Improved Resilience through Simplicity in Power Automation, Control, and Protection

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UNIVERSITY OF NORTH DAKOTA
COLLEGE OF ENGINEERING & MINES

Hidden Cost of Complexity

Complexity takes more maintenance labor

- Functional and Security Updates
- Obsolescence & replacements
- Complex designs are replaced sooner
- Risk means more meetings and longer outages

Staff Challenges

- Training
- Shortage
- Doing more
- Change every 2 years

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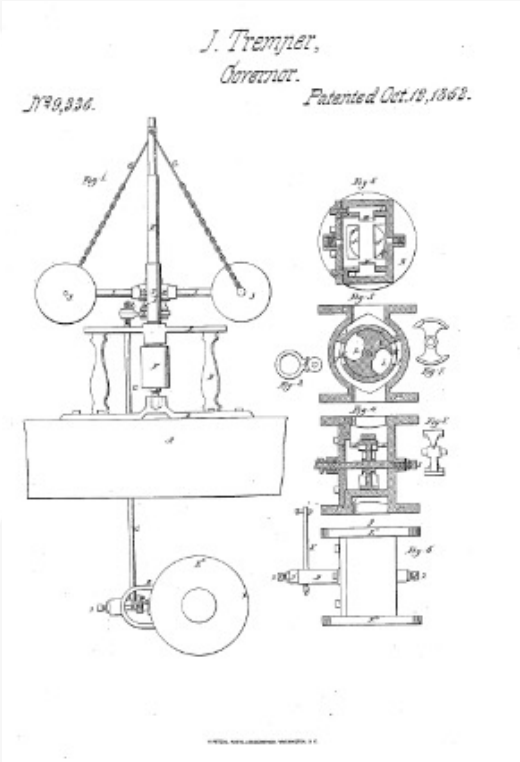
Resiliency may take priority over Efficiency Example: US Department of Defense

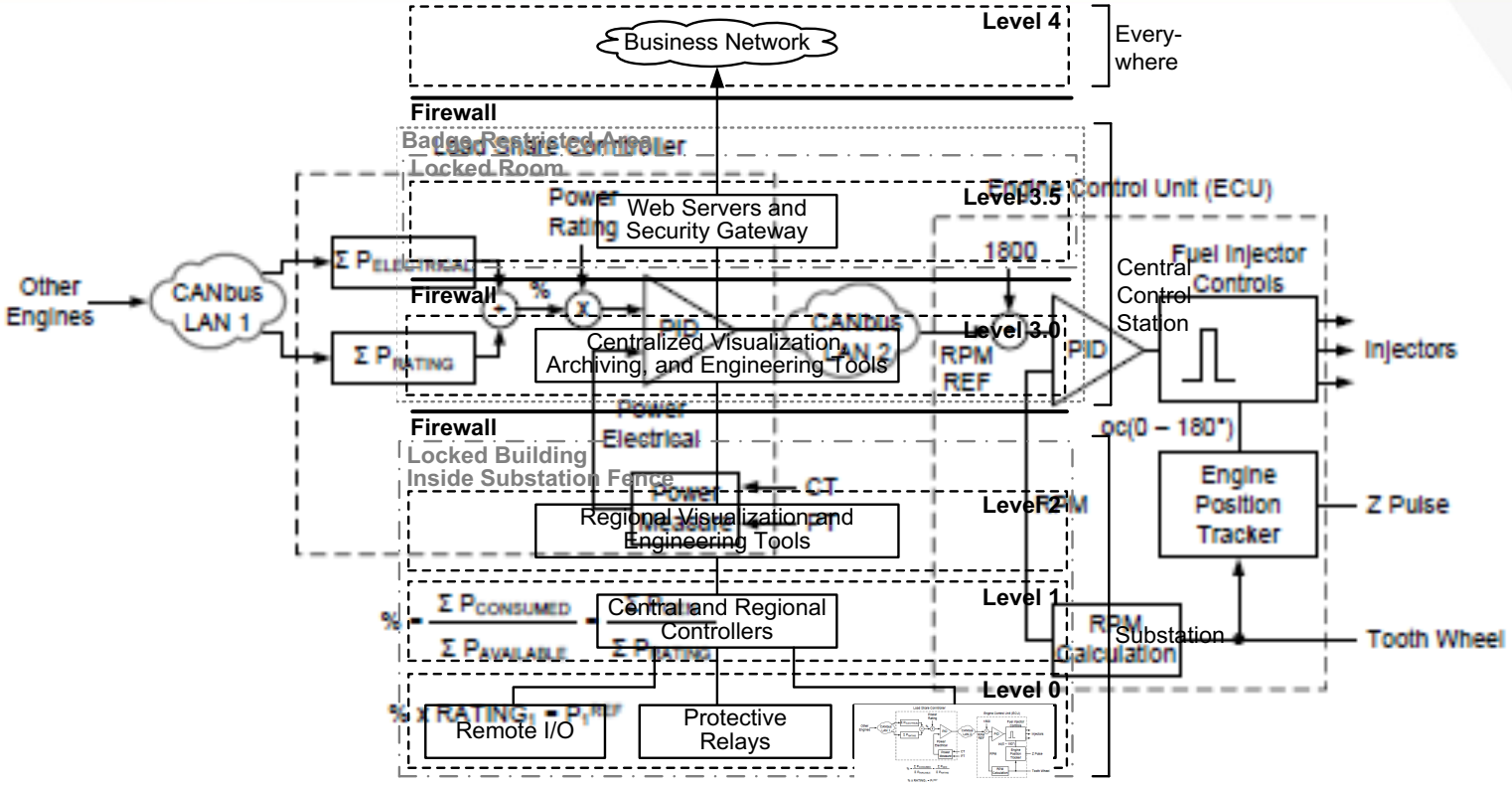
- 2007? - Energy Conservation Investment Program (ECIP)
- 2016 - Energy Resilience and Conservation Investment Program (ERCIP)
- 2023 - “The microgrid is a resiliency project and does not require a specific return on investment (ROI)...”

