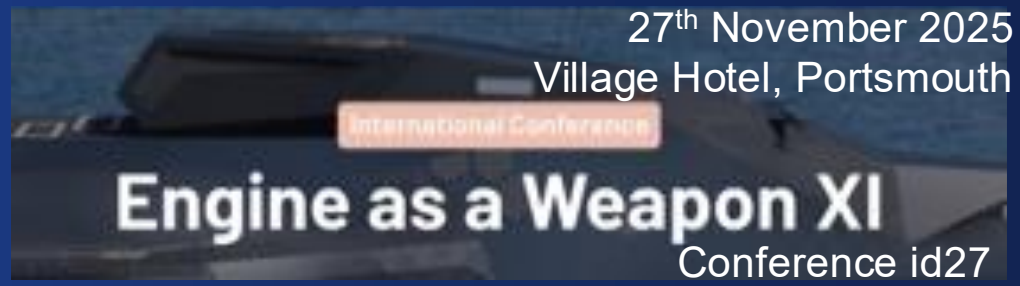
Automated propulsion and generation flexibility for strategic naval warfare advantages

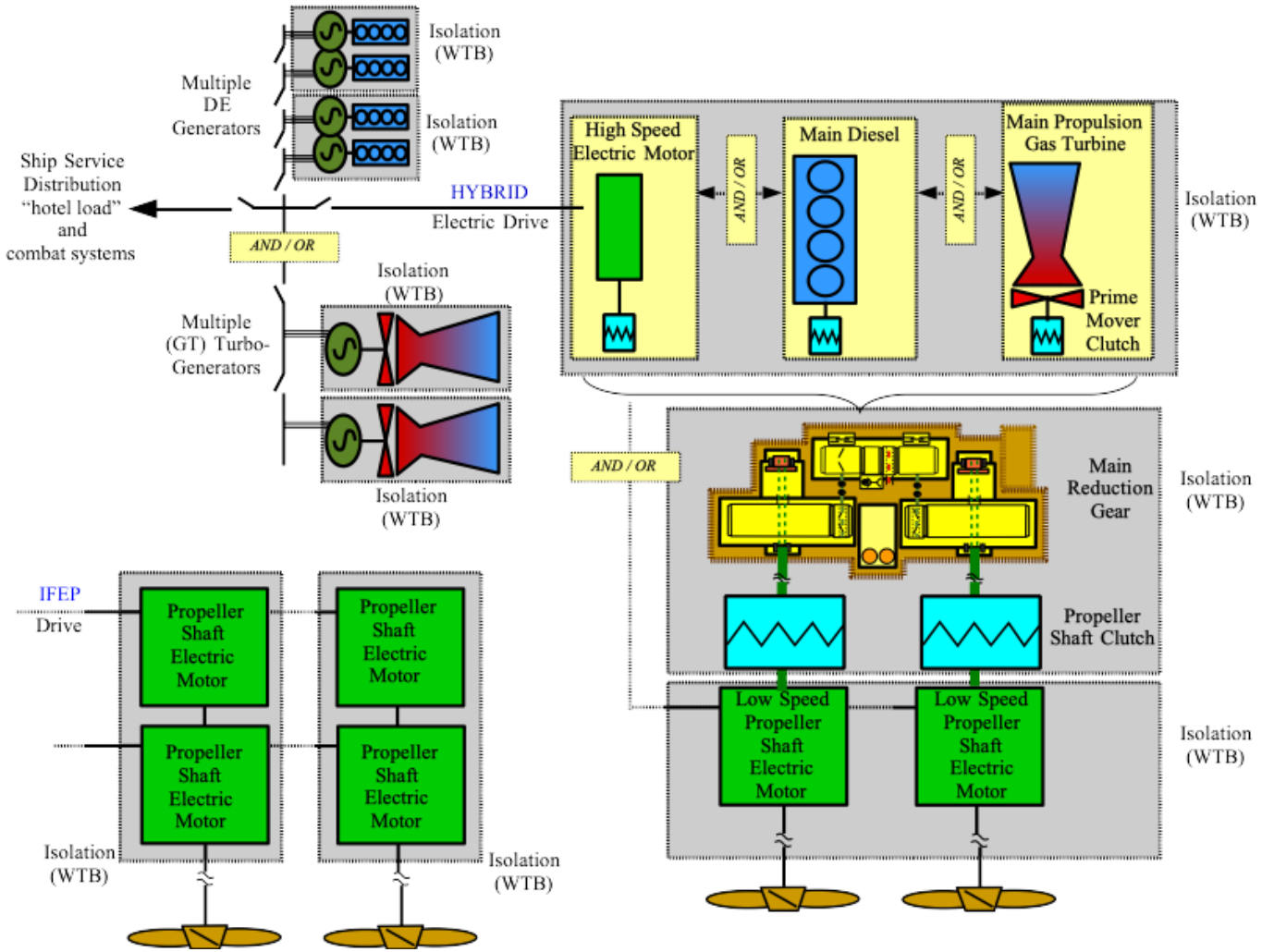
Nicholas Bellamy
SSS Clutch / SSS Gears Limited



27th November 2025
Village Hotel, Portsmouth
Conference id27

Gears Limited

Hybrid or Integrated Full Electric Propulsion?



- Commonality - Hybrid / IFEP Power Generation Blocks arranged to cover redundancy and survivability
- Hybrid Prime Movers include clutches for mechanical functionality and strategic naval advantages
- Clutches most often one of three types:
  - Wet friction multi-plate
  - Sprag / one way bearing type
  - **S**ynchro **S**elf **S**hifting "SSS Clutch"

Can "System of System" multi-task approach optimise use of turbo / piston (DE) engine function?

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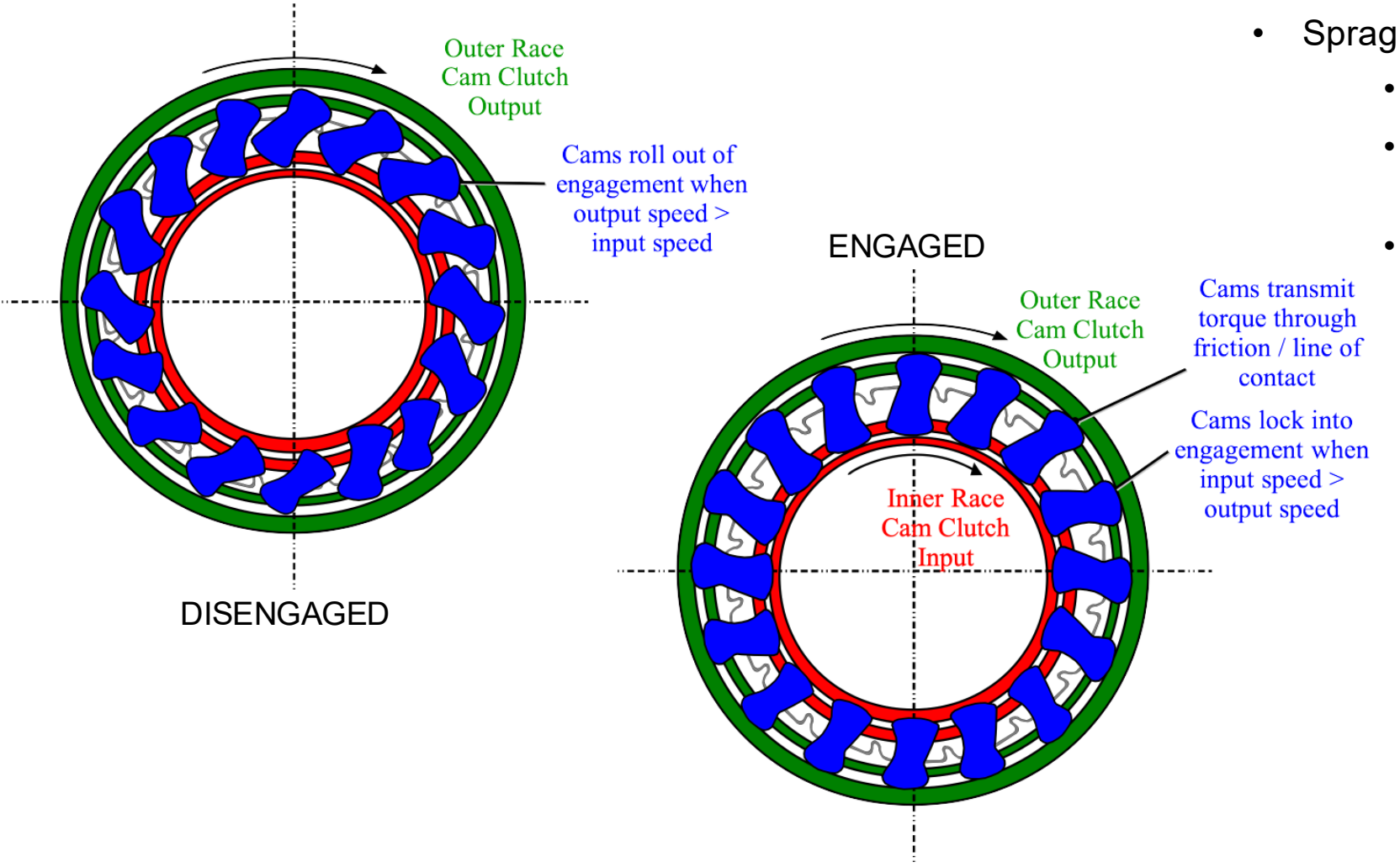
Prime mover clutch types – Cam / Sprag clutches



- Sprag or Cam clutches:
  - Similar to roller bearing
  - “Lock” into engagement when input speed > output speed
  - Single line contact between driving + driven components limits power and causes wear, limiting longevity.

