

[Return to Session Menu](#)



DYNAMIC POSITIONING CONFERENCE
October 14-15, 2014

POWER/THRUSTERS

Enhanced Blackout Recovery Testing of DP Vessels

Nick Clarke, *NJC Power Limited*

Steve Cargill, *DNV GL – Oil and Gas – Noble Denton*

Robby Coggin, *DP Savants*

MTS DYNAMIC POSITIONING CONFERENCE
14 – 15 OCT 2014

**ENHANCED BLACKOUT RECOVERY TESTING OF
DP VESSELS**

NICK CLARKE, NJC POWER LIMITED

STEVE CARGILL, DNV GL

ROBBY COGGIN, DP SAVANTS

BLACKOUT

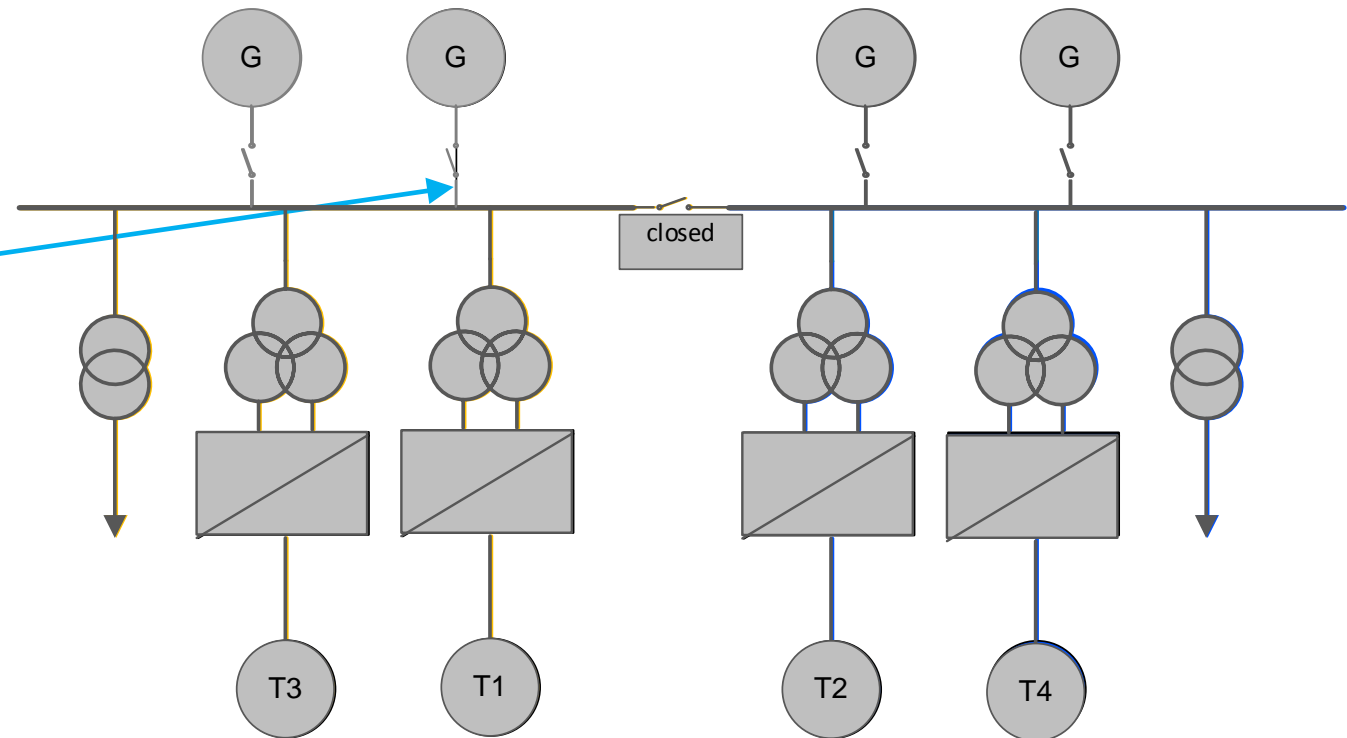
- Blackout on a vessel is the total loss of Electrical Power Generation and Propulsion
- Hence Loss of Positioning & Station Keeping
- Consequences are unimaginable
- Should be avoided at all times
- But if it does happen, the recovery / restoration of Power & Propulsion should be readily available