“The definition of genius is taking the complex and making it simple.” — Albert Einstein

Are we going the right direction?



Ball Valve Governor 1860-2023



Digital Isochronous Load Share 1995-2023

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Example: Evolution of Network Security

UART Data Diode ~ 1965

- Transmit Wire Only

Router/Firewall ~ 2010

Non-deterministic

Allow by default

RSTP learning

Millisecond network healing

Designed for IT

OT SDN ~ 2020

- Deterministic
- Deny by default
- SDN Configured
- Microsecond network healing
- Designed for OT & NERC/CIPS

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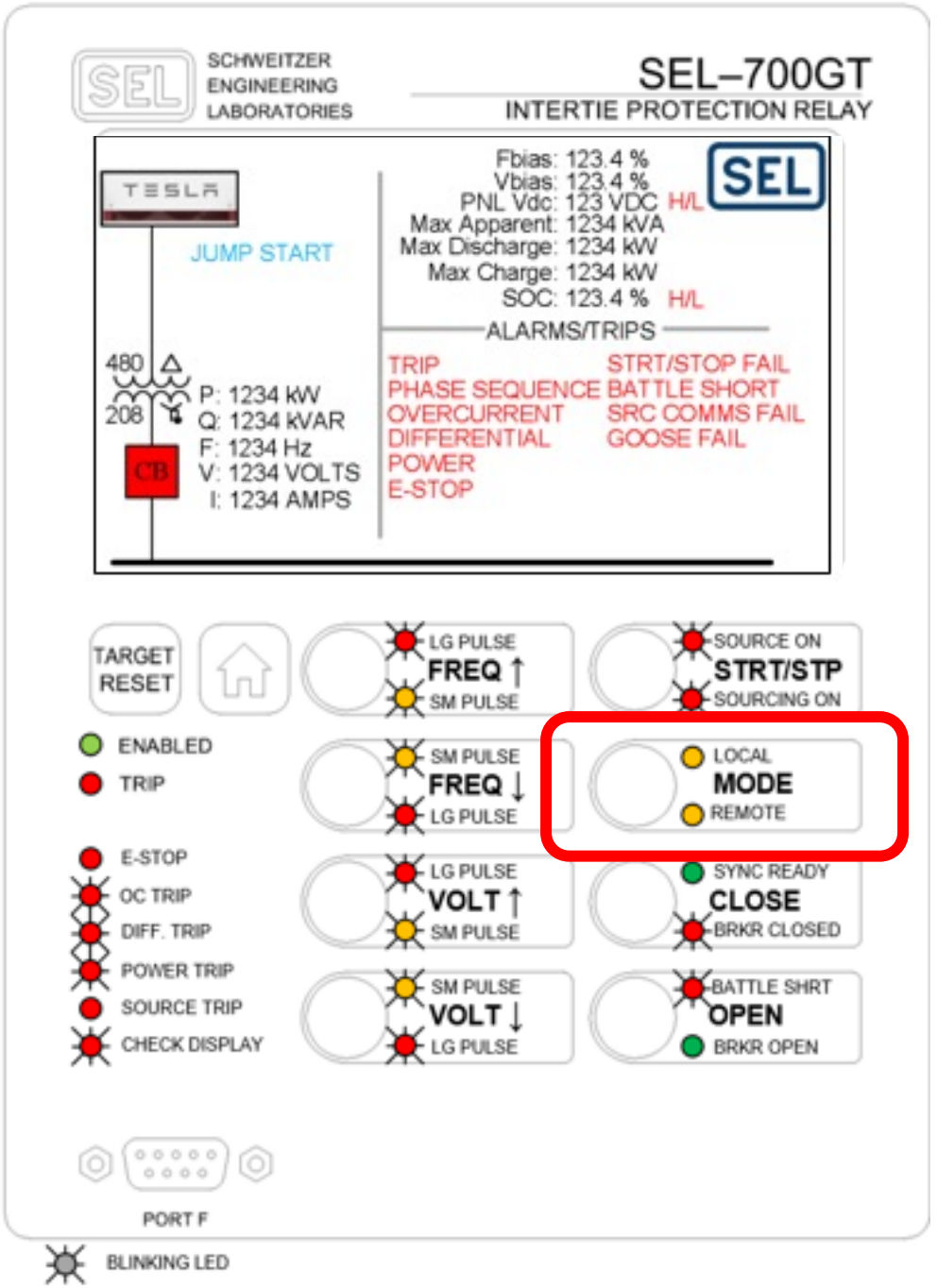
Example: Local Mode Controls are the Cybersecurity plan B



