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White Paper:
ADSS Dry Band Arcing Considerations

Aerial deployment of optical cables along electrical power lines necessitates special cable designs. Electric fields, which surround power lines, may induce potentially damaging electrical fields. These fields require the use of dielectric materials, and under certain environmental conditions the fields may induce arcing along the optical cable jacket.

ADSS cables are suitable for deployment in distribution systems with voltages up to 275 kV, providing the cable is located in space potentials not exceeding 20 kV. In some cases special jacket materials must be used on ADSS cables to withstand the electrical fields encountered. High space potentials have been shown to cause dry band arcing along cable surfaces, which can result in pitting and cracking of jacket materials over time. Eventually dry band arcing may cause the jacket to completely fail, exposing the aramid reinforcement to damaging UV radiation which can eventually lead to catastrophic cable failure. Standard polyethylene jackets may safely be used in space potentials up to 12 kV. Special track-resistant jacket materials are used at higher space potentials or in areas where high levels of pollution are present. Future electrical distribution system upgrades must also be considered when evaluating space potential compatibility. Increases in transmission line voltages or changes in the number or placement of electrical conductors may obsolete the specific cable selected if care is not taken in this analysis.

Dry-band arcing is dependent on the hardware configuration, the system voltage, environmental conditions, and also on the electrical resistance of the cable sheath material itself. The induced voltage difference between a mid-span section of the ADSS cable and any grounded section of the system's hardware creates a possibility of inducing current flow along the sheath. On a newly installed dry cable, the sheath resistance is quite high (>10^9 Ohm/m) so the induced currents are insignificant. However, as a cable ages from exposure to the sun's ultraviolet rays, contaminants such as salt and/or pollutants and moisture can affect the surface resistance of the cable.[1]

A thermoplastic track-resistant jacket with acceptable carbon black content and UV stabilization provides a three pronged solution to dry band arcing. First, the addition of a UV stabilization system including carbon black ensures the ADSS jacket will not prematurely age with UV exposure. This assures a high electrical resistivity of the cable jacket. UV aging of the jacket can allow collection of salt / pollution on cable sheath lowering the cable resistance. Second, thermoplastic track resistant jacket materials minimize carbon surface tracking more effectively than cross-linked materials. Finally, the tough filled thermoplastic track resistant jacket will resist any heat or ablation damage if arcing does occur.[2,3,4]

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[1] William DeWitt, Swati Neogi, Dr. Brian G. Risch, Dr. George Karady, "High Voltage ADSS Reliability Modeling: Environmental and Climatological Effects on Advanced Jacket Material Selection", *Proceedings of the 49th International Wire and Cable Symposium,* November 2000, pp.337-346.

[2] George Karady, Yun Lei, Devarajan Srinivasan, Monty Tuominen, and Brian Risch, "Experimental Investigation of Aging Effects of Dry-Band Arcing on ADSS Fiber-Optic Cables", *2003 IEEE/PES Transmission and Distribution Conference and Exhibition Technical Proceedings,* September 2003, Vol. 3, pp. 898- 903.

[3] Brian G. Risch, Swati Neogi, George Karady, Yun Lei, and Baozhuang Shi, "Evaluation of ADSS Jacketing Compounds and Environmental Exposure Effects Using a New Dry-Band Arc Test Methodology", *Proceedings of the 51st International Wire and Cable Symposium,* November 2002, pp. 551-560.

[4] George G. Karady,Essam Al-Ammar, Baozhuang Shi, and Monty W. Tuominen, "Experimental Verification of the Proposed IEEE Performance and Testing Standard for ADSS

Environmental Pollution

The environmental pollution level at installation routes can vary vastly from location to location. Therefore, some ADSS designs are more suitable for certain geographic locations than other designs. Locations that have low levels of environmental contamination may not require protection for problems like dry band arcing.
Low pollution areas are defined as installation locations that have low levels of contaminate materials such as salts, industrial pollution, volcanic pollution, naturally occurring atmospheric/animal corrosive pollutants or any combinations of these materials. High pollution areas would have high levels of these contaminate materials.

High contamination sites such as salt water zones, industrial pollution zones, volcanic sulfur zones, or combinations of zones require special protection from dry band arcing on the ADSS cable.

a) The outer cable jacket selection should consider the pollution levels at present day and potential future industrial growth.
b) Installation of protective gear, such as animal excrement guard, may be required to minimize pollution damage

Accumulation of pollution on the jacket can lead to dry band arcing when wet cables begin to dry. Pollution and moisture together become conductive and capacitive coupling to adjacent energized conductors induces currents in the pollution layer. The resulting induced voltage across dry bands can be high enough to create arcs which can contain enough energy (heat) to damage the jacket. The user should acquire knowledge of the potential pollutants in the planned service area. Mitigation involves locating the cable on the structure in areas of minimal electric field as well as selecting track resistant jacket material over standard jacket material when required.

Fiber Optic Cable for Use on Electric Utility Power Lines" *IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 21, NO. 1, JANUARY 2006,* pp. 450-455.

The customer should notify the cable supplier of the pollution environment. The supplier shall then determine its product compliance against dry band arcing.

ADSS Cable Pollution Determination in a particular area (Informative)

ADSS cable pollution is one of the key parameters for safely locating ADSS cable in the high voltage environment. Unfortunately data of this type is lacking in most areas of the country and the world. One customer, Bonneville Power Administration, has made measurements in portions of the Pacific Northwest using an instrument developed at Washington State University. ADSS cable Pollution Indices (PI) have ranged from 7.7 to 8.5, placing that part of the United States in the "Very Light" category. However, these were initial measurements and long term levels have yet to be determined. [5]

Until actual measurements can be obtained and recorded, it is strongly suggested that the customer attempt to assess the local area. Pristine mountain areas will fall into Light or better. Areas near salt water can display a large range depending on local climate; two PI measurements close to the Pacific Ocean (Bandon, Oregon) indicated 7.7. In contrast, in other parts of the world (Europe) salt can accumulate in the Heavy region (PI=5) or possibly worse. Industrial and farming locations may tend toward Medium and Heavy. Insulator maintenance practices might provide some indication. A utility having to perform insulator washing should be considered in Heavy category.

To convert to resistance R=10ˆn where n is the stated index (i.e. 7.7) and where R is ohms/m.

Note: The upcoming revision of IEEE 1222 will provide additional information on this topic.

[5] Kenneth S. Edwards, Patrick D. Pedrow, and Robert G. Olsen, "Portable ADSS Surface Contamination Meter Calibrated in High Voltage Environment", IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 18, NO. 3, JULY 2003.