A Review of Electrical Interference Issues on Commercial Fishing Vessels

Ajay Chourasia
Assistant Professor
Department of Electrical Engineering
VIVA Institute of Technology
Corresponding Author's Email: *-ajaychourasia4@yahoo.com*

Abstract

The Canadian Coast Guard (CCG) gives financial support to the Marine Communications Centre (MCC) for Electromagnetic Compatibility and Electromagnetic Interference (EMC/EMI) linked problems on industry based fishing vessels shorter than twenty metres. The purpose of the survey is to offer electrical conditions for the boats. The relevant data was gathered by using the "electrical noise" measuring method. Due to the lack of an electrical noise reduction strategy, some autopilot systems are vulnerable to High Frequency Single Side Band (HF SSB) transmitters. The primary goal of the survey is to identify the best electrical noise reduction solution for fishing vessels.

Keywords: - *Electrical Noise Suppression, Marine Communication, Electrical Noise Measurement, Electrical Interference Problem*

INTRODUCTION

Navigation frameworks and electronic information systems are being employed and often installed on small business-related and pleasure vessels. EMC/EMI difficulties are frequent, regardless of the size or complexity of the fishing craft.

BACKGROUND

Some faults in electronic information systems are typically impulsive in the type of the failure or in the event time [1]. MCC's primary goal is to assist Canadian business while also developing maritime transportation-related commodities and services. Because the problems are sensitive to EMI/EMC and are generally used in a maritime environment, it is the responsibility of the MCC to solve them. With the assistance of CCG, MCC provided an EMC/EMI survey. It contains twenty-three commercial fishing vessels with a length of less than twenty meters [2].

THE PROBLEM

Nonmetallic materials are commonly used in the construction of vessels because they provide an easy and appropriate infrastructure for electrical installations. The goal of the investigation was to provide information while considering the electrical state of these vessels [3].

PROPOSED SOLUTION

The objectives of the survey were:

1. Enumerate the Electro-Magnetic (EM) environment (radiated and conducted) characteristics of these vessels.

2. Recognize the types and extent of electrical installation difficulties seen on these fishing vessels.

MEASUREMENTS METHODOLOGY

To determine the level of "electrical contamination," radiated noise measurements were performed on all experimental vessels in the High Frequency (LF), Medium Frequency (MF), and Low Frequency (HF) spectrums as a consequence of ship equipment operation. The acquired values of radiated noise level and background noise level of the experimental device are compared. The background noise level is nothing more than the measurement of the reference noise level under all feasible settings [4]-[5]. The receiver's control computer would choose frequencies for further testing based on this reference scan. The computer software for the specific application is chosen based on the minimal activity range of test frequencies. The frequencies derived from the experimental value are reviewed, and higher energy values, such as radio range transceiver frequencies, are removed from the radiated experimental data. The gadget that produces the most radiated noise may thus be identified more easily [6].

The likely noise sources were encountered during the survey measurement phase, allowing the vessels' gadgets to be determined. This gives a wealth of information regarding the gadget aboard the fishing vessels. The findings of the radiated noise testing are summarised below.

ALTERNATOR MEASUREMENTS

The alternator is the primary source of noise present on all boats. Seventeen of the twenty-three boats tested (82%) lacked adequate alternator noise containment filters, resulting in noise levels 30 - 80 dB above background. Seven of the boats (36%) had alternator noise levels that were regarded excessive, with intensities more than 50 dB. This noise level is sufficient to collapse the vessel's communication, performance, and navigational utensils [7]. Polystyrene capacitors with 1.0f are connected from each output lead of the alternator to the casing of the alternator by MCC agent in 60% of the survey vessels. Periodically, the freshly connected vessels are subjected to radiated noise measurements for comparison.

DC Motors

The tests are done in DC motors located in twenty three vessels, which create radiated noise measurements on the examined vessels. Radiated noise measurements yielded findings up to 60 decibels above the background. The motor noise was typically 10 - 30 dB above the background level. Filtered capacitors are added to sixteen motors, nine of which are clear vision screen motors. MCC technician's put 0.1pF ceramic capacitors across the dc power lines inside the motor casing to do a second radiated noise test at the same time. Across the input power lines, 1pf polystyrene capacitors were placed, resulting in a 10 - 20 dB decrease in the 300 kHz to 3 MHz frequency range.

Electrical Equipment

Another noise source, very high on some vessels, was the electrical equipment such as battery chargers and dc-to-120 volt-ac power converters. Only a few power converters were encountered during the survey, however all produced very high levels of radiated noise. The reduction of noise from these devices was not attempted due to time constraints.

Electronic Equipment

The final class of noise sources measured was the electronic bridge equipment. Generally, these devices were fairly quiet; however, there were occasions when very high radiated noise (30 - 50 dB) levels were measured. The ships' radars were the noisiest of this group, followed by fish finding equipment (sounders and sonar). Due to the complexity of these devices and their installations, as well as time constraints, no attempt was made to reduce the radiated noise. It is likely that in order to reduce the noise from some of the radars a combination of solutions may be required. Cable shielding, transmitter shielding and scanner motor decoupling are some possible solutions.

