

TIPS & NEWS



SEPTEMBER 1997

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ANDERSON • CHANCE • FARGO • HIPOTRONICS • KERITE • OHIO BRASS

Special
International
Issue

SAFETY-PROVEN METHODS

No service interruptions for maintenance by 'hot sticks' or 'barehand'

FOR EHV HOT-LINE WORK

Reflected in these selected scenes is recent evidence of the Chance Company's continuing worldwide leadership in extra-high-voltage (EHV) energized line work.

Not only are Chance EHV Hot-Line Tools up on your lines with your crews, we're also up there – in person. Our expert Hot-Line Tool Specialists often teach on-site courses to utility crews using their new Epoxiglas® insulated tools and techniques for the first time to complete repairs.

Since the 1950s, when Chance hot-line training expanded outside the U.S., our



curriculum has added the “barehand” method – special conductive clothing allows a worker to get into a line's electrical field to use hand tools for added efficiency on some close work.

For more than 60 years, Chance has helped develop procedures now adopted as standard practices for the benefits of working “hot,” without power interruptions: Revenue savings, continuous customer service, crew scheduling convenience. In joint efforts with many utilities around the globe to

Guatemala, at left and above, Ohio Brass suspension-standoff polymer insulators are placed on an energized 220 kV line using Chance insulated tools.

As shown on the cover of this issue, instructors on this job were Chance Hot-Line Tool Specialists. On this pilot project, they trained and assisted the crews for what now is a standard procedure at this utility.

Without built-in provisions to ascend the concrete poles, Epoxiglas sectional ladders with nylon-strap binders were an innovative solution. They made it possible for all the workers to get into proper positions on the same structure to perform all the necessary tasks.



Costa Rica, left, a maintenance crew gets on-the-job training from Chance Hot-Line Tool Specialists atop this 230 kV tower. The V-string of insulators is supported in an Epoxiglas® cradle positioned by wire-tong hot sticks.



Tanzania, above, crew raises hook ladder while learning cargo-boom method for live installation of deadend insulators on 230 kV free-standing tower.

solve maintenance problems, we have been directly involved in the evolution of EHV hot-line work. From our 161 kV work using plastic-coated select-wood tools in the mid-1930s, our experience

Epoxiglas insulated tools meet IEC-832 and IEC-855.

and hot-stick technology have kept pace with ever-higher transmission levels. On both A.C. and D.C. lines we have instructed utility crews on uses of our state-of-the-art fiberglass Epoxiglas brand tools.

FROM WOOD STICKS TO VIDEOTAPES

Committed to providing tools for the electric industry, Chance has taken an active role in the development of EHV hot-line work standards.

Our world-class EHV tools meet not only applicable U.S.-based ASTM, IEEE, NEMA and OSHA standards, but also those of the International Electro-Technical Commission (IEC). Epoxiglas insulated tools meet IEC-832 and IEC-855. Chance barehand suits meet IEC-895.

Throughout the history of EHV energized work, Chance has made a wide range of educational

CONTINUED, NEXT PAGE 

contributions. Today that includes ongoing roles in industry guidelines, close attention to specific needs dictated by each customer's line design, an experienced staff of tool demonstrators, a free lending library of "how-to" videotapes, the *Hot Sticks* manual on high-voltage line maintenance and the best line of tools in the industry. ■

For more information, contact your Hubbell representative or fax (US code 1) 573-682-8714. If you are not receiving *TIPS & NEWS* magazine on a regular basis, fax (US code 1) 573-682-8714 and request your name be added to the free subscription list.

Chance barehand suits meet or exceed IEC-895.



Above, isolated from the ground plane by sitting on Epoxiglas insulated ladder, conductive garments permit "barehand" work directly on the hardware of this energized transmission line.

Africa, right and below, teamwork and hot-line tools change suspension and deadend strings.





IN THE WORLD OF EXTRA

The companies of Hubbell Power Systems make your life a lot easier

HIGH VOLTAGE . . .

