CREATING VALUE

LINCS II
SR DRIVE SYSTEM

JOYGLOBAL

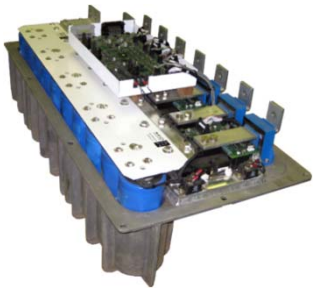
LINCS II DRIVE SYSTEM

MOTOR/GENERATOR

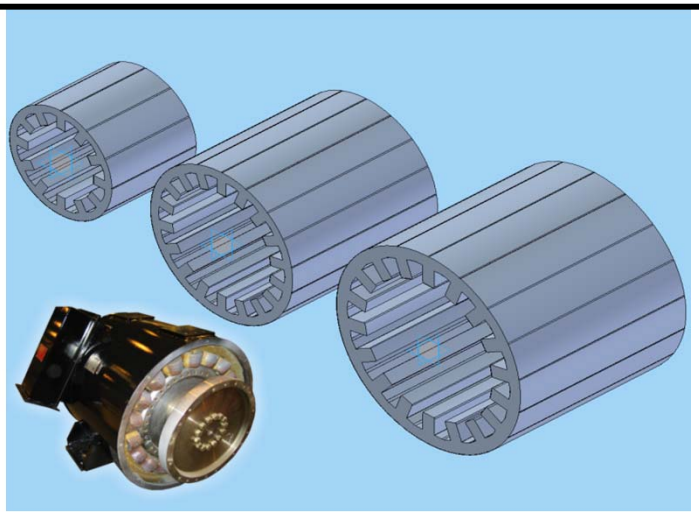
GEAR TRAIN

POWER CONVERSION

LINCS II CONTROL SYSTEM

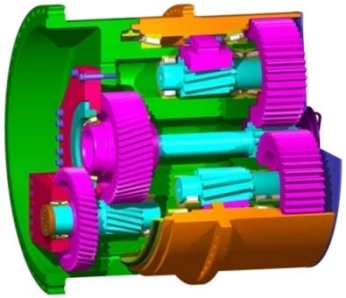


POWER CONVERSION



MOTOR/GENERATOR

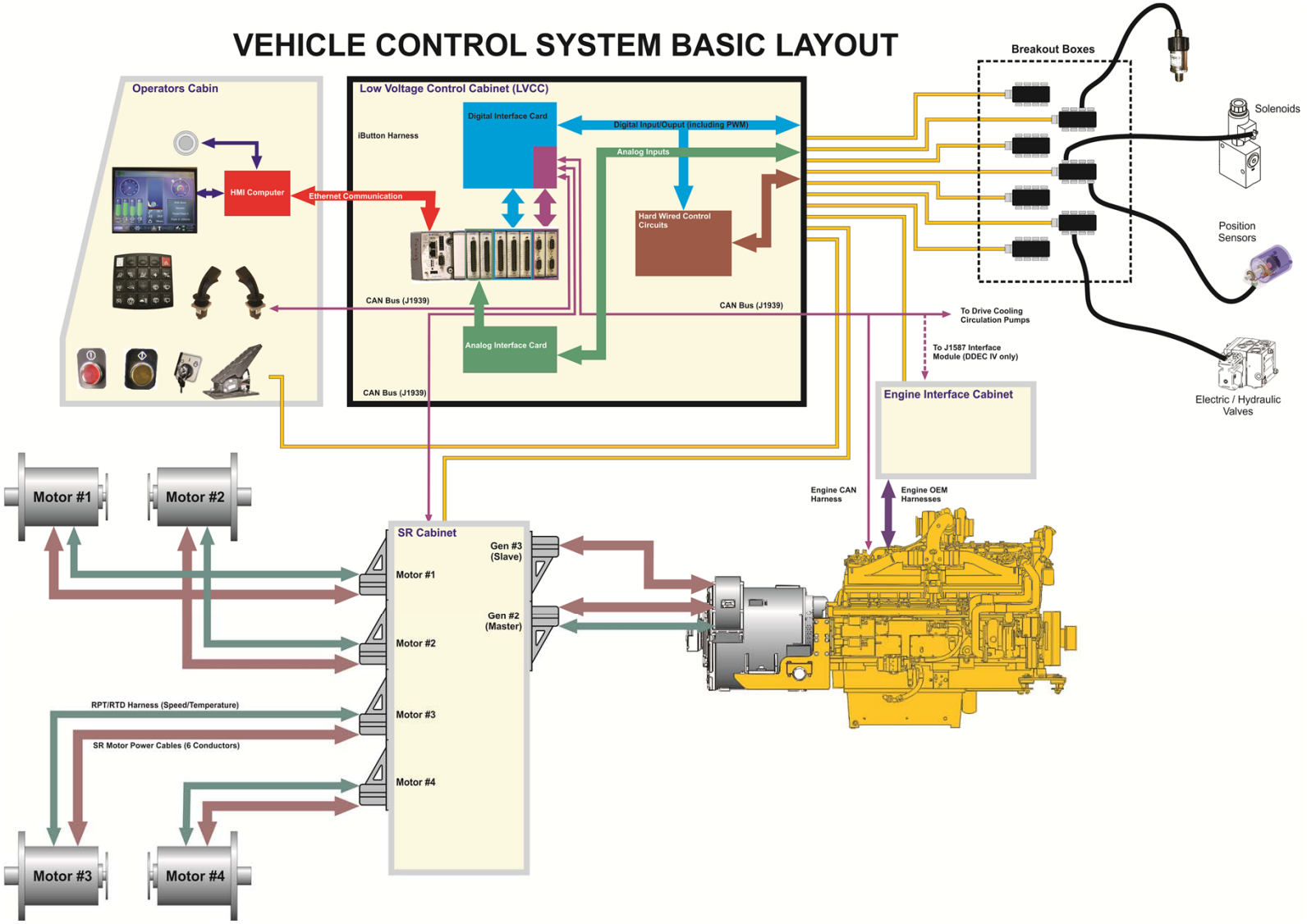
CONTROL SYSTEM



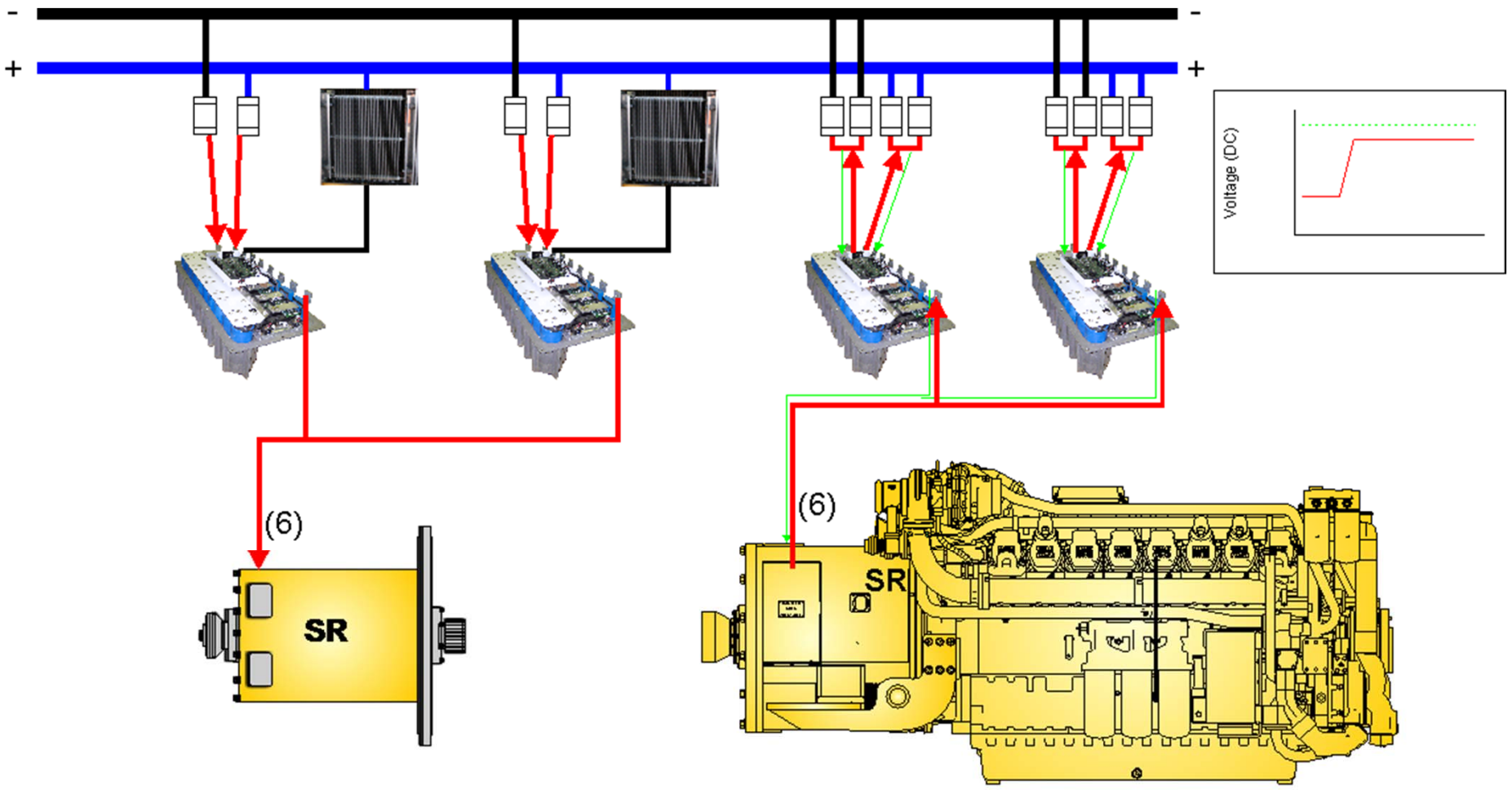
GEAR TRAIN

THEORY OF OPERATION

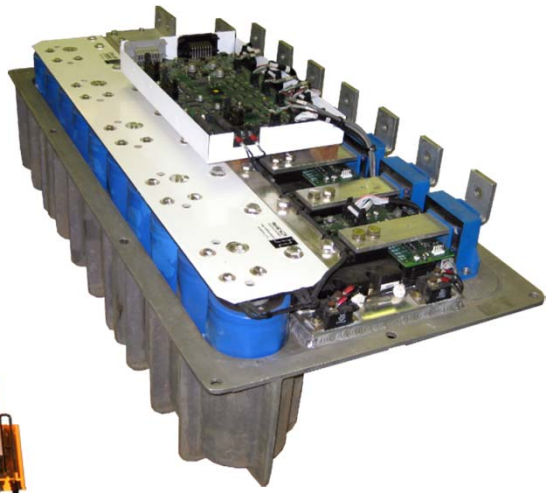
LINCS II LAYOUT

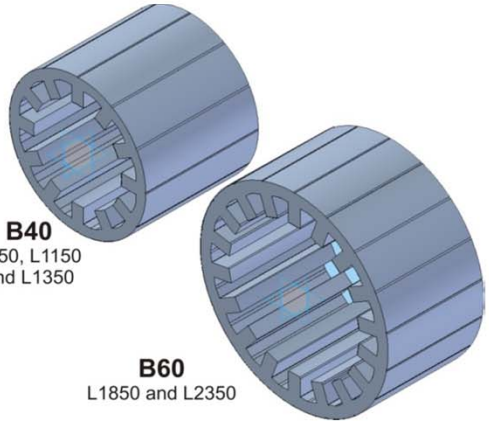


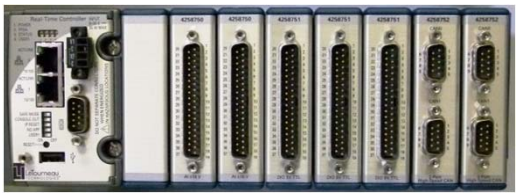
LINCS II LAYOUT

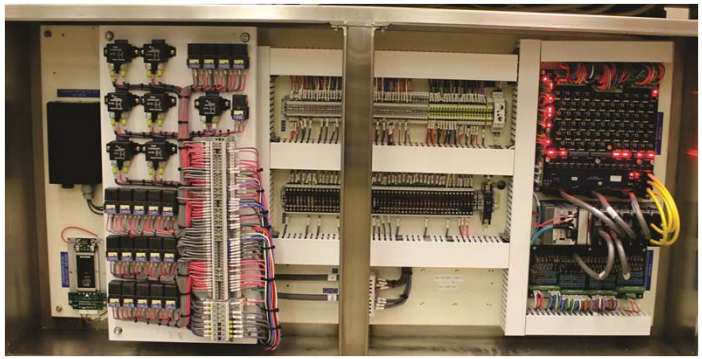


“BUILDING BLOCKS” CONCEPT









COMPONENT DESCRIPTIONS

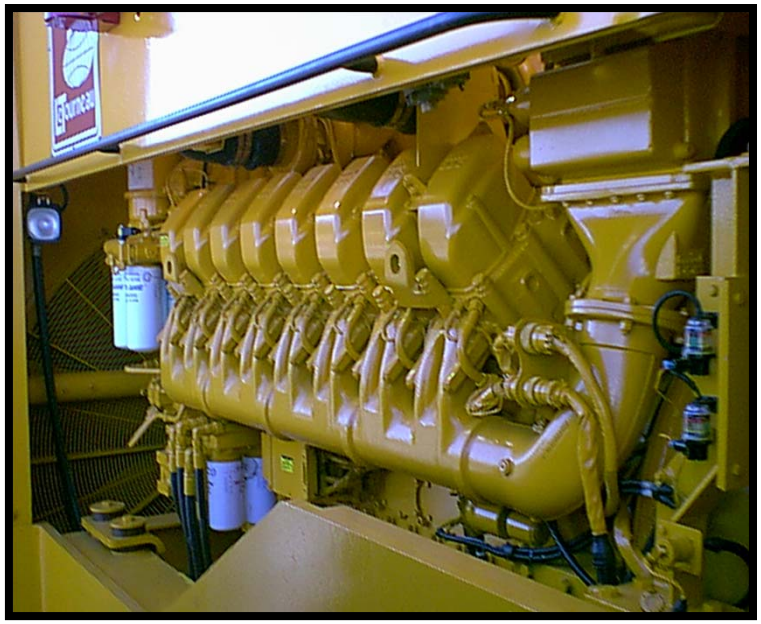
