings simultaneously
- Harmonics resolution to 40th order
- Waveform up to 512 samples/cycle

Update Rate

- Watts, VAR and VA-100msec
- All other parameters-1 second

Power Supply

Option D2:
- (90 to 265) Volts AC and (100 to 370) Volts DC. Universal AC/DC Supply

Option: D:
- (18-60) Volts DC (24-48 VDC Systems)

Burden: 10VA Max

Standard Communication Format

- 2 Com Ports (Back and Face Plate)
- RS485 Port (Through Back Plate)
- IrDA (Through Faceplate)
- Com Port Baud Rate: (9,600 - 57,600)
- Com Port Address: 1-247
- 8 Bit, No parity
- Modbus RTU, ASCII or DNP 3.0 Protocols

KYZ Pulse

- Type Form C Contact
- On Resistance: 35 Ohms Max
- Peak Voltage: 350 VDC
- Continuous Load Current: 120mA
- Peak Load Current: 350mA (10ms)
- Off State Leakage Current @ 350VDC: 1uA

Dimensions and Shipping

- Weight: 2 lbs
- Basic Unit: H4.85 x W4.85 x L4.65
- Shark® 200 meter mounts in 92mm DIN & ANSI C39.1 Round Cut-outs
- Shark® 200T Transducer DIN rail mounted
- 2-inch DIN Rail Included
- Shipping Container Dimensions: 6" cube

Meter Accuracy

- See page 3
- *Note: Accuracy specs doubled for 2.5 Element connections (less accurate).*

Compliance:

- IEC 687 (0.2% Accuracy)
- ANSI C12.20 (0.2% Accuracy)
- ANSI (IEEE) C37.90.1 Surge Withstand
- ANSI C62.41 (Burst)
- IEC1000-4-2 – ESD
- IEC1000-4-3 – Radiated Immunity
- IEC1000-4-4 – Fast Transient
- IEC1000-4-5 – Surge Immunity

Ordering Information

All fields must be filled in to create a valid part number.

	Model	Frequency	Current Input	V-Switch Pack	Power Supply	I/O Slot 1*	I/O Slot 2*
Option Numbers:	–	–	–	–	–	–	
Example:	Shark200 -	-60 -	-10 -	-V2 -	-D2 -	-INP100S -	-X
	Shark200 (Meter/Transducer) Shark200T (Transducer Only)	-50 50 Hz System -60 60 Hz System	-10 10 Amp Secondary -2 2 Amp Secondary	-V1 Multifunction Meter Only -V2 Standard Data-Logging Memory -V3 Power Quality Harmonics -V4 Limits & Control -V5 64 Samples/cycle Waveform Recording -V6 512 Samples/cycle Waveform Recording	-D2 90-265V AC/DC -D 18-60V DC	-X None -RO1S 2 Relays / 2 Status -PO1S 4 Pulses / 4 Status -1mAOS 4 channel Analog Output 0-1 (bidirectional) -20mAOS 4 Channel Analog Output 4-20mA -FOSTS Fiber Optic Output ST Terminated -FOVPS Fiber Optic Output VPIN Terminated -INP100S 100BaseT Ethernet	-X None -RO1S 2 Relays / 2 Status -PO1S 4 Pulses / 4 Status -1mAOS 4 channel Analog Output 0-1 (bidirectional) -20mAOS 4 Channel Analog Output 4-20mA -FOSTS Fiber Optic Output ST Terminated -FOVPS Fiber Optic Output VPIN Terminated -INP100S 100BaseT Ethernet

** I/O cards can be ordered separately using the above part numbers.*

Additional Accessories

Communication Converters

9PINC – RS232 Cable

CAB6490 - USB to IrDA Adapter

Unicom 2500 - RS485 to RS232 Converter

Unicom 2500-F – RS485 to RS232 to Fiber Optic Converter

Modem Manager, Model #, MM1 – RS485 to RS232 Converter for Modem Communication

IrDA232 - IrDA to RS232 Adapter for Remote Read

Compliance Documents

Certificate of Calibration, Part #: CCal – This provides Certificate of Calibration with NIST traceable Test Data.

