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TEXAS BACKUP POWER PACKAGE

Project Number 22483.005

- Prepared for
- **Public Utility Commission of Texas**
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-
- January 21, 2025
- FINAL REPORT
- Submitted by:
- Patrick Engineering Inc.

RINA

Our experience. Your growth.

TEXAS BACKUP POWER PACKAGE
Final Report

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Preface

This Report was commissioned by the Public Utility Commission of Texas (PUCT). It is to enhance the approach to improve the resiliency of the Texas power grid during an unforeseen power grid failure. We commend the Texas Legislature in providing the legislative vehicle to aid in the development of the program known as the Texas Backup Power Package (TBPP). The PUCT along with its Advisory Committee have provided considerable input into this report in terms of required research and viability of the program. RINA welcomes the opportunity to be an integral part of support in the research and design of the TBPPs.

Table of Contents

Abbreviations

Amsl	Above mean sea level
ATS	Automatic Transfer Switch
BESS	Battery Energy Storage System
Btu	British thermal unit (unit of heat capacity)
Btuh	British thermal unit hour (quantity of continuous Btu demand or supply in one hour)
CapEx	Capital expenditure
°C	degrees Celsius
CF	Critical Facility
CI	Compression Ignition
ERCOT	Electric Reliability Council of Texas
ESB	Electric School Bus
°F	degrees Fahrenheit
IC	Internal Combustion
LF	Load Factor
kW	kilowatt (unit of electrical capacity)
kWh	kilowatt hour (quantity of continuous kW demand or supply in one hour)
MG	Microgrid
MW	Megawatt
OpEx	Operating expenditure
PURA	Public Utility Regulatory Act
PV	Photovoltaics
STS	Static Transfer Switch
TBPP	Texas Backup Power Package
TDSP	Transmission and Distribution Service Provider
V2B	Vehicle to Building
V2G	Vehicle to Grid

Definitions

Alternator	The component of a genset that is driven by the IC engine and produces the output electricity rating of the genset.
Battery Storage	Electricity storage equipment enabling generated electricity to be stored for use at a later time.
Capital Expenditure (CapEx)	The total upfront cost to develop, purchase and install a project. Does not include any operating expenditure (OpEx) costs.
Contractor	Provides services under contract for a specific project, purchasing finished goods from vendors to be used as part of project construction under the project requirements.
Critical Facility (CF)	An existing facility under PURA §34.0202 "on which communities rely for health, safety and welfare." This does not include under PURA §34.0205(e)(1), "a commercial energy system, a private school, or a for-profit entity that does not directly serve public safety and health." Based upon this definition residential homes requiring the use of critical care patient equipment do not qualify for TBPPs as they do not fulfill the need to supply health, safety and welfare to the community.
EaaS	Energy as a Service. EaaS deploys custom-designed, on-site energy infrastructure, for example a microgrid, without the need for up-front capital investment.[1] See MaaS also.
Genset (IC)	Gaseous-fueled internal combustion (IC) engine-driven generator which produces electrical energy. Engine is natural gas or propane fueled.
MaaS	Microgrid as a Service. With MaaS, a third-party company provides the upfront capital to design, install, and operate a microgrid on behalf of a customer. The customer pays for the energy it uses, similar to a utility bill, but with the added benefits of increased energy reliability, improved power quality, and potentially lower energy costs.[5]
Manufacturer	A company which produces finished goods from raw materials by using various tools, equipment, and processes, and sells the goods to consumers, wholesalers, distributors, retailers, or to other manufacturers for the production of more complex goods.

Microgrid (MG)	A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. It can connect and disconnect from the grid to operate in grid-connected or island mode.[4]
Operating Expenditure (OpEx)	The cost, usually expressed as monthly or annual, dollars/period, to operate and maintain a project. Does not include any CapEx costs.
Solar Photovoltaics (PV)	Solar modules which generate electricity.
Supplier	An organization which provides a product or service, taking raw or semi-finished material and manufacturing finished goods and services to be sold to vendors.
Texas Backup Power Package (TBPP)	Power sourced from a combination of natural gas or propane with photovoltaic panels and battery storage, or alternatively, power sourced from battery storage on an electric school bus (ESB) meeting requirements of Chapter 34 of PURA. More specifically, a combination of a natural gas or propane fueled engine generator set with solar photovoltaic (PV) panels and a battery energy storage system (BESS) combined into a single power package (or alterative ESB power source), to be operated in island mode only during an electric power outage to provide backup electric power to a critical facility for up to 48 continuous hours without refueling or connecting to a separate power source. This may be considered operationally as a micro grid.
Transmission and Distribution Service Provider (TDSP)	Texas entities responsible for maintaining powerlines, delivering power to end users, reading meters and restoring power outages. Sometimes referred to as Transmission and Distribution Utilities (TDUs) electric utility providers, or "poles and wires" companies.[8]
Transmission and Distribution Utility (TDU)	See Transmission and Distribution Service Provider (TDSP).
Vehicle to Building (V2B)	Utilizing electric vehicles, such as electric school buses, to support a building's electrical system through bidirectional inverters/chargers. This can be used to support a facility during a power outage.

Vehicle to Grid (V2G)	Utilizing electric vehicles, such as electric school buses, to support the grid through bidirectional inverters/chargers. This can be used to support a facility during a power outage.
Vendors	Sellers of finished goods or services that are ready to be used or resold. Vendors shall also provide installation services.

1 Executive Summary

The Public Utility Commission of Texas (PUCT) engaged Patrick Engineering Inc., a RINA Company (Patrick), to evaluate Critical Facilities (CFs) in Texas, provide detailed designs and specifications for the Texas Backup Power Packages (TBPPs), assess costs and benefits, and determine manufacturers and vendors suitable to support the TBPP program.

The results of market research and analysis determine that there are over fifty manufacturers, suppliers and vendors of equipment and microgrids considered suitable based on technical capability and experience to provide components and integrated energy supply systems to support the delivery of the TBPPs. The listing of manufacturers, suppliers and vendors is provided in Appendix 5.

The technical elements of the power generation equipment to provide emergency backup power to critical facilities are based on the statutory requirements codified in PURA § 34.0201-.0205, which limits the packages to those that can operate for a minimum of 48 continuous hours without refueling or connection to a separate power source, prohibits the sale of excess energy or capacity as an ancillary service from the package, and requires the packages to be powered by a combination of natural gas or propane with photovoltaic (PV) panels and battery storage, or alternatively, by battery storage on electric school buses. The maximum load to be supplied by a package at any critical facility is 2.5MW.

An analysis of the sizes and range of power needs of critical facilities in Texas as provided in the previous Initial Report determined there to be five recommended TBPP sizes: 10kW, 25kW, 100kW, 500kW and 1000kW capacity. Package capacities are based on the quantities of TBPPs expected to be furnished in each kW category and which can be easily aggregated together to meet individual critical facility power needs. The package aggregation would require no more than three packages aggregated together to achieve the desired output, whilst allowing sizing up of a package to the next largest recommended size. The individual technical specifications and designs for each package size are attached as Appendices 7 and 8.

The alternative use of battery storage from electric school buses (ESBs) to provide backup power requires consideration that buses are unlikely to be available to the critical facility in a fully charged state (unless already located at the site and fully charged) and the analysis assumes a bus battery is at 80% of fully charged capacity when delivered to the critical facility. The current average electric school bus battery storage is around 150kWh (although expected to increase to 200kWh in the near future), at 80% charge would require a minimum of 4 ESBs to power a 10kW critical facility for 48 hours.

In order to minimize power package capital costs whilst fulfilling the statutory requirements, the design of each package includes a genset (internal combustion engine combined with an electrical generator) sized to the package capacity, a battery energy storage system (BESS) sized to the package capacity and including one hour of storage, and a solar PV system sized at 16% of package capacity based on allowing BESS recharge during a 6 hour daylight period.

Capital cost estimates of the TBPPs are based on pricing information received from suppliers of major components (genset, BESS, solar modules and other main equipment items), and from microgrid (MG) vendors providing energy systems, including technologies and components designed and integrated as a fully engineered package, for delivery to site for installation and connection to a CF. In response to a request for pricing and other technical information, component suppliers and MG vendors provided a range of pricing information which was used along with RINA cost estimates to estimate the cost of the major components, and as a microgrid solution, including an estimate for installation. The installed cost of a TBPP cannot be definitively determined due to unknown site-specific information, including availability of genset fuel source, site layout, and available space for the particular TBPP.

A summary of pricing estimates received from individual component suppliers is shown in Table 1 below. Component pricing excludes ancillary costs such as engineering and integration of equipment, factory testing, administration, etc.

Table 1: Summary of pricing estimates from component suppliers

Component	**10kW**	**25kW**	**100kW**	**500kW**	**1000kW**
Genset	$4,431	$16,268	$37,193	$198,300	$338,375
BESS (1 hour storage)	$7,000	$17,500	$60,000	$300,000	$600,000
PV Modules	$675	$1,688	$6,750	$33,750	$67,500
Inverters	$867	$1,294	$3,893	$11,079	$22,157
Automatic Transfer Switch	$3,100	$3,100	$8,100	$18,409	$29,990
Controller	$6,200	$6,200	$15,500	$77,500	$155,000
Components Total	$22,273	$46,049	$131,436	$639,038	$1,213,022
Components /kW	**$2,227**	**$1,842**	**$1,314**	**$1,278**	**$1,213**

A summary of pricing estimates received from microgrid vendors is shown in Table 2 below.

Table 2: Summary of pricing estimates from microgrid vendors

Pricing Estimate	**10kW**	**25kW**	**75kW**	**300kW**	**1250kW**	**2500kW**
High	$114,500	$547,500	$684,300	$1,322,800	$1,458,447	$6,451,800
Low	$63,655	$98,808	$238,224	$517,300	$1,294,883	$2,531,791
Average	$83,284	$240,337	$423,648	$807,581	$1,376,665	$3,945,062
MG /kW	$8,328	$9,613	$5,649	$2,692	$1,101	$1,578
Average (excluding outliers)	$83,284	$137,949	$336,763	$549,972	$1,376,665	$2,691,694
MG /kW (excluding outliers)	$8,328	$5,518	$4,490	$1,833	$1,101	$1,077
Installation (estimate)	$30,000	$33,750	$45,000	$90,000	$262,500	$375,000
MG Total	$113,284	$171,699	$381,763	$639,972	$1,639,165	$3,066,694
MG Total $/kW	**$11,328**	**$6,868**	**$5,090**	**$2,133**	**$1,311**	**$1,227**

Within microgrid pricing, totals take account of the exclusion of pricing outliers which would otherwise skew the average of vendor pricing information received.

Due to the nature of the program where no definitive site can be considered, microgrid costs do not include equipment foundations, propane tankage/natural gas connection (as required), cabling, construction, CF service upgrades, delivery or transportation; thus, a broad estimate of cost is provided for each package size.

Cost estimates are based on an individual power package, and do not include any quantity discounts which may be available. Delivery times vary from 15 to 25 weeks for systems through 300kW, to 25 to 40 weeks for 1250 – 2500kW systems, up to 15 – 16 months depending on the supplier.

The cost estimates determine that the total cost of each backup power package is significantly greater than the TBPP program grant cap of $500 per kW, in particular for the smaller capacity units.

Package costs for a TBPP using ESB power varies with the size of the inverter/charger and ranges from $6,000 to $10,000, for one inverter/charger station including installation on a concrete pad plus wiring and interconnection at the critical facility.

In conclusion and based on the overall analysis, the market is available to provide the equipment and systems to satisfy the requirements of the TBPP program, however the program grant may only fund a small portion of the cost of the TBPP.

2 Texas Backup Power Packages

2-1 Background

Electricity has become an essential energy source, powering homes, industries, and the economy while ensuring the safety and functionality of daily activities. Its loss can range from being inconvenient to life-threatening. Across the United States, power outages are a persistent risk due to unpredictable events such as severe weather, earthquakes, flooding, and wildfires. These events often disrupt critical utilities, including water supply due to damaged pipes or pump failures, wastewater systems due to broken sewers or power loss at treatment facilities, and natural gas supplies used for heating and industrial needs. Health care services are also severely impacted when utilities that sustain medical facilities become inoperable.

For example, Winter Storm Uri in 2021 caused widespread power outages across Texas, disrupting electricity for homes, schools, healthcare facilities, gas stations, emergency services, and industries. The prolonged freezing temperatures led to the failure of gas wells and compressors, reducing system gas pressure and cutting off heating fuel to numerous customers. This event highlighted the vulnerability of critical infrastructure to extreme weather.

In response, the Texas legislature established the Texas Backup Power Package program to enhance the resilience of critical facilities (CFs). The Public Utility Commission of Texas (PUCT) was tasked with leading the program, beginning with identifying and categorizing critical facilities statewide.

2-2 Program Requirements

The legislation establishing the TBPP program, Senate Bill (SB) 2627, was ratified by Texas voters and codified into Chapter 34 of the Texas Utilities Code, also known as the Public Utility Regulatory Act (PURA). Chapter 34 of PURA includes the following technical requirements for TBPPs:

- Engineered to minimize operational costs.
- Uses interconnection technology and controls that enable immediate islanding from the power grid and stand-alone operation for the host facility.
- Is capable of operating for at least 48 continuous hours without refueling or connecting to a separate power source.
- Is designed so that one or more TBPPs can be aggregated on-site to serve not more than 2.5MW of load at the host facility.
- Provides power sourced from a combination of natural gas or propane with photovoltaic panels and battery storage, or battery storage on an electric school bus.
- Is not used by the owner or host facility for the sale of energy or ancillary services.

In addition, with respect to the provision of financial support to CFs under the TBPP program, the following applies according to Chapter 34 of PURA:

- The amount of a grant provided may not exceed $500 per kW of capacity.

2-4 Technology

The prescribed technology for the TBPP program included standard, readily available, proven systems per the legislation. This includes the use of natural gas or propane fueled IC gensets, solar PV panels and BESS. New technology in relation to the performance of IC engines was also reviewed and included for the genset component. The technology is related to the method of fuel use and power generation. As no special fueling requirements or space constraints beyond the normal IC engine installations are required, this technology was found to be suitable.

Other technologies to be considered in the operation of the TBPP include electronic relaying, transfer switching, monitoring and control. The main controller technology to be used includes programmable logic controllers and microgrid (MG) pre-configured controllers which have built-in and configurable algorithms for combining the various generation technologies to operate together. It is noted that the TBPP sizes do not take into account the potential for reductions in critical load kW resulting from implementation of energy efficiency measures at individual sites to reduce demand.

Vehicle to Grid (V2G)

It is important to note that electric school buses were included as a mobile energy source. The use of electric school buses as a TBPP would require installing bidirectional inverter/chargers at school buildings (or other designated CFs) that require backup power during response and restoration following a natural disaster event. This installation has been included as a separate TBPP.

