# A REVIEW OF FOUR LONG-TERM IN-SERVICE PERFORMANCE STUDIES OF ELECTRICITY DISTRIBUTION POLES FITTED WITH BARRIER PROTECTION SYSTEMS

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## Summary

Thousands of utility poles fitted with Field Liner pole sleeve prototypes of the barrier protection system (BPS) now commercially known as the Biotrans Pole Sleeve have been installed in South Africa by Eskom and municipalities including eThekwini, Ekurhuleni and Buffalo City since 1994. Six thousand distribution poles with BPS have also been installed by Seattle City Light since 1998. The installations have been inspected by the writer and by independent inspection companies and the findings confirmed two major benefits of BPS, viz., BPS prevent preservative migration to soil and BPS prevent decay in the poles. On the basis of these studies and others conducted worldwide it was concluded that BPS prevent pole failure for at least 40 years in service, which in turn reduces end user costs such as pole maintenance expenditure and also reduces ownership liabilities such as the financial ones imposed by insurers in the form of high premiums and the compensatory payments paid by the latter to claimants in cases of catastrophic pole failure..

## Introduction

Wood preservatives collectively constitute a hurdle (Baecker, 1993a) intended to exclude decay agents from treated wood. Unfortunately no preservative is permanently fixed in wood in soil contact therefore treated wooden poles in service will decay with time. This is a global problem and end users around the world continually complain to pole brokers and the International Research Group on Wood Preservation (a former group of OECD experts) about poor service periods.

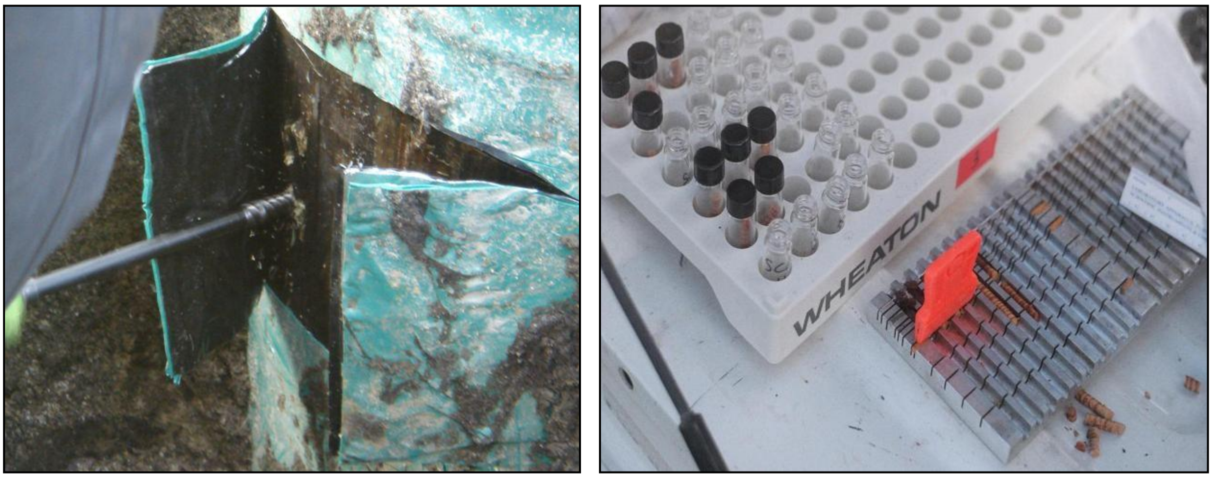
In response to the problem twenty five years ago this writer introduced the Field Liner prototype of the Biotrans Pole Sleeve originally as a simple monolayer barrier protection system (BPS) on the ground contact regions of preserved wooden poles. The hypothesis was that BPS would form an additional hurdle that (a) prevents preservative loss to soil and (b) prevents entry of decay agents from the soil. The first report in the peer-reviewed international scientific press of BPS successfully tested in field trials with creosote-treated and CCA-treated vineyard poles was published in 1993 (Baecker 1993b) and prevention of preservative loss to the soil by BPS was quantified while the exclusion of decay fungi from the poles was also confirmed the following year (Behr and Baecker, 1994). Numerous researchers in accredited institutions worldwide have since confirmed those findings in independent laboratory and field trials with stakes and vineyard poles of various wood species and different wood preservatives (Scheffer and Morrell, 1997; Durrant, 2001; Dearling, 2005; Morris and Ingram, 2005a, 2005b; Howgrave-Graham, Cookson and Hale, 2008).

The first in-service utility pole fitted with a prototype multilayer BPS was installed by eThekwini Electricity in 1994 (**Fig. 1**) and, after successful performance in South Africa was confirmed, BPS were introduced by Seattle City Light (SCL) in 1999. After three years of tests by that utility the BPS was specified in 2002 for use on all poles installed by it thereafter (**App. 1**), and neighbouring Puget Sound Energy Services decided to install poles with BPS in environmentally sensitive areas such as the banks of salmon rivers. Subsequent independent laboratory trials (Morrell *et al*, 2006) and in-field inspections of SCL's distribution lines by the specialist pole unit of Oregon State University (OSU) in 2007 confirmed that poles with BPS that had been in service for eight years were in perfect condition below the ground line (**Fig. 2**). Indeed, this writer was present when all the present photographs were taken and the comment of the widely experienced inspector (Ms. Connie Love, *pers. comm.*, 2007) when the surface of the first SCL pole was exposed for inspection in 2007 was, "I have never seen poles in such good condition below the groundline."

**(a)** **(b)**

**Fig. 1** The first utility pole with BPS was (**a**) installed in RSA by eThekwini Electricity (**b**) in 1994


**(a)** **(b)**




**(c)** **(d)**

**Fig. 2** When utility poles with BPS in Seattle were inspected by OSU pole experts (**a**) after 8 years' service in 2007 all subsoil surfaces of the poles (**b**) were revealed to be in perfect condition. All samples (**c**) were stored in the mobile laboratory (**d**) before transport to OSU to analyse them for preservative retention and moisture content.

