Residential AC Compressor
Low Line Voltage Behavior

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Copeland® brand products

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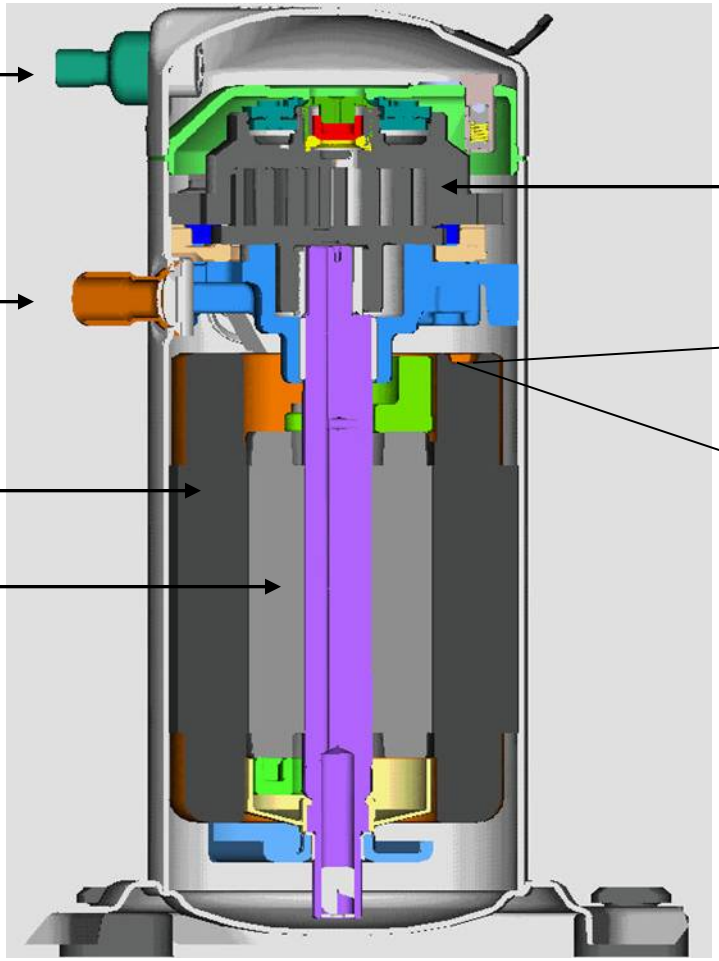
AC Compressor Under-Voltage Stall

- **Background**
  - **SCE & Other Utilities Have Reported Instances Of Residential AC Units Stalling When Line Voltages Dip Fast Due To Grid / Feeder Faults. When Large Numbers Of Units Stall At The Same Time, The Grid Voltage Does Not Recover Quickly After The Fault Has Been Cleared Due To The Excessive Reactive Power Demand From The Stalled AC Units. The Fear Is That This Localized Delayed Voltage Recovery Can Spread Very Rapidly To Other Areas On The Grid Leading To Wide- Spread Voltage Collapse.**