The use of electric school buses as a backup power package is a viable, separate TBPP. It would assume that the CF requesting the use of this option would be in a location where ESBs are available and can be provided within a specific time frame to meet the power needs of the CF. The cost of this ESB service could be an ongoing arrangement with the ESB owner to provide a Resiliency as a Service contract for the supply, operation and maintenance of the ESBs in order to be assured of the ability to receive the needed backup power. The TBPP would consist of one or more bidirectional inverter/chargers, a transfer switch, and the installation of such equipment including the necessary foundations, wiring and interconnection with the CF electric distribution system. The package would not include the ESB itself, but rather only the equipment to utilize the ESB.

V2G ESBs come ready for use as backup power supplies. One issue with the use of ESBs is whether they can be provided to the CF in a fully charged state or if they should be considered "fully charged" at 80% capacity when delivered. This will aid in deciding how many ESBs will be required to power the CF. Today, according to discussions with the Texas Electric School Bus Project team (TESBP), the average ESB battery storage is roughly 150kWh. This is expected to increase to 200kWh in the near future. At 150kWh and an 80% charge, it would take a minimum of 4 ESBs to power a 10kW CF for 48 hours.

2-4.1 Design Basis – Micro Grid

The design basis is outlined as follows and provides design requirements overview and intended operating sequences of the TBPPs.

DESIGN REQUIREMENTS

1. Genset fueled by natural gas or propane.
2. Must use solar with batteries.
   All TBPPs must include items 1 & 2.
3. Can use V2G with electric school buses.
4. Must operate for 48 hours without refueling:
   a. Utilizing natural gas from existing underground pipelines is acceptable.
   b. Propane should be provided utilizing skid mounted tankage.
   c. For V2G with school buses, depending on the CF kW the appropriate number of school buses with fully charged batteries of known kWh storage would be required at each CF at the time of loss of grid in order to comply.
5. Low cost operation.
6. Easy to install and maintain.
7. Operate only islanded with grid failure. Grid connection is not permitted, with the possible exception of charging of the BESS from the grid.
8. Connect to CF main electric service through use of Automatic Transfer Switch (ATS).
   a. This provides for rapid transfer of power to BESS at time of grid failure.
   b. This transfer could be delayed to prevent rapid cycling in the event of short interval intermittent grid failures.
9. Minimum five AC kW output range capacities:
   a. 10kW
   b. 25kW
   c. 100kW
   d. 500kW
   e. 1000kW

All equipment described in the Design Requirements is included in the corresponding specification detailed in the Technical Specifications document for each TBPP output capacity.

DESIGN ASSUMPTIONS

1. Upon grid failure there is to be no delay to transfer to backup power bus.
   a. BESS to pick up Critical Facility load immediately.
   b. Genset to start after 10 second delay.

2. Genset and BESS to share load.
   a. BESS kW rating to be 100% of anticipated CF kW rating with production

capacity sizing at 1 hour (shown in Table 5 below):

i. 10kW TBPP - BESS = 10kW/10kWh
ii. 25kW TBPP - BESS = 25kW/25kWh
iii. 100kW TBPP - BESS = 100kW/100kWh
iv. 500kW TBPP - BESS = 500kW/500kWh
v. 1000kW TBPP - BESS = 1000kW/1000kWh

b. Genset to be rated at 100% of TBPP rating (shown in Table 3 below).
c. Consider Load Factor (LF) of site critical facility when sizing TBPP – to be determined from billing data when available; or use typical LF of 60%.[9]

3. Propane is expected to be used in general for small TBPPs only, except for CFs requiring large TBPPs and where Natural Gas (NG) is not available. Otherwise, NG for the remaining TBPPs.
   a. Propane tank sizing for larger systems to accommodate 48 hours operation becomes unwieldy.
   b. Foundations are large and tanks require considerable space, in addition to the other TBPP equipment.
   c. Piping requirements are an added expense.
   d. Propane piping connections to be provided to TBPP to enable installation in cases where CF has existing on site propane storage which can be utilized.
4. TBPP components to be individually skid mounted. This includes the generator set, automatic transfer switch, and BESS. Other mounting will need to be determined for the solar panels.
5. TBPP components to be transportable over existing roads with flatbeds or other trucking.
6. All TBPP components to be factory installed in individual sound attenuated enclosures, one enclosure for the genset and one enclosure for the BESS fully ready for field interconnection, startup and use (with the exception of solar modules). It is noted that consideration should be given to any requirement to section off/setback BESS equipment, based on fire/safety risk.
7. Solar to be used for BESS charging in daytime and for genset auxiliary power where capable (shown in Table 3 below):
   a. Solar kW sizing to be based on allowing BESS recharge during a 6 hour daylight period. This equates to the solar size being 16% of the TBPP rating.
   b. Example 1: BESS rated at 1000kWh AC output
      i. DC/AC ratio = 1.25
      ii. Solar size = 1000*1.25*0.16 = 200kW DC
      iii. With 500W solar modules = 400 modules
      iv. Space required assumes one module roughly needs 23.9 sf or for the full rating = 9564 sf. (this is approximately 48 average car parking spaces)
   c. Example 2: BESS rated at 25kWh

i. Solar size = 25*1.25*0.16 = 5kW DC
ii. With 500W solar modules = 10 modules
iii. Space required = 239 sf. (or approx. 2 parking spaces)

8. Solar is to be designed for fixed tilt ground mount utilizing available existing lot space.
9. Systems to be plug and play. This assumes components containers are within close proximity to one another where premade cables can be placed in ground mounted wireways and the containers plugged into one another.

Table 3: TBPP Technology capacity summary

TBPP size kW	Genset capacity kW	BESS capacity kW/kWh	Solar capacity kW DC
10	10	10	2
25	25	25	5
100	100	100	20
500	500	500	100
1000	1,000	1,000	200

Table 4: Propane tank sizing examples

Example genset kW	Tank volume gallons	Tank pressure PSI	Tank diameter ft	Tank length ft
500	3,600	250	7	17
750	4,374	250	10	18

EQUIPMENT

Major equipment components comprising the TBPPs include the following:

- Genset
- Battery Energy Storage System
- Solar PV modules
- Inverters (solar PV system)
- Automatic Transfer Switch
- Controller

In addition, the above components, associated engineering and interconnecting equipment can be supplied as a microgrid.

Example lists of manufacturers, suppliers and vendors of equipment and MG systems are provided in Appendix 5.

OPERATING SEQUENCES

A. NORMAL – GRID AVAILABLE
    a. Grid operation is normal providing full power to the site.
    b. TBPP is monitoring grid availability on a continuous basis.
    c. BESS:
        i. Connected to the grid through bi-directional inverter (BDI) and automatic static transfer switch (STS) for maintaining full charge only.
        ii. BESS on grid maintaining charge.
        iii. No power is being supplied by the BESS to the grid for any reason (ATS isolates BESS from the grid).
        iv. Potential for future frequency and voltage regulation for utility to aid maintaining grid resiliency (not part of project).
    d. Genset:
        i. Not on the grid.
        ii. Available on standby mode through automatic transfer switch (ATS).
    e. Solar:
        i. Ground mounted.
        ii. Connected to the TBPP grid for on-site TBPP auxiliary power needs
            1. Genset convenience outlets.
            2. Genset controls include Remote Annunciator (to be mounted in the CF).
            3. TBPP enclosure lighting.
            4. An amount of BESS charging/trickle charging.
            5. Genset battery charging.
            6. Genset enclosure and engine coolant heating (winter thermostat).

B. STORM ANTICIPATION
    a. This is a manual mode of operation that can be initiated if there is an approaching storm that may result in electrical grid failure.
    b. This mode will switch the CF load over to the TBPP and cause the CF to go into island operation.
    c. Return to normal after the storm will be a manual operation also.

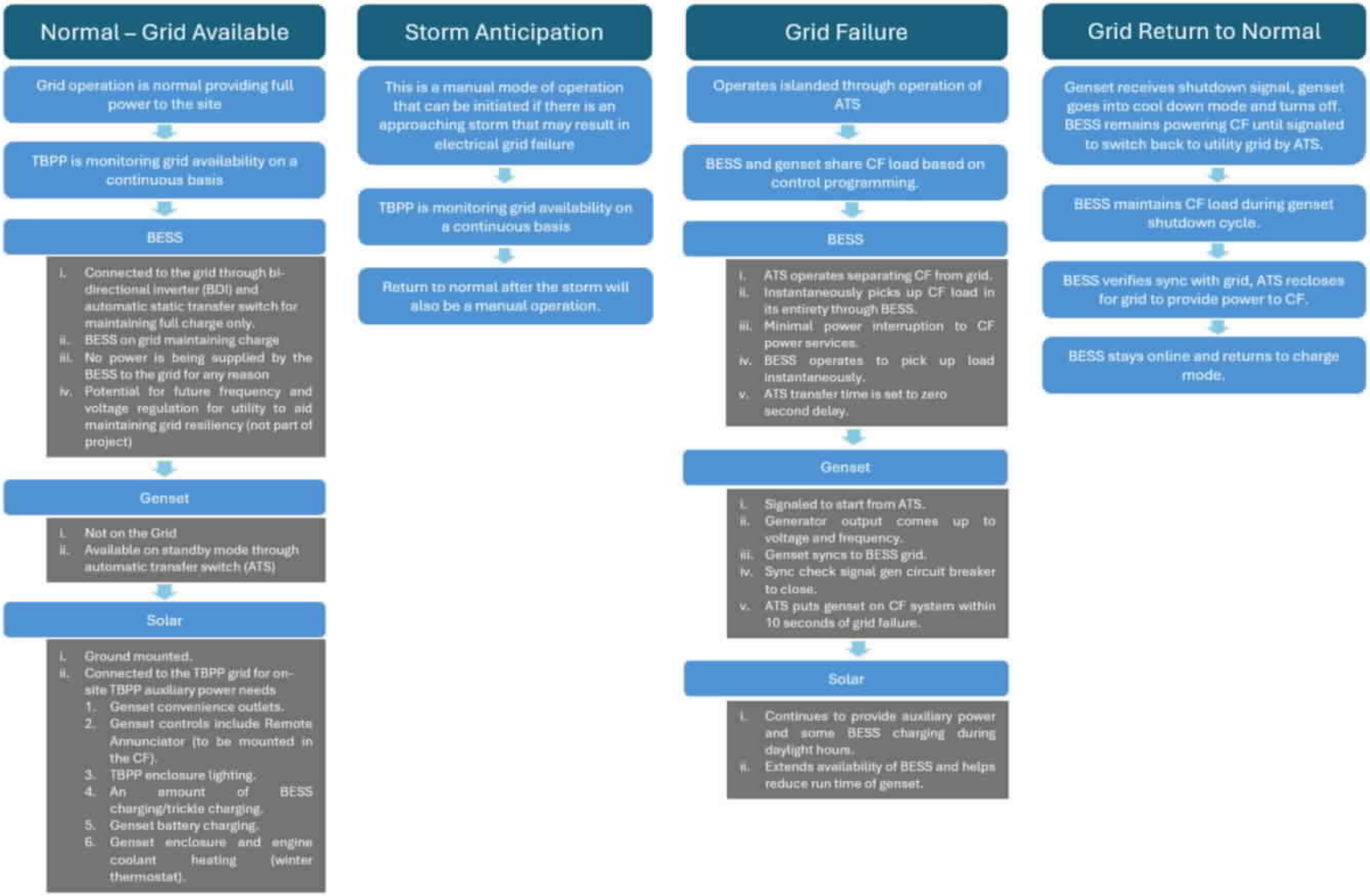
C. GRID FAILURE (for any reason)
    a. Operates islanded through operation of ATS.
    b. BESS and genset share CF load based on control programming.
    c. BESS:
        i. ATS operates separating CF from grid.
        ii. Instantaneously picks up CF load in its entirety through BESS.
        iii. Minimal power interruption to CF power services.

iv. BESS operates to pick up load instantaneously.
v. ATS transfer time is set to zero second delay.

d. Genset:
   i. Signaled to start from ATS.
   ii. Generator output reaches voltage and frequency.
   iii. Genset synchronizes to BESS grid.
   iv. Synchronization check signal generator circuit breaker to close.
   v. ATS puts genset on CF system within 10 seconds of grid failure.
e. Solar:
   i. Continues to provide auxiliary power and an amount of BESS charging during daylight hours.
   ii. Extends availability of BESS and helps reduce run time of genset.

D. GRID RETURN TO NORMAL

a. Genset receives shutdown signal, switches to cool down mode and switches off. BESS remains powering CF until signaled to switch back to utility grid by ATS.
b. BESS maintains CF load during genset shutdown cycle.
c. BESS verifies synchronization with grid, ATS recloses for grid to provide power to CF.
d. BESS stays online and returns to charge mode.


Normal – Grid Available
Grid operation is normal providing full power to the site
TBPP is monitoring grid availability on a continuous basis
BESS
i. Connected to the grid through bi-directional inverter (BDI) and automatic static transfer switch for maintaining full charge only.
ii. BESS on grid maintaining charge
iii. No power is being supplied by the BESS to the grid for any reason
iv. Potential for future frequency and voltage regulation for utility to aid maintaining grid resiliency (not part of project)
Genset
i. Not on the Grid
ii. Available on standby mode through automatic transfer switch (ATS)
Solar
i. Ground mounted.
ii. Connected to the TBPP grid for on-site TBPP auxiliary power needs
1. Genset convenience outlets.
2. Genset controls include Remote Annunciator (to be mounted in the CF).
3. TBPP enclosure lighting.
4. An amount of BESS charging/trickle charging.
5. Genset battery charging.
6. Genset enclosure and engine coolant heating (winter thermostat).
Storm Anticipation
This is a manual mode of operation that can be initiated if there is an approaching storm that may result in electrical grid failure
TBPP is monitoring grid availability on a continuous basis
Return to normal after the storm will also be a manual operation.
Grid Failure
Operates islanded through operation of ATS
BESS and genset share CF load based on control programming.
BESS
i. ATS operates separating CF from grid.
ii. Instantaneously picks up CF load in its entirety through BESS.
iii. Minimal power interruption to CF power services.
iv. BESS operates to pick up load instantaneously.
v. ATS transfer time is set to zero second delay.
Genset
i. Signaled to start from ATS.
ii. Generator output comes up to voltage and frequency.
iii. Genset syncs to BESS grid.
iv. Sync check signal gen circuit breaker to close.
v. ATS puts genset on CF system within 10 seconds of grid failure.
Solar
i. Continues to provide auxiliary power and some BESS charging during daylight hours.
ii. Extends availability of BESS and helps reduce run time of genset.
Grid Return to Normal
Genset receives shutdown signal, genset goes into cool down mode and turns off. BESS remains powering CF until signaled to switch back to utility grid by ATS.
BESS maintains CF load during genset shutdown cycle.
BESS verifies sync with grid, ATS recloses for grid to provide power to CF.
BESS stays online and returns to charge mode.

TBPP INSTALLATION REQUIREMENTS

The following is a list of items required as part of the installation of TBPPs, noting that the details are site specific.

