“High Temperature Current Cycle Test of Implosive Connectors on ACSS Conductor”

C. Pasini, H. Sildva, G. Gorja, Z. Peter

Abstract – **This paper presents the results of a test to analyze the performance of implosive connectors on ACSS (Aluminum Conductor Steel Supported) conductor in a high-temperature environment. A 500-cycle high-temperature current cycle test at 250°C above ambient temperature was carried out on ACSS 1,113 kcmil Finch conductor using implosive full tension joint, dead end and jumper terminal connectors. A total of 15 connectors was tested. This paper discusses the methodology used and presents the results observed. The positive results of this test support the use of implosive connectors in high temperature applications and provided the rationale for continuing the test for an additional 500 cycles for a total of 1000 cycles, the results of which will be reported in a future paper.**

Index of Terms- **connectors, conductors, aluminum conductors, thermal factors, resistance, temperature**

I. INTRODUCTION

THE steadily rising demand for electricity throughout our society in recent decades has outpaced the capacity of utility companies to supply power in a consistently reliable manner. This deficit has placed an ever-increasing burden on many existing transmission lines. Further, while consumption of electricity has increased, environmental restrictions and other considerations have constrained the ability of utility companies to build new lines to supply this growing demand.

The effect is an electrical infrastructure that has not kept pace with our demand for electricity. This is placing new and unprecedented loads on existing transmission systems and is creating new challenges for utilities that push the limits of available technology.

One of the challenges facing utilities is the increasing trend to higher operating temperatures of transmission lines. As the demand for power rises, the electrical current flowing through the lines increases, which raises their operating temperatures to levels higher than they were designed to accommodate. When a transmission line operates at higher temperatures, a number of adverse effects arise. Such effects might include the line becoming less efficient as electrical energy is lost to heat or the line becoming more dangerous as it sags in excess of ground clearance standards. And the various components of the line may become increasingly prone to failure due to heat-induced complications.

In particular, connectors, which are arguably the most important component of any transmission line system, are at risk of accelerated aging. They are responsible for the crucially important task of holding the entire transmission line together, namely maintaining mechanical and electrical integrity at the inherent discontinuities between adjacent sections of a conductor. But prolonged exposure to high temperature can cause a number of harmful effects in a connector such as an increase in electrical resistance causing “hot spots” within the connector, rapid degradation of inhibitor compounds inside the connector, softening of the aluminum, and other effects that consequently reduce the gripping strength of the connector. Eventually, the connector may deteriorate towards ultimate catastrophic failure.

Since connectors are critically important in maintaining the integrity of the electrical grid and since it is often very difficult to predict the failure of a connector, some utility companies are replacing them in a preemptive attempt to forestall premature failure and thereby safeguard their lines.

The newly emerging high temperature environment is now highlighting the need to develop connectors and connector standards that would provide utilities with reliable connecting technologies as they evolve towards higher temperature practices. The test described in this paper is a small step towards understanding this need, as it provides data on the effects of high temperature on the thermal, electrical and mechanical performance of implosive connectors.

II. THE CONDUCTOR

The challenges of the new high-temperature environment have also spawned new technologies that offer practical alternatives to utilities in their quest to supply reliable power to customers. New conductors have been developed that have the capability of carrying greater amounts of electrical current and operating at higher temperatures. One of these is the

Aluminum Conductor Steel Supported (ACSS) conductor. This conductor is designed to carry more electricity and operate at temperatures higher than those of conventional conductors. By comparison, the conventional Aluminum Conductor Steel Reinforced (ACSR) conductor is designed to operate at a normal operating temperature below 100°C, with peak ability to withstand exposure to 125°C for short periods of time [1], while the ACSS conductor can be exposed to temperatures up to 250°C without significant degradation of its essential properties.

To the untrained eye, ACSS and ACSR conductors look the same. Both have outer strands of aluminum 1350 alloy wrapped around several inner steel core strands. The essential difference between the two is that the aluminum alloy used in an ACSR conductor is hard drawn, while in the case of ACSS, it is a softer alloy and already annealed. Another difference is that the steel strands in the ACSS conductor have a higher tensile strength than standard steel core wire.