LINCS II DRIVE SYSTEM

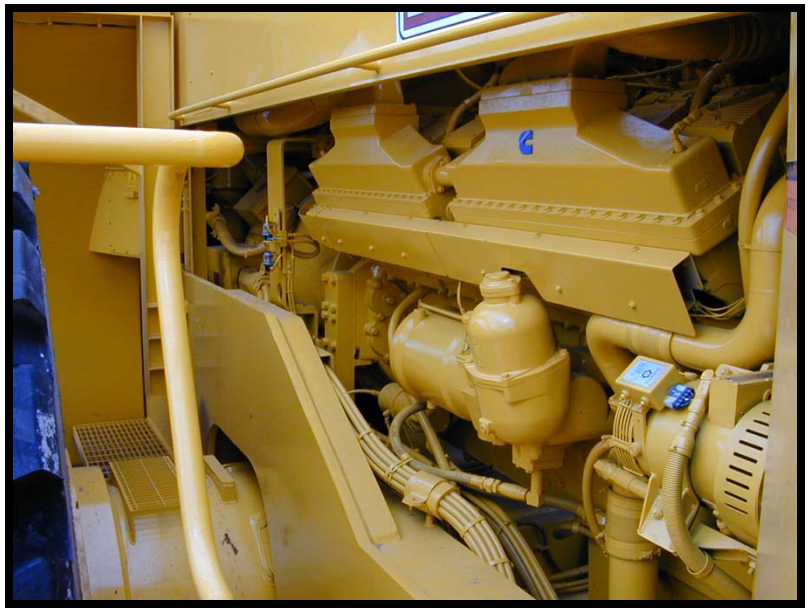
SR Motors

SR Generator

POWER UNITS

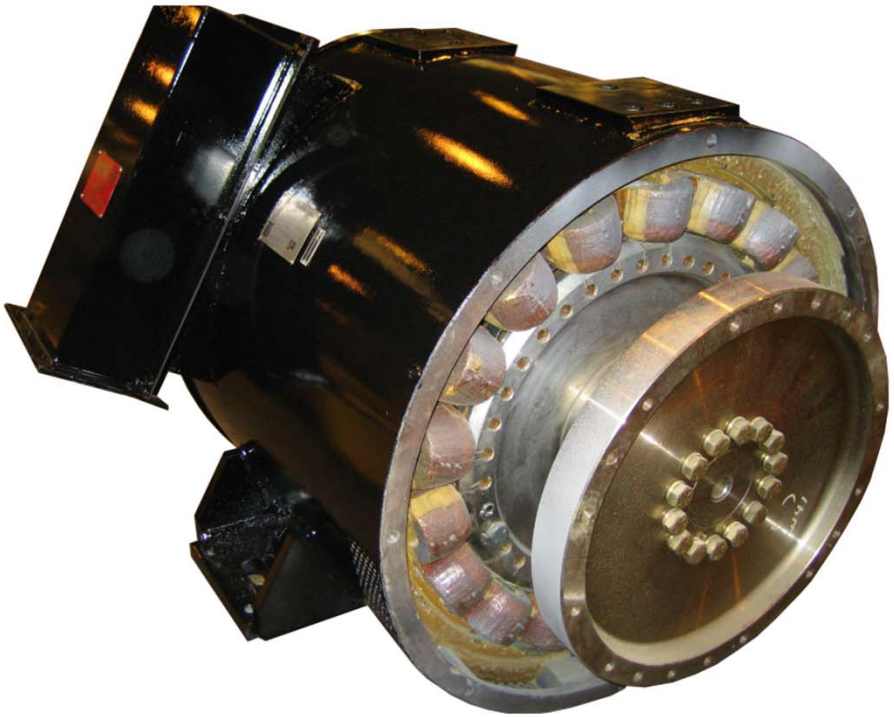
Detroit

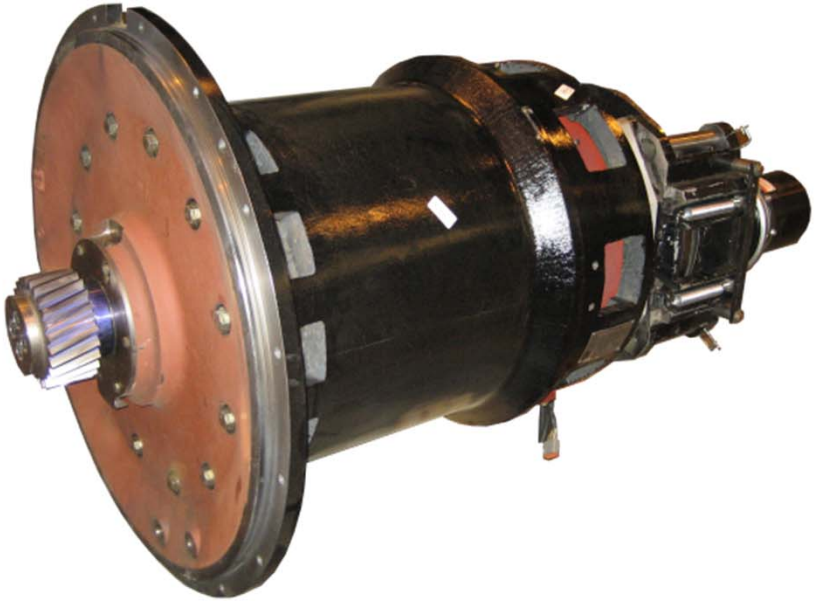




Cummins

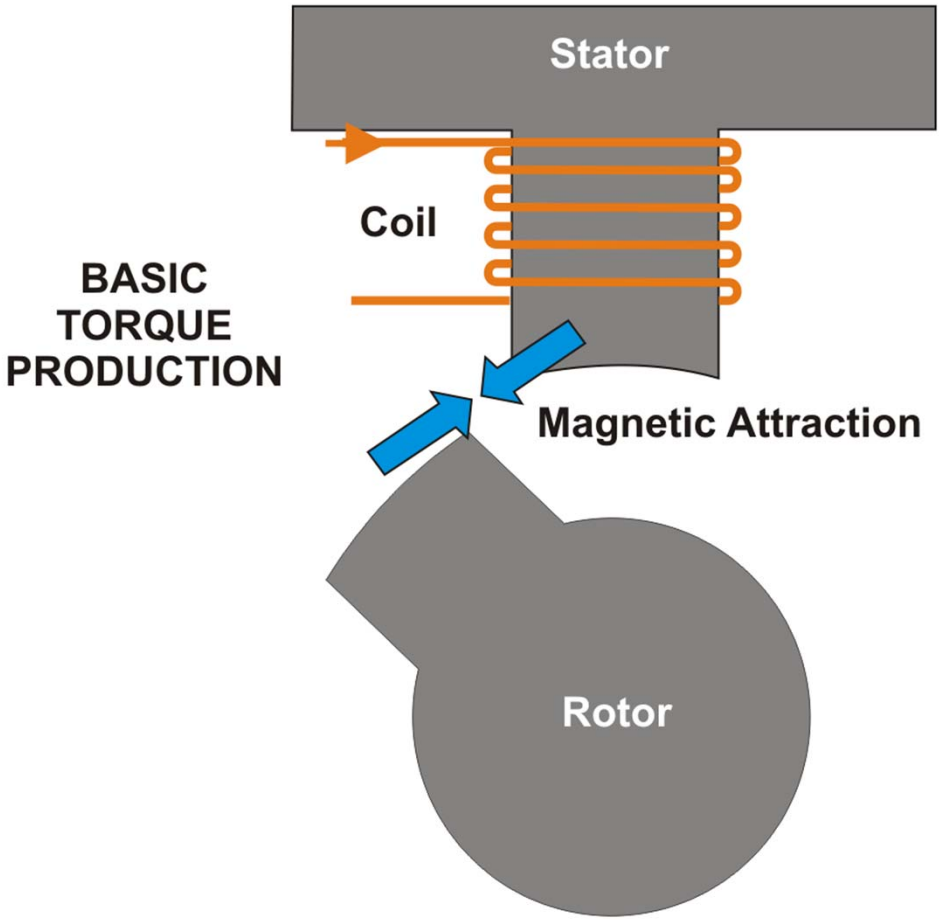
SR MOTORS & GENERATORS





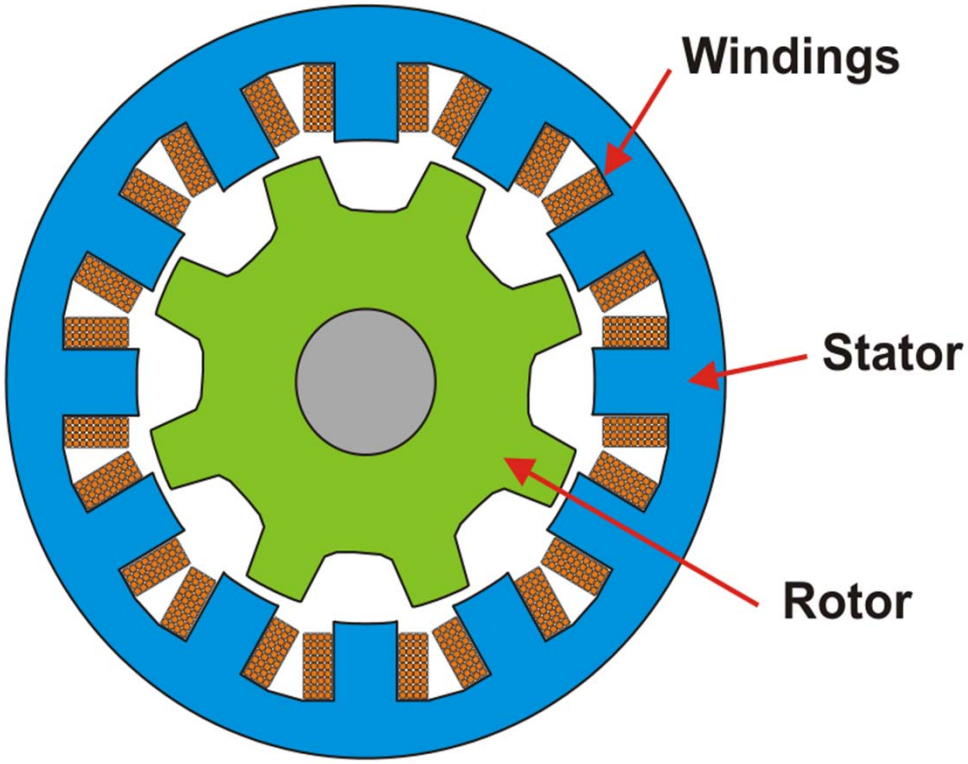
BASIC SR CONCEPT

- Magnetic force pulls pole on rotor
- Vary torque with current and timing
- Propel or braking depending on timing

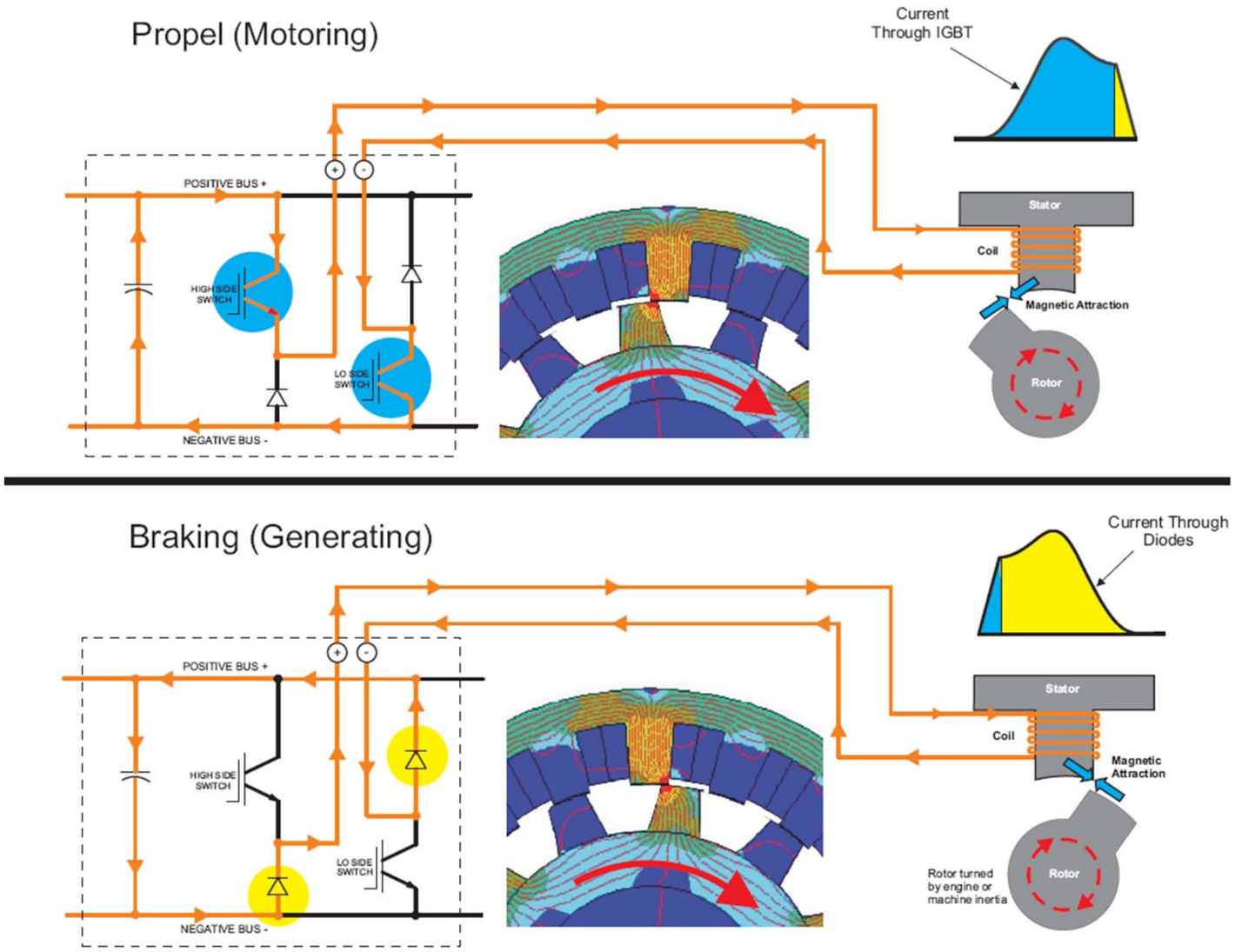


SR SIMPLICITY

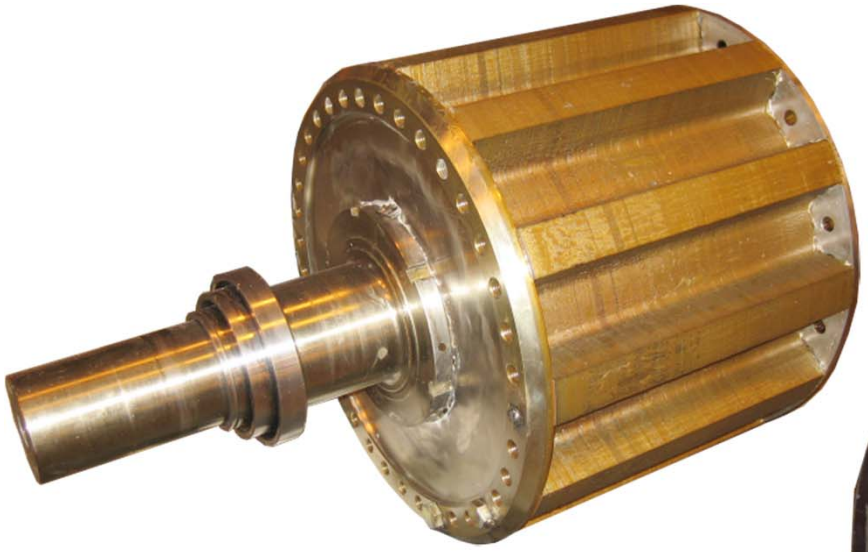
- All coils stationary
- Simple coil design
- Rotor is simply a stack of lam steel
- Bearing is only wear part
- Different number of poles on rotor and stator



