

**Cat® Electric Power**

**Gas Island  
Mode Live  
Demo & LNG**

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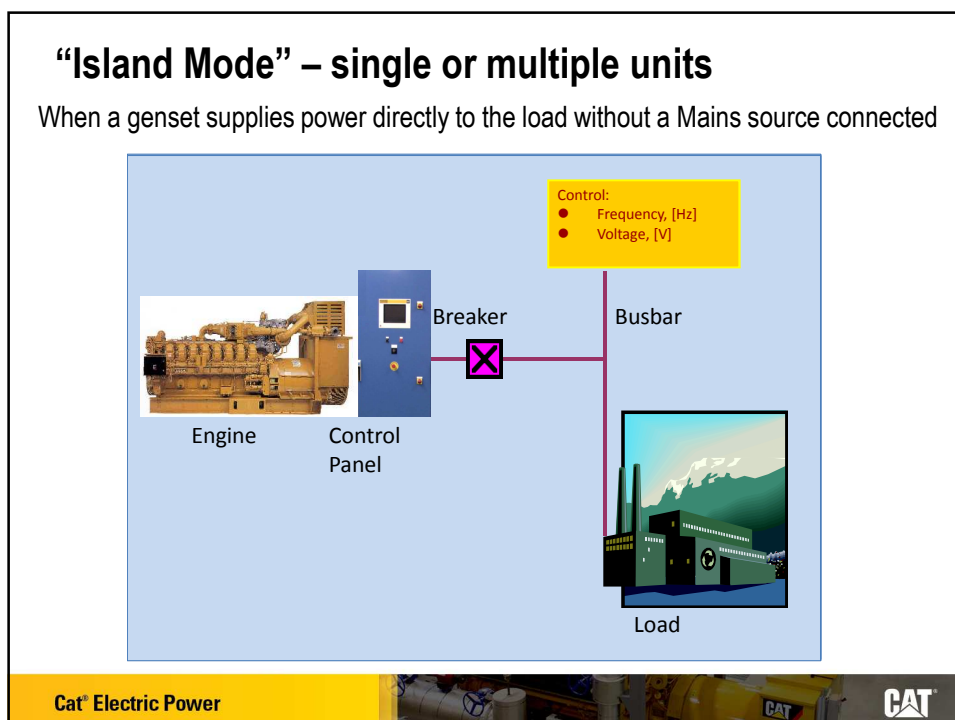






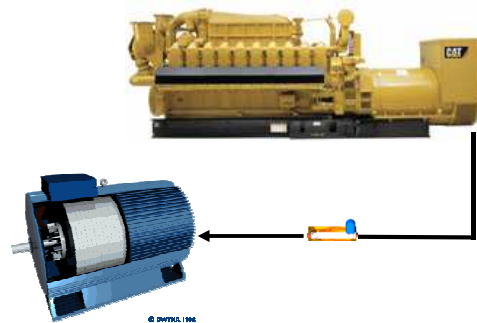
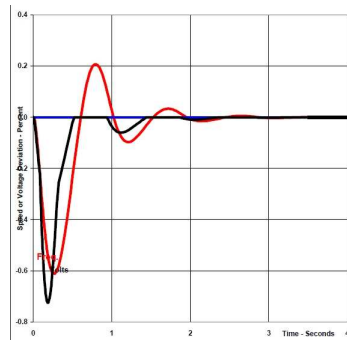
**BUILT FOR IT.**





## “Island Mode”

- Genset runs on variable load and may suffer large ON and OFF block loads



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## What is “Island Mode”?

### Island Mode

- The primary purpose of island mode is to **provide power in place of a utility grid for large periods of time.**
- Typical customer **requirements are strict** in terms of **loading, unloading, recovery time and/or voltage and frequency deviations during the load changes and at steady state.**
  - Island Mode- Load steps with **minimal voltage and frequency dips (5-10%)**
  - Similar to an **“infinite bus”**

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## What is “Standby Mode”?