Current Transformer Kits

CT200K – 200/5 Ratio .94" Window 3 CTs

CT400K – 400/5 Ratio, 1.25" Window, 3 CTs

CT800K – 800/5 Ratio, 2.06" Window, 3 CTs

CT2000K – 2000/5 Ratio, 3.00" Window, 3 CTs

CT Specifications:

Frequency: 50 to 400Hz; Insulation: 600 Volts, 10kV BIL
Flexible Leads: UL 1015 105°C, CSA Approved, 24" Long, #16AWG

Software Option Numbers

COMEXT3 – CommunicatorEXT 3.0 for Windows®

* Consult factory application engineer for additional transformer ratios, types or window sizes.

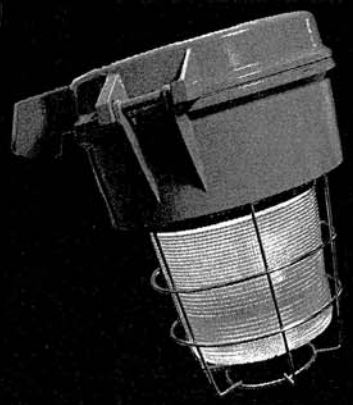
Electro Industries/GaugeTech
1800 Shames Drive • Westbury, NY 11590
1-877-EIMETER (1-877-346-3837) • **E-Mail:** sales@electroind.com
Tel: 516-334-0870 • **Web Site:** www.electroind.com • **Fax:** 516-338-4741

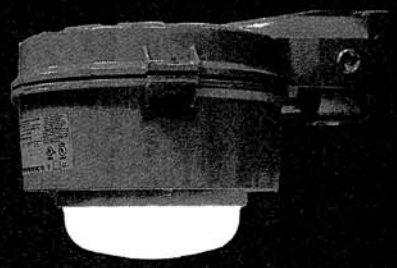
E 149702 121409 N Printed in China

APPENDIX E

STRUCTURE LIGHTING UPGRADE DATA

AZZ | R-A-L™





AZZ | RAL Rig-A-Lite SAFR Series LED Luminaires

Superior LED Technology for Hazardous and Severe Environments

Five-Year Warranty

SAFR Series LED Luminaires

The Rig-A-Lite SAFR LED fixture is the perfect combination of dependability, safety and energy efficiency for customers whose facilities include hazardous and severe environments.

Since 1938, we have been at the forefront of lighting technology, providing industry with intelligent solutions to their lighting dilemmas.

As LED technology has continued to improve, Rig-A-Lite has integrated it into our vision of the future of lighting these specialty environments including petrochemical refining, petroleum refining, waste water treatment facilities, pharmaceutical facilites, food processing facilities power plants and other industrial & manufacturing areas where flammable vapors, gasses, ignitable dusts, fibers or flyings are present.

The SAFR series is also rated for marine environments, wet locations and heavy hose-down applications- indoors or outdoors.

Compared to HID (high intensity discharge) technologies, LED (light emitting diode) technology provides extended life expectancy, greater energy effeciency and reduced maintenace costs with a comparable or better quality of light.