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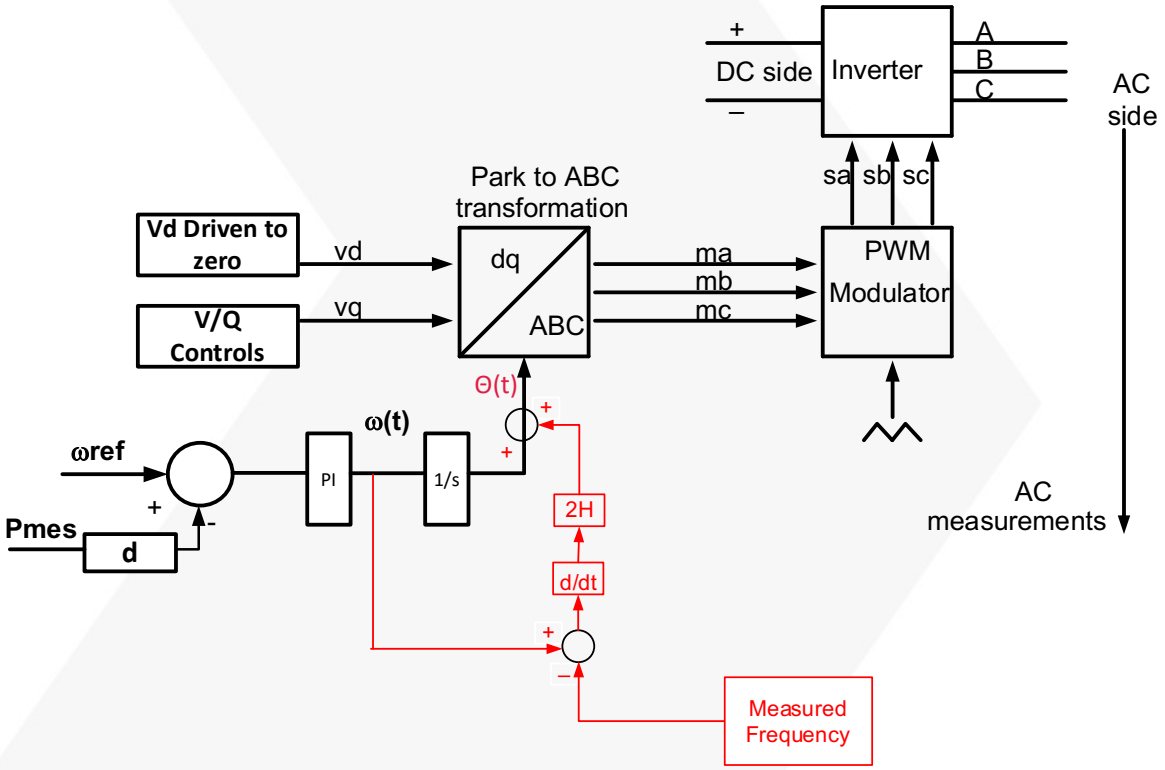
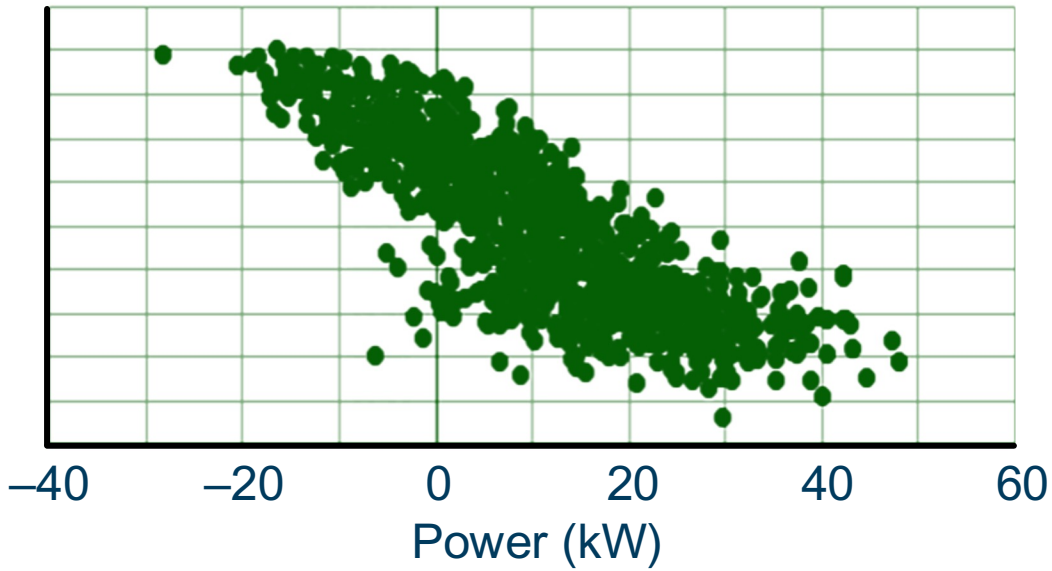
Example: Complex Inverters Erode Reliability