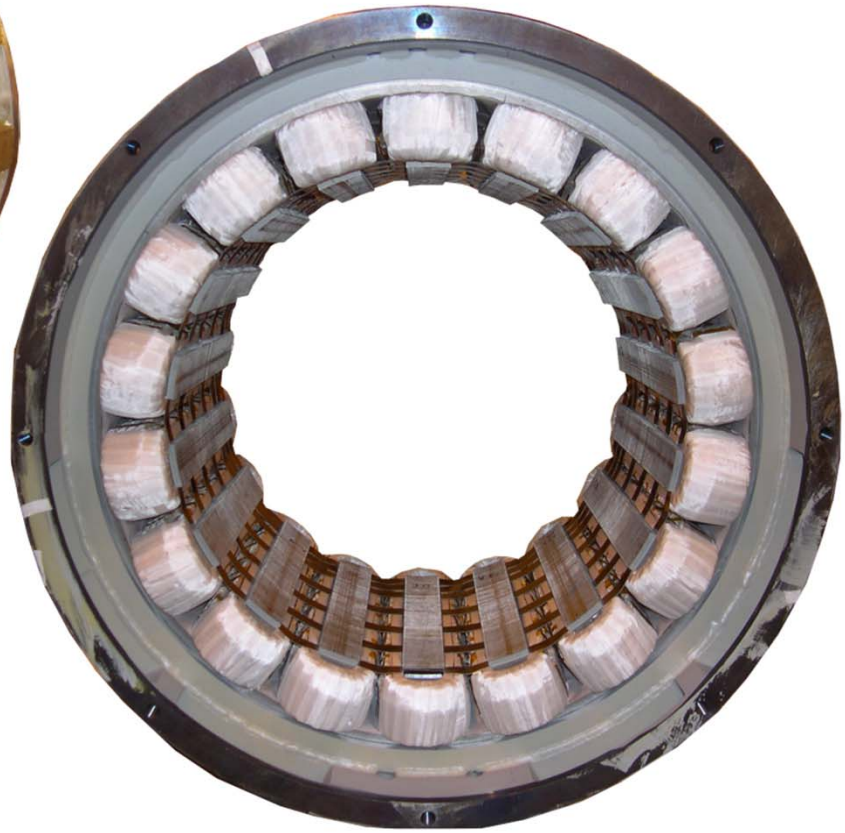
BASIC SR CONCEPT



SR ROTOR & STATOR



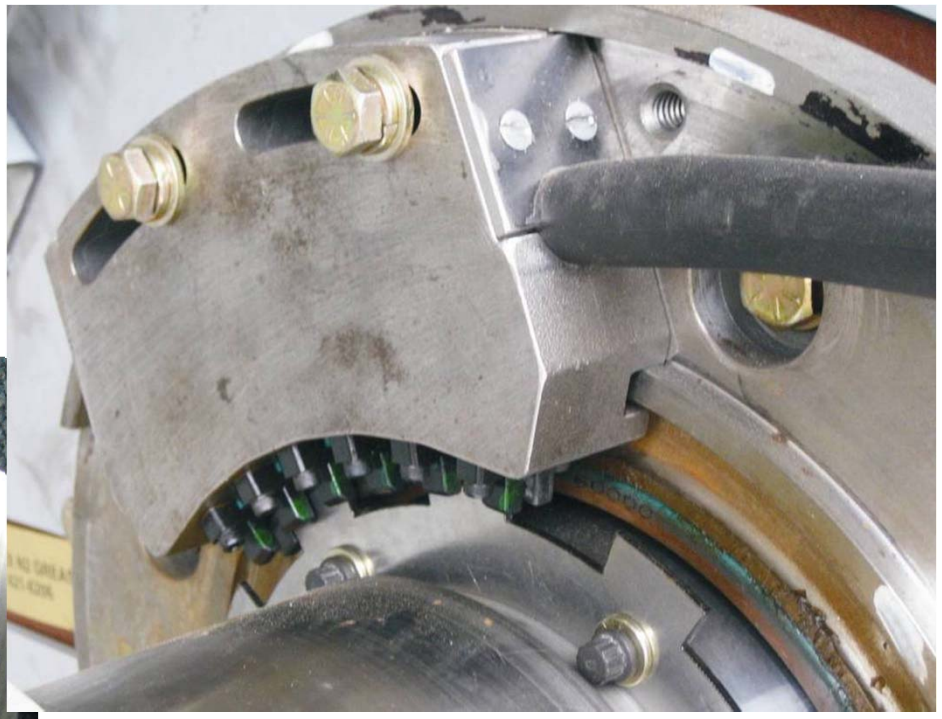
Rotor – No windings

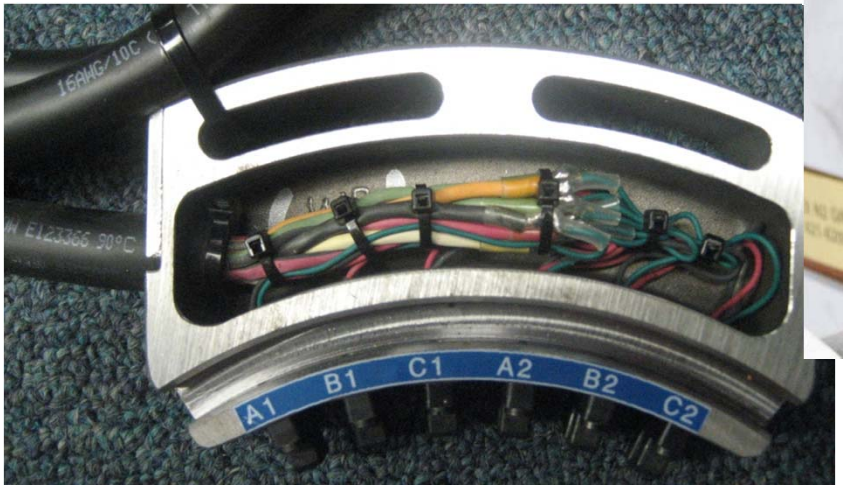


Stator – Simple robust coils

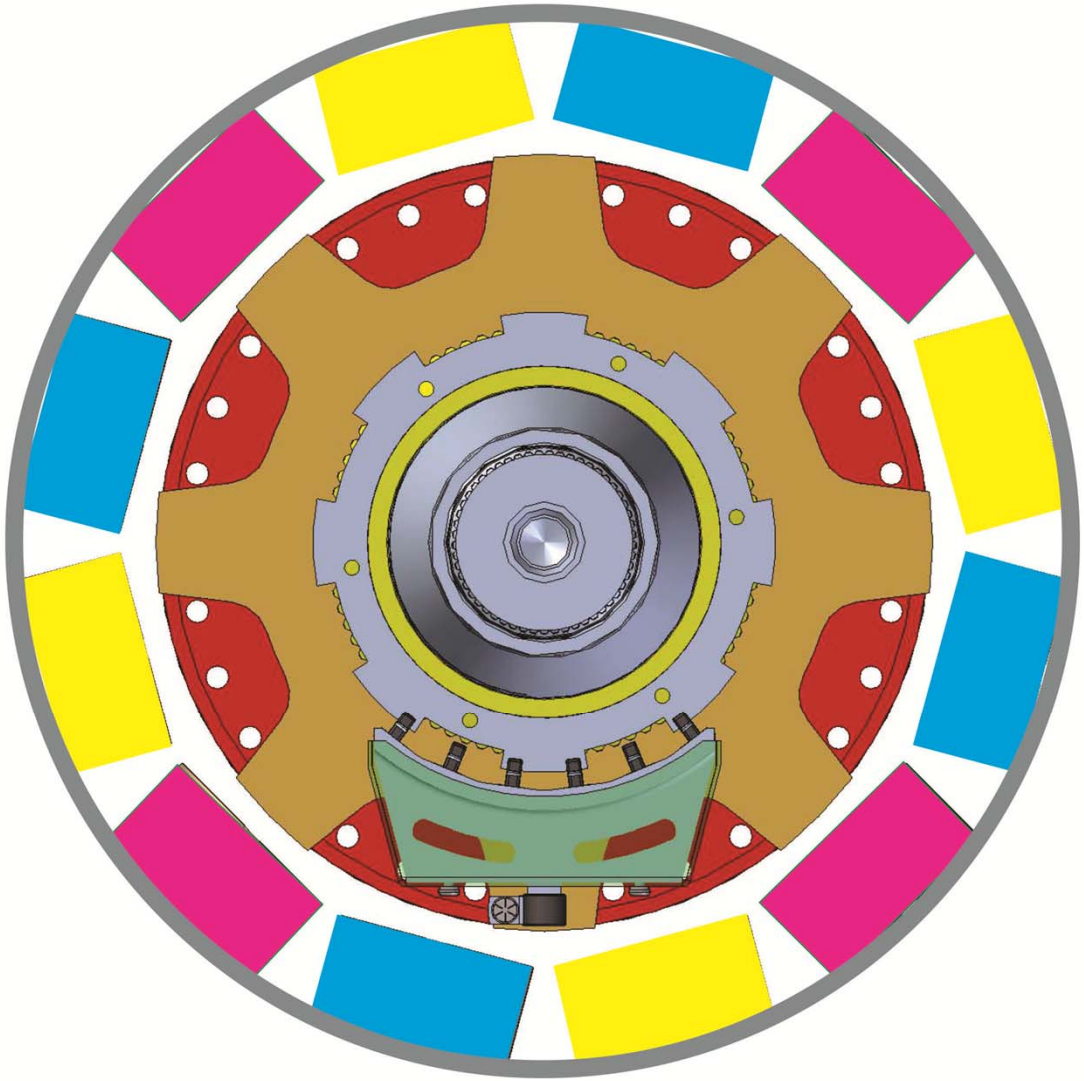
ROTOR POSITION TRANSDUCER

- RPT (Rotor Position Transducer) For Position and Speed
- Two sets of 3
- Used set selected in software

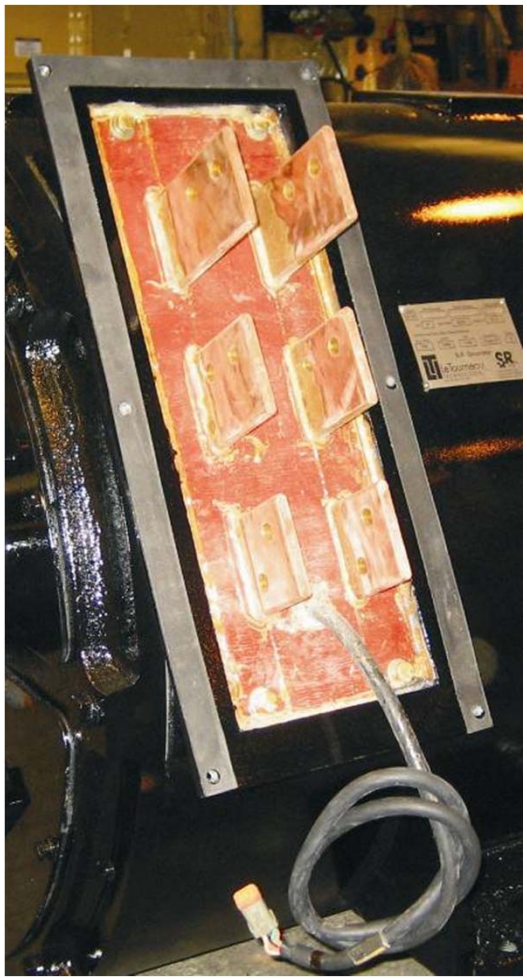




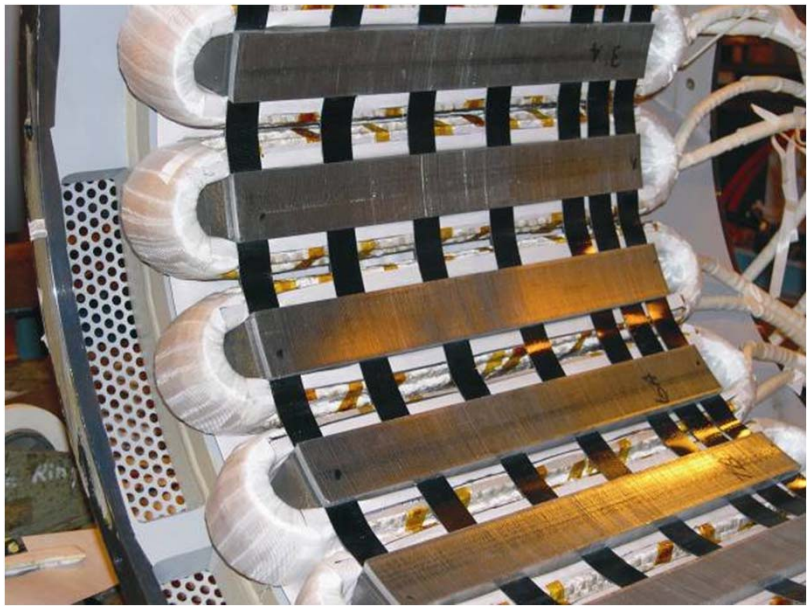
ROTOR POSITION TRANSDUCER



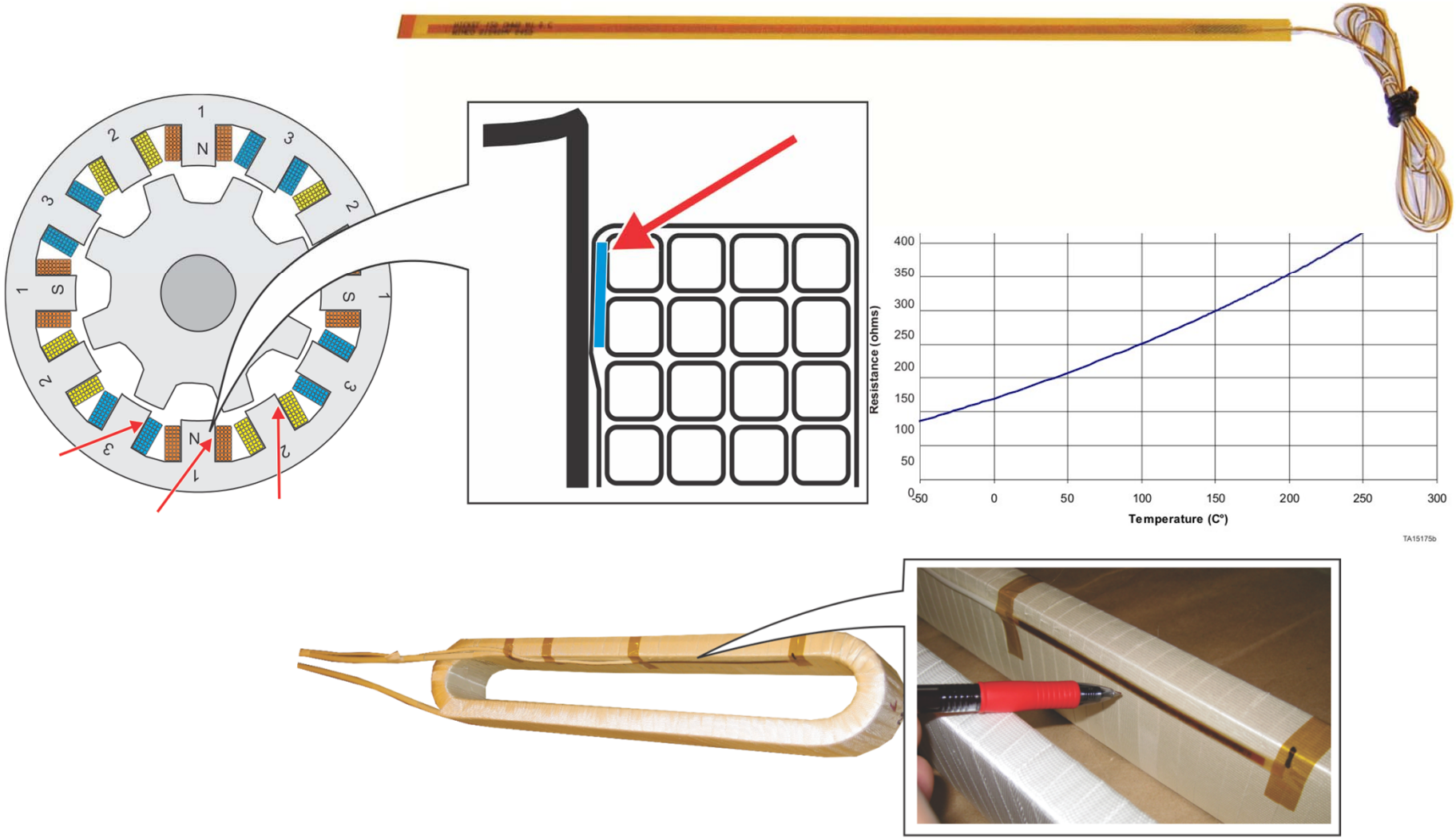
TEMPERATURE SENSING



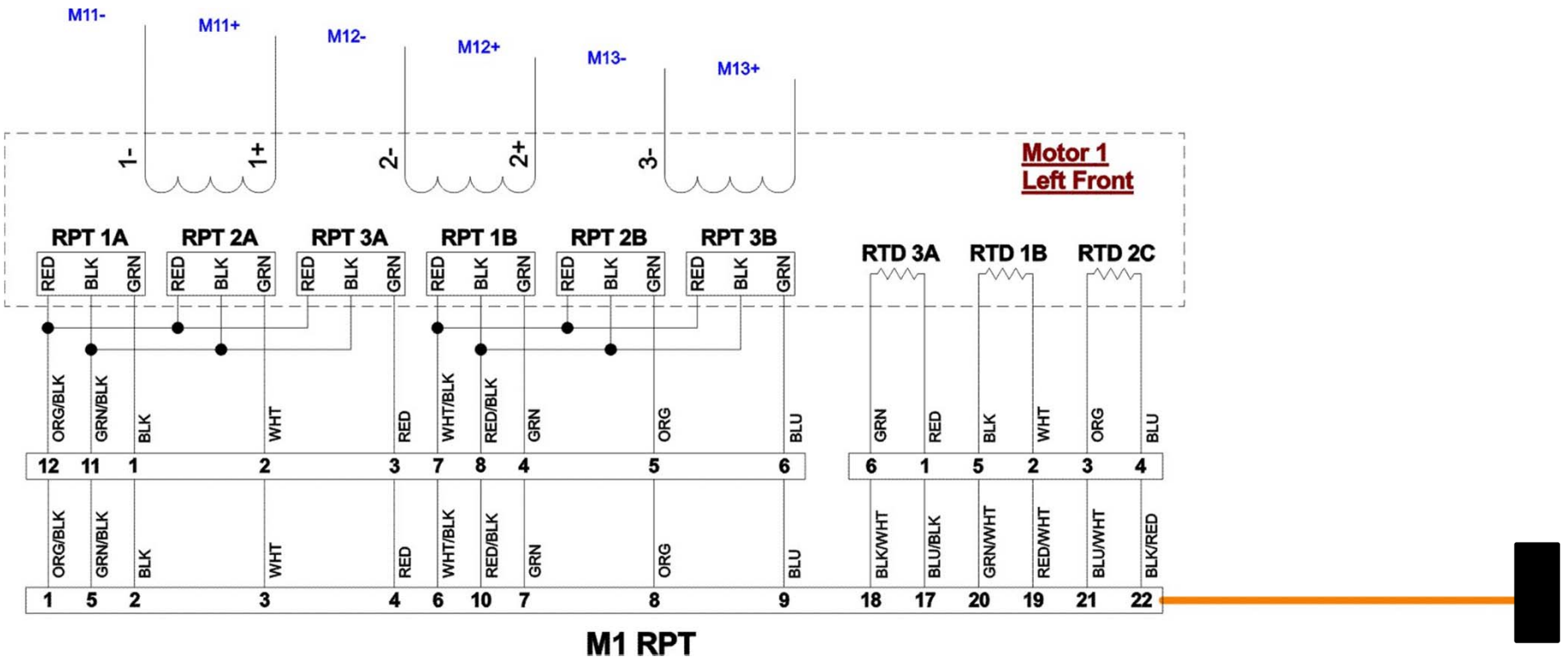
Three imbedded RTD



TEMPERATURE SENSING



RPT / RTD WIRING



CONVERTER PANEL & CABINET

Motor or Generator

- 950/1150 - 6 panels
- 1350 - 7 panels
- 1850 - 12 panels
- 2350 - 12 panels

CABLING & FUSES

L-1150 cabinet

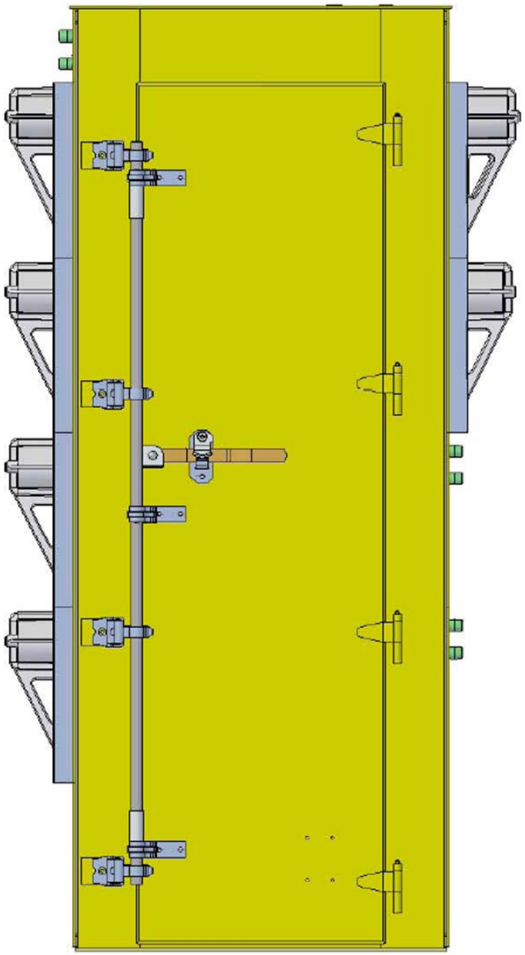
L-950/1150 LOADER CABINET

Motor #1

Motor #2

Motor #3

Motor #4



Generator Slave (G3)

Generator Master (G2)

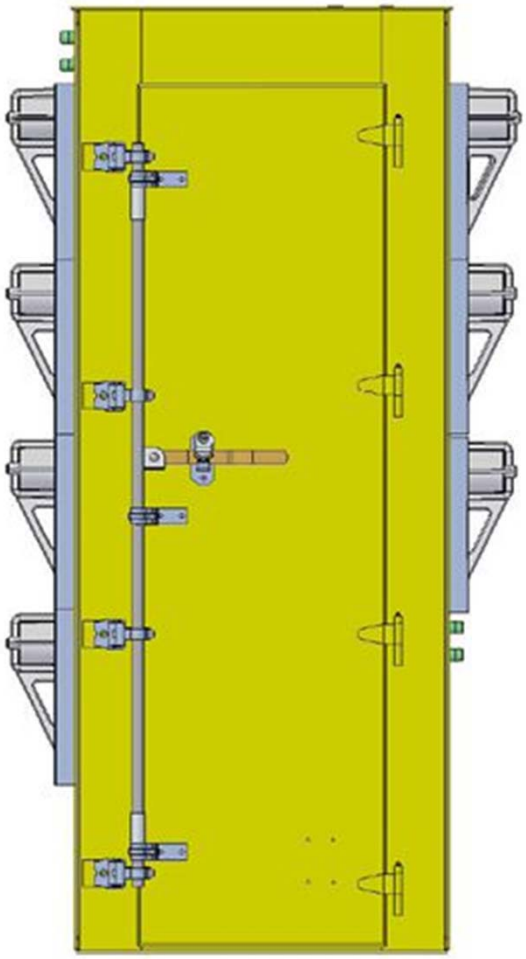
L-1350 LOADER CABINET

Motor #1

Motor #2

Motor #3

Motor #4



Generator Slave (G3)

Generator Slave (G2)

Generator Master (G1)

