GENERAC®

THE ESSENTIAL

HOW-TO GUIDE TO POWER SYSTEM SIZING FOR ELECTRICAL ENGINEERS

Table of Contents

The Essential How-to Guide to Power System Sizing for Electrical Engineers

Generac is a leading energy technology company with over six decades of power generation experience. Generac's Power Design Pro™ is a mechanical and electrical design and sizing tool unmatched by other programs. This innovative software is a one-stop solution center with state-of-the-art sizing and analysis capabilities, including spec sheets, emission information, installation drawings, a gas piping sizer, and an exhaust pipe sizer.

We have incorporated more than 60 years of expertise into Power Design Pro™ with the primary goal of making it easier for engineers to specify generators for their projects. The powerful software includes advanced algorithms that accurately simulate a load's true characteristics, including transient and harmonic analysis to help ensure total generator-to-load compatibility.

Generac's Power Design Pro™ is unsurpassed by any other software on the market, helping users accurately design and size generator solutions. Users benefit from the easy-to-use interface and real-time results from dynamic calculations. Learn more about Power Design Pro™ to see how it can streamline your generator project.

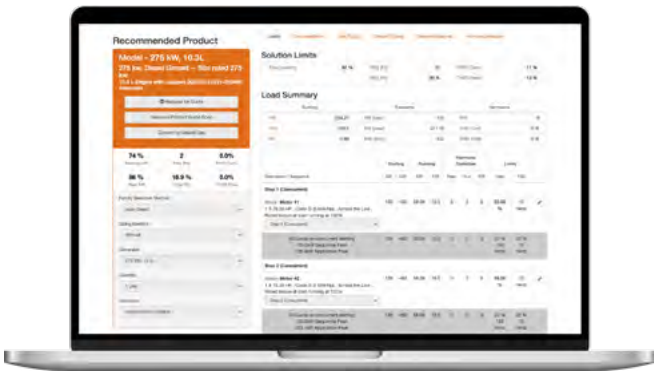
Power Design Pro designs, analysis, and identified product suggestions are dependent on user provided input project details. Customer is solely responsible for the accuracy and integrity of its data, and any errors in project inputs may impact the designs, analysis, and outputs of Power Design Pro. Unique circumstances in any user's project or application may also impact the suitability of the product suggested.

Clarify Project Scope

POWER DESIGN PRO™ CAN HELP USERS CLARIFY THE SIZE OF THEIR PROJECT, OFFERING THE FOLLOWING BENEFITS:

1. **MODEL SOLUTIONS TO HELP ENGINEERS BETTER UNDERSTAND THE TRADEOFFS**
2. **BUILD CREDIBILITY BY LOOKING OUT FOR THE CLIENT'S CAPEX BUDGET**
3. **SAVE TIME WITH FEWER DRAWING REVISIONS**
4. **IDENTIFY BUDGET "BLOWOUTS" EARLY ON IN THE DESIGN PHASE**

Our software focuses on how generators function in real-life scenarios so that customers can appropriately size their generator solution. Competitive software defaults to placing all loads into a single step, which not only creates a challenging condition for the generator but also leads customers to choose an oversized, over-budget solution.



The goal of Power Design Pro™ is to avoid this situation and help users model load sequencing that more accurately represents real-life operation and sequencing of loads.

For example, one of our valued customers recently had their engineer provide us with the horsepower and loads of their motors. We entered the data into Power Design Pro™ and received the recommended size generator. In addition, due to heavy inrush currents, the system identified that the alternator needed upsizing to help ensure facility compatibility. Power Design Pro™ allowed us to quickly identify potential issues and provide a generator size that matched our client's needs.

QUICKLY EVALUATE POTENTIAL DESIGN SOLUTIONS

THE FOLLOWING FEATURES AND BENEFITS OF POWER DESIGN PRO™ HELP USERS QUICKLY EVALUATE THEIR OPTIONS:

Load management or shed scenarios

Find potential problems, such as harmonics, early in the process

Test value engineering scenarios (across-the-line motor starting vs. soft starters or VFDs)

Draw and specify once

Generating a model in Power Design Pro™ does not require follow-up calls from a salesperson. As a user-initiated platform, the tool allows users to download product information through the platform as needed, giving them total control over the project's speed.

We recognize that Power Design Pro™ may be just one of many tools that a design engineer uses when selecting a generator for their project. With this in mind, we designed Power Design Pro™ with an intuitive user interface that allows engineers to input various load types with default settings. This simple process lets users input information quickly.

A recent customer successfully used Power Design Pro™ to determine the recommended size of a generator. They input three 125–horsepower motor loads and the site accessory loads, quickly modeling their ideal solution and receiving a recommendation for a specific Generac product.

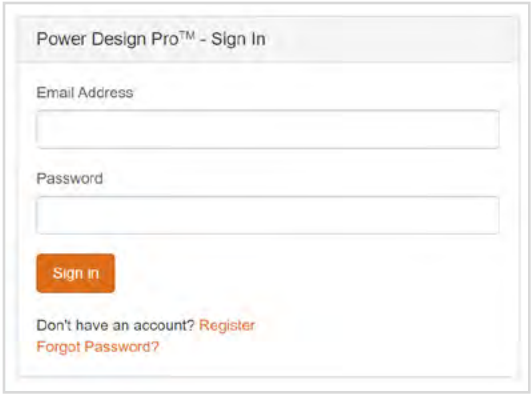
Step-by-Step Tutorial

Take the following steps to get started in Power Design Pro™.

1 INITIAL ACCOUNT SETUP AND NAVIGATING POWER DESIGN PRO™

Create a new account using your work email address. All security and project sharing permissions will be attached to this email address. Once the initial setup is complete, users can remain logged in from any computer and start working immediately. The dashboard will display projects from the past 90 days.

Power Design Pro™ eliminates IT hassles, offers faster updates, and is easier to share while maintaining version control.



