

Additional comments in RED provided by Michael Safina.

Lightship Overfalls

S.O. 449132

Reported to vessel June 5, 2018. Surveyed vessel for possible electrical causes of corrosion. Found the neutral was not isolated from the ground and that there was no galvanic isolation in the ground circuit to the vessel. The 120/240 volt 50 amp shore power distribution system on the ship is wired with aluminum wire (aluminum wire is prone to corrosion at splices and connections in damp environments and is not allowed for marine installations by IEEE, and the US Coast Guard) and the neutral and ground were bonded together in several places. This inappropriate bonding created a dual path for the neutral current that would negate any benefit from a galvanic isolator. (This created a situation for the ship that would accelerate underwater deterioration of the steel due to galvanic action.)

Temporary measures were taken to isolate the ground and neutral. Splices in the junction box on deck aft of the stack were found to be insufficiently insulated. These splices were insulated to avoid a possible short circuit.

1-The ship's shore power distribution system should be rewired using copper wire.

- The existing main power cables from where the shore power connects to the ship and then runs to an exterior junction box and then to two different distribution panels are made of aluminum. Aluminum cable is not approved for shipboard use and evidence of deterioration is already evident inside the exterior junction box and at cable termination points in the distribution panels. Broken cable strands were found inside the junction box. This is not urgent and should be accomplished at the end of the tourist season as the ship will need to be without power while this is accomplished. For the most part, this cabling is accessible and replacement could be accomplished within 3 days. A professional cable installer should perform this work.

2-Manufacturer approved ground bars should be installed in the distribution panels in the auxiliary machine room and the companionway to the officer's day room.

- This is a minor repair and could be accomplished within a couple of hours by members of the Dirty Hands Gang. Material cost should be under \$100. The work could also be done in conjunction with cable replacement.

3-The shore power from the junction box by the gangway should be terminated on the line side of the main breaker of the panel in the companionway to the officer's day room to provide a shipboard single point of disconnect for the shore power.

- It is not clear why the power is distributed in the manner it is. There is a shore power connection point on the ship near the gangway. From here, power goes to a junction box just aft of the stack. From this junction box, the power is split and one power cable goes inside the spaces to a distribution panel and the other cable goes to the auxiliary machinery room. What is recommended here is that the junction box should be eliminated and the power cable from the shore power connection should go directly to the main distribution panel in the space just aft of the stack and then from there, a two-pole breaker protected cable should be run to the auxiliary machinery room to a sub-panel distribution panel. This work should be done in conjunction with main power cable replacement.

4-The feed to the panel in the auxiliary machinery room should be from a two pole breaker in the panel located in the companionway to the officer's day room.

- This is how the cable to the auxiliary machinery room should be run, as described in comments to item 3 above.

5-The disconnect in the auxiliary machinery room should be eliminated as it is in poor condition, marked in a misleading manner, and unnecessary.

- There is an unnecessary disconnect panel in the auxiliary machinery room. The power cable comes into this box and then from there it goes to the distribution panel. This disconnect panel contains fuses and aluminum components that show signs of deterioration. This panel is unnecessary and should be removed when the main power cables are replaced.

6-The wiring into the panel in the auxiliary machine room should pass through a connector not the current exposed wires through an unprotected opening.

- This is minor. Normally, as a cable passes through a distribution panel, it goes through a connector that holds the cable in place and protects the cable insulation from getting damaged by the sharp edges of the panel box. Since the ship is not operational and there is minimal vibration, this can be corrected when the power cables are replaced. But if that work is postponed, then it should be corrected sooner. The material cost would be under \$25 and could be accomplished by Dirty Hands Gang.

7-A galvanic isolator should be placed in the ground circuit to the vessel.

These can be purchased at marine supply stores (approx.. \$800) and could be installed by members of the Dirty Hands Gang. If installed prior to the main cable replacement, this would have to be installed in

the line prior to the main junction box. If after the main cable replacement, then it would likely be installed in the vicinity of the main distribution panel behind the stack.

8-The gang way should rest on an electrically isolating material.

- This could be as simple as installing a rubber mat on the ground at the gangway. But the challenge is the movement of the gangway will wear the mat out quickly. This requires further investigation. A mat should cost \$100-\$1000, depending upon size and type. Gangway modifications may be needed (adding rollers or modifying it to prevent wearing of the mat) and the mat may need to be glued down to the concrete.

Items 1 through 6 improve the safety and reliability of the ship's electrical system.

Items 7 and 8 provide a level of isolation that should reduce or eliminate galvanic corrosion by interrupting the current path from the ship to submerged dissimilar metals while maintaining an effective ground fault current path for the shore power. Future attention to maintaining this isolation would be critical to the long term effectiveness of these measures.

This survey was not a comprehensive review of the entire ship's electrical system due to time and monetary constraints.

EMR is available provide advice or perform any of the listed remedial measures that fall outside the purview of the crew.

Thank you for the opportunity to be of service,

Russell Gordon

EMR

Other comments:

We discussed the need to add an impressed current cathodic protection system to the ship. This would eliminate the need to maintain the zincs. The impressed current systems are expensive, require regular maintenance and operational checks throughout the year, and are not foolproof. The ship currently uses installed zinc sacrificial anodes for cathodic protection. These anodes are bolted on below the waterline of the ship. This is a tried and true method used for decades. An impressed current system eliminates the need for sacrificial anodes and eliminates environmental concerns associated with zinc anodes. However, both methods of cathodic protection are legal. Mr. Gordon indicated that a full survey for an impressed current system could cost 10s of thousands of dollars – just for the survey. In consultation with Mr. Gordon, he recommended that the ship continue to use the zinc anode method of

cathodic protection. However, in lieu of drydocking, a diver should be hired annually to conduct an underwater survey and inspect/replace the zinc anodes as needed.

We also discussed air quality inside the ship. The high humidity and salt content of the air inside the ship is contributing to interior corrosion and mold. It was recommended that an air conditioning system with dehumidification be installed to improve the interior preservation of the ship. This would reduce corrosion of electrical components, reduce corrosion of steel components inside the ship, reduce mold and mildew growth, and generally improve air quality and comfort for tourists and tour guides. This should be further studied and installation considered after this year's tourist season.

It should be noted that many of the electrical components installed in recent history (after the ship was decommissioned) are not of marine quality. They are of traditional land-based building quality. Marine electrical systems are normally subject to USCG standards and requirements not the national electrical code for buildings. While the museum status and inoperable status of the ship may place it in a gray area, marine grade components will last longer as they are built to withstand the marine environment.

These additional comments are provided by Mr. Michael Safina, member of the Dirty Hands Gang. Mr. Safina has a B.S. in Marine Engineering Systems and is a retired civilian naval engineer who worked in shipbuilding repair and construction for the US Navy for 33 years.