### Standby Mode

- In Standby Mode, the **usage is typically very short and only when the utility grid is not available.**
  - A **larger voltage and frequency deviation** during load and unload steps is generally acceptable
    - Standby mode is a secondary function of the gas generator set.
    - Load steps with traditional standby **voltage and frequency dips (20-30%)** as seen in traditional standby applications

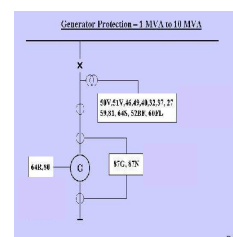
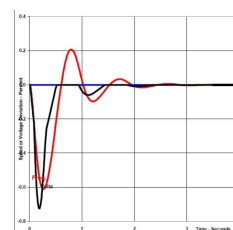
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## “Island Mode”

- Customer requirements in island mode are:
  - Required % load accept & rejected
  - Allowable frequency & voltage dip
  - Allowable recovery time
- Additional Control capabilities may require load and VAR sharing, load shedding, and etc.
- Balance heat radiator for CHP applications;
- A secure gas supply, sufficient to maintain supply pressure with load swings;
- An earthing (grounded connection) to ensure that the earth fault paths are maintained even at times of island operation.



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## Transient Standards ISO 8528-5

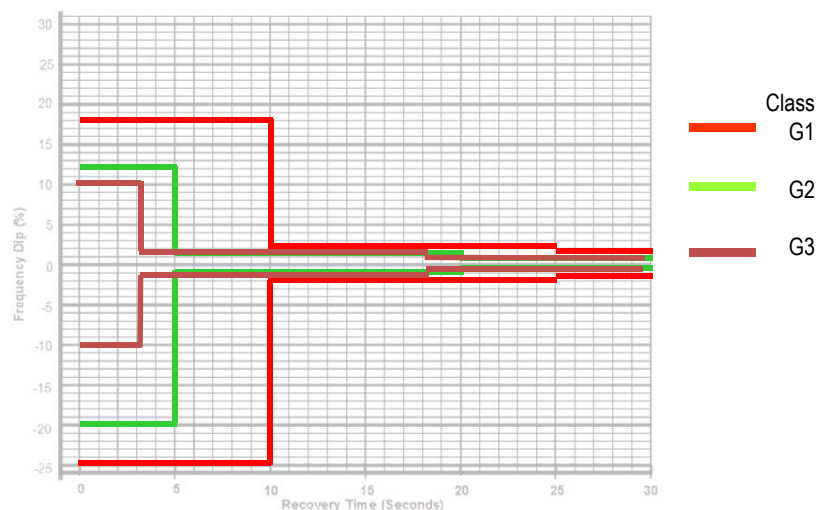
	G1 Class	G2	G3	G4
+25% Power Frequency Voltage	-25 % -25 %	-20 % -20 %	-15 % -15 %	AMC * AMC
- 25% Power Frequency Voltage	+18 % +35 %	+12 % +25 %	+10 % +20 %	AMC AMC
Max Recovery Time Frequency Voltage	10 s 10 s	5 s 6 s	3 s 4 s	AMC AMC
Recovery Frequency Tolerance	+/-1.75 %	+/- 1 %	+/- 1 %	AMC