PRESENT TEST REGIME



Hit the
Emergency Stop
button of the last
Generator on the
system



BLACKOUT

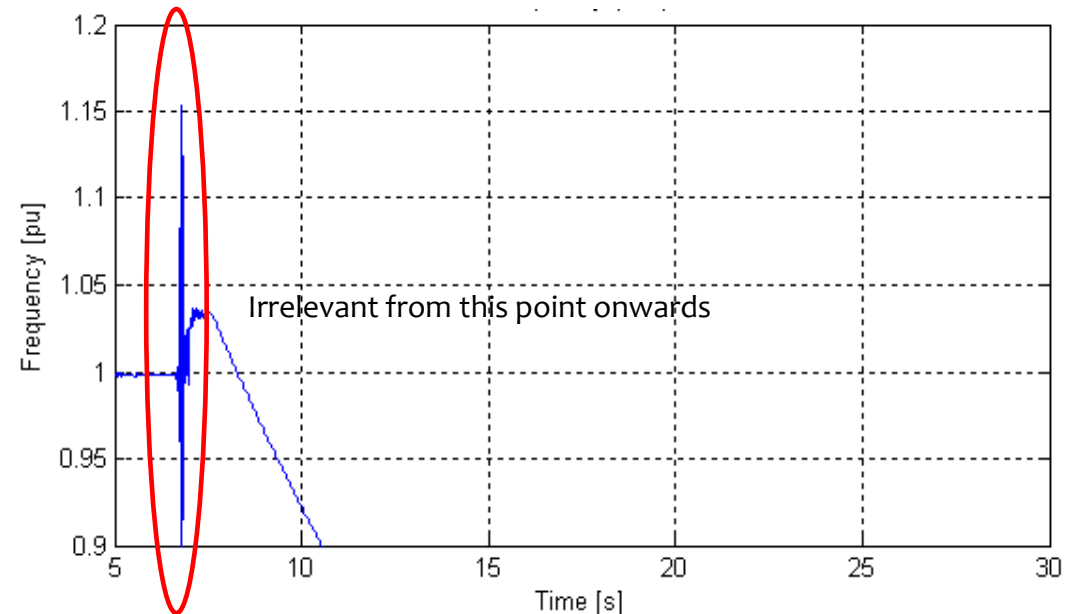
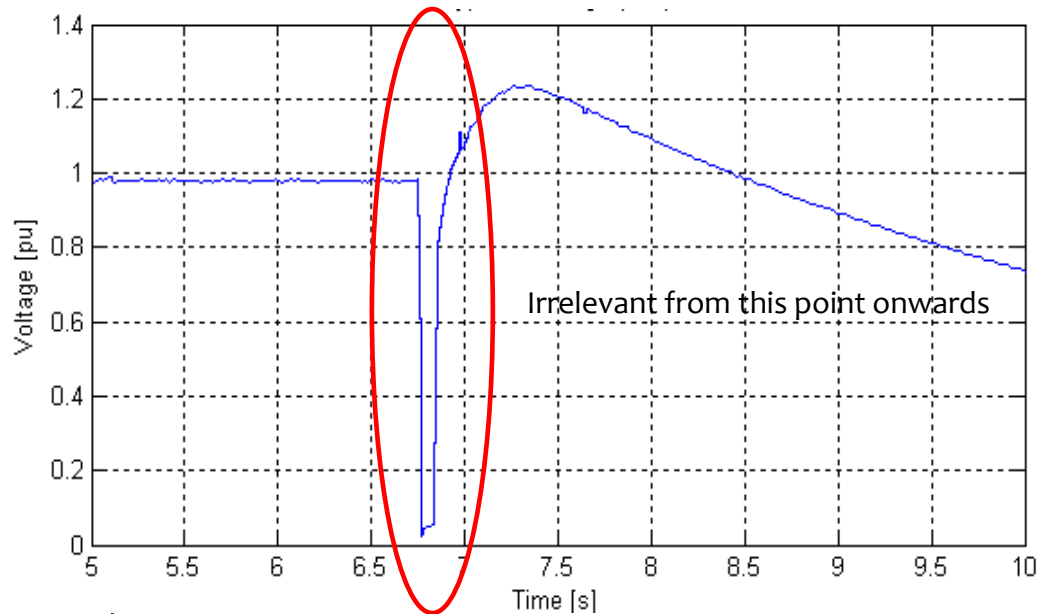
- But what does this test prove?
- Will the system recover if a disturbance occurs before the blackout?