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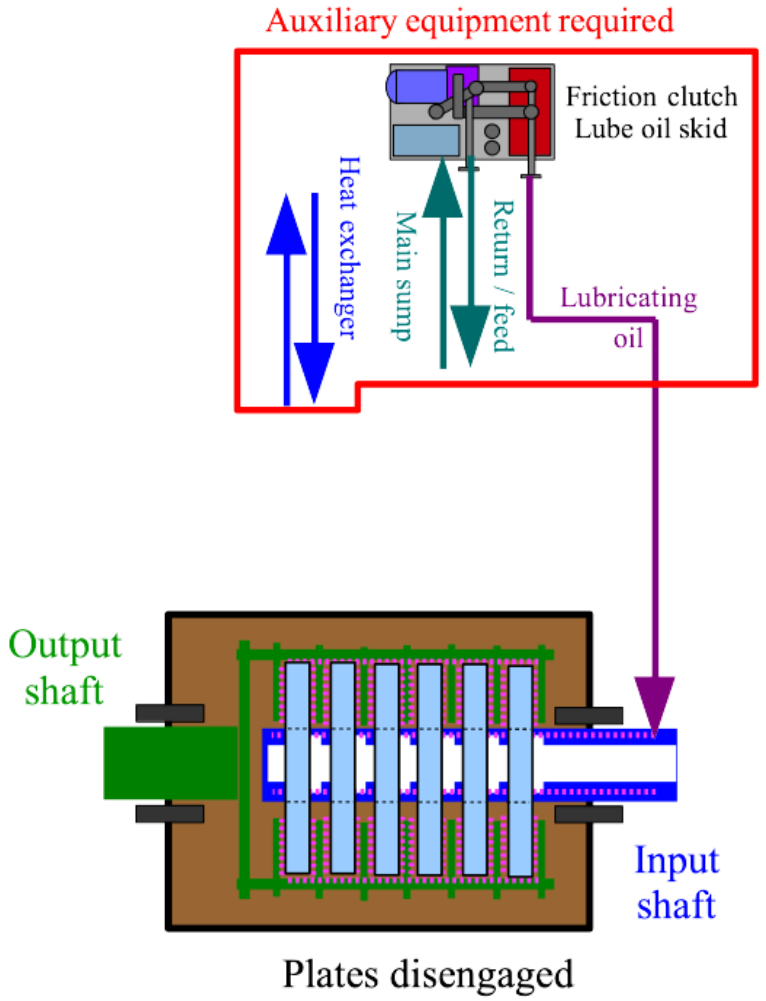
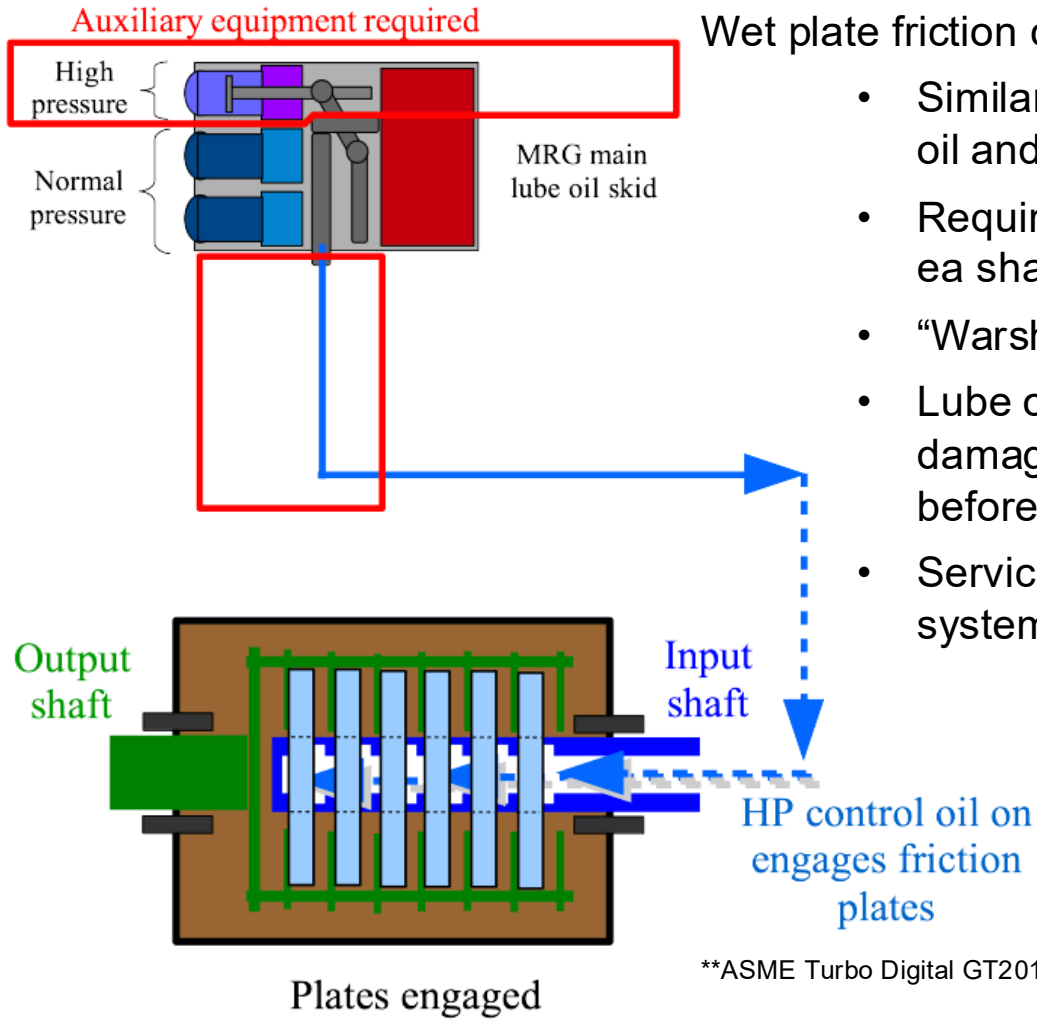
Prime mover and propeller clutch types – Friction plate clutches





Wet plate friction clutches:

- Similar to automotive clutch but with HP oil and control system to engage
- Requires lube oil skid (~ 120 litres / min ea shaft**) disengaged…losses?
- "Warship clutch failure"
- Lube oil skid failure = risk of plate damage / gravity tank limits range before gearbox damaged.
- Servicing / maintenance auxiliary systems and plates

**ASME Turbo Digital GT2018-77291 + GT2019-91873 + GT2020-15543

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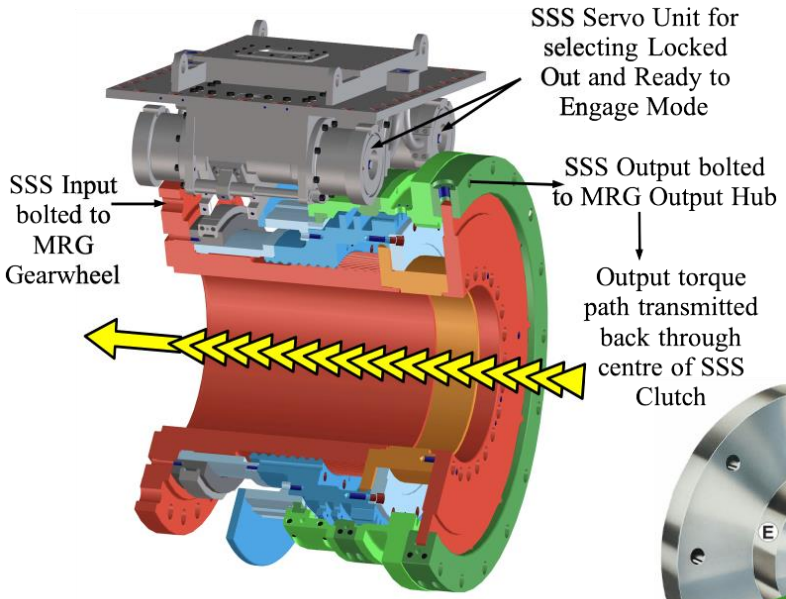
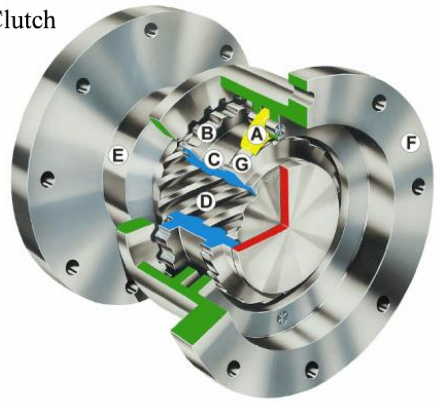
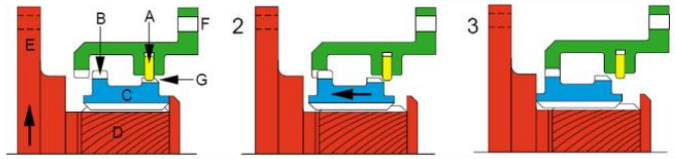
Prime mover and propeller clutch types – SSS Clutches





Key:
A = Pawl
B = Main Gear Teeth
C = Sliding Component
D = Helical Spline
E = Input Component
F = Output Component



Disengaged Engaging Engaged

SSS Clutches:

- Pawl / ratchet slides main gear teeth into engagement IP speed > OP Speed
- Reverse torque reaction disengages main gear teeth
- No control system governing engagement
- Low pressure servo system LOCK OUT option
- Self-lubrication = SSS scope current Navy program
- 52 global navies including UK, US, Japan, France, Germany, Italy
- “Fit and Forget” confirmed by UK RN
- US Navy rated MTBF 270,000 operating hours
- Uses gear oil - quill shaft arrangement possible which allows reduction in platform footprint
- Saves 30 sq.m, 10,000 kg gross weight and fuel savings around US$250 million**

