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PROJECT NO. 57236

PROJECT TO DEVELOP THE TEXAS BACKUP POWER PACKAGE PROGRAM	§ § §	PUBLIC UTILITY COMMISSION OF TEXAS

COMMENTS OF GENERAC POWER SYSTEMS, INC ON TEXAS BACKUP POWER PACKAGE PROGRAM VIRTUAL WORKSHOP AGENDA AND RESPONSES TO COMMISSION QUESTIONS

Generac Power Systems, Inc, (Generac) files these comments in response to Commission questions and invitation for public comment in the design and specifications for proposed backup power packages as part of the Texas Energy Fund. As a leading resiliency provider with over 65 years of experience manufacturing and deploying technology solutions for residential and commercial needs alike, Generac offers a comprehensive suite of product offerings providing homes, businesses, communities, and the grid with increased resiliency. Generac is a leader in the residential energy solutions industry with offerings including smart thermostats, EV charging, batteries, load management, and generators. In the commercial sector, Generac offers a complete portfolio of solutions including generators, battery energy storage systems, microgrid controllers, and more. This product suite works together to reinforce the electrical grid and provide backup power in case of outage, ensuring comfort and reliability at homes and businesses, and providing stability to critical facilities throughout the country. Generac appreciates your consideration of the following comments and remains eager to participate in providing critical resilience to Texas facilities under the program.

I. Introduction

The Patrick report shows a high level of work product and consideration throughout, providing a great starting point to understand the technical aspects of the program. Generac does, however, have concerns that the report is overly restrictive in the package designs and exceeds statutory requirements resulting in excessive cost. Uptake may therefore be limited under these proposed designs, particularly for smaller size packages which are likely to encompass most of the critical facilities in the State. To ensure success with this program, we recommend the following for consideration – first, "immediate" should be taken to mean the industry standard of 10 seconds for power to come online after a grid outage. The Patrick report's interpretation of "immediate" to mean instantaneous, uninterrupted, or near-uninterrupted transfer adds significant unnecessary expense. Second, at least one additional option for package offerings should be considered allowing customers to place higher priority on redundancy and immediacy on one side or cost effective and reliable on the other. Third, we recommend that the PUC consider the possibility of load management to optimize package sizing. Fourth, Generac would seek clarity in the ability to combine grants and loans as needed, particularly for smaller projects where economics are more pressing. Finally, we offer opportunities for design optimizations within the technical specifications, further detailed below. These recommendations will allow the program to provide a better fit to customer needs as well as ensure the best use of state funds to provide service for the greatest number of facilities.

II. Responses to Commission Questions.

1. The Final Report outlines specifications for TBPPs of various sizes to serve critical facilities.

    A. How, if at all, could these specifications affect the ability of critical facilities to apply for, install, or utilize TBPPs?

The recommendations in the Patrick Engineering report create unnecessarily expensive packages unduly restricting access and uptake. Patrick Engineering notes in their design assumptions that upon "grid failure there is to be no delay to transfer to backup power bus" and

"BESS kW rating to be 100% of anticipated CF kW rating." In line with this assumption, Patrick Engineering sized the battery to the facility peak and equivalent to generator size behind an emergency automatic transfer switch to enable immediate islanding. Under this design presumption, the automatic transfer switch opens when power from the grid is interrupted and the battery immediately picks up the facility load until the generator comes online. The generator takes the load in this scenario from the battery within 10 seconds. Under the statute "immediate islanding" is not defined. In our 65 years of experience working with customers we have found that most customers neither need nor value the level of full site immediacy that is included in Patrick Engineering's specifications. Generac recommends optionality for this reason to allow customers to determine the level of immediacy required for their facility in addition to the proposed package solutions in the Patrick Engineering report.

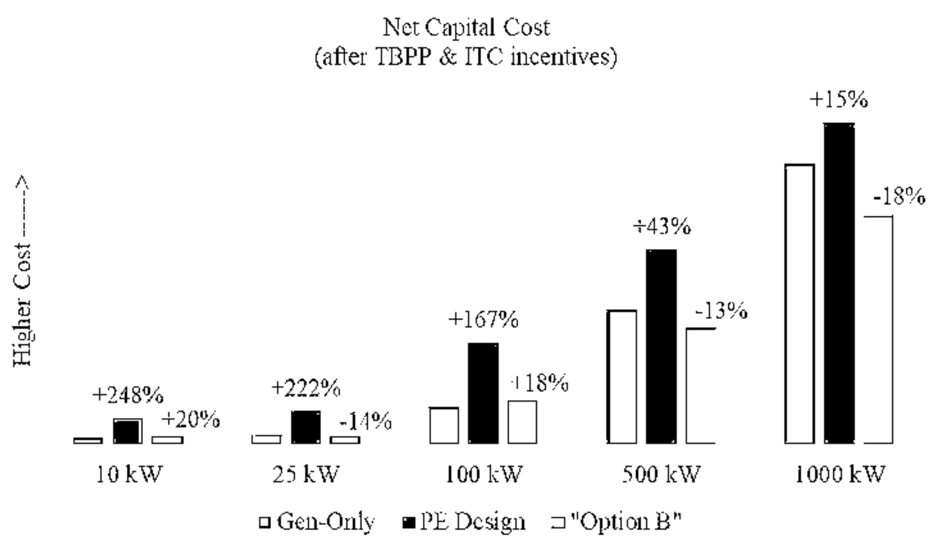
B. How, if at all, should the outlined specifications for TBPP packages be modified to ensure that the packages can serve most critical facilities in Texas?

Generac proposes three categories of modifications to ensure that the packages can serve most critical facilities in Texas. First, an additional variety of the proposed designs should be made available with decreased sizes for battery and solar but the same size as proposed for the generator. Second, provide clarity on system paralleling consistent with statute. Lastly, allow for ground mount or roof mount solar in all packages. Each of these suggestions will be discussed below.

Patrick Engineering's first report noted that approximately 60% of the eligible critical facilities are rated at 75kW or less. For this size range and larger, in most cases, customers are familiar and comfortable with a 10 second outage as the backup system comes online. We propose that in addition to the designs proposed in the report, an additional variety of those designs be made available with the same generator sizes but with a battery and solar configuration smaller than

Patrick Engineering's proposal. This would reduce cost by a material amount while increasing product/market fit and maintains the 3-asset requirements of the program. The PUCT could maintain the designs proposed by Patrick Engineering for customers that require high resiliency and add additional variants of those designs for customers who do not value near-immediate transfer. In Appendix A we have included a revised SLD and sequence of operation for such an alternative, which for example purposes we have labeled as "Option B".

As summarized in the chart below, Generac anticipates that a generator-only solution (in blue) will be a lower cost alternative than any system designed according to the specifications in the Patrick report (in red), even after accounting for the available backup power package incentive and any available Federal Investment Tax Credit (ITC). By contrast, the "Option B" (in green) provides a package conforming specification which, in many cases, is competitive with or is more financially attractive than a generator-only purchase.

