CUSTOMER	VESSEL	DATE
	Balto	30 July 2023
LOCATION	ENGINEER	PAGES
Lisbon, Portugal	Konrad Zagrobelny / Marcin Bieszk	2
WORK ORDER / PO	SENCONTROL PROJECT No.	ADDITIONAL NOTES
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SERVICE REPORT

Main purpose of visit

Main purpose of visit on board were investigation and adjustment of the main propulsion control system.

Technical report summary

Sencontrol LTD was requested to attempt calibration and repair of propulsion control system on board vessel Balto.
Based on information received there was several attempts and services trying to make this system running.
Repair was planned to take approx.. 3 days and divided in three steps:

1. Basic calibration of linear analogue control system based on multiple PCB cards. This calibration was preformed with use of simulated signal generators without engine running. Calibration was done based on received manuals and calibration instruction. Instruction received was limited to laconic information about location of calibration potentiometer and value that should be achieved by adjusting potentiometer. Instruction include multiple calibration points. As build and latest vessel specific calibration values and information was not available same as precise calibration procedure.
2. Calibration on running machinery. After basic calibration we attempted to check system in operation, it was found that system behave unstable. Hi currents on PG motor when try to change rotation direction and Motor operates in one direction only. When motor start with command ahead, worked only ahead, same with aster direction. It was found that additional to calibration procedure there are more calibration points responsible for change over between direction. Entire change over logic in the system based on feedback signals from current transmitters and voltage transmitters on Excitation and main supply lines of Motor and Generator and RPM feedback from tacho generators of Main Motor and Main Diesel Generator. Same signals are responsible for smooth PI (proportional integral) follow-up operation. It was found that cards B32 and A08 are broken. This cards randomly didn't change direction and was giving to low values when activate aster igniter. Replacing this cards helped, but system still shows problem operating astern. Finally magnetisation igniter board was replaced. After that and calibration of additional points we was able to get system operational smooth form Engine Room command lever (Synchro to angle signal converter). When transferring command to bridge system start to behave unstable. It was observed that after some time signals become unstable and values are changed confusing us and control system. Every time we start system we found that some of the values different than it was calibrated as well as feedback signals. System require further investigation, including signal converters. System when starts to behave unstable, is not able to change motor direction. Increasing voltage on main generator when propulsion motor has no excitation and voltage on generator rise, current on motor rise as well.
3. Sea trials and final tunning. This was not done, due to lack of time, step 2 not completed.

1. Control levers – In system works two control stations: wheelhouse (4 levers connected mechanically to one selsyn transmitter) and engine room (selsyn on switchboard door). Control from ER lever was smooth and correct in both directions. Control from WH was disturbed sometimes (especially during changing AS->AH). The control range from WH is smaller than from ER. At the begging we found issue with relays related to switching control station. On WH console missing any signalization of the propulsion system (ready/alarms/tripped/control transfer etc.).
2. Propulsion controller – placed in MSB , consist of 36 analogue cards with amplifiers, limiters, converters etc. which adjust magnetization voltage of PG and PM. Discrete elements (resistors, capacitors etc.) changed their parameters in time (some of them have more than 40 years) and the regulators changed their response. Some of the cards were replaced, but that required new adjustment and not always was possible to compensate differences. Also the controller did not create any alarm to inform operator about danger situations.

3. Rectifiers for magnetization – the magnetization circuits are supplied from AC/DC converters (based on thyristors) which are controlled from propulsion controller. Found that one of the thyristor card was damaged and reverse revolutions couldn't be achieved. This card was replaced with spare one.
4. Auxiliary generators – the control circuit (for magnetization of PG and PM, supply for all control system) is powered from AE busbar. On AEs found that control and protections (EM stop, shutdowns) were not working. Other issues found in AE switchboard with breakers from AE. The AE is necessary to any work of the with the propulsion system.
5. AVR of PG – found that AVR for PG is disconnected which means that PG cannot work as a power supply for the vessels loads.
6. Sea trials – all tests was performed only in port (moored) and commands was given for short time, more test should be performed to check system behaviour during longer work. Often during adjustment system was working unstable what can repeat in future use.

Spare parts delivered

Qty	*Item Name*	*Type / SN*	*Comment*
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Recommendations

It is highly recommended to replace control system with modern solution, old cards are unstable and unreliable.
In order to avoid full system swap, this can be done in steps:

1. Replacing command leavers to get steady and smooth +/- 5V signal directly in to control PCB. (removing synchro torque transmitters and angle converter amplifier).
2. Replacing control PCBs with modern PLC. Including safety relays and signal converter (currents, voltages and RPM). Leaving igniters for motor and generator excitation only.
3. Replacing Excitation units.

Recovery of safety automation on remaining machinery and generators.

Start of service	SEnControl Representative	Work accepted on behalf of Customer:
26/07/2023 06:00		
End of service		
30/07/2023 23:00	Signature	Stamp and Signature