POWER DESIGN PRO™

ONE OF THE MOST POWERFUL GENERATOR SIZING TOOLS IN THE INDUSTRY

Get Started

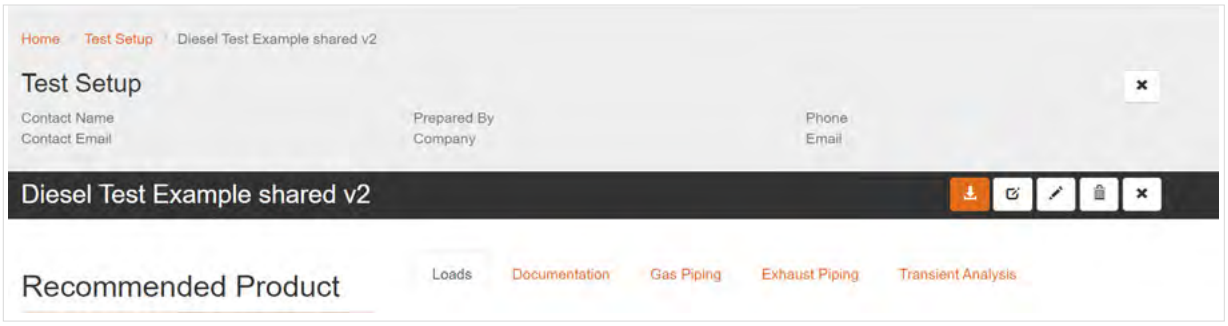
2 SOLUTION SETUP

Global constraints are set within the project to include the following:

- Fuel type
- Voltage (nominal and specific), frequency, and phase
- Maximum allowable voltage and frequency dip
- Maximum allowable voltage distortion (continuous and momentary)
- Maximum running load
- Power rating

Certain selections limit the range of available solutions, such as:

- Drive engine derates (altitude, temperature, LP fuel)
- Engine or alternator upsizing (Vdip or Fdip limits, rated frequency)
- No solutions (single phase limited to 200kw, no MPS, LP fuel)



3 ADDING LOADS

Load types typically use conservative parameters but can be adjusted when specific information is available. Different load types address the following:

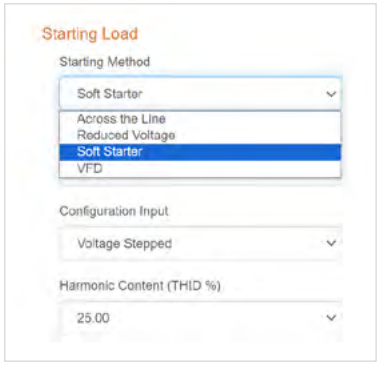
- All load types (starting and running power factor)
- Non-linear loads (momentary and continuous harmonic distribution)
- Across the line vs. VFD, soft start vs. wye/delta (starting kVA requirements)
- Fire pumps, NEMA contactors, general building loads (Vdip limits)
- UPS types (Frequency dip limits, battery recharge rate, revert to battery)
- Soft start (current limit and voltage stepped vs. ramped)
- VFD (rectifier type, configuration input)
- Reduced voltage starter (wye/delta open vs. closed, auto transformer tap-point)

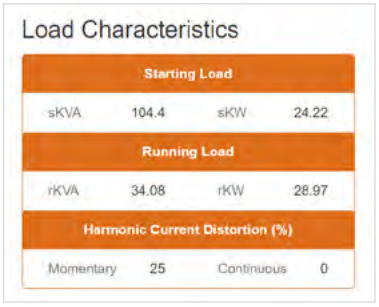
4 MOTOR LOADS

Since the motor load and starting technique affect the generator size, Power Design Pro™ assumes the motor is 100% loaded unless otherwise indicated. Inputs include the suggested voltage and frequency limits, with tighter limits driving the project cost and generator size. Implementing improved motor starting techniques can significantly reduce generator costs.

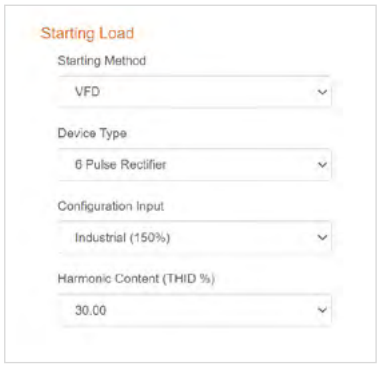
The following factors affect motor loads:

Soft Starters:
A lower current limit extends the start-up time and reduces the sKVA requirement. A soft starter gets bypassed once the motor reaches rated speed. Soft starters are common on larger fire pumps.



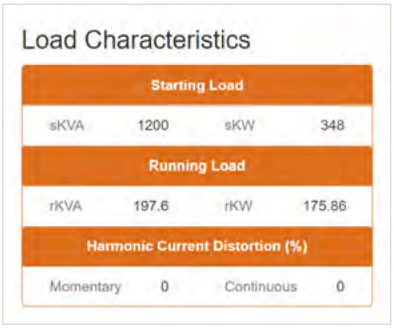


VFDs:
Due to modern energy efficiency requirements, VFDs are common and often found in HVAC systems. THID may vary considerably and will default to 30% when no other information is available.

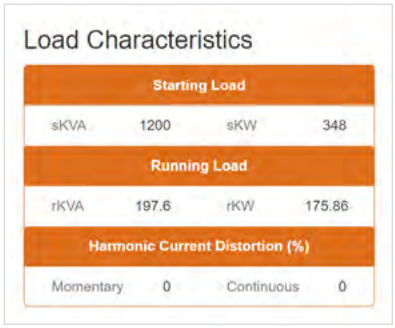


Starting Methods:

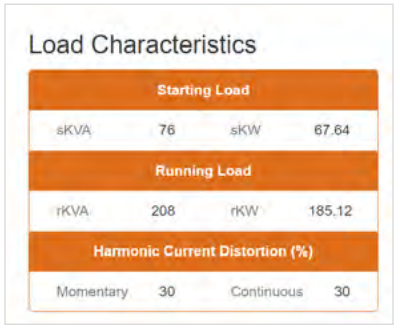
The most challenging load for a generator is motor starting. It is often an economic decision that dictates an improved starter or upsized generator. VFDs and soft starters reduce sKVA but result in harmonic distortion. Upsizing the alternator to reduce the effects of harmonic distortion can sometimes offset the advantages of VFDs.