WHAT IF



SYSTEM RESPONSE DURING A SHORT CIRCUIT

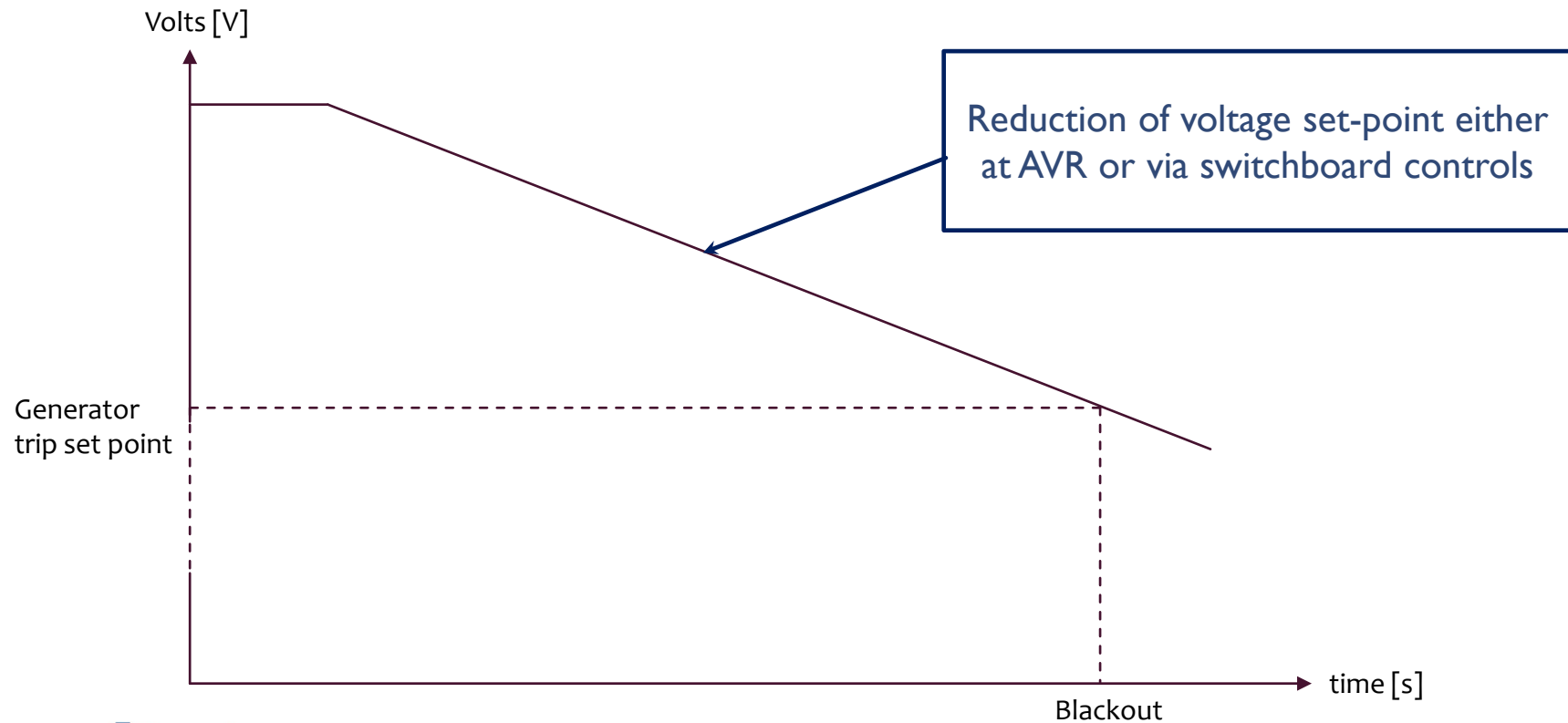


Frequency and Voltage interaction during a short circuit on an 11kV power system.
This could result in a blackout.



