Labour Comparison Study

Hydraulic Compression vs. Implosive Connectors

Deadends and Jumper Installation

Project: Nevada Power 500kV 3 bundle 1590 Lapwing ACSR

Contractor: InfraSource Transmission Services Inc.

BACKGROUND:

This study endeavoured to quantify the difference, if any, of the amount of total labour required when comparing implosive connectors and compression connectors used on a typical project involving the installation of deadends and jumper terminals.

In the powerline construction industry, it is not easy to precisely calculate the cost of labour or the savings in labour that can be attributed to the use of any one particular technology or operating practice over another. This is due to the multitude of variables that affect any particular task or job function on any particular tower structure. These variables may relate to any number of items such as environmental factors, management style, operating practices, personal skill levels, interpersonal dynamics within workgroups, materials, equipment used, etc. Therefore, in order to properly compare the labour content of the two connector types, it was necessary to carry out a study in a manner that minimized the variation between the compared elements to the extent possible.

A SPECIALIZED CONSTRUCTION TECHNIQUE WHICH COULD REDUCE LABOUR REQUIREMENTS

PURPOSE:

This study sought to quantify the difference, if any, of labour costs between implosive connectors and the corresponding conventional hydraulic connectors in deadend installations and in jumper installations.

COMPARISON:

In order to quantify the difference in labour content between two different deadending methods, this study monitored each of the two methods under conditions as similar as possible, given that every installation on every tower on every project is different to some degree. To minimize the variation, the comparison in this study was made on the same powerline job, on the same conductor, and using the same crew, and the same equipment.

THE JOB:

The study was carried out on the Nevada Power 500KV construction project near Las Vegas. The contractor working on the project was Infrasource Transmission Services Inc. of Arizona. The conductor was a 3 bundle 1590 Lapwing ACSR, attached to the towers at a height of approximately 65 feet. The contractor had prior experience with the installation of implosive full tension joints, but had no experience with the installation of implosive deadend connectors. Implo Technologies Inc. carried out the study.

VIEW OF THREE TANGENT TOWERS ON THE JOB TO BE

PROCEDURE:

Two tower structures were chosen for observation. One tower was completed (dead-ended and jumpered) using only compression fittings, while the other tower was completed using only implosive fittings. The observation consisted of documenting the time and labour required for the complete installation of the connectors on the tower, as well as the number of crewmembers working on the installation and any general installation practices that might be pertinent to the study, such as equipment usage, and possible problems that might contribute to increased costs. The aim was to make a fair and reasonable comparison between the two types of connectors from a labour savings perspective.

GENERAL CONDITIONS:

The transmission line under study was being constructed in the Nevada desert, where temperatures in the 95ºF to 105ºF range prevail. Due to environmental concerns, access by road was limited, making only one access roadway available at each tower structure location. Adding to the difficulty was the rugged topography of the local terrain, which compromised access to some degree. The new circuit was installed horizontally in some sections of the line and vertically in others. The access to both of the structures observed in this labour study was good, removing any variation in installation that might be due to physical accessibility.

NEVADA DESERT AS SEEN FROM THE RIGHT-OF-WAY

THE CREW:

The installation team was comprised of 6 crew members, each of them a professional lineman with considerable field experience. Of this 6 person crew, 3 were journeyman linemen, and 3 were operators or apprentices. This crew had installed many deadend connectors of the hydraulic compression type on this particular transmission line prior to the study, but had no experience whatsoever with the installation of implosive deadend connectors.

THE CREW AT WORK

INSTALLATION OF COMPRESSION CONNECTORS:

INSTALLING COMPRESSION DEADENDS

Tower "A" was the tower structure upon which the compression deadend connectors were installed. This tower had horizontal conductor. Only one side of this tower structure was observed in this study. The compression connectors were manufactured by Alcoa, and were of the one-piece "Unigrip" design. All the conductor was sagged and marked. Rigging was installed prior to this study. The 6 person crew installed the deadends on one side of the tower structure using a 1 man-lift in a total of twelve hours. Since the two sides of the tower are identical, it was reasonable to conclude that it would take the same amount of time to install the same deadends on the opposite side of the tower to complete the deadending operation. The contractor reported that the crew required another full twelve-hour day to install the jumpers and finish the structure completely. **Therefore, 3 full days was required to complete a deadend structure, with no intervening problems.**

The crew reported that this observation represents an error-free installation. As such, this is the best that a compression installation can achieve. Based on field experience, the crew reported that a large

INSTALLATION OF COMPRESSION CONNECTORS (cont'd):

conductor size such as this will impose a heavy load on the hydraulic press equipment. Typically, after completing 6 structures, the equipment would become worn out, needing repair or replacement. This would add to the time and labour required for installation of the compression connectors. Moreover, if repair were to be required at an unplanned time, the risk of a full shutdown would be higher, as the crew would be forced to wait idle for replacement equipment.