100 HP
ACROSS THE LINE



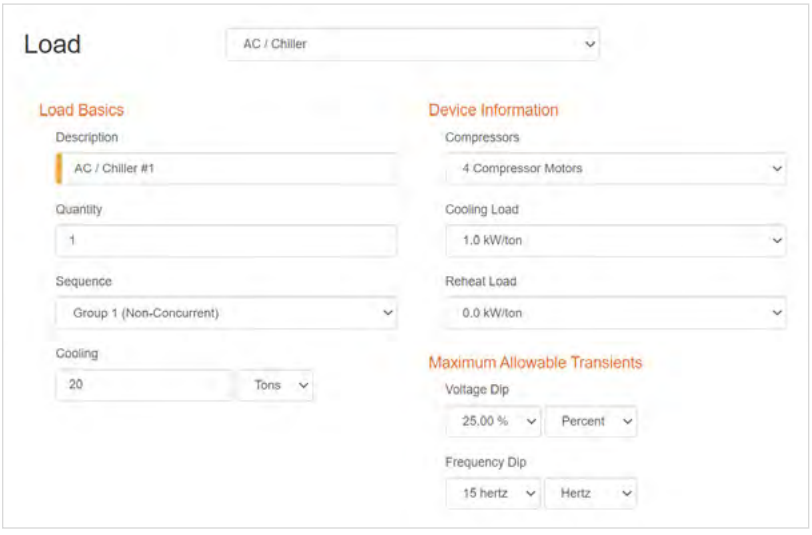
100 HP
WYE-DELTA

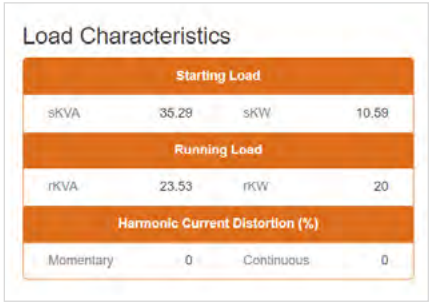


100 HP
350% VFD

HVAC/Chiller:

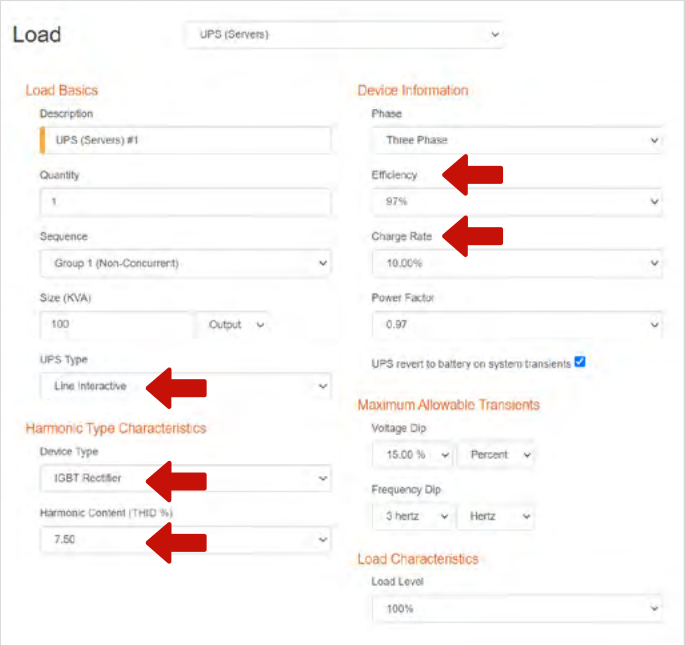
Many commercial HVAC systems today consist of multiple standard-sized compressors. Power Design Pro™ makes it easy to model the starting sequence of multiple compressors. Using this load type will accurately model the starting kVA of each individual compressor as the required cooling capacity varies, while showing the correct running load at full cooling capacity.





The following factors affect non-linear loads:

UPS:
While the technology has improved over the years, THD and PF efficiency varies based on the system's age. Active front end units are more commonly used today and significantly reduce the THID with less need for alternator up-sizing Some UPS can be configured to adjust behavior when using generator power.



Total Harmonic Current Distortion (THID):
A measurement of non-sinusoidal current flow and the defining characteristic of a non-linear load.

Total Harmonic Voltage Distortion (THVD):
A consequence of non-sinusoidal current flow, proportional to the power source impedance.

THVD may be acceptable (<10% per IEEE-519) when connected to a low-impedance utility power source. The same load may result in excessive THVD levels when connected to a higher impedance generator source.

Power Design Pro will assist the engineer to select the correct alternator to maintain THVD within acceptable limits.

Harmonic Content:
All non-linear loads suggest harmonic content depending on the device type. Modest improvements in THID often eliminate or reduce the need for upsizing the alternator.

Loads | Documentation | Gas Piping | Exhaust Piping | Transient Analysis

Harmonic Analysis

Harmonic Analysis

Harmonic Profile

Application Total (running)

Harmonic Profile:	Application Total (running)	Sequence:	(Total)		
kVA Nonlinear Load:	148.3	THID:	11.9%	THVD:	9.9%
kVA Base (all non-linear):	148.25	Selected sequence(s) harmonic alternator loading:	70%		