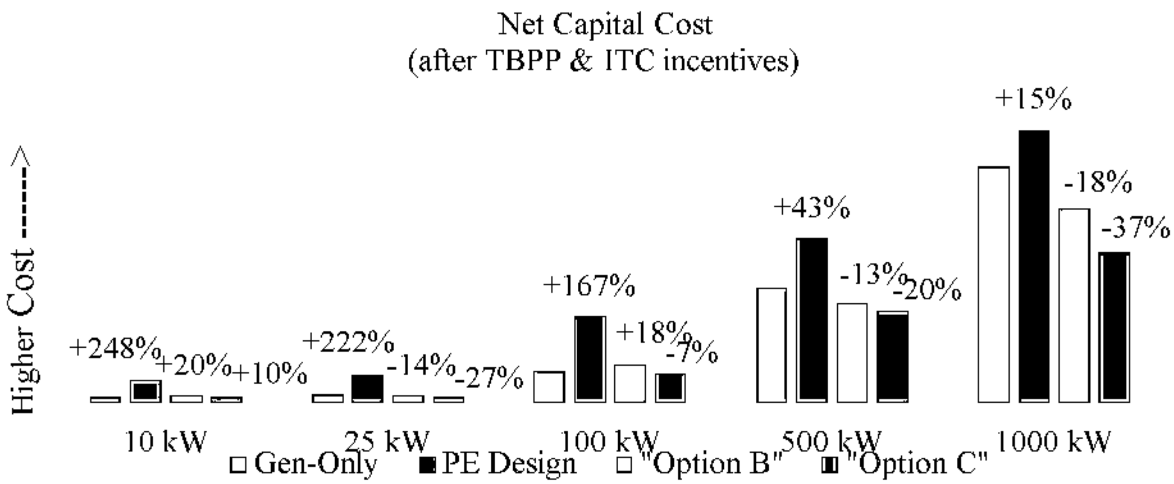


Percentages in the chart are in comparison to "Gen-Only" cost. The guidelines of the legislation will be met under the "Option B" proposal at reduced cost which is competitive or in some cases more competitive (after incentives) when compared to buying a natural gas engine alone.

Further considerations for the proposed "Option B" configuration include the following:

- Consistent with Patrick Engineering's proposed design, the solar continues to serve only to charge the battery and Aux Gen.
- During any grid outage event, the generator will start up and take load within 10 seconds. The battery and solar will then come online to supplement.
- The required square footage for solar would be reduced by approximately 50% under this proposal.
- In this design revision, if the generator has a failure, the battery can provide redundancy up to its capacity. The customer can either manually shed load or automate the process with an appropriate microgrid controller with automated load control capability to not exceed battery capacity. We provide additional details in Appendix B.
- Additional savings are available from specifying an ATS instead of a much more expensive STS as recommended by Patrick Engineering. In addition, the SEL 751 Relay and Automated Main Breaker may not be necessary in the "Option B" configuration. ATS specifications have been provided in the Appendix.
- Savings will further result from downsizing the switchboard with lower BESS/PV

Generac also evaluated an "Option C", below, which reduces the battery and solar further to ¼ of the report's recommendation. Percentages are in relation to "Gen-Only" cost.



Second, the Patrick Engineering report affirmatively offers that, "current regulations only permit use during a power outage. Islanding is a requirement with the use of the microgrid with use of the microgrid in parallel with the electric grid is not permitted." (Appendix 4, p. 51). This is incorrect. SB2627 does not address paralleling with the utility. Interconnection and controls technology must enable immediate islanding in addition to making it clear that the sale of energy or ancillary services to the grid are not permitted. It is reasonable to interpret this clause to mean parallelling with the utility is permissible while paralleling and exporting is not. The report's proposed design does not allow any parallelling with the utility and specifies an emergency ATS (rapid STS) with a battery that is unnecessarily oversized. The PUCT here should interpret the legislation in such a way as to allow flexibility for the proposed design in the report, our proposed options as alternatives, and/or to permit customers to pursue utility interconnection for parallelling.

Finally, the legislation lists solar as part of the system; however, we are unclear why the proposed system designs in the report specify that the solar needs to be ground mount and rooftop is only permissible for small systems. We understand the report's rationale for PV sizing, but if the customer is best served with a rooftop system, there doesn't appear to be any reason to limit that option to "small customers".

2. The Final Report provides a list of potential vendors for the TBPP program.

A. What factors, if any, could affect the ability of such vendors to assist with the sale, installation, operation, and ongoing maintenance of TBPPs?

In reviewing the report's detailed specification documents, the following technical requirements are overly prescriptive and may be favorable to only a few select vendors. Generac is available to provide further insight into our technical view of designing integrated and packaged systems to meet specified levels of AC power requirements.

1. DC Bus Voltage Range – specified at 600-900VDC. This is too prescriptive and providers are required to provide expected AC power output at required voltage and kW power level. We recommend this range be removed and allow battery manufacturers to determine their best battery configuration.
2. Overload Capability – This is overly prescriptive given the microgrid controller can instruct load management. If the generator and battery are in parallel operation, the generator can take the bulk of the load while the battery handles transient peaks. The providers need to have flexibility to work with the end user to meet their requirements.
3. K. Power conversion system – Item 8.a. UL1741CRD is mainly CA specific. We believe this is not always necessary, particularly if the systems are not grid tied.
4. Prescribed Ambient Temperature range is overly prescriptive. Manufacturers will provide systems which can meet the tolerances of a given geography and warranty the system within the appropriate range.

5. Item L "Batteries" – Cell and Module Capacity, Nominal Energy, and Voltage Range are too prescriptive. Energy output (AC requirements) is the meaningful factor and manufacturers need to solve capacity, energy, and range in a manner which meets the energy requirement.
6. Item L "Batteries" – C-Rate listed here as 0.5C, but from the other documentation we believe C-Rate should be listed as 1C capable. We request clarification here.
7. Combining packages to meet customer requirements/peak demand is not technically or financially efficient. If customer is 600kW demand, provide a system to meet the requirement, versus coupling a 100kW TBPP with a 500kW TBPP etc. We do not suggest adding additional package sizes to the report recommendation, rather creating an option for the provider to supply a package to the customer which meets the technical requirements of the program when the combination of approved package sizes would result in an inferior outcome.

3. In Sections 2-4 and 2-5, the Final Report outlines design requirements and assumptions; technology specifications; operating sequences; and installation requirements.

A. How, if at all, could the specifications described in these sections affect implementation of the TBPP program?

These specifications are overly prescriptive – see specific technical feedback provided earlier. See also proposed "Option B" package configuration provided earlier, and revised technical spec and operating sequences for "Option B" in Appendix A.

B. How, if at all, should the specifications be modified to ensure effective implementation of the TBPP program?

Again, these specifications are overly prescriptive – see specific technical feedback provided earlier. See also proposed "Option B" package configuration provided earlier, and revised technical spec and operating sequences for "Option B" in Appendix A.

4. How should the TBPP be designed to mitigate or remedy any other factors that could negatively affect program implementation or participation, while ensuring compliance with statutory requirements?

SB2627 allows for the combination of grants and loans. This opportunity should be developed further if needed. The PUCT should also develop and maintain a consolidated list of additional funding sources available in the State. Finally, while legislation is clear that a system must be able to operate for 48 hours without refueling, some eligible critical facilities are limited in their ability to access piped natural gas because of conflicting regulations. This conflict should be investigated and clarified to ensure that backup power is accessible through the program for all critical facilities.