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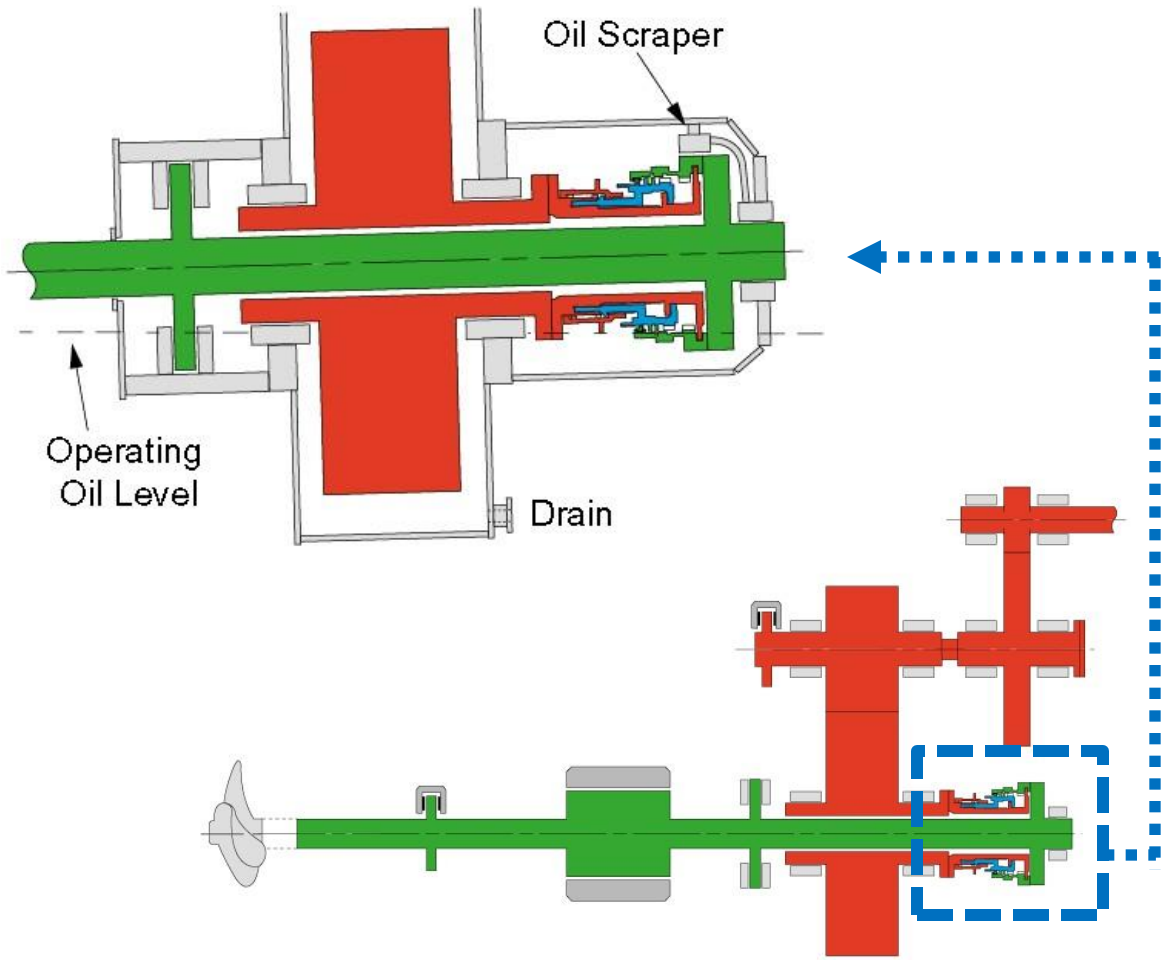
Prime mover and propeller clutch types – SSS Clutches



SSS Propellor Clutches originally designed for Type 23 frigate:

- Reduce noise
- Improve propulsion efficiency (less auxiliaries)
- Quill shaft = Optimise platform space

CONCLUSION:

- Increased time on station (more efficient)
- Towed Array Sonar performance optimized
- Public domain confirms T23 + FFX-II + other

"Smart use of functional propulsion equipment improves combat system sensor performance and efficiency to provide strategic naval advantage"

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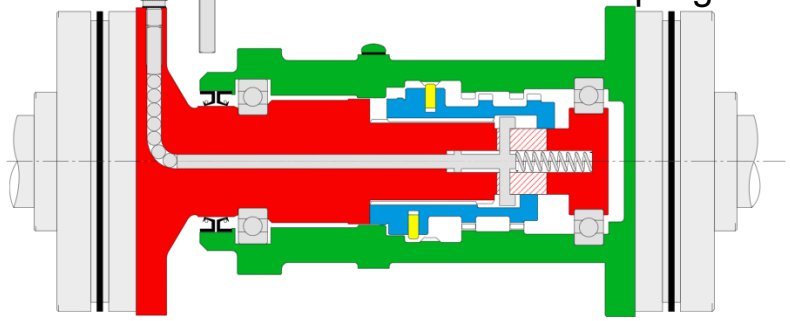
MCMV Single Role Minehunter
UK + Spain + SA

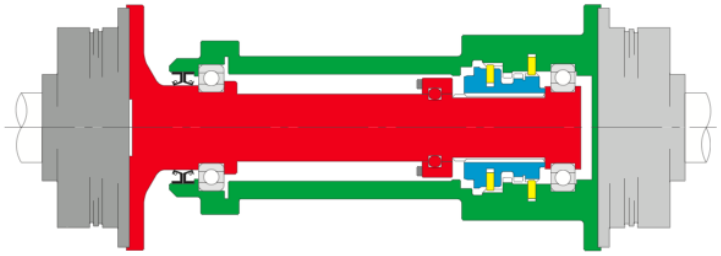
CODLOD

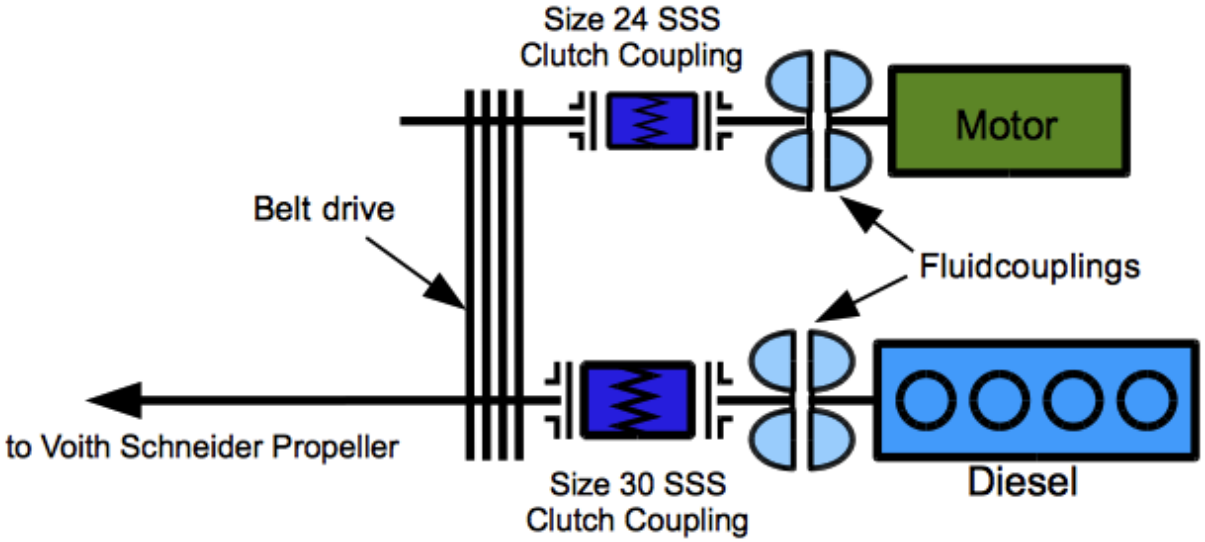
- **SSS Clutch Couplings:**
  - **Shaft mount**
  - **Self-lubricated (sealed)**
  - **Self-Cooling**

Size 30 SSS Clutch Coupling DE



Size 24 SSS Clutch Coupling EM





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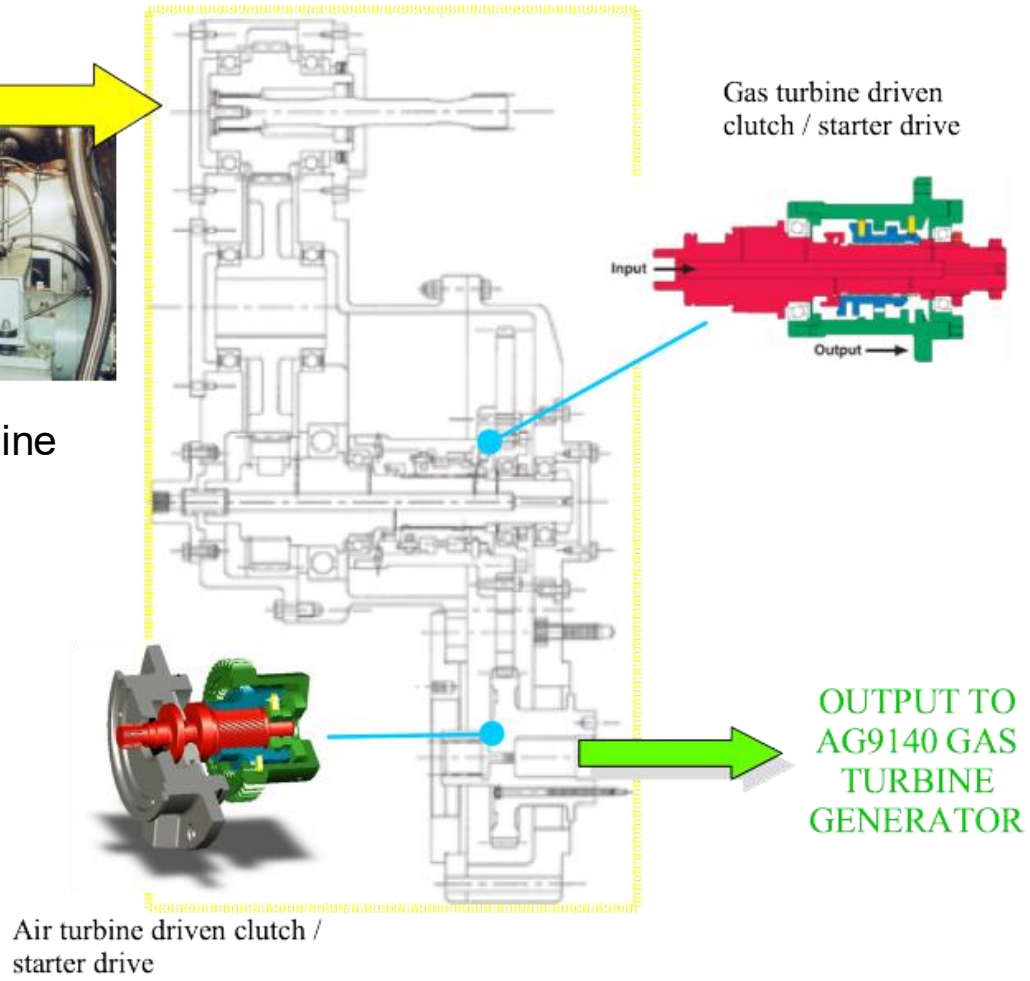
Gas Turbine Generator Starter Drives