Selected Harmonic Current and Voltage Profiles

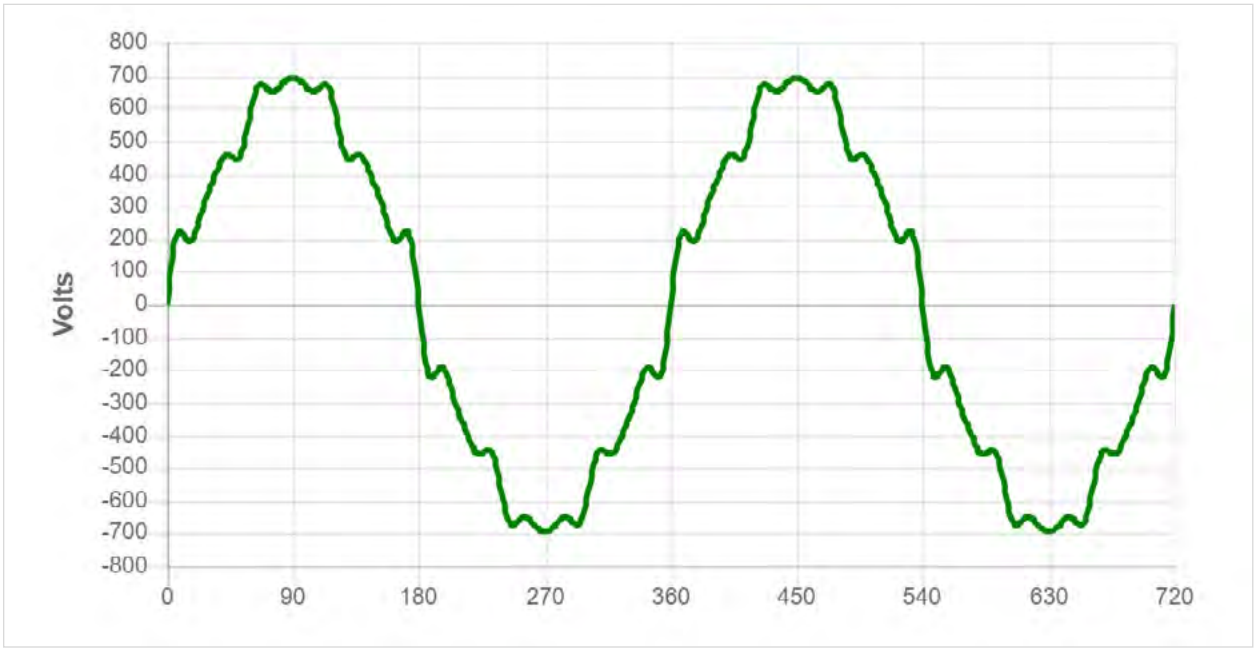
Profile	3rd	5th	7th	9th	11th	13th	15th	17th	19th
Current	0%	8.1%	5%	0%	4%	4.8%	0%	2.4%	2.4%
Voltage	0%	4.1%	3.5%	0%	4.5%	6.3%	0%	2.1%	2.3%

Harmonic Type Characteristics

Device Type: IGBT Rectifier

Harmonic Content (THID %): 7.50

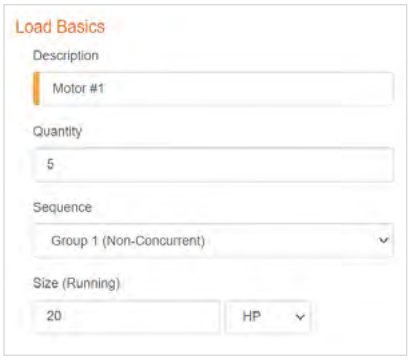
Harmonic Current Distortion	
3rd	0
5th	2.49
7th	3.25
9th	0
11th	2.87
13th	4.78
15th	0
17th	2.01
19th	2.1



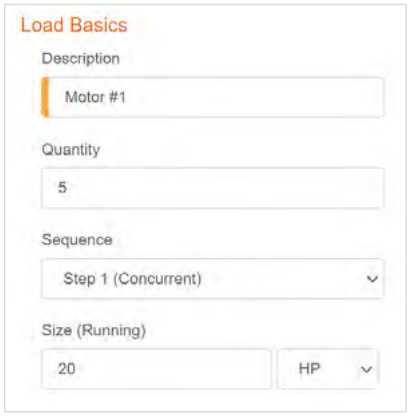
5 SEQUENCE CONTROL

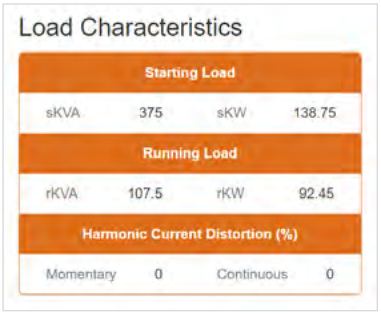
There are three load categories:

Group (non-concurrent): This category assumes the harshest transient in the group starts last with all other loads running. The largest skW and skVA will be added to the sum of rkW and rkVA of all other loads, minimizing the Vdip and Fdip transient impact compared to modeling multiple loads in a single step.



Step (concurrent): This category assumes every load in a step starts simultaneously. This could lead to upsizing the alternator and generator to meet starting transient requirements.





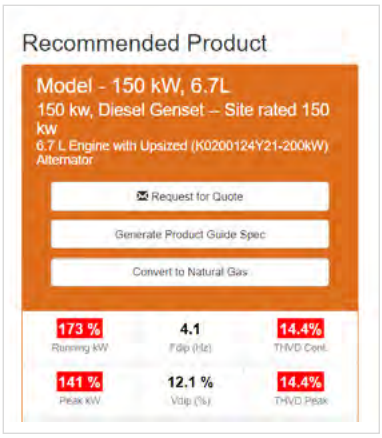
Cyclic (non-concurrent): All loads start at a different time, assuming average load factor as specified in the project setup phase.

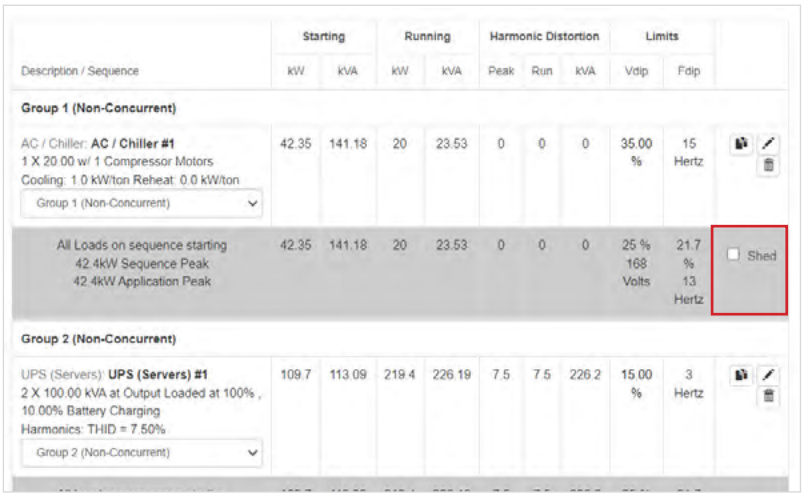
Users can quickly add all loads to Group 1 as a default, easily adjusting the sequencing at a later time.