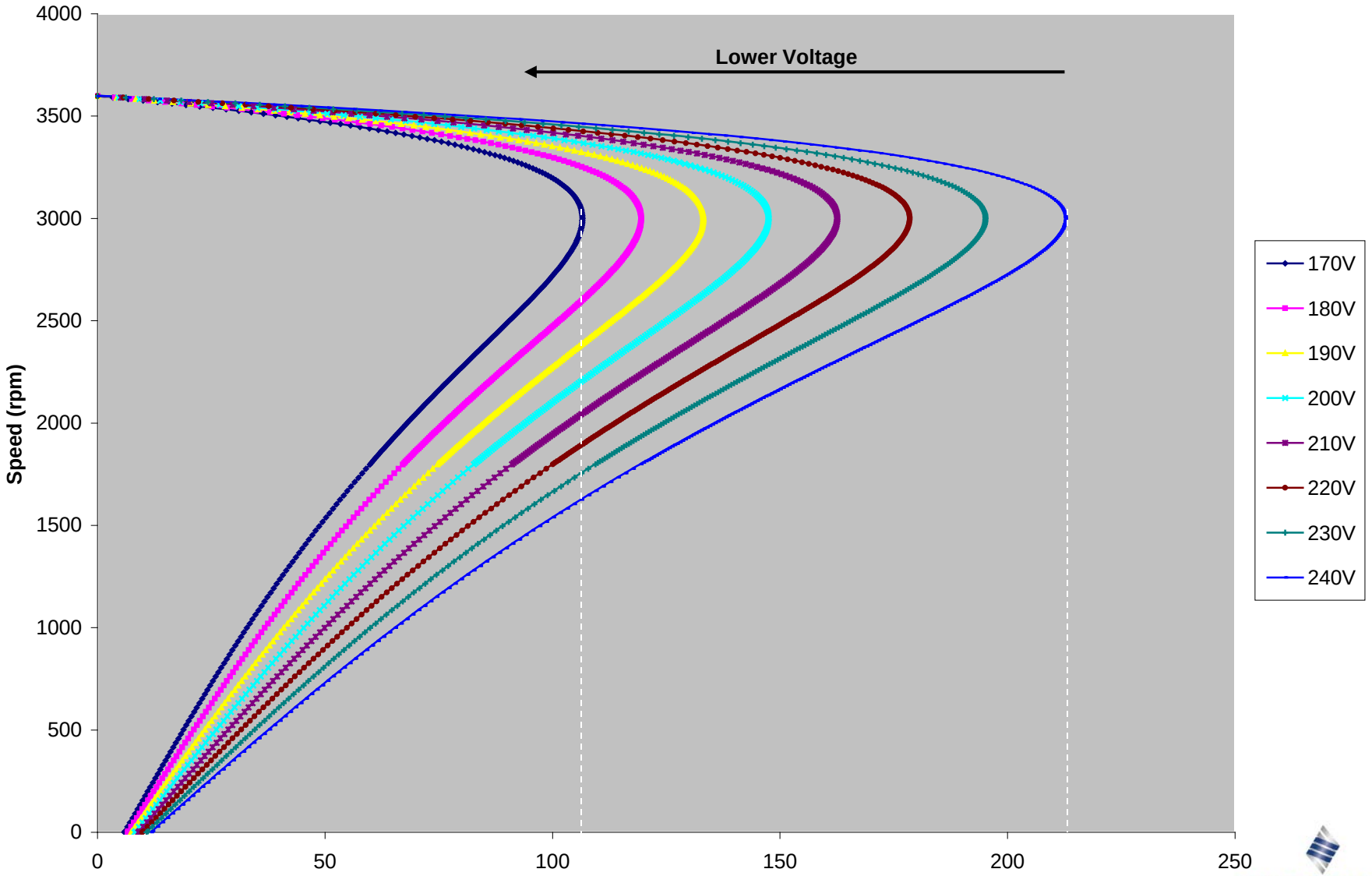
- **Presentation Objective**
  - **Share Basic Compressor Design Attributes That Drive Its Behavior Under Low Voltage Conditions**