Mandated Feature	Undesired Outcome
Unintentional Island Detection	Unnecessary shutdowns
Virtual Inertia	Oscillations
Cessation	Unpredictable behavior
Cascaded Controls & transforms	Sub-synchronous Control Interactions

Complex and Fragile: Virtual Inertia





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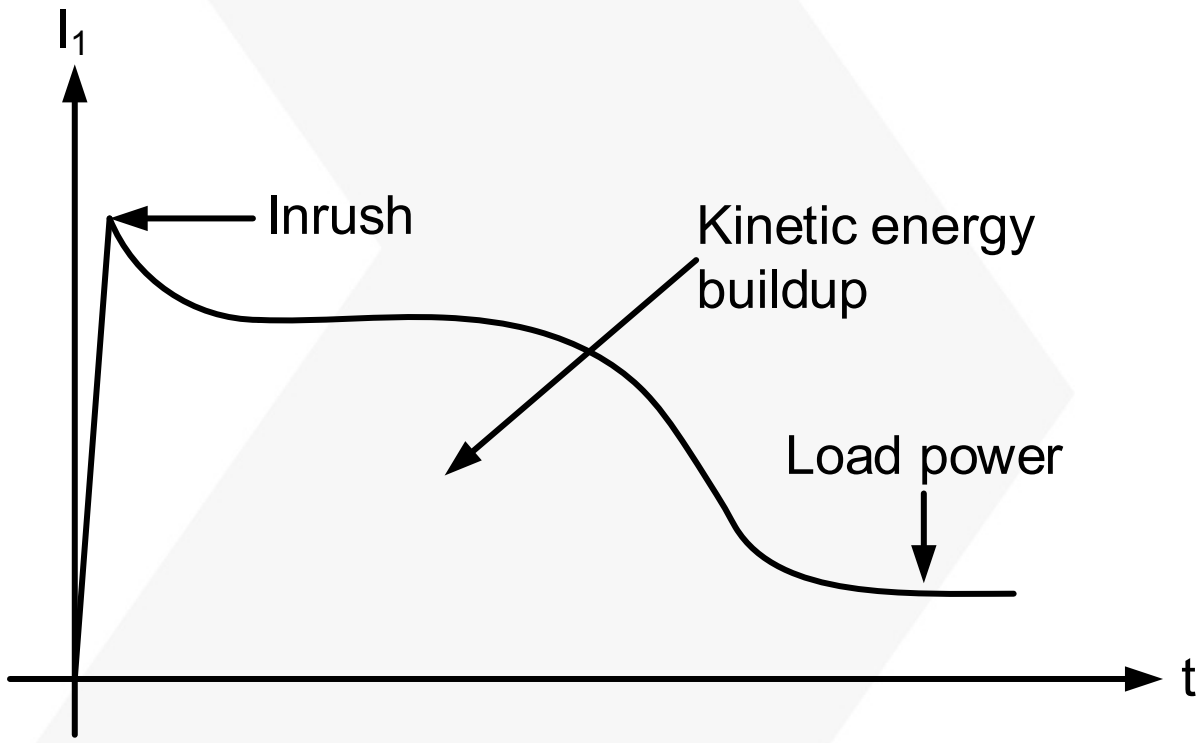
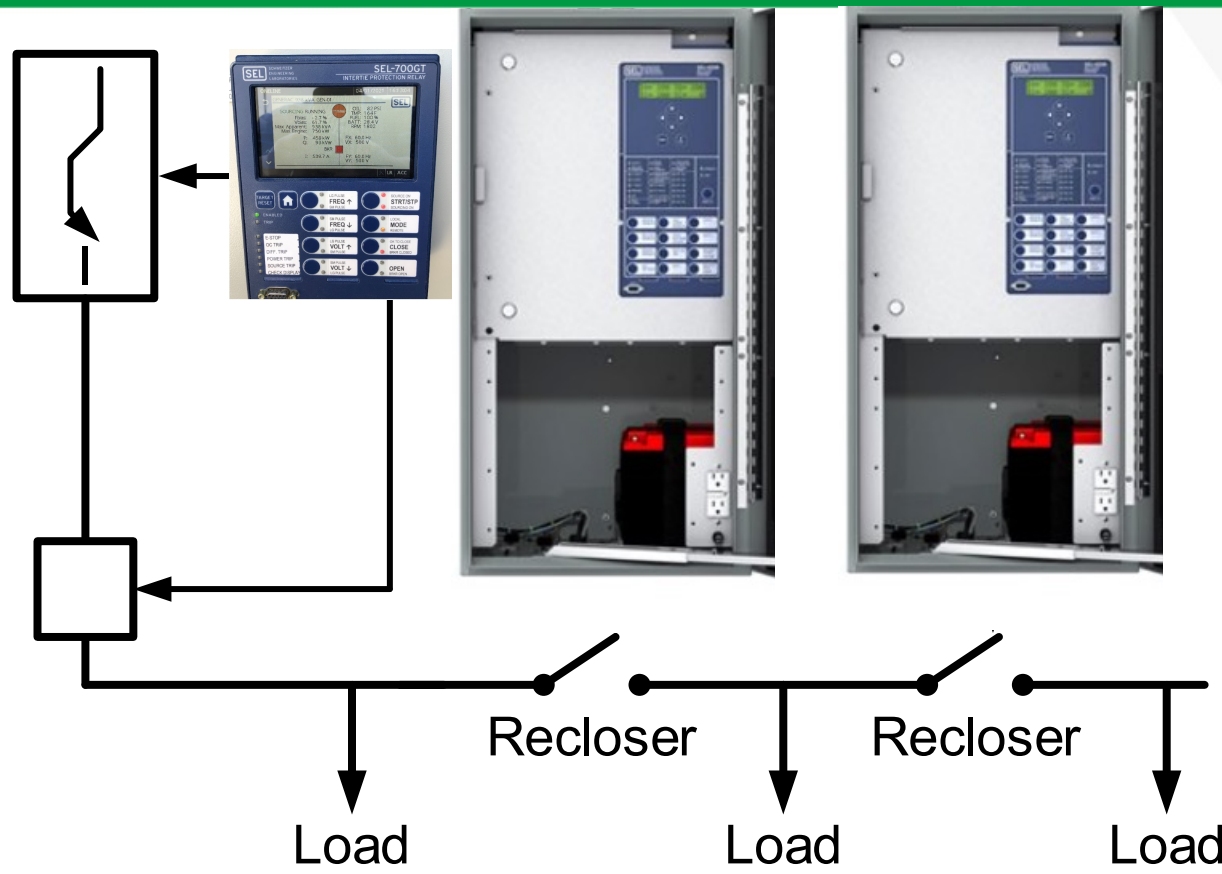
Example: Re-energizing a Microgrid is Challenging





