iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** VI **Month of publication:** June 2015

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)

New Techniques and Approaches for Live Wire Maintenance of Transmission Lines

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Abstract:-In the field of Electrical Engineering, the transmission line play an important role for transmission of electricity one place to another place. Generally we have to see that during transmission of electricity, some faults occur in it. Initial these faults are minor but after it creates major problems. To solve these problems effectively by the new techniques and approaches of live wire maintenance of transmission line. Live-line working is the maintenance of electrical equipment, often operating at high voltage, while the equipment is energised. Electricity utilities wish to avoid loss of supply, for which they receive customer complaints or are financially penalised. At the same time they are obligated to maintain and replace their electrical equipment on a regular basis. Due to the hazard of high voltage, it is normally necessary for equipment to be isolated from the supply before being worked upon, termed a planned outage the first techniques for live-line working were developed in the early years of the 20th century, and both equipment and work methods were later refined to deal with increasingly higher voltages. In the 1960s, methods were developed in the laboratory to enable field workers to come into direct contact with high voltage lines. Such methods can be applied to enable safe work at the highest transmission voltages
KEYWORDS:-Transmission Lines, Live Line Maintenance, Hot sticks Techniques, Bare hand Technique, Rubber Glove Working,

I. INTRODUCTION

Interruption of supply is one of the major problems in electrical power transmission and distribution. It causes a loss to the revenue department of electricity board. This problem can be reduced by the "LIVE LINE MAINTENANCE ". Live line maintenance is nothing but to maintain the line without interruption of supply means if any problem (cut of leads) occurred on the line, we can clear the problem without taking line clear cut of leads on the line will not cause a major problem, but it may cause a problem in future. so we had remove the problem if we take line clear to this problem it causes interruption of supply at line cleared end and it cause a loss to the revenue department of electricity board. There is a solution to this problem.

We remove the fault on the line without interruption of supply by using live line maintenance techniques. There are three methods employed in live line maintenance. HOT STICK METHOD: This method can be employed up to 220 kV. In this using the hot sticks which are made up of EPOXY GLASS insulated material. It has a dielectric strength of 25kv per feet. In this method a person is standing at ground potential and he can clear the problem on the line without interrupting the supply. BARE HAND METHOD: In this method a person is lying at the line potential. This method is employed up to 735kv. The damaged insulators can be replaced by this method without interrupting the supply. THERMOVISION SCANNING: The entire equipments in the substation are scanned by an instrument called THERMOCAM. The scanning operation can be based on temperature. The fault can be indicated by a red spot, if red spot is bright it indicates a major problem.

Live Line Maintenance can be resorted for

A. Changing of insulators
B. Replacement of damaged section of conductor
C. Testing of insulators (on-line insulator tester)
D. Changing of cross arm
E. Changing of poles

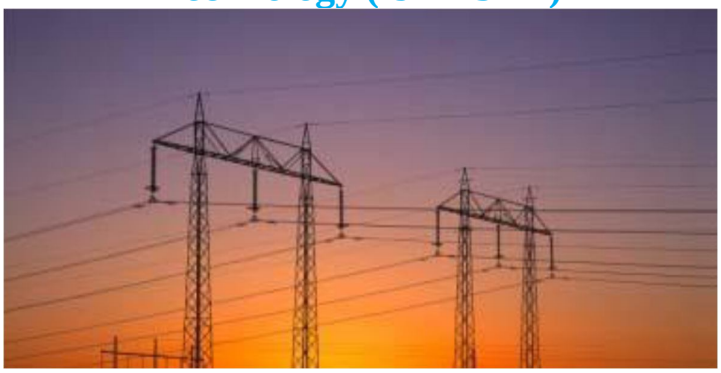


Fig.1 Shows Over headed Transmission line

II. LITERATURE REVIEW

While the use of live-line maintenance tools is sometimes considered a recent development in the electrical power industry, forerunners of modern live-line tools made their appearance as far back as 1913. These initial tools were homemade, crude, and bulky; however, they sparked the development of our present efficient and refined tools.

In 1916, a tool that was known as an "electrical hook" was introduced in Atlanta, Georgia. This was essentially a spring-type clamp for tapping energized circuits. The electrical hook necessitated a hotstick for installation purposes, and its use suggested additional tools which were soon developed for grounding and jumper service, applying parallel-groove clamps, handling conductors, pulling cotter pins, and manipulating tie wires. These were followed by a hacksaw, a live-line come-a-long, and saddles which could be attached to the poles for supporting certain tools.