On the basis of this writer's South African work since 1993 and that of Durrant (2001) and Dearling (2005) in the United Kingdom the BPS was in 2007 approved nationally for use with preserved wooden poles in the United States (American Wood Protection Association, 2007) and the history of BPS development as a South African invention was reviewed by the writer to provide an outline of the work of the previous two decades in this field (Baecker, 2010).

## Purpose of the Present Report

The objective of this report was to provide motivation to amend the pole specifications of the South African Bureau of Standards to include reference to BPS for augmentation of pole performance. The appraisal of meaningful performance data was therefore of paramount importance.

It is well known in wood preservation research worldwide that field trials evaluated on the basis of samples from stakes and posts in soil test beds provide results that are more meaningful than those of laboratory tests with small test blocks and monocultures of decay fungi in incubators and fungal cellars, but it is also well known that by far the most meaningful performance data in wood preservation is obtained from full sized specimens in actual service. As time has passed since 1994 it has become possible to provide reports on the long term performance of BPS under actual service conditions in South Africa.

This report presents results from full scale installations of utility poles fitted with BPS in service on electricity distribution lines of three municipalities in South Africa, and on an Eskom distribution line in the national grid at Umbumbulu, and also in Seattle's municipal electricity distribution grid.

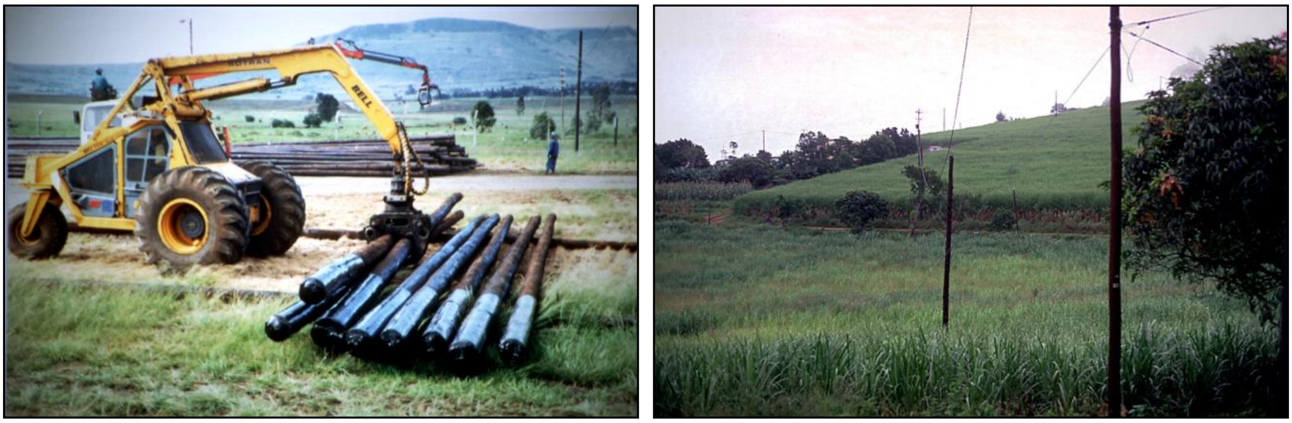
## Installations

All South African installations reported in this report employed *Eucalyptus* utility poles treated with creosote. As mentioned above, since 1994 several thousand such poles with BPS fitted to them have been placed in service in South Africa.

**Commencement**. The BPS prototypes for utility poles were multilayered heat shrink sleeves and they were installed by eThekwini Electricity in 1995 (**Fig. 3**), by Eskom at Umbumbulu in 1995 (**Fig. 4**), and by Ekurhuleni Electricity in 1997 (**Fig. 5**). Several more installations were made by

**(a)** **(b)**

**Fig. 3** Utility poles with BPS at eThekwini Electricity's Springfield pole yard in 1995 (**a**) before installation (**b**) on electricity distribution line in Newlands West, Durban eThekwini Electricity around Durban, by Ekurhuleni Electricity in 1998, and by Eskom on distribution lines at Hotazel and at Hluhluwe in 1999 (**Fig. 6**).



**(a)** **(b)**

**Fig. 4** Utility poles with BPS at Eskom's Vryheid pole yard in 1995 (**a**) before installation (**b**) on electricity distribution line in Umbumbulu

**(a)** **(b)**

**Fig. 5** Utility poles with BPS being fitted (**a**) at Ekurhuleni Electricity's Benoni pole yard (**b**) before installation on electricity distribution line in 1997

**(a)** **(b)**

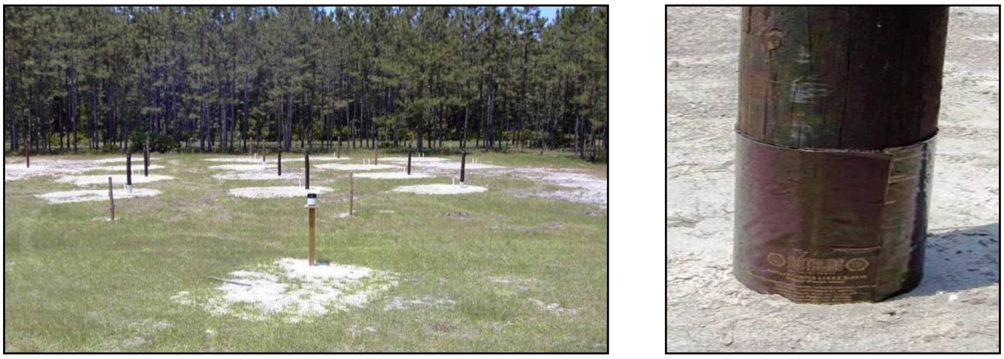
**Fig. 6** Utility poles with BPS at Eskom's Hluhluwe pole yard in 1999 (**a**) before installation (**b**) on local electricity distribution line

**Completion**. After several years of positive results from inspections of the utility poles with BPS at Umbumbulu Eskom requested (Mr. Phil. Crowdy, *pers. comm*., 1998) that ready-to-use BPS be introduced. Ekurhuleni Electricity and eThekwini Electricity each installed distribution lines using strap-on BPS in 1999 and 2000 respectively (**Fig. 7**). The ready-to-use design was finalised