III. Executive Summary

The Patrick Engineering Report provides significant technical guidance for the implementation of the Backup Power Package program under SB2627. The proposed designs, however, result in packages that are unnecessarily expensive and too restrictive for most use cases. Generac Power Systems recommends modifications to their proposal that will dramatically increase accessibility of the program for critical facilities across the State. Those changes, broadly, are the following:

1. Allow for an industry standard 10 second startup time for on-site generation. This will allow for the right-sizing of all three assets, eliminate the need for some more expensive components, and provide a reliable and affordable solution for critical facilities under the program.
2. Allow for an additional package category for individually designed solutions that meet the program requirements but for either space, power, or other needs, do not fit easily into the predetermined package sizes.
3. Allow providers greater flexibility in providing technical components according to site requirements and manufacturer capabilities.

Generac is eager to participate in this program and believes it to be an excellent template for the rest of the nation to follow to ensure critical facilities are able to stay online in the case of an outage. We have provided technical appendices and details throughout and are available for additional information or clarification as needed.

IV. Conclusion

Generac appreciates the opportunity to contribute to the development of the Backup Power Package program and looks forward to continuing our engagement. We are excited about the potential of this program to provide robust support to Texas' reliability landscape, and we are eager to contribute our technologies and expertise towards realizing this potential. Please do not hesitate to contact me at Meredith.Roberts@generac.com with any questions about our recommendations.

Thank you for your consideration of our questions and comments.

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Via electronic submission.

GNRC TBPP Option B: Generac Proposed Adjustments for Improved Package Cost and Market Fit

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 transfer of power to TBPP at time of grid failure within 10 seconds.
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 minimal delay to transfer to backup power bus.
   a. Genset to pick up Critical Facility load within 10 seconds.
   b. BESS and Solar brought online to load share with generator
2. Genset and BESS to share load.
   a. BESS kW rating to be 50% of anticipated CF kW rating with production capacity sizing at 1 hour (shown in Table 5 below):
      i. 10kW TBPP - BESS = 5kW/5kWh
      ii. 25kW TBPP - BESS = 12.5kW/12.5kWh
      iii. 100kW TBPP - BESS = 50kW/50kWh
      iv. 500kW TBPP - BESS = 250kW/250kWh
      v. 1000kW TBPP - BESS = 500kW/500kWh
   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 BESS rating. See revised Table 3 below.

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.

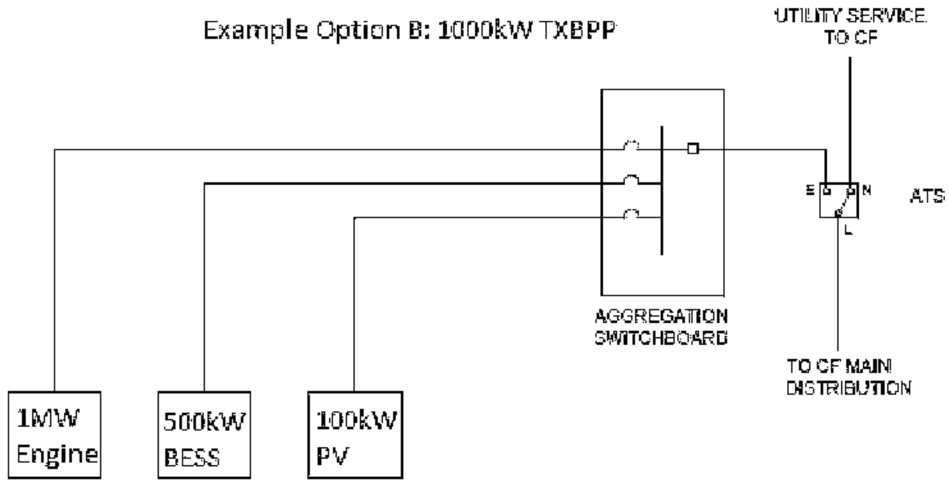
Table 3: TBPP Technology capacity summary (Generac Option B)

V1 1/2 BESS/Solar									
TBPP size kW	**Genset capacity kW**	**BESS capacity kW/kWh**	**DC/AC Ratio Solar**	**Solar % of BESS**	**Solar capacity kW DC**	**SQ Ft**	**Solar Modules**	**Car Spaces**	**BESS Recharge Time**
10	10	5	1.25	16%	1	47.8	2	0.24	6 Hours
25	25	12.5	1.25	16%	2.5	119.5	5	0.6	6 Hours
100	100	50	1.25	16%	10	478	20	2.4	6 Hours
500	500	250	1.25	16%	50	2390	100	12	6 Hours
1000	1,000	500	1.25	16%	100	4780	200	24	6 Hours

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

GNRC Option B SLD (1000kW Package Example):



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.

<u>OPERATING SEQUENCES</u> – GNRC Option B Package

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:
      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 or roof mounted depending on best techno/financial solution
      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).
         7. Solar curtailed via controller if Gen Aux Power and BESS at full SOC

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.
      i. Generator picks up CF load in its entirety with minimal power interruption (10 seconds) to CF power services.

ii. ATS transfer time is set to zero second delay.

b. BESS and genset share CF load based on control programming.

c. Genset:

i. ATS operates separating CF from grid.

ii. Genset signaled to start from ATS.

iii. Generator output reaches voltage and frequency to form grid.

iv. Synchronization check signals generator circuit breaker to close.

v. Genset on CF system within 10 seconds of grid failure.

d. BESS:

i. BESS brought online and synchronizes to gen.

ii. Synchronization check signals BESS circuit breaker to close.

iii. BESS shares loads with Engine

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. BESS enters standby mode.

b. Genset receives shutdown signal, switches to cool down mode and switches off.

c. ATS recloses for grid to provide power to CF.

d. Loads are then transferred to utility.

e. BESS brought online and returns to charge mode.

<u>BPP INSTALLATION REQUIREMENTS</u>

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

GNRC Comment: In the revised design recommendation, "immediate" does not need to mean "instant". Generator can provide full site backup and revised BESS can supplement.

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	GNRC Comment: Cost is high and most of market does not value this level of immediate islanding	X		
		BESS is rated for less than building full load	GNRC Comment: Cost is much improved and better product/market fit	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		

GNRC TBPP Option B: Generac Proposed Adjustments for Improved Package Cost and Market Fit

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

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2. Must use solar with batteries.
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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~~TBPP at time of grid failure~~.~~
   ~~b.~~a. ~~This transfer could be delayed to prevent rapid cycling in the event of short interval intermittent grid failures.~~ within 10 seconds.
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~~minimal delay to transfer to backup power bus.
    ~~a. BESS~~Genset to pick up Critical Facility load ~~immediately.~~
    ~~b.~~a. ~~Genset to start after~~within 10 ~~second delay~~seconds.
    b. BESS and Solar brought online to load share with generator
2. Genset and BESS to share load.
    a. BESS kW rating to be ~~100~~50% of anticipated CF kW rating with production capacity sizing at 1 hour (shown in Table 5 below):
        i. 10kW TBPP - BESS = ~~10kW/10kWh~~5kW/5kWh
        ii. 25kW TBPP - BESS = ~~25kW/25kWh~~12.5kW/12.5kWh
        iii. 100kW TBPP - BESS = ~~100kW/100kWh~~50kW/50kWh
        iv. 500kW TBPP - BESS = ~~500kW/500kWh~~250kW/250kWh
        v. 1000kW TBPP - BESS = ~~1000kW/1000kWh~~500kW/500kWh
    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~~BESS rating. See revised Table 3 below.
   ~~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 (Generac Option B)