A. FOUNDATIONS
   a. Genset(s)
   b. BESS
   c. Solar
   d. Propane tanks (where included)
   e. Switchgear/boards
B. TBPP CONTAINERS
   a. Weatherproof (NEMA 3R at a minimum) – All, gensets, BESS, Switchgear/boards
   b. Sound attenuated – All, gensets, BESS
C. PROPANE FUEL TANKS (as required)
   a. Fuel piping
   b. Tank, piping heaters
   c. Regulators
   d. Valving
   e. Connection to genset fuel pipe train
D. FUEL PIPING (as required)
   a. Fuel piping
   b. Tank, piping heaters
   c. Regulators
   d. Valving
   e. Connection to genset fuel pipe train
E. CONTAINER INTERCONNECT CABLING
F. TBPP POWER OUTPUT CABLING TO CRITICAL FACILITY
G. CRITICAL FACILITY SERVICE UPGRADES.
   It is noted that the TBPP sizes do not take account of the potential for reductions in critical load kW resulting from implementation of energy efficiency measures at individual sites to reduce demand.
H. COMMUNICATIONS WIRING

In determining the BESS sizing, the length of power outages in the State of Texas was reviewed and it was found that on average power outages last approximately 2 hours and 40 minutes.[5] Based on this as an average data point, the BESS was sized to handle a continuous one-hour time frame at full load. Power will be transferred to the genset and the genset will pick up load within 10 seconds. This leaves the BESS available with almost a full charge to supplement the genset where the instantaneous load of the CF may exceed the genset rating. Sizing the BESS for a time frame longer than one hour would impose a severe cost burden to the TBPP. For example, a 4-hour rated BESS may use x individual batteries while an 8-hour BESS would require 2x that number of individual batteries and a 48-hour BESS would require at least 12x individual batteries, resulting in a twelve-fold increase in real estate footprint and capital cost.

2-4.2 Design Basis – V2G

The design basis has been outlined as follows and provides a design requirements overview and intended operating sequences of the V2G TBPP.

DESIGN REQUIREMENTS

1. Utilization of electric school buses for providing AC power to a CF in the event of normal power grid failure.
2. Must operate for 48 hours without refueling or recharging.
3. Low cost operation.
4. Easy to install and maintain.
5. Operate only islanded with grid failure. Grid connection is not permitted.
6. Connect to CF main electric service through use of ATS.
    a. This provides for rapid transfer of power to ESB at time of grid failure.

DESIGN ASSUMPTIONS

1. ESB will be available for AC power support at the CF.
2. ESB will arrive at the CF with a minimum charge of 80%.
3. A 10kW CF will require four charging stations at 150kW to provide 48 hours of continuous operation.
    a. kWh required = 10*48 = 480kWh.
    b. Charging station at 150kW can deliver approx. 150kWh/hr. An average school bus has 160kWh battery capacity. At 80% charge when delivered, available capacity is 0.8*160 = 128kWh. To meet the 480kWh need would require a minimum of four ESBs. This would require one charging station and replacing the ESB every 12 hours or four charging stations aggregated together to allow for four ESBs to be connected simultaneously.
    c. The lowest cost alternative would be one charging station per V2G TBPP.

OPERATING SEQUENCES

A. NORMAL – GRID AVAILABLE
    a. Grid operation is normal providing full power to the site.
    b. No buses on site.

B. STORM ANTICIPATION
    a. This is a MANUAL mode of operation that can be initiated if there is an approaching storm that may result in electrical grid failure.

b. This mode will switch the CF load over to the TBPP and cause the CF to go into island operation and utilize connected buses.
c. Return to normal after the storm will be a manual operation.

C. GRID FAILURE (for any reason)
   a. Operates islanded through operation of ATS.
   b. Buses need to be brought on site and connected.
   c. ATS automatically transfers over to bus supplied power once voltage and frequency from charger are sensed.

D. GRID RETURN TO NORMAL
   a. Upon sensing NORMAL power from grid, ATS retransfers to grid power.

<u>V2G TBPP INSTALLATION REQUIREMENTS</u>

The following will be required in order to install an ESB V2G TBPP at any CF site:

A. FOUNDATIONS (required at each CF site, see project plans)
   a. Charger.
   b. Charger PCS.
   c. Transformer.
B. COMPONENT INTERCONNECT CABLING
C. ESB V2G TBPP POWER OUTPUT CABLING TO CF
D. CF SERVICE UPGRADES (as required)
E. COMMUNICATIONS WIRING (between TBPP components)

2-5 Specifications

Available as separate documents.

2-6 Drawings and Exhibits

Available as separate documents.

3 Report of Findings

3-1 Summary of Initial Findings

The Texas Backup Power Packages Initial Report can be found in its entirety in Appendix 1 at the end of this Final Report. The initial findings concluded that there were approximately 31,000 facilities in the State of Texas that fell within the definition of Critical Facility (CF). All or part of these entities may be eligible to receive grants under Chapter 34 of PURA for the purchase and installation of a TBPP.

The definition of a Critical Facility for purposes of the TBPP program under Chapter 34 is as follows:

- Under PURA §34.0202 is a facility "on which communities rely for health, safety, and well-being", as outlined in TBPP Advisory Committee letter dated March 15, 2024 (see Exhibit B).
- Eligible facilities will include the types identified and listed in 16 Texas Administrative Code §25.52 as "loads for which electric service is considered crucial for the protection or maintenance of public safety, including but not limited to hospitals, police stations, fire stations, critical water and wastewater facilities", as outlined in TBPP Advisory Committee letter dated March 15, 2024. As outlined by the TBPP Advisory Committee, additional facilities upon which communities rely for critical services during a grid outage may also qualify as CFs (e.g., hospice, nursing homes, storm and homeless shelters, heating and cooling centers, evacuation route fuel stations, among other facilities that provide critical community services).

A Critical Facility does not include those entities that are disallowed under PURA §34.0205(e)(1): "a commercial energy system, a private school, or a for-profit entity that does not directly serve public safety and health", and in addition does not include electrical loads above 2.5MW.

A summary of CF from the Initial Report is shown in Table 5 below.

Table 5: Summary of Critical Facilities from Initial Report

Critical Facility power requirement kW	**Number of Critical Facilities**
10	3,051
25	7,594
75	7,565
150	329
300	11,323
2500	357
Total	**30,219**

It is noted that approximately 60% of the CFs are rated at 75kW or less.

Facilities that met the CF criteria fell into six broad categories:

1. Hospitals, nursing homes and medical facilities.
2. First responder facilities (i.e. fire and police stations).
3. Water, wastewater and sewage treatment plants.
4. Storm and homeless shelters.
5. Public schools and municipal buildings (which provide critical services).
6. Grocery stores and evacuation route gas stations.

Facilities not included were residential, that would be classified as chronic condition residential or critical care residential, as well as critical industrial. These latter residential and industrial categories are listed by or included in the annual critical care reports to the PUCT by the TDUs and are not included in the initial findings report. For the TDUs this is a data point for them in order to establish a priority listing of locations to be restored in order of life safety needs. See Appendix 2 – Critical Care Reports by TDUs. A comparison with the TDU submissions of CFs and the initial report summary is shown in the table below. These TDU listings are for ERCOT utilities and are shown in Table 6 below. Utilities within Texas that are not in the ERCOT system also have CF reporting criteria and generally record the chronic care and critical care residential.

Table 6: TDU listings for ERCOT utilities

TDU Company	Critical Load Public Safety	Critical Load Industrial	Chronic Condition Residential	Critical Care Residential	Total CFs	Date of TDU submissions recorded to PUCT
AEP Texas	5,750	2,885	475	1,250	10,360	2/23/2024
Oncor	10,928	6	2,327	5,356	18,617	2/26/2024
Texas-New Mexico	1,325	191	113	241	1,870	2/23/2024
Centerpoint	11,681	22	778	2,169	14,650	2/23/2024
Totals	**29,684**	3,104	3,693	9,016	45,497	
Initial Report total CFs	**30,762**					

It is noted that the quantity of critical load public safety facilities reported in the Initial Report tracks well with the reported CFs in the TDU filings (29,684 vs. 30,762).

3-2 Revisions to Initial Findings

It has been suggested that the use of average energy consumption figures be revised to Texas specific consumption figures. It was thought that this would better take into account the western and southern areas of Texas. It is considered that the use of the averages underestimates the sizes of TBPPs needed. However, the opposite could be said by utilizing the higher temperature and more arid climate conditions throughout the State would oversize the TBPPs to be deployed. The use of a specific size TBPP, regardless of where it is sited, will be determined by the actual usage requirements of the CF requesting a TBPP. The TBPP specifications will address the actual design and operating conditions including climate and elevation amsl that the TBPP must contend with in order to provide the required nameplate electrical output. A revision to the initial usage findings is not recommended.

The Initial Report did not include water and wastewater pump stations as these numbers in both quantities and sizes were not available at the time the report was generated. Additional data has since been developed through direct inquiry by the PUCT to 14 TDUs within the State of Texas. This data added 6,417 sewage lift and water pump stations to the CF totals of which this number was added as noted above.

It has been suggested that the calculations used to arrive at the energy usage including the use of load factor figures was overly complicated. In order to derive reasonably accurate kW and kWh usage figures the conversion factors and load factor numbers must be used. As stated in the Initial Report, not utilizing the load factors would significantly cause the kW capacities to be underestimated and the reliability of the TBPP to be severely reduced due to under sizing. A revision to the initial sizing of the TBPPs in this regard is not recommended.

The research identified 16 specific CF types, grouped into six broad categories, with an estimated total of nearly 40,000 CFs across Texas. Data from Transmission and Distribution Service Providers (TDSPs) indicated that water and wastewater pump stations account for over 55% of CFs in the 10kW or below category. The approximate distribution of CFs across the six broad categories is summarized in Table 7 below.

Table 7: Summary of Critical Facilities

CF Broad Category	CF Description	Approximate Quantity in Texas
1	Hospitals, nursing homes, and medical facilities	**5,985**
2	First responder facilities (e.g., police and fire stations)	**8,922**
3	Water/wastewater treatment plants including associated pump stations	**13,099**
4	Storm and homeless shelters	**1,901**
5	Public schools and municipal buildings (that provide critical services)	**7,957**
6	Grocery stores and evacuation route fuel stations	**2,355**
TOTAL CFs		**40,219**

A summary of CF quantities against TBPP sizes is shown in Table 8 below.

Table 8: Summary of CF quantities against TBPP sizes

TBPP kW range	CF Quantity by TDU	CF % of total	CF quantity by Initial Report	CF % of total	TBPP kW range	CF quantity by Final Report	TBPP kW selection examples
<10kW	7,058	30.0%	3,051	9.9%	10	13,051	10
10-25kW	3,854	16.4%	7,594	24.6%	25	7,594	25
25-50kW	2,930	12.5%	6,931	22.5%	50	6,931	2@25
50-100kW	2,539	10.8%	634	2.1%	100	634	100
100-150kW	1,399	5.9%	329	1.1%		329	1@100 & 2@25
150-200kW	992	4.2%		0.0%			2@100
200-250kW	748	3.2%		0.0%			2@100 & 1@50
250-500kW	1,993	8.5%	11,866	38.6%	500	11,323	500
500-1,000kW	1,121	4.8%		0.0%			1000
1,000-2,500 kW	453	1.9%	357	1.2%	2500	357	2@1000, 2@1000 & 1@500
2,500-5,000 kW	130	0.6%		0.0%			n/a
>5,000kW	277	1.2%		0.0%			n/a
Totals	**23,494**	**100%**	**30,762**	**100%**		**40,219**	

TBPP range & quantity as requested by PUCT

TBPP quantities as reported in Initial Report

TBPP quantities for Final Report

TBPP selected capacities

TBPP suggested aggregation to meet capacities

Based on reported data from the present TDUs in and out of the ERCOT service area, discrepancies in reported registered CFs were noted. Critical facilities reports filed annually with the PUCT indicated the TDUs serve around 27,000 CFs. The Initial Report findings indicated around 30,000 CFs could be expected, whilst a special inquiry by the PUCT saw around 23,000 CFs being served by all the TDUs statewide. The most significant quantity of CFs was in the public water and wastewater (WW) sector. The Initial Report used average figures for determining the number of WW facilities. This reported figure from the TDUs for WW facilities was considered significant enough that they were added to the Initial Report figures so as to provide a more accurate number of CFs in that category. This boosted the expected CF figure from around 30,000 to 40,000.

3-3 Implementation

Under Chapter 34 of PURA, the technical requirements for TBPPs would be considered to fall into a general definition of a microgrid (MG). As defined, MGs can be and are typically deployed to operate in a connected mode (in parallel) with the grid or islanded (stand-alone) from the grid or both. In the context of the application of the TBPPs under Chapter 34 of PURA, the use of the MG will be in islanded mode only.

Implementation of the deployment of TBPPs is dependent on many factors:

1. Supply chain availability of raw materials to suppliers.

2. Manufacturing capacity of suppliers to meet demand.
3. Availability of qualified vendors to provide complete packages.
4. Availability of qualified contractors to install and maintain the TBPPs.

3-4 Phasing

Phasing of the installation of a TBPP may become necessary in order to provide a more rapid implementation of the TBPP program. This could be a function of supply chain issues where some components, such as gensets or BESS or transfer switches, may become available sooner than other components. Where this is occurring, the TBPP could be deliverable in two parts – 1) as a genset package and 2) as a solar with battery package. Controls and cabling would be supplied independently to allow the phased packages to be placed in service independently and then be interconnected with the other to complete the final installation. It is expected that overall costs would marginally increase where the installation is phased, due to additional site mobilization and interconnection works. Utilizing electric school buses through supply of V2G bi-directional inverters and transfer switches could introduce an additional potential TBPP.

3-5 Cost

TBPP cost estimates are derived through a direct Request for Qualification (RFQ) solicitation to numerous equipment suppliers and MG vendors. The RFQ is provided in Appendix 3 – Solicitation.

Pricing information was initially sought according to the following TBPP sizes:

- 10kW
- 25kW
- 75kW
- 300kW
- 1250kW
- 2500kW

The above capacities were estimated to be suitable as TBPPs at an early stage of the investigation. However, the TBPP sizes were subsequently revised based on further development of the analysis, considering improved suitability to the quantities of CF capacities across the range, and availability of gensets at specific capacities within the market. Thus, the following TBPP sizes are recommended in this Final Report and have accompanying package designs:

- 10kW
- 25kW
- 100kW
- 500kW
- 1000kW

Major components making up TBPPs include the following:

- Genset (natural gas or propane fueled).

- BESS.
- Solar PV modules.
- Solar system inverters.
- Controller.
- Automatic Transfer Switch.

A summary of the major components for each package size is shown in Table 9.

Table 9: Summary of major components for each package size

Component	10kW	25kW	100kW	500kW	1000kW
Genset (kW)	10	25	100	500	1,000
BESS (kW/kWh)	10	25	100	500	1,000
PV Modules (kW)	2	5	20	100	200
PV Modules quantity	4	10	40	200	400
Inverters (kW)	2	4	16	80	160
Inverters quantity (kW)	1x 2	1x 4	1x 16	2x 40	4x 40
ATS	10	25	100	500	1,000
Controller	10	25	100	500	1,000

Pricing estimates were received from component suppliers and MG vendors, and are outlined below.