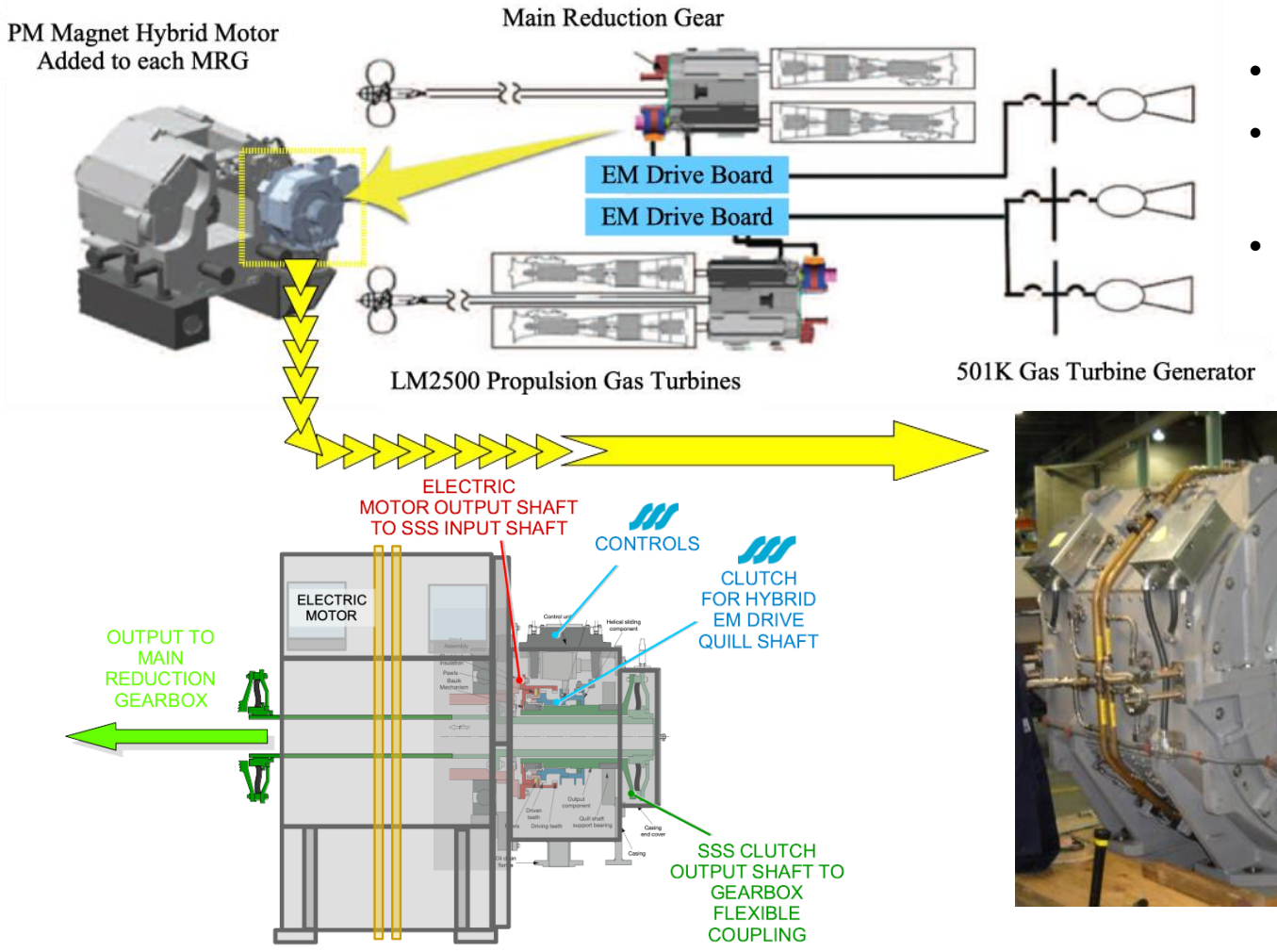
Small Gas Turbine



SSS Starting Clutches for Gas Turbine Starting – End User Operation Experience

- Reliance on one starting fuel affects resilience
- More robust SSS Starting Clutch replaced cam clutch (fluctuating torques)
- Fire fighting pumps and many other critical systems powered by onboard electrical generation

Hybrid Motor Drives



- Propulsion GT Fuel efficiency drive ~ EM Hybrid retrofit
- Motor (electrical and mechanical) resilience ~ SSS Clutch required
- Repeated by second global navy

SSS Clutch Terrestrial Energy Applications
4,000 SSS Clutches Globally

- Global push for renewable generation = less rotating electrical machines
- Solar PV panels have no large rotating machinery mass
- Wind turbine grid connection via inverter (no electrical inertia)
- Lack of rotating electrical inertia and reactive power on AC grids = instability
- Rotating standalone inertia popular but cannot produce “real power”
- Adds inertia and fault current to grid
- 2,000+ SSS Clutches in gas turbine drives since Bristol Siddeley / Rolls Royce Proteus and Olympus in 1963

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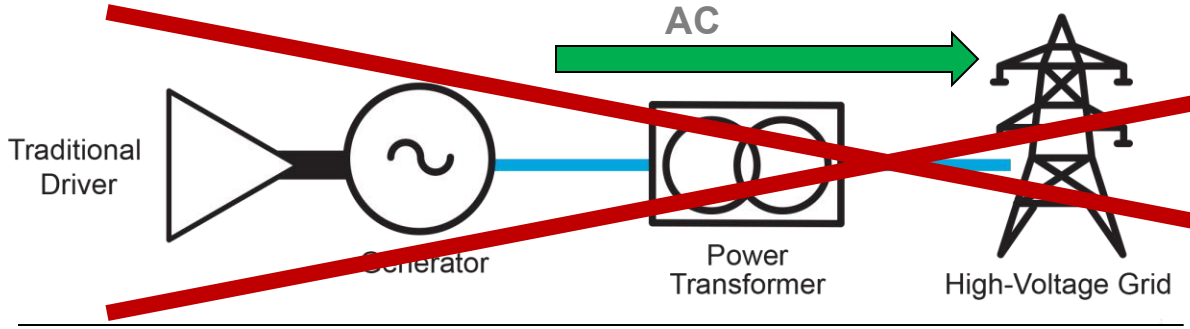
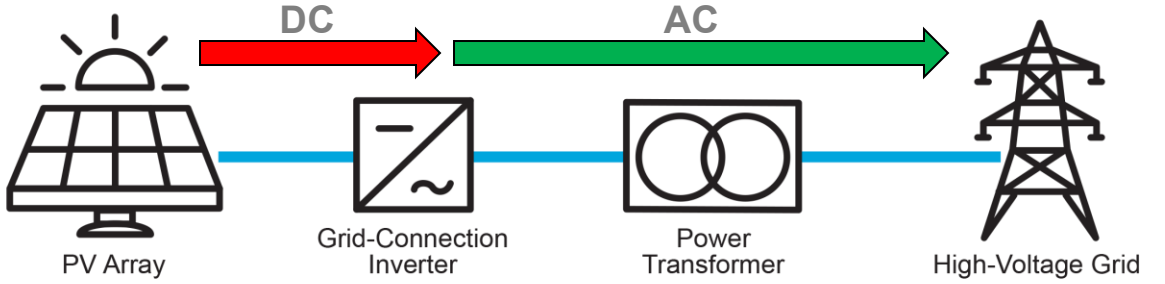
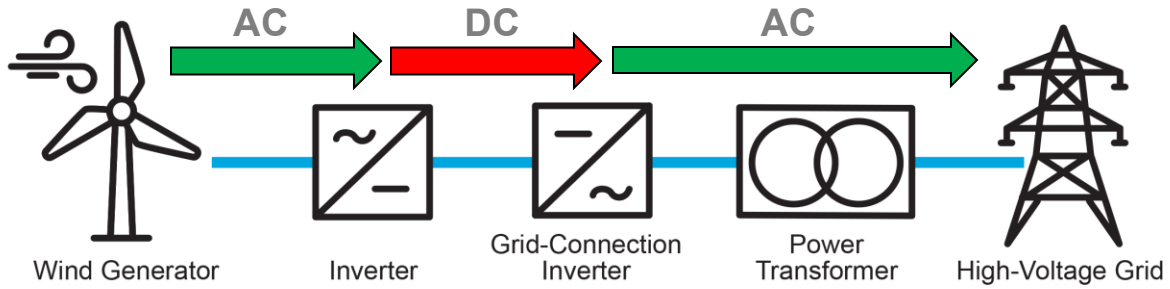
Renewables need backup and rotating inertia for grid stability



