Cat® Electric Power

Sizing Gensets (Specsizer)

Krishnan Pandiaraj

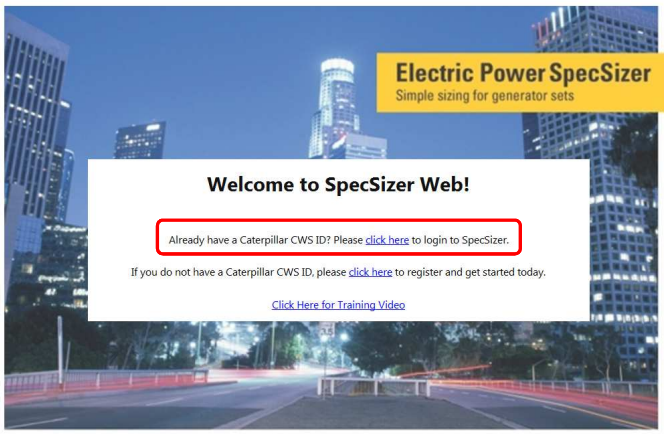
BUILT FOR IT.

CAT

Electric Power SpecSizer

- SpecSizer Web - https://specsizer.cat.com

CAT



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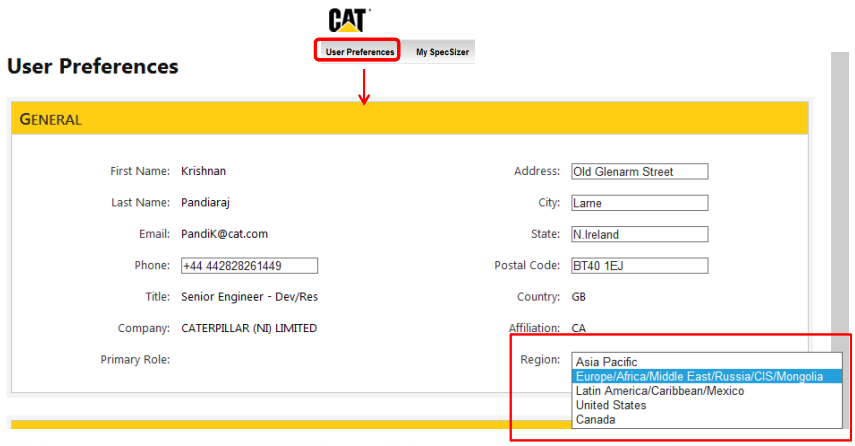
Electric Power SpecSizer

- Generator Set Sizing Program
  - User Preferences, My SpecSizer – Site Conditions
- Load Analysis and Load Step Optimization
  - Add Loads: Template loads, Cat UPS loads, Optimizer
- Genset Selection
  - Site Specific Environmental Considerations
  - Generator Set Details
- Reports and Guide Specifications
- File Sharing | Help & Support
  - specsizersupport@cat.com

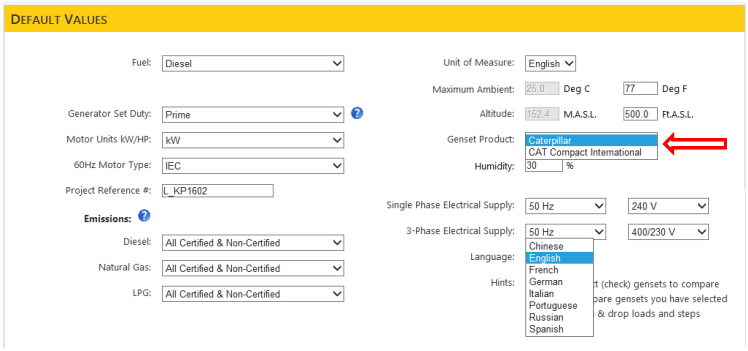
Electric Power SpecSizer

- User Preferences (top half of page) - Set defaults for Site Conditions for new projects
  - Set "Region" here: (aligns product selection to regional price lists / product offerings



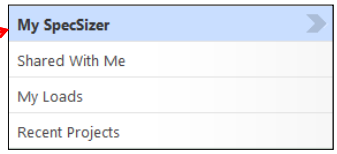
Electric Power SpecSizer

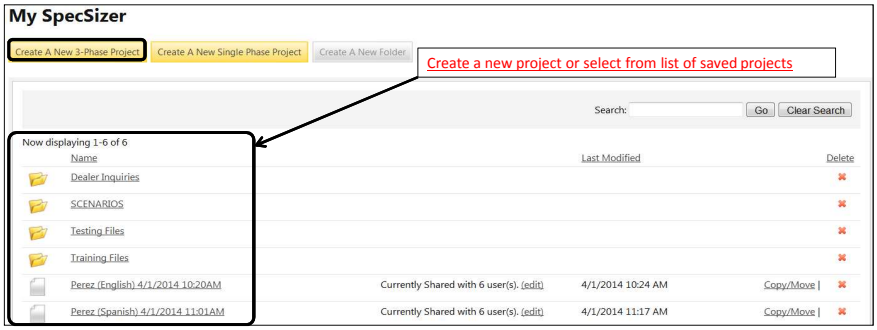
- User Preferences (bottom half of page) – set defaults for Site Conditions for new projects
  - Genset Product: Caterpillar (for Cat compact and Olympian branded gensets) - filters genset list for "Select Genset" page
  - Eight (8) language options