L-1850/2350 LOADER CABINET

Motor #1 - Slave

Motor #2 - Master

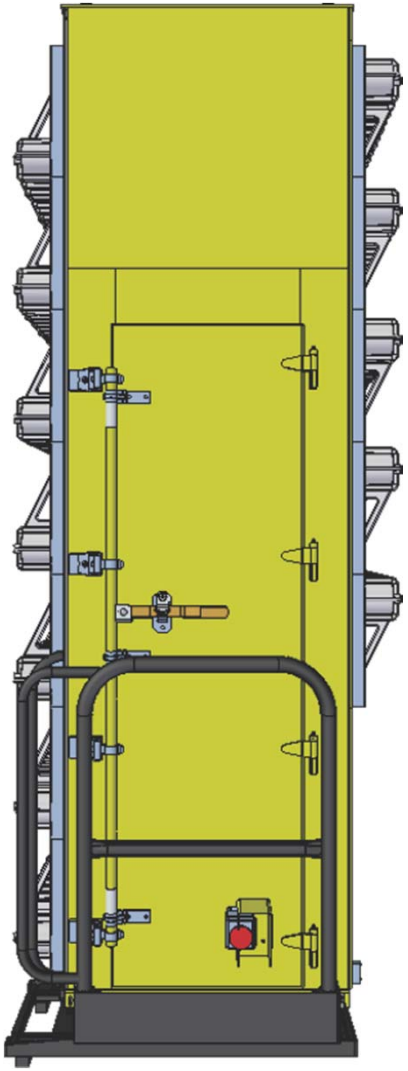
Motor #2 - Slave

Motor #3 - Master

Motor #3 - Slave

Motor #4 - Master

Motor #4 - Slave



Motor #1 - Master

Generator Slave (G4)

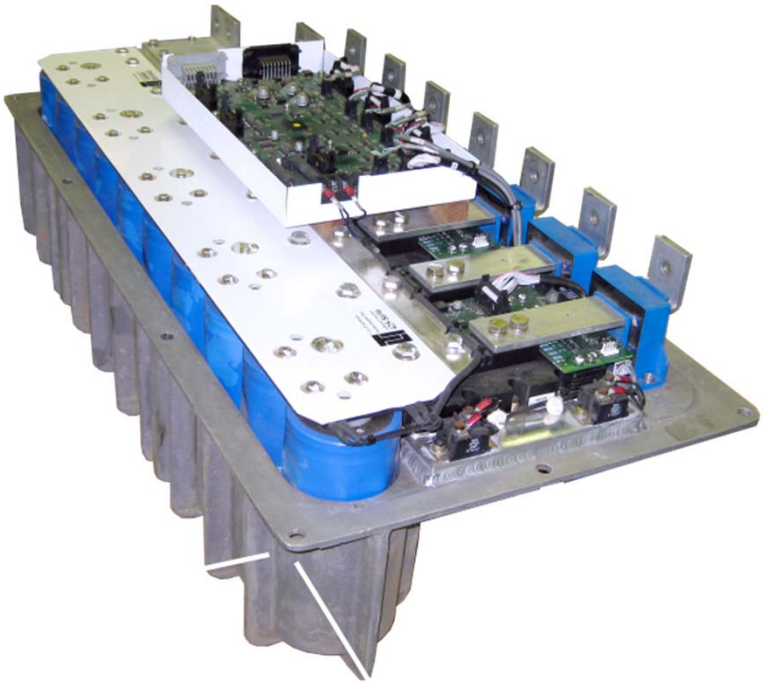
Generator Slave (G3)

Generator Slave (G2)

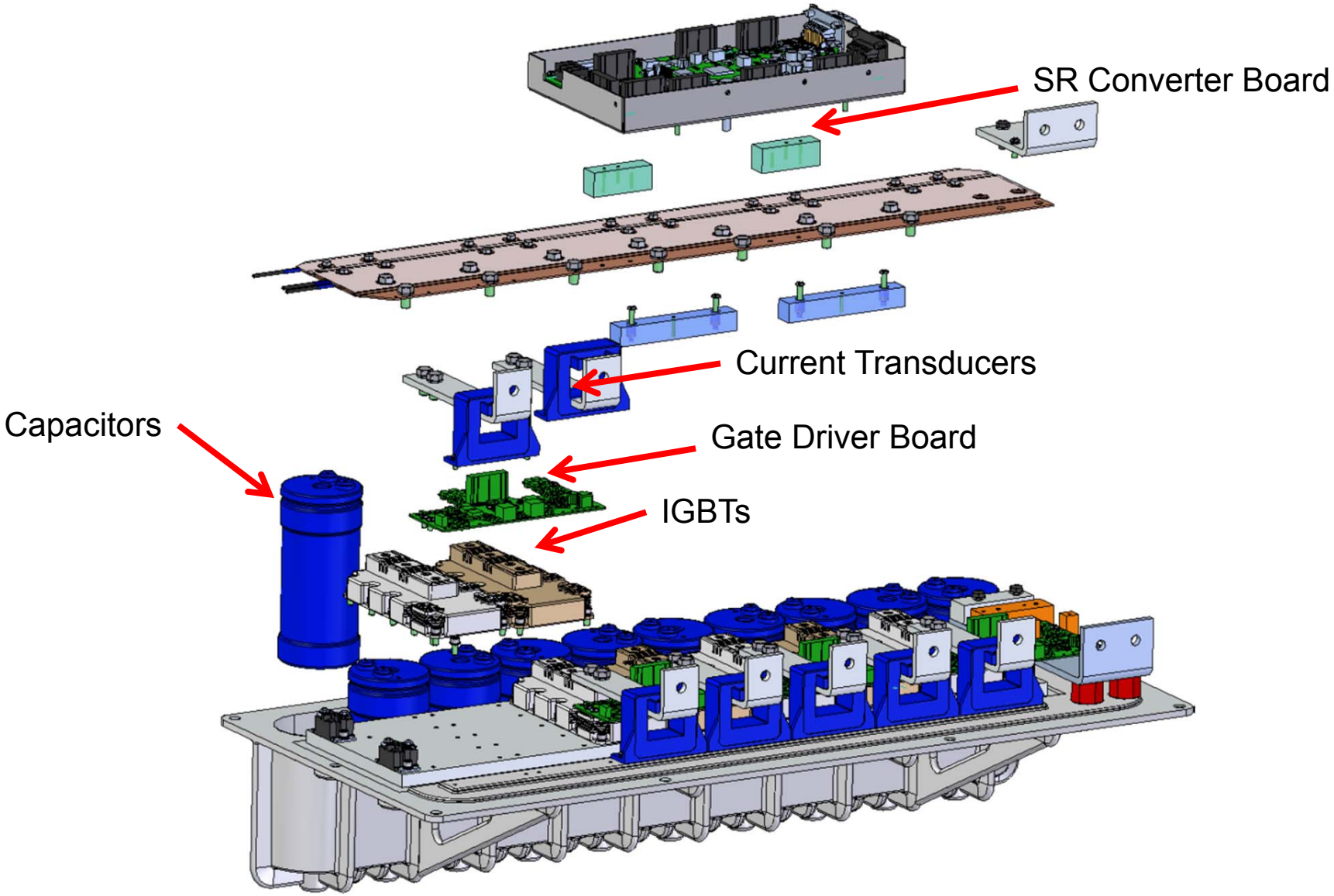
Generator Master (G1)

MODULAR SR CONVERTER

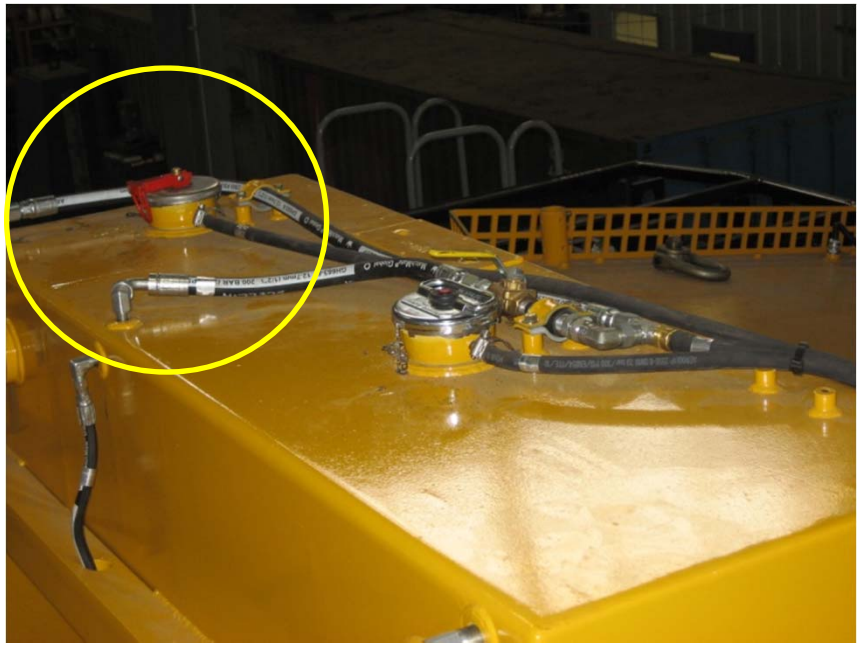
- LTI designed & manufactured
- Commonality – same converter used for both motors & generators
- Liquid Cooled IGBTs
- Under 100 lbs
- Self contained – fuses and cables are only external parts

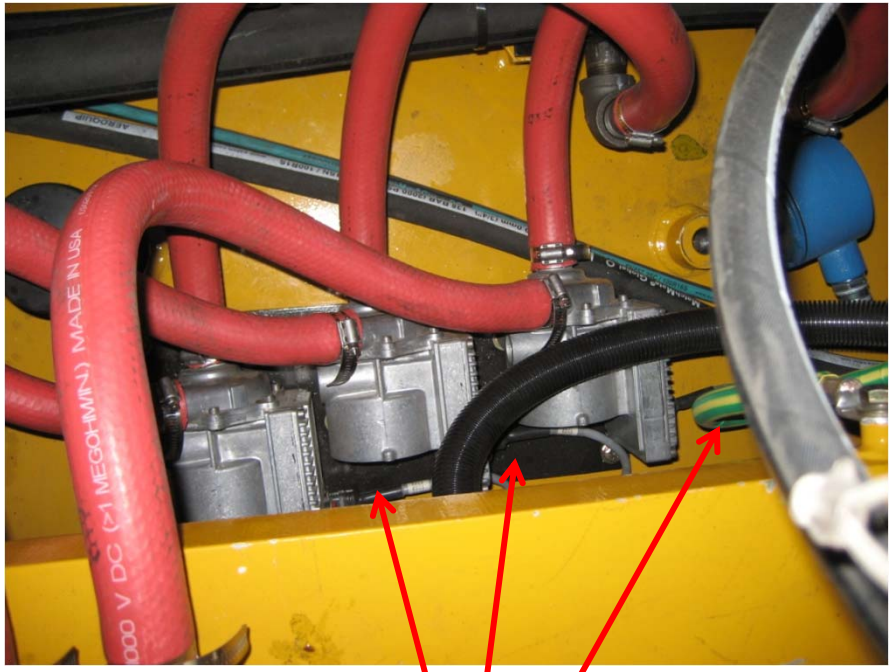


SR CONVERTER PANEL



COOLING PUMPS

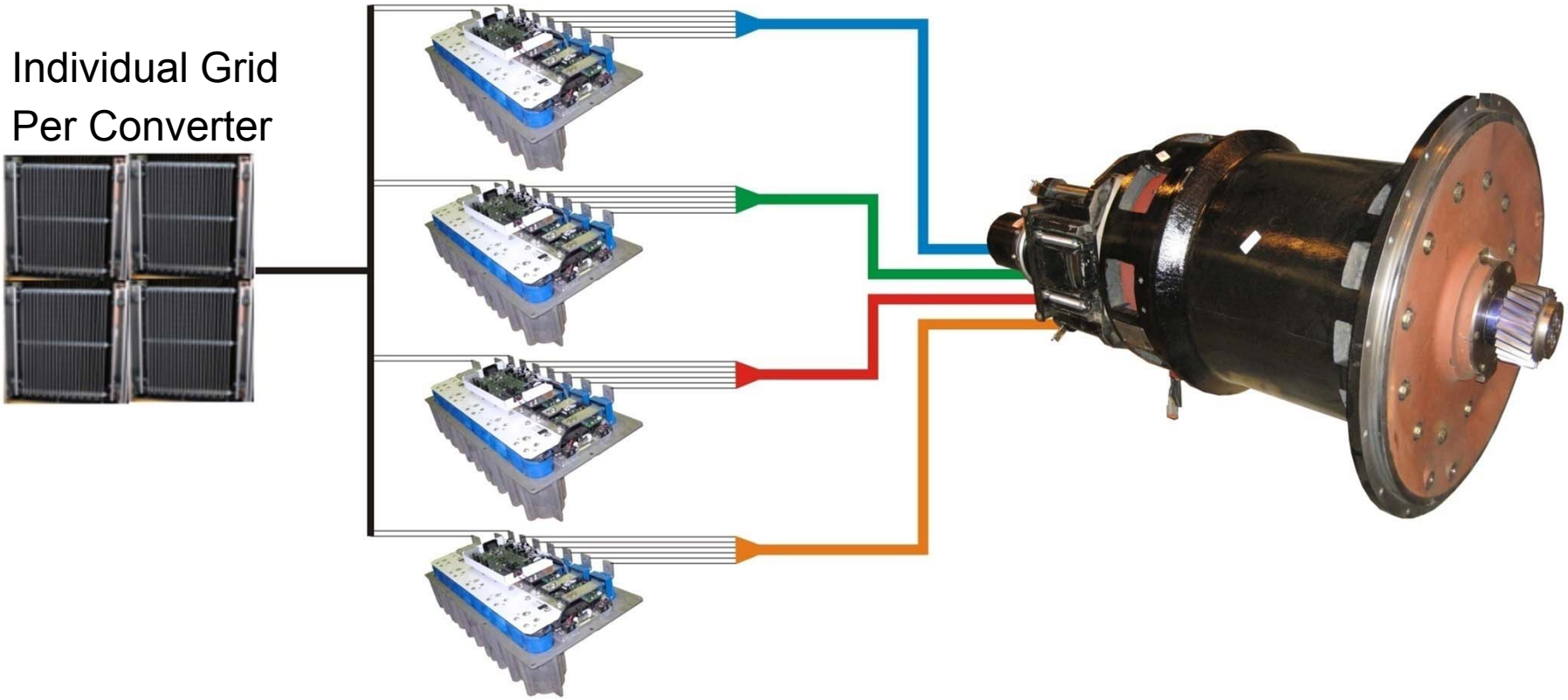




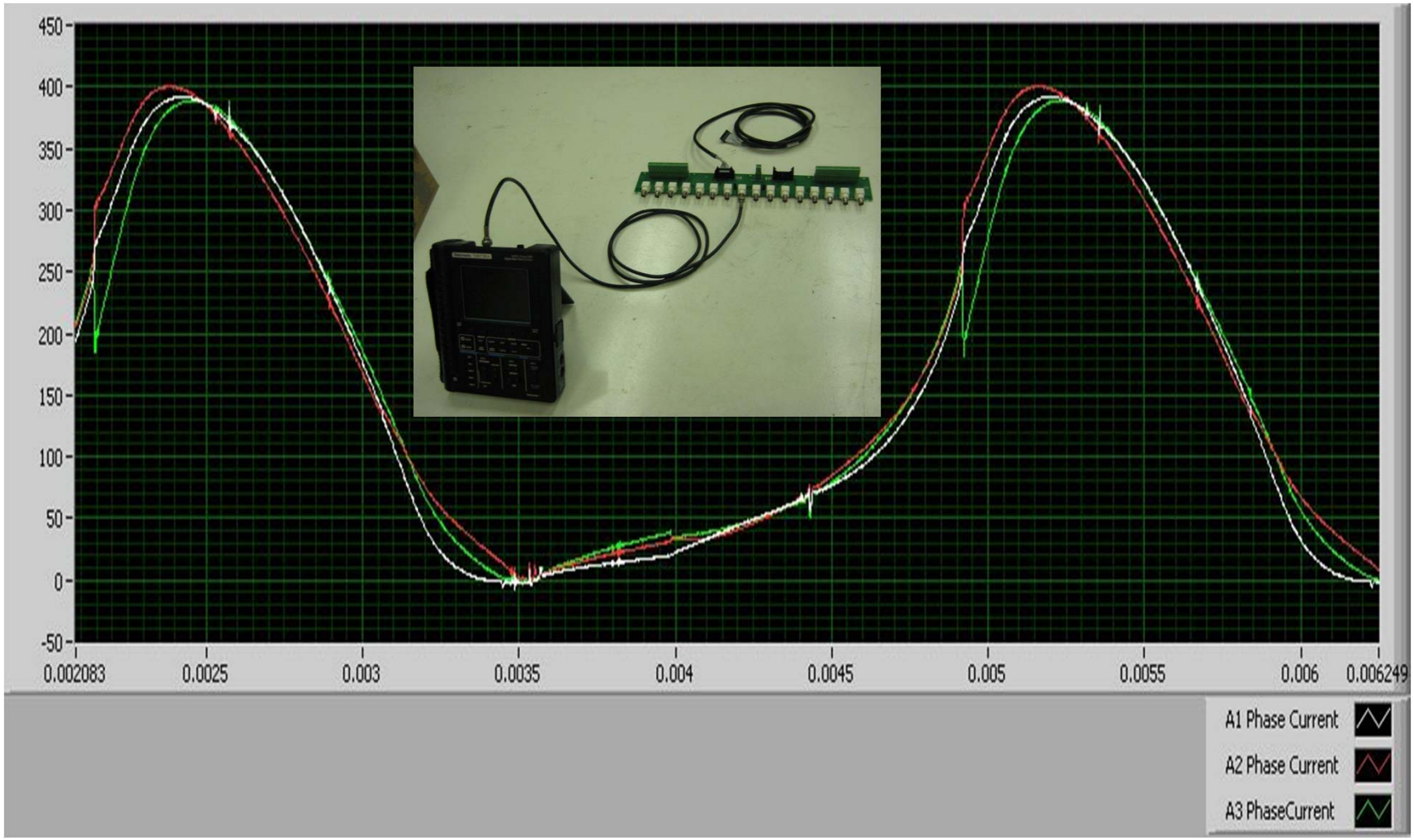
CAN Cable

COOLING FLOW

PARALLEL CONVERTER WIRING

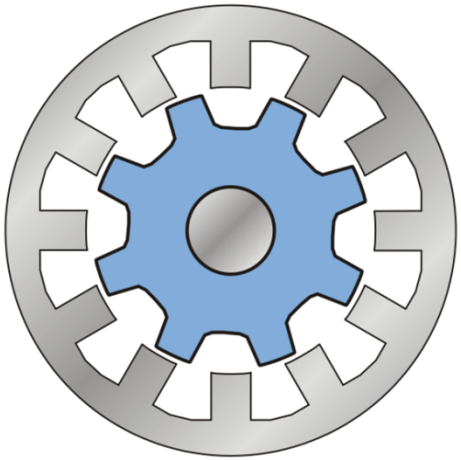


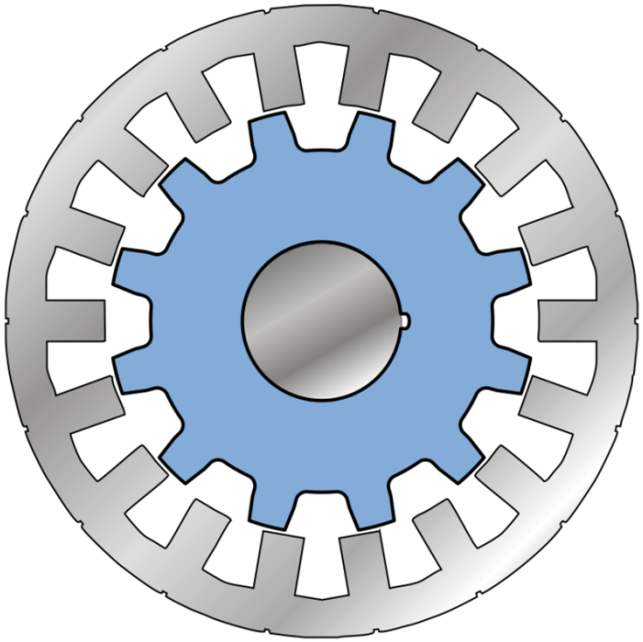
PARALLEL CONVERTER CURRENTS



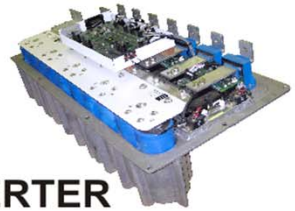
SR FAMILIES

- Varying Stack Length Allows for the Creation of a Broad Family of SR Devices from a few Lamination Sizes
- Generator Lams From Smaller Machines Can Serve as Motor Lams For Larger Machines .