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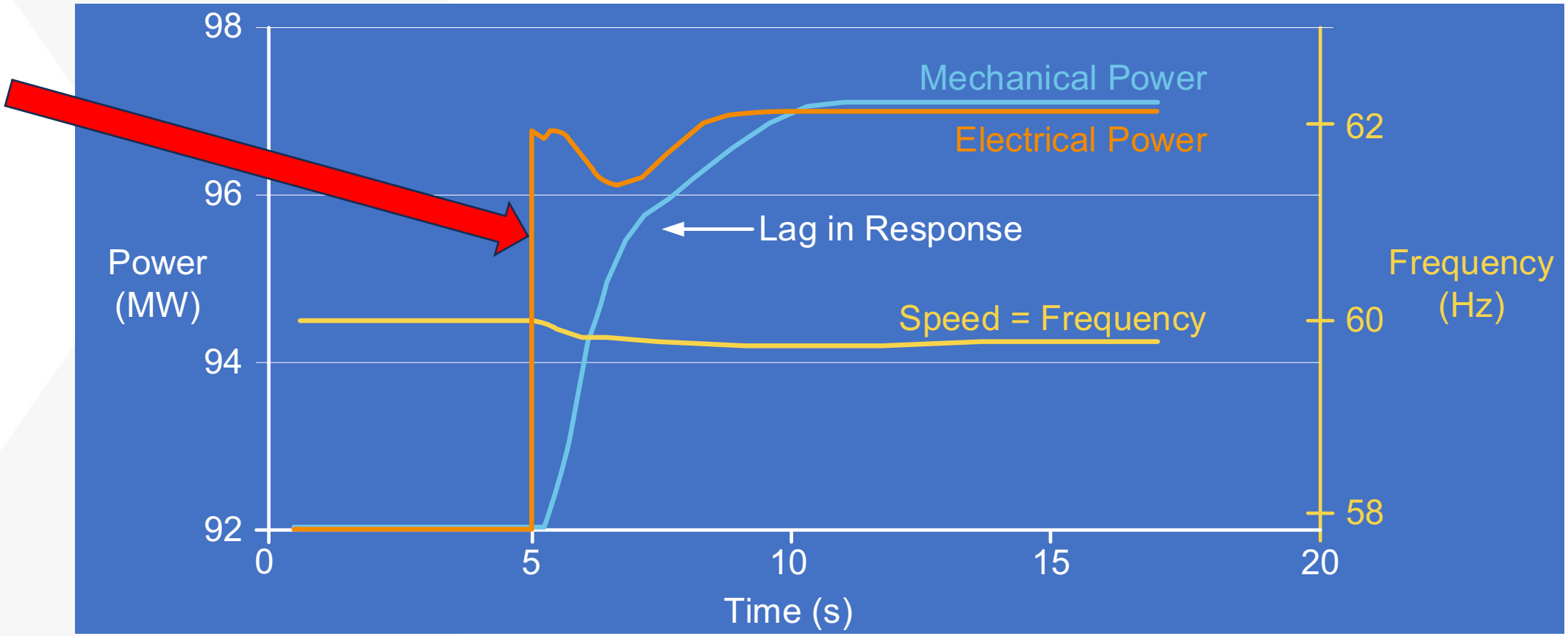
Ultimate Resilience is an Energy Dispenser at speed of light



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Example: Generator Complexity Reset