V1 1/2 BESS/Solar									
TBPP size kW	Genset capacity kW	BESS capacity kW/kWh	DC/AC Ratio Solar	Solar % of BESS	Solar capacity kW DC	SQ Ft	Solar Modules	Car Spaces	BESS Recharge Time
10	10	~~10~~ 5	1.25	16%	1	47.8	2	0.24	6 Hours
25	25	12.5	1.25	16%	2.5	119.5	5	0.6	6 Hours
100	100	~~100~~ 50	1.25	16%	10	478	20	2.4	6 Hours
500	500	~~500~~ 250	1.25	16%	50	2390	100	12	6 Hours
1000	1,000	500	1~~,000~~ .25	16%	100	4780	200	24	6 Hours

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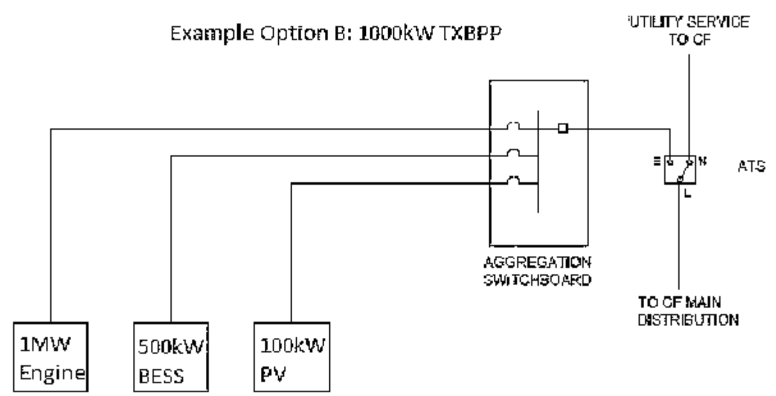
Table 4: Propane tank sizing examples

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

GNRC Option B SLD (1000kW Package Example):



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 – GNRC Option B Package

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).
      iii. 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:
   e. Solar:
      i. Ground mounted – or roof mounted depending on best techno/financial solution

- 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).
  7. 6. 7. Solar curtailed via controller if Gen Aux Power and BESS at full SOC

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.
  - i. Generator picks up CF load in its entirety with minimal power interruption (10 seconds) to CF power services.
  - ii. ATS transfer time is set to zero second delay.
- b. BESS and genset share CF load based on control programming.
- ~~c. BESS:~~
- c. Genset:
  - 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.~~i. ~~ATS transfer time is set to zero second delay.~~
- ~~d.~~a. ~~Genset:~~
  - ~~i.~~ii. ~~Signaled~~Genset signaled to start from ATS.
  - ~~ii.~~ Generator output reaches voltage and frequency~~.~~
  - iii. ~~Genset synchronizes~~ to ~~BESS~~form grid.
  - iv. Synchronization check ~~signal~~signals generator circuit breaker to close.

v. ~~v. ATS puts genset~~ Genset on CF system within 10 seconds of grid failure.

d. BESS:

i. BESS brought online and synchronizes to gen.

ii. Synchronization check signals BESS circuit breaker to close.

iii. BESS shares loads with Engine

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. BESS enters standby mode.

~~a.~~ b. Genset receives shutdown signal, switches to cool down mode and switches off.

~~b. BESS remains powering CF until signaled to switch back to utility grid by ATS.~~

~~c. BESS maintains CF load during genset shutdown cycle.~~

~~d.~~ c. ~~BESS verifies synchronization with grid,~~ ATS recloses for grid to provide power to CF.

d. Loads are then transferred to utility.

e. BESS ~~stays~~brought online and returns to charge mode.

BPP 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

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		

GENERAC | LINK

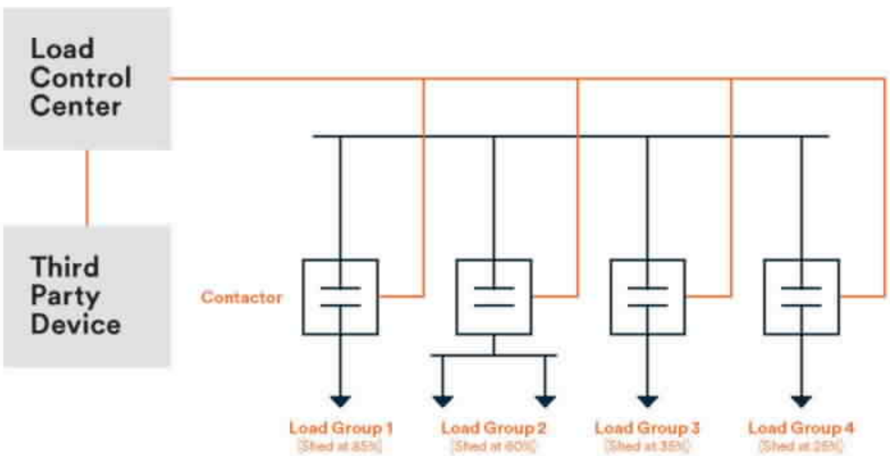
Microgrid Load Control Center

The Load Control Center (LCC) is a flexible load control solution designed to extend battery life during grid outages. Manage up to four load groups at different state-of-charge limits easily configurable in the ARC user interface. Send configurable discrete signals to third-party devices to indicate system status (ie. grid failure, excess solar production, etc)

ARC and ARC Pro seamlessly integrates with the LCC, allowing for finer control of your system load groups.

Features

- Up to four load groups
- Up to two additional discrete signals useful for interaction with:
  - Building automation systems
  - Demand response programs
  - Other third party devices
- Load priority management through ARC controller
- Streamlined installation



"I got lucky and found Generac Link (formerly Ageto) before I found anybody else."

– Jeff Richardson, Owner, CPM Design and Construction

	Load Control Center (LCC)
CABINET DATA	
External Dimensions (height x width x depth)	277 mm x 239 mm x 185 mm (10.5" x 9.4" x 7.3")
Mounting Dimensions (height x width)	273 mm x 152 mm (10.75" x 6")
Mounting Style	Wall-mount
Certifications	UL 508A
NEMA Rating	NEMA 4
Weight	4.5 kg (10 lb)
POWER SUPPLY	
Voltage	24 VDC
Frequency	Not applicable
Current Requirement	2 A
Wire Gauge	16 AWG
CLIMATE LIMIT	
Operating Temperature Range	-10 to +60°C (+14 to +140°F)
Humidity	5 - 95% RH (non-condensing)
Altitude Limit	4000 m (13,123 ft)
COMMUNICATION	
External Communication Interfaces	Modbus TCP
INPUT/OUTPUT RATINGS	
Digital Inputs	0 VDC, Quantity (6)
Relay Outputs	6 A, 250 VAC (Form C), Quantity (6)

GENERAC

TX301 Series Transfer Switch

800 — 1000 Amps

Service Entrance Rated ·Contactor Type ·Closed Transition

- Automatic Transfer Switch
- 800 – 1000A up to 600V VAC, 60 Hz, 100% current rated
- Single or Three Phase
- 2, 3, or 4 Poles
- NEMA 1 or 3R
- Closed Transition
- ETL Listed to UL 1008
- High Withstand and Closing Ratings

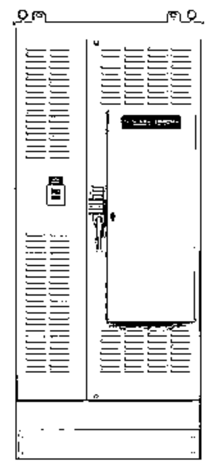


Image used for illustration purposes only

Codes and Standards

Not all codes and standards apply to all configurations. Contact factory for details.

cETL Listed

NFPA 70, 99, 110

NEC 700, 701, 702, 708

Description

Generac's patented* closed transition contactor type transfer switches are double-throw robust switch construction with inherent interlocks for safe positive transfer between power sources. The contacts are silver composite for long life, resisting pitting or burning. The switches are rated for full load transfers in mission critical, emergency, legally required, and optional power systems.