Residential Scroll Compressor

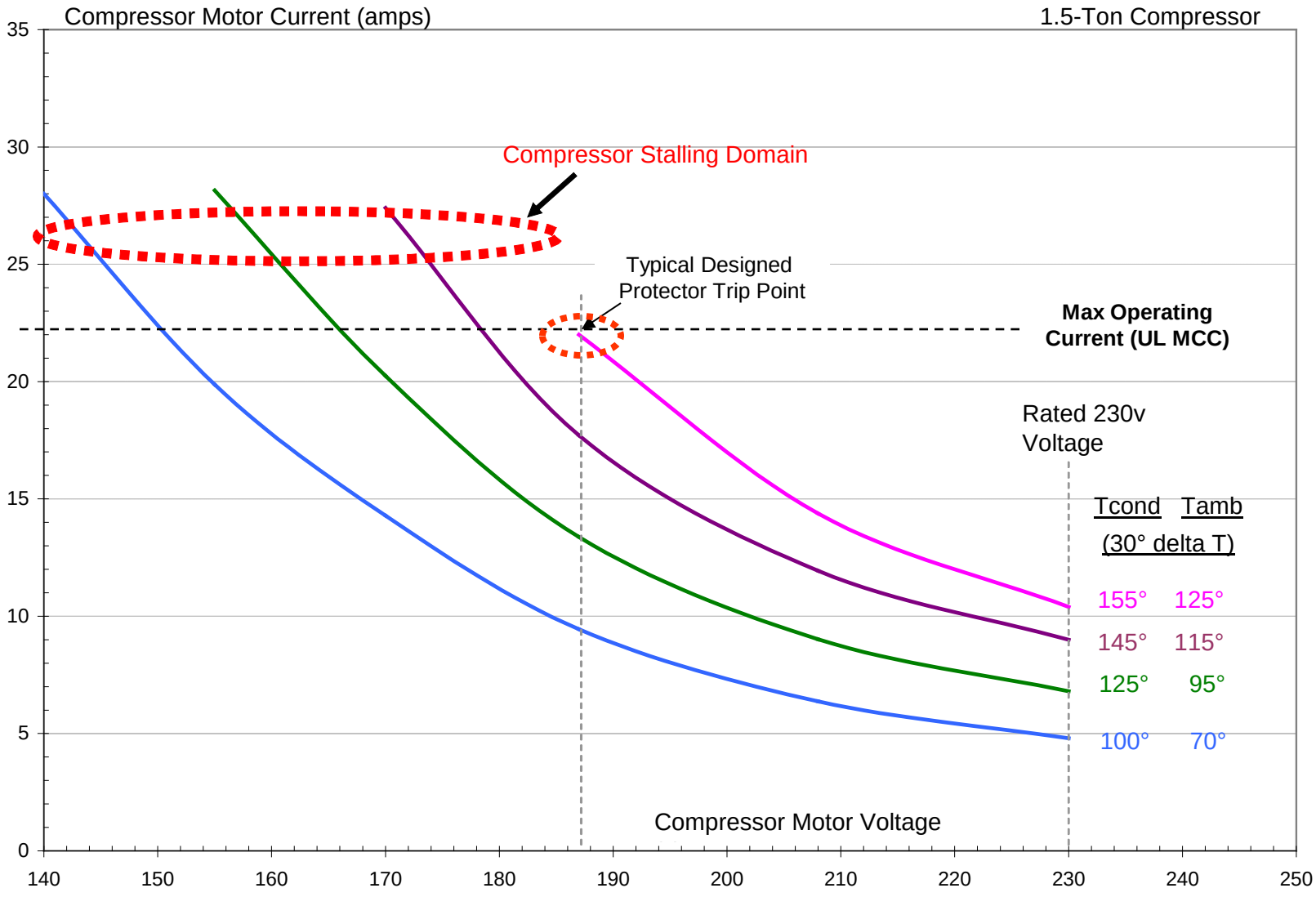


Speed-Torque Curves As f (Voltage)