60 kW Genset

Removed 32 lb of complexity

Streamlined Control & Protection

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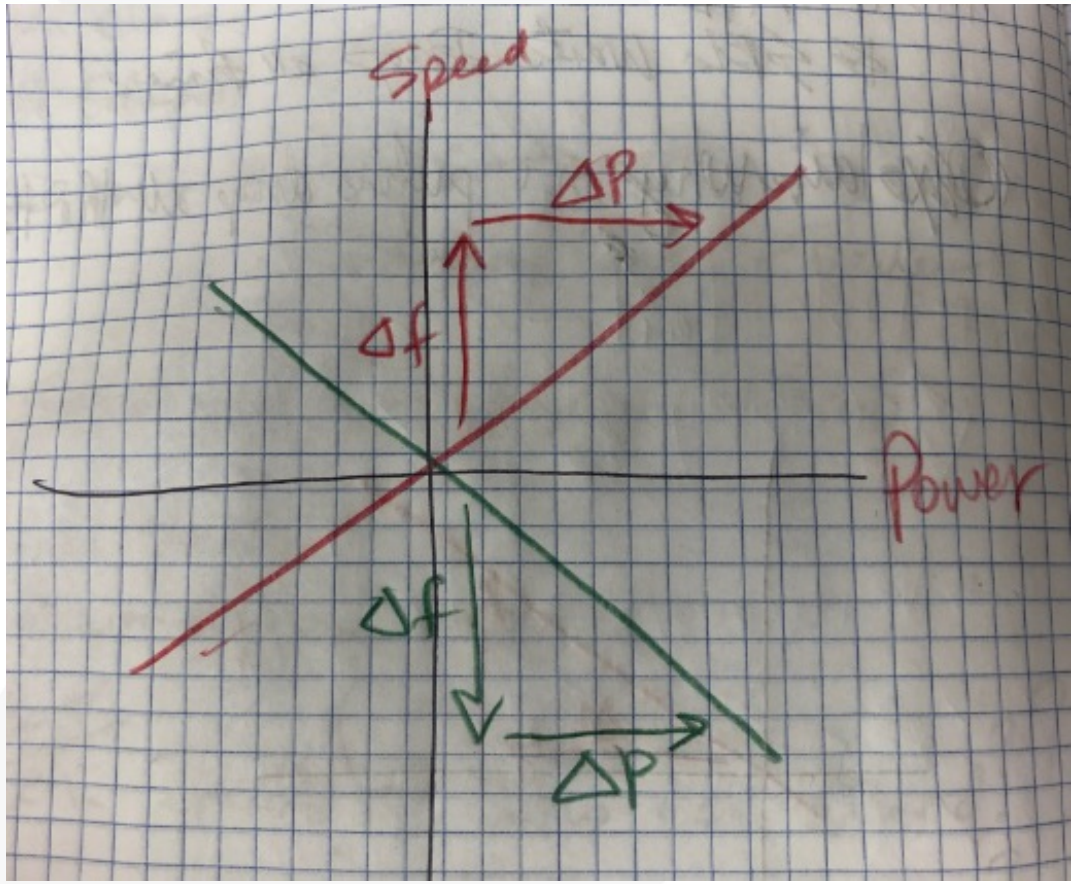