Electric Power SpecSizer

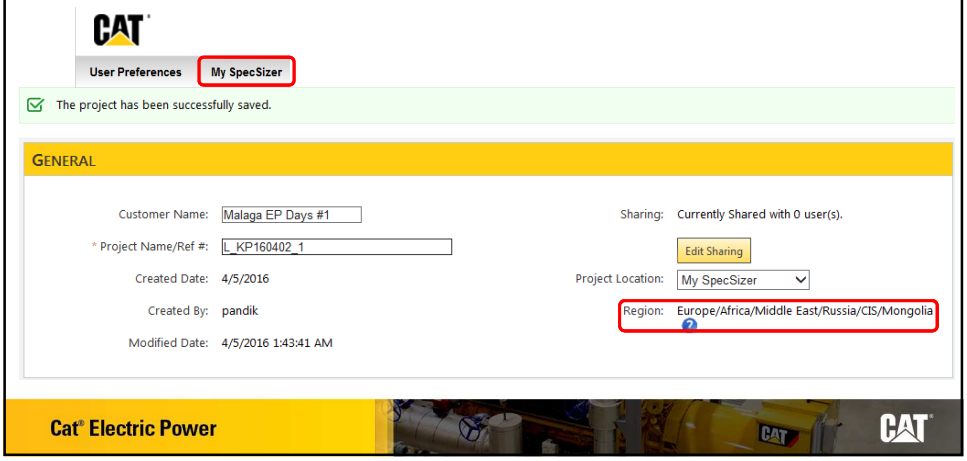
- User Preferences → My SpecSizer (main page)





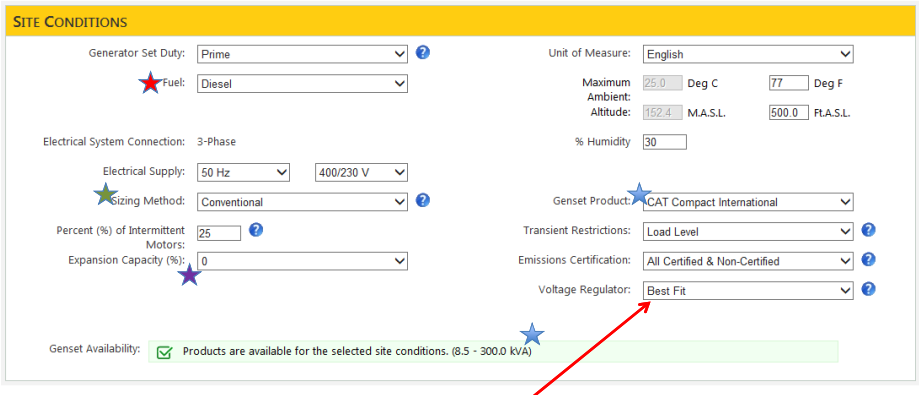
Electric Power SpecSizer

- My SpecSizer → Create A New 3-Phase Project → Define Site Conditions
  - GENERAL (top half of page): Defaults auto-populated from User Preferences, are editable. Region not editable here, editable on User Preferences only

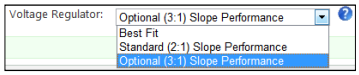


Electric Power SpecSizer

- My SpecSizer → Create A New 3-Phase Project → Define Site Conditions

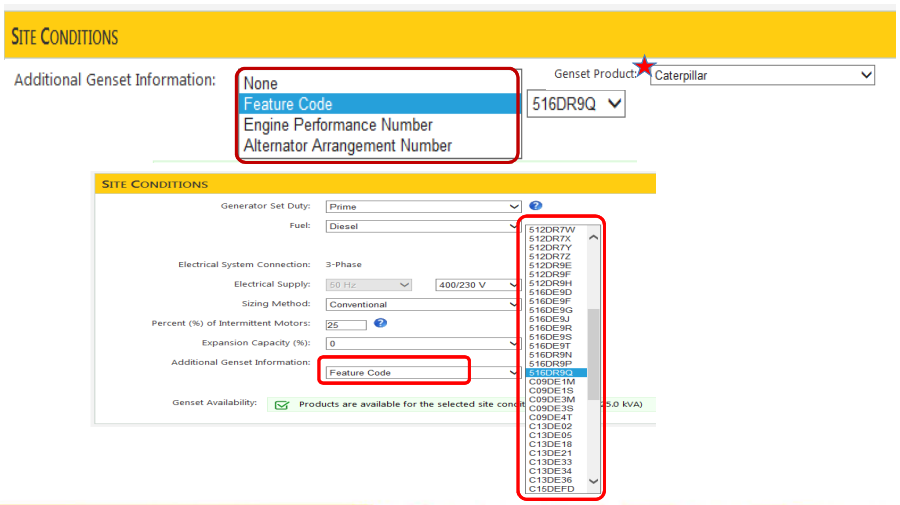


Voltage Regulator: CDVR can be forced by selecting: Optional (3:1) Slope Performance



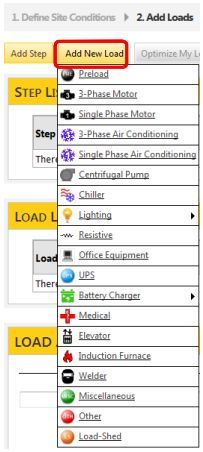
Electric Power SpecSizer

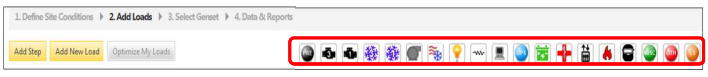
- Filtering genset models *... feature added recently*



Electric Power SpecSizer

- Define Site Conditions → **Add Loads**
  - New feature – Template loads
  - Add Loads page displays "Effective" Frequency and "Effective" Voltage
    - Effective Fdip/Vdip vs. User Defined Fdip/Vdip
      - Subsequent loads and load steps adopt
      - the most restrictive Fdip or Vdip of prior loads or load steps