Residential Single-Phase Compressor Motor

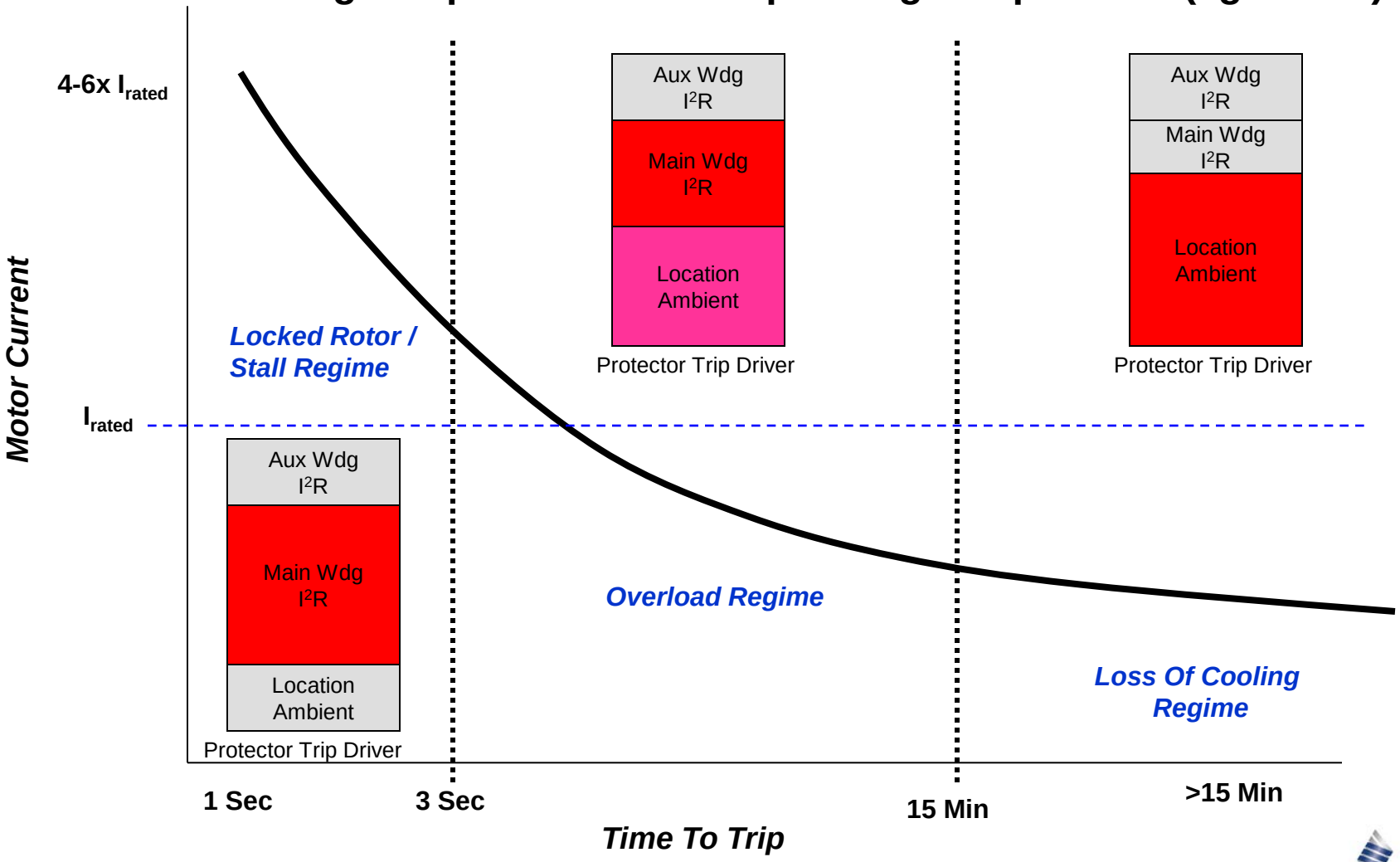


Compressor Motor Current As f (Voltage, Load)