**(a)** **(b)**

**Fig. 7** Utility poles with BPS (**a**) being installed on an eThekwini Electricity distribution line (**b**) in Durban in 2001

in conjunction with that work and also with field trials conducted by the Electric Power Research Institute (EPRI) in the United States of America (**Fig. 8**) when in 2003 the commercially-available wraparound BPS known as the Biotrans Pole Sleeve was introduced with Snohomish Public Utility



**(a)** **(b)**

**Fig. 8** Poles at EPRI test site in Gainesville USA (a) with wraparound BPS in 2003


**(a)** **(b)**

**Fig. 9** Poles with BPS (**a**) being installed on a SNOPUD distribution line (**b**) in Snohomish in 2003

**(a)** **(b)** **(b)**

**Fig. 10** Poles with BPS (**a**) being installed (b) on a KPLC distribution line (**c**) in Nairobi in 2003

Department (SNOPUD) also in the United States (**Fig. 9**), and also with Kenya Power and Lighting Company (KPLC) in Africa (**Fig. 10**). In South Africa, eThekwini Electricity and Buffalo City Electricity were also supplied with the wraparound BPS in 2003 and Buffalo City installed distribution lines using it in 2004.

## Reports

**Seattle City Light.** SCL's Chief Pole Engineer Mr. Brad Combs in 2001 published a report reviewing the utility's work with Biotrans and the BPS and he concluded that a preserved wooden pole fitted with a Biotrans pole sleeve constituted a "Near Perfect Pole" (**App. 1**).

**Eskom, Umbumbulu.** The 300 poles with BPS were substandard ones with creosote retentions of 80 kg.m$^{-3}$ instead of that specified at 130kg.m$^{-3}$ and the penetrations never exceeded 11mm instead of the 16mm specified. They were installed at Umbumbulu alongside standard creosoted poles without BPS as controls.

The poles were inspected by this writer with Mr. Barry Hill of Eskom after a year (**Fig. 11**) and it was found that poles without BPS were leaching their creosote to the surrounding soil with corresponding losses obvious in cores taken from the poles. In contrast cores taken from the substandard poles with BPS showed that creosote penetration in the groundline zone had increased to values ranging between 20 – 22mm. This striking trend continued through subsequent inspections (Behr, Shelver and Baecker, 1996, 1997 and chemical analyses of cores at the 4-year stage showed that the creosote retentions of standard poles without BPS had fallen to levels below 80kg.m$^{-3}$ whereas retentions in the previously substandard poles with BPS had increased to levels over the 130kg.m$^{-3}$ (Baecker and Behr, 2000). This trend progressed and at the 6-year stage some of the previously standard poles without BPS were rotting while the previously substandard poles with BPS were in perfect condition (Baecker and Behr, 2003).

Significantly, Eskom's approved inspectors examined these poles at the 10-year inspection cycle and confirmed that the previously substandard poles fitted with BPS had passed inspection as Class 1 Poles, independently proving that their creosote penetrations had increased over the Specification's minimum 16mm requirement (**App. 2**).

The poles were inspected again at the 15-year stage and those with BPS remained in perfect condition below the groundline (**Fig. 12**) whereas standard poles without BPS were seen to have been replaced.

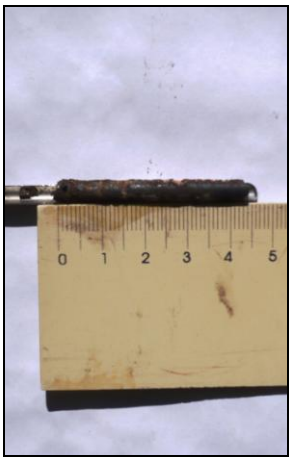
  

(a) (b) (c)

(d) (e) (f)

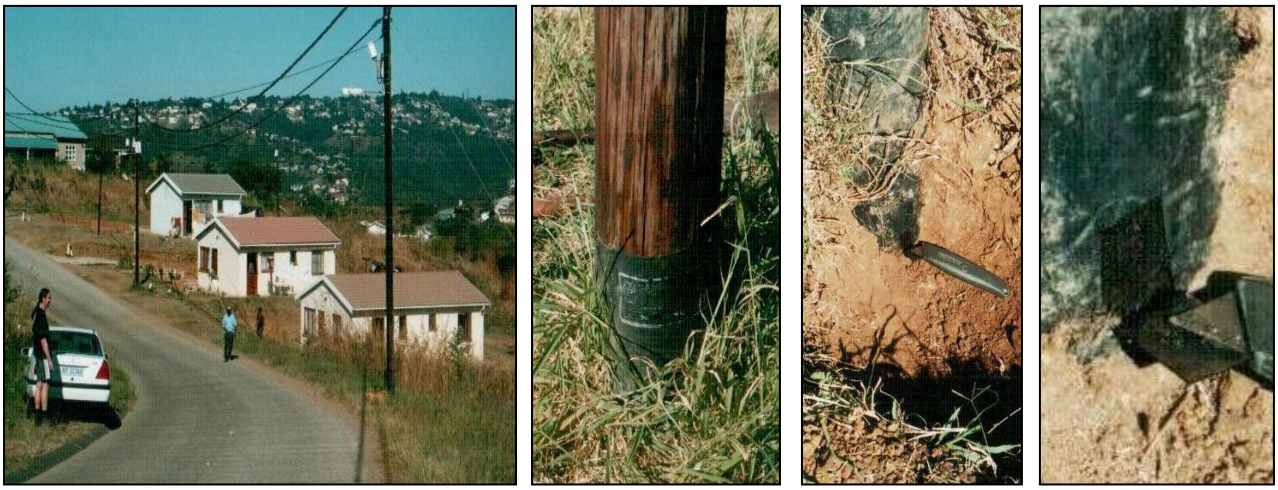
**Fig. 11** Standard pole at Umbumbulu after 1 year's service without BPS (**a**) leached creosote to the soil (**b**) and cores taken from the groundline zone showed corresponding losses (**c**). In contrast excavated substandard poles with BPS (**d**) showed perfect surfaces when inspection windows were cut (**d**) and cores taken from the groundline zones (**e**) showed creosote penetration had increased from 11mm to over 20mm during the first year.