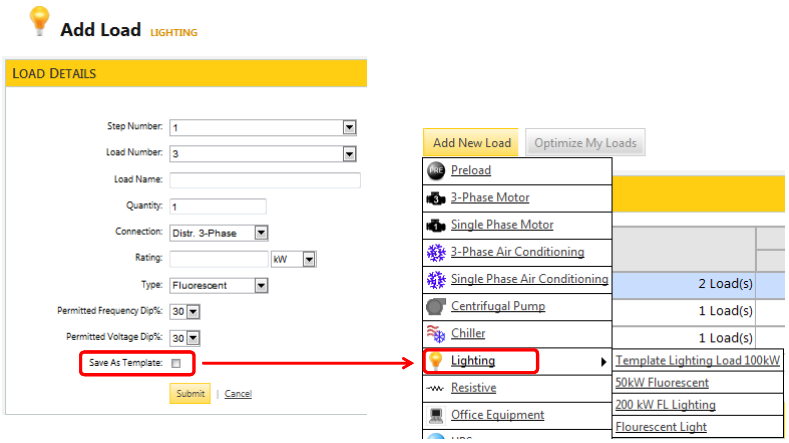




Add loads using 'Add New Load' button or load icons

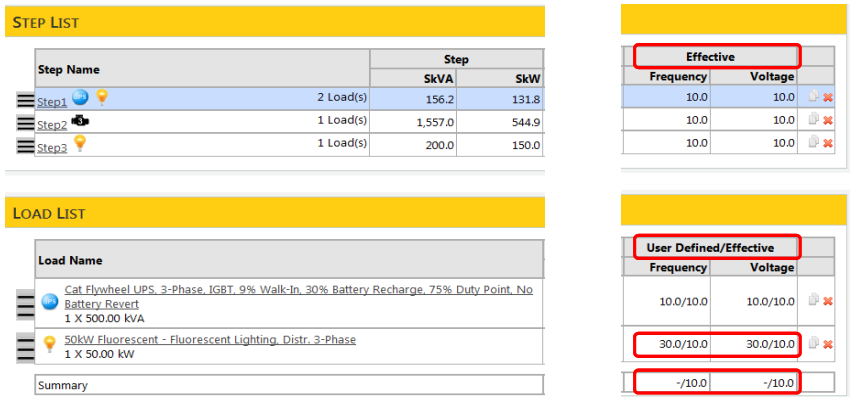
Electric Power SpecSizer

- **Add Loads**: New feature – Template loads



Electric Power SpecSizer

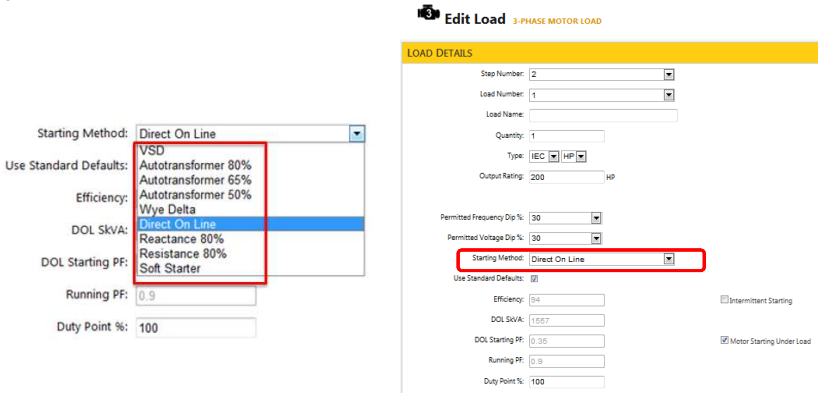
- **Add Loads**: New Feature - Effective frequency/voltage dip: added to help user see effect of restrictive fdip/vdip rule: Sequence restrictive loads later if possible to downsize genset



- 3-Phase Motor in Step 2 and Fluorescent Lighting in Steps 1 & 3 adopted 10% Fdip/Vdip of Step#1 UPS load;
- Motors & Lighting were spec'ed for 30% Fdip/Vdip, restricted to 10% Fdip/Vdip due to UPS sequenced prior

Electric Power SpecSizer

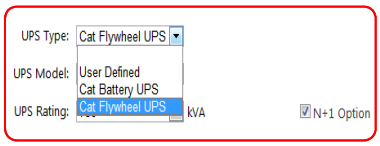
- **Motors:** cause high Inrush – Reduced Voltage Starters can reduce size of recommended genset, reduces load's SkVA & SkW

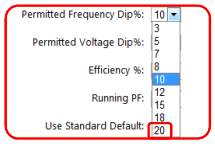


Electric Power SpecSizer

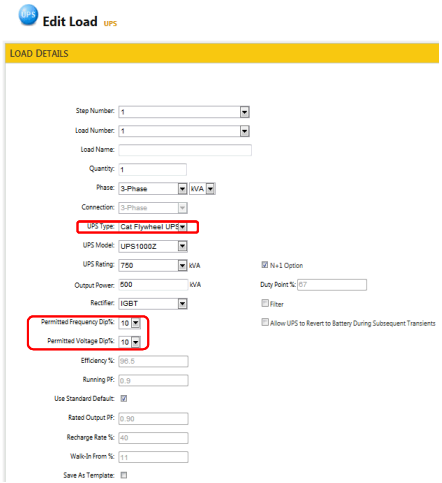
- **UPS load:** new UPS load options (besides generic/User-Defined UPS)
  - Cat Battery UPS & Cat Flywheel UPS!

(3) UPS Types:



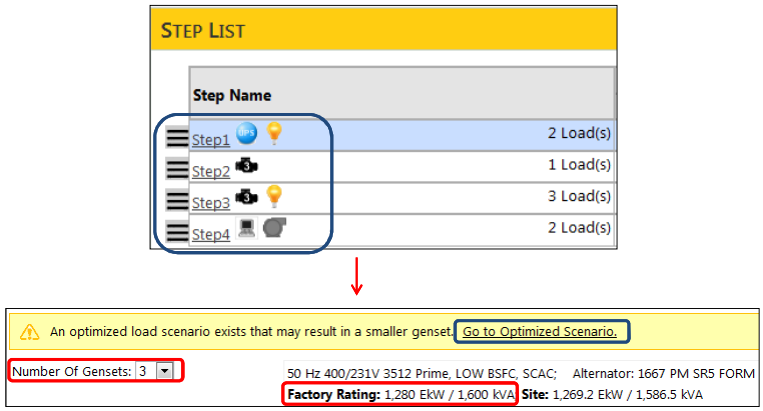


20% max allowed Fdip/Vdip on all UPS
Sequence later in load scenario if possible

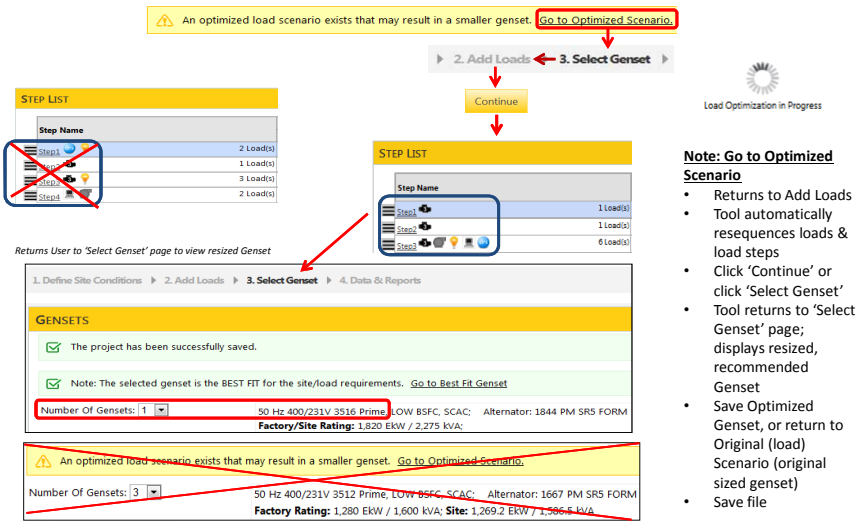


Electric Power SpecSizer

- **Select Genset**: Optimized genset may be possible (downsizes genset!)
  - Optimizer runs automatically in background & prompts user if Optimized load scenario or genset is possible



Electric Power SpecSizer



Note: Go to Optimized Scenario

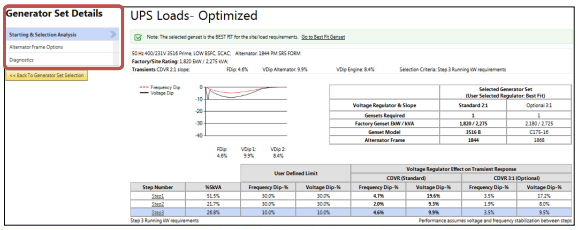
- Returns to Add Loads
- Tool automatically resequences loads & load steps
- Click 'Continue' or click 'Select Genset'
- Tool returns to 'Select Genset' page; displays resized, recommended Genset
- Save Optimized Genset, or return to Original (load) Scenario (original sized genset)
- Save file

Electric Power SpecSizer

- Select Genset: click **View** → Generator Set Details

Generator Set Details
- Starting & Selection Analysis
- Alternator Frame Options
- Diagnostics

	Factory Genset EkW/kVA	Site Genset EkW/kVA	Site Alternator kVA	Genset Model	Generator Set Duty	Emissions	Alternator								
							Frame	Excitation	Winding	Type	Std/Opt	RkVA	VDip1	% Genset Capacity Used	
☐	* 2,260 / 2,825	* 2,260 / 2,825	3,000	C175-16	Prime	LOW BSFC	1868	PM	FORM	SR5	Optional	3,000.0	17.2%	77.5	View
☐	* 2,260 / 2,825	* 2,260 / 2,825	3,000	C175-16	Prime	LOW BSFC	1868	PM	FORM	SR5	Standard	3,000.0	17.2%	77.5	View
☐	2,180 / 2,725	2,180 / 2,725	3,000	C175-16	Prime	LOW BSFC	1868	PM	FORM	SR5	Optional	3,000.0	17.2%	80.4	View
☐	2,180 / 2,725	2,180 / 2,725	2,750	C175-16	Prime	LOW BSFC	1866	PM	FORM	SR5	Optional	2,750.0	10.3%	-	View
☐	2,180 / 2,725	2,180 / 2,725	2,750	C175-16	Prime	LOW BSFC	1866	PM	FORM	SR5	Optional	2,750.0	10.3%	-	View
☐	2,180 / 2,725	2,180 / 2,725	2,750	C175-16	Prime	LOW BSFC	1866	PM	FORM	SR5	Standard	2,750.0	10.3%	-	View
☐	2,180 / 2,725	2,180 / 2,725	2,750	C175-16	Prime	LOW BSFC	1866	PM	FORM	SR5	Standard	2,750.0	10.3%	-	View
☐	1,820 / 2,275	1,820 / 2,275	2,500	3516 B	Prime	EMISSION	1844	PM	FORM	SR5	Standard	2,500.0	19.6%	96.3	View
☐	1,820 / 2,275	1,820 / 2,275	2,500	3516 B	Prime	EMISSION	1844	PM	FORM	SR5	Standard	2,500.0	19.6%	96.3	View
☐	1,820 / 2,275	1,820 / 2,275	2,500	3516 B	Prime	LOW BSFC	1844	PM	FORM	SR5	Standard	2,500.0	19.6%	96.3	View
☑	1,820 / 2,275	1,820 / 2,275	2,500	3516 B	Prime	LOW BSFC	1844	PM	FORM	SR5	Standard	2,500.0	9.9%	96.3	View
☐	1,600 / 2,000	1,600 / 2,000	2,750	3516 B	Prime	EMISSION	1866	PM	FORM	SR5	Optional	2,750.0	10.3%	-	View