You know us as Anderson, Chance, Fargo and Ohio Brass. Trusted names united together as Hubbell Power Systems. We bring our combined 350+ years of EHV construction and maintenance expertise together to offer a package that combines power-installed anchors, foundations, insulators, live-line tools, conductor dampers, tower hardware and fittings in a cost-saving approach that can come only from a global supplier with a broad product offering.

By relying on Hubbell, there's no going from company to company trying to coordinate products from different manufacturers. We do that for you. You save time and money. It all comes together in a coordinated manner from a single source.

We'll help with your engineering by using our more than 100 years of experience. We can help you configure your construction to be maintenance friendly. We'll work with you to develop Chance hot line tool lists to assure that your line is built

for ease of maintenance by hot line tools.

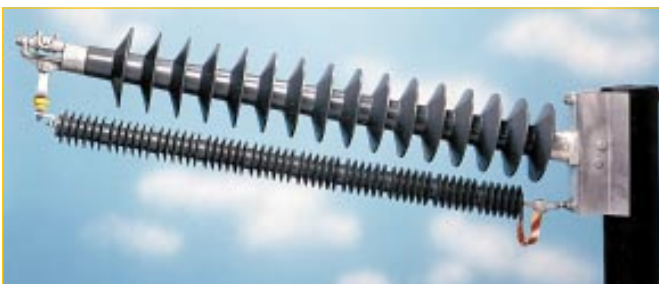
With our Ohio Brass Protecta*Lite surge arresters and polymer insulators factored into your construction, you'll have unequalled lightning protection and dependable insulator performance delivered as a proven system.

Our Anderson and Fargo tower hardware product lines are broad and varied. From vibration dampers to splices, connectors and fittings, including OPGW hardware, we will meet your requirements.

We'll review with you how products you may not have considered before can work with others to cut costs and provide more dependable service. But, just as importantly, we'll work with you to ensure you keep saving far into the future thanks to the initial construction and maintenance planning we'll do together.

It's truly a systems approach to EHV construction, maintenance and protection. A proven way to save using the Hubbell Power Systems product and experience package.

The Ohio Brass Protecta*Lite™ system combines the world's foremost lightning arrester with the world's leading polymer insulator to eliminate lightning-related breaker operations.





Many companies supply products. A leader brings expertise to help you pick the right product for your application.

You can find transmission products throughout the world, including products from us. But, you won't find the experience and support we provide to back you up throughout the planning, construction and ongoing maintenance that will continue years into the future. That's why you should let us work with you from the very beginning. Consider what Hubbell Power Systems brings to your project besides the products . . .

Assistance

On the ground, we'll bring the resources of our computerized geotechnical soil data bank to match anchors and foundations to specific soil classifications. Chance engineers can analyze your soil data and load requirements. Utilizing our computer facilities and proprietary software, we'll review with you the anchors and foundations that will work best on your project. And, on guyed towers we'll combine the anchors and deadends into a coordinated system specifically engineered to your requirements.

At the tower top, we'll factor Ohio Brass insulators and arresters into your construction to provide unequalled lightning protection. It will be a proven system based on years of field experience. Since 1976, more miles of line have been installed with Hubbell polymer insulators for transmission and distribution than any other manufacturer of polymer insulators. When you bring our insulators and arresters together, you'll obtain low watts loss and consistent lightning protection.

Fargo's use of Tecnosoft™ vibration analysis software provides a comprehensive approach to aeolian vibration assessment and suppression. This modeling system simulates aeolian vibration characteristics for any transmission line - existing or proposed. With the use of Tecnosoft, increased conductor and static wire line tensions may be utilized. That translates directly into lower construction costs by permitting longer spans or lower tower heights.

Our Anderson engineering design specialists will work with your engineers to help you plan and design your hardware assemblies to obtain maximum savings and performance. Bringing the Anderson and Chance team together with your engineers early in the planning will help you configure your tower hardware and structure design to make hot line tool maintenance a part of the design.



Chance demonstrators can help train your crews on the latest hot line techniques.

We'll help you cut your financing, ordering and delivery costs.