Certifications

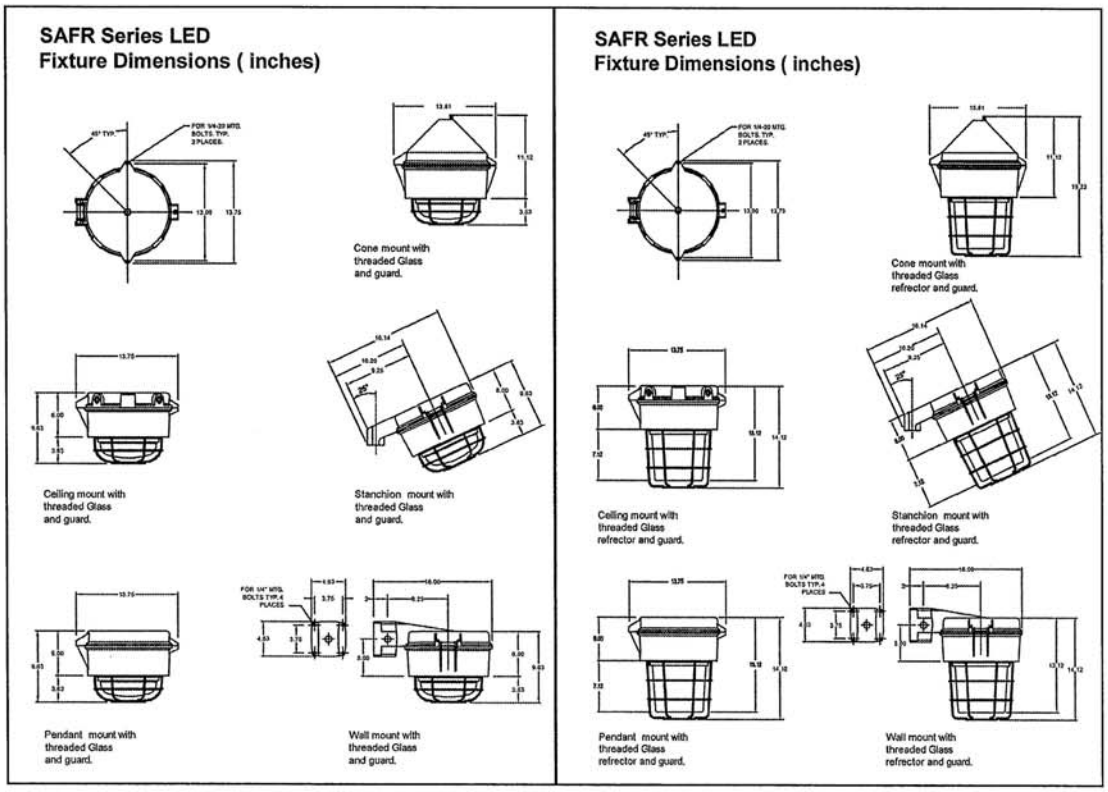
- Class I, Division 2, Groups A,B,C & D
- Class II, Division 1 & 2, Groups E,F & G
- Class III
- Zone 2, Groups IIA, IIB & IIC
- Simultaneous Presence
- Enclosed and Gasketed
- NEMA 3R, 4X
- UL 8750,1598, 1598A & 844
- CUL
- IP 66
- AEx nR II, T4
- Tested to LM79 & LM80 standards

Standard Materials

- Copper Free Cast Aluminum Alloy Housing
- Baked Epoxy Powder Coating
- Stainless Steel Hardware
- Tempered Glass Globe
- Stainless Steel Guard
- Silicone Gaskets

Features

Glare Free Performance with Threaded Refractors
Replaces up to 100 watt Metal Halide and 100 watt High Pressure Sodium
Color Temperature: 5,000 CCT (K)
CRI: >75
60,000 or more hours rated lamp life with 70% lumen maintenance
2,489 Total Lumens with Threaded Refractors
3,614 Total Lumens with Clear Globe
75 Watts Input Power Constant Current
100-277V, 50-60Hz
40 Lumileds™ Luxeon® Rebel
Junction Temperature: 97° C in a 55° C Ambient
Total Efficacy of 33.1 Lm/W with Threaded Refractors, 48.3 Lm/W with Clear Globe
Line Transient Protection: 1 KV line to line. 1 KV line to ground



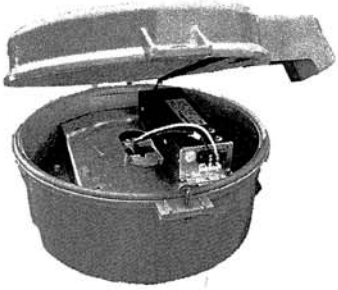
Certification Guide

MODEL	AMBIENT °C	Class I, Div.2 Groups A,B,C & D	CLASS II & III GROUPS		Simultaneous Prescence	UL 1598A OUTDOOR	Class I, Zone 2 AEx nR II	CUL	SUPPLY WIRE SUITABLE TEMP °C
SAFR09L	40	T4A	E,F,G	T6	T3C	YES	YES	YES	90
SAFR09L	55	T4A	E,F,G	T6	T3C	YES	YES	YES	105

Photometric Testing by:
ITL, Inc.- Boulder, CO.
Test Report- ITL63820
Test procedeure: IESNA LM-79-08

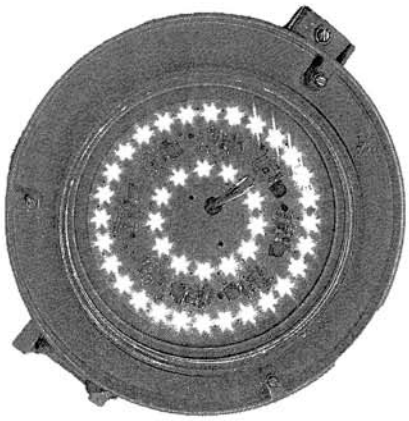
SAFR Series LED Luminaires

The Rig-A-Lite SAFR LED fixture is the perfect combination of dependability, safety and energy efficiency for customers whose facilities include hazardous and severe environments.