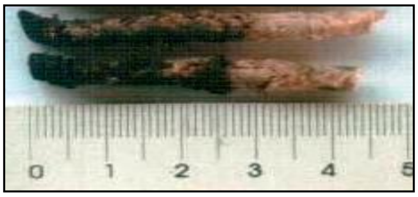
(a) (b) (c)

**Fig. 12** Pole with BPS after 15 years' service at Umbumbulu excavated (**a**) for inspection. Pole surfaces were all free of decay when BPS were opened (**b**) and cores taken (**c**) showed that creosote penetration in the groundline zones of all poles with BPS continued to increase

**eThekwini Electricity** After 6 years' service at Newlands West a line of poles with BPS fitted to them was inspected (**Fig. 13**) in 2002. When sounded by the conventional hammer test all of the poles resonated with the distinctive audible ring that is indicative of sound wood free from



**(a)** **(b)** **(c)** **(d)**




**(e)**

**Fig. 13** A line of electricity distribution poles in service at Newlands West for 6 years (**a**) with BPS fitted to them (**b**). All poles were excavated (**c**) and inspection windows showed all pole surfaces free of decay (**d**). All cores taken showed creosote penetrations (d) of over 25mm

decay. The poles were excavated to examine their subsoil surface areas through inspection widows, and all surfaces were all found to be free from decay. Cores taken from the poles were all within specification and the poles were concluded to be in perfect condition.

In 2004 two poles were extracted for destructive tests and examination after 9 years' service in eThekwini Electricity (**Fig. 14**). One pole had been in service without a BPS on it whereas the other had been protected by a BPS. Again, when sounded by the conventional hammer test the pole with BPS resonated with the distinctive audible ring that is indicative of sound wood free from decay, but the pole without BPS did not.

The poles were sectioned transversely at the previous groundline to examine their creosote distributions. In terms of quantity it was clear that the pole without BPS had significantly less creosote at the groundline than did the pole with BPS. In terms of distribution pattern both poles manifested spotty penetration which could only be attributable to incomplete drying before treatment took place. The surface of the pole with BPS was sound and free from decay however, while that of the pole without BPS was extensively decayed. It was clear that the BPS had prevented the onset of decay in the poorly-treated pole it had been applied to.

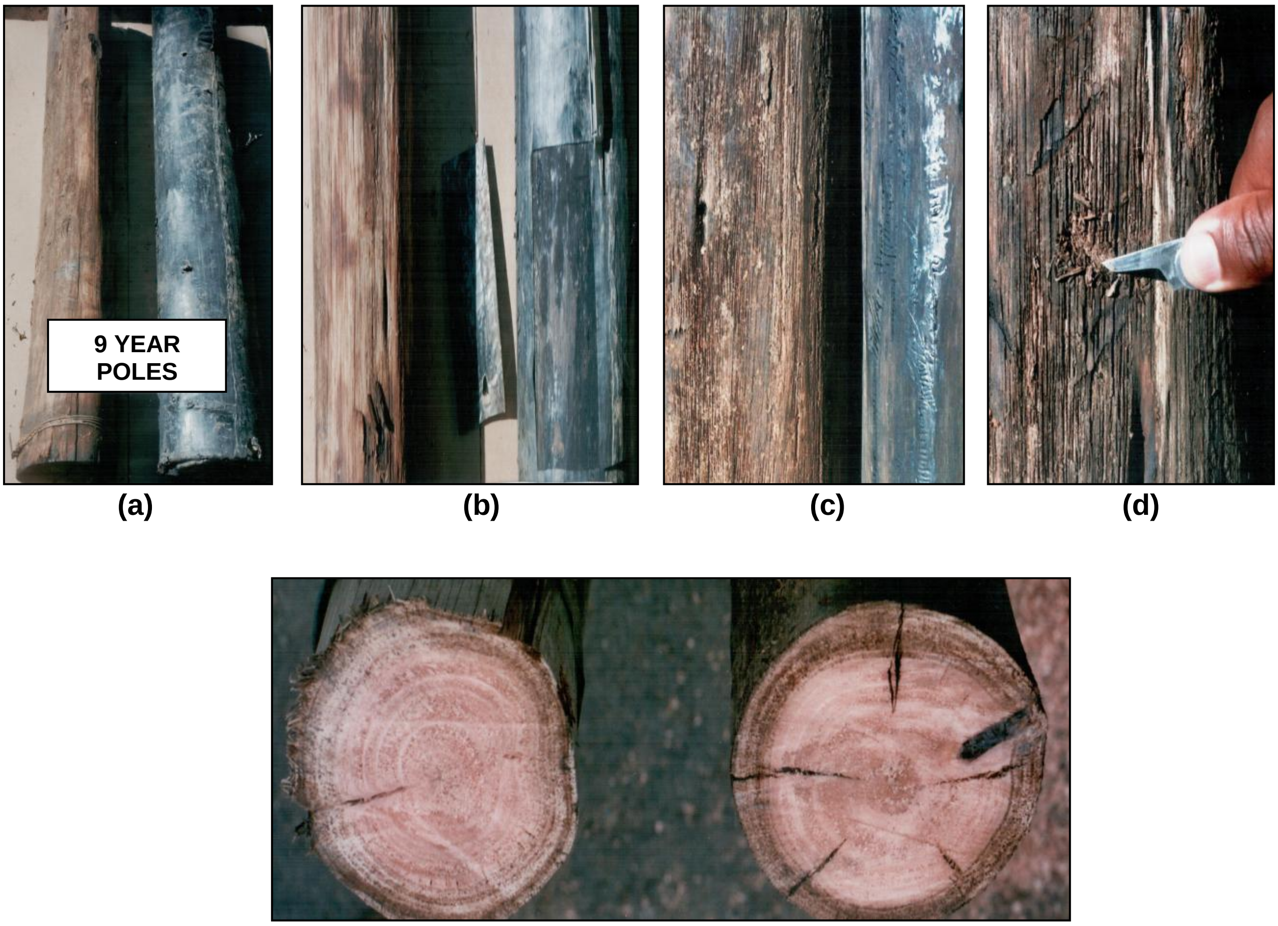



**Fig. 14** The butts of two 11m electricity poles extracted after 9 years' service, one with BPS fitted (**a, right**) and one without (**a, left**). An inspection window (b) revealed the pole surface beneath the BPS was free from decay (**b**) whereas the surface of the pole without BPS was extensively degraded (**c**) in the classical pattern of soft rot (**d**). When the poles were sectioned at their previous groundlines it was clear that the pole with BPS (**e, right**) retained significantly more creosote than the pole without BPS (**e, left**) but it was also clear from the spotty distribution patterns of creosote that both poles had been improperly treated while still wet