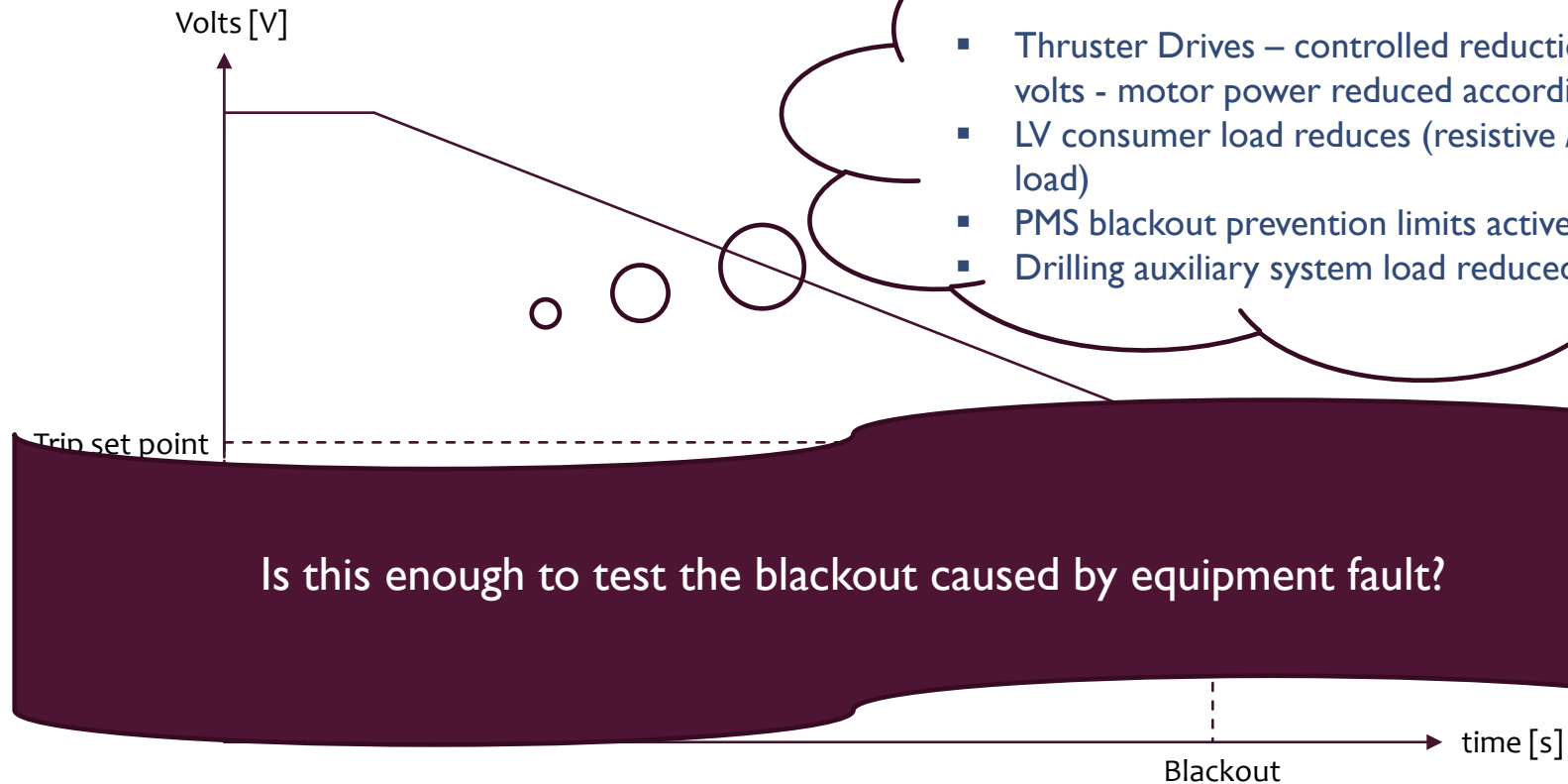
OTHER POSSIBLE TEST REGIME

Single Generator – Gradual reduction in voltage until trip point reached



OTHER POSSIBLE TEST REGIME

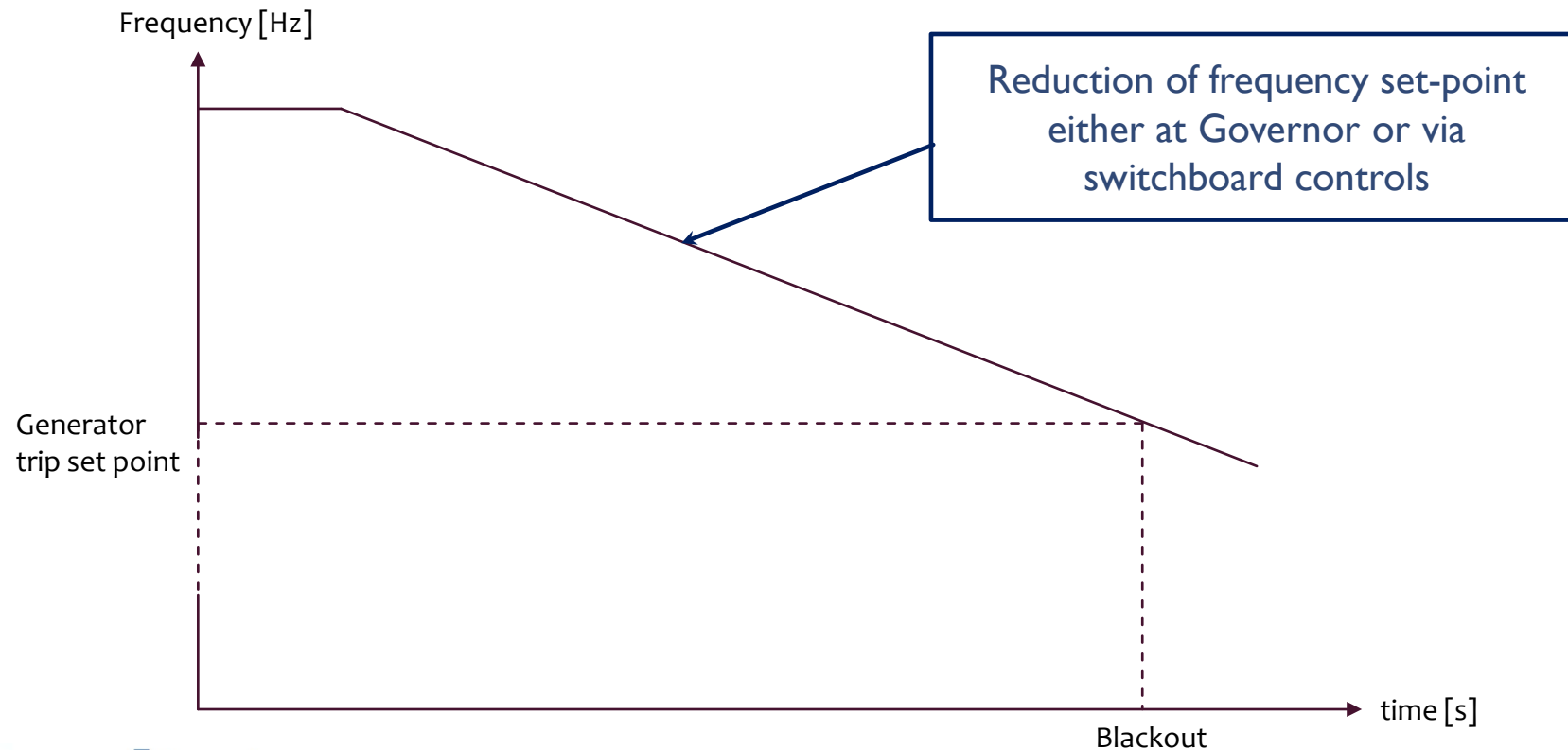
What happens during this period?



Is this enough to test the blackout caused by equipment fault?