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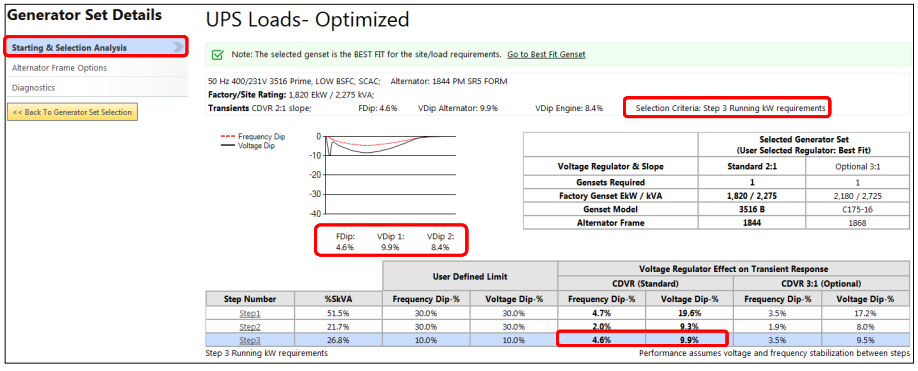
Electric Power SpecSizer

- Select Genset: click **View** → Generator Set Details → Starting & Selection Analysis
  - Details related to site loads, e.g. loads' calculated transients
  - Selection Criteria – why the next smaller genset than Best-Fit would fail

Note: Vdip1 = synchronous (alternator only) voltage dip
Note: Vdip2 = frequency-induced (engine caused) voltage dip



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Electric Power SpecSizer

- Select Genset: click **View** → Generator Set Details

Generator Set Details
- Starting & Selection Analysis
- Alternator Frame Options
- Diagnostics

Now displaying 161-180 of 970

Generator Set								Alternator							% Genset Capacity Used	
Model	Factory EkW/kVA	Site EkW/kVA	Duty	Emissions	Feature Code	Site kVA	Arrangement Number	Frame	Excitation	Winding	Type	Std/Opt	RkVA	VDip1		
3516 B	† 1,600 / 2,000	† 1,591.3 / 1,989.1	Prime	EMISSION	516DEB2	2,000	2523850	1625	PM	RANDOM	SR5	Optional	2,000.0	21.1%	98.1	
3516 B	† 1,600 / 2,000	† 1,591.3 / 1,989.1	Prime	EMISSION	516DEB2	2,000	2523850	1625	PM	RANDOM	SR5	Optional	2,000.0	21.1%	98.1	
3516 B	† 1,600 / 2,000	† 1,591.3 / 1,989.1	Prime	LOW BSFC	516DEB2	2,000	2523850	1625	PM	RANDOM	SR5	Optional	2,000.0	21.1%	98.1	
3516 B	† 1,600 / 2,000	† 1,590.3 / 1,987.9	Prime	LOW BSFC	516DEB2	2,000	2523850	1625	PM	RANDOM	SR5	Optional	2,000.0	21.1%	98.2	
3516 B	† 1,600 / 2,000	† 1,591.3 / 1,989.1	Prime	LOW BSFC	516DEB2	2,000	2523850	1625	PM	RANDOM	SR5	Optional	2,000.0	9.7%	98.	
3516	† 1,460 / 1,825	† 1,460 / 1,825	Prime	LOW BSFC	516DE9F	2,750	3723064	1866	PM	FORM	SR5	Optional	2,750.0	8.1%	-	
3516	† 1,460 / 1,825	† 1,460 / 1,825	Prime	LOW BSFC	516DE9F	2,750	3723064	1866	PM	FORM	SR5	Optional	2,750.0	8.1%	-	
3516	† 1,460 / 1,825	† 1,451.8 / 1,814.7	Prime	LOW BSFC	516DR9N	2,500	3723056	1844	PM	FORM	SR5	Optional	2,500.0	7.8%	-	
3516	† 1,460 / 1,825	† 1,454.8 / 1,818.5	Prime	LOW BSFC	516DR9N	2,150	2523866	1647	PM	RANDOM	SR5	Optional	2,150.0	8.4%	-	

Note: The selected genset is USER SELECTED and meets or exceeds the site/load requirements. Go to Best Fit Genset

Electric Power SpecSizer

- Select Genset: click **View** → Generator Set Details → Alternator Frame Options
  - Provides details of all Alternators that are options for selected genset model & rating
  - Provides Alternators' RkVA values (running kVA capacity)
  - Can order an Alternator with better Non-Linear load capability
    - e.g. for Data Centers, an option for sites with high harmonic & voltage & current distortion loads

Starting & Selection Analysis
Alternator Frame Options
Diagnostics
<< Back To Generator Set Selection

Note: The selected genset is the BEST FIT for the site/load requirements. Go to Best Fit Genset

3516 Prime, LOW BSFC, SCAC: Alternator: 1625 PM SR5 RANDOM

Factory Rating: **1,600 EkW / 2,000 kVA;** Site: **1,591.3 EkW / 1,989.1 kVA**

Transients **CDVR 2:1 slope;** FDip: **2.9%** VDip Alternator: **9.7%** VDip Engine: **5.5%**

Engine Performance Number: **DM7939** Top-Level Feature Code: **516DEB2**
Electricity Supply: **3-Phase 50 Hz 400/230 V** Generator Arrangement Number: **2523850**
Selection Criteria: **Step 3 Running kW requirements**

Selected Generator Set Standard & Optional Alternator Frames								Alternator Frame					
Genset Model	Alternator Type	Alternator Arrangement Number	Winding Type	Excitation	Temperature Rise	Standard	Optional	1866	1669	1842	1647	1667	1625
3516 B	SR5	3723064	FORM	PM	80 C		X	2,750.0					
3516 B	SR5	3723064	FORM	PM	80 C		X	2,750.0					
3516 B	SR5	3723064	FORM	PM	80 C		X	2,750.0					
3516 B	SR5	3723064	FORM	PM	80 C		X	2,750.0					
3516 B	SR5	3723064	FORM	PM	80 C		X	2,750.0					
3516 B	SR5	3723064	FORM	PM	80 C		X	2,750.0					

Electric Power SpecSizer

- Select Genset: click **View** → Generator Set Details → Diagnostics
  - Technical data for sized genset: Genset, Alternator, Engine and Project information
  - Diagnose sized genset's technical capabilities; provides useful product numbers for TMI system searches, On-Line Price List searches