Live-line tools were first accepted for work on lines up to 34 kV, but many linemen were hesitant to perform hotstick operations on this voltage. Because of this fear, many companies restricted live-line maintenance to 22 kV or less. As linemen began to realize that the use of live-line tools always kept them at a safe distance from energized lines, they began to lose their fear of performing this work, and restrictions were gradually relaxed, until by 1930 several companies were permitting live-line operations to be performed on 66-kV lines. This soon rose to 110 kV, and in the late 1930"s, the astonishing news was circulated that a west coast line of 220 kV had been successfully worked "hot." Another milepost was passed in March of 1948, when suspension insulators were changed on a 287-kV Hoover Dam-Los Angeles line, using tools especially designed for the job.

In 1959, live-line tools with fiberglass poles were introduced. The fiberglass consists of layers of resin coated glass fibers wound around and laid lengthwise over a plastic foam core, formed into a single unit by curing in an oven maintained at a constant temperature. It is highly resistant to moisture absorption and damage. The introduction of fiberglass live-line tools materially advanced electric utilities to the present day live-line maintenance of 345-kV, 500-kV, and 765-kV transmission lines. Western has performed both hot stick and bare hand methods of live-line maintenance since its inception in 1970 Bare hand Technique.

The electric utility industry first heard of the live-line bare hand technique in late 1960. Conceived by Harold L. Rorden, high-voltage practices engineer for the American Electric Power Service Corporation, the live-line bare hand technique was developed and perfected in extensive field and laboratory tests. The tests were conducted in the Ohio Brass Company's high-voltage laboratory, where Rorden was assisted by a co-developer of the new technique, Dr. Charles J. Miller, Jr., Ohio Brass high-voltage research engineer.

The live-line bare hand technique was developed as a result of: (1) rapidly increasing load levels; (2) cumbersome live-line tools; and (3) a lack of parallel or backup facilities. The live-line bare hand technique is an alternate method of live-line maintenance.

III. MAJOR TOOLS USED FOR LIVE LINE MAINTENANCE

A. Wire tongs: Normally used on pin type or suspension type construction for maneuvering and holding live conductors clear of the working area or for transferring to conductors to knee positions.

*B. Wire tongs saddle***:** are used to secure wire tongs to a structure.

C. Tie stick: used for manipulation of the wires.

D. Strain link sticks: used principally for supporting heavy conductor loads either for assisting wire tongs or for supporting entire load when changing insulators on running corners and dead end structures.

E. Roller link sticks: used principally to hold conductors aside when relocating poles in mid span.

F. Suspension link sticks: principally designed for lifting the conductor to relieve the strain from suspension insulators on high voltage lines.

G. Strain carrier: used principally for relieving the strain on conductors when changing insulators on dead end structure.

H. Auxiliary arms: used principally for holding conductors while damaged conductors or cross arms are being changed on pole structure.

I. Double string dead end insulator tool: normally used to remove the strain from the one side of the double insulator strings.

J. Gin poles: Used for lifting heavy conductors, hoisting transformers switches and other heavy items around energized conductors and other objects.

K. Cum-a-along-clamp: normally used to grip the conductor when tension is applied to the clamps by rope blocks, link sticks etc.

L. Safety equipment: like conductor guards, cross arm guards, insulator covers, hand gloves.

IV. TECHNIQUES AND METHODS OF LIVE LINE MAINTENANCE OF TRANSMISSION LINE

A. Hot Stick Method Using Insulated Sticks

In this method the linemen is at the ground potential and is isolated from the energized conductor. This method is generally adopted for transmission lines up to 220 KV. The sticks enable the linemen to carry out the work without infringing minimum clearance distances from live equipment. As experience with the techniques developed, the operating voltages at which the work was performed, increased. With the advent of fibre glass poles in the late 1950s, which neither split nor soaked up rainwater, utilities were prepared to carry out hot-stick working to their highest operating voltages, perhaps 765 kV. Tools, such as hooks or socket wrenches can be mounted at the end of the pole. More sophisticated poles can accept pneumatically or hydraulically driven power tools which allow, for example bolts to be unscrewed remotely. A rotary wire brush allows a terminal to be scoured clean before a connection is made. However, a worker's dexterity is naturally reduced when operating tools at the end of a pole that is several meters long.

Fig.2 shows hot stick method using insulated sticks

B. Insulating Glove Or Rubber Glove Working

Usually applied for work above 1kV ac 1.5kV dc The primary classes are: Class 1 - phase to phase working voltage 7.5kV Class 2 - phase to phase working voltage 17kV Class 3 - phase to phase working voltage 26.5kV Class 4 - phase to phase working voltage 36kV

Gloves protect the worker from exposure to the live part being worked upon sometimes referred to as the 1st point of contact; the point where current would enter the body should an inadvertent contact be made. Covers of insulating material such as blankets and linehose are employed in rubber glove working to protect the worker from exposure to a part at a different potential sometimes referred to as the 2nd point of contact; the point where current would leave the body should an inadvertent contact be made.