The performance of a conductor is the combined result of the electrical and mechanical properties of its components. Although ACSR and ACSS conductors are made with similar materials, their electrical and mechanical properties are quite different because of the combined effect of their aluminum and steel components. When an ACSR conductor is exposed to higher temperatures, it begins to anneal, which weakens the aluminum and along with it, the conductor. This can cause excessive sag and under severe climatic conditions such as high winds or ice loading, may even result in breakage. Therefore, ACSR conductors generally cannot be allowed to operate above their design temperatures.

The ACSS conductor, on the other hand, is comprised of aluminum strands that are already annealed, and since this conductor relies more on its steel core stranding for strength, it is able to tolerate continuous higher temperatures without compromise to its overall strength or sag properties. Several manufacturers are developing connectors for these higher temperature conductors, but the challenge of maintaining mechanical strength and integrity remains a fundamental pursuit. The emergent challenge is to find a connector technology that will perform reliably for the full life expectancy of the ACSS conductor operating at the higher temperatures for which it was designed.

III. THE CONNECTOR

While conductors have evolved towards higher temperature operation, connectors and connector standards have not kept pace. There is presently no ANSI (American National Standards Institute) or IEEE (Institute of Electrical and Electronics Engineers) industrial electrical standard in place for high-temperature connectors. ANSI 119.4-2004 [2] is the standard for conventional High Voltage connecting technologies but it does not address the high temperature scenario. An initiative to develop new standards for high temperature connectors is underway, led by a joint NEMA (National Electrical Manufacturers Association) and ANSI working group, known as ANSI 119.7, but this is yet a long way from being approved for practical use by utilities. To advance the front, some utility companies and independent test laboratories are evaluating high-temperature conductors and connectors on their own.

A connector is designed for the sole purpose of providing continuity at the point where two conductor lengths are joined. This task becomes particularly challenging in high temperature situations partly because thermally induced complications are the most severe at discontinuities, such as the interfaces between components and between material surfaces. High temperatures promote the accumulation of non-conductive materials at the contact points where electricity flows from one surface to the other. As temperatures rise, existing contact points become blocked by these materials and new contact points develop as current seeks out easier pathways. This creates a constantly changing landscape within the connector as new contact points open and existing ones close. Eventually the connector no longer has enough workable surface area to develop clean new contact points and current is forced to flow through the non-conductive areas, causing temperature and resistance to rise. This process is known as thermal “aging” [3].

The hydraulic compression connector is one of two basic methods for joining high voltage transmission conductors and has been in use for a very long time. This type of connector is generally made of a soft alloy so that a compression die can deform it and crimp the conductor. But this method has only a limited amount of energy available, meaning that its ability to deform the strands of a conductor to produce a good electrical and mechanical connection is also limited. The compression process itself is slow, which allows the material of the connector to flow in all directions, including longitudinally as well as inward towards the conductor.

The other method for joining high voltage transmission conductors is the implosive connector. This type of connector has now been in use for over three decades. It is made of high strength, hard aluminum alloy and uses the energy produced by the detonation of an explosive charge to compress the connector. This process applies a compression pressure in the range of 400 to 600 tons in about 1/10,000 of a second and with a high degree of accuracy. During the detonation process, the implosive energy drives the connector body inward, forcing the aluminum strands of the conductor to deform tightly against one other. This fills in the voids between the strands and reshapes them to increase their perimeter. During the detonation, a very complex set of collision dynamics takes place, one effect of which is the removal of oxides and other impurities from the surfaces of each strand. The overall effect is a larger, cleaner area of surface contact, providing ideal conditions for electrical efficiency and mechanical grip of the connection.

Fig. 1 shows a micrograph of the cross-sections of a typical hydraulic and implosive connector. The deformation of each strand can be clearly seen. Measurements of strand perimeter before and after compression show that an implosive connector produces greater deformation and fewer voids. As an example, a typical hydraulically compressed Dead End connector (Burndy #YNA451RT) measured a perimeter increase of 108.6%, while an implosive Jumper Terminal (Xeconex #3207) measured 114.8% and an implosive Dead End (Xeconex #2214) measured 122.4%.