MG vendors provide energy systems with all technologies and components designed and integrated as a fully engineered package, for delivery to site for installation and connection to the CF. Component suppliers supply only the individual components as listed.

A summary of pricing estimates from individual component suppliers is shown in Table 10 below.

Table 10: Summary of pricing estimates from component suppliers

Component	10kW	25kW	100kW	500kW	1000kW
Genset	$4,431	$16,268	$37,193	$198,300	$338,375
BESS (1 hour storage)	$7,000	$17,500	$60,000	$300,000	$600,000
PV Modules	$675	$1,688	$6,750	$33,750	$67,500
Inverters	$867	$1,294	$3,893	$11,079	$22,157
Automatic Transfer Switch	$3,100	$3,100	$8,100	$18,409	$29,990
Controller	$6,200	$6,200	$15,500	$77,500	$155,000
Components Total	$22,273	$46,049	$131,436	$639,038	$1,213,022
Components /kW	**$2,227**	**$1,842**	**$1,314**	**$1,278**	**$1,213**

Component pricing excludes ancillary costs such as engineering, factory testing, administration, etc.

A summary of pricing estimates from MG vendors is shown in Table 11 below.

Table 11: Summary of pricing estimates from microgrid vendors

Pricing Estimate	10kW	25kW	75kW	300kW	1250kW	2500kW
High	$114,500	$547,500	$684,300	$1,322,800	$1,458,447	$6,451,800
Low	$63,655	$98,808	$238,224	$517,300	$1,294,883	$2,531,791
Average	$83,284	$240,337	$423,648	$807,581	$1,376,665	$3,945,062
MG /kW	$8,328	$9,613	$5,649	$2,692	$1,101	$1,578
Average (excluding outliers)	$83,284	$137,949	$336,763	$549,972	$1,376,665	$2,691,694
MG /kW (excluding outliers)	$8,328	$5,518	$4,490	$1,833	$1,101	$1,077
Installation (estimate)	$30,000	$33,750	$45,000	$90,000	$262,500	$375,000
MG Total	$113,284	$171,699	$381,763	$639,972	$1,639,165	$3,066,694
MG Total $/kW	**$11,328**	**$6,868**	**$5,090**	**$2,133**	**$1,311**	**$1,227**

Within MG pricing, totals take account of the exclusion of pricing outliers which would otherwise skew the average of vendor pricing information received.

Due to the nature of the program where no definitive site can be considered, component and MG dollar per kW costs additionally do not include equipment foundations, propane tankage/ natural gas connection (as required), cabling, construction, CF service upgrades, delivery or transportation.

For MG systems, an estimate of installation cost has been provided for each TBPP size, based on experience.

Cost information is based on an individual TBPP, and does not include any quantity discounts which may be available. Delivery times vary from 15 to 25 weeks for systems through 300kW, to 25 to 40 weeks for 1250 – 2500kW systems, up to 15 – 16 months depending on supplier.

Under Chapter 34 of PURA, the statute requires the following in respect for TBPPs:

- The amount of a grant provided may not exceed $500 per kW of capacity.

As can be seen from the cost data, the TBPP program grant cap would be unable to substantially fund the TBPPs.

The high cost of the TBPP results from the requirement to provide three levels of backup power – generator, solar, battery - as well as the extensive amount of electrical switchgear, and the communications and control systems necessary to manage the coordinated operation of all three systems as a microgrid.

Interpretation of the legislation determined that the packages are, for all intents, microgrids, requiring all three technologies to be present to meet the genset, solar and battery requirements. As can be seen from the pricing from the RFQ responses for the various size packages, the grant cap of $500/kW will only cover a minimal portion of the total cost of the TBPPs.

Table 12: Summary of small scale genset pricing

Item	10kW	25kW	50kW	75kW
Including panelboard & ATS	$3,857			
Plus panelboard & ATS		$13,400	$20,000	$27,597
Estimated Installed cost	$7,600	$26,800	$40,000	$55,194
Estimated Installed cost /kW	$760	$1,072	$800	$736

For residential, commercial, and small industrial BESS, the range is due to battery technology being used, with Lithium-Ion Batteries between $500 to $700 per kWh, and Lead-Acid Batteries between $200 to $400 per kWh[7].

As can be seen, a 10kWh BESS in a 10kW rated TBPP, at the high end, may run as much as $7,000 whilst the same capacity BESS at 48 hours, 480kWh would be $336,000. For the 100kW/100kWh BESS the cost might be as low as $60,000 while at 48 hours would be $2,880,000, and for the 1000kW/1000kWh BESS the cost could be as low as $600,000 while at a 48-hour rating the cost could be $28,800,000.

3-6 Cost Benefit Analysis

A cost/benefit analysis was performed to aid in determining the best combination of proposed technologies and components to assist in the selection of the designs of the TBPPs and to provide the kW required on the most effective cost basis. The cost basis is $/kW delivered but not installed. Installation costs are indeterminate at this time since site specific conditions are unknown, and only broad estimates can be applied to MG vendor costs. Transportation costs were not included since site locations were indeterminate however based on an online search and experience may be estimated at an average cost of $4/mile. This would not include any additional costs for special over the road permits, chase vehicles for oversize loads, special routing to avoid low bridges, police or utility escorts through cities and towns or any potential or needed rail transport.

The cost/benefit relationship to any project is applied to the scope of the singular work to analyze the best and least costly designs and methods to accomplish the given required outcome. Several factors must be balanced during a cost/benefit analysis, such as: type(s) of materials to best fulfill the project's purpose, costs of materials and components, project location(s), maintenance requirements of different materials, etc. All of these items and more can be ranked by cost, need, and benefit to the end user, etc. and allow the project to proceed on an efficient, least cost track that includes what is required for the task. Contrary to this, the TBPP program is looking not at one size package that fits all, but at five packages that are under one TBPP umbrella. Under this scenario, the cost/benefit analysis is more related to the design decisions that are incorporated in all packages aside from the regulation requirements. These design decisions include the following:

1. Size of TBPP packages to meet CF demand, only five sizes have been determined.
2. Capacity of battery storage to meet CF demand on a kWh basis.
3. Capacity of solar to meet CF demand in conjunction with genset and battery storage.

The following chart provides the basis of the design decisions made to aid in streamlining the cost. Aside from the design elements noted in the chart, also considered was the individual component costs that define the TBPP size ranges. The least $/kW in each size potential helped determine the actual TBPP sizes. For example, would it be more cost effective to install two 10kW TBPPs than one 20kW package or should a 25kW TBPP be installed to meet a 20kW need? The actual TBPP sizes are also dependent on the quantitative summary of the CFs.

TEXAS BACKUP POWER PACKAGES - COST/BENEFIT ANALYSIS							
			Benefits		Cost		
ID#	Item	Options	Pros	Cons	High	Med	Low
1	BESS Sizing						
		BESS is rated for building full load	Powers all building loads for its rated hour capacity		X		
		BESS is rated for less than building full load		Cannot maintain full building load when power outage occurs. May cause battery to trip off-line on overload.			X
2	BESS Capacity						
		Capacity can range from 1 hour to 48 hours	1 hour output provides power during transition from utility to generator, and can provide a limited period power supply should the genset fail				X
				Cost increases with every additional hour of capacity.	X		
3	Genset Sizing						
		Genset rated for full building load	Can maintain building load throughout length of outage without load share from battery and solar			X	
		Genset rated at less than building full load and shares load with BESS		Requires load share with battery and solar to maintain building load		X	
4	Solar						
		Provide full building load capacity		Requires considerable space. One panel would be minimum 2.2 square meters (23.9 square feet). At 500 watts per panel a 25kW system would require a minimum of 50 panels using around 1200 sq. ft. plus electrical equipment and wiring.	X		
		Provide enough solar to recharge battery in one 6 hour daylight period	Maintain battery capacity to assist genset should battery become discharged			X	
			For a 25kW/25kWh BESS with 500W solar panels to deliver 25kWh in 6 hours would require a minimum of solar delivery of 4,200 watts per hour or only 9 solar panels in lieu of 50. More panels may be required depending on location within Texas and day of the year.				X
		Ground mount or roof mount		Roof mount imposes limitations due to roof structural capabilities and avoiding roof mounted HVAC equipment.		X	
			Ground mount requires available space such as parking lots. There are unlikely to be structural support issues.				X

TEXAS BACKUP POWER PACKAGES - COST/BENEFIT ANALYSIS							
			Benefits		Cost		
ID#	Item	Options	Pros	Cons	High	Med	Low
5	Project						
		Genset only	Can meet building demand continuously.				X
			Natural gas supply				X
		Genset plus Battery	Battery provides some redundancy in event of genset failure	Battery sized for 48 hour capacity is extremely costly. For a 10kWh (1 hour at 10kW) the cost is around $7000 ($700/kWh). At 48 hour capacity the cost may be in the range of $28,800 to $33,600 ($600-700/kWh).	X		
				Battery provides no increased extended reliability at design conditions of one hour capacity. No percieved benefit.		X	
		Genset plus Battery plus Solar		Solar takes up considerable real estate. No percieved benefit.	X		

3-7 Sizing Tool for End User

A sizing tool utilizing Excel data insertion has been developed and made available with this Final Report. The tool is user friendly, but should be filled out by an individual familiar with the site where the TBPP is to be installed and with the site's electrical systems and utility billings. See Appendix 6.

4 Siting

The design of the TBPPs is intended to allow for deployment at any location within the State of Texas. This would vary from rural areas to densely populated city areas. Siting at the location of the CF will require the use of available real estate. This could be adjacent fields, parking lots, storage areas, indoor space within existing garages or warehouses when properly outfitted, and possibly rooftops if structurally sound.

Two main factors must be accommodated when siting a TBPP. These are operating ambient air temperature and elevation above mean sea level. Normal operating parameters for gensets would be a temperature range of 32°-104°F (0°-40°C) and 0-1000ft (0-300m) amsl.

A general formula can be used to calculate estimates for the output levels. The standard derating formula states that for every 1000 ft above sea-level, a gasoline, diesel, or liquid propane generator usually should be derated by 2–3% of its standard output. In case of generators using natural gas, the derating factor is typically closer to 5%.[1]

As far as the alternator (the engine driven equipment that generates the electricity) is concerned, it is also affected by high temperatures. The majority of manufacturers guarantee the power of their alternators, as long as they operate at an ambient temperature of below 40°C (104°F). At higher values, the derating in an alternator is generally 3% for each additional 5° C.[2]

The deployment site must be able to accommodate a minimum of two 8'x20'x9'H containers to upwards of four or more 8'x40'x10'H containers. Component quantities will be dependent upon the size rating of the TBPP to be deployed. It should be noted that all clearances shall be observed during siting.

The effects of climate on the operation of the deployed TBPP could have a negative operational effect on the TBPP resulting in a possible de-rating of the nameplate output rating of the TBPP. Texas climate varies from temperate in the east to arid in the west to humid along the gulf coast. The average temperature at the Northern Texas panhandle is typically 10-15°F cooler than the average temperature in the extreme Southwest areas of Texas.[3] This is from climate data published from 2011 by the Texas Water Development Board. It is noted that 2011 was the hottest summer at that time, which may have been surpassed in 2023, and resulted in the most extreme drought in the state.

4-1 Location

Location within the state will dictate to the supplier/vendor the MG output in order to meet the CF load requirements. The genset is most affected by location as to siting altitude and climate at the site. The CF loading will dictate the required kW output. The manufacturer/supplier will need to verify that they will meet the nameplate rating of the system at the location for installation of the MG.

5 Manufacturers, Suppliers and Vendors

Example listings of manufacturers, suppliers and vendors are provided in Appendix 5. Based on market research to determine capability, and a minimum of five years' experience in production and supply of equipment and systems which are appropriate to the technical requirements, these organizations are considered to be broadly suitable to provide components (manufacturers) and microgrids (suppliers), and furnishing, installing and maintaining microgrids (vendors) in line with the needs of the program.

It is noted that the listings are not intended to be all inclusive or prescriptive, and additions to the list may be permitted at the time of individual TBPP selection for any particular site within Texas. Vendor selection would be based on years of experience as a business overall with at least five years' experience in the supply, installation and maintenance of microgrids.

5-1 Warranties

Warranties are to be provided in accordance with the manufacturers' standard warranties for their equipment. These warranties shall extend to the final end user of the equipment installed as part of the TBPP and shall be serviced through the final vendor and/or installer of the TBPP. All warranties shall be serviced through one final entity involved with final installation and start-up of the TBPP. Should the TBPP be installed by a MaaS or EaaS entity who is responsible for the operation and maintenance of the TBPP, that party shall be responsible for all elements covered by all warranties.

6 References

(If the link below does not work, please copy the link and then paste it into the address bar in your web browser.)

1 https://www.generatorsource.com/Generator_Output_Rating.aspx

2 https://genesalenergy.com/en/communication/articles/how-temperature-and-elevation-affect-generators/

3 https://www.twdb.texas.gov/publications/state_water_plan/2012/04.pdf

4. https://www.nrel.gov/grid/microgrids.html

5. https://www.governing.com/infrastructure/texas-has-had-the-most-power-outages-over-past-5-years

6. https://www.energy-storage.news/bess-prices-in-us-market-to-fall-a-further-18-in-2024-says-cea/

7. https://exencell.com/blogs/how-much-does-commercial-industrial-battery-energy-storage-cost-per-kwh

8. https://www.vaultelectricity.com/texas-utility-companies-tdu/

9. https://electricityplans.com/load-factor-commercial-demand-charges/

10. Annual Technology Baseline per the NREL. Select Technology then select desired tech menu item. https://atb.nrel.gov/electricity/2024/index

11. BloombergNEF report from November, 26, 2023 https://about.bnef.com/blog/lithium-ion-battery-pack-prices-hit-record-low-of-139-kwh/

12. Retail pricing from internet queries of various supplier equipment costs. Pricing is for standby genset backup power systems components. Solar and battery were considered as linear cost commodity items and would only uniformly affect the TBPP pricing.

13. https://www.nrel.gov/news/features/2022/microgrids-for-anyone.html

14. https://www.transportation.gov/urban-e-mobility-toolkit/e-mobility-basics/bus

15. https://electricschoolbusinitiative.org/all-about-total-cost-ownership-tco-electric-school-buses

7 Appendices

1 Texas Backup Power Packages Initial Report - September 9, 2024

2 Critical Care Reports by TDUs

3 RFQ Solicitation

4 Public Workshop November 13, 2024

5 Manufacturer, Supplier, Vendor Listing

6 Sizing Tool for End User

7 Technical Specifications

8 Design Drawings

Appendix 1

TBPP Initial Report

TEXAS BACKUP POWER PACKAGES

INITIAL REPORT

Project Number 22483.005

Prepared for

Public Utility Commission of Texas

September 9, 2024

Submitted by:

Patrick Engineering Inc.