6 SIZING

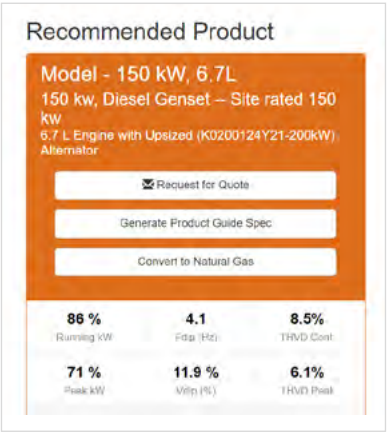
Generator sizing can be automatic or user-selected, dependent upon the following factors:

Load Shed



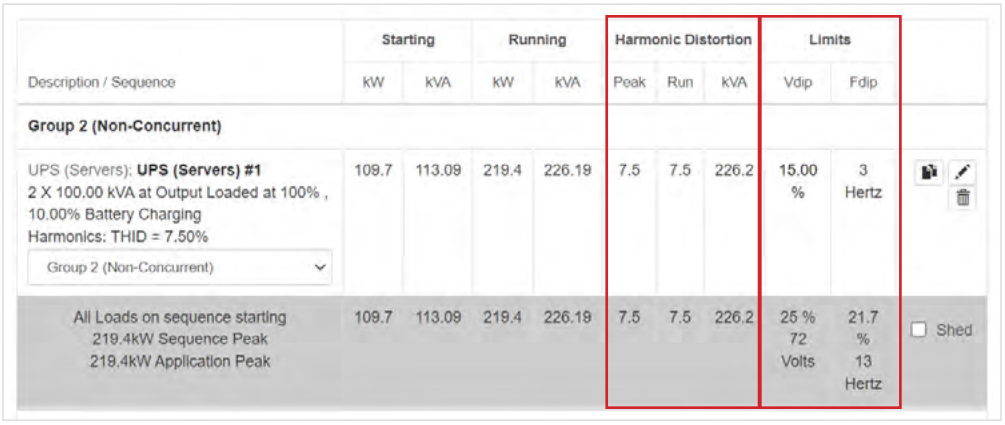


Selecting the Shed check box on a specific load will exclude that load from the starting sequence. This feature helps support What-if-Analysis and will optimize utilization and system reliability.



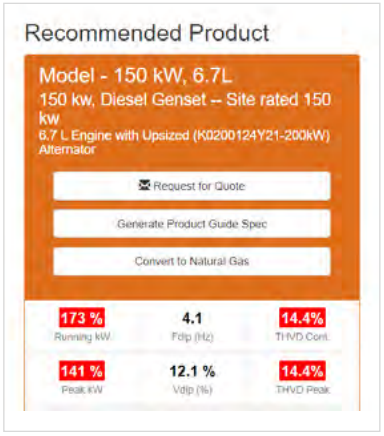
Transient Limits

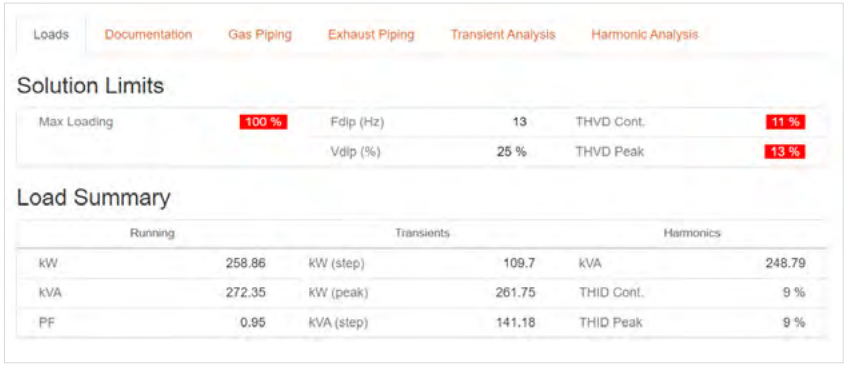
Harmonic Distortion Limits



7 PROJECT LOAD SUMMARY

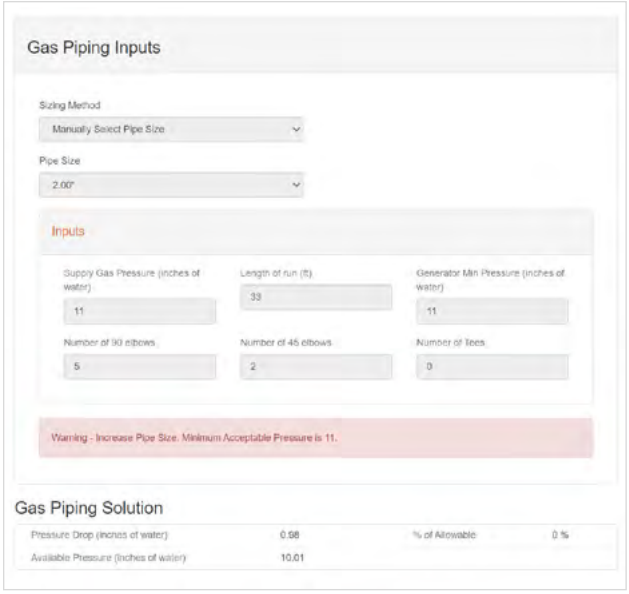
The project load summary considers all loads entered, with parameter limit violations flagged. Performance metrics are updated with each addition or change to loads, and immediate feedback is provided on how the generator size changes with load changes.



