LABOR ANALYSIS

COMPRESSION VS. IMPLOSIVE DEADENDS

This report prepared for

AEP
AMERICAN ELECTRIC POWER

and

IMPLO TECHNOLOGIES INC.

Compiled by

Canadian Lineworks Inc.

JULY 20, 2005

LABOR ANALYSIS
IMPLOSIVE VS. CONVENTIONAL DEADENDS

PURPOSE:

This report has been prepared by Canadian Lineworks Inc., a consulting firm based in Edmonton, Alberta. Canadian Lineworks Inc. has produced this report at the request of Implo Technologies Inc. for American Electric Power. The purpose of this report is to present a list of job tasks associated with the operation of deadending 795 MCM ACSR conductor, comparing the conventional compression method with the implosive connection method. The report shows how the operation may be performed with implosive connectors without additional equipment and without disrupting work patterns and practices already in place. Additionally, this report shows that implosive deadends are cost effective and require less labor to install. The steps involved in deadending conductors are outlined in detail, comparing both methods, along with comments about possible differences in the steps outlined, and case studies of deadend usage by previous contractors. This report is based on the structures and conductor configuration of the new 765 KV line which AEP is constructing in West Virginia and Virginia.

JOB TASK OUTLINE:

It is assumed that the conductor is 6 bundle 795 MCM ACSR and that the contractor will work on one bundle at a time. It is also assumed that the working crew will have 2 man baskets and 4 men working aloft, with one basket on each side of the structure. The wire is to have been previously sagged, and the only job at hand is the cutting of the deadend.

STEP #1 (CONVENTIONAL AND IMPLOSIVE):
The wire first needs to be measured and marked for cutting. This is usually accomplished by the use of a wire square, and is measured from the pinning point on the tower. This step is exactly the same for both types of deadends, although the difference in length between compression and implosive deadends must be ascertained in order to get the right measurement.

STEP #2 (CONVENTIONAL AND IMPLOSIVE):
The rigging is installed on both sides of the tower. This will probably require the use of 6-ton hoists, depending on the sag tension. Rigging must be installed on all 6 conductors, on both sides of the tower, therefore requiring the use of 12 sets of rigging. This step is identical for both types of deadends. In the case of implosive deadends, however, it is recommended that the rigging be 4 - 6 feet longer than for conventional rigging, which is simply a matter of taking longer steel slings, an item already in use.

STEP #3 (CONVENTIONAL AND IMPLOSIVE):
The conductor is cut to length. This is a simple operation. The wire is cut with the cutters on the mark that was made earlier. This task is identical in both cases.

STEP #4 (CONVENTIONAL AND IMPLOSIVE):
The conductor is prepared by measuring the length of the steel insert and trimming the aluminum stranding back to fit. This step is identical for both types of deadeands, although it should be noted that the trim length is specific to each type of deadend and must be checked if changing types.

STEP #5 (CONVENTIONAL):
The aluminum body is positioned to slide over the conductor, and the steel body is positioned over the exposed steel, and then compressed steel using the hydraulic press.

(IMPLOSIVE):
This is the first step where the process diverges. With the implosive deadend, the steel spring sleeve slides over the exposed steel, and the aluminum filler tube slides over the steel spring. The implosive deadend body slides over the entire assembly until it bottoms out. The edge of the deadend is then marked on the conductor. No hydraulic press is required. The process is repeated for all 6 conductors, on both sides of the tower.

STEP #6 (CONVENTIONAL):
The aluminum body is positioned to slide back over the compressed steel sleeve. Filler compound is installed and the hole is corked.

(IMPLOSIVE):
Blasting caps are installed on the deadends, using electrical tape. Using rope slings, all the deadends are tied in a horizontal position, keeping each at a 3 foot radius from each other and from any rigging.

STEP #7 (CONVENTIONAL):
The dies in the press are changed and the aluminum deadend bodies are compressed.

(IMPLOSIVE):
A final check of marks and rigging is carried out. The manlifts are brought to the ground and the implosion is initiated.

STEP #8 (CONVENTIONAL AND IMPLOSIVE):
Insulators are installed, and the deadends are cleaned and pinned.

STEP #9 (CONVENTIONAL AND IMPLOSIVE):
All the rigging is removed and brought to the ground.

POSSIBLE PROCEDURAL DIFFERENCES:

It is possible that some job steps may overlap and not occur exactly in the order described herein. The fact remains that all the steps must be completed before the deadending process is finished. For example, insulators are sometimes installed at the same time as the rigging. Some linemen may choose to press all the steel cores in a bundle before pressing aluminum, while others may prefer to complete one conductor before moving on to another. These minor differences are negligible and may occur during either method of deadending.