Our experience. **Your growth.**

September 9, 2024

TEXAS BACKUP POWER PACKAGES
for
CRITICAL FACILITIES

Our supporting research is organized as follows:

EXECUTIVE SUMMARY

The Public Utility Commission of Texas (PUCT or Commission) contracted with our firm, Patrick Engineering Inc., a RINA Company (Patrick) to (i) conduct research, analyze data, and prepare reports and recommendations to evaluate critical facility characteristics and requirements in this state for the Texas Backup Power Packages (BPPs), as described in Public Utility Regulatory Act (PURA) Chapter 34, Subchapter B; and (ii) provide recommended detailed designs and specifications for the Texas BPPs. This Initial Report provides data related to the quantification and characterization of Critical Facilities (CFs) and a recommendation of the corresponding sizes of Texas BPPs which could be developed to meet the needs of those CFs. Patrick will submit its final report to the Commission no later than December 2, 2024.

In accordance with the Texas Backup Power Package Advisory Committee's letter of March 15, 2024 (See Exhibit B), a "Critical Facility" for purposes of Texas BPPs is outlined as follows:

- "Critical Facility" under PURA §34.0202 is a facility "on which communities rely for health, safety, and well-being."
- Eligible facilities will include the types identified and listed in 16 Texas Administrative Code §25.52 as "[l]oads for which electric service is considered crucial for the protection or maintenance of public safety, including but not limited to hospitals, police stations, fire stations, critical water and wastewater facilities, and customers with special in-house life-sustaining equipment."
- A "Critical Facility" does ***not*** include those entities that are disallowed under PURA §34.0205(e)(1): "a commercial energy system, a private school, or a for profit entity that does not directly serve public safety and health."

Through our research, we determined that there are 16 specific CF types, grouped into six broad categories. We estimate that there are almost 31,000 total CFs within the State of Texas. The approximate quantity in each of the six broad categories is provided in the following chart. (See Sections 1-3 for further details, including the 16 specific CF types and energy consumption.)

CF Broad Category	CF Description	Approximate Quantity in Texas
1	Hospitals, nursing homes, and medical facilities	**5,985**
2	First responder facilities (e.g., police and fire stations)	**8,922**
3	Water/wastewater/sewage treatment plants	**2,842**
4	Storm and homeless shelters	**1,901**
5	Public schools and municipal buildings (that provide critical services)	**7,957**
6	Grocery stores and Evacuation route fuel stations	**3,155**
TOTAL CFs		**30,762**

Table 1 – Quantities of CFs by Broad Category

In addition to determining the approximate quantity of CFs throughout the state, we estimated the annual electric consumption of each facility type using the Energy Star Portfolio manager (See Sections 1, 2, and Exhibit A.) Using this information, we found that five (5) different BPP sizes would best serve the electrical needs of the CFs during an energy emergency: 10kW, 25kW, 75kW, 300kW and 2500kW. These capacities can be formed either directly as individual BPPs or by connecting smaller BPPs into one package to accomplish the necessary kW output. Details on those packages can be found in Section 3. It should be noted that the BPP sizes listed above may change in size or number, as the research required during the design process will determine the final number and sizes of BPPs that will be included in the final report.

We used the Energy Star Portfolio Manager[10] to obtain annual average energy usage for each CF in Btu/SqFt. This data references the Energy Information Administration (EIA) Commercial Buildings Energy Consumption Survey (EIA CBECS) reports. From this, the electrical usage in kW and kWh for each building type was calculated allowing the determination of basic BPP sizes in output kW. Based on the number of facilities at or below a given kW requirement, the number of BPP units of a given size that would meet this load was determined. These sizes are listed in Section 3 of this report.

This report also identifies facilities statewide that currently exist and can be considered CFs. The exclusion of any CF that does not meet the exact definition as stated above but could be viewed as meeting the needs of the health, safety and welfare of the surrounding community, is unintentional. That final determination is beyond the scope of this report.

Please note that any number in superscript corresponds to the same number in the reference table in Section 4.

SECTION 1 - METHODOLOGY

The methodology for providing the necessary data to ultimately determine the quantity of BPPs statewide and their sizes, in terms of electrical power kW output, will be on a macro basis. The BPPs will be for general deployment and are not site specific. This methodology will follow the below guidelines:

A. Define/Identify Critical Facility
    1. Develop database of facilities
    2. Develop list of essential services
B. Data Gathering
    1. Determine average size of each defined CF using available EIA data[9]
        i. For example, if the average clinic size is 10,000 SqFt the average energy consumption can be calculated and a BPP size can be determined for that CF.
    2. Determine average energy consumption of each defined CF in common energy units such as British Thermal Units per Square Foot (Btu/SqFt) (See Exhibit A – Energy Star Portfolio Manager – Technical Reference – U.S. Energy Use Intensity [EUI] by Property Type)
    3. Determine average number of each defined CF to be found in a community on a population basis where applicable (i.e.: nursing homes per 1000 people; police per 1000 people, etc.)
        i. Extrapolate number of each CF likely to be found in a community
        ii. For example:
            1. Determine number of police departments in the state
            2. Determine number of fire departments in the state
            3. Determine number of Cities, Towns and Villages in the state (See Texas Demographics by CUBIT)[16]
                a. Generally speaking, each population center will have a water system, sewer system, police department with one or more police stations, fire department with one or more fire stations, gas stations, and so on.
                b. Each of these systems and services would benefit from at least one BPP each.
C. We can get energy use in annual Btu/SqFt. We can then extrapolate to -Btu/SqFt/Hr- and then convert to kWh/h (or theoretically kW, which is demand). However, kWh used in an hour is not actually peak demand, but only an average over time. Typical utility kW demand is based on a fifteen-minute average peak. A CF using 1000 kWh over an hour may have demanded 2000kW for fifteen minutes, consuming only 500kWh (2000/4), and then demanded only 166.7kW for the next three fifteen-minute periods for an additional consumption of 500kWh. This equates to a total hourly consumption of 1000kWh. In this example, sizing a BPP for 1000kW would not meet the actual peak demand of 2000kW

and the BPP might fail in overload. An unacceptable scenario for CF in an emergency situation.

D. If we consider load factor (LF) in the discussion, we can get closer. LF is the ratio of (actual usage kWhr)/ (max possible usage kWh). In the example above, actual usage is 1000 kWh while max usage would be 2000 kWh (2000kW for one hour) giving a LF = 1000/2000 = .5 (or 50%). Therefore, taking the expected LF for a particular building type, police stations, for instance, we can take the kWh/h figure, divide by the LF and come up with an estimated kW demand figure.
E. For the purpose of sizing BPPs we will take the annual energy use per SqFt extrapolated to kWh/hr divided by a load factor. See **Table 2** below for typical load factors[6].
F. Specific CFs that may be co-located with other CFs have not yet been defined and are not part of the scope of this report. Facility BPPs have not been designed to know if there are co-located CFs that one BPP may fulfill a kW need at that specific site.

Load factors will vary by business. Below are average load factors by type of business:

Industry Type	Average Load Factor	Electrical Load Factor Category	Electricity Demand Category
Education	75-80%	High	Low
Grocery	75-80%	High	Low
Health Care	55-65%	Medium	Medium - Low
Retail Store	50-60%	Medium	Medium
Hotel/Motel	45-60%	Low	High
Restaurant	50-55%	Low	High
Office	45-55%	Low	High
Manufacturing	35-50%	Low	High
House of Worship	25-35%	Low	High

Table 2 - Electrical Load Factor by Usage

DEMOGRAPHICS

An understanding of the Texas demographics related to community size is essential in determining the quantities of BPPs by kW size. Tabulated below are the basic numbers of population centers broken down by range[16] (i.e.: populations greater than 50 but less than or equal to 1000, etc.) according to population census data from 2022 and 2023. The location of these population centers within the State was not considered relevant, as the findings of this report are only for quantification and characterization of the CFs. The communities counted do include those designated as CDP (Census Designated Places) as they include populated areas that are unincorporated but might benefit from a BPP to maintain CFs considered as providing essential services for that community group. (See definition below Figure 1 for CDP.)

Number of Communities by Size	Population Greater than	Population Up to
800	50	1000
566	1000	5000
162	5000	10000
196	10000	50000
32	50000	100000
37	100000	500000
3	500000	1000000
3	1000000	3000000
1799	Total Communities of 50 or more	
636	CDP	
1163	Incorporated Places	

Figure 1 - Demographics by Community Population

CDP Census Designated Places:
Examples of incorporated places include cities, towns, villages, etc. CDPs are statistical equivalents of incorporated places and represent unincorporated communities that do not have a legally defined boundary or an active, functioning governmental structure.

SECTION 2 - CRITICAL FACILITY

Disaster events that can disrupt the operation of the electric grid can include earthquakes, tornados, hurricanes, fires, flash floods, inland windstorms and severe rain and thunderstorms, winter storms, and heat waves. These events may occur individually, in any location and in any combination. For this report, Critical Facilities are considered to be existing physical resources under the definition from PURA and are in the CF count shown in Table 3 below. Table 3 is a detailed breakdown of the broad categories identified in Table 1. It lists those facilities by definition that have been determined to be CFs. This table provides the average annual energy usage in Btu/SqFt of each type of CF. This data was then used to calculate the kW and kWh of the various CFs.

Critical Facilities		
ID	**Type**	**Annual Energy Use per Sq Ft (Ave) - kBtu/SF EUI per Energy Star Portfolio Manager[10]**
1	Hospitals	426.9
2	Nursing Homes	213.2
3	Water Treatment Plants	5.9 (energy use in gal/day)
4	Potable Water pumping stations	Unknown
5	Waste Water Treatment plants	7.51 (energy use in gal/day)
6	Sewerage lift/pumping stations	Unknown
7	Storm Shelters/Buildings	89.3
8	Public Schools	104.4
9	Town Halls and Municipal Buildings	109.6
10	First Responder facilities	124.9
a	Fire Stations	124.9
b	Police Stations	124.9
c	Ambulance dispatch facilities	89.3
d	Emergency call centers such as 911	89.3
e	Radio/television emergency alert systems	90
11	Health care treatment facilities where procedures may be in progress such as dental offices, remote site hospital clinics	145.8
12	Hospice, assisted living	213.2
13	End stage renal disease and dialysis centers	232.8
14	Heating and cooling centers	109.6
15	Homeless shelters	143.6
16	Grocery Stores and Evacuation route fuel stations	120

Table 3 - Critical Facilities

SECTION 3 - QUANTIFICATION OF POWER PACKAGE SUPPLY

It was considered for the CF count that at least one CF for small communities (under 1000 population) could be designated as a disaster shelter that could be furnished with a BPP in order to provide shelter for those that need it. These small communities may also include a convenience store that has stocked food, water and workable gasoline pumps. This would be roughly 800 communities of population between 50 and 1000. This could be upwards of 1600 or more BPPs just for the smaller communities.

For the larger communities:
As indicated in Section 1 - Methodology, this study will quantify BPP units and their sizes based on average values of existing CF in terms of average numbers in the community, energy consumption on a Btu/SqFt basis for that usage (then calculated to kW), and the size of a typical CF in SqFt[5]. For example:

- **Houston** has 26 police stations with contact phone numbers. Population[16] is 2,300,000 or roughly 88,500 people served/station coverage. BPPs that may be designated for this essential service could be upwards of 26.
- **Houston** has 105 fire stations or 1 for every 22,000 people served. This essential service could benefit from upwards of 105 BPPs.
- There are over 2,700 **law enforcement agencies in Texas**. One agency per 11,000 population. This could be serviced by up to 2,700 BPPs statewide.
- There are 53 fire stations in **Austin**, population 974,447[16] or 1 for every 18,400 people served. This might result in the application of 53 BPPs.
- **San Antonio** has a population of 1,473,000[16] with 54 fire stations or 1 for every 27,277 people served. This essential service might benefit from upwards of 54 BPPs.
- For police and fire stations noted above the quantity of BPPs may not necessarily be on a one-to-one ratio (one BPP per fire station or one BPP per police station). The quantities of BPPs for these facilities in this report is based on the number of departments of each type within the State.

In **Table 4** below, the CFs are listed along with their average quantities statewide, their average size in square feet per individual facility and energy consumption in Btu/SqFt, kWh and kW.

Critical Facility Type (See Section 4 for References)	Quantity of Bldgs in Texas	Average Floor Space, SqFt*	EUI kbtu/SqFt*	Energy ** Usage 1 hr Cont. kWh	Load *** Factor (LF)	Demand Based on LF, kW
Hospitals (10)(15)(16)	357	100000	426.9	1427.86	0.65	2196.71
Nursing Homes (10)(16)	1195	18000	213.2	128.36	0.65	197.47
Water Treatment Plants * (8)(9)(10)	329	1000000	5.9	72028.52	0.50	144.06
Potable Water pumping stations						0.00
WasteWater Treatment plants *(7)(9)(10)	2513	1000000	7.51	91683.76	0.50	183.37
Sewerage lift/pumping stations						0.00
Storm Shelters/Buildings (9)(10)(16)	1799	2000	89.3	5.97	0.60	9.96
Public Schools (4)(10)(16)	6158	50000	104.4	174.59	0.80	218.24
Town Halls and Municipal Buildings(9)(10)(16)	1799	7500	109.6	27.49	0.55	49.99
First Responder facilities (5)(10)(14)(16)				0.00	0.55	0.00
Fire Stations	2332	4500	124.9	18.80	0.55	34.18
Police Stations	2800	3500	124.9	14.62	0.55	26.58
Ambulance dispatch facilities (3)(10)(15)(16)	2332	2500	89.3	7.47	0.55	13.58
Emergency call centers such as 911 (1)(10)(16)	206	5000	89.3	14.93	0.80	18.67
Radio/television emergency alert systems (2)(10)(16)	1252	1500	90	4.52	0.50	9.03
Health care treatment facilities where procedures may be in progress such as dental offices, remote site hospital clinics (3)((9)(10)(16)	634	7500	145.8	36.57	0.65	56.27
Hospice, assisted living (3)(10)(16)	1000	15000	213.2	106.96	0.65	164.56
End stage renal disease and dialysis centers (3)(10)(16)	1000	15000	232.8	116.80	0.65	179.69
Heating and cooling centers (3)((9)(10)(15)(16)	1799	3000	109.6	11.00	0.60	18.33
Homeless shelters (10)(14)(15)(16)	102	3000	143.6	14.41	0.60	24.02
Grocery stores and Evacuation route fuel stations (10)(14)(16)	3155	2000	120	8.03	0.80	10.03

Table 4 - Energy Consumption

Table 4 Notes:

*Water and Wastewater values are in gals/day and not kbtu/Sq/Ft.

**These numbers represent demand (kW capacity) as a peak value during a 60-minute period. It is possible that the actual demand could be higher when viewed over a 15-minute period and then extrapolated over an hour. In this case the demand value represents kWh as opposed to kW. For example, a demand schedule every 15 minutes may look like 1500, 2000, 500, 1200. The max demand would be 2000 during this particular one-hour period but the kWh consumed would only be 1300 (i.e. the facility is using 1500kW for ¼ hour and 2000kW for ¼ hour and 500kW for ¼ hour and 1500kW for ¼ hour; then the kWh consumption would be 1500/4 + 2000/4 + 500/4 + 1200/4 = 1300kWh). BPP sizing would then have to be based on the 2000kW demand requirement and not the 1300kWh consumption.

