Insulated Bus Pipe (IBP), Revolutionary Alternative to Cables for Shipboard Power Distribution

DEC 11, 2018
Electrical Panel Meeting

Public Release
Background

• Cables used since the advent of electrical distribution in 1800’s
• Primary cable advancements are in standardization and insulation materials
• Copper carries a finite amount of current
• Skin effect and size precludes the use of large conductors for AC
• Only option for supplying high current loads is parallel cables
• Cable bend radius is over twelve times the overall diameter, or 26.4” minimum for typical 400 MCM cable
• Cables run after a ship is fully assembled, does not support modular construction
• Cable repulls costly and time-consuming
About IBP

• Touch-safe power distribution able to be shaped into complex shapes
• Multiple sizes available
  • AC applications up to 36 kV and 6.5 kA
  • DC applications up to 60 kV and 7 kA
• Shielding/protection options
  • EM shielding
  • High temperature capability
  • Stainless steel outer layer
• Prefabricated sections installed similarly to pipes
• Bend radius limited by mechanical strength of conductor
  • 7.2kV AC/12kV DC at 2kA allows an 8” bend radius
• Designed for 40+ year life
IBP Construction

• Copper or aluminum conductor, can be solid or hollow
• Up to 30’ sections are standard
• Alternating layers of insulating/semiconducting crepe paper vacuum impregnated with resin
• Up to IP68 construction
• High temperature coatings
• Shielding options
• Multiple connecting methods to suit application
• Connecting sleeve constructed similar to IBP
IBP Connection Methods
IBP Benefits

• Provides SWAP-C savings for increased endurance and design margin
• Supports modular ship construction, savings cost, and schedule
• Significant space and weight savings
• Manufactured into complex shapes, can be placed in tight spaces
• Rigid construction ensures accurate model
• High abrasion resistance, increased survivability
• Repairs easily accommodated, only the damaged section is replaced
Testing Completed

- Navy has performed a number of tests on IBP
- No MIL-STD governs IBP, so mostly cable tests performed
- Tests performed chosen by NSWC PD and interested Program Offices

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<td>Basic Insulation Test, IEC 60502</td>
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2018 Project Status

• Current project

• Manufacture AC and DC sections of IBP, JUL 2018
• Perform updated Return on Investment (ROI) calculation for DDG 51 FLT II, SEP 2018
• Perform land-based demonstration at Florida State University Center for Advanced Power Systems (FSU CAPS), JAN 2019
First Production
DC Cart
AC Run
2019 Proposed Project Overview

• Current project developed US Navy (USN) Return on Investment and will provide a demonstration for stakeholders to observe
• IBP must be qualified before USN can utilize
• This proposal provides a path to qualify IBP and will develop a coaxial section of IBP to reduce magnetic fields and space
  • Must work with stakeholders and Tech Warrant Holder (TWH) community to determine tests for qualification
  • ABS providing cost share to further qualify for commercial use
  • Conduct the qualification test for IBP at AeroNav test lab
  • Write a detailed Technical Final Report to include updated ROI estimate and draft specification for IBP
IBP Outlook

• Current project has shown exceptional potential for Navy and shipyards
  • 78% weight savings
  • 20% labor savings (Estimated using pipes)
• This last project will qualify IBP, allowing Navy use
• OEMs are involved in this project to integrate IBP with new weapon systems, sensors, and electrical equipment
• With Large Future Surface Combatant, IBP will have already been integrated on small scale applications, making whole ship low risk
Conclusion

• Provides numerous benefits to designers, builders, and the Navy
• Benefits increased with high power loads
• Increased design margin for future upgrades
• IBP has already passed a number of tests, and will work with Tech Warrant Holder community to determine qualification path
• Once qualified, IBP will be available for shipboard integration