**Ekurhuleni Electricity** This writer has never seen the poles in service but on 16th August 2010 the writer discussed progress with BPS performance telephonically with Mr. Chris Day, Senior Engineer Operations at Ekurhuleni Metropolitan Municipality Benoni Branch. Mr. Day confirmed that all poles fitted with BPS and service in Ekurhuleni since 1997 have been inspected and remained sound.

**Buffalo City Electricity** This writer has never seen the poles in service. A report by Mr. Otto Mgoqi of Buffalo City Municipality on the performance of BPS on poles in service in Buffalo City since 2004 is presented in **Appendix 3**.

**Electric Power Research Institute** At the 6-year stage of EPRI's field trials with the Biotrans Pole Sleeve in North America, extensive soil and water analyses showed that no preservative leaching had taken place with poles fitted with the barrier protection system (Ms. Mary McLearn, Senior Scientist at EPRI, *pers. comm*., 2009). The trial remains ongoing but it has been concluded that no leaching findings can be expected from such poles for many years to come.

## Challenge of BPS in Worst Case Scenario

A mistake some scientists make when they perform tests to investigate their hypotheses is that they perform experiments designed to prove that their hypotheses are correct. In science this is a fundamentally incorrect approach bordering on the “cherry picking” methods used by unscrupulous marketers of inferior products when they advertise their products’ positive features and ignore points that might detract from the positive images they seek to portray of those products.

The reality is that scientists should perform experiments designed to disprove their hypotheses, in order to challenge those hypotheses as vigorously as possible, and if they consequently fail to disprove them they are entitled to maintain the hypotheses are correct.

In 2007 BPS were subjected to challenge under worst case conditions. One hundred and eighty four 9m poles were cut from freshly-felled *Eucalyptus* trees and treated with creosote while still

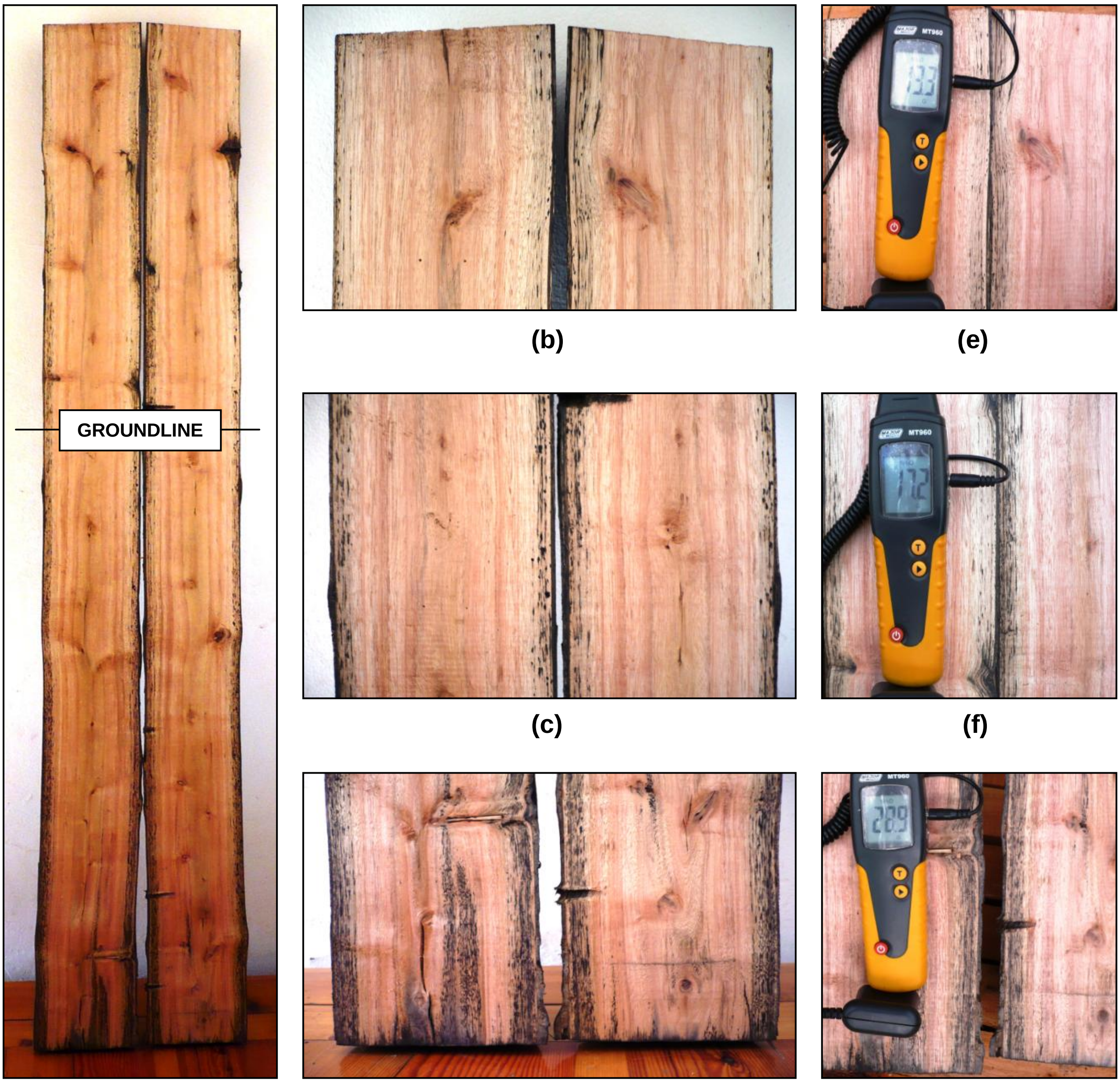
**(a)** **(b)** **(c)**

**(d)** **(e)** **(f)**

**Fig. 15** A telephone line (**a**) of 184 green poles fitted with BPS between Thornville and Pietermaritzburg. After 4 years’ service all poles were extracted (**b**) and stockpiled (**c**) for inspection. When BPS on the subsoil regions (**d**) were opened (**e**) all wood surfaces were sound (**f**) and free from decay.