***Load factor (LF) represents the (actual usage)/ (max possible usage). In the above example the max usage would be 2000kWh (2000kW continuous demand for one hour) and the actual usage is perhaps only 1300kWh. This would make the LF be 1300/2000 = .65 (65%). If, however, the actual usage was only 1000kWh then the LF would be 1000/2000 or .5 (50%). In other words, the available capacity needs to be 2000kW (to meet the 15 minute demand) while the energy consumed was only 1300kWh. Actual load that may be incurred during disaster recovery is indeterminate making it necessary to use those EUI data that are available for normal use of the CF.

1. For Storm Shelters/Buildings, Town Halls and Municipal buildings, and Heating and Cooling Centers, no direct data was found. The quantity values assumed here reflect one BPP per community for each such critical facility.
2. Wastewater Treatment plant quantities shown in Table 3 are for plants that treat one million gallons per day (MGD) or less. This accounts for roughly 76%[7] of the facilities statewide. The following cities treat more than that:
    a. Houston - 39 treatment plants with total flow of 250 MGD (ave MGD/plant = 6.4 MGD) https://www.houstontx.gov/cip/22cipadopt/e_wastewater.pdf
    b. Austin – 2 major treatment plants with total flow of about 100 MGD. https://communityimpact.com/austin/south-central-austin/government/2024/05/30/more-than-1b-approved-for-generational-austin-wastewater-treatment-plant-upgrades/
    c. San Antonio – 5 treatment plants with total flow of over 200 MGD https://www.waterandwastewater.com/dos-rios-water-recycling-center/ https://www.sariverauthority.org/services/utilities/wastewater-treatment-plants/
    d. Dallas – 2 treatment plants with total flow of 260 MGD (ave MGD/plant = 130 MGD) https://dallascityhall.com/departments/waterutilities/Pages/water_intersting_facts.aspx

   From a Statewide perspective these four cities would add 48 BPP to the 2500 kW count for wastewater treatment alone.

Critical Facility Type (See Section 4 for References)	Quantity of Bldgs in Texas	Unit Size, kW					
		10	25	75	150	300	2500
		Unit Quantity					
Hospitals (10)(15)(16)	357						357
Nursing Homes (10)(16)	1195					1195	
Water Treatment Plants * (8)(9)(10)	329				329		
Potable Water pumping stations		0					
WasteWater Treatment plants *(7)(9)(10)	2513					2513	
Sewerage lift/pumping stations		0					
Storm Shelters/Buildings (9)(10)(16)	1799	1799					
Public Schools (4)(10)(16)	6158					6158	
Town Halls and Municipal Buildings(9)(10)(16)	1799			1799			
First Responder facilities (5)(10)(14)(16)		0					
Fire Stations	2332			2332			
Police Stations	2800			2800			
Ambulance dispatch facilities (3)(10)(15)(16)	2332		2332				
Emergency call centers such as 911 (1)(10)(16)	206		206				
Radio/television emergency alert systems (2)(10)(16)	1252	1252					
Health care treatment facilities where procedures may be in progress such as dental offices, remote site hospital clinics (3)((9)(10)(16)	634			634			
Hospice, assisted living (3)(10)(16)	1000					1000	
End stage renal disease and dialysis centers (3)(10)(16)	1000					1000	
Heating and cooling centers (3)((9)(10)(15)(16)	1799		1799				
Homeless shelters (10)(14)(15)(16)	102		102				
Grocery stores and Evacuation route fuel stations (10)(14)(16)	3155		3155				
Quantity	30762	3051	7594	7565	329	11866	357
Unit Size, kW		10	25	75	150	300	2500

Table 5 - BPP Size, kW and Quantity Statewide

As can be seen in **Table 5** above, five primary sizes of BPP are evident at 10kW, 25kW, 75 kW, 300 kW and 2500kW due to their large quantities. The 150kW range can be formed by deploying two 75kW to handle that group. Other capacities can be formed by combining smaller BPPs' capacities to accomplish the desired kW output. Final sizes of BPPs to meet actual kW needs will be determined during the design of the BPPs in the upcoming phase of the project. It may be more feasible from a cost, delivery, and installation standpoint to develop a 1250 kW group to bridge the BPP size gap in Table 5, and to meet the 2500 kW output group by aggregating two 1250 kW BPPs together.

Table 5 Notes:

1. Fire Stations were considered to have an average of two engine bays each when determining floor space and energy use.[5]
2. Police stations assume one station per department. There are 2800 law enforcement departments in Texas.[5]
3. The quantity of heating/cooling centers in the State of Texas was assumed at one per community although no actual data is available.
4. Ambulance dispatch centers were assumed to equal the quantity of fire stations and to be independent facilities. No actual data could be found.
5. Radio/TV alert systems are considered to be part of the broadcast station's public service offerings and was quantified as each licensed broadcast station.[2]

Number of communities	Gas stations/community	Total TBPPs	Community population
1528	1	1528	50-10000
196	2	392	10001-50000
69	5	345	50001-500000
3	10	30	500001-1000000
3	20	60	1000000-3000000
1799		2355	
		800	Grocery stores
		3155	Totals

Table 6 – Evacuation Route Filling Stations and Rural Grocery Stores

Table 6 Notes:

1. Evacuation route fuel stations breakdown is shown in **Table 6** above. In the smaller rural communities, it was determined that there would be one major route out of town. For the largest 6 communities, multiple interstate, US, and Texas highway routes pose possible

evacuation routes. In these larger 6 communities, gas station counts were estimated. See Figure 1 on page 8 of this report for population groups.

2. Grocery stores were considered as CF in smaller and rural communities and are part of the total CF count shown in Table 6.

SECTION 4 – RESOURCES

The following links are to the pages where the count and energy use data was secured. If the link does not work directly, copy and paste it into the address bar at the top of your browser page.

Ref. No.	Ref. Title	Hyperlink
1	For 911 Call Centers	https://capitol.texas.gov/tlodocs/85R/handouts/C4202017022808001/187f7790-83d8-4e1b-9732-bd53d8b78687.PDF
2	Radio Stations	https://gov.texas.gov/Apps/Music/Directory/radio-station/all/p5
	TV Stations	https://www.stationindex.com/tv/by-state/TX#google_vignette
3	For Essential Services	https://www.ncsl.org/labor-and-employment/covid-19-essential-workers-in-the-states
		(see the Read More under the second paragraph)
4	For Public Schools	https://authority.org/k12/states/texas/elementary-schools
		(Shows school quantities by type – elementary, middle, high)
5	For Police Stations	https://texapedia.info/criminal-justice/law-enforcement/
	For Fire Stations	https://apps.usfa.fema.gov/registry/summary#d
		(Copy and paste link into browser)
6	For Electrical Load Factor	https://electricityplans.com/load-factor-commercial-demand-charges/
7	For Wastewater Treatment Plants	https://www.researchgate.net/figure/Municipal-wastewater-treatment-plants-in-Texas-are-concentrated-in-urban-and-suburban_fig1_43336462
		https://www.legis.state.tx.us/tlodocs/86R/handouts/C3902020080100001/7c1bd09b-b0e1-41a5-81bb-91abe613351d.PDF
	Houston	https://www.houstontx.gov/cip/22cipadopt/e_wastewater.pdf
	Austin	https://communityimpact.com/austin/south-central-austin/government/2024/05/30/more-than-1b-approved-for-generational-austin-wastewater-treatment-plant-upgrades/
	San Antonio	https://www.waterandwastewater.com/dos-rios-water-recycling-center/ https://www.sariverauthority.org/services/utilities/wastewater-treatment-plants/
	Dallas	https://dallascityhall.com/departments/waterutilities/Pages/water_intersting_facts.aspx
8	For Water Treatment Plants	https://www.legis.state.tx.us/tlodocs/86R/handouts/C3902020080100001/b9bca724-9d09-4d9a-b62e-1231e973e00f.PDF
9	EIA	https://www.eia.gov/
10	Energy Star	https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf
11	NREL	https://www.nrel.gov/

12	FEMA	https://emilms.fema.gov/is_0350/groups/70.html
13	CISA	Cybersecurity and Infrastructure Security Agency
		https://www.cisa.gov/about/regions/region-6
		(For background on Cybersecurity infrastructure)
14	FEMA	Homeland Security - Federal Emergency Management Agency – https://apps.usfa.fema.gov/registry/summary https://www.fema.gov/glossary/critical-facility
15	HHSC	Health and Human Services Commission (of Texas)
		https://www.hhs.texas.gov/sites/default/files/documents/sb-1519-ltc-facilities-council-report-jan-2023.pdf
		(Refer to pages 8 & 9 for rough facility counts)
16	TEXAS	Texas Demographics by CUBIT (Data as of June 20, 2024 – download (.xlsx)
		https://www.texas-demographics.com/cities_by_population

The listing of codes below governing energy use and backup power requirements and installation cover various building types. These were referred to for background information.

Code No.	Code Description
NFPA 1	Fire Code
NFPA 30	Flammable and Combustible Liquids Code
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 54	National Fuel Gas Code
NFPA 58	Liquefied Petroleum Gas Code
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code
NFPA 99	Health Care Facilities Code
NFPA 101	Life Safety Code
NFPA 110	Standard for Emergency and Standby Power Systems
NFPA 780	Standard for the Installation of Lighting Protection Systems
ASCE/SEI 7	Minimum Design Loads for Buildings and Other Structures

Exhibit A – Energy Star Portfolio Manager

(Reprinted from the Energy Star Website[10])

OVERVIEW

This reference table is designed to help you to compare your property's energy use to the national median (or mid-point) energy use of similar properties.

Benchmarking your Property

When benchmarking in Portfolio Manager, we recommend that you focus on the primary function (or, main activity) in your building(s). Begin by selecting your primary function from the table below and then enter as few additional use types as possible. Benchmarking your building using a single use type will most closely approximate how your building would have been recorded in the reference data survey, and therefore yield the most accurate comparisons to median performance. In some cases, buildings may have multiple distinctly different uses. For example, an office and a hotel that share a common building. In these mixed-use settings, it is appropriate to enter multiple use types. Definitions of all property types are available at: www.energystar.gov/PMGlossary.

Using Median Site and Source Energy Use Intensity (EUI)

The *national median source EUI* is a recommended benchmark metric for all buildings. The median value is the middle of the national population – half of buildings use more energy, half use less. The median works better than the mean (arithmetic average) for comparing relative energy performance, because it more accurately reflects the mid-point of energy use for most property types.

The table below presents the median in both *site EUI* and *source EUI*. Site EUI is what you may be familiar with from your utility bills. Site EUI contains a mixture of what is called primary energy (i.e., a raw fuel like natural gas) and secondary energy (i.e., a converted product like electricity or district steam). Source energy provides the most equitable way to combine primary and secondary energy types into a single common unit, ensuring that no building receives either a credit or a penalty based on its energy source or utility. You can learn more about source energy and the way it is computed at www.energystar.gov/SourceEnergy. We strongly encourage you to use source EUI.

While almost all commercial building types have a national Median Source EUI, some (*presented in cyan*) will also have a 1-100 ENERGY STAR Score. The score evaluates a building relative to its peers, similar to the median energy use values, and also adjusts for climate and business activity. You can learn more about the score at: http://www.energystar.gov/ENERGYSTARScore

Understanding Reference Data

The right-most column in the table indicates the reference data source we use to determine the median performance of buildings in your peer group. To compute the national median, we always rely on nationally representative data.

For the majority of property types, the reference data is from the Commercial Building Energy Consumption Survey (CBECS). This is a national survey conducted by the U.S. Department of Energy's Energy Information Administration (for more information visit: http://www.eia.gov/consumption/commercial/). Three additional surveys are referenced for data centers, wastewater treatment plants, and multifamily housing. Additional information on these surveys can be found in the technical reference document for each property type.

U.S. National Median Reference Values for All Portfolio Manager Property Types

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Banking/Financial Services	Bank Branch *		209.9	88.3	CBECS - Bank/Financial
	Financial Office*		116.4	52.9	CBECS - Office & Bank/Financial
Education	Adult Education		110.4	52.4	CBECS - Education
	College/University		180.6	84.3	CBECS - College/University
	K-12 School*		104.4	48.5	CBECS - Elementary/Middle & High School
	Pre-school/Daycare		131.5	64.8	CBECS - Preschool
	Vocational School		110.4	52.4	CBECS - Education
	Other - Education				
Entertainment/Public Assembly	Convention Center		109.6	56.1	CBECS - Social/Meeting
	Movie Theater		112.0	56.2	CBECS - Public Assembly
	Museum				
	Performing Arts				
	Recreation	Bowling Alley	112.0	50.8	CBECS - Recreation
		Fitness Center/Health Club/Gym			
		Ice/Curling Rink			
		Roller Rink			
		Swimming Pool			
		Other - Recreation			
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Entertainment/Public Assembly	Stadium	Indoor Arena	112.0	56.2	CBECS - Public Assembly
		Race Track			
		Stadium (Closed)			
		Stadium (Open)			
		Other - Stadium			
	Other	Aquarium			
		Casino			
		Zoo			
		Other - Entertainment/Public Assembly			
		Bar/Nightclub	297.0	130.7	CBECS - Bar/Pub/Lounge
Food Sales & Service	**Convenience Store***	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Restaurant/Bar	Bar/Nightclub	297.0	130.7	CBECS - Bar/Pub/Lounge
		Fast Food Restaurant	886.4	402.7	CBECS - Fast Food
		Restaurant	573.7	325.6	CBECS - Restaurant/Cafeteria
		Other - Restaurant/Bar			
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Wholesale Club/Supercenter*		120.0	51.4	CBECS - Retail Store
	Other	Food Sales	592.6	231.4	CBECS - Food Sales
		Food Service	527.7	270.3	CBECS - Food Service

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Healthcare	Ambulatory Surgical Center		138.3	62.0	CBECS - Outpatient Healthcare
	Hospital	**Hospital (General Medical & Surgical)***	426.9	234.3	Industry Survey
		Other/Specialty Hospital	433.9	206.7	CBECS - Inpatient Healthcare
	Medical Office*		232.8	97.8	Industry Survey
	Outpatient Rehabilitation/Physical Therapy		138.3	62.0	CBECS - Outpatient Healthcare
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Urgent Care/Clinic/Other Outpatient		145.8	64.5	CBECS - Clinic/Outpatient
Lodging/Residential	**Barracks***		107.5	57.9	CBECS - Dormitory
	Hotel*		146.7	63.0	CBECS - Hotel & Motel/Inn
	Multifamily Housing*		118.1	59.6	Fannie Mae Industry Survey
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Residence Hall/Dormitory*		107.5	57.9	CBECS - Dormitory
	Residential Care Facility		213.2	99.0	Industry Survey
	Senior Living Community*		213.2	99.0	Industry Survey
	Single Family Home		N/A	N/A	None Available
	Other - Lodging/Residential		143.6	63.6	CBECS - Lodging
Manufacturing/Industrial	Manufacturing/Industrial Plant		N/A	N/A	None Available
Mixed Use	Mixed Use Property		89.3	40.1	CBECS - Other
Office	**Medical Office***		121.7	51.2	CBECS - Medical Office
	Office*		116.4	52.9	CBECS - Office & Bank/Financial
	Veterinary Office		145.8	64.5	CBECS - Clinic/Outpatient
Parking	Parking		N/A	N/A	None Available