- ~~Inertia~~
- Fault Currents
- Reactive Power

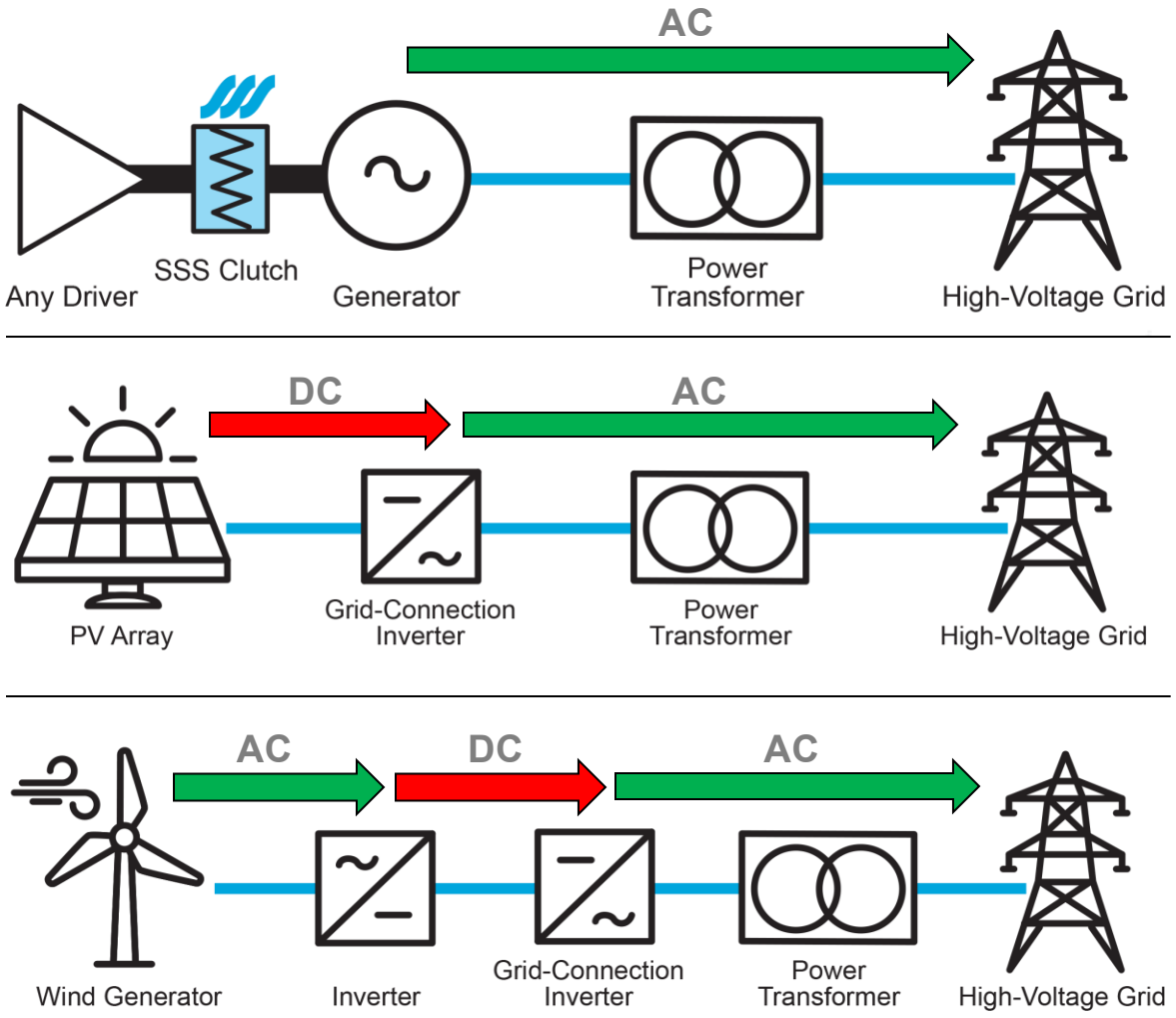


- ~~Inertia~~
- ~~Fault Currents~~
- ~~Reactive Power~~



- ~~Inertia~~
- ~~Fault Currents~~
- ~~Reactive Power~~

Clutches added to peak loppers to multi-task or "revenue stack"



- Inertia
- Fault Currents
- Reactive Power

~~- Inertia~~
~~- Fault Currents~~
~~- Reactive Power~~

~~- Inertia~~
~~- Fault Currents~~
~~- Reactive Power~~

"Revenue Stacking"

- "Peak demand" typically only run for a few hours per week but are necessary to back up adverse weather.
- "Black Start" machines rarely operate (hopefully!)
- Machine "assets owners" include SSS Clutches for operational flexibility
- Enables more diverse solutions for power generation including inertia, fault current, reactive power → voltage stability.
- Additional revenue sources to owners

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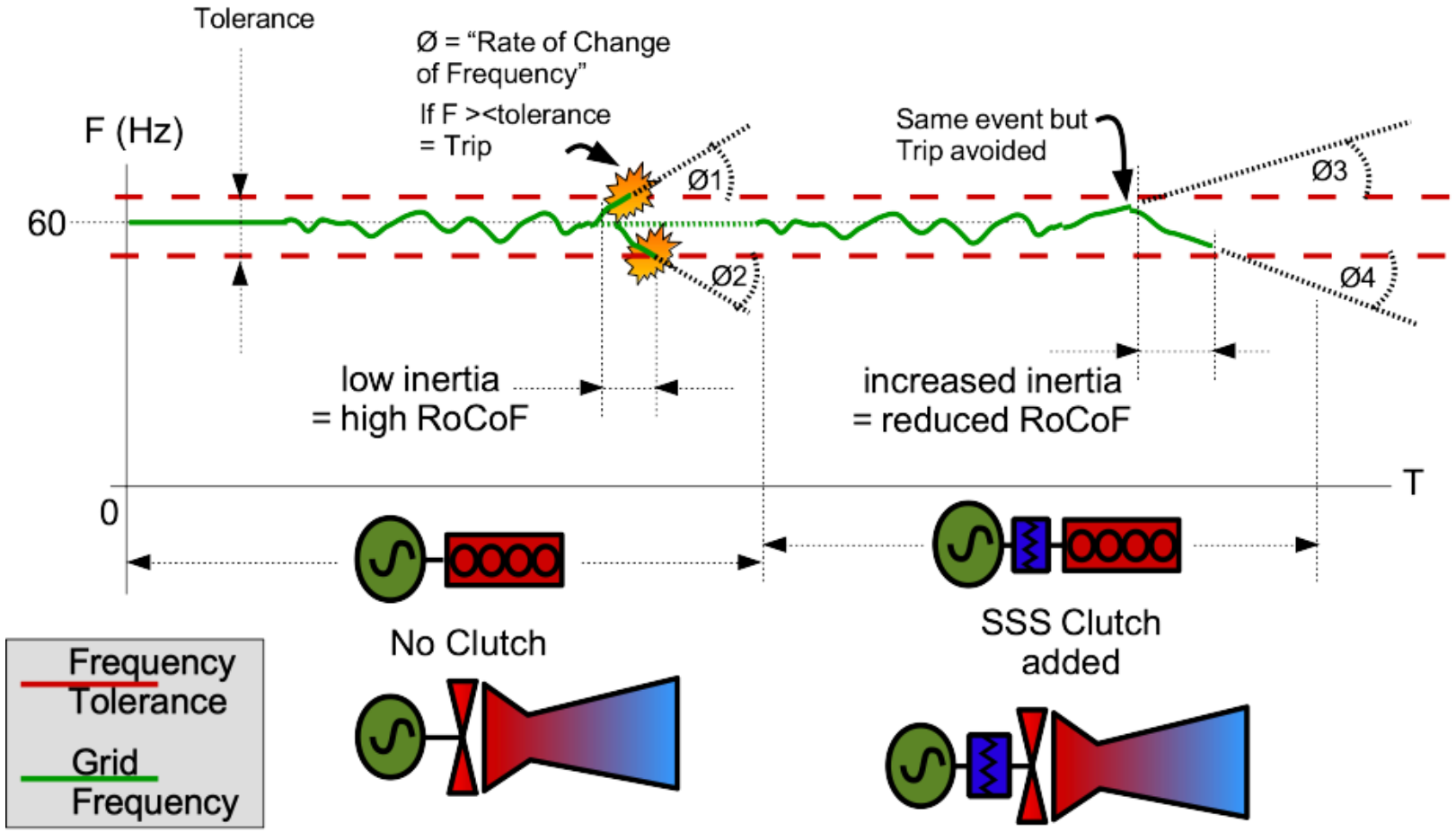
SSS Clutch Couplings in Diesel / Gas Piston Engine Generators



Summary:

Add SSS to "switched off" machines improves:

- Electrical inertia
- Fault current
- Reactive power (MVARs)

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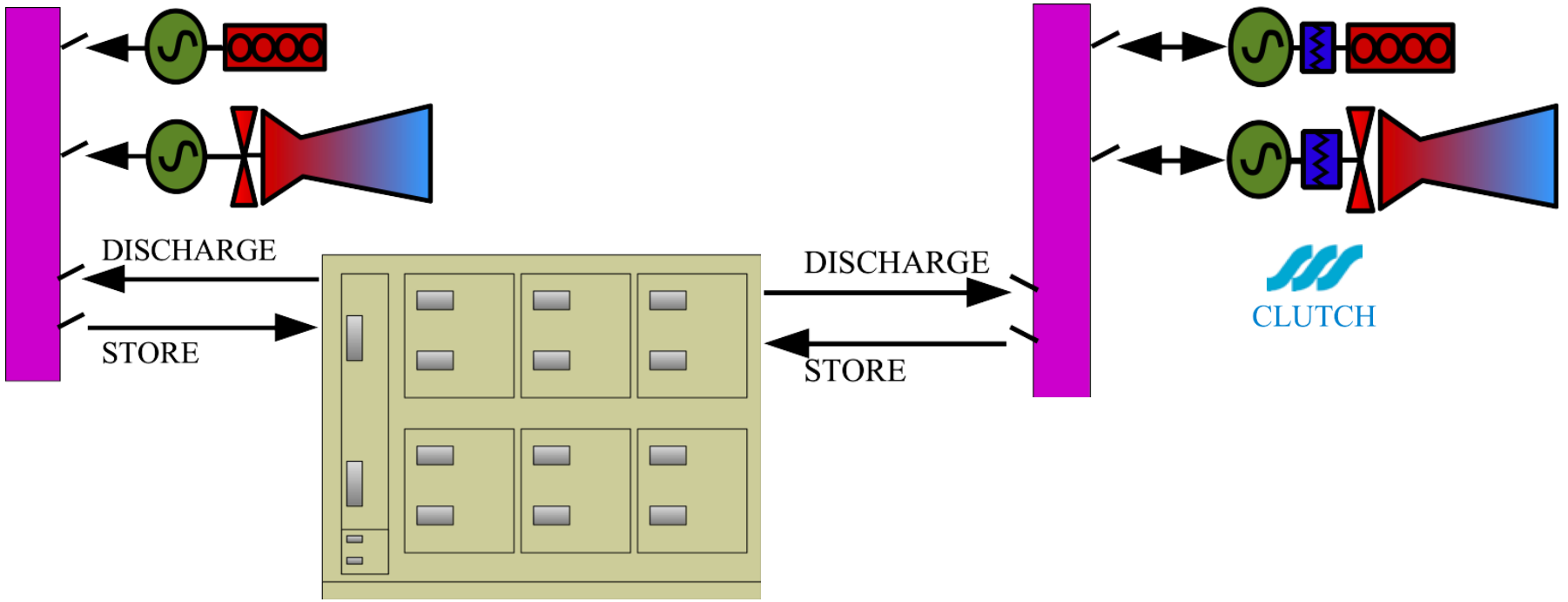
SSS Clutches improve grid inertia for BESS