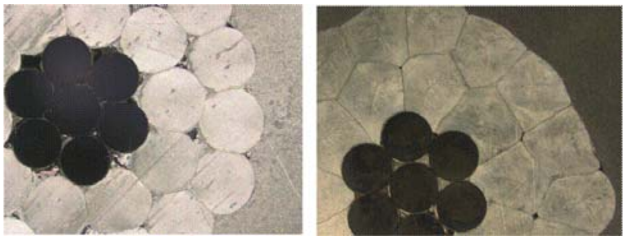
Hydraulic Implosive

Fig. 1. Micrograph of Connector Cross-Section

Another feature of implosive connectors is that they do not use oxide inhibiting compounds, a significant variable in the longevity of a connector, so there is no compound to decompose during high temperature operation.

Overall, it is important to understand that there are fundamental differences between static and dynamic deformation, making it difficult to make a direct comparison between compression and implosive connection technology. However, since the implosive connector has an excellent track record with conventional ACSR conductors and has been used on ACSS conductors operating at conventional operating temperatures, its features and composition make it a suitable candidate for consideration on high temperature conductors and therefore a good subject for study.

IV. DESCRIPTION OF TEST METHODOLOGY

In September 2008, Implo initiated a research project to evaluate implosive connectors in a high temperature environment [4]. The purpose of this test was to study the mechanical and electrical effects of recurrent exposure to high temperatures on implosive connectors installed on ACSS conductor from a perspective that would be of practical relevance to a transmission line operator. A target of 250°C above ambient temperature was chosen after discussion with a utility company that planned to use this conductor in an upcoming new line installation, where the design criteria required that the conductor operate at this temperature, at least for brief periods of time.

A temperature endurance test, heating the conductor by applying current of 2,150 Amperes AC to bring it to 250°C above ambient temperature for 500 cycles, was designed and carried out in a test laboratory under controlled ambient conditions. In the absence of industry standards for testing high temperature connectors, the test was performed using the procedures described in ANSI C119.4 as a guideline, but at a higher control temperature. It was not intended that testing in conformity with these parameters would be an evaluation against the standard. Rather, it would be a procedure for obtaining information about the electrical and mechanical performance of implosive connectors at high temperature on ACSS conductor. Even though the modified test parameters corresponded to more severe operational conditions than those prescribed in the standard, this testing would not result in qualifying the connectors to ANSI C119.4, Class AA standard.

The conductor used for this test was 1,113 kcmil 54/19 ACSS (Finch), consisting of 54 annealed aluminum strands and 19 high strength steel strands and with a Rated Tensile Strength (RTS) of 15,059 kilogram-force (kgf), or 33,200 pound-force (lbf). A total of 15 connectors was tested. Twelve of these connectors were standard off-the-shelf implosive connectors typically used with ACSR and ACSS conductors at conventional temperatures. The remaining 3 were manufactured with longer barrel lengths, with the Long Full Tension Joint at 34" in overall length and the 2 Long Dead Ends at 20". The test was completed in December 2008, logging a total of 505 current cycles. Data collection included temperature and electrical resistance measurements taken at 20 cycle intervals.

Thermographic images of each connector were taken at 305 cycles and again at 505 cycles. Surface emissivity of the connectors was unknown, so it was necessary to measure this parameter. An emissivity value was determined by heating the samples and varying the emissivity in the infrared camera until the reading at the thermocouple location matched the corresponding thermocouple temperature. To account for surface changes, emissivity was re-measured each time thermal images were recorded, measuring 0.35 after 300 cycles and 0.37 after 500 cycles. Since emissivity was determined from thermocouple measurements, the thermal image results and thermocouple readings for the same connectors were within +/- 5 degree C.

At the end of 505 cycles, tensile strength testing was carried out on the 3 connectors that indicated the highest temperature and resistance increases of the lot [5]. The 15 connectors tested are listed in Table 1 below.