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Public Services	Courthouse*		211.4	101.2	CBECS - Courthouse
	Drinking Water Treatment & Distribution *(Average EUI presented in Energy per Flow in gallons per day)*		5.90	2.27	AWWA - Water Treatment Plant
	Fire Station		124.9	63.5	CBECS - Fire Station/Police Station
	Library		143.6	71.6	CBECS - Library
	Mailing Center/Post Office		96.9	47.9	CBECS - Service
	Police Station		124.9	63.5	CBECS - Fire Station/Police Station
	Prison/Incarceration		156.4	69.9	CBECS - Public Order and Safety
	Social/Meeting Hall		109.6	56.1	CBECS - Social/Meeting
	Transportation Terminal/Station		112.0	56.2	CBECS - Public Assembly
	Wastewater Treatment Plant* *(Average EUI presented in Energy per Flow in gallons per day)*		7.51	2.89	AWWA - Wastewater Plant
	Other - Public Services		89.3	40.1	CBECS - Other
Religious Worship	Worship Facility*		58.4	30.5	CBECS - Religious Worship
Retail	Convenience Store*	Convenience Store with Gas Station	883.5	350.9	Industry Survey
		Convenience Store without Gas Station			
	Mall	Enclosed Mall	170.7	65.7	CBECS - Enclosed Mall
		Lifestyle Center	228.8	103.5	CBECS - Strip Shopping Mall
		Strip Mall			
		Other - Mall	225.3	101.6	CBECS - Enclosed Mall and Strip Shopping Mall
	Retail Store*		120.0	51.4	CBECS - Retail Store
	Supermarket/Grocery Store*		444.0	196.0	CBECS - Grocery Store/Food Market
	Vehicle Dealership*		138.2	71.9	Industry Survey
	Wholesale Club/Supercenter*		120.0	51.4	CBECS - Retail Store

Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	Reference Data Source - Peer Group Comparison
Technology/Science	**Data Center*** *(Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)*		1.82	1.82	EPA - Data Center
	Laboratory		318.2	115.3	CBECS - Laboratory
	Other – Technology/Science		89.3	40.1	CBECS - Other
Services	**Data Center*** *(Average PUE presented in place of EUI: PUE = Total Energy / IT Energy)*		1.82	1.82	EPA - Data Center
	Personal Services (Health/Beauty, Dry Cleaning, etc.)		96.9	47.9	CBECS - Service
	Repair Services (Vehicle, Shoe, Locksmith, etc.)				
	Other - Services				
Utility	Drinking Water Treatment & Distribution *(Average EUI presented in Energy per Flow in gallons per day)*		5.90	2.27	AWWA - Water Treatment Plant
	Energy/Power Station		89.3	40.1	CBECS - Other
	Wastewater Treatment Plant* *(Average EUI presented in Energy per Flow in gallons per day)*		7.51	2.89	AWWA - Wastewater Plant
	Other - Utility		89.3	40.1	CBECS - Other
Warehouse/Storage	Self-Storage Facility		47.8	20.2	CBECS – Non-refrigerated Warehouse
	Warehouse/Distribution Center	**Distribution Center***	52.9	22.7	CBECS – Non-refrigerated Warehouse & Distribution Center
		Non-Refrigerated Warehouse*			
		Refrigerated Warehouse*	235.6	84.1	CBECS – Refrigerated Warehouses
Other	Other		89.3	40.1	CBECS - Other

Exhibit B – Texas Backup Power Package

Advisory Committee Letter

15 March 2024

Ms. Tracie Tolle
Project Manager, Texas Energy Fund
Public Utility Commission of Texas

The Commission will soon issue a request for proposal for a research entity to conduct a survey of facilities that may qualify for funding under the *Texas Power Promise* of Chapter 34 of the Texas Utilities Code, to inform the design process of the Backup Power Packages under that chapter. At the Commission's request, the Texas Backup Power Package Advisory Committee provides the following guidance regarding the types of facilities that may qualify under the program.

Eligibility, generally. Financial grants and loans under the Texas Backup Power Package program (TBPP) should, by statute, be awarded to "facilities on which communities rely for health, safety and well-being." Texas Utility Code § 34.0202. The program is fundamentally aimed at providing backup power for *critical* community services where otherwise it would be financially unfeasible to do so (whether due to insufficient tax base, commercial viability, or other factors).

Facilities not eligible. Also by statute, electrical loads of greater than 2.5MW are not eligible; nor are commercial energy systems (or their supporting infrastructure), private schools, or for-profit entities that do not directly serve public safety and human health.

Eligibility determination. Eligible facilities will include the types identified and listed in the Texas Administrative Code [16 TAC §25.52] as "loads for which electric service is considered crucial for the protection or maintenance of public safety":

- hospitals, police stations, fire stations, critical water and wastewater facilities, and medical facilities.

The TBPP project, however, contemplates a larger set of facilities upon which communities may rely for critical services in the event of a local or widespread sustained grid outage. These may include the following, for example, provided that they supply *critical* community services:

- facilities providing hospice, nursing, assisted living facilities, end stage renal disease and dialysis;
- community heating or cooling centers and homeless shelters;
- evacuation route fuel stations;
- gas stations and grocery stores in areas (urban and rural) that have highly limited access to essential supplies;
- communications facilities that serve 911 call centers and radio/television emergency alert systems.

In addition to these categories, TBPP eligibility may, upon consideration of relevant factors, extend to certain facilities that local officials identify as critical – *if* those facilities are designated to and in fact do provide critical services to their communities at large. Depending on the critical needs of the community, these many include food banks and gathering places like public schools, libraries, or houses of worship if they in fact provide critical community services. (The Committee does not expect or intend that an initial assessment of the scale and scope of eligible facilities will include every school, etc., in the state.)

Again, these recommendations pertain to the survey to be performed by the research entity. The Committee will make separate and further recommendations in a report at a later date, and otherwise in response to requests from the Commission, which may include recommendations on the award of grants and loans.

Nathan Johnson
State Senator, District 16

Appendix 2

TDU Critical Care Reports

Filing Receipt

Filing Date - 2024-02-26 02:22:17 PM

Control Number - 39275

Item Number - 69

PUBLIC UTILITY COMMISSION OF TEXAS
PROJECT NO. 39275
UTILITY REPORT CONCERNING CRITICAL CARE CUSTOMERS

ANNUAL REPORT RELATING TO CRITICAL CARE FOR AEP TEXAS INC. FOR JANUARY 1, 2023, THROUGH DECEMBER 31, 2023

FEBRUARY 26, 2024

AEP TEXAS

CONTACT PERSON:
CHERRON RINEHART
(512) 481-4585

(Required by 16 Tex. Admin Code §25.497 (TAC) – Critical Load Industrial Customers, Critical Load Public Safety Customers, Critical Care Residential Customers, and Chronic Condition Residential Customers.)

PROJECT NO. 39275 - CRITICAL CARE ANNUAL REPORT
AEP TEXAS INC.
REPORT FOR JANUARY 1, 2023 THROUGH DECEMBER 31, 2023

16 TAC §25.497(i)	Critical Load Public Safety Customer	Critical Load Industrial Customer	Chronic Condition Residential Customer	Critical Care Residential Customer	Total
Number of Customers	5750	2885	476	1250	10,361
Number of Applications Rejected Due to Incomplete Forms	0	0	362	475	837
Number of Requests from REPs for Disconnection	4	80	13	60	157
Number of Disconnects for Non-Pay Completed	0	0	0	0	0
Number of Reconnects for Non-Pay Completed	0	0	0	0	0

Filing Receipt

Filing Date - 2024-02-23 12:36:04 PM

Control Number - 39275

Item Number - 67

PROJECT NO. 39275

UTILITY REPORT CONCERNING	§	**PUBLIC UTILITY COMMISSION**
	§	
CRITICAL CARE CUSTOMERS	§	**OF TEXAS**

CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC
2023 CRITICAL CARE REPORT
PURSUANT TO P.U.C. SUBST. R. §25.497(i)

Joymesha Jones
Analyst, Regulatory & Rates
(713) 207-5865
(713) 207-9819 (fax)
joymesha.jones@centerpointenergy.com

February 23, 2024

Table of Contents

PROJECT NO. 39275

UTILITY REPORT CONCERNING	**§**	**PUBLIC UTILITY COMMISSION**
	§	
CRITICAL CARE CUSTOMERS	**§**	**OF TEXAS**

CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC
2023 CRITICAL CARE REPORT
PURSUANT TO P.U.C. SUBST. R. §25.497(i)

Pursuant to P.U.C. Subst. R §25.497(i), CenterPoint Energy Houston Electric, LLC ("CenterPoint Energy") submits this report. The rule requires transmission and distribution utilities ("TDUs") to file an annual report with the Commission by March 1 of each year. The report provides information from the books and records of CenterPoint Energy for calendar year 2023.

Respectfully submitted,

Joymesha Jones
Analyst, Regulatory & Rates
1111 Louisiana St., Suite 1929
Houston, Texas 77002
713-207-5865
713-207-9819 (fax)

CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC

CenterPoint Energy Houston Electric, LLC
2023 Critical Care Report
Pursuant to P.U.C. Subst. R §25.497(i)

1) **The number of customers of each type of customer defined in the subsection (a) §25.497 as of 12/31/2023 (Snapshot).**

CRITICALCARECUSTOMER'	Total Number
Critical Load Public Safety	11,681
Critical Load Industrial	22
Chronic Condition Customer	778
Critical Care Customer	2169

2) **The number of applications that were rejected as a result of "Incomplete Forms" for each type of customer defined in the subsection (a) §25.497 from 01/01/2023 to 12/31/2023.**

CRITICALCARECUSTOMER'	Total Number
Critical Load Public Safety	0
Critical Load Industrial	0
Chronic Condition Customer	384
Critical Care Customer	565

3) **The number of requests from REPs for disconnect for each type of customer defined in the subsection (a) §25.497 from 01/01/2023 to 12/31/2023.**

CRITICALCARECUSTOMER'	Total Number
Critical Load Public Safety	9
Critical Load Industrial	0
Chronic Condition Customer	22
Critical Care Customer	54

4) **The number of requests from REPs for DISCONNECT COMPLETED for each type of customer defined in the subsection (a) §25.497 from 01/01/2023 to 12/31/2023.**

CRITICALCARECUSTOMER'	Total Number
Critical Load Public Safety	0
Critical Load Industrial	0
Chronic Condition Customer	12
Critical Care Customer	0

5) **The number of requests from REPs for RECONNECT COMPLETED for each type of customer defined in the subsection (a) §25.497 from 01/01/2023 to 12/31/2023.**

CRITICALCARECUSTOMER'	Total Number
Critical Load Public Safety	0
Critical Load Industrial	0
Chronic Condition Customer	12
Critical Care Customer	0

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Filing Date - 2024-02-26 04:13:39 PM

Control Number - 39275

Item Number - 70

PROJECT NO. 39275

PUBLIC UTILITY COMMISSION OF TEXAS
REPORTS BY ELECTRIC UTILITIES RELATING TO CRITICAL CUSTOMERS
SR §25.497 (i)

REPORT CONCERNING CRITICAL CUSTOMERS FOR ONCOR ELECTRIC DELIVERY COMPANY LLC FOR PERIOD JANUARY 1, 2023 – DECEMBER 31, 2023

FEBRUARY 26, 2024

ONCOR CONTACT PERSON: L. Clayton Zachary
(214) 486-4822

Project # 39275 - Critical Customer Annual Report
Oncor Electric Delivery Company LLC - Report for January 01, 2023 Through December 31, 2023

SR 25.497 (l)	Critical Care Residential	Chronic Condition Residential	Critical Load Public Safety	Critical Load Industrial	Totals	Comments
Number of Customers	5,356	2,327	10,928	6	18,617	
Number of Applications Rejected due to incomplete forms	540	429	0	0	969	A total of 3,460 forms received for Critical Care Residential or Chronic Condition Residential designation were returned due to incompleteness. Out of the 3,460 returned forms, 2,491 of these forms were ultimately corrected and resulted in a Critical Care Residential or Chronic Condition Residential designation for the account.
Number of Requests From REPs for Disconnection	95	36	20	0	151	Total includes multiple requests for disconnection for the same customers. A total of 151 requests were sent for 109 unique customers.
Number of Disconnects for Non-Pay Completed	0	34	0	0	34	
Number of Reconnects for Non-Pay Completed	0	31	0	0	31	

ATTESTATION STATEMENT

Pursuant to P.U.C. Subst. R. 25.71(d), I attest that the information provided in this Annual Report Concerning Critical Customers has been reviewed internally for accuracy and I have the authority to make this report on behalf of Oncor Electric Delivery Company LLC.

L. Clayton Zachary   2/26/2024

L. Clayton Zachary   Date

Filing Receipt

Filing Date - 2024-02-23 03:07:37 PM

Control Number - 39275

Item Number - 68

DOCKET 39275

ANNUAL REPORT ON CRITICAL CARE CUSTOMERS PURSUANT TO 16 TEX. ADMIN. CODE § 25.497(i)	§ § § § § §	**THE PUBLIC UTILITY COMMISSION OF TEXAS**

TEXAS-NEW MEXICO POWER'S
REPORT FOR THE YEAR
<u>JANUARY 1, 2023 THROUGH DECEMBER 31, 2023</u>

As required under 16 Tex. Admin. Code § 25.497(i), Texas-New Mexico Power Company ("TNMP") hereby files the attached Report Concerning Critical Care Customers for the year ending December 31, 2022.

February 23, 2024

Respectfully submitted,

Kevin Lewis
Regulatory Analyst
TEXAS-NEW MEXICO POWER
577 N. Garden Ridge Blvd.
Lewisville, TX 75067
Direct: (214) 222-4125
Fax: (214) 222-4156
kevin.lewis@tnmp.com

Project No. 39275

Annual Report Concerning Critical Care Customers Pursuant to 16 T.A.C. § 25.497

TEXAS-NEW MEXICO POWER COMPANY

CALENDAR YEAR:
January 1, 2023 - December 31, 2023

Number of Critical Load Public Safety	1325
Number of Critical Load Industrial	191
Number of Critical Care Residential	241
Number of Chronic Condition Residential	113

Number of applications rejected	0
Number of requests from REPs for disconnection	
REP - Critical Load Industrial	0
REP - Critical Load Public Safety	0
REP - Critical Care Residential	1
REP - Critical Care Chronic Condition	3

Number of disconnections/reconnections completed	0

Appendix 3

Vendor Request

Solicitation For Information – Backup Power Packages (Rev 1)

RINA is under contract with the Public Utility Commission of Texas (PUCT) to provide studies and design backup power packages to be deployed throughout the State of Texas. The Texas Backup Power Packages (TBPP) are to be used in island mode only and are to provide backup power for up to 48 hours continuously at full load. The packages are essentially microgrids and are required to utilize IC gensets with natural gas or propane as fuel, and include solar photovoltaic panels and Battery Energy Storage Systems (BESS). All three technologies are required. Microgrid sizes have been determined to be 10kW, 25kW, 75kW, 300kW and 2500kW. The 2500kW package may be replaced with two 1250kW packages.