INSTALLATION OF IMPLOSIVE CONNECTORS:

Tower "B" was the tower on which implosive connectors were installed. This tower was of the vertical construction type. This structure was used as a demonstration for Nevada Power, and to complete the demonstration in the requested time frame, the contractor doubled the crew size, which would not have been necessary other than for this reason. A 12 person crew and 2 man-lifts were used to do the job. The implosive connectors were manufactured by Implo Technologies, identified as catalogue numbers 2072 and 3072 for deadends and jumper terminals respectively. The rigging conditions were the same as the conditions on the compression structure, namely, the rigging was all installed and the conductor was marked. The 12 person crew, using 2 man-lifts, installed all the deadends on the structure, and prepared one end of all of the jumpers in a total of three hours. The crew took an additional hour to remove the rigging, and 2 more hours to complete the structure. This is a total of 6 hours for 12 persons. **Therefore, to make the observations comparable, it can be concluded that 6 men and 1 man-lift, can complete an entire structure in twelve hours, or 1 day.**

COMPARISON:

This study shows that the use of implosive connectors reduces the labour content and time required to dead-end a tower by two-thirds. A reduction of 66% in labour and equipment time was achieved by using implosive connectors instead of compression connectors in this study. The crew completed the dead-end structure in a single 12-hour day using implosive technology, while using conventional technology, they required three 12-hour days to complete the same job.

LIMITATIONS:

Variations in local field conditions could not be totally eliminated, but they were not substantial enough to meaningfully affect the observations or the outcome of this study. Local ground conditions are always different in some way or other at every tower structure at every location. In this study, one tower structure was of horizontal construction, while the other of vertical construction. Moreover, it was necessary to use two different crew sizes, as a crew of 6 persons was used for the tower receiving the compression connectors, while a 12 person crew was needed for the tower receiving the implosive connectors.

Another variable is the difficulty in predicting equipment failure, or the need for unplanned repair during the job, which could affect one task execution but not another, thereby possibly skewing the observations. In this study, there was no equipment failure or maintenance. However, experience shows that these factors are very real in every installation. Consequently, it is reasonable to conclude that a labour content allowance must be added to a compression connector installation to allow for equipment use and maintenance. This is not required in any implosive connector installation. This fact improves the labour savings of implosive connectors over compression connectors even further in any typical installation project involving more than a few towers.

A very important consideration is crew experience. In this study, the crew was very proficient at installing compression connectors, but had never used implosive deadends before this study. Therefore, it is reasonable to conclude that the time and labour needed to install implosive connectors can be further reduced as the installation crew gains experience with the implosive installation process. This fact further improves the labour savings of implosive connectors over compression connectors.

CONCLUSION:

Implosive connectors are installed in 1/3 the time required to install the equivalent number and type of compression connectors in a tower deadending operation. Although every installation job is different, and all tower structures are different, it is reasonable to generalize this conclusion to virtually every tower deadending operation.

Further studies and observations could be performed under various conditions to refine these findings further, and using an experienced crew that is equally familiar with both compression connector installation methods and with implosive connector installation methods could be used to remove some variability and improve the accuracy of these results.

ADDENDUM:

Upon completion of this study, the contractor reported that it now, having experience with both types of connectors, prefers the implosive deadend connector to the compression one. The contractor intends to abandon the use of compression connectors and to adopt implosive deadends and jumper terminals for all the remaining tower structures on this powerline.

The contractor also reported that the same 6 person crew, now having further experience with implosive deadend connectors, routinely completes a deadend tower structure within 10 hours, reducing the former 12 hour installation by 2 hours, by using implosive connectors. This increases the time leverage even further, giving the implosive connector a 75% faster installation time over the equivalent compression connector, with a corresponding 75% reduction in labour content. In this particular powerline project, the time required for deadending and jumpering a tower was reduced from 36 hours to 10 hours by using implosive connectors.