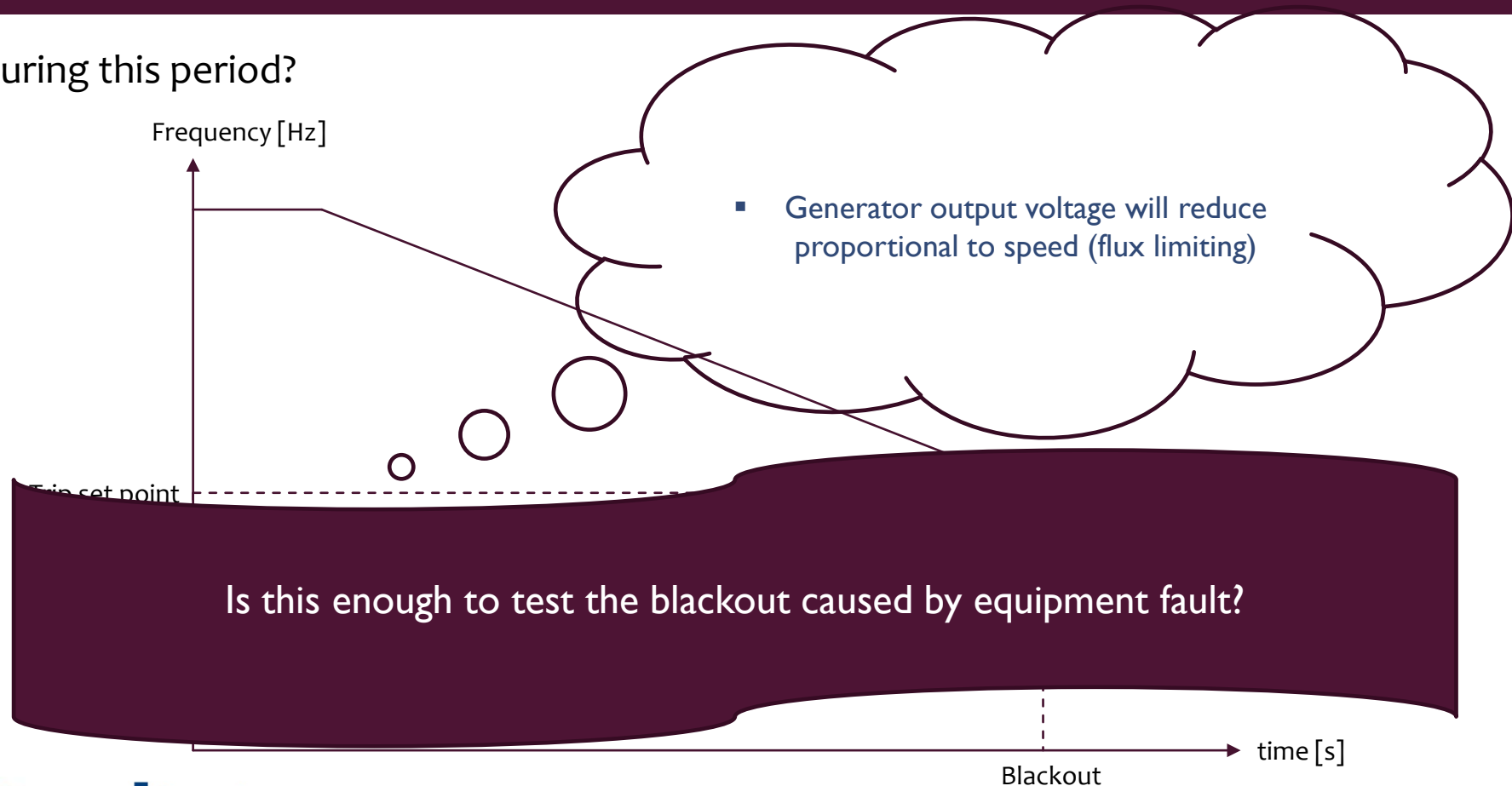
OTHER POSSIBLE TEST REGIME

Single Generator – Gradual reduction in frequency until trip point reached



OTHER POSSIBLE TEST REGIME

What happens during this period?



OTHER POSSIBLE TEST REGIME

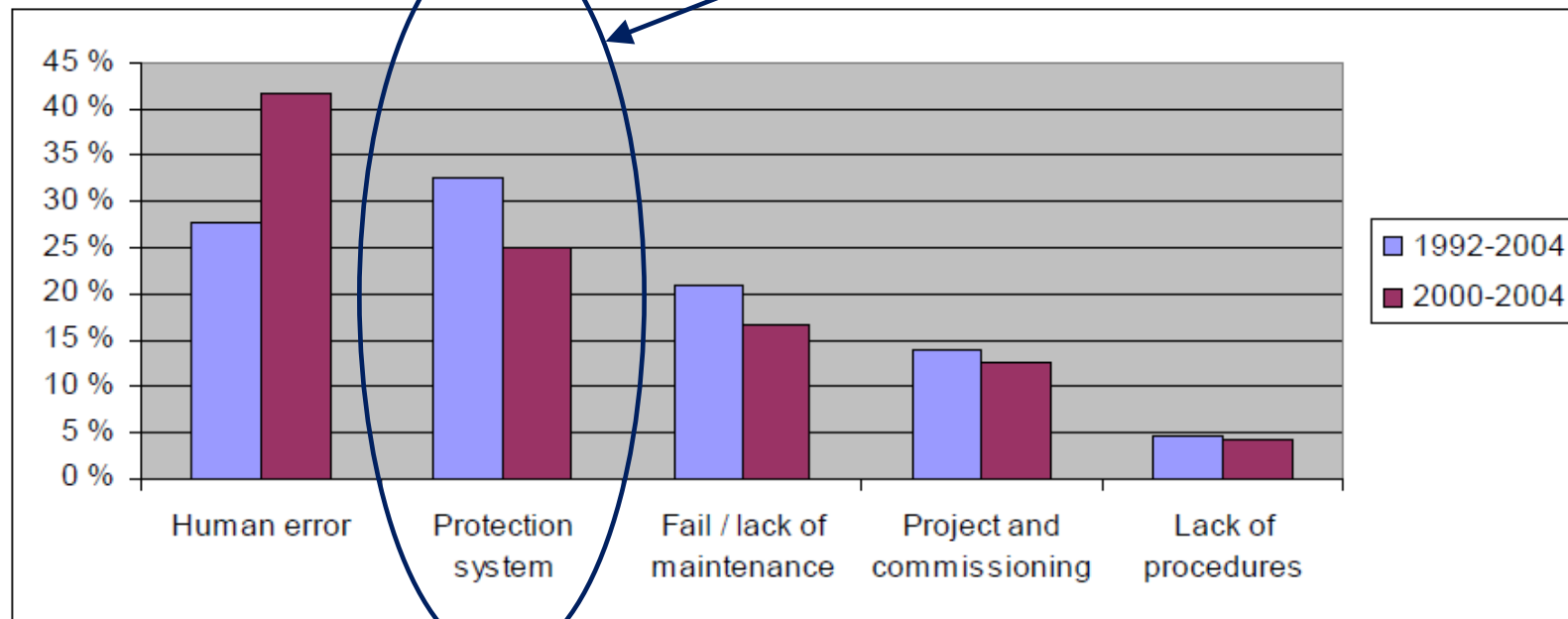
- Gradual reduction in voltage or frequency is a very good way of replicating a sequence of events leading to a blackout
- Power system reacts in a controlled manner to compensate for the variations.
- However, the system is not subjected to any transient or abrupt abnormal conditions
- May not fully evaluate the blackout recovery sequence.