This solicitation is for informational and research purposes only. No contract is expressed or implied between any supplier, vendor or contractor and RINA or the PUCT to furnish, install or maintain the listed equipment at the quotation prices provided herein and no other contract of any type is expressed or implied between any supplier, vendor or contractor and RINA or the PUCT as a result of providing the requested information noted herein. . Vendors will not be held to pricing information should any formal request for quotation for the provision of equipment follow this Solicitation For Information.

Package quantities have been estimated to be as follows:

1. 10kW 3,051
2. 25kW 7,594
3. 75kW 7,565
4. 300kW 11,866
5. 2500kW 357 (or 714@1250kW)

This is a long-term delivery project. **<u>We are currently requesting assistance as follows</u>**:

1. Typical design layouts of components to develop the microgrid sizes
2. Pricing per each microgrid if purchased by a vendor for installation by an energy as a service (EaaS) or microgrid as a service (MaaS) contractor
3. Pricing per each microgrid if offered as a MaaS energy supply service by the supplier (no intervening vendor)
4. Material availability to manufacture and produce microgrid components (i.e. with reference to supply chain issues)
    a. Time frame to deliver from date of approved order.
    b. Existing inventory available for immediate delivery.
5. Provide information regarding warranties and maintenance.
6. Component supplier information on major items if not by you. These components would be gensets, switchboards/switchgear, controllers, solar panels, solar inverters, and BESS.

Design requirements are detailed on the following pages. Other supply requirements:

1. Major components for 300kW packages and up are to be factory assembled into walk-in containers suitable for over the road transport to the final site/s. Containers are to be acoustically outfitted to reduce noise levels to factory designed standard ratings, but not to exceed 84db(A) at 23 feet. 300, 1250 and 2500kW gensets and switchgear may be quoted in acoustically modified non-walk-in enclosures in order to reduce cost.
2. Transportation and installation is not included unless considered as a normal part of the EaaS or MaaS.
3. Start up and testing at installation is to be part of the TBPP.

PLEASE RETURN THIS FORM BY **OCTOBER 30, 2024** AND SEND ANY QUESTIONS by **OCTOBER 18, 2024** TO:

Alan Hymans, PE
Senior Engineer

Email: alan.hymans@rina.org

RINA North America
55 E. Monroe Street, Suite 3450, Chicago, Illinois 60603
www.rina-us.org

RINA

QUOTATIONS – Base Microgrid		Delivery Times from Date of Individual Order
10kW Microgrid	$____________________________	____________________Months
25kW Microgrid	$____________________________	____________________Months
75kW Microgrid	$____________________________	____________________Months
300kW Microgrid	$____________________________	____________________Months
1250kW Microgrid	$____________________________	____________________Months
2500kW Microgrid	$____________________________	____________________Months

Rev 1 – 10/11/2024

1. Rev sound attenuation requirement on page 1.
2. Revised genset start time to 30-60 seconds from 10 seconds.
3. Added aternate BESS kWhr alternate capacity to 1/2kWh.

PUCT BPP DESIGNS

This document provides design requirements overview and operating sequences of the Texas Backup Power Packages (TBPP). The terms TBPP and microgrid have the same meaning as used within this document.

Abbreviations:

ATS	Automatic Transfer Switch
BESS	Battery Energy Storage System
CF	Critical Facility
EaaS	Energy as a Service
MaaS	Microgrid as a Service
STS	Static Transfer Switch
TBPP	Texas Backup Power Package

DESIGN REQUIREMENTS

1. Genset fueled by natural gas or propane
2. Must include solar with battery storage
   All TBPPs must include items 1 & 2
3. Must operate for 48 hours without refueling
   a. Utilizing natural gas from existing underground pipelines is not considered as refueling
   b. Propane should be skid mounted tankage
4. Economical cost /kW
5. Low cost operation
6. Straightforward installation and low maintenance
7. Operate islanded with grid failure
8. Connect to critical facility main electric service through use of Static Transfer Switch
   a. This provides for uninterupted transfer of power to BESS at time of grid failure

DESIGN ASSUMPTIONS

1. Upon grid failure there is to be no power interuption.
   a. See Operating Sequence paragraph B below.
2. Genset and BESS to share load.
   a. BESS kW rating to be 100% of Microgrid kW rating with production sizing (minimum storage period at Microgrid kW rating) of 1 hour.
      i. For 10kW BESS = 10kW/10kWh.
      ii. For 25kW BESS = 25kW/25kWh.
      iii. For 75kW BESS = 75kW/75kWh.
      iv. For 300 kW BESS = 300kW/300kWh.
      v. For 1250 kW BESS = 1250kW/1250kWh.
      vi. For 2500 kW BESS = 2500kW/2500kWh.

vii. BESS production sizing may be recommended to be alternate sizing (i.e. ½ hour or 2 hours or 8 hours or some other value) depending on control programming to provide best use of shared resources.

b. Genset to be rated at 100% of TBPP Rating (actual site load).

3. Propane will typically be for small TBPPs (10kW through 300kW) only if natural gas is unavailable.
   a. Propane tank sizing for larger systems to accommodate 48 hours becomes unweildy.
   b. Foundations are large and tanks require considerable space.
   c. Piping requirements are an added expense.
   d. Provide propane piping connections to allow if critical facility has existing on site propane storage that could be utilized.
4. TBPP components to be skid mounted.
5. TBPP components to be transportable over existing roads with flatbeds or other trucking.
6. All TBPP components to be factory installed in containers fully installed ready for field interconnection, startup and use.
7. Solar to be used for BESS charging in daytime and for genset auxiliary power.
8. Systems to be plug and play.
9. TBPPs may be aggregated so as to meet kW sizes required by CFs that are not part of the basic package sizes (i.e. – to meet a site requirement of 150kW, two 75kW BPPs could be sited at that location. Load share and synchronizer equipment would be necessary to meet this configuration).

EQUIPMENT REQUIRED

1. Solar Photovoltaic Modules.
2. Solar Inverters – String.
3. Gaseous fueled Gensets.
4. BESS.
5. Interconnecting component cabling, control system.

OPERATING SEQUENCES

A. NORMAL – GRID AVAILABLE
   a. Grid operation is normal providing full power to the site.
   b. BPP is monitoring grid availability on a continuous basis.
   c. BESS
      i. Connected to the grid through bi-directional inverter (BDI) for maintaining full charge only and automatic static transfer switch (STS).
      ii. BESS on grid maintaining charge.
      iii. No export of power to the grid by the BESS at any time.
   d. GENSET
      i. Not on the grid, no export of power to the grid by the Genset at any time.
      ii. Available on standby mode through automatic transfer switch (ATS).
   e. SOLAR

i. Rooftop or ground mounted.
ii. Connected to the TBPP grid for on-site TBPP auxiliary power needs:
1. Genset convenience outlets.
2. Genset controls incl Remote Annunciator.
3. TBPP container lighting.
4. BESS charging/trickle charging.
5. Genset battery charging.
6. Genset container and engine coolant heating (winter thermostat).

B. GRID FAILURE (for any reason)
a. Operates islanded through operation of STS and ATS.
b. BESS and Genset share CF load based on control programming.
c. BESS
i. STS operates separating CF from grid.
ii. Instantaneously picks up CF load in its entirety.
iii. No power interuption to CF power services.
iv. BESS operates similar to large UPS.
v. STS transfer time is around 4ms or ¼ cycle (one cycle is .016 seconds).
d. GENSET
i. Signaled to start from ATS.
ii. Generator output up to voltage and frequency.
iii. Genset synchronizes to BESS grid.
iv. ATS puts Genset on CF system within 30 – 60 seconds of grid failure.
e. SOLAR
i. Continues to provide auxiliary power and some BESS charging during daylight hours.
ii. Extends availability of BESS and helps reduce run time of genset.

C. GRID RETURN TO NORMAL
a. Genset receives shutdown signal, ATS transfers to standby mode, genset transfers into cool down mode and switches off. STS remains on BESS until signaled to switch back to utility grid by ATS.
b. BESS maintains CF load during Genset shut down cycle.
c. BESS verifies synchronization with grid, STS recloses for grid to provide power to CF.
d. BESS remains on line and returns to charge mode.

TBPP BALANCE of PLANT REQUIREMENTS

Please identify if any of these items are included in your offering. Please identify added quotation pricing to include if not part of the above base microgrid offering.

A. FOUNDATIONS
B. TBPP CONTAINERS
C. PROPANE FUEL TANKS (IF REQUIRED)

D. FUEL PIPING (IF REQUIRED)
E. CONTAINER INTERCONNECT CABLING
F. TBPP POWER OUTPUT CABLING TO CRITICAL FACILITY
G. CRITICAL FACILITY SERVICE UPGRADES
H. COMMUNICATIONS WIRING

Appendix 4

Public Workshop Nov 13, 2024

The following includes transcribed notes recorded from the public workshop forum presented by the PUCT for public input to the Texas Backup Power Package program. The workshop requested input from interested public entities that currently do business in or have a stake in power system resiliency during an electric power grid failure. The thrust of the workshop was primarily focused on discussing maintaining that resiliency through the TBPP program for critical facilities. The topics that were addressed included the following:

- **Topic 1: Critical Facility Input**
  - o Consideration for providing TBPPs to new critical facilities

This Topic 1 was addressed by two presenters.

Topic 1 discussion centered on creating resiliency hubs.

- **Topic 2: Technology Components and Specifications**
  - o Flexibility in package ranges and component sizing (generator, battery, and panel independently) to accommodate site-specificity and supply chain optimization
  - o Considerations for adaptation to existing backup generator systems
  - o Consideration for electric school buses as a viable TBPP option

This Topic 2 was addressed by eight presenters.

Topic 2 discussion centered on the following:

- Provide flexibility in the specifications.
- Provide flexibility in package sizing.
- School buses should be provided as a mobile power source.
- Can the TBPP be considered as an add-on to a critical facility that already has backup power?
- **Topic 3: Ownership Models and Financing**
  - o Direct ownership by critical facility or provider is the only model allowed in a NOIE (non-opt-in entity)
  - o Alternative ownership models, such as leasing or resiliency-as-a-service, may lower upfront costs for critical facilities to access TBPPs
  - o Critical facilities may not have the expertise to operate and maintain TBPPs, requiring heavier reliance on vendors
  - o Critical facilities may not be able to use loans (due to credit or revenue model) and loans to individual facilities may not benefit from economies of scale for loan size
  - o Alternative revenue streams, including selling ancillary power back to the grid, could reduce overall system costs

This Topic 3 was addressed by eight presenters.

Topic 3 discussion centered on the following:

- In lieu of direct ownership consider lease or lease to own.

- Provide a flexible ownership model with allowed federal tax incentives.
- Desire to have TBPP provide revenue stream to offset capex and cost of ownership.

Summary

Part of the underlying theme of the presenters' comments lost sight of the fact that the current regulations only permit use during a power outage. Islanding operation is a requirement with use of the microgrid in parallel with the electric grid is not permitted.

Presenters all wanted flexibility in what can be provided as part of the TBPP package. The use of the gaseous fueled genset, PV modules and battery storage system was not disputed as the technologies of choice.

Flexibility in methods of ownership was considered as a high priority. Lease or lease to own or other financing models that made the capex and cost of ownership as painless as possible. Vendors that can provide Energy as a Service (EaaS) should be considered as a possible method for the installation and operation as a least cost alternative to the Critical Facility.

Appendix 5

Manufacturers, Suppliers, Vendors

Definitions

Manufacturer: A person or company which produces finished goods from raw materials by using various tools, equipment, and processes, and then sells the goods to consumers, wholesalers, distributors, retailers, or to other manufacturers for the production of more complex goods.

Supplier: A person or organization that provides something needed such as a product or service. They take raw or semi-finished material and manufacture finished goods and services to be sold to vendors.

Vendor: Sellers of finished goods or services that are ready to be used or resold.

Listings

The listings included herein provide examples of manufacturers and suppliers of equipment, and vendors of microgrids appropriate to the requirements of the Texas Backup Power Package Program. The lists are not exhaustive.

Manufacturers

Genset	BESS	PV Modules	Inverters
CAT	Tesla	Canadian Solar	Generac
Cummins/Onan	ABB	Jinko	Fronius
Generac	SolarEdge	JA Solar	Yaskawa Solectria
Jenbacher	Generac	Talesun	SolarEdge
Waukesha		Sungold	SMA
Gillette		Vsun	CPS
Kohler		Trina	Sungold
Mainspring		Boviet	Solis
MasterAire		Hyperion	

Suppliers

CAT	MG All
Cummins/Onan	MG All
Generac	MG All
Jenbacher	MG All
Waukesha	MG All
Gillete	
Kohler	

Motive Energy	BESS
SEL	Protective relaying; microgrid controllers
Mainspring	Genset

Vendors – Furnish, Install and maintain

CAT
Cummins/Onan
Generac
Jenbacher
Waukesha
Gillete
Kohler
PowerSecure
Box Power
Spirae, Inc
Anbaric Development Partners
Texas Microgrid
Schneider Electric
Siemens
Eaton
Exergy Energy
General Electric
ABB
Hitachi Energy, Ltd
Honeywell International Inc
Homer Energy
S&C Electric Co.
Power Analytics Global Corp
Faraday Microgrids
Enchanted Rock Ltd
ELM Microgrid and Solar
Metco Engineering
Total Energy Solutions
RavenVolt
Instant On
TechFlow

Appendix 6 Sizing Tool for End User

Date Submitted ______

SITE ELECTRIC POWER USAGE for TBPP kW SIZING

Applicant/Business Name

______

PUCT Critical Facility Applicant ID#

______

Site/Business Address

Street #1	
Street #2	
Town/City	
State	Texas
Zip Code	

On Site Fuel Availability

Natural Gas	Natural Gas or Propane
2	if Natural Gas, service size, inch (if available)
	MCFH from natural gas bill, if available

Power Usage Information

from Utility Billing (if available)

	kW	kWh
January		
July		

Connected Electrical Load, kW

lighting		
electric heating	Yes	enter yes or no

Appliances	Quantity	Esimated Power Requirement
Washers		
Dryers		
Refrigerators		
Electric Ovens		
Electric Cooktops		
Water Heater		
Sump pumps		
Air Conditioners		

Motors		Operating Voltage
5HP or less		120/208v, 3P

5+hp through 10hp		120/208v, 3P
10+hp through 25hp		120/208v, 3P
greater than 25hp		120/208v, 3P

Special Use Equipment	Power Requirements	Operating Voltage
		120/240v, 1P
		120/208v, 3P
		120/208v, 3P
		120/208v, 3P
		120/208v, 3P
		120/208v, 3P

Enter medical, life safety, other critical care equipment in above list

Building Information

building size	length, ft	depth, ft	ceiling height, ft

multi - story		enter yes or no
if yes, how many		
Are building electrical systems separated into general use and critical use		enter yes or no

Does building currently have