BESS systems:

- Develop synthetic inertia (2-way)
- Inertia “blips” when switching between storage and discharge mode
- Additional “ride-through” inertia available if generator can operate as motor-flywheel

Recent terrestrial power generation gas turbine success

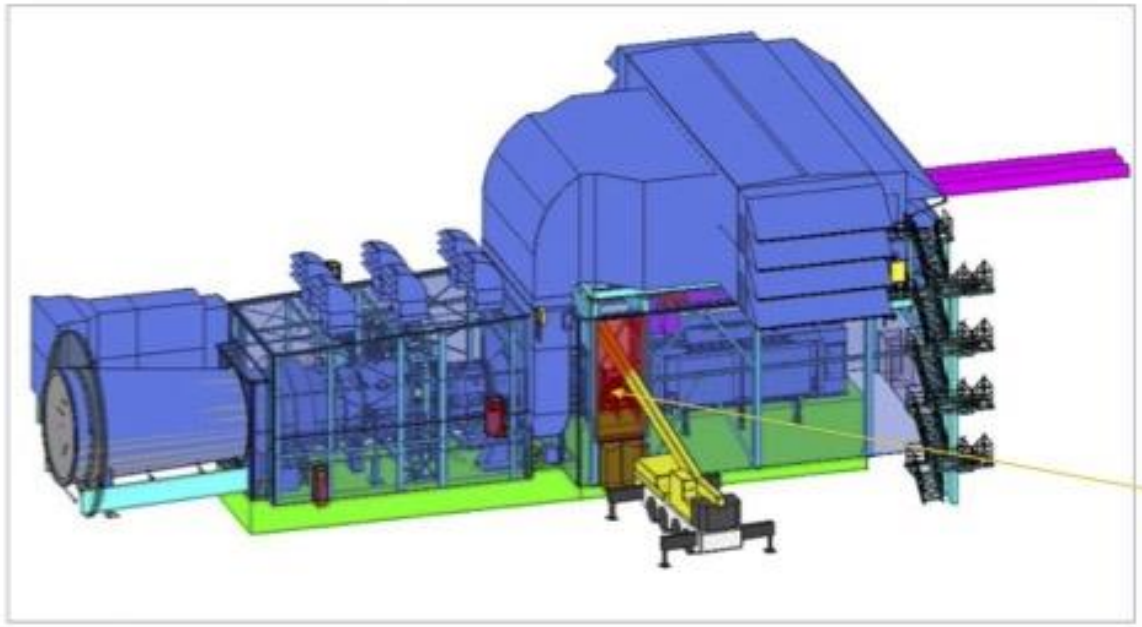


IMAGE CREDIT - Siemens

Expansion in GT Main drive sales:

- 2024 - 4 x 350 MW Rated SSS Clutches for UK new build
- 2025 - 1 x 180 MW rated SSS Clutch for Australian retrofit
- 2027 - 10 x 50 MW Rated SSS Clutches for new build
- 2021 – 2026 - 38 x 65 MW rated machines various US
- 450 MW order EOI
- 650 MW designs complete

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SSS Clutch Couplings in Diesel / Gas Piston Engine Generators

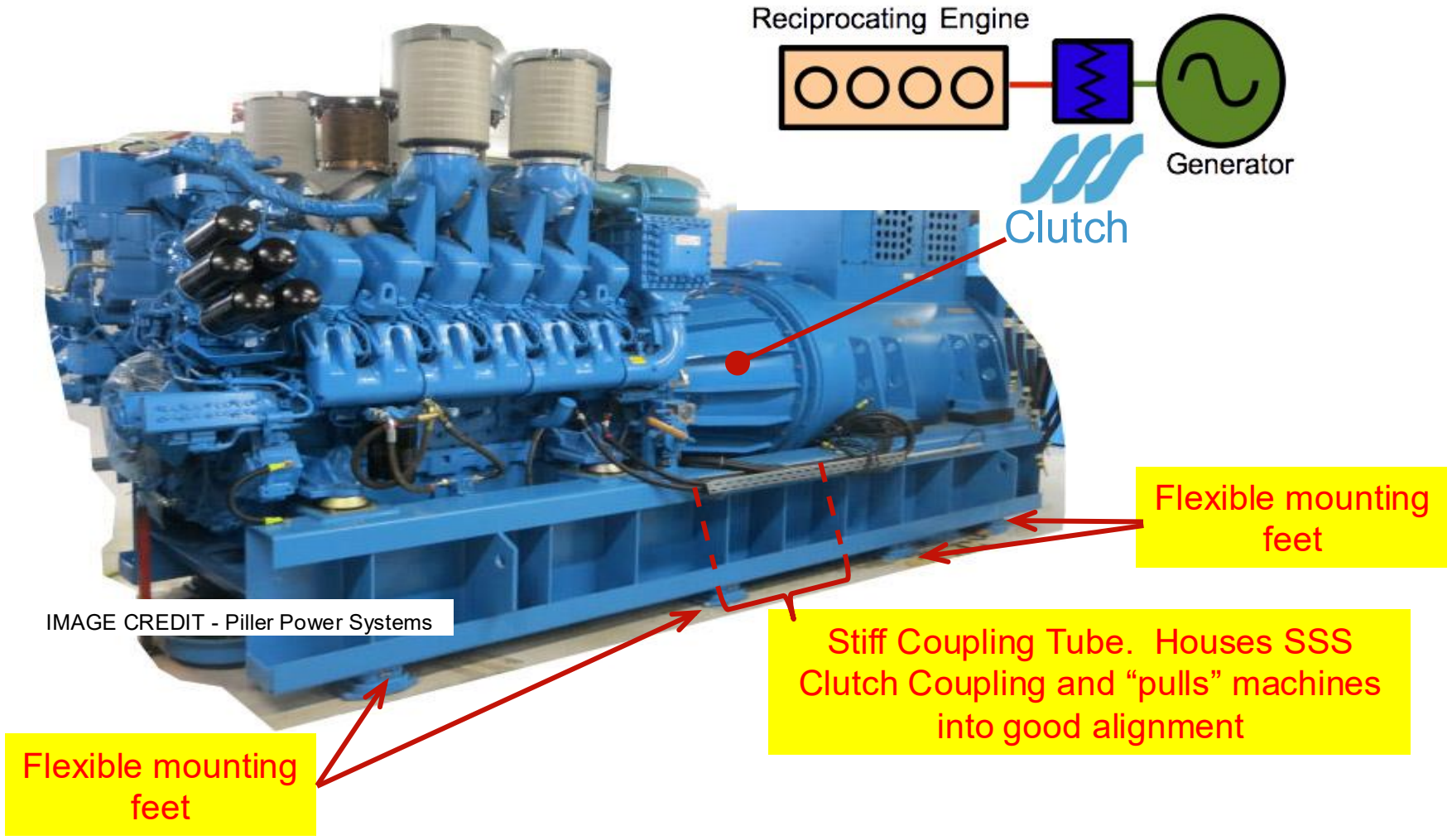

IMAGE CREDIT - Piller Power Systems

SSS Clutch Coupling:

- Originally applied to UPS Ride through application combined with on-site mechanical flywheel
- System now being applied to larger reciprocating engines to improve grid inertia and fault current
- Total sales approaching 1,500 x SSS Clutches end 2026
- Applications 200 kW – 13 MW in 2-pole, 4-pole and 6-pole