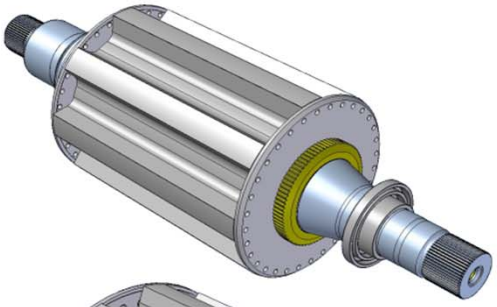


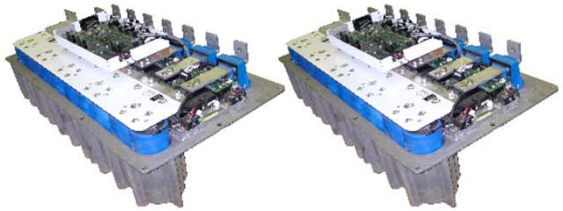


SCALABLE SYSTEM

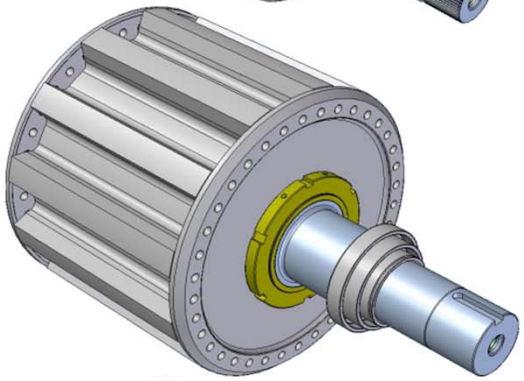


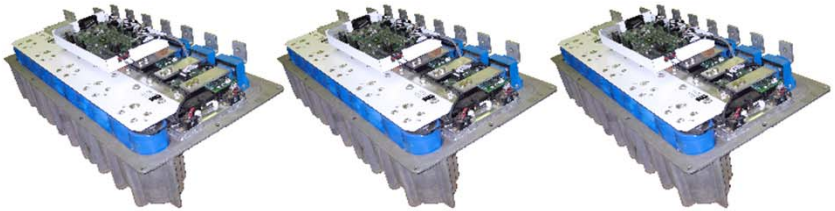
1 CONVERTER



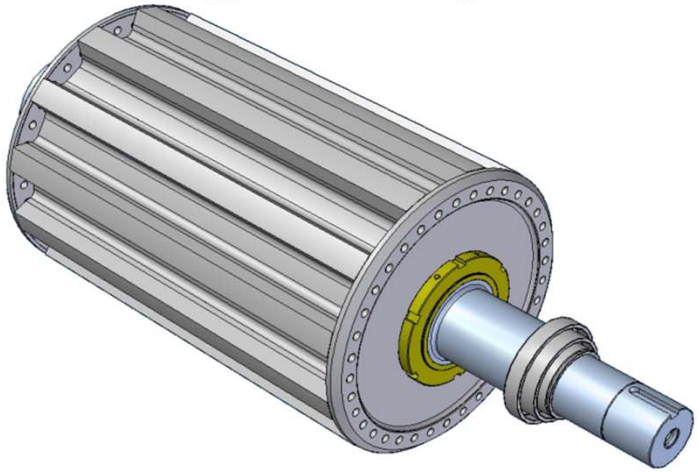


2 CONVERTERS

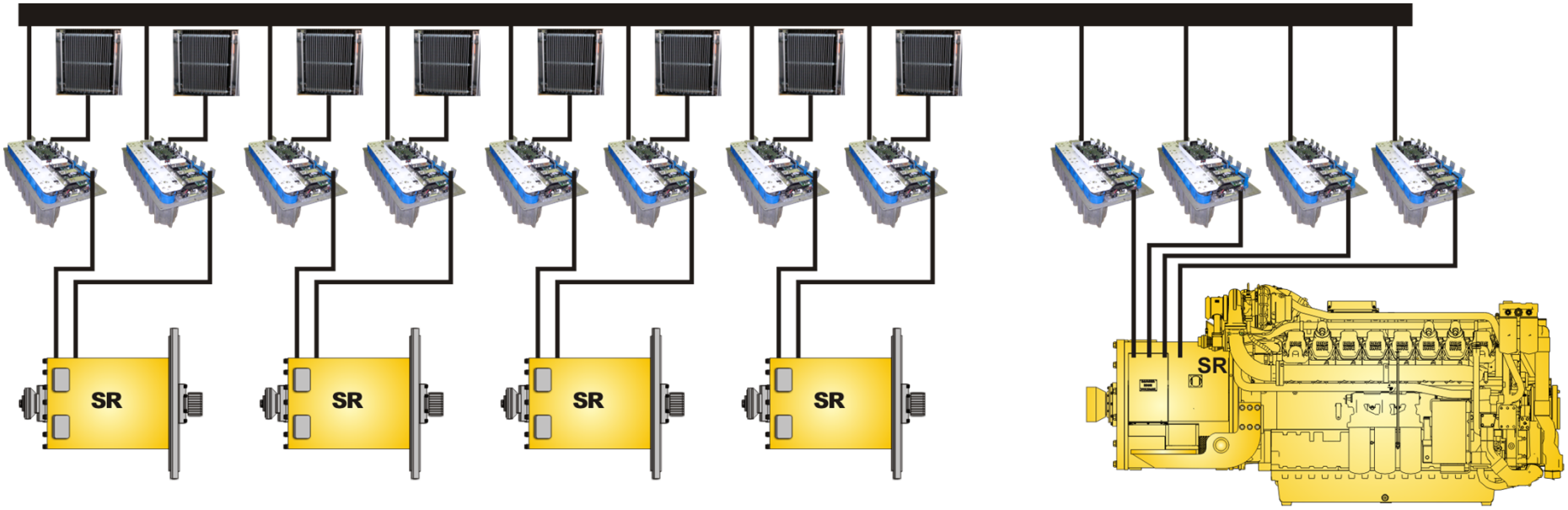




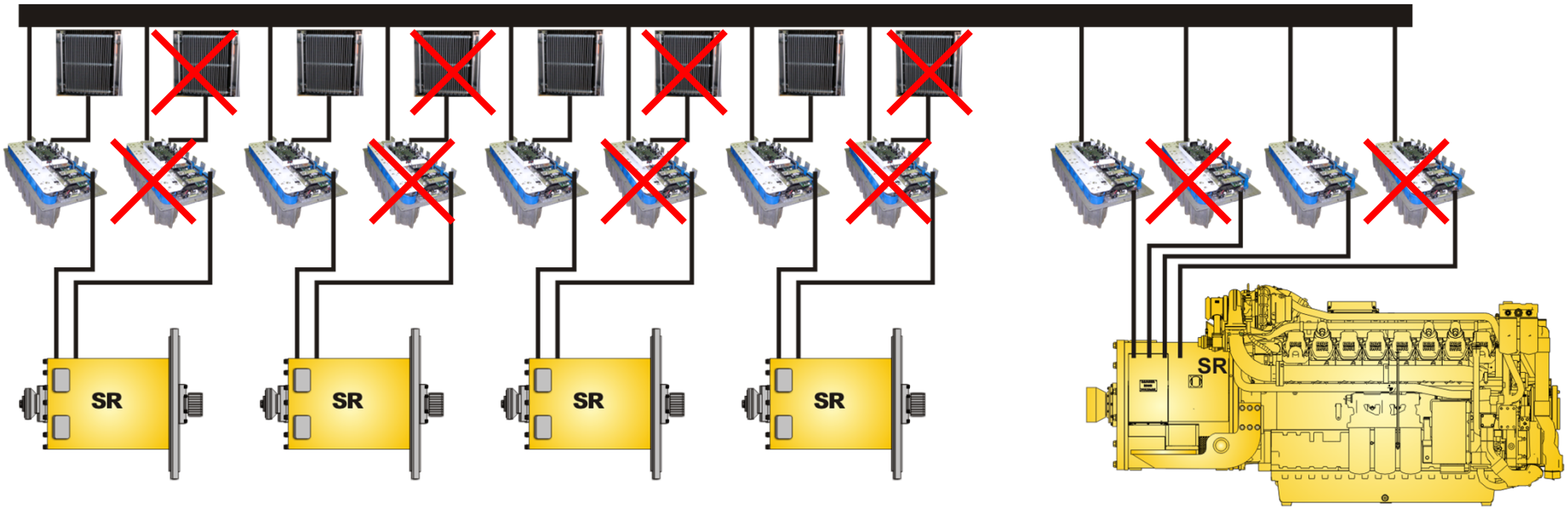
3 CONVERTERS



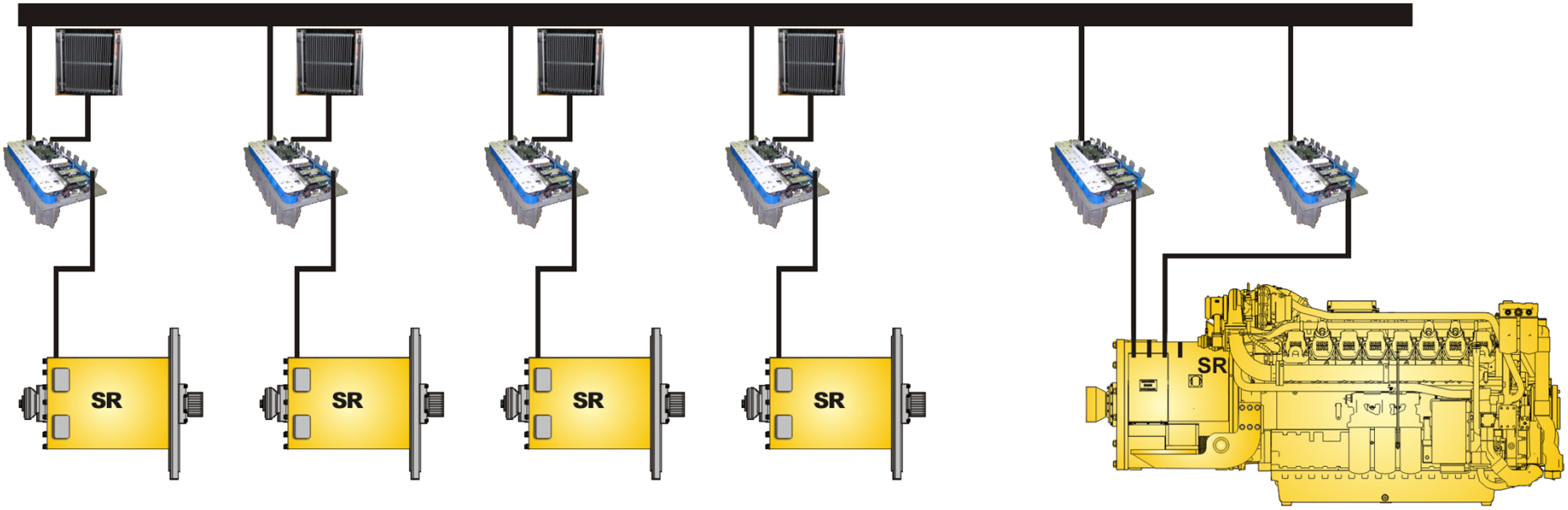
L-2350 SYSTEM



L-950/L-1150 SYSTEM



L-950/L-1150 SYSTEM



OPERATOR INPUTS

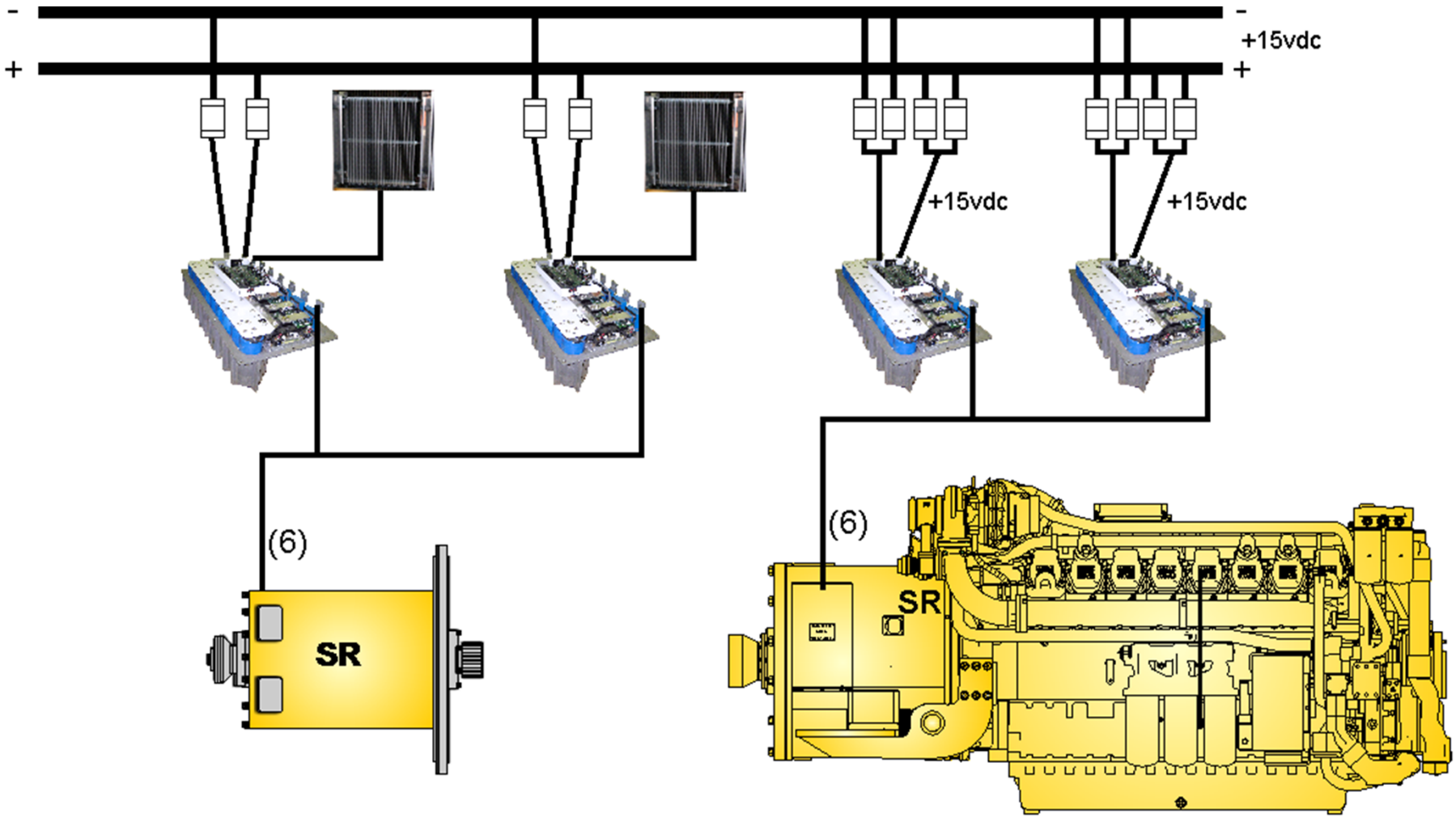
- J1939 CAN
  - Joystick controls
  - Switch pad
- Ethernet
  - Display / Touch screen
- Discreet wired
  - Foot pot
  - E-stop