TABLE I
LIST OF TESTED CONNECTORS

Con. #	Type	Key
1	Long Full Tension Joint	LFTJ1
2	Dead End #1	DE1
3	Jumper Terminal #1	JT1
4	Full Tension Joint #1	FTJ1
5	Long Dead End #1	LDE1
6	Jumper Terminal #2	JT2
7	Full Tension Joint #2	FTJ2
8	Dead End #2	DE2
9	Full Tension Joint #3	FTJ3
10	Dead End #3	DE3
11	Long Dead End #2	LDE2
12	Jumper Terminal #3	JT3
13	Jumper Terminal #4	JT4
14	Dead End #4	DE4
15	Full Tension Joint #4	FTJ4

Before installation, each conductor was wire brushed loosely to remove some of the oxidation on the outer surfaces of the aluminum strands in the area of contact with the connector. No other preparation of the conductor or the connector was carried out.

The test environment was a closed loop circuit of 15 connectors, as shown in Fig. 2, with temperature and resistance probes installed on each connector. AC current was applied to the circuit until the target temperature of the control conductor was attained. The first set of data was collected after 25 cycles. Thereafter, data was recorded after each 20 cycle interval for a total of 505 cycles of heating to the maximum control temperature, followed by air cooling back to ambient temperature.

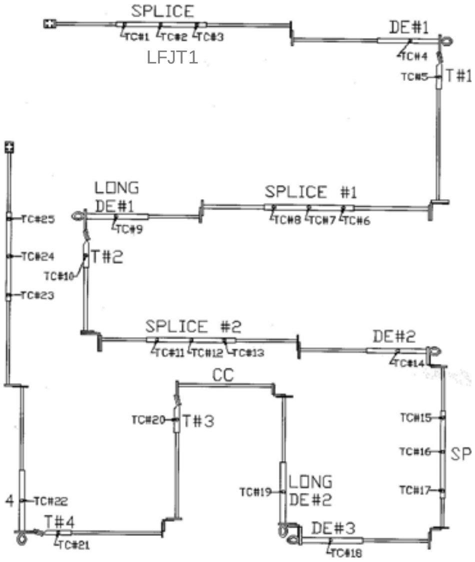

Fig. 2. Circuit Diagram for Test Layout

The current required for the control conductor to reach 250°C above ambient temperature was established during the initial 25 heat cycles. This current (2,150 Amperes AC) was then used during the remainder of the test, regardless of the actual temperature of the conductor. Each connector was exposed to the maximum temperature for a period of 2 hours and then cooled by forced convection to ambient temperature.

DC resistance readings were taken manually using a calibrated micro-ohmmeter after every 20 cycles, and measured from equalizer to equalizer on full tension connectors and from equalizers to pad across terminal jumpers and dead end connectors.

Connector #12 (JT3) was connected directly to the conductor. The other 3 jumper terminals were connected to dead end connectors.

After the completion of 505 cycles, the 3 connectors indicating the highest increases in temperature and resistance were removed from the circuit and pull-tested [4]. These connectors were #4 (FTJ1), #2 (DE1) which was running hotter than the others at 86.1°C lower than the conductor, and #14 (DE4) which was running cooler at 110°C lower than the conductor. After removal from the circuit, these 3 connectors were tensile tested consistent with the method prescribed by ANSI C119.4.

V. DISCUSSION OF RESULTS

Overall, the connectors showed good thermal and electrical stability, displaying only minimal increases in temperature and resistance. Even those connectors that did display a rise in temperature or resistance showed no compromise in mechanical strength in mechanical pull-testing, suggesting that these implosive connectors, in general, did not sustain mechanical degradation to a degree that might be anticipated with thermal aging.

A. Thermal Performance

Thermal performance was monitored by measuring the difference in temperature (Delta T) between the control conductor and the connector. By observing the difference in temperature, variations in ambient temperature were removed. A declining curve of Delta T plotted against number of cycles would indicate a rising temperature of the connector, while a rising curve would suggest that the temperature of the connector is falling. Thermal stability of the connector would be indicated as a straight horizontal line.

Fig. 3 shows the Delta T curve for a connector which displayed very good thermal performance, in this case Connector #5 (LDE1). This assessment was based on the flatness of the curve of Delta T against number of cycles, indicating that the temperature of the connector remained relatively constant as it aged during the test.