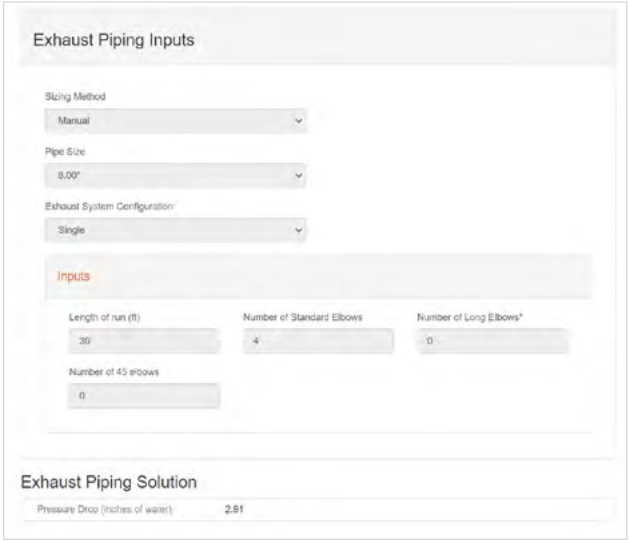


8 GAS SUPPLY AND EXHAUST PIPE SIZING

This step involves sizing natural gas pipes after the primary gas regulator (dedicated regulator immediately upstream from the generator fuel inlet) to provide minimum pressure drop and adequate gas flow at maximum load, based on the required gas flow for the selected generator. The supply pressure, run length, and number of bends must be entered to determine the required pipe size.

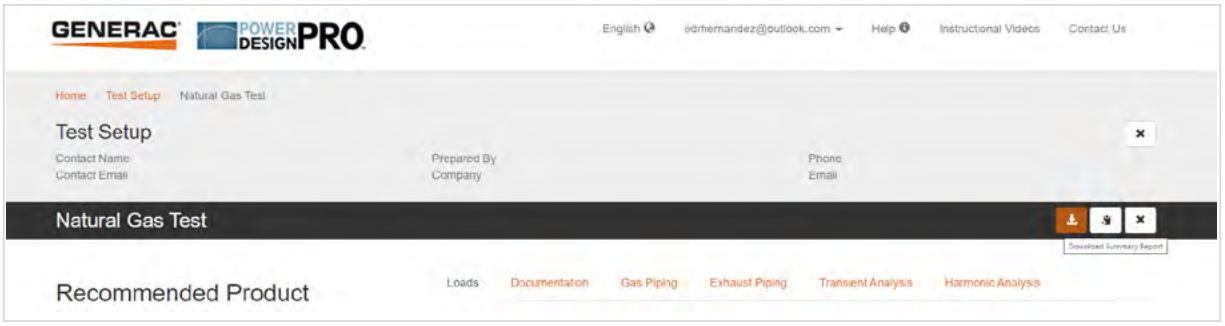


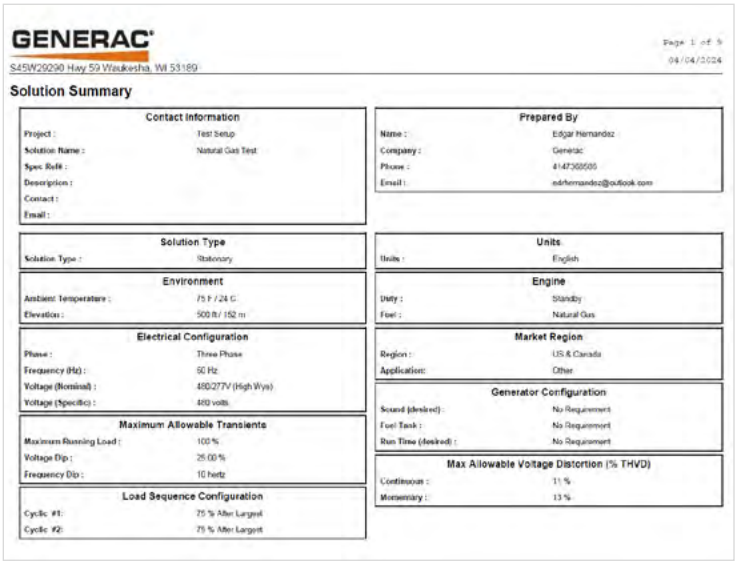
The exhaust pipe sizing applies to generators for indoor use and is based on the size of the generator selected according to the input loads. The run length and number of bends must be entered to determine the required pipe size.

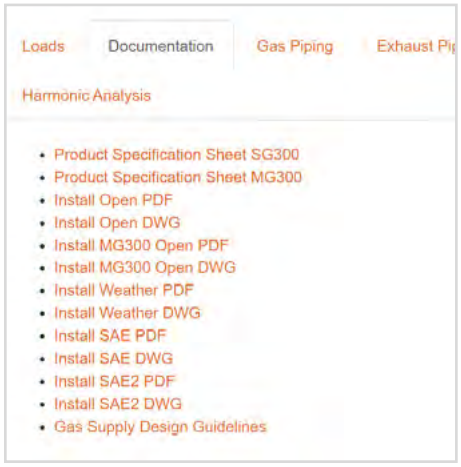


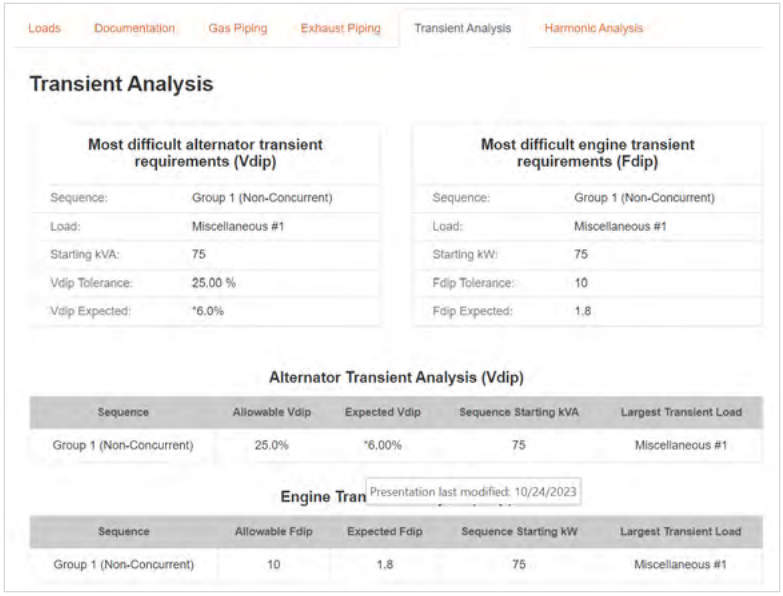
9 ANALYSIS & REPORTING

The Project Summary Report will include transient, load, and harmonic analyses in an exportable PDF. Product documentation can be directly downloaded.