The microprocessor based controller provides the customers with the flexibility to program a comprehensive group of set points to match the application needs. The controller has two programmable inputs and one programmable output as standard and is available with an optional expansion board for up to four programmable inputs and outputs. The LCD displays real time and historical information with time-stamped events. The integrated plant exerciser can be configured in off, daily, day of week, biweekly, and monthly intervals with user selectable run time. Standard features of the controller include three phase sensing on both sources, phase unbalance, phase reversal, load shed, emergency inhibit, and communications.

*Patent Number: US 11,616,386 B2

TX301 Series Transfer Switch

800 — 1000 Amps

Service Entrance Rated ·Contactor Type ·Closed Transition

STANDARD FEATURES

GENERAL

- Floor Mounted, Wall Secured
- Cable Entry is Top or Bottom
- Double-Throw, Stored Energy Transfer Mechanism
- Can be Electrically Isolated while Energized
- Graphical LCD-Based Display for Programming, System Diagnostics and Help Menu Display Mimic
- Diagram with Source Available and Connected
- Method of Transfer: Closed Transition
- Mechanically Interlocked to Prevent Connection of Both Sources
- Modbus® RTU
- TXC 100 Controller
- Operating Temperature -4 ° to 158 °F (-20 ° to 70 °C)
- Removable Top and Bottom Plates for Ease of Entry
- Voltage Agnostic*
- High Withstand and Closing Ratings
- Heater Kit Standard on All 3R Enclosures
- Auxiliary Input Includes: Permissive Inputs (24VDC)
- General Alarm Indication
- Expandable Input/Output Board Module Includes: 4 Relay Outputs and 4 Optically Isolated Inputs
- 2 Year Standard Warranty

VOLTAGE AND FREQUENCY SENSING

- Three Phase Under and Over Voltage Sensing on Normal and Emergency Sources
- Under and Over Frequency Sensing on Normal and Emergency
- Selectable Settings: Single or Three Phase Voltage
- Sensing on Normal and Emergency 60 Hz
- Phase Sequence Sensing for Phase Sensitive Loads

START CIRCUIT

- 2-wire Start
- 3-wire Start from C Contact for Circuit Monitoring

DIGITAL OUTPUTS

- Switch Position Indication (2 Form C)
- Signal Before Transfer (Elevator)
- General Alarm

DIGITAL INPUTS

- Emergency Inhibit (Permissive & Load Shed)
- Go to Emergency
- Manual Generator Retransfer

CONTROLS

- Front Programmable Control Reduces PPE Needs and Arc Flash Hazard
- Built in Battery Backup – Increases Switch Reliability and Reduces Switch Transition Time to Alternate Source
- Battery Backup Able to Power the Controller for up to 60 Minutes in the Event of No Source Availability
- Generator Battery Backup for Controller
- Accessible USB Port for Easy Data Downloads, Firmware Updates without Requiring PPE, Reducing the Risk of Arc Flash
- All Amp Nodes Offered with Delayed Transition
- Heater Programmable through Control for Desired Temperature and Humidity Settings
- Front Accessible Customer Connections
- Time-Stamped Event History Log
- Programmable Exerciser – Daily, Weekly, Biweekly, Monthly

* 480 V 3-Wire Systems and all 600 V systems must be specified at time of ordering for Transformer Kit to be included

AVAILABLE OPTIONS

- Remote Annunciator
- 3R Padlockable Cover for Controller (Standard on 3R Enclosure)
- CTs for Integrated Metering
- Heater Option for Temperature and Humidity Control (Standard on 3R Enclosure)
- Expandable Input/Output Board Module Includes: 4 Relay Outputs and 4 Optically Isolated Inputs
- Kickplate Kit
- Lug Kit for up to 750 MCM Cables
- 2 Year Extended Limited Warranty
- 5 Year Basic Limited Warranty
- 5 Year Extended Limited Warranty
- 7 Year Extended Limited Warranty
- 10 Year Extended Limited Warranty

ENGINEERED OPTIONS

- Transient Voltage Surge Suppressor (TVSS)
- Manual Generator Retransfer Switch
- Go to Emergency Switch

CONVERSION KITS

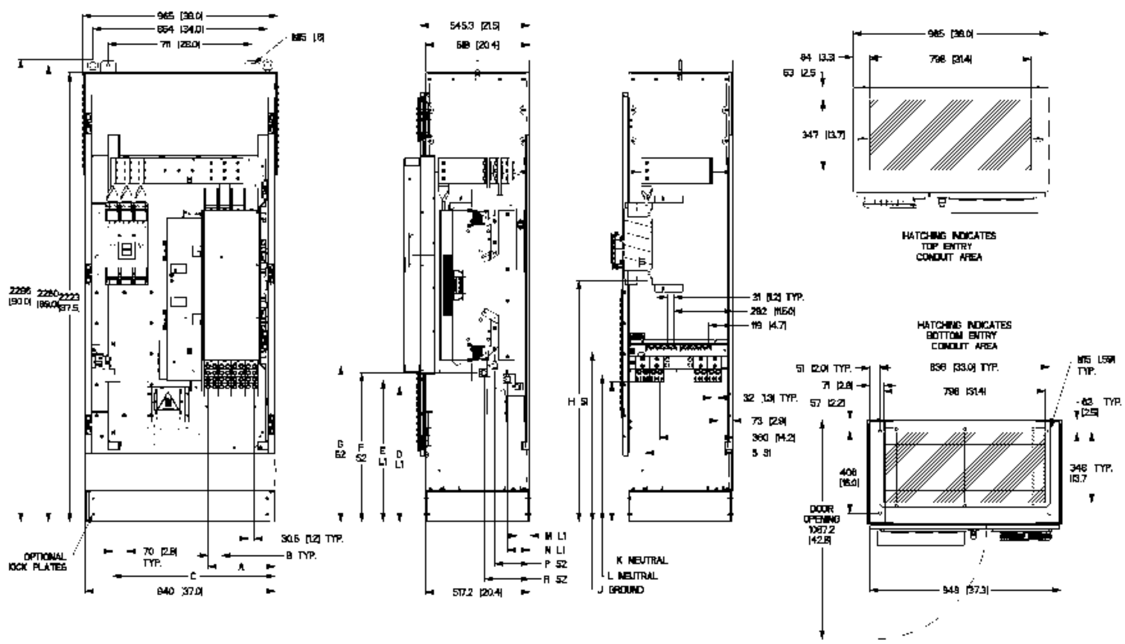
- 480 V Transformer Kit for 3-Wire Systems
- 600 V Transformer Kit