Vulnerability Tests

During the survey, vulnerability testing were done. The main test measures the field strengths from the ship's SSB and VHF radios, and the secondary test determines the interference level to the ship's autopilot, which results in the operation of the HF SSB radio. The major objective in the high frequency SSB transmitter is to determine Radio Field Strength (RFS) by measuring the antenna in the wheelhouse. The computed level was typically 160dBpV/m. The secondary vulnerability test is used to determine autopilot susceptibility. This test is carried out during a transmission utilising the ship's HF SSB radio and in autonomous steering mode. During this test, there were several malfunctions. The experiment was normally completed with the radio set to AM mode and an output power of around 25 watts [8].

In the vessels, power, electronic messaging, and navigational systems create radiated and conducted electromagnetic interference, which is measured during the survey. Data from the electrical coordination system were also recorded in common condition, along with noise measurements for the conjunction [9]. The status of the examined vessels may alter since the electrical frameworks on the examined vessels changed dramatically. [10] discusses the design and performance analysis of a MIMO-OFDM system with several antenna configurations. As a result, some older boats possessed electrical frameworks that used private wiring materials and procedures, however more recent vessels used marine conveyance boards and marine safeguarded connections or conductors. [11] explains Reactive Power Pricing Using Group Search Optimization in a Deregulated Electricity Market. Examining the purposeful generated uproar levels amongst boats, with differing electrical frameworks but operating equivalent gear, was done as a test to see if the more recent installations influenced the sent disturbance from the ship [12].

The alternator calculations were included in the analysis since the great majority of the boats used comparable alternators. Radar estimates were moreover chosen because various warships had comparable models and the radars often gave truly high emanated commotion when contrasted with a significant part of other gear. The results showed that an older vessel was never less noisy than the more modern vessel with which it was compared. Some of this increase might be attributed to hardware maturation or general deterioration of the ship's electrical architecture. In any event, the protected maritime linkages and waterway used by modern boats are likely to have contributed to the transformation.

CONCLUSION

The small vessel study yielded excellent data on the electrical condition of the kind of vessel examined. Because the information base acquired is rather small (22 boats), the survey may not accurately speak to the general electrical status of this kind of vessel. In any event, the significant incidence of deviations from the norm observed shows that potentially challenging issues exist that might impact the vessel's security. Almost none of the boats' electrical devices (motors, battery chargers, etc.) had effective noise suppression, and in fact, the majority of devices did not have any. The majority of the gadgets produced noise levels that might potentially interfere with radio navigation and communications. Several difficulties, including as emissions and interference effects, might be decreased to acceptable levels by providing dependable and appropriate shielding and filtering procedures.

REFERENCES

1. Perera L. P. and Soares C. G., “Maritime Traffic Monitoring Based On Vessel Detection, Tracking, State Estimation and Trajectory Prediction,” IEEE Trans. Intell. Transp. Syst., vol/issue: 13(3), pp. 1188–1200, 2012.
2. “Mapping UK shipping density and routes from AIS,” Marine Management Organisation, Newcastle upon Tyne, U.K., MMO Project no. 1066, pp. 35, 2015.
3. Yue Y. and Krishnan R., “Non-Myopic Adaptive Route Planning in Uncertain Congestion Environments,” IEEE Transactions Knowledge Data Eng., vol/issue: 27(9), pp. 2438–2451, 2015.
4. C. J. Saunders, “Procedure for Minimum Electrical Interference in New Research Laboratories,” in Electromagnetic Compatibility Symposium Record, IEEE International, pp. 1-2, 1973.
5. Melvin and Hicks, “Results of a survey of electrical interference problems on commercial fishing vessels,” in Vehicle Navigation and Information Systems Conference, Proceedings of the IEEE, pp. 777-779, 1993.
6. Whitehead S. and Gill A. J., “Electrical interference with radio reception,” Journal of the Institution of Electrical Engineers, vol/issue: 83(501), pp. 345-386, 1938.

7. R. Zhang and C. K. Ho, “MIMO broadcasting for simultaneous wireless information and power transfer,” IEEE Transactions on Wireless Communications, vol/issue: 12(5), pp. 1989-2001, 2015.
8. Mahboub A. and M. Arioua, “Energy-Efficient Hybrid K-Means Algorithm for Clustered Wireless Sensor Networks,” International Journal of Electrical and Computer Engineering (IJECE), vol/issue: 7(4), pp. 2054-2060, 2017.
9. M. D. N. Bhange and C. G. Dethe, “Performance of Pilot-Aided 3D-OFDM Channel Estimation Using Different Antenna Configurations,” Indonesian Journal of Electrical Engineering and Computer Science, vol/issue: 8(1), 2017.
10. Agarwal A. and Mehta S. N., “Design and performance analysis of MIMO-OFDM system using different antenna configurations,” in Electrical, Electronics, and Optimization Techniques (ICEEOT), International Conference on, pp. 1373-1377, 2016.
11. Kannan G., et al., “Reactive Power Pricing Using Group Search Optimization in Deregulated Electricity Market,” in Power Electronics and Renewable Energy Systems, pp. 305-312, 2015.
12. V. Nagaraj, et al., “Development of Communication Technologies and Networks for Smart Grid,” IJMSR, vol/issue: 8(1), pp. 81-92, 2016.