Generator Set Details

- Starting & Selection Analysis
- Alternator Frame Options
- Diagnostics
- << Back To Generator Set Selection

UPS Loads- Optimized

Note: The selected genset is the BEST FIT for the site/load requirements. Go to Best Fit Genset

50 Hz 400/231V 3516 Prime, LOW BSFC, SCAC; Alternator: 1844 PM SR5 FORM
Factory/Site Rating: 1,820 EkW / 2,275 kVA;
Transients CDVR 2:1 slope; FDip: 4.6% VDip Alternator: 9.9% VDip Engine: 8.4% Selection Criteria: Step 3 Running kW requirements

Genset Diagnostics

Genset Model	Site kW/kVA	Rating kW	Top-Level Feature Code	Facility Code		Source (Price List)		Region	
3516 B	1,820.0 / 2,275.0	1,820.0 / 2,275.0	516DE8R	LE Griffin	X	#1	3516 PGDG	E901 EPNA	X
				88 Lafayette		#2		E860 APPS	X
				XJ Tianjin		#3		E500 EAME	X
				JC Larne		#4		E50W Canada	X
				LS Newberry				E50Z LACD	X

Alternator Diagnostics

Genset Model	Site kW/kVA	Rating kW	Alternator Arrangement Number	Alternator Rating kVA	Efficiency	Temperature Rise	Standard	Optional
3516 B	1,820.0 / 2,500.0	1,820.0 / 2,275.0	3723056	2,500.0	95.6	105 C	X	

Engine Diagnostics

Genset Model	Site kW/kVA	Rating kW	DM Performance Number	Rack Stop kW	Max Single Step kW	Fan kW (Power)	Fan Ratio
3516 B	1,825.0 / 2,275.0	1,820.0 / 2,275.0	DM7967	2,502.5	1,687.9	46.0	0.0

Project Diagnostics

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Electric Power SpecSizer

- Compare Gensets' performance: click **View** → Generator Set Details

GENSETS

Note: The selected genset is the BEST FIT for the site/load requirements. Go to Best Fit Genset

Number Of Gensets: 1

C13 Prime, LOW BSFC, ATAAC; Alternator: LC6124B AREP LC RANDOM

Factory/Site Rating: **280 EkW / 350 kVA;**

Transients **R450M 1:1 slope;** FDip: **8.4%** VDip Alternator: **9.3%** VDip Engine: **4.4%**

Compare Gensets | Compare Optional vs Standard

Now displaying 901-920 of 934

Model		Factory EkW/kVA	Site EkW/kVA	Duty	Emissions	Feature Code	Site kVA	Arrangement Number	Frame	Excitation						
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	455	4215088	LC6124D	AREP						
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE18	455	3969607	LC6114D	SE						
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	455	3969607	LC6114D	SE						
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE18	400	4215199	LC6134C	PM						
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	400	4215199	LC6134C	PM						
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	400	4215200	LC6124C	AREP						
C13	☑	280 / 350	280 / 350	Prime	LOW BSFC	C13DE18	400	4215199	LC6114C	SE	RANDOM	LC	Optional	400.0	10.8%	-
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	400	4215199	LC6114C	SE	RANDOM	LC	Optional	400.0	10.8%	-
C13	☑	280 / 350	280 / 350	Prime	LOW BSFC	C13DE33	380	3969606	LC6134B	PM	RANDOM	LC	Standard	380.0	9.3%	71.4
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE18	380	3969606	LC6134B	PM	RANDOM	LC	Standard	380.0	9.3%	71.4
C13	☐	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	380	3969606	LC6134B	PM	RANDOM	LC	Standard	380.0	9.3%	71.4
C13	☑	280 / 350	280 / 350	Prime	LOW BSFC	C13DE02	380	4215087	LC6124B	AREP	RANDOM	LC	Optional	380.0	9.3%	71.4

Compare Gensets | Compare Optional vs Standard

Now displaying 901-920 of 934

Model	Factory EkW/kVA	Site EkW/kVA	Duty	Emissions
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC
C13	280 / 350	280 / 350	Prime	LOW BSFC

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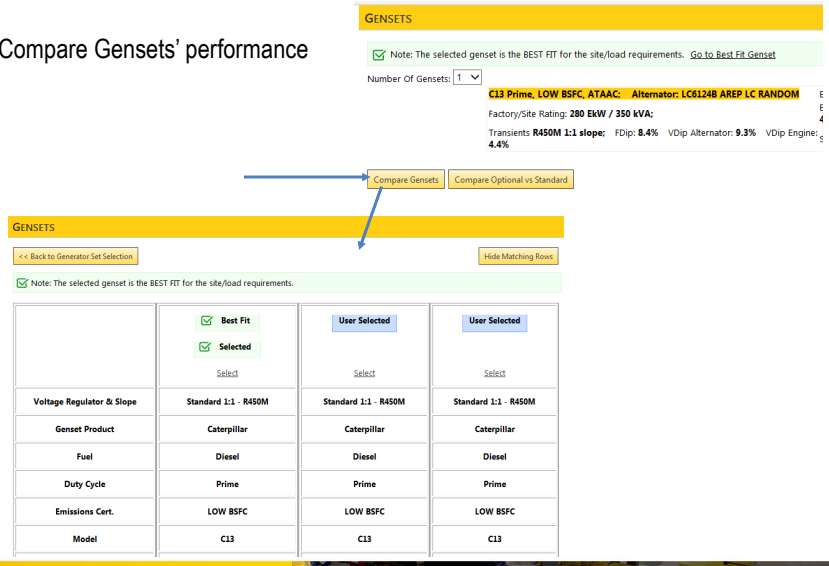
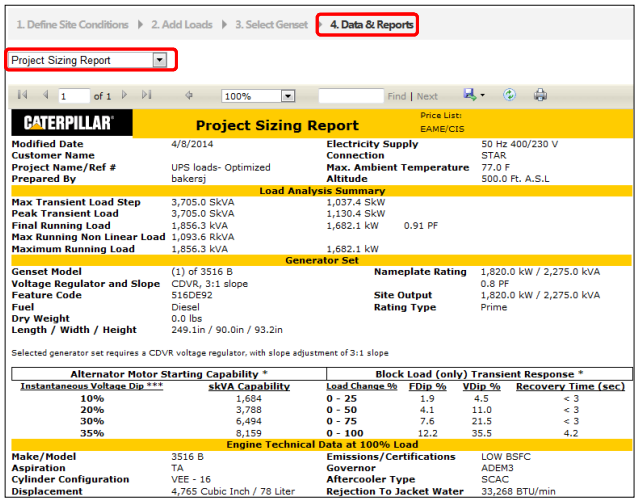
Electric Power SpecSizer