INSTALLATION TIME COMPARISON

Seq	Description of Operation	Conventional	Implosive
1	Measure and mark conductor in preparation to cut.	0.5	0.5
2	Install rigging. (12 – 6 ton hoists)	1.0	1.0
3	Cut conductor to length.	0.5	0.5
4	Prepare conductor. (trim aluminum back)	0.75	0.75
5	Slide aluminum body over conductor, and compress steel sleeve.	2.0	
	Slide deadends on 12 conductors and mark the edge.		0.25
6	Slide aluminum body over steel and install filler compound.	0.5	
	Install blasting caps and rope deadends horizontal.		0.25
7	Change dies, and press aluminum body.	2.25	
	Bring the manlifts to the ground and initiate implosion.		0.25
8	Install glass, clean and pin deadends.	1.5	1.5
9	Remove rigging.	1.0	1.0
	TOTAL	**10.0**	**6.0**

TABLE OF INSTALLATION TIME COMPARISON:

The Installation Time Comparison table shows estimated average task completion times for conventional and implosive connectors. The times shown are based on dialogue with several crew foremen as well as on documented actual complete installation times for similar jobs performed by other contractors with similar equipment. The times shown are projected per bundle on 6-conductor bundle 795 MCM ACSR. To estimate conductor deadend times for the job under consideration, these figures must be multiplied by a factor of three. *This report projects 30 hours per tower using the conventional method, and 18 hours when using implosive connectors. This is a saving of 12 hours per tower using implosive deadends.*

CASE STUDIES:

CASE #1:
Midlite Construction was contracted to build a 260KV line from 848S Ruth Lake to Syncrude D05, approximately 50 km north of Fort McMurray, AB, Canada. The project was started in September 2004 and was completed in February 2005. The line was double circuit, conductor size .795 Drake ACSR. During the project, wire was pulled through tower 12, a deadend, and pulled up to sag. The implosive deadends were installed on tower 12 on December 14, 2004. On that morning, a 7-man crew with 2 baskets was assigned to install the deadends, a job similar to one bundle as described in this report. The men were working aloft by 7:30AM. The implosion was recorded in the blaster's logbook that day at 10:25. By 12:00 pm, the insulators were installed and the crew was looking for another task. It is important to note that this particular crew had been working with implosive deadends for 3 weeks prior to this particular tower. However, the fact remains that *they completed the job in just 4 ½ hours*.

CASE #2:
In October of 2004, Par Electric sent an 8-man crew to install a new tower in an existing line 20 miles north of Fort Dodge, IA. The line was a double circuit with 345KV on one side and 161KV on the other. The 345 was bundled, and the 161 was single conductor. The conductor size was .795 Drake. The work was being done for Mid-American Energy, and they supplied Fargo compression deadends. The general foreman reports that after the tower was erected, it took 20 hours for 8 men and 2 man baskets to both cut the deadends and install jumpers. He further estimates that it took approximately 6 hours to install jumpers, which means that *it took 14 hours for an experienced crew to install compression deadends on 9 conductors.*

CASE #3:
Hydro One, a utility in Ontario, regularly utilizes XECONEX™ implosive deadends during scheduled maintenance. Hugh Crockett, a transmission superintendent for Hydro One reports: "To replace a deadend with an implosive deadend takes us approximately 30 minutes. If we were to do the same job using compression fittings, we are looking at 3 hours."

JUMPER TERMINATIONS:

Although not necessary, it is recommended that implosive jumper paddles be used with implosive deadends. There are two main reasons for this. Firstly, this eliminates the need to carry a 65-ton hydraulic press around for making jumpers. Secondly, it saves time. Typically, jumpers are partially built on the ground and then field fitted. It is difficult to assign construction times to jumper construction because there are many variables, not the least of which are the number of crew members involved and the equipment available. However, from previous experience, 2 people can cut and install paddles on one end of 18 conductors in an hour using implosive paddles. That would be at least a 3-hour job using a hydraulic press. In the air, it is a very easy operation, simply because the workers work with rope instead of juggling a press head. Two hours per bundle is reduced to ¾ of an hour using the implosive connector method. Therefore, *it may be assumed that jumpering a tower using conventional methods could take approximately 9 hours, while the use of implosive paddles will cut the job down to as little as 4 hours. This is a saving of 5 hours, or half a day.*

CONCLUSION:

On any job, the saving of more than a day per deadend tower is attractive for even a single tower, but becomes even more so on a large job where there may be over 100 deadend structures. The savings could add up to months of time, not only in man-hours and associated costs, but also in project control and scheduling, with successful management of completion deadlines. There is also a substantial savings in the time required to install jumpers.

The heavy equipment, including hydraulic press, dies, generator, lifting equipment, used for the installation of conventional fittings is not required for implosive fittings. Equipment is inherently prone to unexpected breakdown, repair and regular maintenance, all of which add to labor costs and possible project delays. The implosive fitting is not burdened by these added costs as it does not require any equipment for installation.

It is clear that the use of implosive fittings, in this case for deadend joints, is the preferred alternative for ensuring time savings. Although not within the scope of this study, the implosive connector is known to provide a better compression than other types of connectors, having superior electrical and mechanical performance ratings. As well as having high process consistency, the implosive fitting is also the preferred alternative from a performance perspective.

This report compiled and produced by

Canadian Lineworks Inc.

Canadian Lineworks Inc.

Kandus MacMillan
General Manager
Ph:780-598-3937
Fax:780-790-2030
Email: kandusm@canadianlineworks.ca