\* AMC = by agreement between manufacturer and customer

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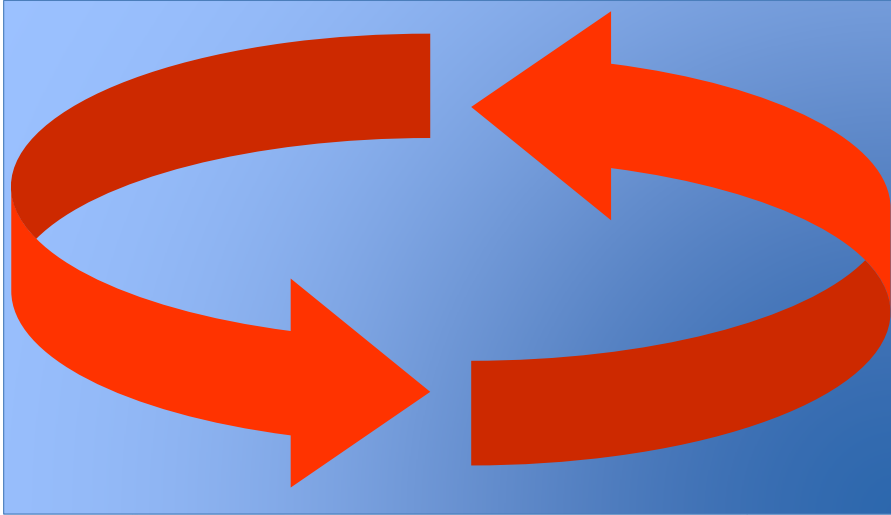
## ISO8528-5 Freq. Requirements



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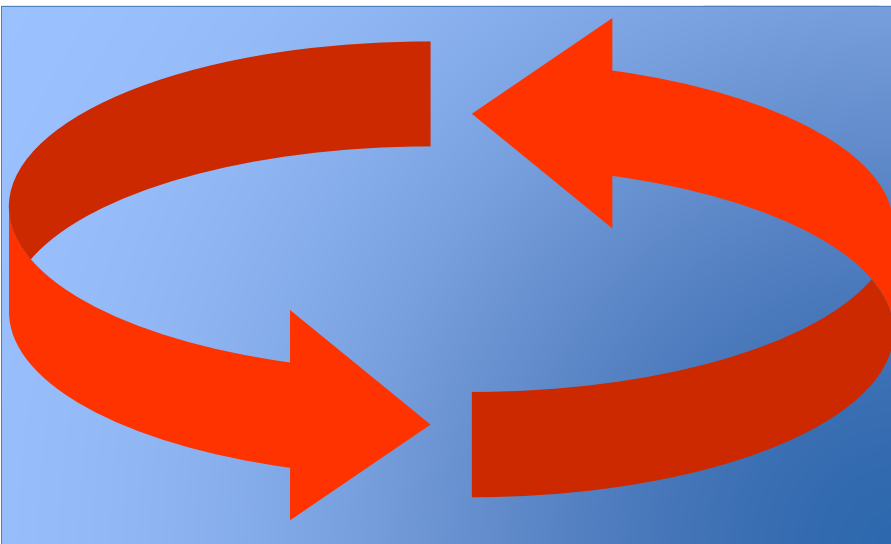
## How Diesel Engines Accept Load?



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## How Gas Gensets Accept Load?



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## Gas vs Diesel

- Transient capability is VERY different between gas and diesel.

	GAS	Diesel
transient capabilities	Weaker	Better
Steady state stability	Less stable	Better
Start up time	Longer	Shorter

- Today the Island Mode feature on G3500C high performance is capable to accept large transients

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## Example

- Today G3500C meets G1 class up to 25% load change @500mg/Nm<sup>3</sup> NO<sub>x</sub>.