OPERATOR INPUTS

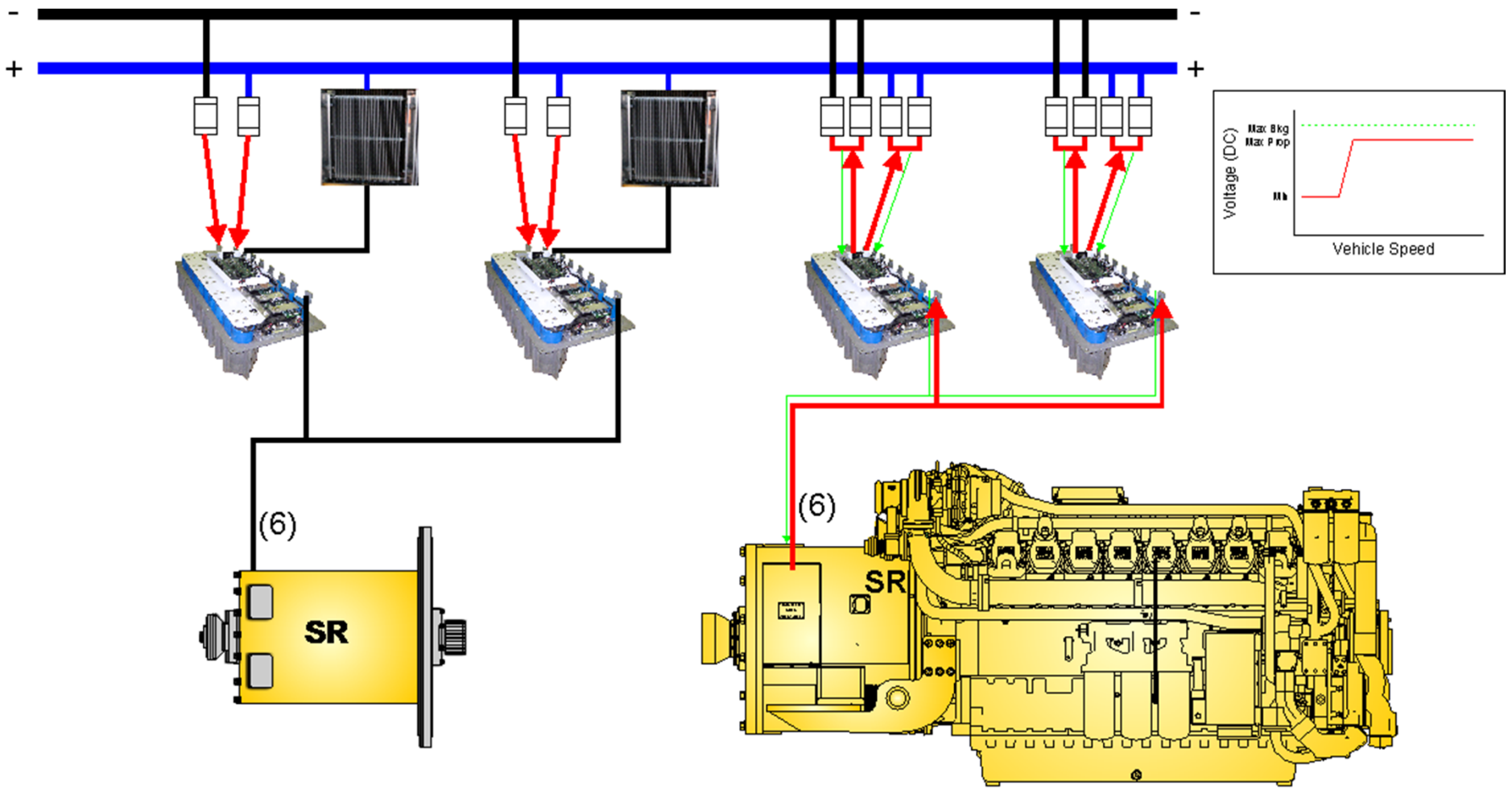
- J1939 CAN
  - Switch pad

CIRCUIT DESCRIPTIONS

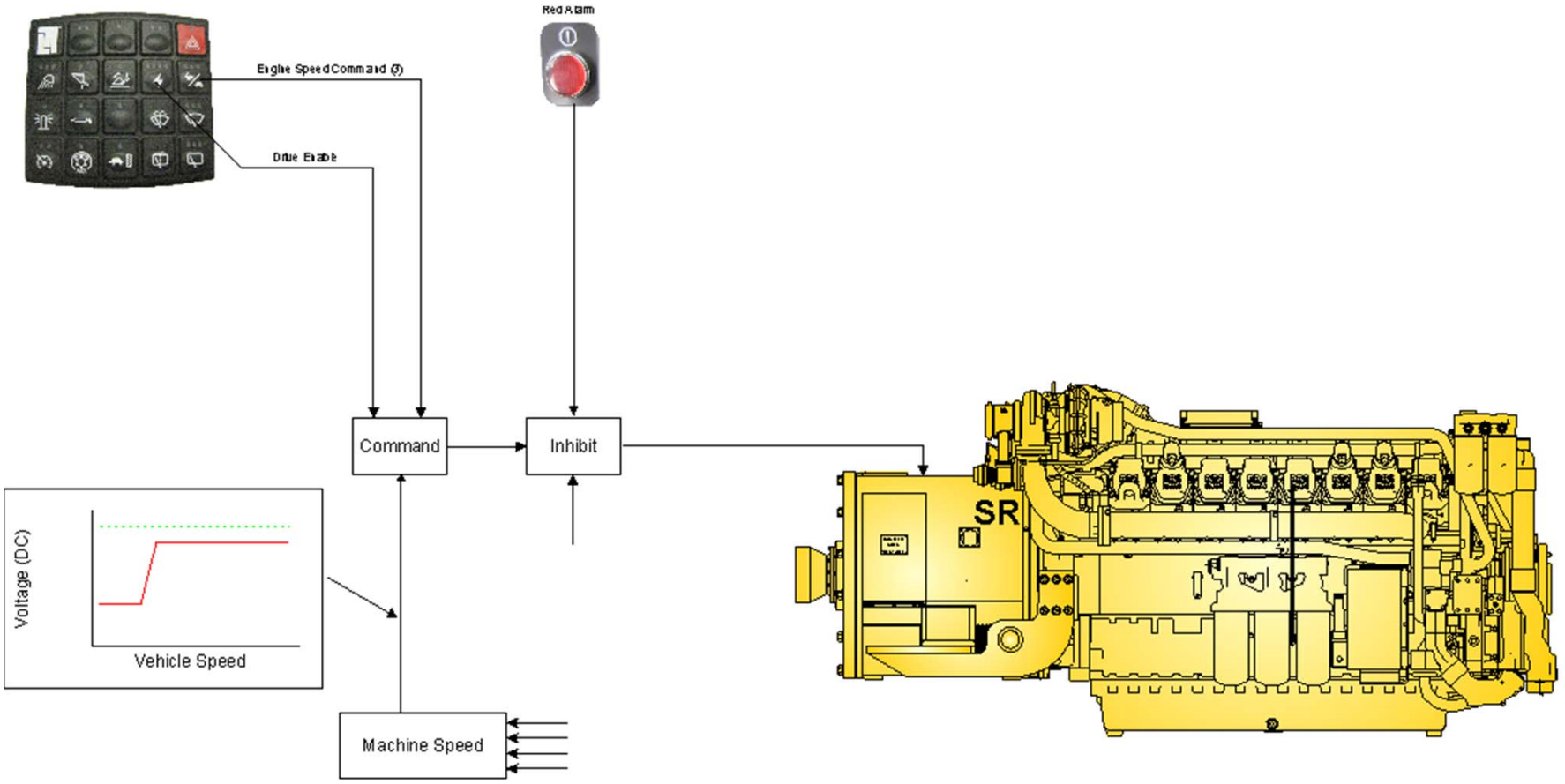
LINCS II BOOTED



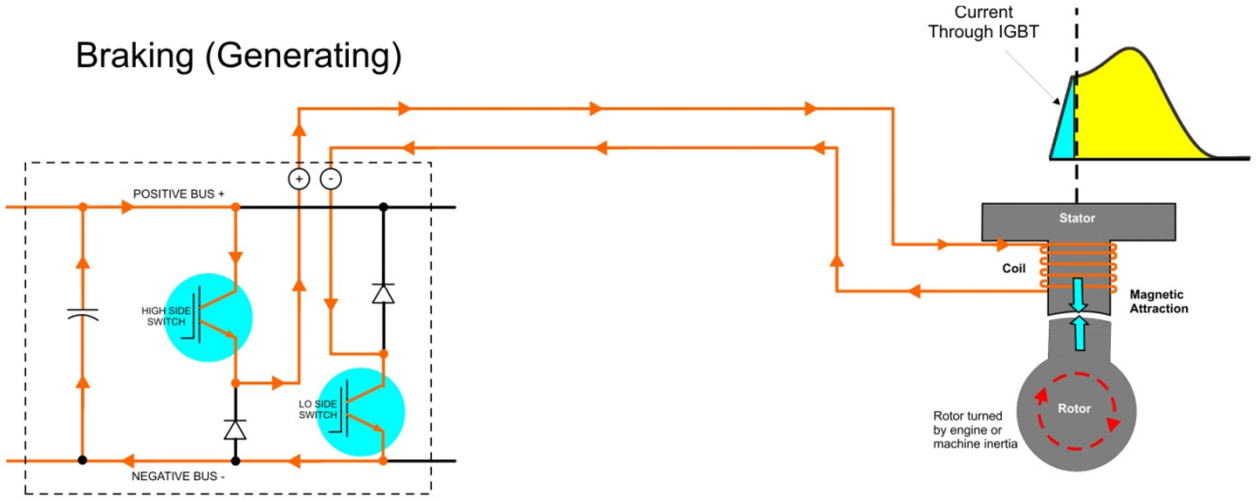
GENERATOR ENABLED

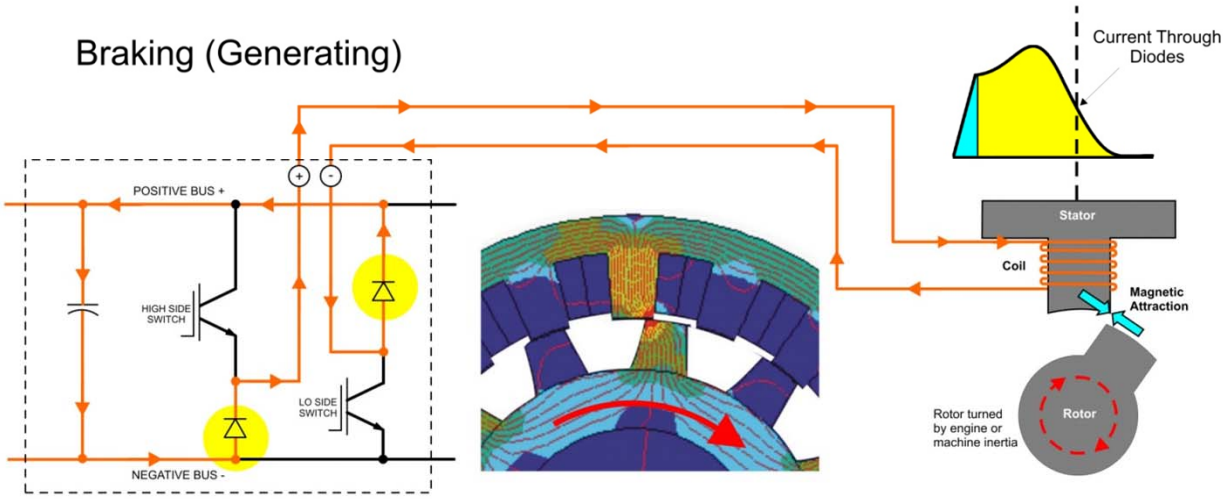


GENERATOR ENABLE LOGIC



GENERATING





Notes

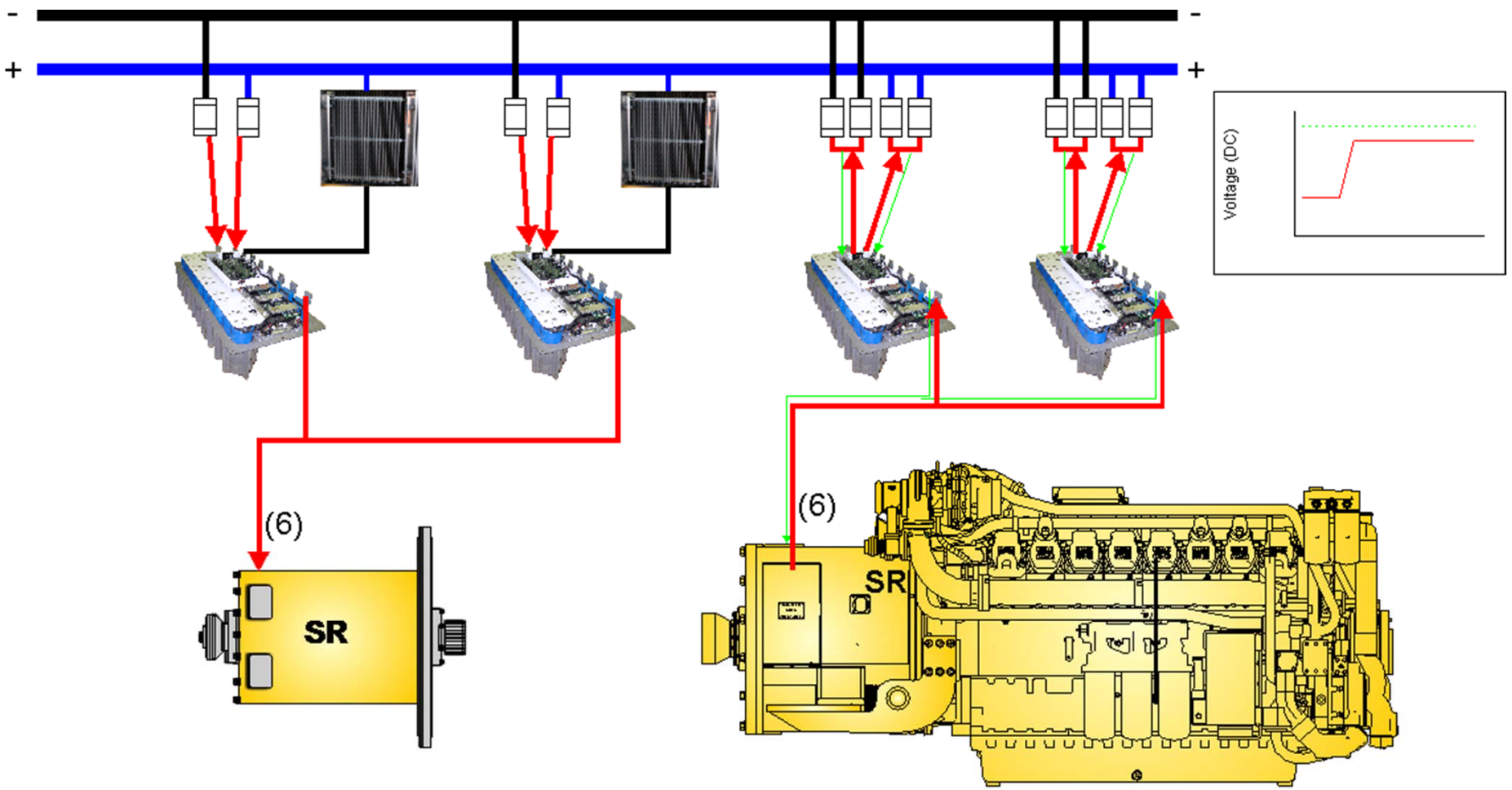
1. Current always flows in the same direction

2. During braking - small amount of current in with lots out.

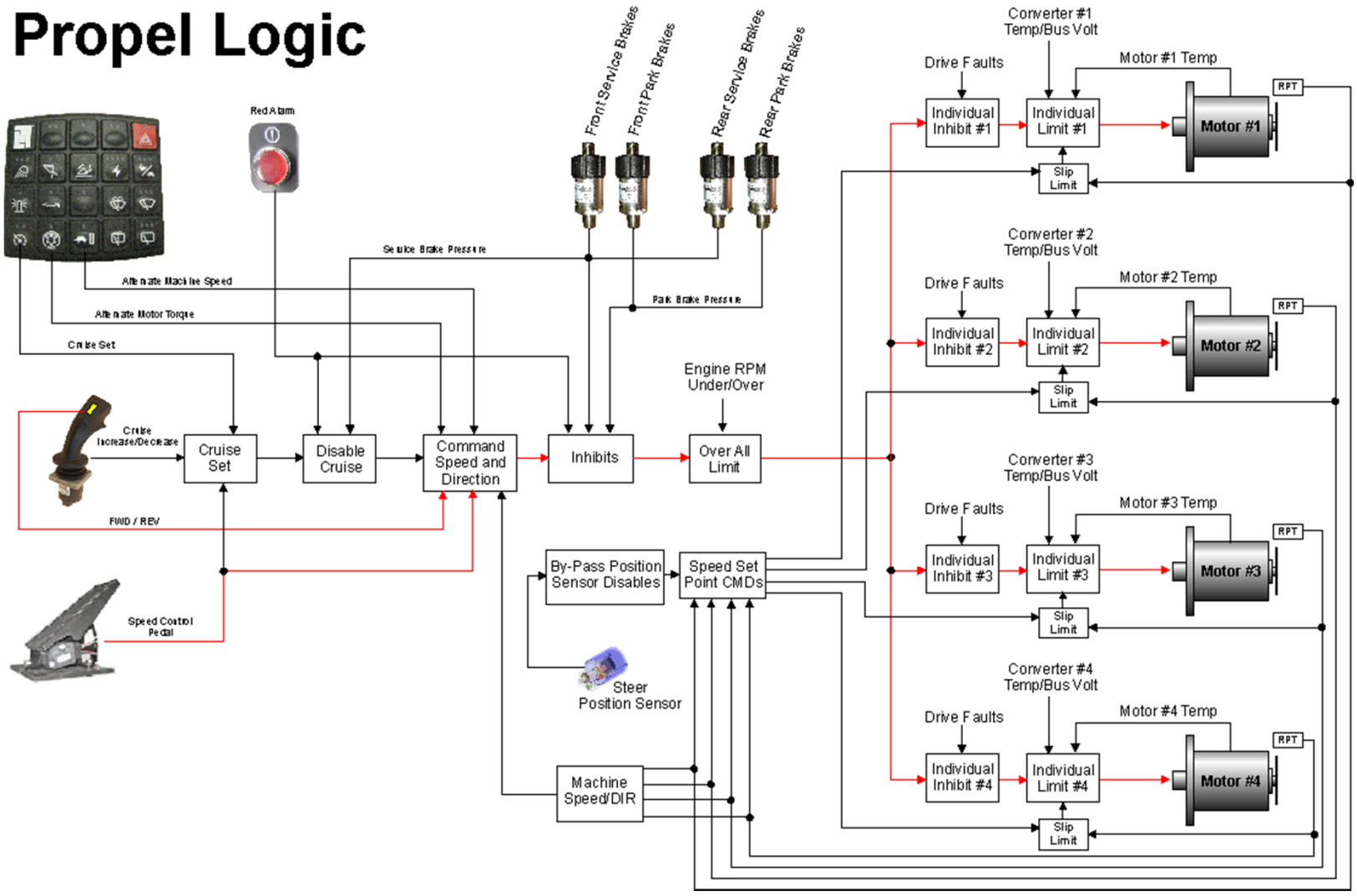
3.After the initial excitation current the IGBT is turned off.