green at 55 – 60% moisture content. Biotrans Pole Sleeves were then fitted to the poles and they were used to install an overhead telephone line between Thornville and Pietermaritzburg in South Africa. Apart from inoculating the poles with decay fungi before putting them into service it is hard to imagine a more rigorous test of the BPS’s ability to keep a pole sound. The BPS were even punctured during backfilling, and veldt fires burned much of the surrounding vegetation every year. The BPS survived the fires because the flames and heat of such fires exert their major temperature effects well above the groundline. Four years later all the poles were extracted and examined to establish whether the BPS had performed differently from any other cases reported here.

When the BPS were opened the subsoil surfaces of all poles were in pristine condition (**Fig. 15**), free from any form of decay, and the creosoted surfaces seemed fresh to the senses of smell and touch. When the lower ends of the poles were sectioned longitudinally (**Fig. 16**) it was clear that the pattern of creosote distribution was typical of improperly-treated wet wood. Solid penetration never exceeded 3mm and the overall depth of solid plus spotty penetration never exceeded 13mm above the groundline in any pole. However, in terms of BPS performance two striking observations




**(a)** **(d)** **(g)**

**Fig. 16** Longitudinal sections (**a**) of a pole treated with creosote while "green" and put into service for four years with BPS fitted. Creosote distribution was sparse as expected but increased downwards from 1 metre above the groundline (**b**), through the groundline (**c**) to maximum concentration at the butt (**d**). Moisture content of the pole had fallen below 14% above the ground (**e**) to below 20% in the groundline zone (**f**) and below 30% at the extreme end (**g**) of the butt

were made, viz., (**i**) the creosote concentrations in the butts were all greater than above the groundlines and (**ii**) the moisture contents in the butts had fallen from the original levels of 55 –

60% at which the poles were installed to less than 20% at the groundline and less than 30% at the extreme ends of the poles.

The observation that creosote had concentrated in the butts of creosote-treated poles with BPS was totally consistent with all previous studies in this field. The fact that the moisture contents of poles with BPS are lower than poles without BPS is also fairly well-known but the actual reason for that phenomenon is less well-known because the Institutions to date that have proven this fact have all done so in the course of confidential studies for third parties (e.g., studies mentioned at committee meetings in North America when the AWPA approved BPS in Standard AWPA-P20). However, it is now accepted logic that a wet wooden pole with its butt inside an encapsulating BPS in soil is analogous to a flower in a vase of water and transpiration will rapidly deplete the water from the vase or the BPS. This logic explains perfectly the above observations particularly when it is borne in mind that the BPS used were totally impervious to water which could not therefore diffuse into the butts to replace that water which was transpired from the butts to the surrounding atmosphere by the poles.

## Conclusions

Many workers have independently confirmed that BPS protect and extend the service lives of preserved wooden poles in soil. For example, researchers in Australia (Howgrave-Graham, Cookson and Hale, 2008) tested encapsulating BPS designed by this writer with water-soluble alkaline copper quaternary (ACQ) preservative under controlled conditions in accelerated field simulation trials and within three years they made significant findings. The ACQ was applied to *E. globulus* and *E. cladocalyx* merely at Hazard Class 1 retentions and it was established (Howgrave-Graham, Cookson and Percy, 2009) that BPS extended the lives of untreated posts 3.6 fold. In contrast, all the treated posts with BPS remained sound throughout the tests therefore it was "not possible to estimate how much a BPS would extend the life of even a lightly treated post or pole." The workers concluded however that if the extension was the same as for untreated posts, "an H5 pole expected to last 35 years without BPS may last 126 years with BPS at a cost of A$17 less than the cheapest alternative to timber."

Similarly, the ongoing long-term EPRI tests in the United States have also shown over four sampling intervals since 2003 that no detectable levels of any active ingredient losses from any preserved poles with BPS could be measured (McLearn, 2009).

On the basis of the above long-term results with utility poles in service as described in the present report it was therefore unequivocally concluded that the BPS constitutes a means to use preserved wooden poles in clean technology under H4 service conditions as a safe and environmentally preferable choice that guarantees a pole service life of at least the 40 years that municipalities and utility companies desire in the present day green economy. Indeed, in the United States AWPA P-20 specifies that poles fitted with BPS may be treated with preservative retentions less than those specified for H4 in the pole standards, with the only proviso being that the buyer of such poles is fully informed by the seller when such reductions have been implemented.

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## APPENDIX 1 – Reproduced from www.electricenergyonline.com

The Near-Perfect Utility Pole

*Seattle City Light Teams With J.H. Baxter for Environmentally Preferred Utility Pole*

"With the unique combination of the best wood, an environmentally friendly preservative, and the Biotrans Field Liner, we feel we have the near perfect wood utility pole," says Brad Combs, a senior Pole Engineer for Seattle City Light.

If this sounds like a pretty bold statement, don't discount the history of one of the nation's largest municipally owned electric utilities. In the 1970's Seattle City Light was one of the first utilities in the U.S. to use poles treated with Copper Naphthenate (CuNap), a more environmentally friendly, non-restricted use wood treatment chemical. Now, over 20 years later, Seattle City Light is once again at the forefront of the industry specifying Copper Naphthenate thermal butt-treated Western Red cedar utility poles with polywrap liners to help bring power to their 345,000 customers.

Here's the winning combination as Combs sees it — an environmentally preferable preservative chemical, Copper Naphthenate; the most efficient treatment procedure, thermal butt-treatment; and extra reassurance with the poly wrap Biotrans Field Liners. The Biotrans Field Liners are designed to prevent leaching into the surrounding soil by keeping the preservative in the wood, and increase the lifespan of the pole. Seattle City Light uses Western Red Cedar for all poles 60 feet or less. Poles longer than that are full-length treated Douglas fir.