- Compare Gensets' performance



Electric Power SpecSizer

- Data & Reports: Project Sizing Report, Load Report & Transient Performance Report
  - Sizing Report – Provides Project, Load Analysis, Genset, Engine & Alternator data for sized Genset



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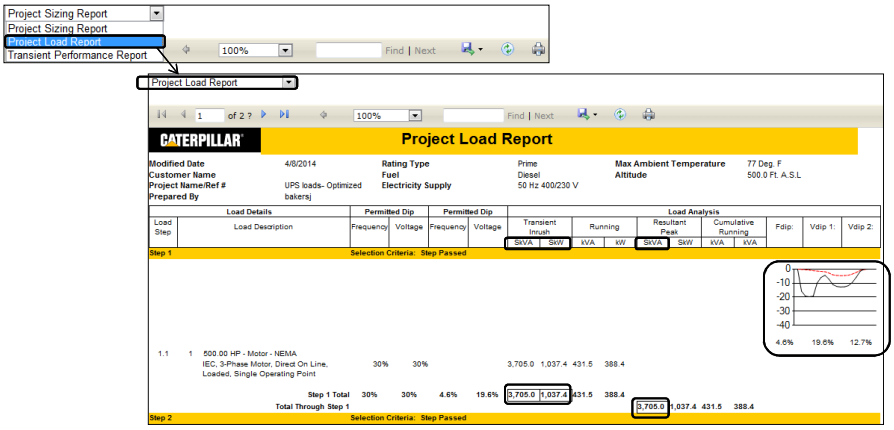
- Data & Reports: Load Report
  - Worst sizing factors (Inrush, Running & Non-Linear) are boxed in load step they occur; work to reduce these sizing parameters to downsize genset
  - Transient graph provided for each load step



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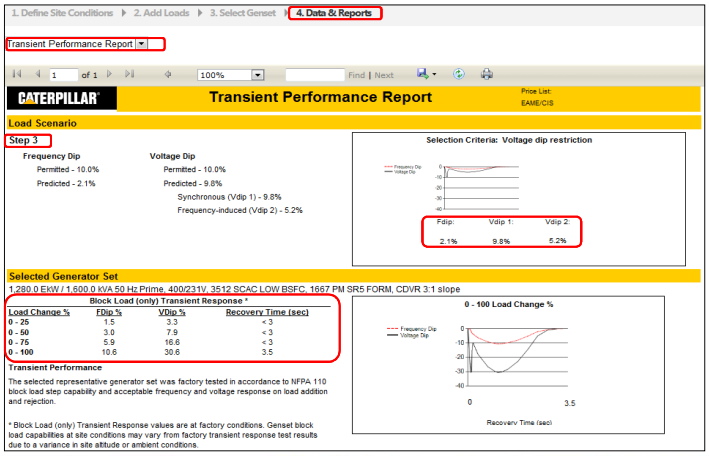
- Data & Reports: Transient Performance Report
  - Load Scenario – load step & step's transients that the genset sizing is based upon
  - Selected Generator Set – factory block load test, transient response at 25% load changes



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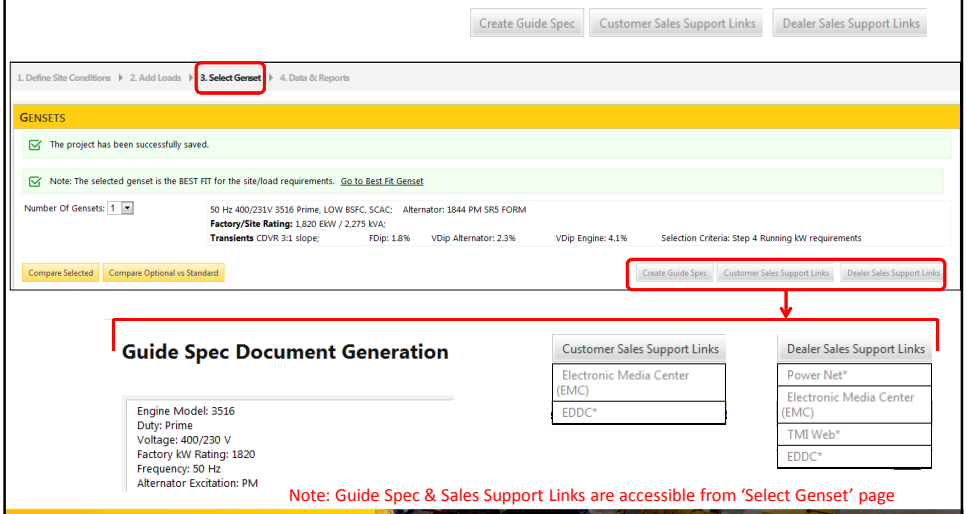
- Sales Support web links & documents