4. All based on timing

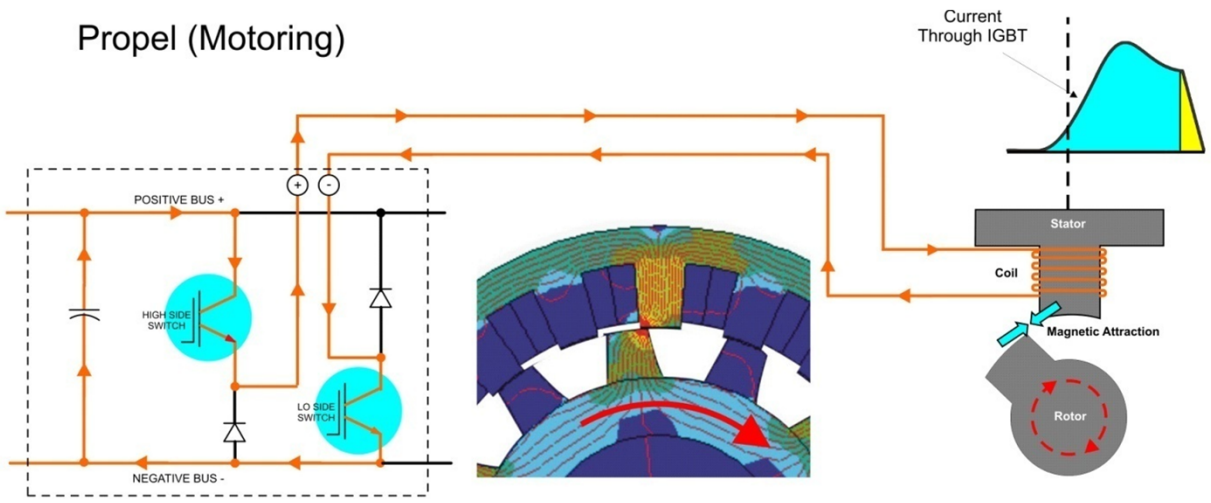
PROPEL

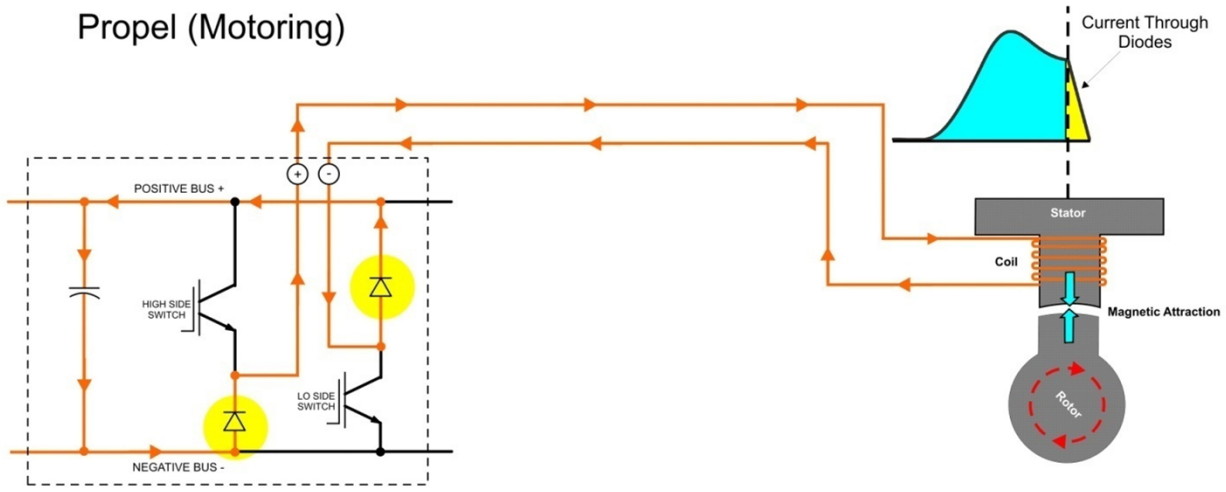


PROPEL LOGIC



PROPEL





Notes

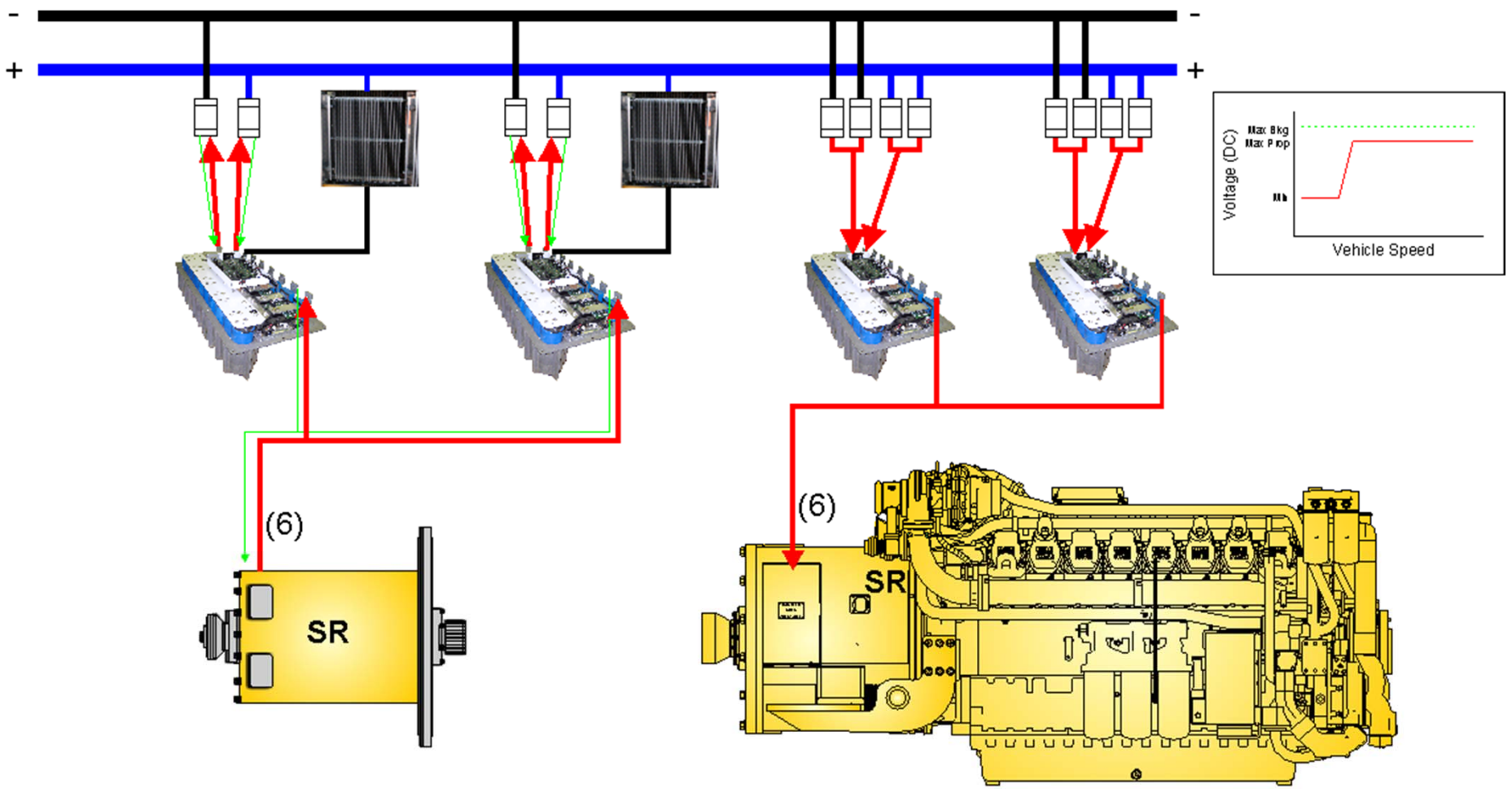
1. Current always flows in the same direction

2. During propel - lots of current in with a small amount out.

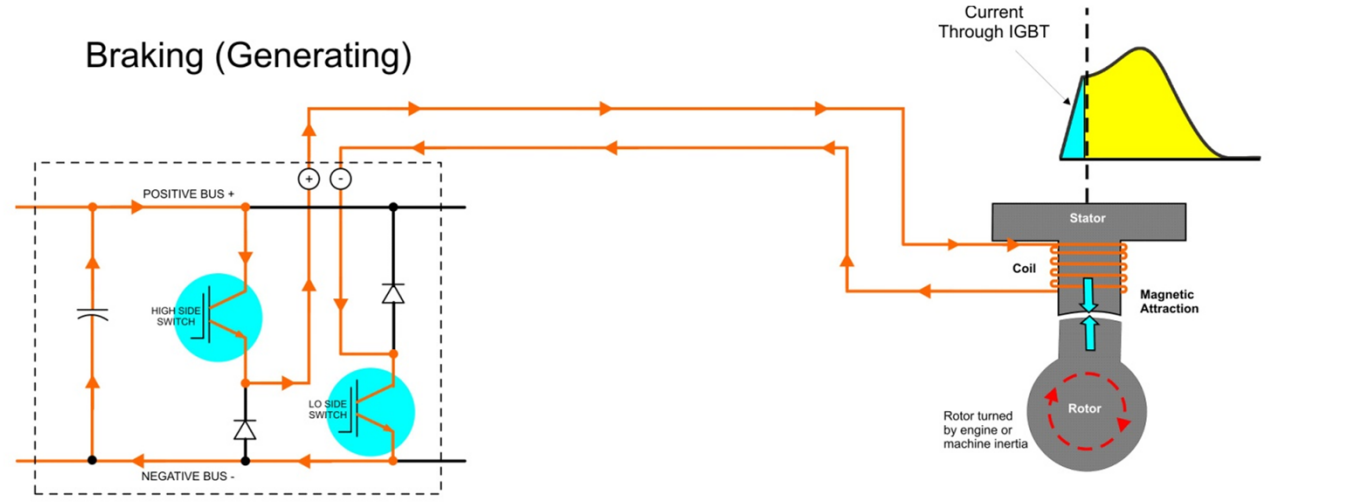
3. As the IGBT is turned off the energy created by the collapsing coil is sent back to the DC buss.

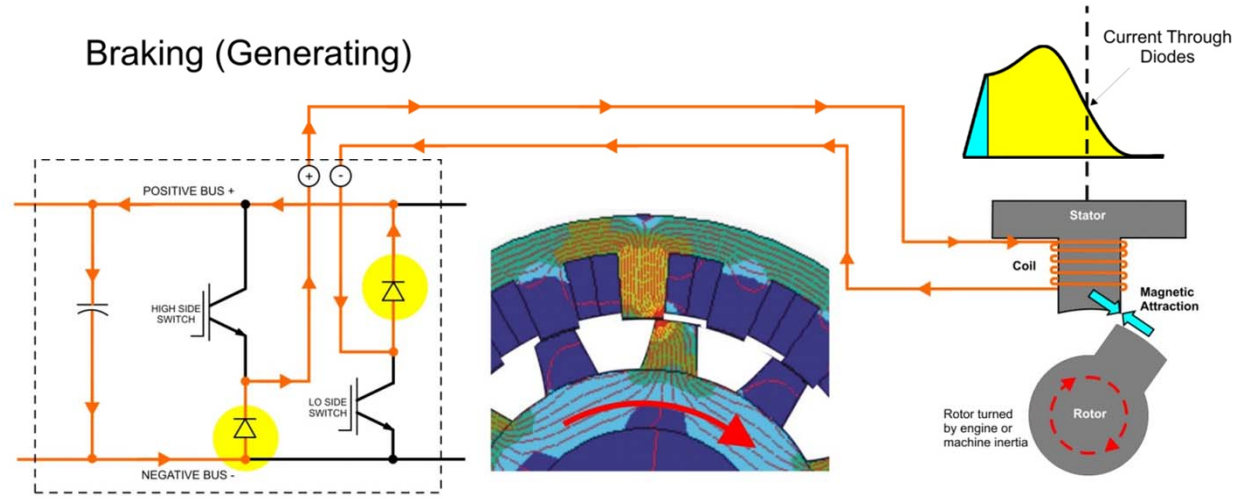
4. All based on timing

BRAKING



BRAKING





Notes

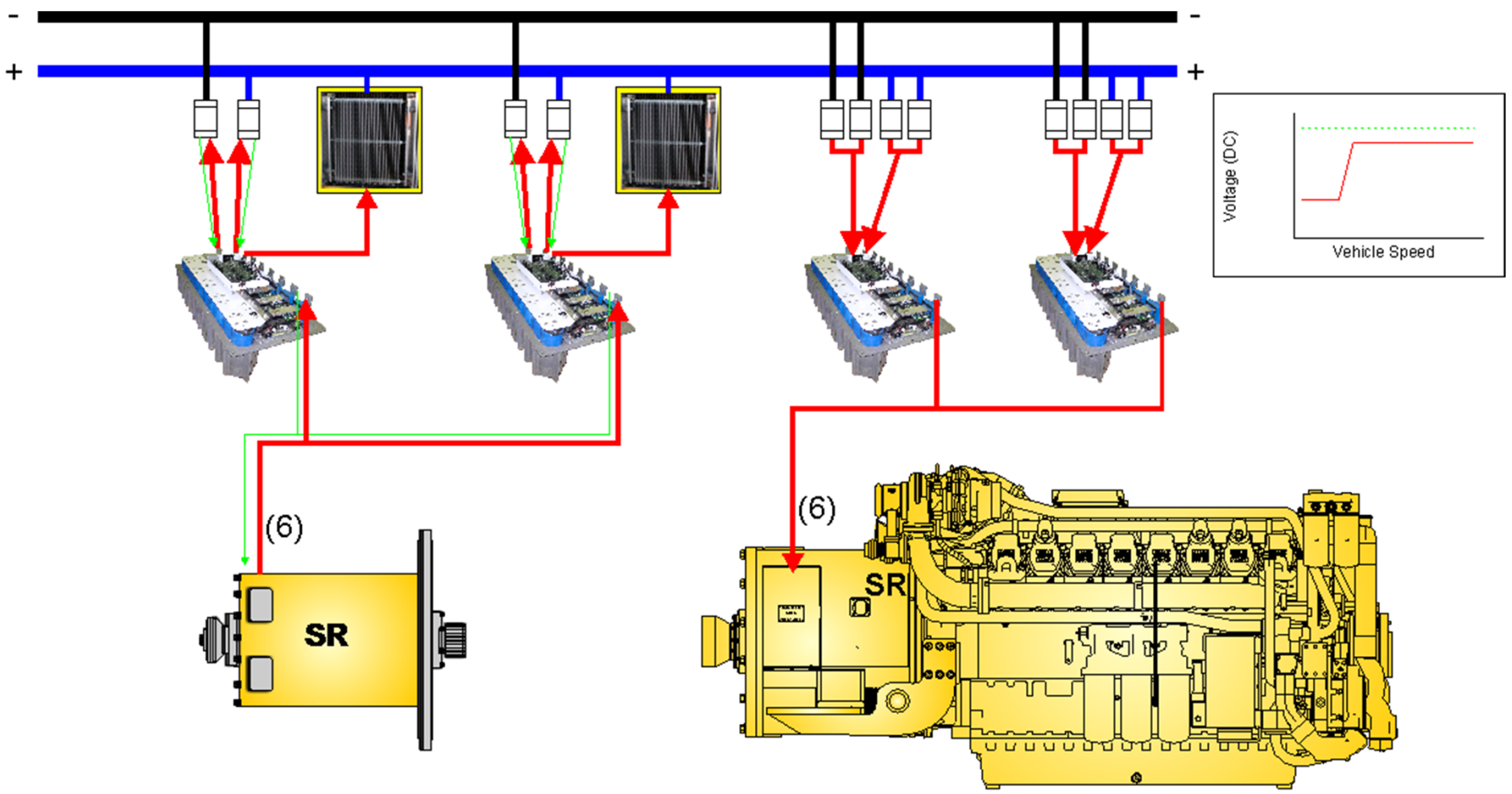
1. Current always flows in the same direction

2. During braking - small amount of current in with lots out.

3.After the initial excitation current the IGBT is turned off.