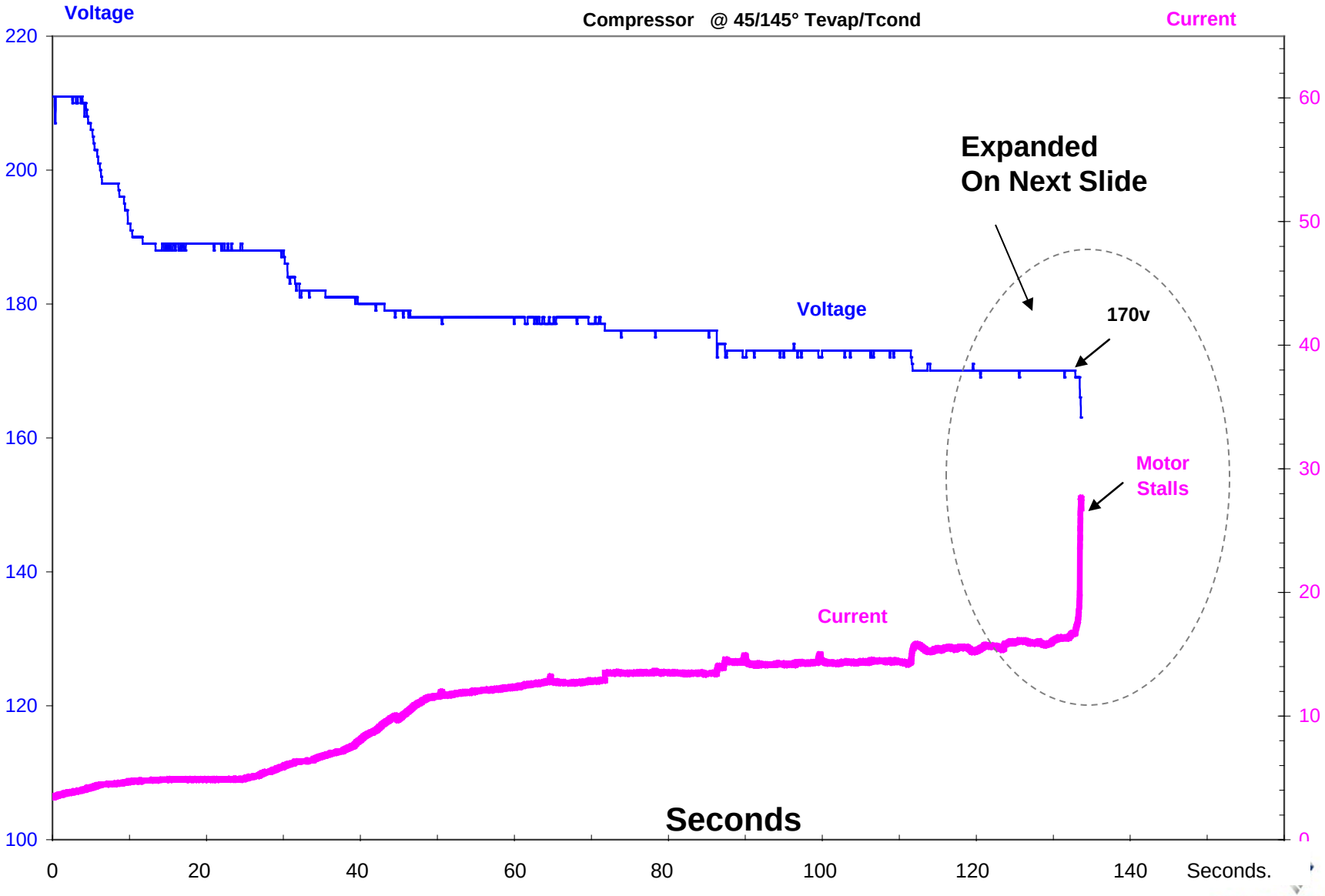
Typical Motor Protector Drivers / Response

Tuned To Trip
If Motor Winding Temperature >Safe Operating Temperature (eg. 285°F)