The cedar poles are manufactured, treated and wrapped at J.H. Baxter's treating plant in Arlington, WA. In 2000, Combs presented a challenge to J.H. Baxter and others: "If you can meet AWPA standards for penetration and retention with this product, we'll change our material specification and put a new pole contract out for bid." A pilot project was undertaken at Baxter to determine the feasibility of producing Copper Naphthenate thermal butt-treated poles with liners. JH Baxter was able to meet all applicable standards with this process and went on to become the successful bidder for that contract. "We're pleased and proud to be part of this environmental breakthrough." Says Georgia Baxter, JH Baxter president and CEO.

Although official field tests have not been concluded on the new poles, a great deal of anecdotal data shows positive effects of this new type of pole. Previous poles that were used have decayed more rapidly and have damaged vegetation surrounding them. Copper Naphthenate butt-treated poles have shown no signs of early decay and as a result of the applied liners, vegetation grows right up to the base of the poles, according to Combs.

Combs has done his homework. He rejected the alternate materials of concrete, steel and fiberglass for several reasons, but mostly because of his line crews. "This would turn their world upside down," says Combs, referring to the necessary changes in work practices and needed equipment. "Now we have a pole that we expect will prove to be as inert to the environment as steel, concrete or fiberglass at one-fourth the cost, while linemen are still able to use their normal gear and our equipment and practices stay the same."

"There is every indication that the Cu-Nap butt-treated wood is doing exactly what we want it to do. With the applied liners, the preservatives will penetrate further into the wood over time and therefore increase its durability and lifespan, while remaining extremely safe to our environment," said Combs.

Seattle City Light started with a public vote in 1902 to construct a dam and generator on the Cedar River. Seattle City Light was established as a utility in 1910 by the City of Seattle and looks upon environmental stewardship as a core value. They approved an Environmental Policy Statement early on. The language in this historic document is powerful, naming among their many objectives to "perform beyond strict regulatory compliance" and to "seek the commitment of all employees to environmental stewardship."

## APPENDIX 2

## INDEPENDENT IN-SERVICE RESULTS FROM ESKOM DISTRIBUTION LINES: BPS PRODUCED "SUPERPOLES"

Albin AW Baecker, Biotrans Africa CC

In 1995 Eskom's Distribution Technology (DT) division wanted to install 300 substandard poles on distribution lines at Umbumbulu, KwaZulu Natal. Unknown to this writer, the then Head of the Timber Division at SABS, Mr. Sakkie Burger, refused to approve the use of the substandard poles because instead of having the Standard retention of 130kg/3 creosote they had only 80kg/m3, and instead of having the Standard creosote penetration of 16mm they had only 11mm, and all 300 of the poles would therefore have rotted and failed in service. DT responded that there were no other poles available and requested that approval be given for their use. Also unknown to this writer, Mr. Burger had read about the Biotrans Pole Sleeve (BPS) and he consented to DT's use of the substandard poles providing BPS were fitted to them. The first time that this writer heard of the situation was when DT thereafter contacted his company to fit BPS to the 300 poles, which was done when they were installed alongside Standard non-BPS poles in distribution lines at Umbumbulu at the end of 1995.

After one year's service this writer and DT together inspected the BPS poles and found that creosote penetrations and retentions in the critical ground line zones had increased. This trend continued into the 2-year, 4-year and six-year intervals, by which time period all of the 300 previously-substandard poles had creosote retentions and penetrations that exceeded those specified in the National Standard. These findings were published as formal Documents at the annual meetings of the International Research Group on Wood Preservation (IRG) and as journal articles in the mainstream scientific press.

In 2005 two of the Umbumbulu distribution lines containing BPS poles were then independently inspected by Eskom-approved pole inspectors and those findings confirmed that all but one of the previously-substandard BPS poles had become Class 1 poles (i.e., they were within Specification and required no remedial treatment) during the ten-year inspection cycle. Specifically, **Fig. A** shows the analysis of the inspectors' results for the Richmond Beaumont NB 63 distribution line, which had 907 non-BPS poles and 28 BPS poles in it. The overall failure rate of this line was 3%, all of which poles were previously Standard non-BPS poles. In contrast, **Fig. B** shows the analysis of the same inspectors' results for the Richmond Beaumont NB 22 LV distribution line, which had 110 non-BPS poles and 190 BPS poles in it. The failure rate among the previously Standard non-BPS poles was the normal 3%, however the overall failure rate of the whole line was only 1% because approximately two thirds of the poles in it were BPS poles that had become Class 1 poles during the ten year service period. These findings prove categorically that BPS usage slashed the normal pole failure rate when mixed with non-BPS poles, in spite of the fact that the non-BPS poles were all Standard ones while the BPS poles were all substandard ones when the distribution lines were erected in 1995.

In 2009/10 the present writer again visited the Umbumbulu distribution lines and reconfirmed these findings at the 15-year interval. Eskom therefore has distribution lines in service that categorically prove that BPS-usage produces "superpoles" from substandard poles when the creosote migrates downwards and soaks into previously-untreated internal wood when its loss to the soil is prevented by the BPS.