Most utilities require work to be performed from an insulating platform to provide isolation from earth/ground potential hence the term "insulate and isolate".

Fig.3 Shows insulating glove or rubber glove working

C. Bare Hand Technique

In this method linemen works either from the insulated bucket / truck or ladder and is bonded to the energized conductor and isolated from the ground. This method is generally employed for transmission lines above 220 kV. The first procedures for bare hand working were developed in 1960 by Harold L. Rorden, a high-voltage engineer for American Electric Power. Techniques were further refined following field and laboratory tests.

There are a number of ways in which the worker can access the live parts:

1) The worker can access from a specialist type of mobile elevating work platform (MEWP) termed an insulating aerial device (IAD) which has a boom of insulating material and which all conductive parts at the platform end are bonded together. There are other requirements for safe working such as gradient control devices, means of preventing a vacuum in the hydraulic lines.

2) The worker can stand on a insulating ladder which is maneuvered to the line by means of non conductive rope.

3) The worker is lowered from a helicopter and transfers himself to the line.

He is brought alongside the wire in a hovering helicopter and works from that position. As the lineman approaches the wire, an arc will form between them as his body is charged. Although this arc carries no more than a few micro amps, it is debilitating, and the worker must immediately bond himself electrically to the line to prevent further arcing. He may use a conducting wand during the approach to first make the connection. Once on the line, he is safe from shock as both the lineman and the wire are at the same electric potential and no current passes through his body. This is the same principle that allows birds to safely alight on power lines. When the work is completed, the process is reversed to remove him safely from the wire.

Fig.4 Shows bare hand technique

D. Working Hot: Life At 765 Kv

Specially trained utility workers, clad in conductive suits to equalize voltage over their bodies, repair live lines 'barehanded,' sometimes perched below a helicopter cockpit

Fig.5 Shows bare hand live line maintenance by Helicopter Cockpit

In March of 1987, a vandal with a high-powered rifle shot up three conductor bundles on a 500-kilovolt transmission link over a swamp between Miami and Fort Lauderdale, Fla. When Florida Power & Light Co. officials arrived to inspect the damage, some of the conductors, or uninsulated power lines, appeared ready to break and fall. The situation could have turned into something far worse than a simple line outage. Because of maintenance on other parts of the transmission grid, those lines were for the time being the main source of power to Miami. Turning them off to make the repair could have meant a blackout at least in part, possibly throughout all, of the city. The only way to avert such a disaster was to make the repairs without reenergizing the lines, working while the lines were hot. To get to the damaged spot, workers from the Miami-based utility had to truck in landfill and create a makeshift road through the swamp that would carry a bucket truck with an insulated boom. Lifted from the ground, a lineman clad in a steel-mesh suit touched the live line with a wand, a three-foot-long implement that looks like a car antenna. With his body energized to the line voltage, he could splice the conductors safely.

V. SAFETY PRECAUTIONS TO BE TAKEN DURING LIVE LINE WORKING

A. A golden rule for hot line operation is "nothing is too safe when a life is at stake". Records prove that hot line work on high voltage lines is actually safer than maintenance work on "Cold" lines which could possibly become energized while the line is being worked. Linemen working with hot sticks are always conscious of the danger involved, and being aware of this danger they work more cautiously and keep a safe distance.

B. While working it should be kept in mind that the person working invariably keeps a certain distance from the earth point. In addition to this he should also keep a certain safe distance from the other phases of the lines.

C. Use freely safety equipment like cross-arm guards, hand gloves, etc.

D. Never use a tool which is not tested and which is not familiar, never use a damp tool.

E. Do not exceed the manufacturer‟s ratings in the use of hot line tools. Linemen must know the approximate weight of a conductor span and the line tensions which they are dealing with. When in doubt use a longer tool or two identical tools.

F. Check each tool regularly for indicating that the tool may have been overstressed.
7. When not in use, tools should be kept in the tool container and not on the ground.

G. All the hotline tools shall be inspected manually and electrical strength test shall be carried out as per design at site.