4. All based on timing

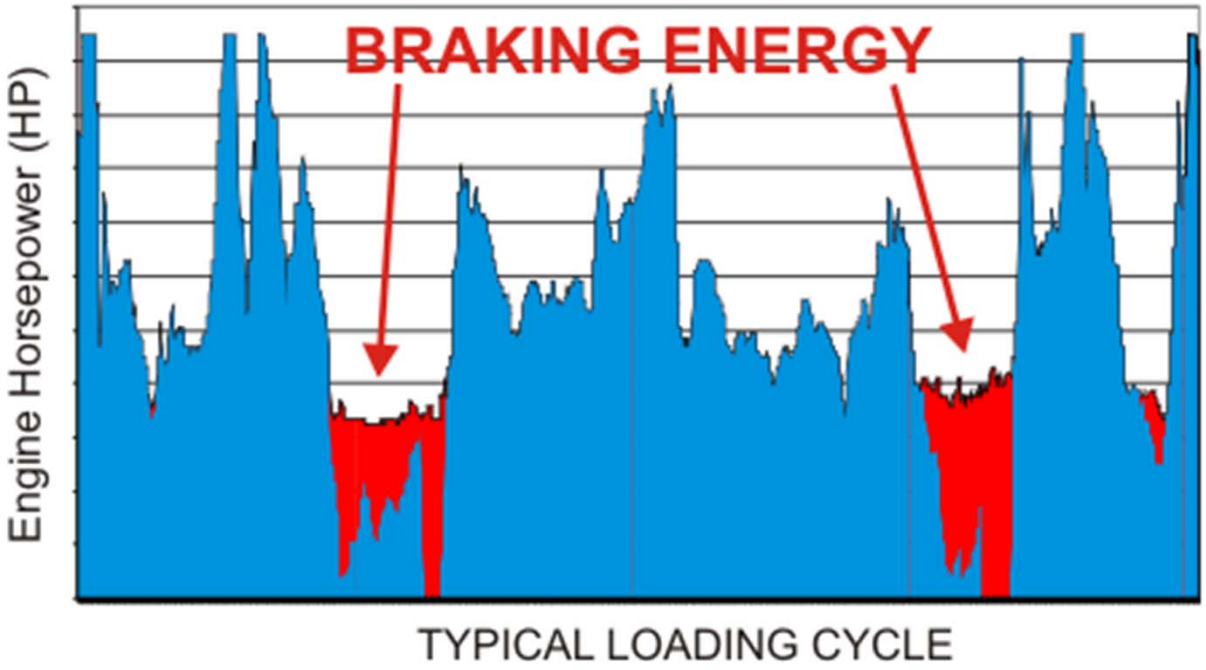
EXTENDED BRAKING



SR ENERGY RECOVERY

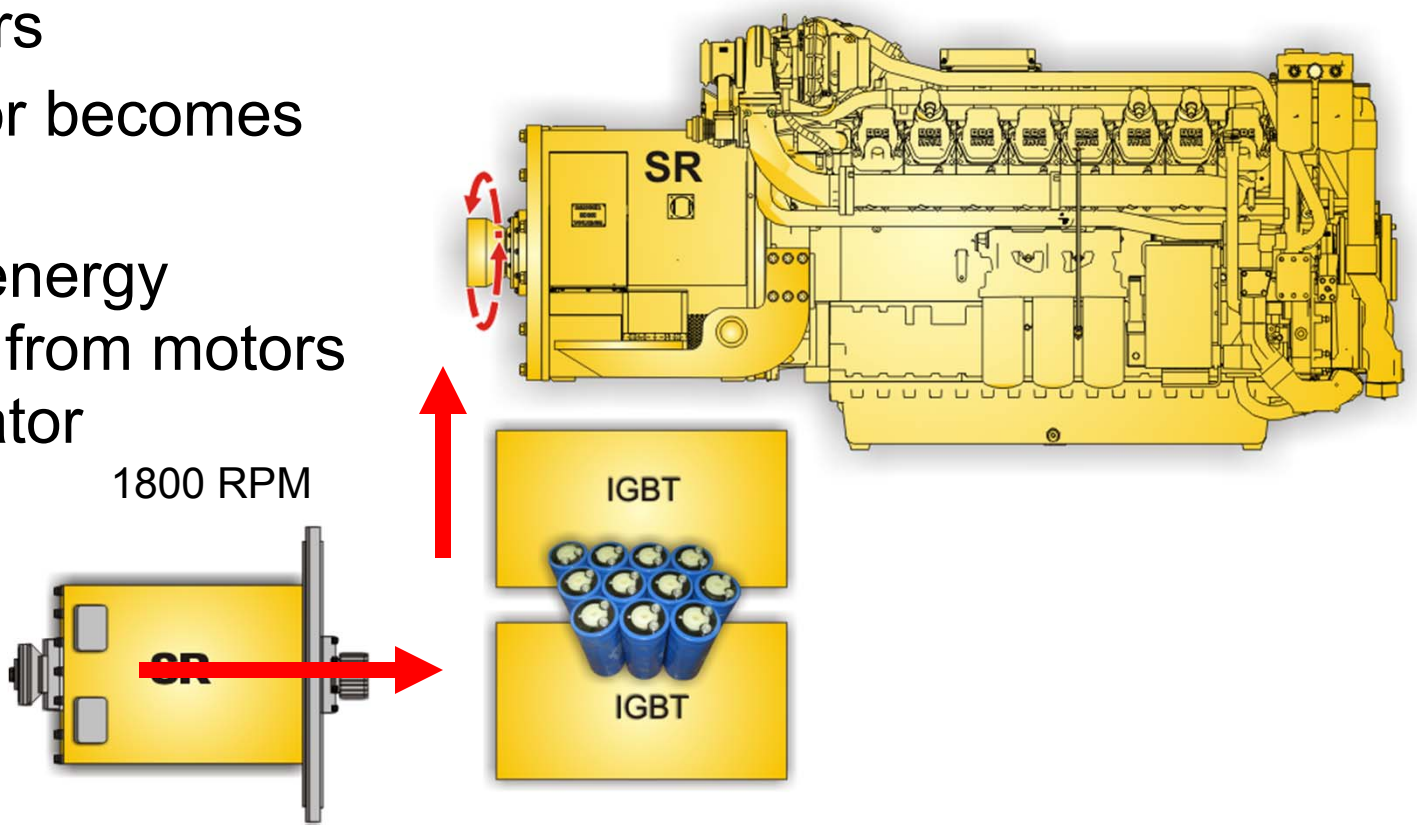
ENERGY RECOVERY

Braking energy (red) available in a normal loading cycle



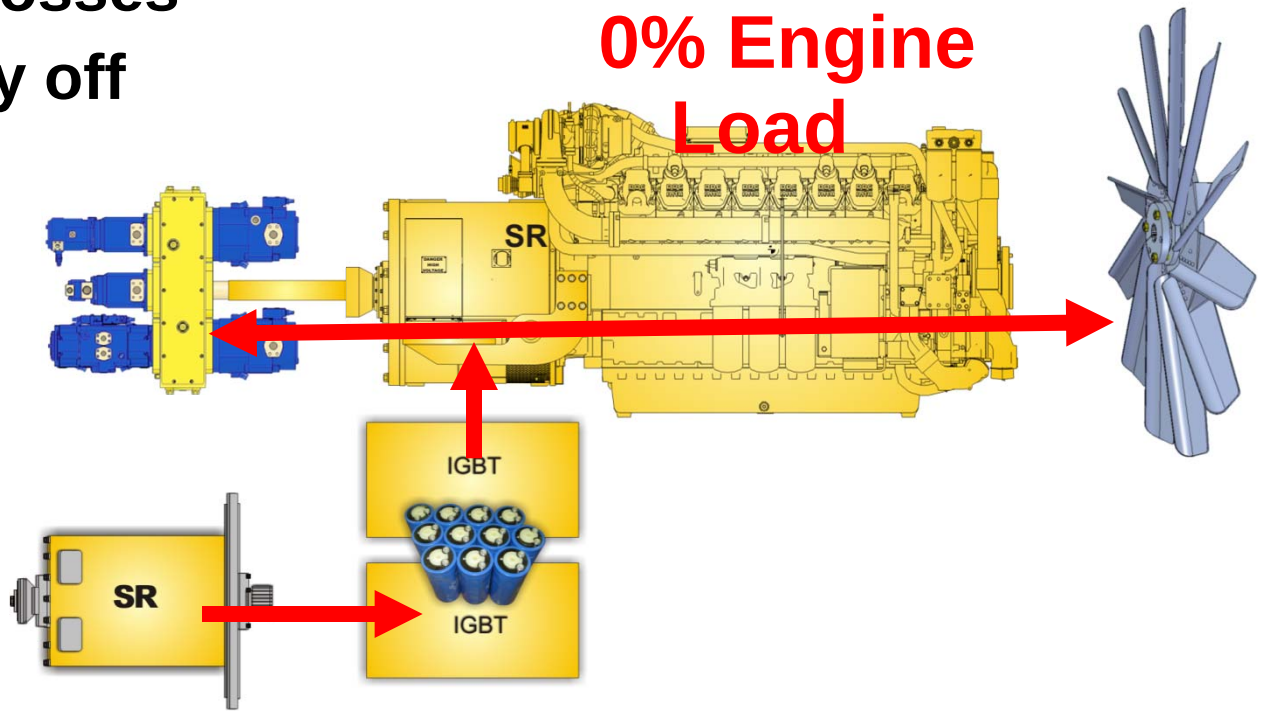
SR ENERGY RECOVERY

- During Braking
  - Motors become generators
  - Generator becomes motor
  - Braking energy transfers from motors to generator



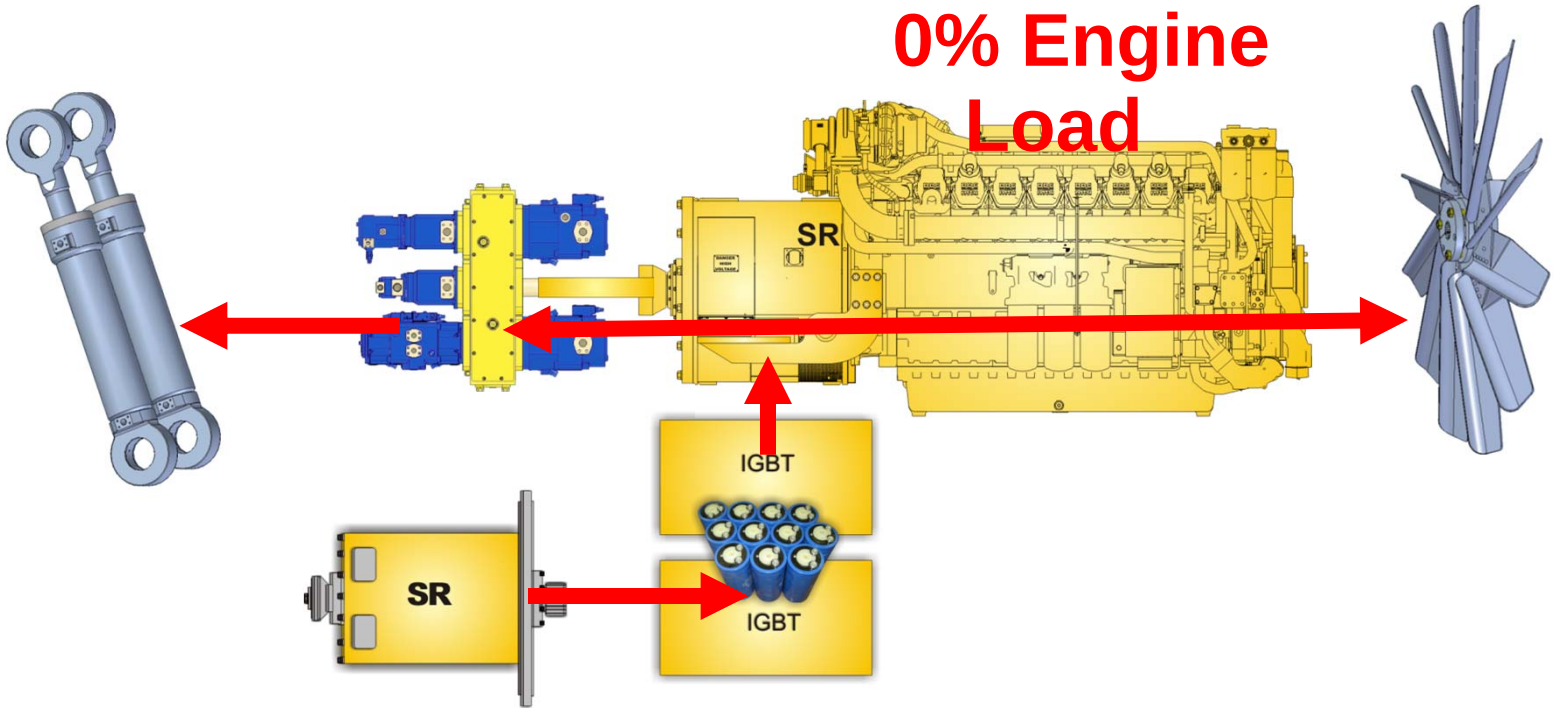
SR ENERGY RECOVERY

- Step 1 Supply Losses
  - Satisfy hydraulic parasitic
  - Satisfy engine losses
  - Shut fuel supply off



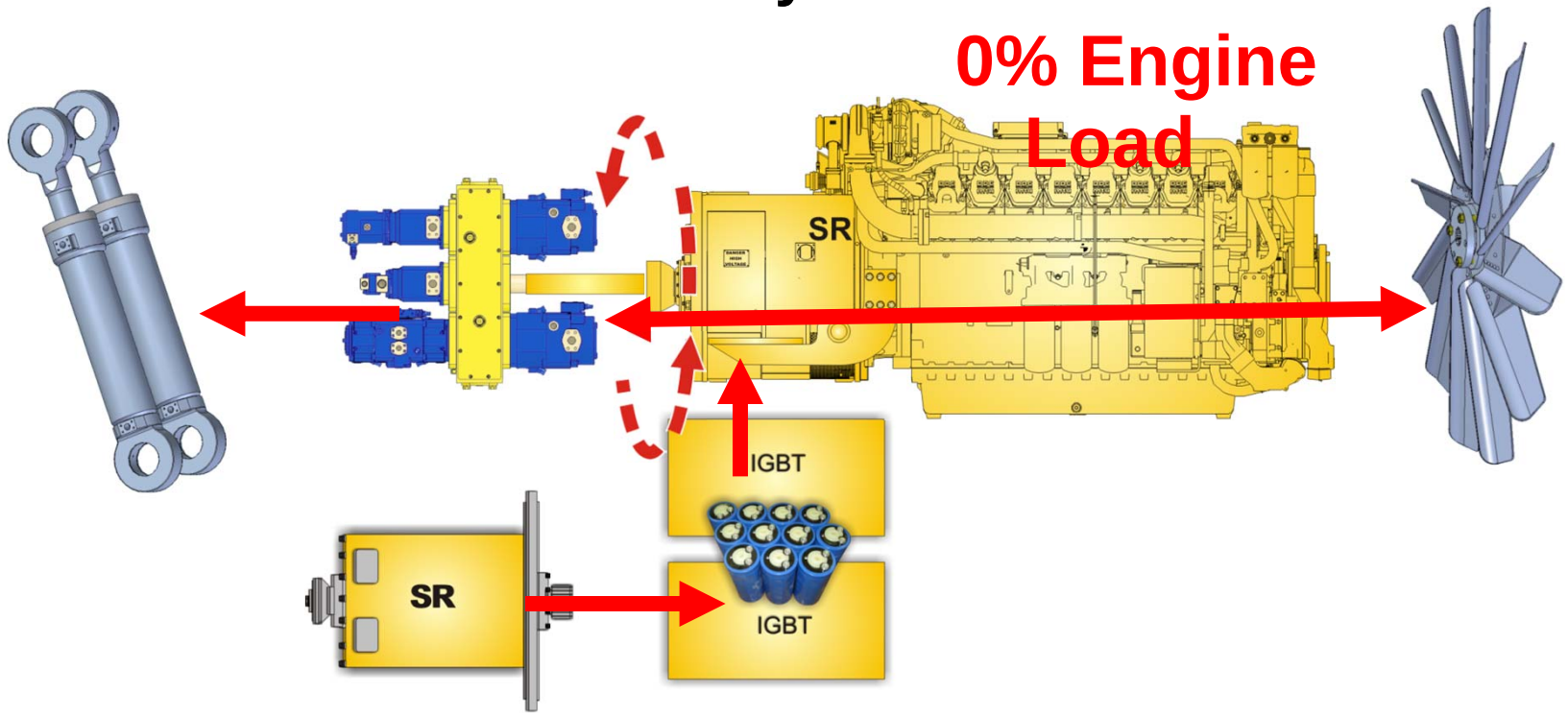
SR ENERGY RECOVERY

- Step 2 Supply Working Hydraulics
  - Energy for lifting load



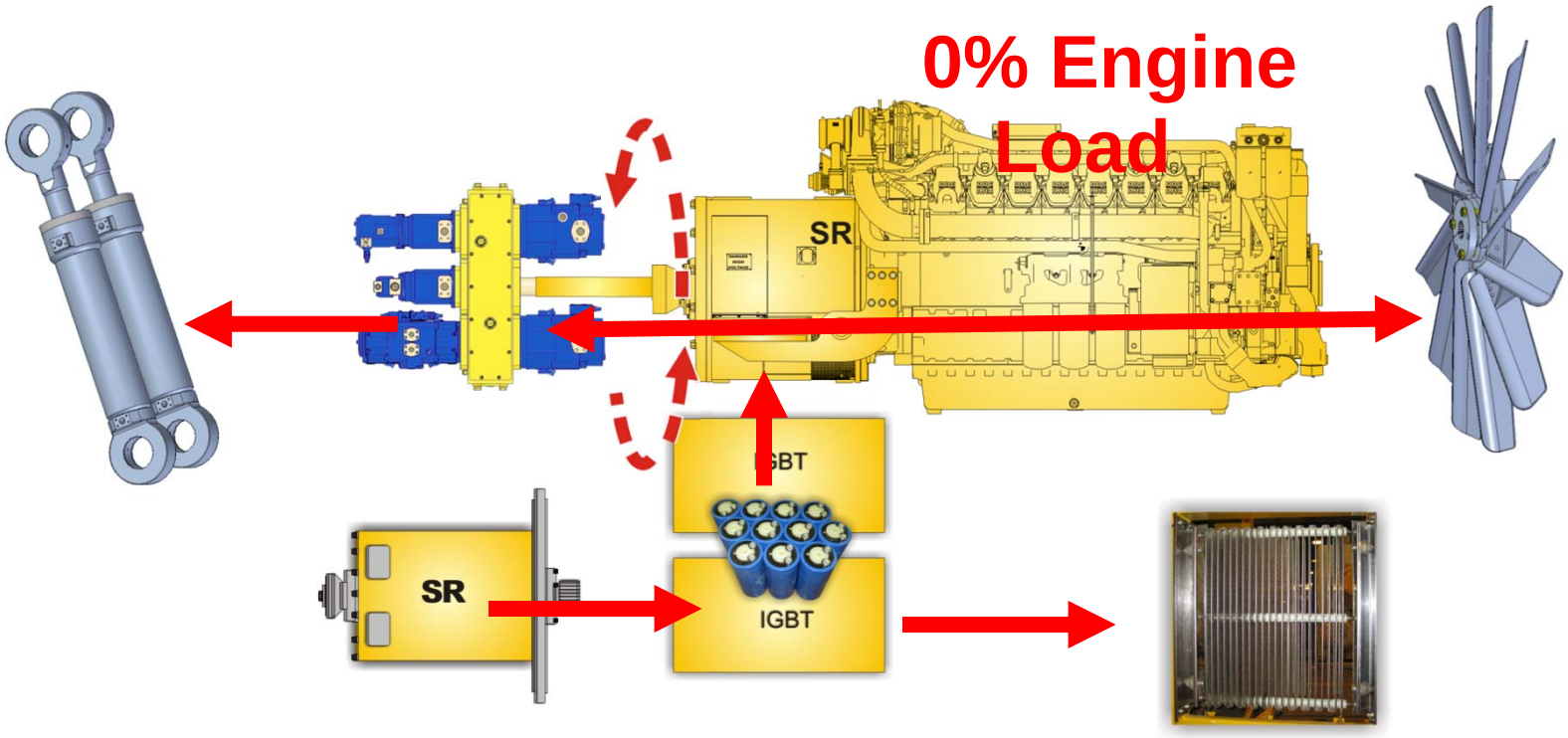
SR ENERGY RECOVERY

- Step 3 Store Energy
  - Drive line speed increases
  - Mass of drive train acts as flywheel



SR ENERGY RECOVERY

❑ Step 4 Excess Energy Transfers to Grids



SR ENERGY RECOVERY

100% Energy Recovery
with SR System
(During typical loading cycle)