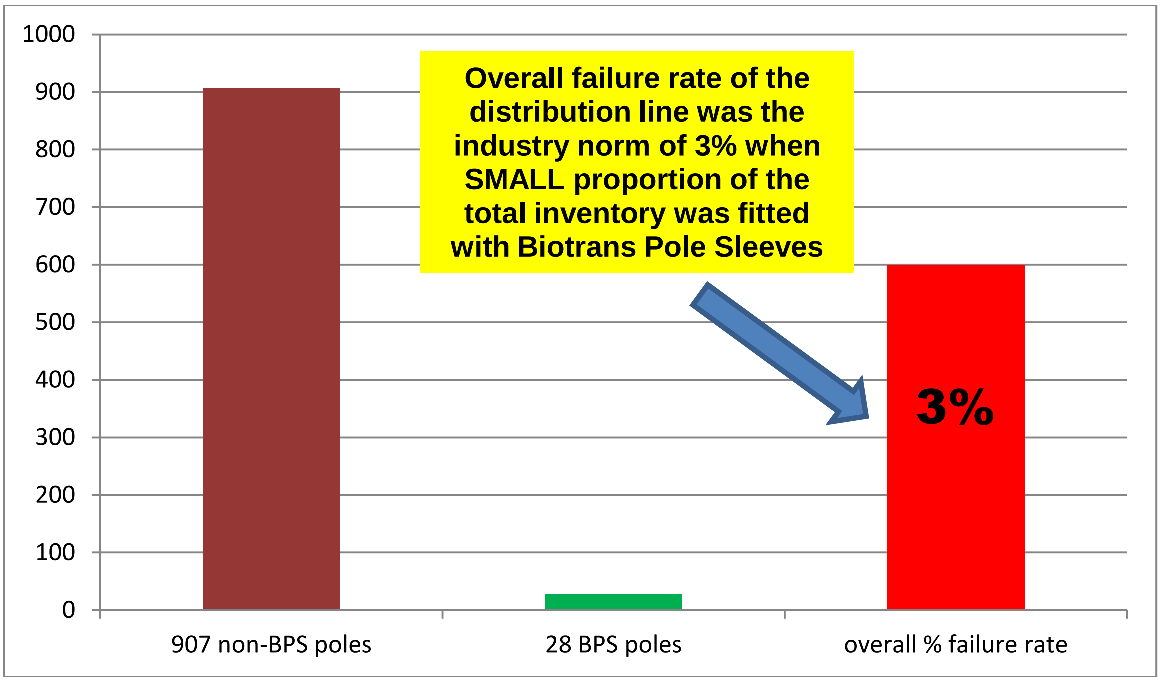


**Figure A:** Eskom-approved inspectors' findings in 2005 on Richmond Beaumont NB 63 distribution line after 10 years' service: overall failure rate among all 935 poles was 3% (although the failure rate among the 28 BPS poles was 0%)

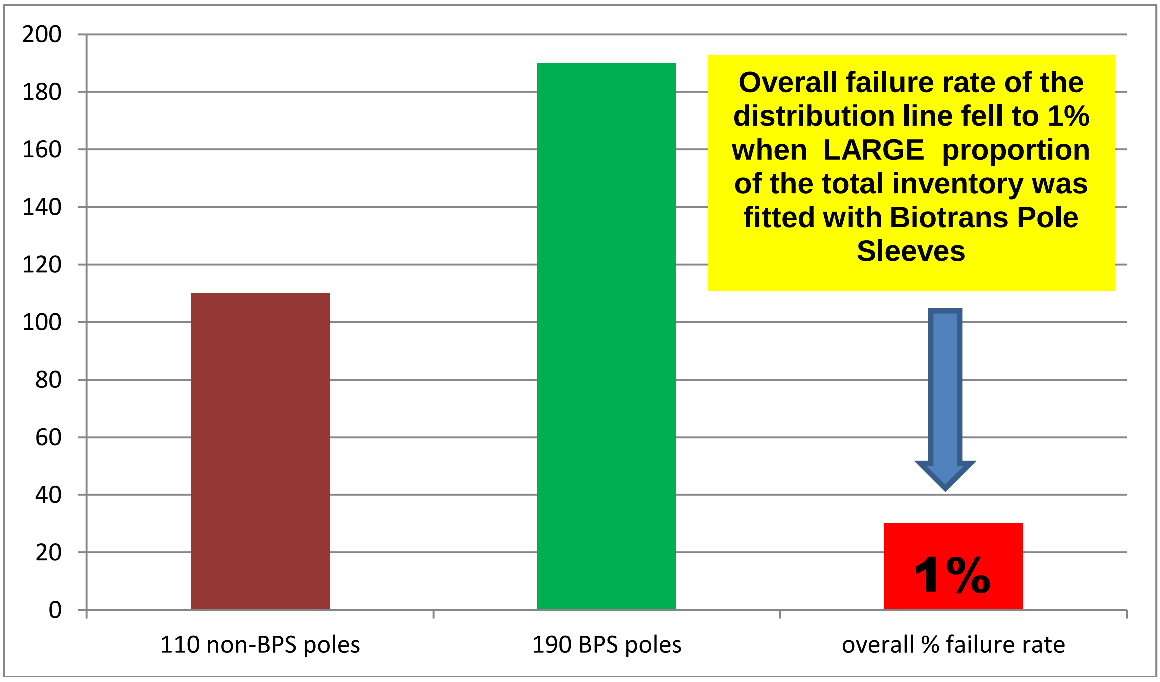


**Figure B:** Eskom-approved inspectors' findings in 2005 on Richmond Beaumont NB 22 LV distribution line after 10 years' service: overall failure rate among all 300 poles was 1% (although the failure rate among the 110 non-BPS poles was the normal 3% while among the 190 BPS poles only 1 of them had not become a Class 1 pole)

## APPENDIX 3 – Report from Buffalo City Electricity

**From:** Albin A W Baecker [mailto:albin@biotrans-uk.com]
**Sent:** Wednesday, September 08, 2010 11:49 AM
**To:** Jean Smit
**Cc:** Johan Olivier; Otto Mgoqi
**Subject:** RE: pole sleeve follow-up

Dear Mr. Smit, Thank you for your reply. Dear Mr. Mgoqi,

I would be most interested in learning how the pole sleeves delivered to you in 2004 have performed in your routine inspections since then, and I am presuming you are the correct person to ask? If so, I would be very grateful to hear from you in this regard and I would like to thank you now in anticipation of your message.

Looking forward to your reply,

Albin Baecker
Biotrans Africa

**From:** Otto Mgoqi
**Sent:** Monday, September 13, 2010 16:10
**To:** Albin Baecker
**Subject:** RE: pole sleeve follow-up

Hi Albin

Find this positive results below from the superintendent responsible with overhead lines. Regards.

Otto

**From:** Sisa Duna
**Sent:** Monday, September 13, 2010 3:52 PM
**To:** Otto Mgoqi
**Subject:** RE: pole sleeve follow-up

We did this request and the result are good

The condition of those poles with muti sleeve is good