H. All the insulators in the string must be healthy except one or two depending on voltage class.

I. Altitude correction factor should be applied in the above electrical clearances.

J. Distance from inadvertent movement shall be considered depending on the work procedure and expertise of the lineman.

K. Permissible current in the energized tool is 1 micro amp per kV line to ground.

VI. ADVANCEMENTS AND NEW TRENDS

By integrating maintenance aspects into the structure design at planning stage rather than as after thoughts, safety and efficiency can increase. Clearances can be pre-established, and working ease can be assured through scaled layouts utilizing human factor considerations. This should encompass the structures, insulators, hardware and tools to be used and the approach interfaces of these with the line workers (accessibility, steps, hand holds, platforms, attachments, weight, visibility, etc.).

There are several different telerobotics systems for live-line maintenance being developed around the world. Each of these systems is specially designed to fulfill a series of requirements for the application they are suited for. In order to fulfill these requirements the designers had to cope with different solutions and approaches, some specific of their application and others of general relevance for all the systems. The solutions taken define the practical and efficient use of the telerobotic system, and have to be taken with care, being fairly conservative but always looking what would be needed in the future.

The latest techniques also employ helicopters, useful where transmission lines traverse inaccessible terrain or where a bucket truck would damage crops.

VII. CONCLUSION

This Paper has thoroughly discussed the live line maintenance of transmission line practices being adopted in different parts of the world. Considering the fact that system availability can be greatly increased keeping the revenue loss due to shutdowns and inconvenience to customers to minimum, live line maintenance has proved to be a must choice for Power utilities.

At the same time it must be kept in mind that electricity is hazardous and strict Regulations for live working and rigid adherence to protocols must be ensured.

Following are the main Advantage which concludes the benefit for the inconvenience and losses of transmission of electricity.

A. Economic Benefits

Circuit availability has a positive impact on a utility's balance sheet, because the availability index is an integral part of the remuneration formula applicable to transmission companies. In the event a network's availability is above the fixed value, the utility receives a bonus over and above the standard remuneration. Live-line working is one of the maintenance activities where innovation and improvements are continually developed. This often leads to the creation of applied research projects, and the cost of this research and development can attract tax relief, depending on the prevailing national policies.

B. Social Benefits

A key external social benefit of using live-line working techniques for routine maintenance and construction work is that energy is supplied without interruption. This effectively increases system availability, reducing planned outages and thereby satisfying society's demand for improved service quality.

Another external social benefit affects the use of helicopters for public services. Transmission circuits are often routed over roads and reservoirs, the same locations commonly used by helicopters for public service responsibilities. The transmission lines are highly visible and serve as beacons in adequate numbers, size and colour, which are installed using live-line working procedures.

C. Environmental Benefits

The reduction of losses by an increased availability leads to savings in generation and lower emissions of polluting gases in the atmosphere. Also, live-line working procedures and methods are specially designed to address environmental issues, such as the installation of bird flight diverters and the replacement of insulators, spacers and other accessories that generate noise.