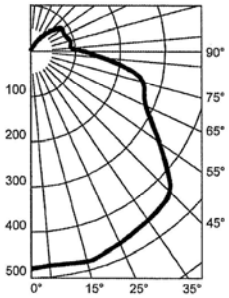


- LED arrays provide consistant, energy efficient and long life light output.
- Glass refractors provide type I, III & V glare free light distribution.
- Die cast aluminum provides efficient heat sink properties and UL Listed/NEMA rated protection.

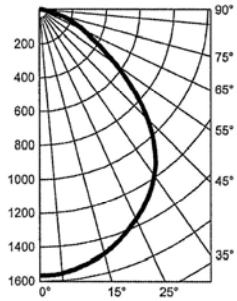
- Highly efficient LED drivers provide current regulation for consistant performance in severe environments.
- Easy to install for remodel & new construction- same mounting components as standard SAFR.



SAFR09LXT5G



SAFR09LXGG



Candlepower: SAFR09LXT5G

Deg.	Parl.	22.5	45	67.5	Norm	Zonal Flux
0	480	480	480	480	480	
5	462	461	463	461	460	44
15	469	471	469	479	471	134
25	468	470	469	474	471	218
35	446	452	451	455	452	281
45	437	435	432	433	431	333
55	350	346	345	341	340	313
65	282	279	283	282	285	282
75	259	258	258	261	263	270
85	164	166	165	163	167	181
90	120	121	120	119	122	

Total Lumens: 2,489 75 Watts
Efficacy: 33.1 Lm/W
CCT (K): 5,000

Candlepower: SAFR09LXLCG

Deg.	Parl.	22.5	45	67.5	Norm	Zonal Flux
0	1564	1564	1564	1564	1564	
5	1558	1557	1559	1559	1555	148
15	1487	1489	1487	1489	1492	420
25	1361	1363	1368	1370	1371	630
35	1191	1193	1200	1202	1203	750
45	912	914	917	920	923	702
55	558	564	569	572	581	511
65	327	334	335	339	345	323
75	109	112	113	109	110	118
85	12	12	12	12	12	12
90	0	0	0	0	0	

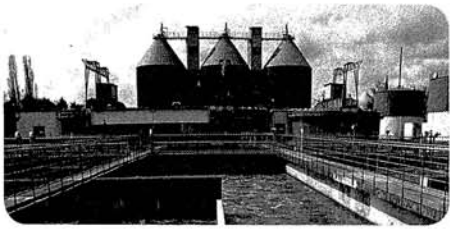
Total Lumens: 3,614 75 Watts
Efficacy: 48.3 Lm/W
CCT (K): 5,000

Coefficients of Utilization SAFR09LXT5G

% Effective Ceiling Cavity Reflectance Icc	80			50			10		
% Wall Reflectance Iw	50	30	10	50	30	10	50	30	10
Room Cavity Ratio RCR	20% Effective Floor Cavity Reflectance								
0	115	115	115	101	101	101	86	86	86
1	95	90	85	84	80	76	71	68	66
2	81	73	67	71	65	60	60	56	52
3	70	61	54	62	55	49	52	47	43
4	62	52	45	54	47	41	46	40	36
5	54	45	38	48	41	35	41	35	31
6	49	39	32	43	36	30	37	31	27
7	44	35	28	39	32	26	33	28	23
8	40	31	25	36	28	23	30	25	21
9	36	28	22	33	25	21	28	23	19
10	33	25	20	30	23	18	26	21	17

Coefficients of Utilization SAFR09LXLCG

% Effective Ceiling Cavity Reflectance Icc	80			50			10		
% Wall Reflectance Iw	50	30	10	50	30	10	50	30	10
Room Cavity Ratio RCR	20% Effective Floor Cavity Reflectance								
0	119	119	119	111	111	111	102	102	102
1	106	103	99	100	97	95	93	91	89
2	94	88	83	89	84	80	83	80	87
3	84	77	71	79	64	69	74	70	67
4	75	67	61	71	65	60	67	62	58
5	68	59	53	68	54	52	61	55	51
6	61	53	47	59	51	46	55	50	45
7	56	47	42	53	46	41	51	45	41
8	51	43	37	49	42	37	47	41	37
9	47	39	34	45	38	34	43	37	33
10	43	36	31	42	35	31	40	34	30