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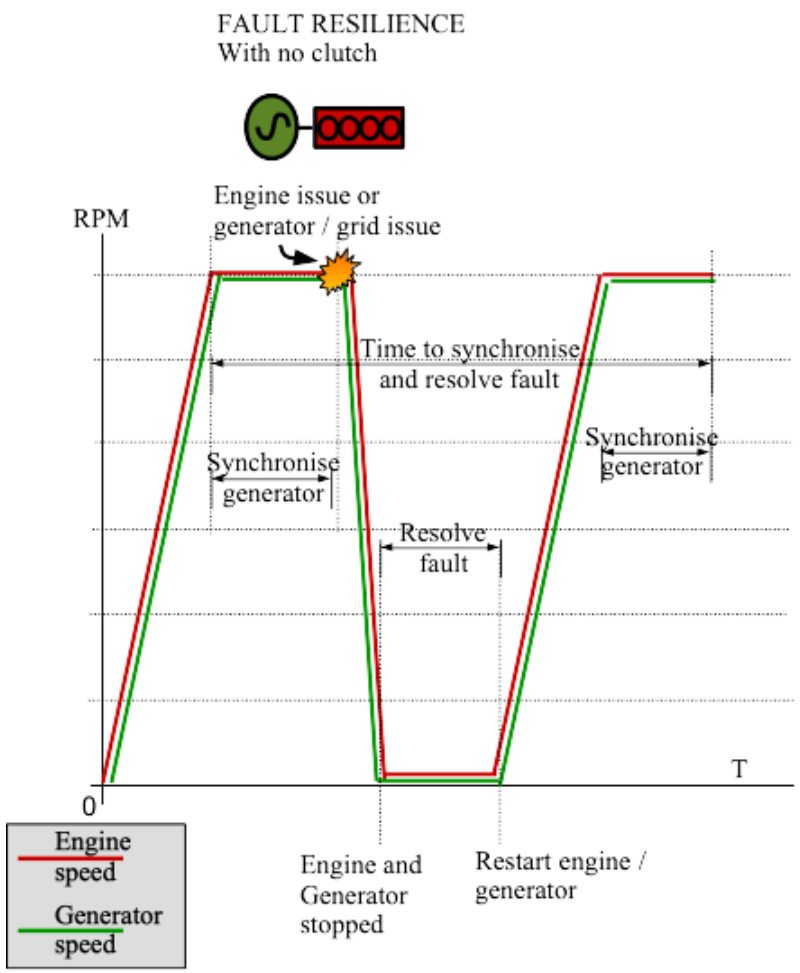
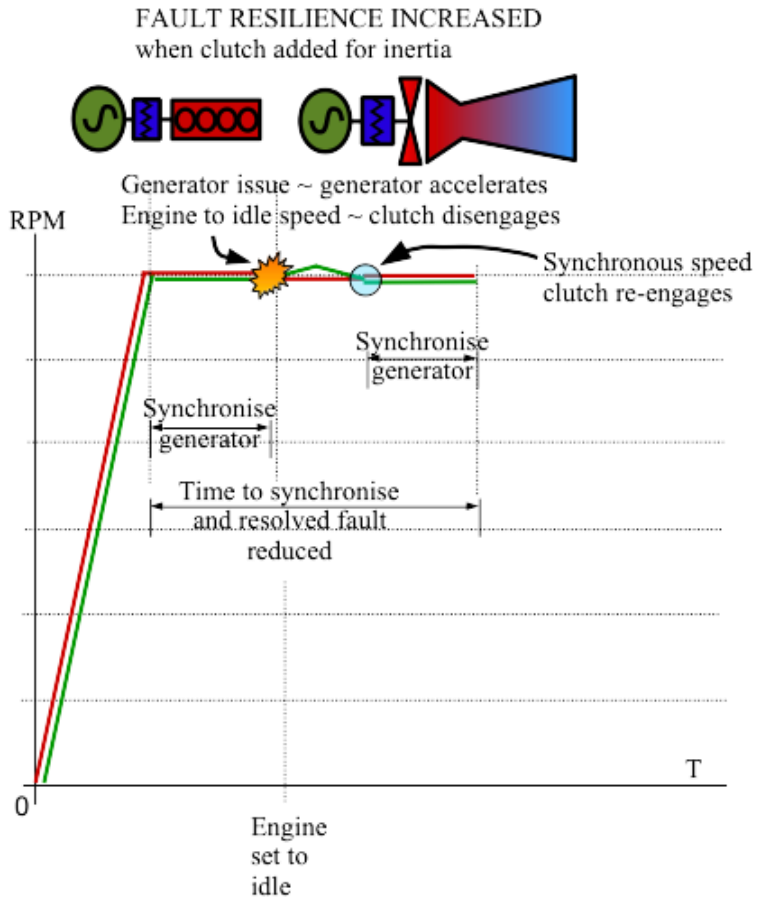
Mechanical fault resilience

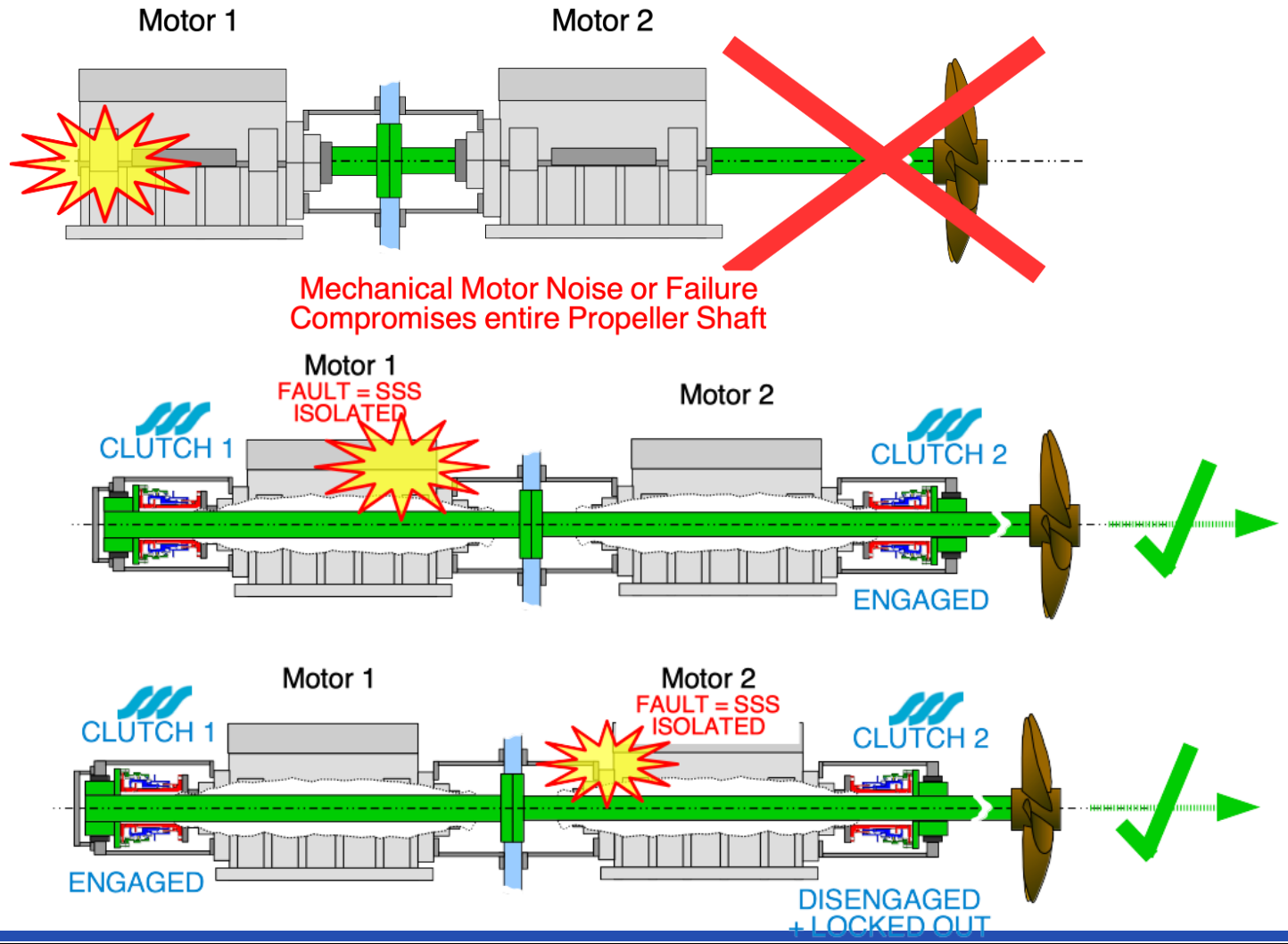




SSS Clutches improve:

- Start-up time ~ electrical machine already synchronized with local grid
- Generator reconnection if engine misfires during start-up

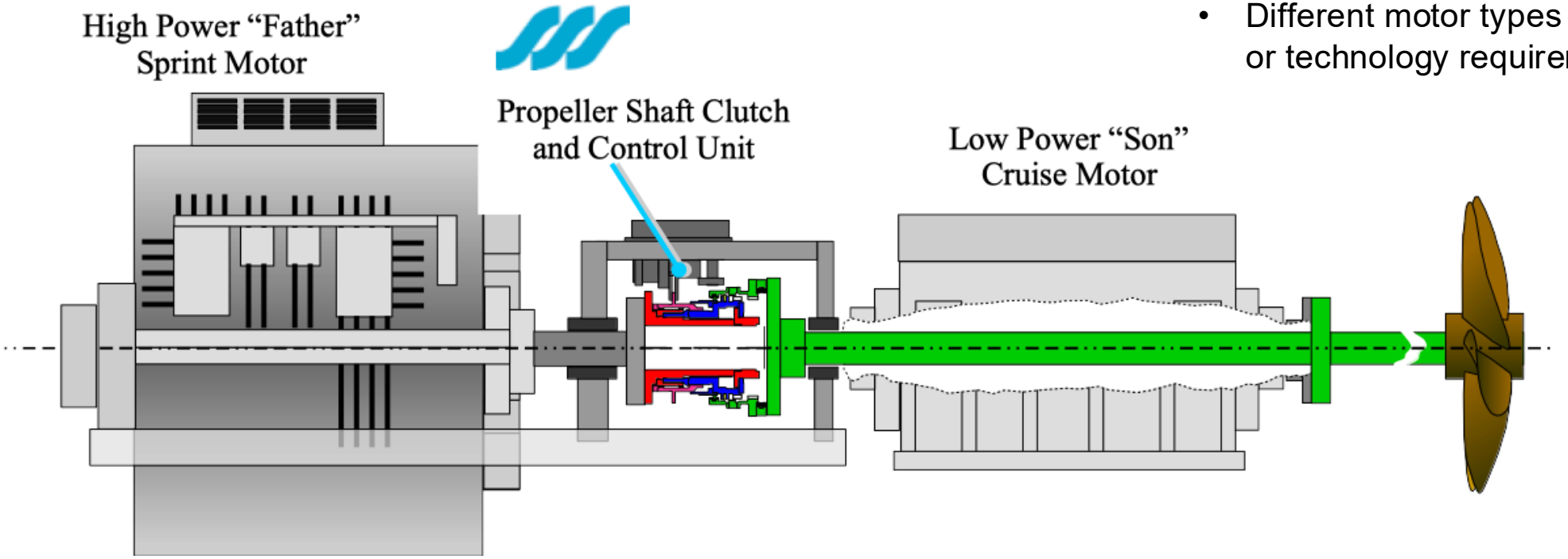
IFEP - Propulsion system mechanical resilience