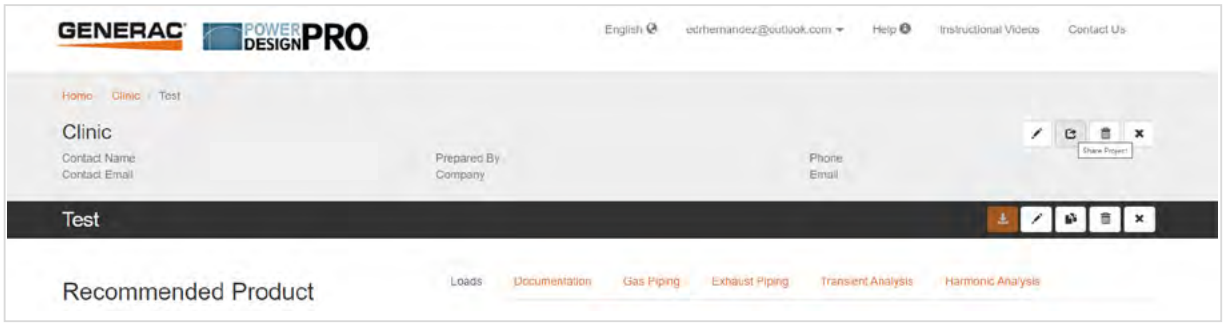


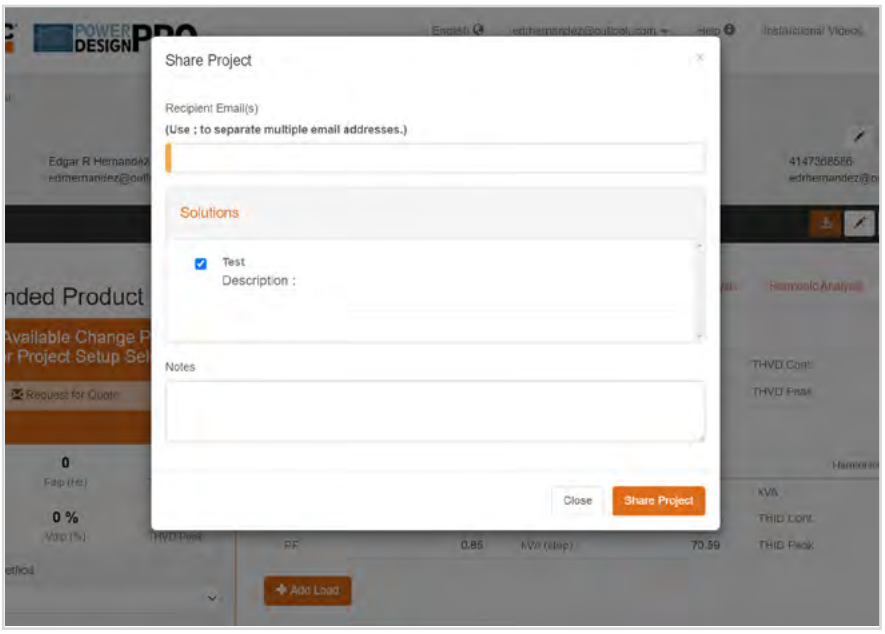




10 SHARING A PROJECT

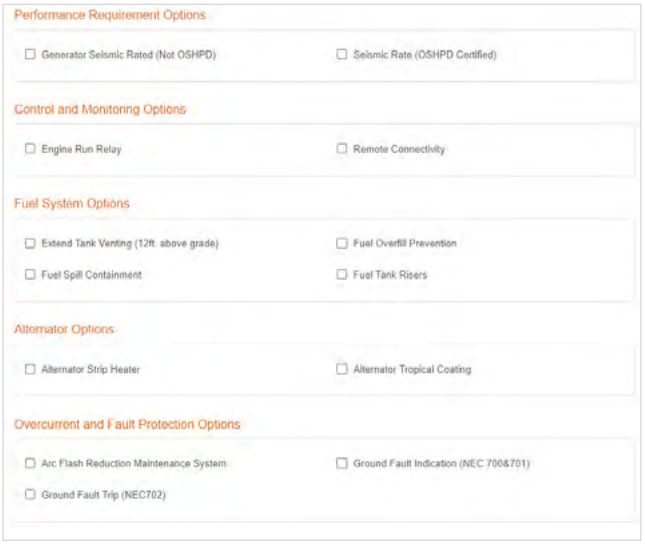
Project solutions can be shared from within the web interface, with access based on the user's login email address. There is no need to email files or deal with security or version control issues. When the project is shared, recipients cannot edit the original document. The recipient can make revisions to share back with the original user, and revised projects appear on the dashboard with the original project.

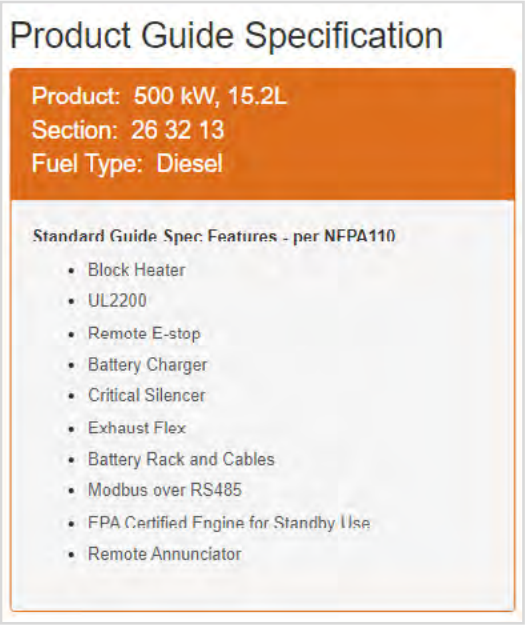


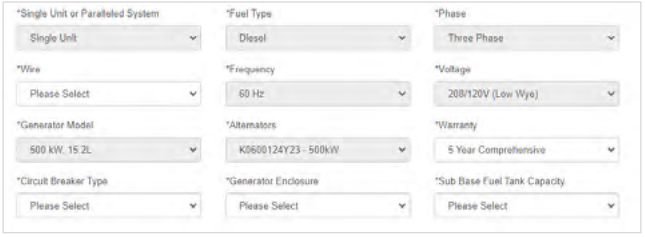


11 GENERATE A PRODUCT GUIDE SPECIFICATION

With the generator sizing complete and performance limits verified to the engineer's satisfaction, an specification text can be easily generated after selecting desired generator set options.







