

UNIVERSITY OF WASHINGTON



SCHOOL OF OCEANOGRAPHY

*R/V THOMAS G. THOMPSON (AGOR-23)*

LINGERING ISSUES FROM MID-LIFE

ROBERT KAMPHAUS

MANAGER OF MARINE OPERATIONS

UNOLS – FIC - 20 NOV 2019

# R/V THOMAS G THOMPSON (AGOR-23)



- First of AGOR-23 class to go through mid-life period
- Mid-life refit June 2016 to December 2017
- Vessel back in service Jan 2018; first science cruise Mar 2018
- Total shipyard contract: \$45.5M All costs: \$52M
- Expected to extend life of the vessel by 15 years to 45 year service life = anticipated retirement of 2036

# LINGERING ISSUES

- A total of 33 warranty items were opened during warranty period with a total cost of \$1.2M. Grouped into the “Big 4”
  - #11 - Power Quality
  - #23 & 32 – Caterpillar 3516 Engine Valve Failures
  - #24 & 27 – AC Unit Condenser Issues
  - #22 – Aft Main Deck Non-skid Failure
- As of Sep 2019, 6 items remained unresolved; 2 of “Big 4”
  - Power Quality and Cat Engine Valve Failures
- UW Settled all Warranty Claims with Vigor LLC on 10/31/19 to close out the contract.
- Non-warranty issue: Still ‘tuning’ the Integrated Control Management System (ICMS) for optimal settings

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  - #11 - Power Quality
  - #23 & 32 – Caterpillar 3516 Engine Valve Failures
  - #24 & 27 – AC Unit Condenser Issues – resolved VFDs
  - #22 – Aft Main Deck Non-skid Failure - repainted
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# POWER QUALITY = VOLTAGE NOTCHING

## Quick Reminder of Timeline

Dec 2017 – Mid-life refit & repowering complete

Feb 2018 – transit to Auckland, NZ

Mar 2018 –

- First cruise, JASON onboard – electrical problems with JASON systems
- Onload deck generator to provide dedicated power to JASON
- Ockerman rep onboard for assessing power quality

Apr 2018 – Vigor summary of issues

- Recommend installation of 15 tuned line filters (“lineators”)

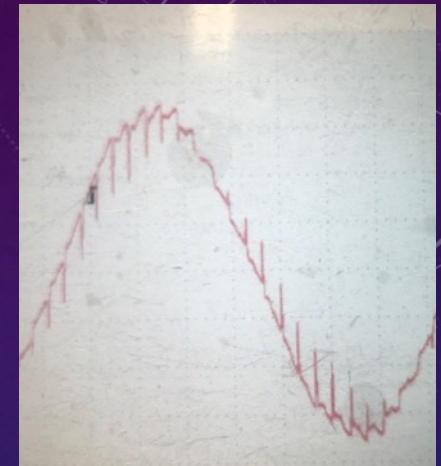
June 2018 – Ockerman Power Quality Report

Aug 2018 – installed 5 line filters during Kaohsiung port call Nov 2018

- had to use a portable generator on deck again for Sikes cruise
- Dynacon winch couldn't work with lineator L-13 (200A) - too much voltage drop

March 2019 – Last update to FIC

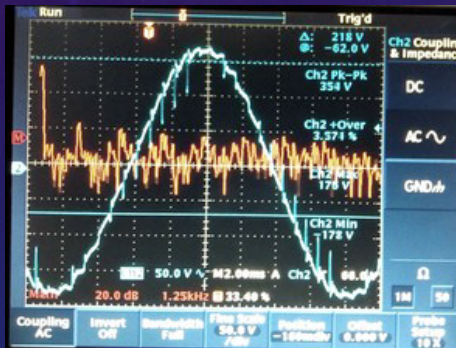
- Feb – Mar 2019 – SENTRY onboard – electrical problems reported in PCAR
- March-April 2019 - Third party assessment of power quality issue



# POWER QUALITY = VOLTAGE NOTCHING

Since then:

- Sentry PCAR and report document issues during TN-365
- June 2019 – installed 5 additional line filters (10 total)
- Several successful projects without power issued noted:
  - July 2019 (TN-368; McGillicuddy) – Successfully operated (smaller) Dynacon winch with 0.681 fiber for MOCNESS tows, REMUS aboard, no problems on lineated circuit
  - Aug 2019 (TN-370; Chave) – Towed CSEM Streamer – very concerned about power for experimental instrument used deck generator; no problems with Dynacon as above on ship's power
  - Nov (TN-373; Sager) – Current cruise, seismic and magnetometer
- One project with power issues:
  - Sep-Oct (TN-372; Slowey) – Seismic and Coring – several undervoltage releases of non-essential loads at beginning of trip – traced to bad relay. Replaced with more robust relay.
  - Troubleshooting of this issue did cause one loss of power event
  - **Continues reputation of 'bad power'; appears not directly related**



# POWER QUALITY = VOLTAGE NOTCHING

- Oct 2019 - Third party power quality report refuted by other experts; sampling insufficient to make conclusions about meeting IEEE standard.

## PROBLEM HAS BEEN MITIGATED BUT NOT SOLVED

### Going Forward:

- **Additional power quality data needed. Power meter on order to send to ship. Ongoing monitoring and documentation of science loads**
- **Work with oncoming science projects to identify sensitive electronics that may be affected and find ways to provide power from clean power (MG) switchboard**
- Project Engineer – with contractor assistance - to continue to research other potential filters to further reduce the voltage notching issue

# CATERPILLAR 3516 ENGINE VALVE FAILURES



- The Cat valve failures in Aug 2018 and Feb 2019 caused the delay of one cruise and the cancellation of a second. Total lost science time was estimated at \$1.96M
- Cat concluded that valve failures were due to “closed crankcase ventilation” (CCV) setup of new engines = reingestion of crankcase vapors into engine

- Higher sulfur fuel (still commonly and only thing available in some countries) believed to contribute
- Solution was to route CV to atmosphere. Excellent help from WHOI shop service to complete (June 2019)



- Required USCG approval due to air emissions concerns – EPA compliance (IAPP) and types of material used
- Still awaiting final approval of installation materials as permanent from USCG Marine Safety Center
- Additional inspections of valves in drydock 2020

**Engines performing well since CV routing to atmosphere**



# TUNING THE ICMS

Integrated Control Management System (ICMS) – specifically Power Management- has taken a couple iterations to get tuned.

Working to balance load on generator [average of 35% loading] with starting of additional generators to handle variable loads

- Previously ICMS programming had additional engines coming on-line for short duration load increases – still well below capacity of on-line generators

Grooming period with Ockerman Automation in June 2019 – included sea trial prior to INSURV for programming modifications to ICMS (funded by ONR)

- Several programming issues resolved
- Since documented notable voltage swings on the 600 VAC (propulsion bus) during rough seas = highly variable propulsion load
- Due to combined bus, these voltage variations also show up in the 480 VAC (hotel and science load)
- Procedural change is to *manually* put additional generator on when in rough seas before ICMS calls for it to better regulate voltage

Additional operations and varying conditions are needed to optimize settings; planning for regular grooming – **will be added to annual maintenance plan**

# QUESTIONS ?



Robert Kamphaus  
Manager of Marine Operations  
UW School of Oceanography

[kamphaus@uw.edu](mailto:kamphaus@uw.edu)