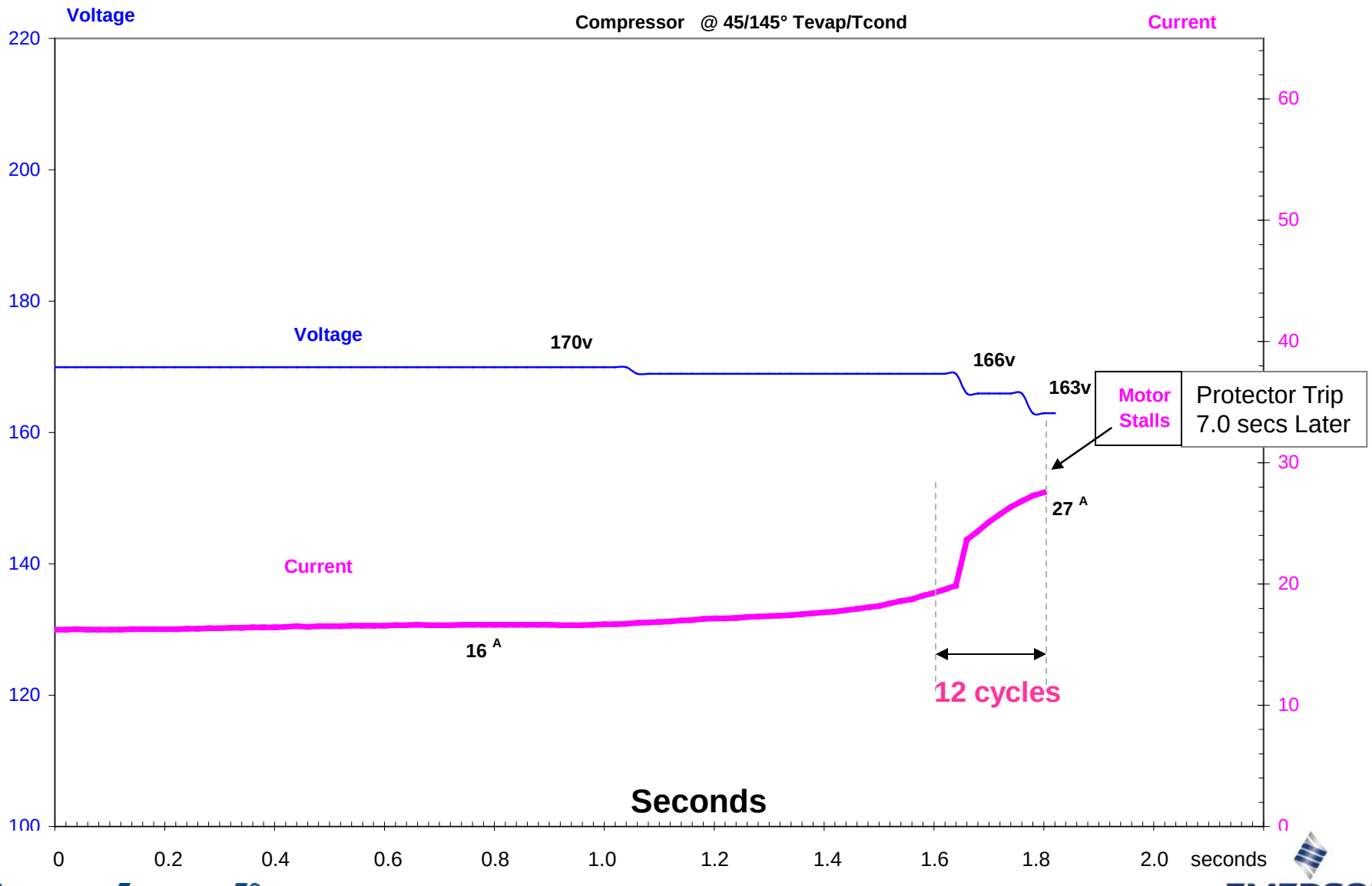


**Not to scale

Actual Response To Slow Voltage Changes (Secs)



Response To Fast Voltage Transients (Cycles)



Summary

- **Compressor Motor Designed To**
  - **Meet Max-Load Torque (Typical 115° - 125°F Outdoor Ambient) At Low Line Voltage Condition (Typical 187VAC)**
  - **Start At Low Line Voltage Condition (Typical 187VAC)**

- **Current Protection Leads To Observed Behavior Under Low Voltage Conditions**
  - **Time To Trip Protector When Rotor Stalls Is In Seconds**
    - **3 to 15 Secs**
  - **Protector Trip Actuation Is Thermally Driven**
    - **Not Designed To Respond To "Transient" Low Voltage Dips < 1 Sec**

- **No Known Commercially-Available Solution Today**
  - **Can Be Developed**