When you deal with Hubbell Power Systems, we make your job easier. We help you cut costs, too. Think about it! You cut the hassles and needless correspondence with multiple suppliers. It's the smart way to save during the financing process, and we'll be able to offer assistance in cutting through troublesome paperwork.

Based on our more than 100 years of combined experience serving the utility industry, we know how to get material on site. On time. Properly packed. Ready to use. Our shipping experts will work with you to make it easy. By coming to Hubbell, we take care of coordinating all your EHV material requirements except the towers and conductors.

With Hubbell Power Systems, it's truly a systems approach to EHV construction, maintenance and protection. And, we'll make sure your products meet all applicable ANSI and IEC standards. ■



Anderson Suspension Clamp



Fargo 4R Vibration Damper

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BRAZILIAN UTILITY CHOOSES PROTECTA**LITE*TM SYSTEM

Companhia Energetica de Minas Gerais (CEMIG), which serves the state of Minas Gerais, Brazil with electrical energy was experiencing an unacceptable level of outages on a 34.5 kV sub-transmission line identified as "Parauna-Gouveia Line". The line experienced more than 30 lightning induced outages per year. The line was a 3-wire circuit and constructed without shield wire protection. The region is characteristic of very high soil resistivities which resulted in structure footing resistances up to 500 ohms in an area which has very high atmospheric discharges (isokeraunic level of 80 and a ground flash density of 9.6 strokes per km² per year). These conditions make the circuit very susceptible to lightning induced interruption, caused by a phenomenon known as "backflash¹."

Ohio Brass analyzed a combination of Protecta**Lite* line arresters for different structure footing resistances². To achieve the target line performance of

1 to 4 outages per year, Ohio Brass recommended supplementary three-phase protection with arresters on every structure and confirmation of the structure footing resistance to be less than 500 ohms. Results of the analysis are in Chart 3.

During October 1996, 417 Ohio Brass 36.5kV surge arresters were installed on 139 structures. The arresters were installed on about half of the transmission line structures in three different sectors. As of March 1997, no outages have been reported on the line protected by the surge arresters even though the structures are in areas of high ground resistance (high ground resistance indicates an area susceptible to lightning induced outages due to backflash).

Analysis

Lightning strokes to lines (shielded and unshielded) may result in insulator flashover. Whether flashover occurs depends upon the stroke current and the line parameters. For a given line design, stroke current high enough to cause flashover is called "critical current".

The objective of all lightning protection methods is to maximize critical current. Higher critical currents result in better lightning performance. This is because there are fewer strokes of higher current magnitude in the stroke current probability distribution.

CONTINUED, NEXT PAGE ➔

Parauna - Gouveia - Line Data -Chart 1

System Voltage: 34.5 kV
 Length of Line: 75 km actual
 Protecta**Lite* line arrester MCOV: 36.5 kV
 Structure Footing Resistance: 50, 100, 250 & 500 OHMS
 Grounds are Located: At Every Structure
 Span Length: 262 Meters
 Total Phase Insulation Used: 250 kV
 Isokeraunic Level: 80
 Targeted Line Performance: 1 - 4 Inter.

Unshielded lines have the lowest critical currents. Therefore, nearly all strokes to unshielded/unprotected lines will cause flashover. This is particularly true for distribution and lower voltage transmission lines.

Shielded lines with well-designed static wires will have higher critical currents, but strokes to the static wire can result in insulation flashover due to backflash. Backflash may be reduced by increasing the voltage coupling. The greater exposure of a shielded line to lightning results from the additional height and increased shadow width.

As with unshielded lines, strokes that miss the shield wire (shielding failure³) will nearly always cause a flashover. Even lines built with good shielding angles may have some shielding failures.

Surge arresters spaced at appropriate intervals along the line protect the line from flashover. Arresters are connected in parallel with insulators to prevent flashover of the air gap insulation. This is the same function they serve when placed in parallel with transformers to protect the insulation from damage. Arresters can be applied



cases, increasing the number of arresters will vary depending on where they are applied. In other cases, increasing the number of arresters is less effective than properly locating them. That's why Ohio Brass engineers will carefully review utility information before making recommendations.