TX301 Series Transfer Switch

800 — 1000 Amps

Service Entrance Rated ·Contactor Type ·Closed Transition

UNIT DIMENSIONS*



Service Entrance Rated, Contactor Type, Closed Transition, 800 - 1000 A, Type 1 or 3R					
Description		800A 2 & 3 Pole	800A 4 Pole	1000A 2 & 3 Pole	1000A 4 Pole
in (mm)	A (Dim)	13.0 (331)	13.0 (331)	13.0 (331)	13.0 (331)
	B (Dim)	2.6 (66)	2.6 (66)	2.6 (66)	2.6 (66)
	C (Dim)	31.7 (805)	31.7 (805)	31.7 (805)	31.7 (805)
	D (Dim)	26.4 (669)	26.4 (669)	26.4 (669)	26.4 (669)
	E (Dim)	27.3 (703)	27.3 (703)	27.3 (703)	27.3 (703)
	F (Dim)	29.0 (736)	29.0 (736)	29.0 (736)	29.0 (736)
	G (Dim)	30.3 (770)	30.3 (770)	30.3 (770)	30.3 (770)
	H (Dim)	47.1 (1195)	47.1 (1195)	47.1 (1195)	47.1 (1195)
	J (Dim)	33.1 (841)	33.1 (841)	33.1 (841)	33.1 (841)
	K (Dim)	27.2 (691)	27.2 (691)	27.2 (691)	27.2 (691)
	L (Dim)	28.6 (726)	28.6 (726)	28.6 (726)	28.6 (726)
	M (Dim)	2.4 (62)	2.4 (62)	2.4 (62)	2.4 (62)
	N (Dim)	4.4 (111)	4.4 (111)	4.4 (111)	4.4 (111)
	P (Dim)	6.9 (175)	6.9 (175)	6.9 (175)	6.9 (175)
	R (Dim)	8.9 (175)	8.9 (175)	8.9 (175)	8.9 (175)
	S (Dim)	17.0 (432)	17.0 (432)	17.0 (432)	17.0 (432)

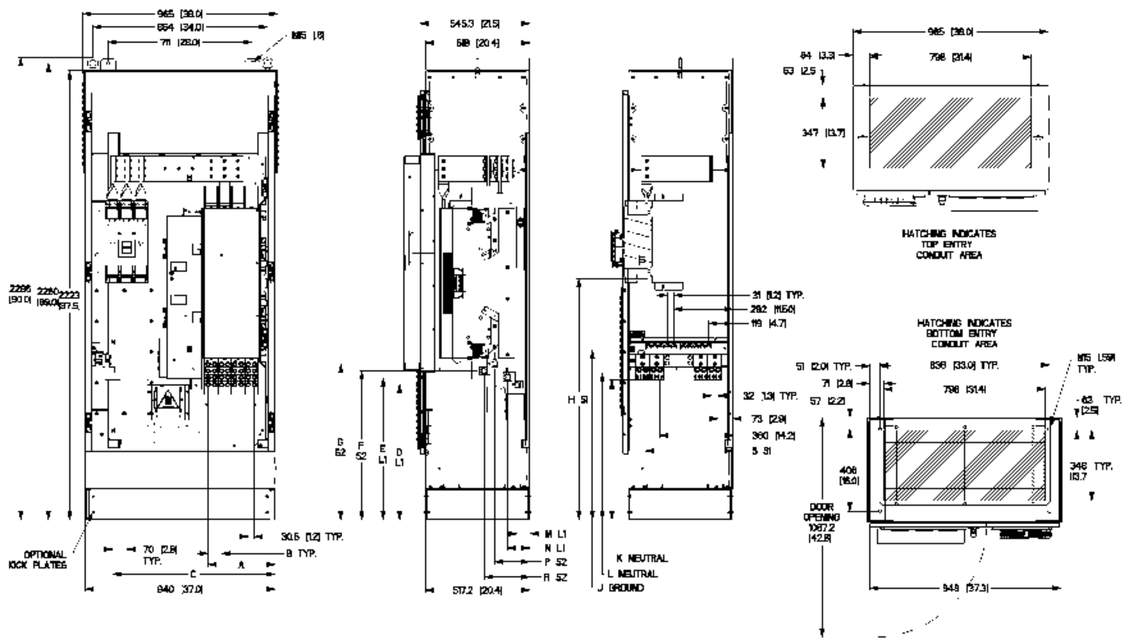
* All measurements are approximate and for estimation purposes only. Specification characteristics may change without notice. Please contact a Generac Power Systems Industrial Dealer for detailed installation drawings.

TX301 Series Transfer Switch

800 — 1000 Amps

Service Entrance Rated ·Contactor Type ·Closed Transition

UNIT DIMENSIONS*



Service Entrance Rated, Contactor Type, Closed Transition, 800 - 1000 A, Type 1 or 3R					
Description		800A 2 & 3 Pole	800A 4 Pole	1000A 2 & 3 Pole	1000A 4 Pole
Cu/Al	Normal 75 °C Wire**	(4) 500 - 4/0	(4) 500 - 4/0	(4) 500 - 4/0	(4) 500 - 4/0
	Normal Wire Lug Torque lb/in (Nm)	375 (42.4)	375 (42.4)	375 (42.4)	375 (42.4)
	Standby/Load Source 75 °C Wire	(4) 750 - 4/0	(4) 750 - 4/0	(4) 750 - 4/0	(4) 750 - 4/0
	Standby/Load Wire Lug Torque lb/in (Nm)	620 (70)	620 (70)	620 (70)	620 (70)
	Neutral Connection	(16) 750–1/0	(16) 750–1/0	(16) 750–1/0	(16) 750–1/0
	Neutral Wire Lug Torque lb/in (Nm)	500 (56.5)	500 (56.5)	500 (56.5)	500 (56.5)
	Ground Connection	(10) 600–4 or (20) 250–1/0	(10) 600–4 or (20) 250–1/0	(10) 600–4 or (20) 250–1/0	(10) 600–4 or (20) 250–1/0
	Ground Wire Lug Torque lb/in (Nm)	375 (42.4)	375 (42.4)	375 (42.4)	375 (42.4)
lbs (kg)	Weight	2–Pole: 840 (381) 3–Pole: 915 (415)	990 (449)	2–Pole: 840 (381) 3–Pole: 915 (415)	990 (449)

UL 1008 Withstand and Closing Ratings		
Ampere Rating	Service Entrance (kA)	Voltage (V)
800	100	Up to 480
800	65	Up to 600
1000	100	Up to 480
1000	65	Up to 600

* All measurements are approximate and for estimation purposes only. Specification characteristics may change without notice. Please contact a Generac Power Systems Industrial Dealer for detailed installation drawings.
** Optional Lug Kit available (3) 500 - 750 MCM; Torque: 450 in-lb (50.8).

Part No. A0002846632
Rev. C 1/19/2024

TX301 Series Transfer Switch

100 – 400 Amps

Contactor Type - Open and Delayed Transition - Service Entrance Rated

GENERAC | INDUSTRIAL

- Automatic Transfer Switch
- 100 – 400 A, up to 480 VAC, 60 Hz, 100% Current Rated
- Single or Three Phase
- 2, 3, or 4 Poles
- UL Type 1 or Type 3R
- Open and Inphase or Open with Delayed Transition
- ETL Listed to UL 1008
- High Withstand and Closing Ratings

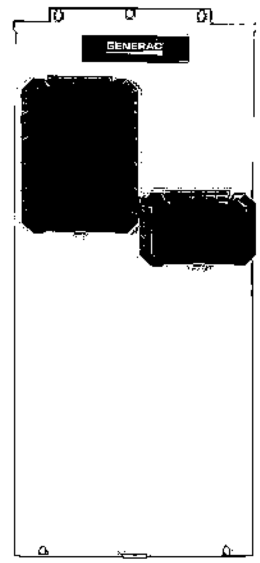


Image used for illustration purposes only

Codes and Standards

ETL Listed

NFPA 70, 99, 110

NEC 700, 701, 702, 708

OSHPD and Seismic Certified CBC 2019, CBC 2016, IBC 2018, IBC 2015, IBC 2012, IBC 2009, ASCE 7-10, ASCE 7-16, ICC-ES AC-156

Description

Generac's patented* contactor is featured in the TX contactor type transfer switch, which is a double-throw robust switch construction with inherent interlocks for safe positive transfer between power sources. Featuring a transition time of less than 20 milliseconds, this high speed transfer is ideal for all applications, including motor load applications. The contacts are silver composite for long life, resisting pitting or burning. The switches are rated for full load transfers in mission critical, emergency, legally required, and optional power systems.