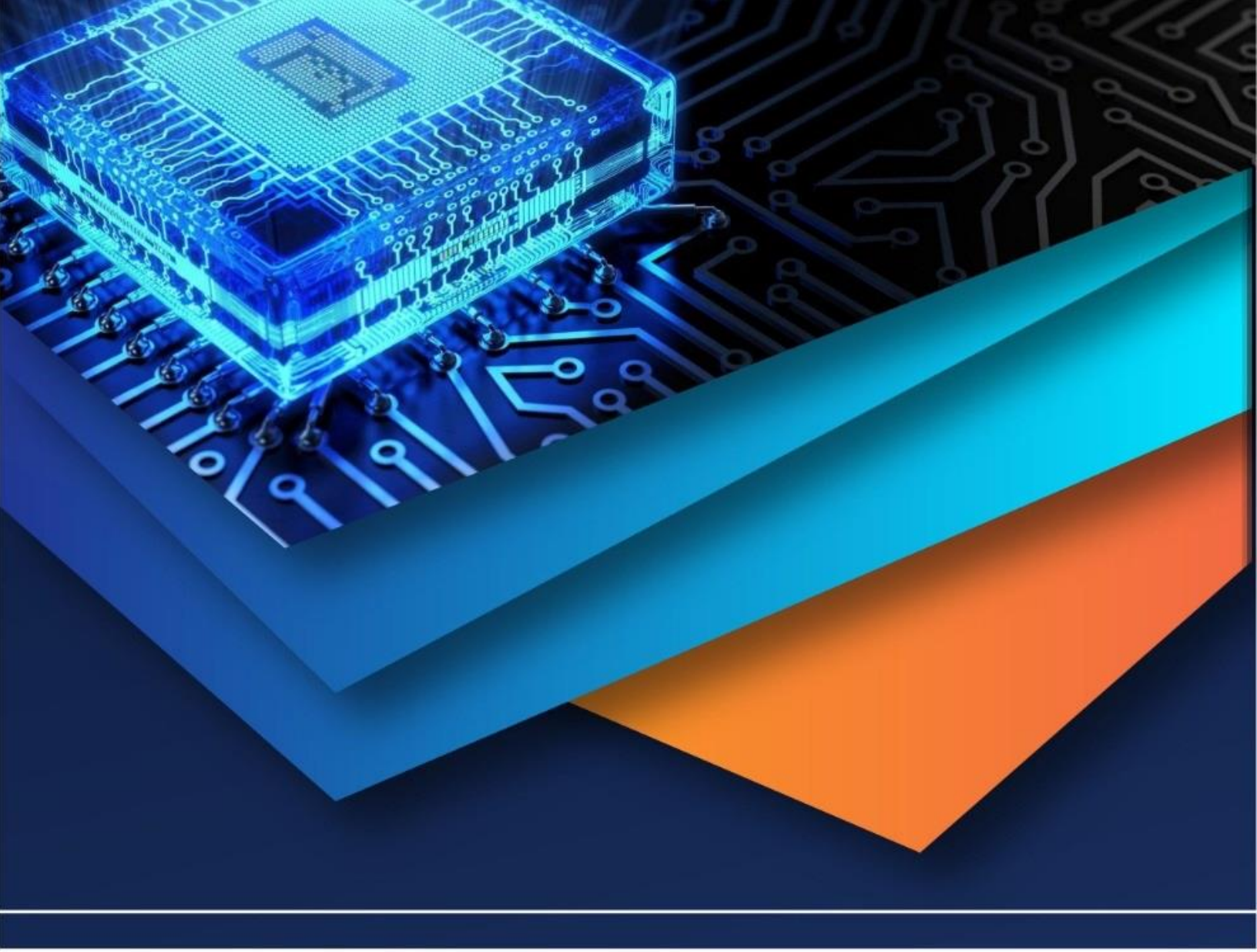
REFERENCES

[1] Fengyu Zhou & Yibin Li,et al. (2008). Research onautonomous negotiation action planning for110kvpower transmission line inspection robot, pp. 7455–7459,Chongqing, China,2008, IEEE, USA.

[2] Nicolas Pouliot & Serge Montambault (2008). Geometric design of the lines cout, a teleoperated robot for power line inspection and maintenance, IEEE International Conference on Robotics and Automation, pp. 3970–3977, USA,2008, IEEE, USA.

[3] Paulo Debenest, et al.. (2008). Expliner – robot for inspection of transmission lines, IEEE International Conference on Robotics and Automation, pp. 3978–3984, USA,2008, IEEE, USA.

[4] Ren Zhibin, Ruan Yi,et al. (2008). Control of inspection robot for the power transmission lines based on database, Proceedings of the 27th Chinese Control Conference, pp. 281–285, Kunming, China, 2008, IEEE,USA.
[6] Wang Ludan, Wang Hongguang, et al (2007).
[7] Visualservo-based line-grasping control for power transmission line inspection robot, robot, vol.29, 2007.
[8]Anonymous. Live-line working: From Wikipedia, the free encyclopaedia. Retrieved from http://en.wikipedia.org/wiki/Live-line_working
[9] Silcock, R. Live maintenance of high voltage transmission lines Safety is paramount.
[10] Anonymous. Live line working: western area power administration Power system maintenance manual.
[11] Iberdrola, S.A. Robtet a new teleported system for live-line maintenance.
[12] Anonymous. Working hot line at 765 kV, IEEE spectrum.
[13] Hildreth, J.; Gillies, D.; , "Evaluation of live-line maintenance techniques used on BPA reduced clearance 500 kV lines," Power Engineering Society General Meeting, 2004. IEEE , vol., no., pp. 445- 450 Vol.1, 6-10 June 2004
[14] Dansereau, R.; Beauregard, C.; Meloche, G.; , "Innovative tools for better live-line maintenance," Transmission and Distribution Construction, Operation and Live-Line Maintenance, 2003. 2003 IEEE ESMO. 2003 IEEE 10th International Conference on , vol., no.,pp.25-326-April2003
[15] Silcock, R. Live maintenance of high voltage transmission lines Safety is paramount. Retrieved from http://www02.abb.com/global/gad/gad02077.nsf/lupLongContent/5975E9472 CDC92C1256EFA0048910
[16] Iberdrola, S.A. Robtet a new teleported system for live-line maintenance. Retrieved from http://arvc.umh.es/documentos/articulos/ArticuloEsmo95.



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