Unshielded lines with arresters may have better lightning performance than shielded lines. This is partially the result of a line with narrower shadow width being exposed to fewer strokes. A significant economic benefit comes

to prevent backflash, as well as direct stroke flashovers.

Protecta*Lite is a gapless MOV arrester. It conducts at high levels for the duration of the lightning stroke. The use of the arresters reduces the number of substation breaker operations thereby reducing the number of circuit interruptions.

The performance of lines equipped with arresters will vary depending on where arresters are installed. In some

from eliminating the costs of the shield wire and the taller structures they require.

Elimination of the shield wire and use of Ohio Brass arresters can result in the following benefits:

- Equal or better lightning protection
- Reduced installation costs
- Reduced right-of-way
- Reduced power losses
- Reduced EMF
- Lower Profile

**Parauna - Gouveia Line Without Protection
Chart 2**

Summary

The Ohio Brass Protecta*Lite System consists of a metal-oxide surge arrester in parallel with the line insulation. During a surge, the arrester limits voltage across the insulation to a value below the insulator flashover voltage. Lightning surge current is diverted to ground in a controlled manner and service is not interrupted. If you are experiencing lightning problems, Protecta*Lite can help you overcome the difficulty. Contacts at CEMIG: Jonas Antunes de Costa or Rubens Leopoldo Markeniez Tel: 55-31-329-5539 Division of Transmission Line Maintenance

MINIMUM # FLASHOVERS /100/KM/YR	MAXIMUM # FLASHOVERS /100/KM/YR	AVERAGE # FLASHOVERS /100/KM/YR
9	62	37.52
9	62	37.52
9	62	37.52
9	62	37.52

**Ohio Brass Three Phase Protection Method
for the Parauna - Gouveia Line**

Chart 3

STRUCTURE FOOTING RESISTANCE	CRITICAL CURRENT* (kA)	PERCENT FLASHOVER	MINIMUM # FLASHOVERS /100/KM/YR	MAXIMUM # FLASHOVERS /100/KM/YR	AVERAGE # FLASHOVERS /100/KM/YR
50 OHMS (A)	> 200.0	0.00	0	0	0.00
50 OHMS (B)	35.2 - 42.2	30.34	2	19	11.38
50 OHMS (C)	31.3 - 37.5	37.72	2	24	14.15
100 OHMS (A)	> 200.0	0.00	0	0	0.00
100 OHMS (B)	19.5 - 30.5	58.80	4	31	22.06
100 OHMS (C)	19.5 - 22.7	68.80	5	41	25.81
250 OHMS (A)	200.0	1.02	0	2	0.38
250 OHMS (B)	11.7 - 24.2	75.26	6	43	28.24
250 OHMS (C)	11.7 - 20.3	83.71	5	50	31.41
500 OHMS (A)	200.0	2.65	0	6	0.99
500 OHMS (B)	8.6 - 16.4	87.03	6	54	32.65
500 OHMS (C)	8.6 - 21.1	86.25	6	48	32.36
(A) : Protecta*Lite Spacing of 262 meters (B) : Protecta*Lite Spacing of 524 meters (C) : Protecta*Lite Spacing of 786 meters					

Glossary

¹Backflash - An insulator flashover from the structure to the phase conductor. This is due to surge voltage difference between the structure and the induced voltage in the phase conductor. High footing resistance aggravates backflash problems.

²Footing Resistance - The resistance to a surge from the base of the structure to true earth.

³Shielding Failure - A stroke that terminates on a phase conductor rather than a shield wire. ■

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Put the Anderson and Fargo experience and resources to work for you. As part of Hubbell, Anderson and Fargo offer the largest line of connectors, fittings, accessories and associated products in the industry. Make us your choice to secure, repair and protect your transmission lines. ■

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Your suggestions and editorial or photographic contributions are invited and may be submitted to **Hubbell TIPS & NEWS**.

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