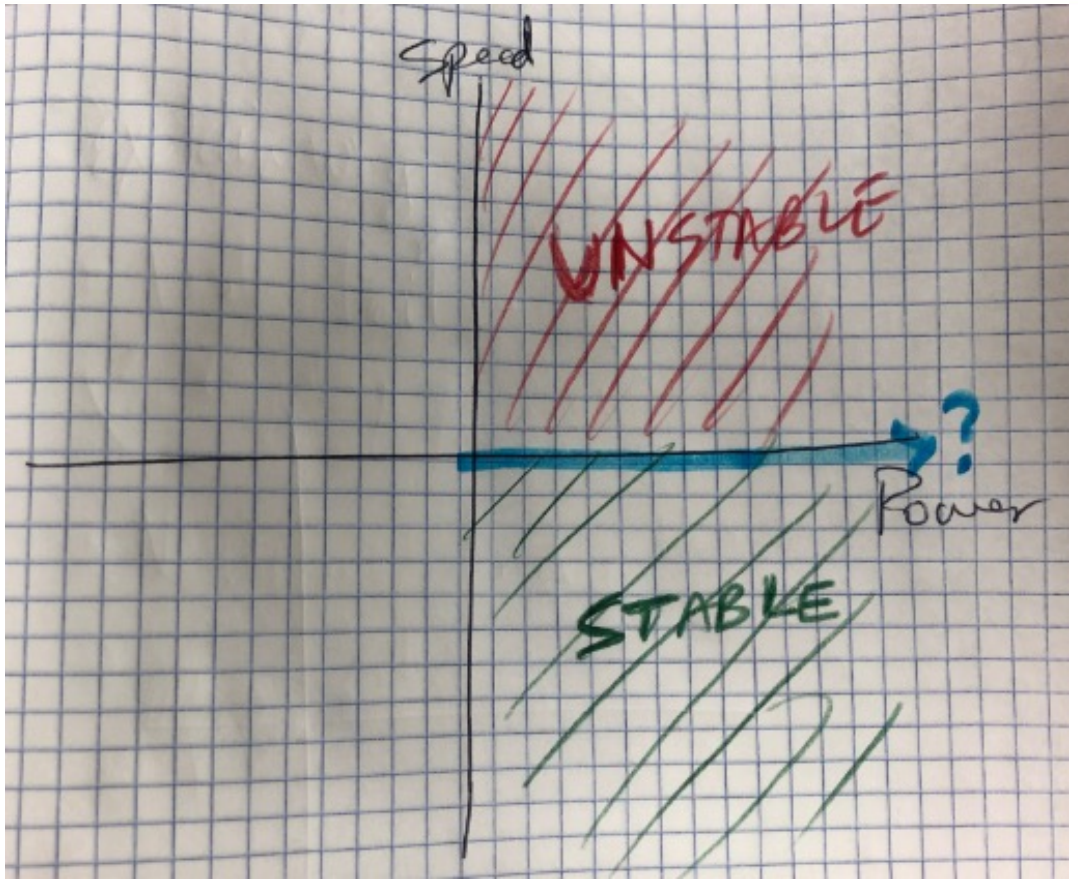
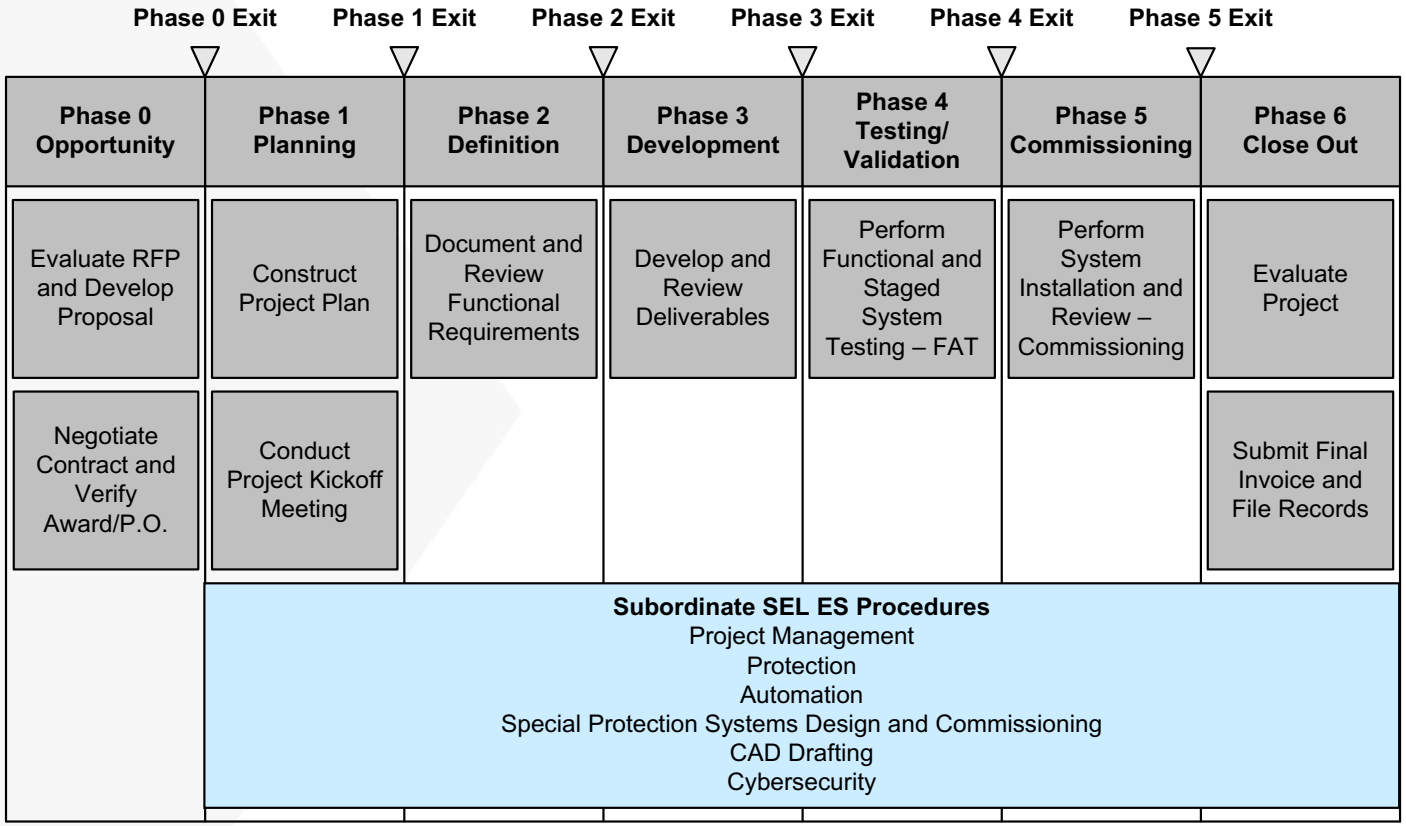
Re-Examine All Your Assumptions
Example: positive feedback avoidance