The microprocessor based controller provides the customers with the flexibility to program a comprehensive group of set points to match the application needs. The controller has two programmable inputs and one programmable output as standard and is available with optional expansion boards for up to four programmable inputs and outputs. The LCD displays real time and historical information with time-stamped events. The integrated plant exerciser can be configured in off, daily, day of week, biweekly, and monthly intervals with user selectable run time. Standard features of the controller include three phase sensing on both sources, phase unbalance, phase reversal, load shed, emergency inhibit, and communications.

*Patent Number: US 11,227,728 B2

TX301 Series Transfer Switch

100 – 400 Amps

Contactor Type - Open and Delayed Transition - Service Entrance Rated

GENERAC INDUSTRIAL

STANDARD FEATURES

GENERAL

- Small Footprint, Results in Easy Mounting and Installation for Reduced Time and Costs
- Cable Entry is Top or Bottom (400A Units are Bottom Only)
- Double-Throw, Stored Energy Transfer Mechanism
- Can be Electrically Isolated while Energized
- Graphical LCD-Based Display for Programming, System Diagnostics and Help Menu Display Mimic
- Diagram with Source Available and Connected LED Indicator
- Method of Transfer: Open with Inphase Transition
- Mechanically Interlocked to Prevent Connection of Both Sources
- Modbus® RTU Communications
- TXC 100 Controller
- Operating Temperature -4 ° to 158 °F (-20 ° to 70 °C)
- Removable Top and Bottom Plates for Ease of Entry
- Voltage Agnostic*
- High Withstand and Closing Ratings
- Heater Kit Standard on All 3R Enclosures
- Auxiliary Output Includes: Two Wire Start, Signal Before Transfer, Fault, and a Programmable Relay Output
- Auxiliary Input Includes: Permissive Inputs (24 VDC)
- General Alarm Indication
- 2 Year Standard Warranty
- IBC 2018, 2015, 2012, 2009

VOLTAGE AND FREQUENCY SENSING

- Three Phase Under and Over Voltage Sensing on Normal and Emergency Sources
- Under and Over Frequency Sensing on Normal and Emergency
- Selectable Settings: Single or Three Phase Voltage
- Sensing on Normal, Emergency and Load 60 Hz
- Phase Sequence Sensing for Phase Sensitive Loads

Start Circuit

- 2-Wire Start
- 3-Wire Start From C Contact for Circuit Monitoring

Digital Outputs

- Signal Before Transfer (Elevator)
- General Alarm

Digital Inputs

- Emergency Inhibit (Permissive & Load Shed)
- Go to Emergency (Demand Response)
- Manual Generator Retransfer

CONTROLS

- Front Programmable Control Reduces PPE Needs and Arc Flash Hazard
- Built in Battery Backup - Increases Switch Reliability and Reduces Switch Transition Time to Alternate Source
- Battery Backup Able to Power the Controller for up to 60 Minutes in the Event of No Source Availability
- Accessible USB Port for Easy Data Downloads, Firmware Updates without Requiring PPE, Reducing the Risk of Arc Flash
- All Amp Nodes Offered with Delayed Transition
- Heater Programmable through Control for Desired Temperature and Humidity Settings
- Front Accessible Customer Connections
- Time-Stamped Event History Log
- Programmable Exerciser - Daily, Weekly, Bi-Weekly, Monthly

* 480 V 3-Wire Systems Must be Specified at Time of Ordering for Transformer Kit to be Included

CONFIGRUABLE OPTIONS

- Chicago Code Kit
- 3R Padlockable Cover for Controller (Standard on 3R Enclosure)
- 3R Padlockable Cover for Service Entrance Breaker (Standard on 3R Enclosures)
- CTs for Integrated Metering
- Generator Battery Backup for Controller
- Heater Option for Temperature and Humidity Control (Standard on 3R Enclosure)
- Time Delay in Neutral Transition (TDN), or Inphase with a Default to Time Delay in Neutral Transfer
- Expandable Input/Output Board Module Includes: 4 Relay Outputs and 4 Optically Isolated Inputs
- IBC Seismic Certified/Seismic Rated
- 2 Year Extended Limited Warranty
- 5 Year Basic Limited Warranty
- 5 Year Extended Limited Warranty
- 7 Year Extended Limited Warranty
- 10 Year Extended Limited Warranty

Engineered Options

- Transient Voltage Surge Suppressor (TVSS)
- Manual Generator Retransfer Switch
- Go to Emergency Switch