Catalog Number Logic

SAFR 09-L-U -T5G-P-XX

(1) (2) (3) (4) (5) (6) (7)

(1) BASIC SERIES SAFR
Hazardous Location LED
Class I, Division 2,
Groups A, B, C & D
Class II, Division 1 & 2,
Groups E, F & G
Class III
Simultaneous Prescence
Zone 2, Groups IIA, IIB & IIC
Enclosed and Gasketed
Wet Locations
NEMA 3R, 4X
IP66
UL 1598, 1598A & 844
CUL
Restricted Breathing
(Annual Testing Not Required)
AEx nR II

(2) LAMP CURRENT/LAMP WATTAGE
09 = 75 Watt

(3) LAMP TYPE
L = LED

(4) DRIVER VOLTAGE
U = 120 thru 277 50/60HZ

(5) GLOBE & GUARD
LC = Low Profile Clear Globe Only
LCG = Low Profile Clear Globe & Guard
LF = Low Profile Frosted Globe
LFG = Low Profile Frosted Globe & Guard
T1 = Type I (Asymmetric) Closed Bottom Threaded Glass Refractor
T3 = Type III (Asymmetric) Closed Bottom Threaded Glass Refractor
T5 = Type V (Symmetric) Closed Bottom Threaded Glass Refractor
T1G = Type I (Asymmetric) Closed Bottom Threaded Glass Refractor with Guard
T3G = Type III (Asymmetric) Closed Bottom Threaded Glass Refractor with Guard
T5G = Type V (Symmetric) Closed Bottom Threaded Glass Refractor with Guard

(6) MOUNTING STYLE
P = 3/4" Pendant Mount
P1 = 1" Pendant Mount
F = 3/4" Flexible Pendant Mount
F1 = 1" Flexible Pendant Mount
C = 3/4" Ceiling Mount
C1 = 1" Ceiling Mount
W = 3/4" Wall Mount
W1 = 1" Wall Mount
S = 1-1/4" Stanchion Mount
S1 = 1-1/2" Stanchion Mount
K = 3/4" Cone Top
K1 = 1" Cone Top

(7) OPTIONS[1]
SS = Stainless Steel Inserts
FB1 = Fuse Block[2,3]
TB = Terminal Block
SAF = SAF-PAK (Assembled Fixture)
RB = Restricted Breathing UL Listed Class I, Zone 2, AEx nR II, T4

AZZ | R-A-L™
8500 Hansen Road
Houston, TX 77075
713-943-0340 phone
713-943-8354 fax
www.rigalite.com

[1] Consult factory for pricing.
[2] When installed, one fuse block is provided for 120, 277V and two fuse blocks are provided for 208 & 240V. Fuse not included. Voltage must be specified.
[3] Fuse option not available for marine listed fixtures.

Catalog logic is for explaining catalog number structure only. Not all combinations are possible; consult factory for catalog numbers not listed in charts.

AZZ | ELECTRICAL PRODUCTS GROUP

ATKINSON-EPSI • BLENKHORN & SAWLE • CALVERT • CENTRAL ELECTRIC • CGIT SYSTEMS • R - A - L

APPENDIX F

CONDENSER WATER PUMPS
&
FEED FANS ANALYSIS

APPENDIX-F – CONDENSER WATER PUMPS & FEED FANS

MATCH CONDENSER WATER PUMPS AND COMBUSTION FEED FANS TO LOADING

While evaluating power plant, process equipment energy use was not in the planned scope of services. However, it came to the attention of the survey team that some large motors are operated at full capacity whenever a generating unit is in operation. This led to a discussion of whether that is necessary, and to what alternatives could be available. *It is not TEESI's intent to recommend process changes, however, we did pursue a short evaluation of what savings could be possible if the fan and pump operations can be modified.*

Each of the three (3) generating units has two (2) condenser water pumps rated 1350 HP each, with both pumps at each unit operated whenever the unit is operational. The two (2) Sim Gideon units, which are Rankine cycle units, each have two (2) 1350 HP combustion air blowers, with both blowers at each unit operated whenever the unit is operational.