Learn More About Generac's Power Design Pro™

Generac's Power Design Pro™ offers a broad range of innovative capabilities to benefit any generator project. When you work with Generac, we provide assistance at every step of your advanced power management project. Our priority is to develop optimal solutions for our customers' unique problems, from custom-designed systems to turnkey options. Additionally, we provide our customers receive top-quality parts, sensible service agreements, financing services, and industry-leading warranties.

Learn more about Generac's Power Design Pro™ generator sizing software system, or contact us today to discuss how it can benefit your power system project.

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ONE OF THE MOST POWERFUL GENERATOR SIZING TOOLS IN THE INDUSTRY

Get Started

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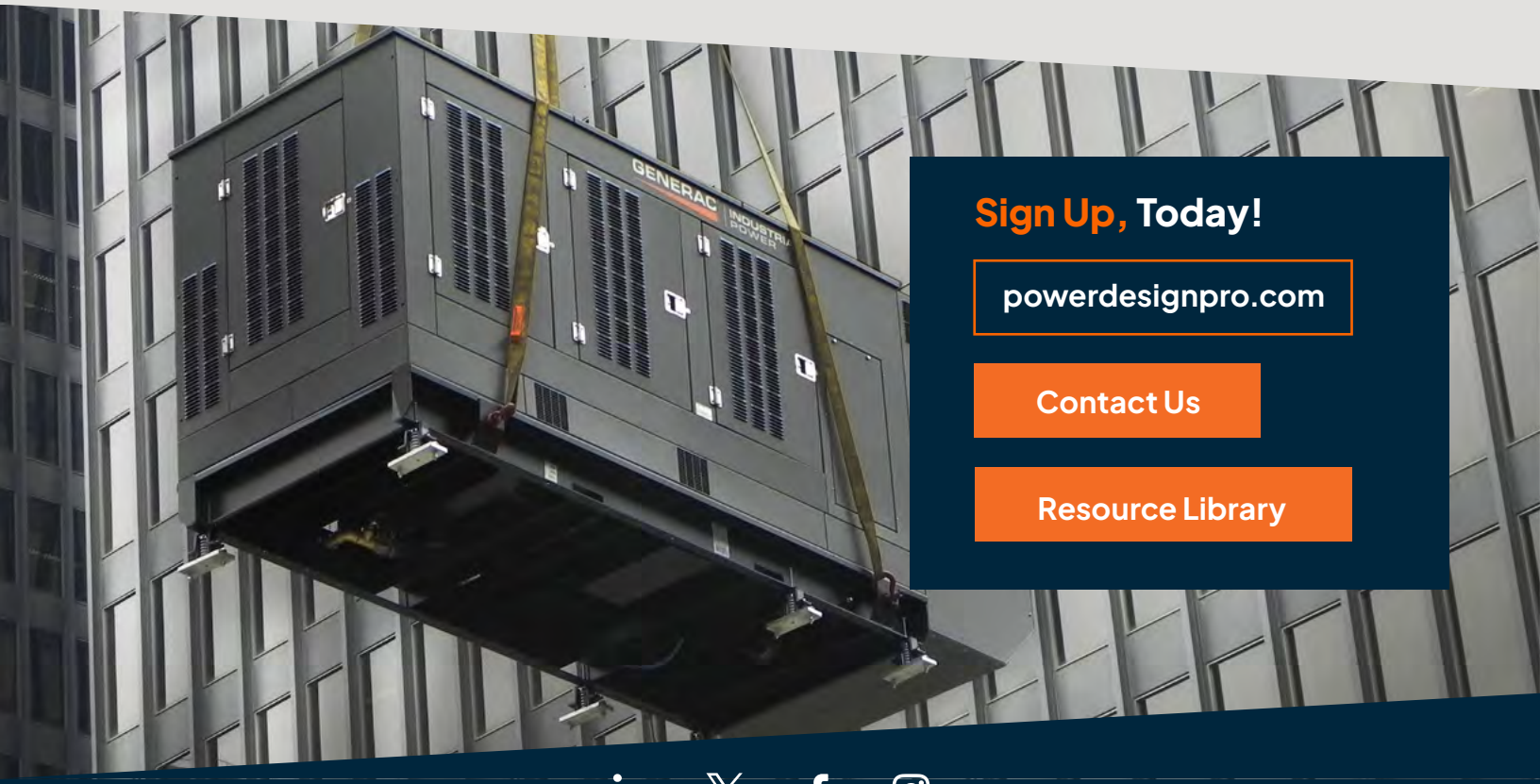
About Us

At Generac we're not just a company – we're pioneers charting the course towards a more resilient, efficient, and sustainable energy future. Founded in 1959, our legacy is rooted in innovation and leadership in the power generation industry. We've crafted our name by creating affordable, dependable power solutions, and designing engines specifically tailored for the rigors of generator use.

Today, as a leading provider of a broad array of energy solutions, we're committed to serving the complex needs of the commercial and industrial sectors. Our expertise extends to designing and manufacturing advanced manual and automatic transfer switches and accessories, enhancing backup power applications up to 2 MW.

But we're not simply maintaining the status quo. We're committed to leading the evolution of energy management. Whether through remote microgrids, demand response software, or efficient grid asset optimization, Generac Industrial Power is dedicated to making energy more accessible, manageable, and sustainable.

Trust Generac to energize your evolution, as we forge ahead towards a more resilient and sustainable energy future.



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