QUESTION: Should we be checking the stability of the protection systems for the healthy equipment to prove that they don't operate in error during this transient condition?

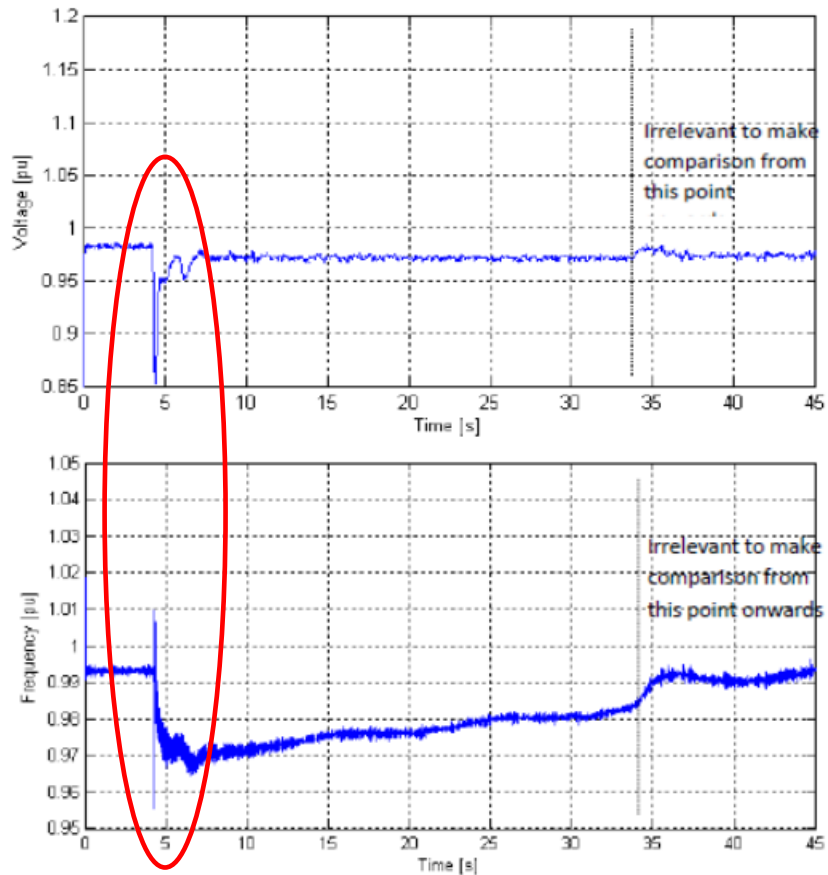
BLACKOUT ROOTCAUSE

Data from Petrobras

Are we addressing this root cause enough in our testing?