Note: Guide Spec & Sales Support Links are accessible from 'Select Genset' page

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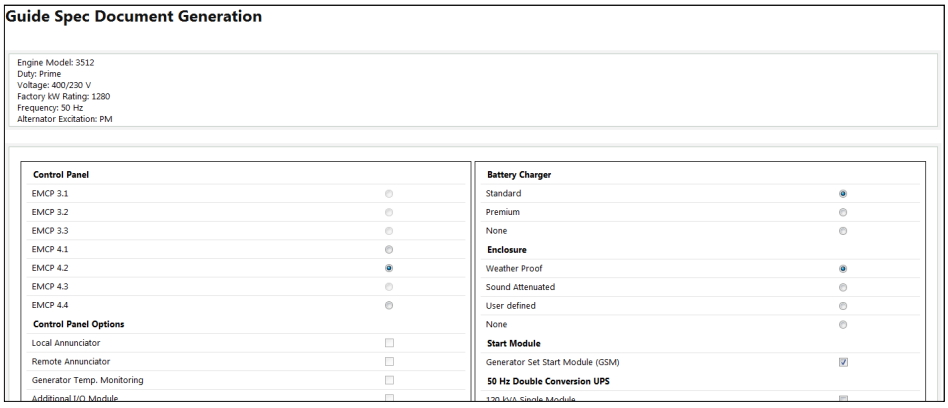
- Guide Spec – MSWord doc, editable
  - Available in English & French
  - Discussions on Spanish Guide Spec planned; communicate if need for other languages



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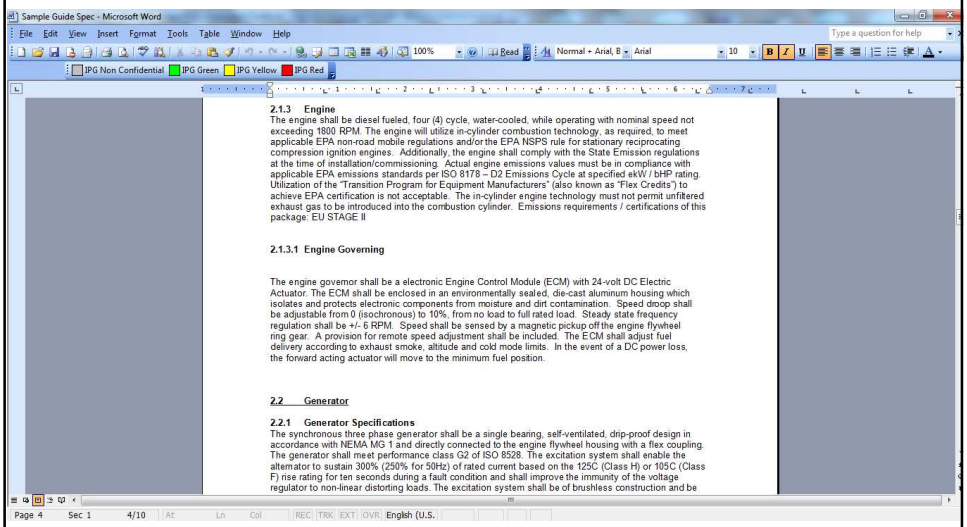
Electric Power SpecSizer



2.1.3 Engine

The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified ekW / bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder. Emissions requirements / certifications of this package: EU STAGE II

2.1.3.1 Engine Governing

The engine governor shall be a electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10%, from no load to full rated load. Steady state frequency regulation shall be +/- 6 RPM. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

2.2 Generator

2.2.1 Generator Specifications

The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300% (250% for 50Hz) of rated current based on the 125C (Class H) or 105C (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be

Note: Guide Spec comprised of (3) sections: Genset, ATS & Switchgear

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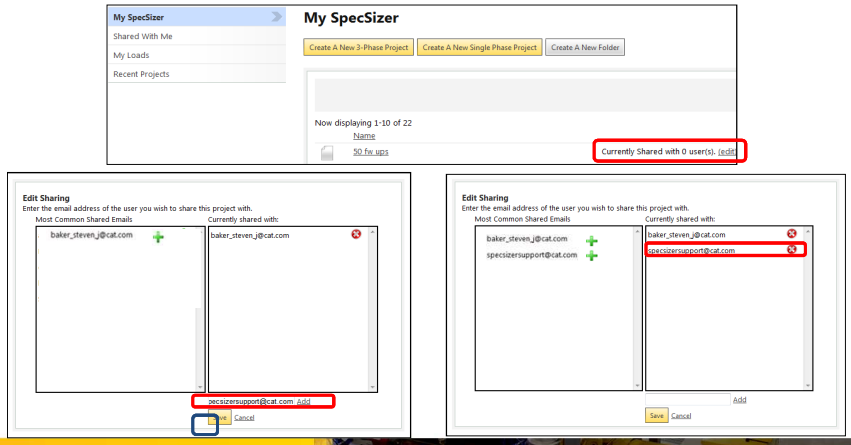
  - Add user's email address in 'Add' box. Save.
  - Previously added User can be moved from left to right box by clicking on green plus sign



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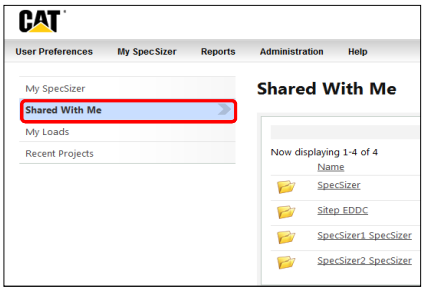
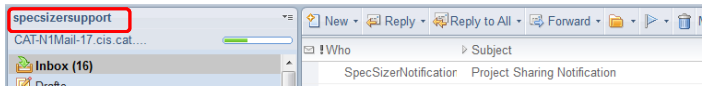


- **SpecSizer Help & Support – email inquiry to specsizersupport@cat.com**
  - Share user sizing file with specsizersupport@cat.com | Share file using (edit) link



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- Gas Genset Availability
  - End of October/November for Dealers
  - All NG units in GERP
    - 423ekW – 2.5eMW
    - Over 600 Gas genset configurations
      - Including Price List and DTO Gensets
- Targeting 4th Quarter of 2016 for Customer & Consultant Availability
- Future Plans
  - Link to CSQ
  - Gas Spec Sheets
  - Add Methane Number Program
  - Add CG Gensets

Questions?

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