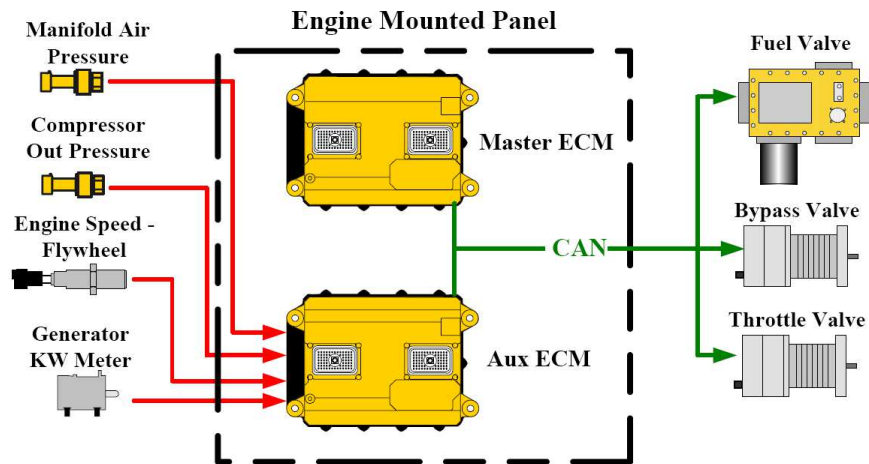
Classification as Defined by ISO 8528 - 5	Dynamic Frequency Deviation	Frequency Recovery Time	Dynamic Voltage Deviation	Voltage Recovery Time
Class G1	+18/-25 %	10 seconds	+35/-25 %	10 seconds

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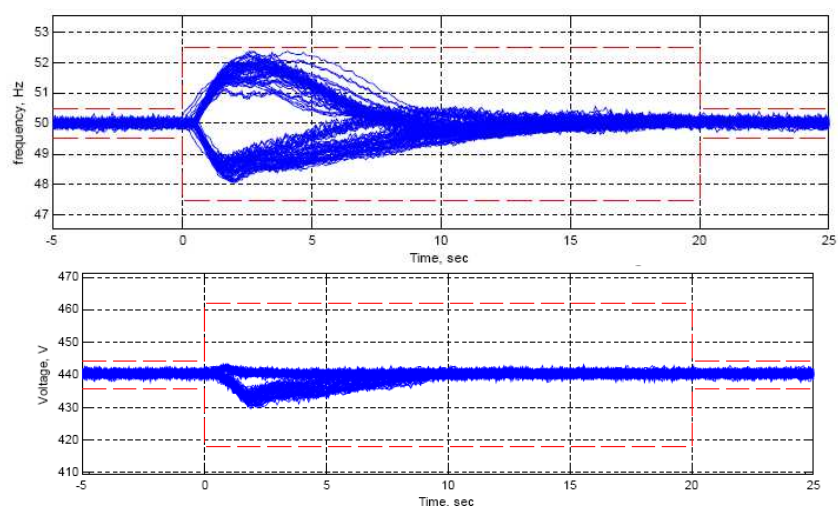
## Improved Design



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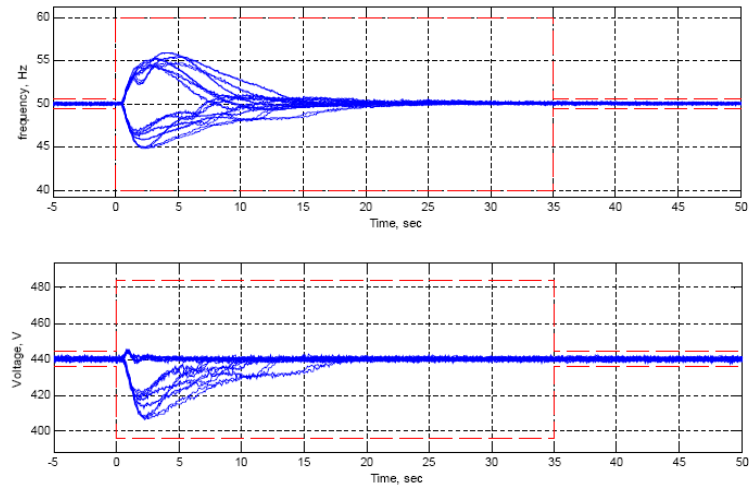
## Island Mode 10% load step recovery data