SYSTEM RESPONSE DURING GENERATOR LOSS OF EXCITATION

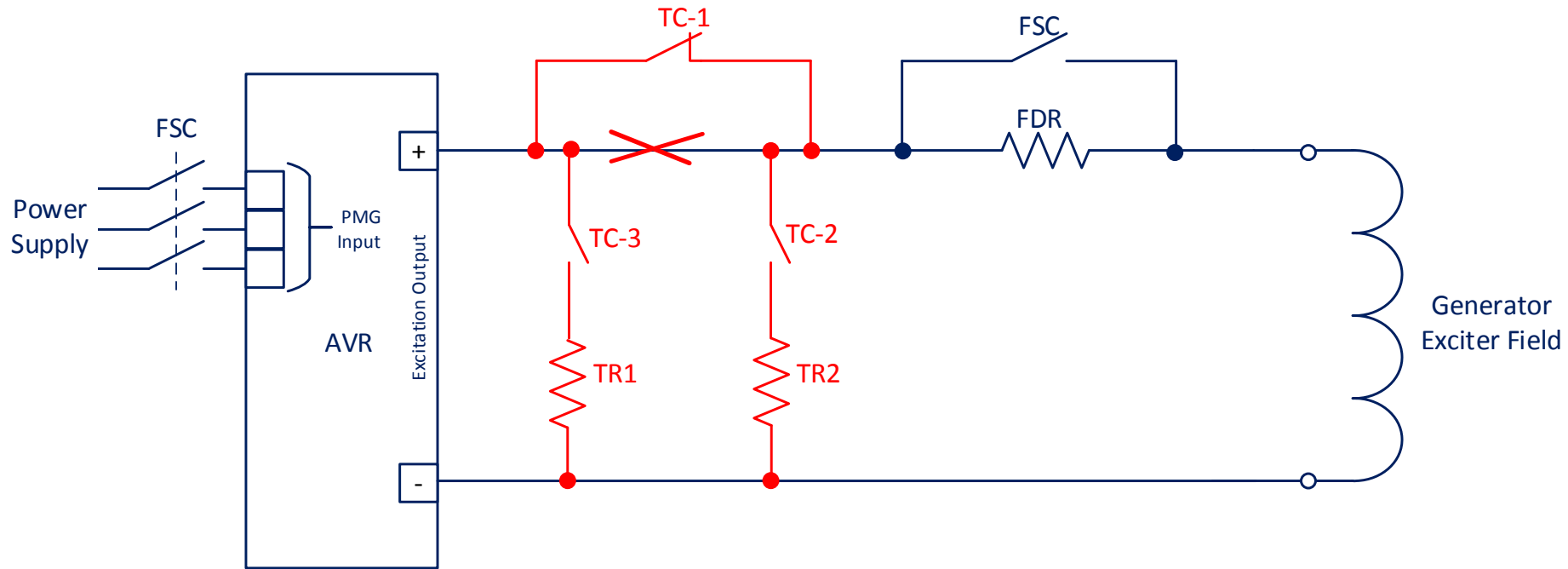


Frequency and voltage interaction during a generator loss of excitation. This could result in a blackout.

HOW CAN WE CREATE THE VOLTAGE DISTURBANCE?

- Applying a short circuit is a realistic test!
- Need a benign method that can be performed more frequently with almost zero impact on equipment longevity
- Loss of excitation could yield a similar response (voltage and frequency transient).
- A test circuit engineered into the power system at the design stage.
- A test circuit that could be connected into the existing power system with minimal disruption.
- Fault ride through or short circuit tests should still be performed, but less frequently

ALTERNATIVE TEST METHOD (I)



— Existing Circuit

— Modifications for Test

TC = Test contact from Test Box (3-pole relay)

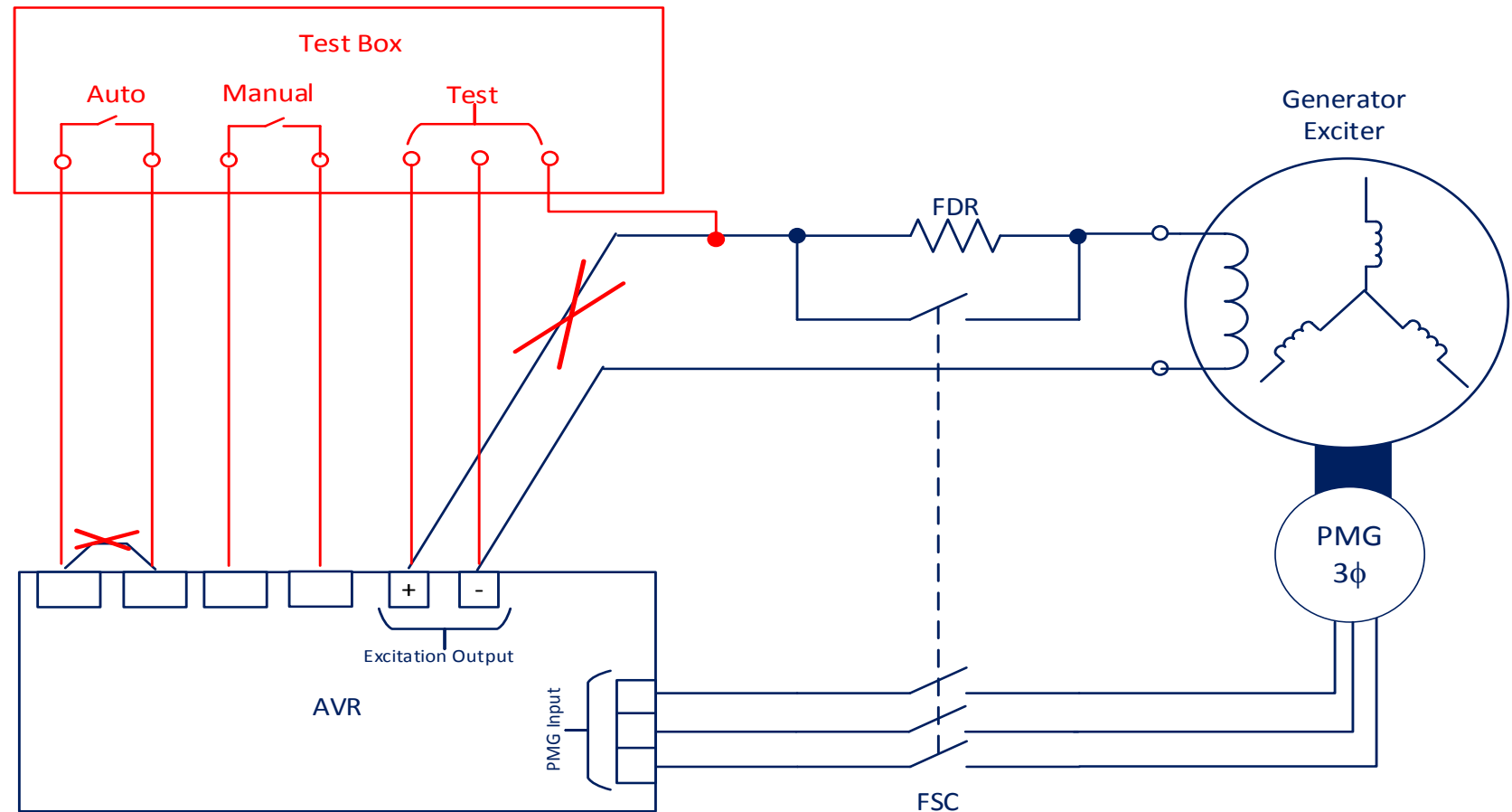
TR1 = Test resistor (similar value to generator exciter field resistance)