SSS Clutches quill shaft mounted:

- Similar to Type 23, FFX-II and FF
- Allows independent operation of EITHER / OR motor isolating fault to improve resilience
- Enables independent testing during commissioning or following service

IFEP – Mixing / Isolating motor types



Father / son motor:

- Provides simplified isolation
- Different motor types can combined for speed or technology requirements

DEW Challenges

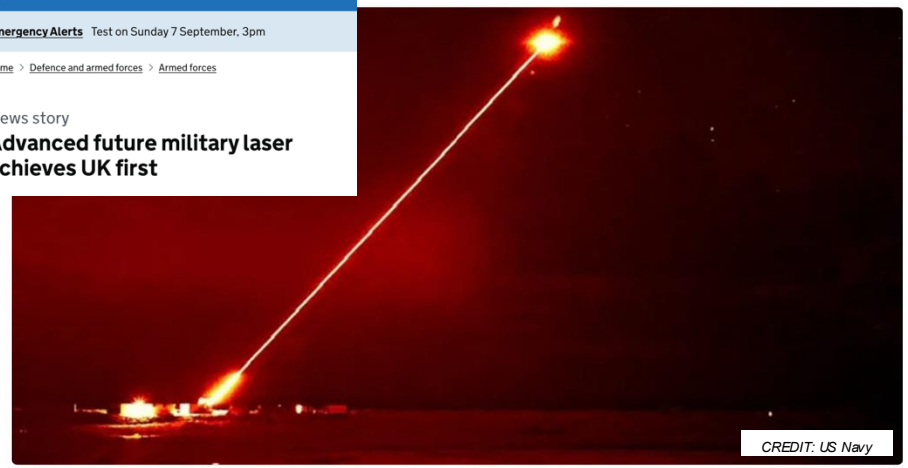
GOV·UK

Emergency Alerts Test on Sunday 7 September, 3pm

Home > Defence and armed forces > Armed forces

News story

Advanced future military laser achieves UK first



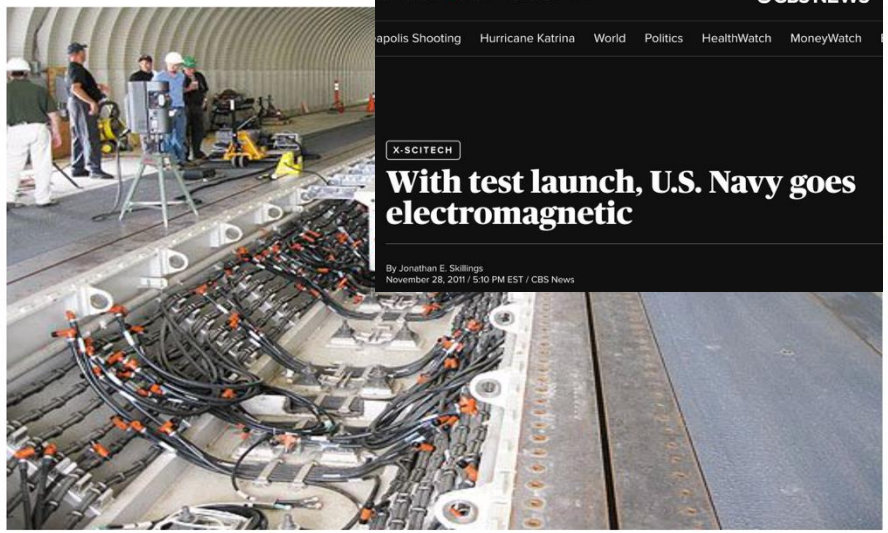
TheDefensePost

US Navy to Test Onboard Microwave Weapon in 2026

INDER SINGH BISHT APRIL 2, 2024

Leonidas high-power microwave weapon. Photo Epirus

EMALS trough



U.S. NAVY

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X-SCITECH

With test launch, U.S. Navy goes electromagnetic

By Jonathan E. Skillings
November 28, 2011 / 5:10 PM EST / CBS News

Summary:

- Lasers and Electromagnetic Catapults (EMALs) require large amounts of power at high recharge rates.
- Switching in / out high-power demand affects frequency regulation of generation systems on board.
- Electromagnetic Weapons switch frequencies rapidly and "tune the waveform" for "precision strikes" [ONR].

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Some weapons already include flywheels

A rendering of the DragonFire laser installed on a Royal Navy ship. In the box: the DragonFire prototype. (Images: Royal Navy)

ENGINEERING NEWS

CREDIT: UIMechE

Navy's new Dragonfire laser weapon gets energy boost from Formula One flywheel

01 May 2019
Professional Engineering

Summary:

- DEWs will require not just large amounts of power but also high recharge rates.
- Laser weapons have already fitted flywheels for ride through power (e.g. QINETIQ "Dragonfire")

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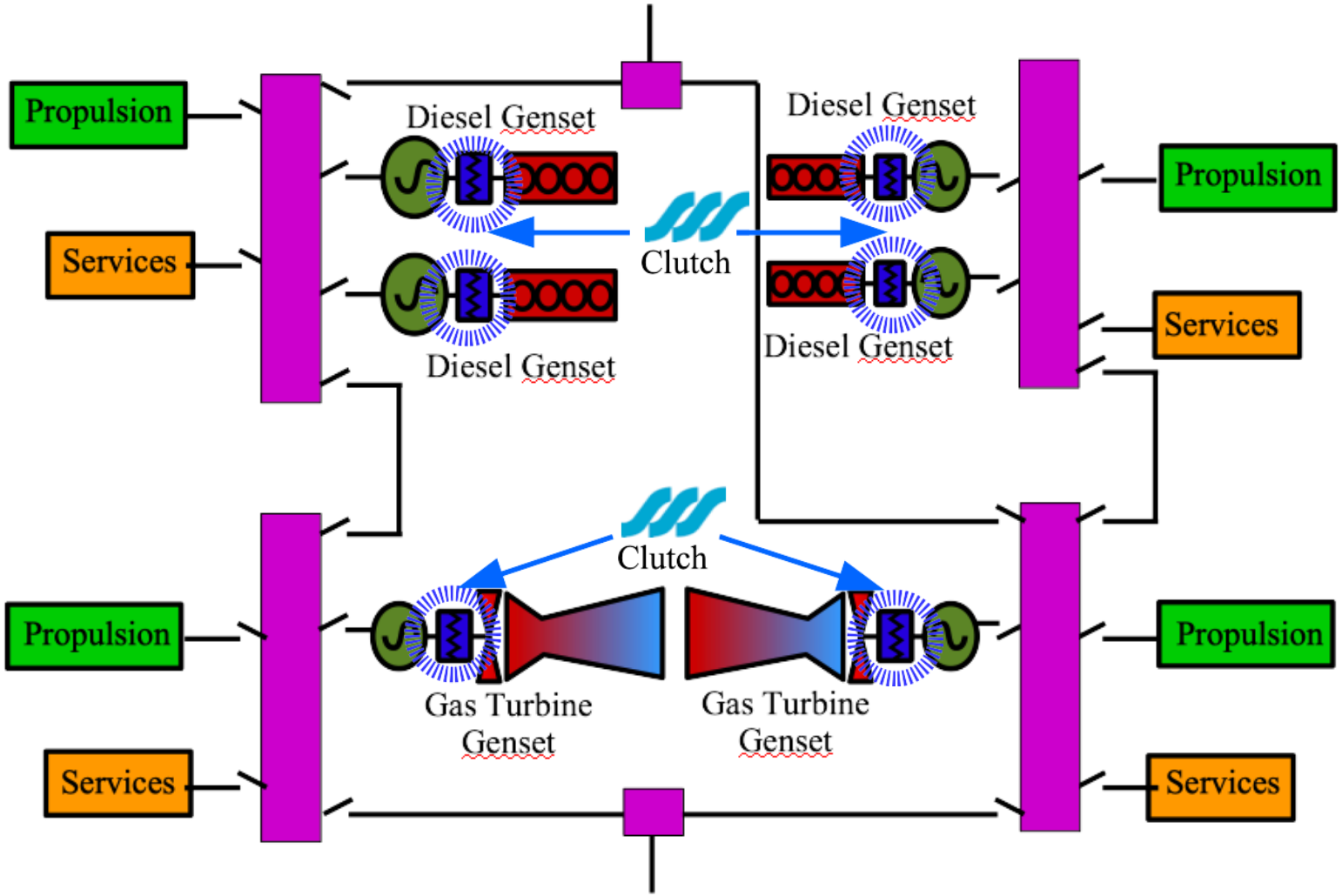
SSS Clutches –Improved inertia, fault current, reactive power control and resilience



Summary:

Will adding SSS Clutches to “switched off” machines improve:

- Electrical inertia
- Fault current
- Reactive power (MVARs)

Which helps

- Rapid DEW charge / discharge, combat system power demand and management of ship services load
- RF / Microwave Weapons rapidly change frequency, which could further complicate frequency challenge on board.

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"FIT and FORGET"
- UK RN – zero defects / 30+ years
- USN MTBF rating 270,000 hours

FUEL EFFICIENCY INCREASED
- Less drag / less cooling losses
- Improved time on station

WEIGHT IMPROVEMENTS
- Common MRG oil system
- HP oil system unnecessary

REDUCED NOISE – EM Drive / ASW
- SSS Clutch LOCKED OUT
- Reduced oil flow = pumps off

POWER DENSITY INCREASED
- Clutch auxiliary and HP pump unnecessary
- SSS Clutch = gearwheel quill shaft mount
- Reduced space = improved power density

IMPROVED MANOEUVRABILITY
- SSS differential drive**
- Reduced MRG load during turns**

ASME Digital GT2019-91873

? ? COMBINED GENERATOR / FLYWHEEL "OPERATIONAL STACKING" ? ?

STRATEGIC NAVAL WARFARE ADVANTAGE

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