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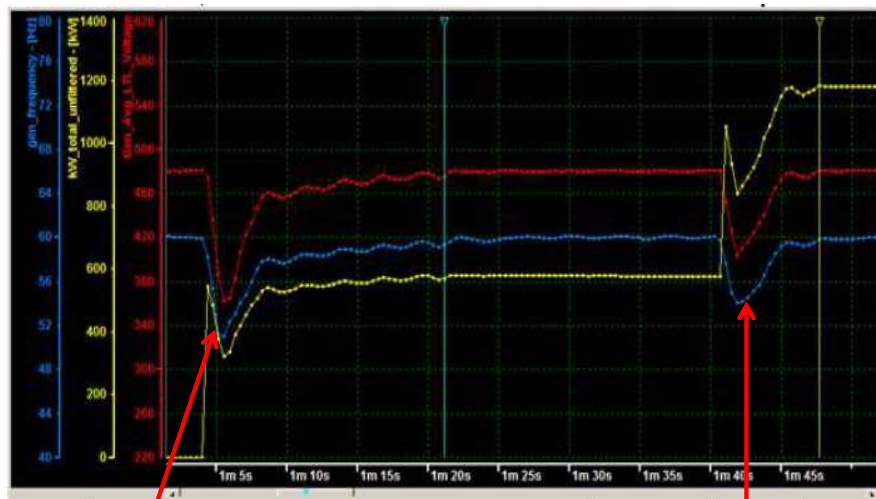
## Island Mode 25% load step recovery data



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## Block Loads



First 50% Step

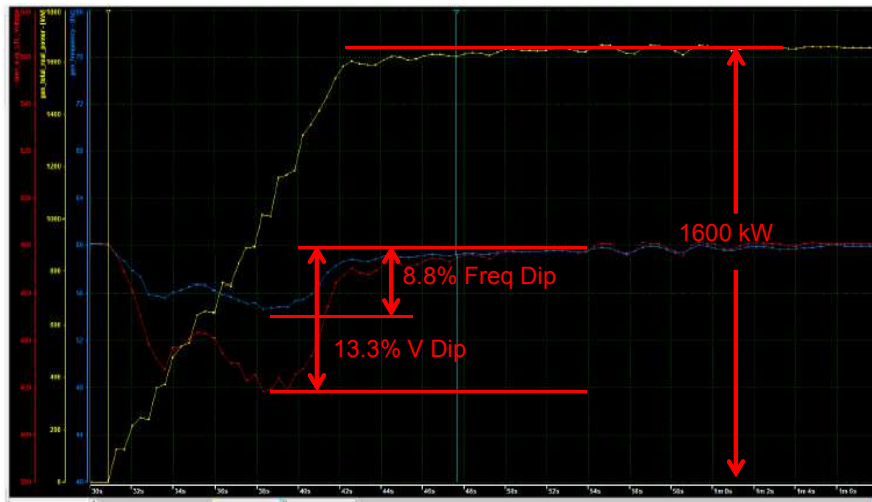
Second 50% Step

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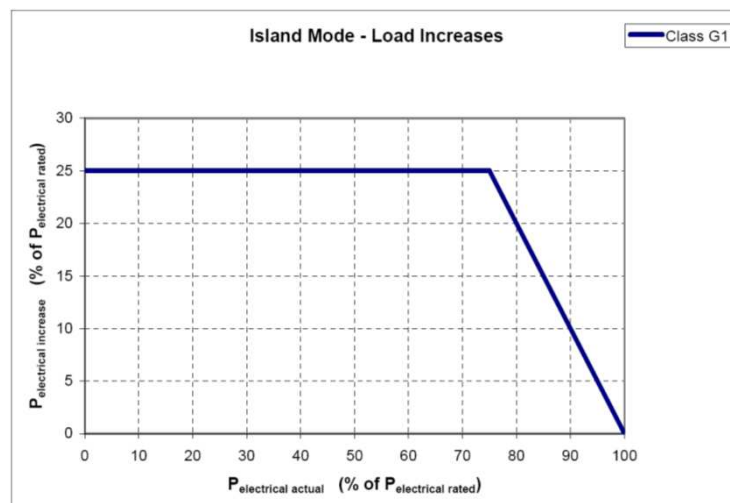
## Ramp Loading