TR2 = FDR for field suppression purposes

ALTERNATIVE TEST METHOD (I)

FDR = Field Discharge Resistor (Existing)

FSC = Field Suppression Contactor (Existing)



ALTERNATIVE TEST METHOD (2)

- The previous slides show how we can create an abrupt voltage variation
- How can we implement an equivalent frequency excursion as an alternative test method?
- Will it give a corresponding voltage excursion in a similar way that a reduction in voltage impacts on system frequency?
- Sudden loss of a generator – resulting in overload on the remaining generator(s)- possible blackout?
- Sudden loss of a generator - transient limits being exceeded on the remaining generator(s) - possible blackout?
- Loss of common fuel supply to a group of engines causing loss of a redundancy group?
- The way ahead or are we unnecessarily stressing the equipment?

ALTERNATIVE TEST METHOD

Function	System / Equipment fault (Protection Trip)?	Operator Error?	PMS Fault?	Other?
E-Stop Engine	x	√	x	
CB Trip	x	√	√	
Ramp Volts to trip Set-point	x	√	√	
Ramp Hz to trip set-point	x	√	√	
Excitation Interruption	√	x	x	

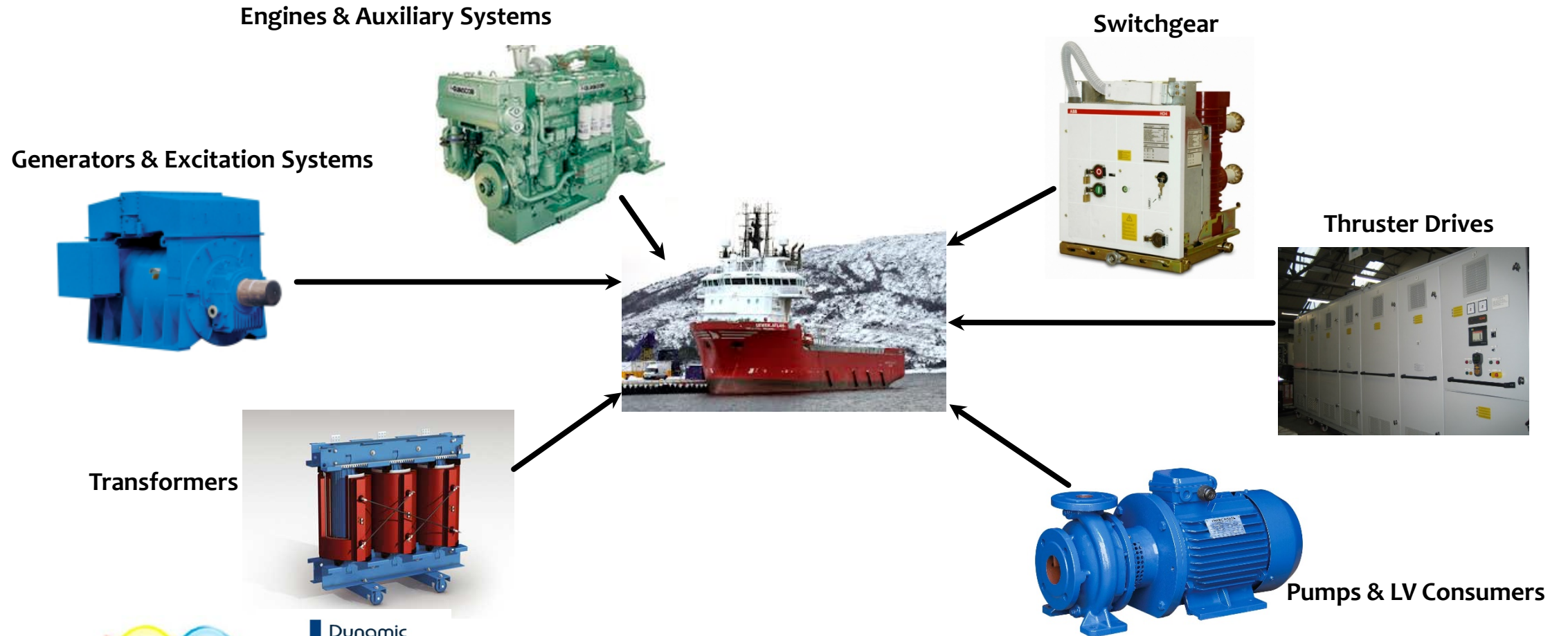


IMPACT ON EQUIPMENT LIFE

- Anxiety over performing tests
- Safety first
- Design Build To Test systems



IMPACT ON EQUIPMENT LIFE



TO SUMMARIZE

- Can we as an industry develop a set of realistic Blackout Recovery Tests?
- Propose additional tests to compliment tests already practised
- Impact on equipment longevity must be kept to a minimum
- Can these additional tests provide important information as to how we design power & propulsion systems in the future?
- Build To Test is a very important consideration



GENERAL DISCUSSION