Project Execution Process Must be Simple, Repeatable, Resilient



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Keep It Super Simple (KISS)

“I didn't have time to write a short letter, so I wrote a long one instead.” -Mark Twain

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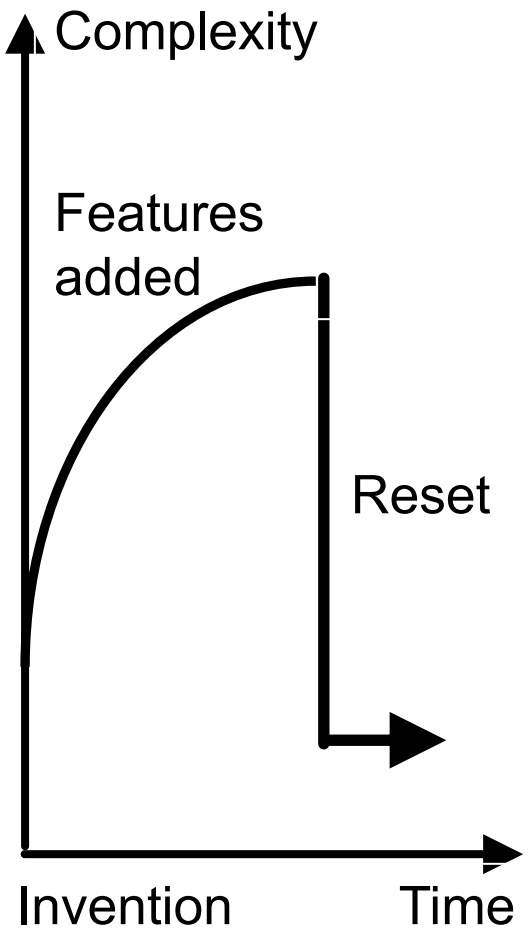
Simplicity Killers

- Group think
- Making Assumptions
- Can’t trace it to physics
- Politics
- Commercialism
- Timelines

Go Forth and Reset Complexity



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Paperclip Award

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