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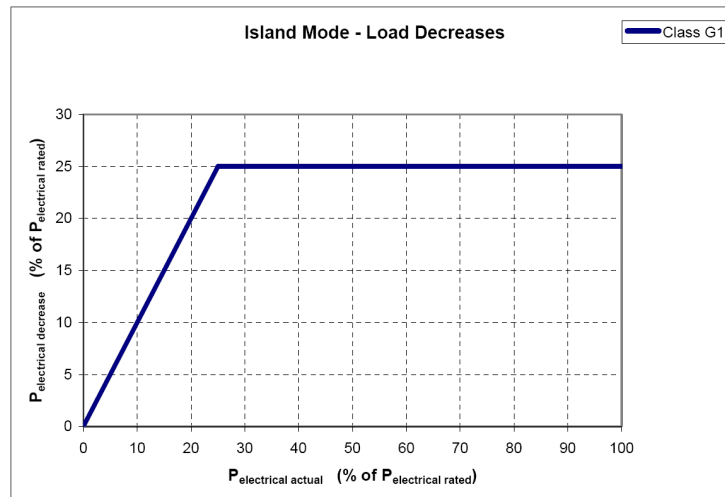
## IM Block Load Diagram



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## IM Block Unload Diagram



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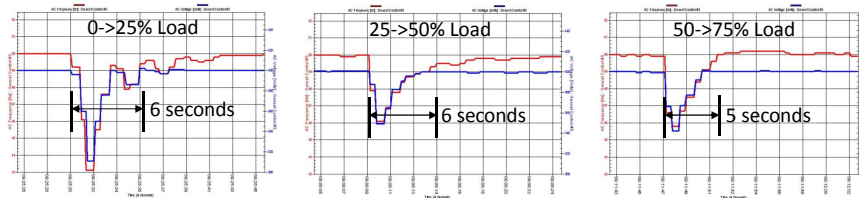
## Factors affecting Load Acceptance

- Required Emission level
  - The higher the better
- Ambient conditions
  - Altitude
  - Temperature at the air intake
- Fuel “quality” and pressure
  - Methane number & Low Heat Value
  - Inert gases
- System backpressure and restrictions
  - Fuel, air and exhaust are most important

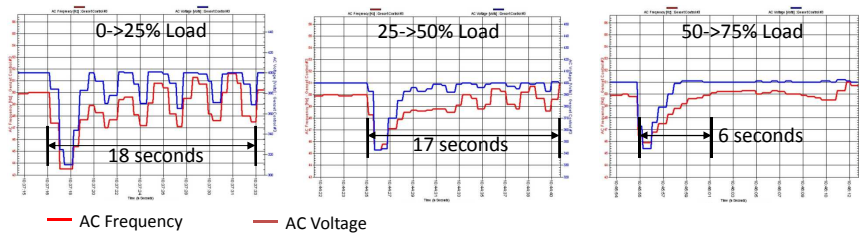
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## Optimal Operating Conditions



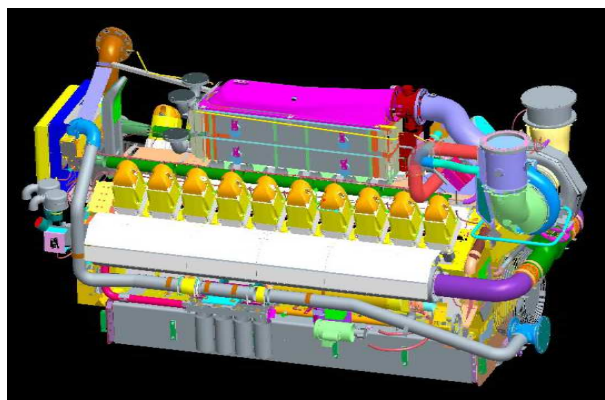
## Restricted Situations



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## Questions?



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