Discussion of MBARI Umbilical Options Proposed by Cortland Fibron

Email from Neil McAdam dated 8 October 2010

PCC acknowledges that the major difference between Option 2 and Option 3 is the power cable insulation thickness.

We agree the drain wires must be able to contact the copper tape surrounding the cable core.

The insulation on the existing cable shows the insulation color at the conductor and on the outside as well as some coloration throughout the insulation. What is the difference of the manufacturing process between the existing cable and the proposed new designs?

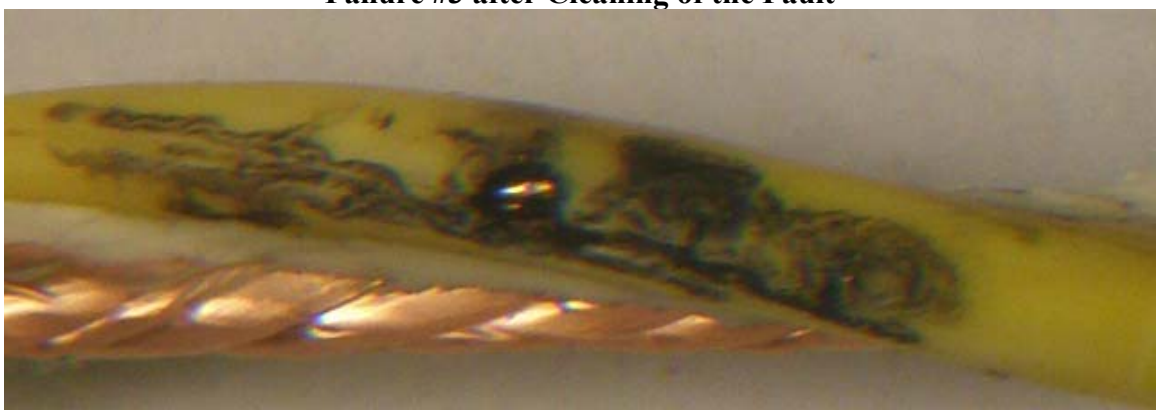
Discussion of Cortland Fibron Cable Option 2

In this cable design, there are five equal diameter power cables with an insulation thickness of 0.85 mm. By eliminating one layer of armor wire the outer diameter of the cable core is larger than the existing construction. With a larger core diameter, the interstices will be larger and able to accommodate the jacketed fiber optic tube and the drain wire. The copper taped center quad will also be jacketed with the same material as the power cable conductors.

PCC has participated in one of the umbilical cable failure dissections, failure # 3. No observation was made of any mechanical deformation or activity of the cable core at the fault location or any other location within the dissected cable sections. Because of the closeness of the bare fiber optic tube to the cable insulation, any external force may have contributed to the electrical failure because of the size of the electrical stress at that location.

In this failure, the actual fault location is clearly between the power cable insulation and the fiber optic steel tube. After cleaning the fault location, the actual fault location does not show any mechanical determination, but only the markings from the fiber optic steel tube, see Figure 1.

Figure 1
Failure #3 after Cleaning of the Fault



It appears the cable insulation was heated by the fault current. Note the indent into the insulation following the line where the fiber optic tube was located along the insulation. Also note the discharge patterns coming off the fiber optic line indicating electrical discharges prior to the failure. Additional insulation thickness and jacketing the fiber optic tube will make a substantial improvement in the stress distribution at the interface between the cable insulation and the fiber optic tube.

As proposed in Option 2, the power cable insulation thickness would be increased and each fiber optic steel tube jacketed with the same material as the power cable insulation.

As pointed out by Cortland, the interstices in this construction will have ample room for the fiber optic tubes and the drain wires. The jacket thickness on the fiber optic tubes could be designed to occupy the optimum amount of space within the interstice.

Discussion of Cable Option 3

In Option 3, there are six equal diameter components occupying the outer layer of the cable core, with one being the bundle of the fiber optic tubes. In this configuration, the power cable insulation thickness would be 0.58 mm.

Moving all of the fiber optic tubes into a single enclosure will eliminate possible interference between the power cables and the fiber optic tubes. Still, the drain wires will be located in the interstices and potentially interfere with the power cable. The cable would have an insulation thickness of 0.58 mm compared to the original construction with an insulation thickness of 0.55 mm, a 0.03 mm increase.

Recommendations

Having the five power cables in the outer layer of the cable core will allow the insulation thickness to increase to 0.85 mm. In addition the jacketed fiber optic tubes located in the interstices together with the drain wires will provide the optimum power cable insulation thickness and the protection from electrical contact between the power cables and the fiber optic tubes. The metal contact to the power cable insulation will be limited to the outer copper shielding tape intercalated with the plastic tape and the drain wires. Any internal core shifting and movement would be at interfaces between insulating materials except to the above mentioned copper tape and the drain wires.

Therefore, based on the available information, we propose Option 2 for the future cable construction.

We believe this design has the optimum electrical and mechanical characteristics within the confinements of the MBARI umbilical cable handling system's capabilities.

Please clarify any manufacturing and/or cable behavior issues we may not have addressed.

Torben Aabo
11 October 2010