Conversion Kits

- 480 V Transformer Kit for 3-Wire Systems
- UL Type 1 to Type 3R Kit

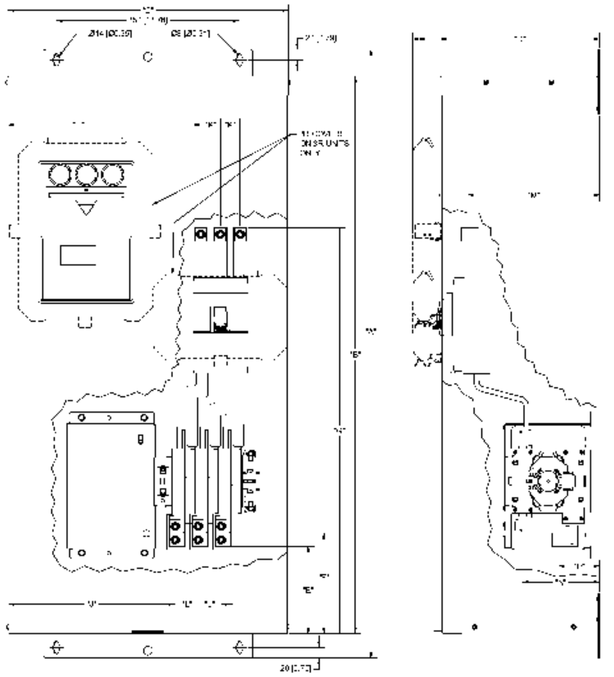
TX301 Series Transfer Switch

GENERAC | INDUSTRIAL POWER

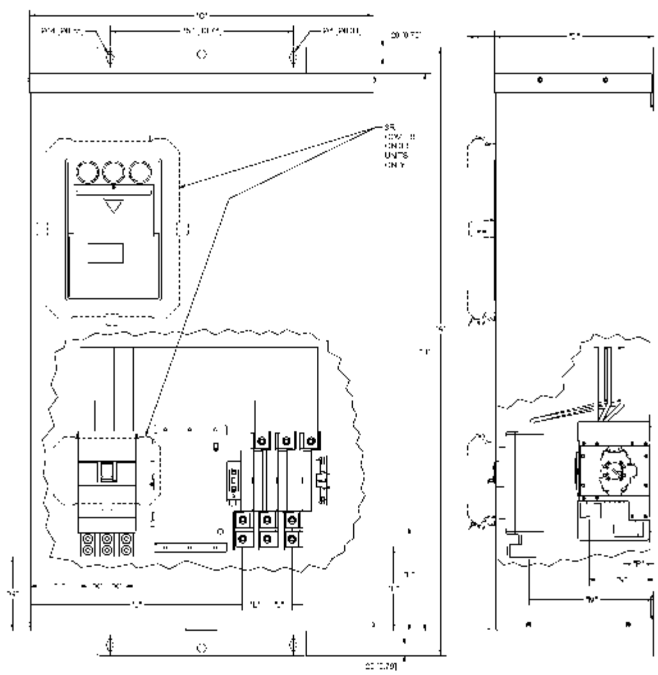
100 – 400 Amps

Contactor Type - Open and Delayed Transition - Service Entrance Rated

UNIT DIMENSIONS*



100 - 200 A



300 - 400 A

Service Entrance Rated, Contactor Type, Open and Delayed Transition, 100 – 400 A

Description	in (mm)														Cu/Al					lbs (kg)
	A (Height)	B (Height)	C (Width)	D (Depth)	E (Dim)	F (Dim)	G (Dim)	H (Dim)	J (Dim)	K† (Dim)	L (Dim)	M (Dim)	N (Dim)	P (Dim)	Normal 75 °C Wire	Standby Source 75 °C Wire	Load 75 °C Wire	Neutral Connection	Ground Connection	Weight
100A SER TYPE 1	51.3 (1,303)	47.5 (1,206)	21.2 (538)	12.0 (305)	9.5 (242)	10.6 (268)	38.3 (973)	14.5 (369)	12.6 (320)	1.5 (38)	1.7 (44)	10.1 (257)	5.8 (148)	3.1 (79)	(1) 3/0 - 6	(1) 2/0 - 14	(1) 2/0 - 14	(5) 2/0 - 14	(6) 2/0 - 14	154.3 (70)
100A SER TYPE 3R	51.3 (1,303)	47.5 (1,206)	21.2 (538)	13.9 (355)	9.5 (242)	10.6 (268)	38.3 (973)	14.5 (369)	12.6 (320)	1.5 (38)	1.7 (44)	10.1 (257)	5.8 (148)	3.1 (79)	(1) 3/0 - 6	(1) 2/0 - 14	(1) 2/0 - 14	(5) 2/0 - 14	(6) 2/0 - 14	158.7 (72)
150A SER TYPE 1	51.3 (1,303)	47.5 (1,206)	21.2 (538)	12.0 (305)	9.9 (253)	10.9 (279)	38.3 (973)	14.5 (369)	12.6 (320)	1.5 (38)	1.7 (44)	10.1 (257)	5.8 (148)	3.3 (84)	(1) 250 - 6	(1) 250 - 6	(1) 250 - 6	(5) 350 - 6	(5) 350 - 6	165.3 (75)
150A SER TYPE 3R	51.3 (1,303)	47.5 (1,206)	21.2 (58)	13.9 (355)	9.9 (253)	10.9 (279)	38.3 (973)	14.5 (369)	12.6 (320)	1.5 (38)	1.7 (44)	10.1 (257)	5.8 (148)	3.3 (84)	(1) 250 - 6	(1) 250 - 6	(1) 250 - 6	(5) 350 - 6	(5) 350 - 6	169.8 (77)
200A SER TYPE 1	51.3 (1,303)	47.5 (1,206)	21.2 (538)	12.0 (305)	9.9 (253)	10.9 (279)	38.3 (973)	14.5 (369)	12.6 (320)	1.5 (38)	1.7 (44)	10.1 (257)	5.8 (148)	3.3 (84)	(1) 250 - 6	(1) 250 - 6	(1) 250 - 6	(5) 350 - 6	(5) 350 - 6	165.3 (75)
200A SER TYPE 3R	51.3 (1,303)	47.5 (1,206)	21.2 (538)	13.9 (355)	9.9 (253)	10.9 (279)	38.3 (973)	14.5 (369)	12.6 (320)	1.5 (38)	1.7 (44)	10.1 (257)	5.8 (148)	3.3 (84)	(1) 250 - 6	(1) 250 - 6	(1) 250 - 6	(5) 350 - 6	(5) 350 - 6	169.8 (77)
300A SER TYPE 1	51.4 (1,305)	47.5 (1,206)	33.9 (860)	12.0 (305)	9.9 (253)	11.7 (297)	9.0 (228)	7.6 (192)	22.1 (562)	1.8 (46)	2.3 (59)	8.7 (222)	6.5 (166)	3.3 (84)	(2) 600 - 2/0	(1) 600 - 4 or (2) 250 - 1/0	(1) 600 - 4 or (2) 250 - 1/0	(5) 600 MCM - 4 or (10) 250 MCM - 1/0	(5) 350 - 6	260.1 (118)
300A SER TYPE 3R	51.4 (1,305)	47.5 (1,206)	33.9 (860)	13.9 (355)	9.9 (253)	11.7 (297)	9.0 (228)	7.6 (192)	22.1 (562)	1.8 (46)	2.3 (59)	8.7 (222)	6.5 (166)	3.3 (84)	(2) 600 - 2/0	(1) 600 - 4 or (2) 250 - 1/0	(1) 600 - 4 or (2) 250 - 1/0	(5) 600 MCM - 4 or (10) 250 MCM - 1/0	(5) 350 - 6	264.6 (120)
400A SER TYPE 1	51.4 (1,305)	47.5 (1,206)	33.9 (860)	12.0 (305)	9.9 (253)	11.7 (297)	9.0 (228)	7.6 (192)	22.1 (562)	1.8 (46)	2.3 (59)	8.7 (222)	6.5 (166)	3.3 (84)	(2) 600 - 2/0	(1) 600 - 4 or (2) 250 - 1/0	(1) 600 - 4 or (2) 250 - 1/0	(5) 600 MCM - 4 or (10) 250 MCM - 1/0	(5) 350 - 6	260.1 (118)
400A SER TYPE 3R	51.4 (1,305)	47.5 (1,206)	33.9 (860)	13.9 (355)	9.9 (253)	11.7 (297)	9.0 (228)	7.6 (192)	22.1 (562)	1.8 (46)	2.3 (59)	8.7 (222)	6.5 (166)	3.3 (84)	(2) 600 - 2/0	(1) 600 - 4 or (2) 250 - 1/0	(1) 600 - 4 or (2) 250 - 1/0	(5) 600 MCM - 4 or (10) 250 MCM - 1/0	(5) 350 - 6	264.6 (120)

† K Dimension for 100-200A 2-Pole Configuration is 3 (75). K Dimension for 300-400A 2-Pole Configuration is 3.6 (92)

UL 1008 Withstand and Closing Ratings

Ampere Rating	Specific Breaker (kA)**	Service Entrance (kA)	Fuse Rating (Class J)	Fuse Size
100	35	35	35 kA	200 A
150	42	42	100 kA	200 A
200	42	42	100 kA	200 A
300	65	65	100 kA	400 A
400	65	65	100 kA	400 A

* All measurements are approximate and for estimation purposes only. Specification characteristics may change without notice. Please contact a Generac Power Systems Industrial Dealer for detailed installation drawings.
** See Specific Breaker List available on GENconnect.

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Part No. A0000416970
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