It is our understanding that frequently the units operate often at reduced load. This is especially true of the less efficient Sim Gideon units, which often serve as rotating reserve for peaking use.

On the surface, it appears that one condenser water pump should be turned off any time the unit load falls below about 50% of capacity. (Actually, the second pump is likely not justified even at 60% capacity, since one pump will likely produce more than 60% of design flow at less than 60% of design power.) Similarly, one combustion air fan should provide sufficient air for over 60% combustion rate at much less than 60% fan power; however, the impacts on combustion stability, emissions, and boiler safety are beyond our analysis. Also, the combustion blowers have damper controls that are without parallel in the pumping analysis.

The summary table on the following page addresses one pair of 1350 HP pump motors, considering the base case and three possible improvements. Each case is predicated on the assumption that a Unit operates at low load (50% or less of design capacity, not counting times when totally off) for about 20% of each year. The pump hours at each speed should be adjusted to reflect actual load profiles.

Case 2 assumes that one motor of each pair at full speed can carry at least 50% of load. Case 3 assumes that two motors running at half speed can carry 50% of load. Case 4 considers that the motor may not be suitable for use with a VFD, so a new, high-efficiency motor is included in the cost. Case 2 is highly attractive, requiring only a small amount of training or automation to achieve excellent savings, and resulting in an immediate payback. Case 3 is very attractive with a rapid return on investment. Case 4 has almost the same payback and includes a new motor. Cases 3 and 4 may turn out to be even more attractive if the actual load profile has more hours in the 30% to 90% load range.

Another case not evaluated is adding a VFD for only one motor of each pair. That could be very attractive if the load is <u>well below</u> 50% for many hours per year and not between 60% and 100%

very often. However, the pump efficiency is badly reduced when the system resistance is only 50% of its most efficient match. Therefore, savings are greatest when both pumps operate in parallel at the same reduced speed at all loads.

VFD PAYBACK ANALYSIS							
		Base Case (Existing)	Switch 1 Pump Off 20% of Yr	Slower, New VFD, Ex. Motor	Slower, New VFD & Motor		
		1	2	3	4		← Cases
		2	2	2	2	Motors	Quantity
		1,350	1,350	1,350	1,350	HP	Motor Rating
		95.5%	95.5%	95.5%	**96.5%**		Motor Efficiency
		2,109	2,109	2,109	2,087	KW	Motor Input Rating
		0%	3%	3%	3%		Drive Load Losses
		0%	4%	4%	4%		Drive Static Losses
		2,109	2,112	2,112	2,090	KW	Drive Input Rating
Speed	Shaft Pwr	8,760	8,760	8,760	8,760	Hr/Yr	Operating Time
100%	100%	**80%**	**70%**	**60%**	**60%**		% of Operating Time
90%	73%	0%	0%	0%	0%		% of Operating Time
70%	34%	0%	0%	0%	0%		% of Operating Time
50%	13%	0%	0%	**20%**	**20%**		% of Operating Time
30%	3%	0%	0%	0%	0%		% of Operating Time
0%	0%	20%	30%	20%	20%		% of Operating Time
		80%	70%	63%	63%	Hr/Yr	Equiv. Full Load Time
		14,781	13,838	12,485	12,356	MWH/Yr	Annual Energy Use
		35.00	35.00	35.00	35.00	$/MWH	Effective Value of Energy
		517,322	484,343	436,976	432,448	$/Yr	Est. Operating Costs
			32,979	80,347	84,875	$/Yr	Energy Cost Reduction w.r.t Base Case
380	$/HP			513,000	513,000	$	VFD, 4160v/3ph - Cost
10,000	$		2,000	10,000	10,000	$	VFD Installation Cost
81.5	$/HP				110,025	$	Motor Cost
4,000	$				4,000	$	Motor Installation Cost
			2,000	523,000	637,025	$	Cost Est. By Case
			Immediate	**6.51**	**7.51**	Yr	Simple Payback

The effective value of energy used in the analysis above was estimated arbitrarily ($35/MWH), and is probably lower than the actual value. This evaluation is presented without detailed research into possible impacts on the power generation process and equipment, so no specific recommendation, cost or energy reduction for the suggested actions is included in main body of the report. Detailed engineering assessment of the system is highly recommended.