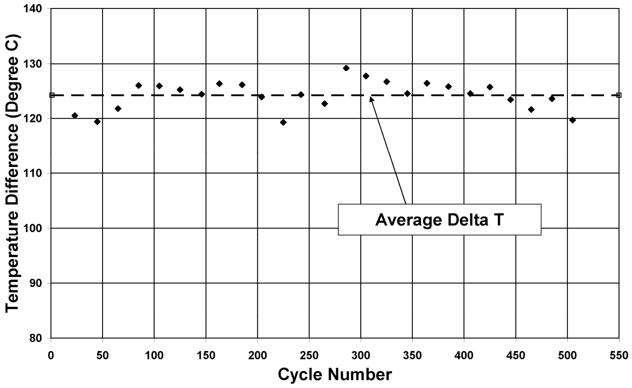

Fig. 3. Temperature Difference vs. Heat Cycles
Connector #5 (Long Dead End #1)

Fig. 4 shows the Delta T curve for a connector which displayed a worsening thermal performance, in this case Connector #4 (FTJ1). This assessment was based on the curve of Delta T against number of cycles, which showed a rising temperature of the connector. This would suggest the possibility of thermal degradation or fatigue as the connector ages. However, contrary to this supposition, this particular connector performed very well in a mechanical pull test, surviving to 118% RTS after exposure to 505 current heat cycles. This suggests that the mechanical strength of the connector had not been compromised despite its apparent or potential thermal degradation.

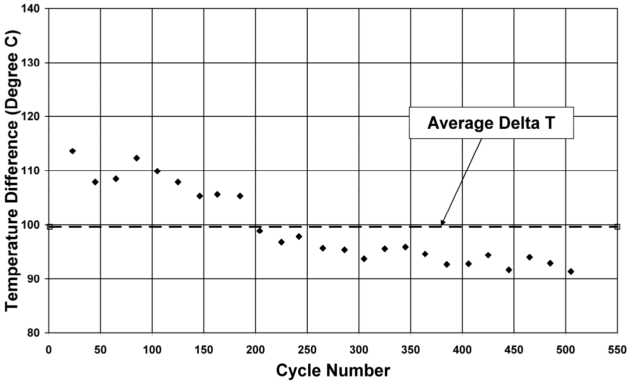

Fig. 4. Temperature Difference vs. Heat Cycles
Connector #4 (Full Tension Joint #1)

Table 2 presents a ranking of all the tested connectors based on a subjective assessment of the curve of Delta T for each connector. Out of the full bank of 15 tested connectors, 8 were judged as "excellent" because they showed a very minimal rise in temperature as they aged. Three were judged as "good" because they showed only a nominal rise in temperature and 4 were labeled as "questionable" because they showed a rise in temperature as they aged. The term "questionable" was chosen because the indicated rise in temperature was not conclusive evidence of poor performance.

The 3 connectors showing the greatest increases in temperature were as follows. Connector #2 (DE1) increased by 39°C to end at 207°C. Connector #4 (FTJ1) increased by 22°C to end at 201°C. Connector #14 (DE4) increased by 22°C to end at 183°C. After completion of the 505 cycles, these 3 connectors were removed from the circuit and pull tested. All 3 exceeded the rated tensile strength of the conductor, as described in section D below.

TABLE 2
CONNECTORS RATED BY THERMAL PERFORMANCE

Con. #	Key	Rating
6	JT2	Excellent
12	JT3	Excellent
5	LDE1	Excellent
9	FTJ3	Excellent
1	LFTJ1	Excellent
13	JT4	Excellent
11	LDE2	Excellent
15	FTJ4	Excellent
10	DE3	Good
3	JT1	Good
7	FTJ2	Good
8	DE2	Questionable
4	FTJ1	Questionable
2	DE1	Questionable
14	DE4	Questionable

Overall, the connectors in the test group averaged 116°C lower than the conductor and 141°C above ambient temperature. The average temperature of the connectors rose by 15°C to end at 184°C after 505 cycles.

The 2 Long Dead Ends (Connectors #5 and #11) and the Long Full Tension Joint (Connector #1) showed the best thermal stability, rising only 0.8°C, 9.5°C and 9.5°C to final temperatures of 173°C, 154°C and 201°C respectively. The average temperature of these 3 long connectors was 126°C lower than the conductor and 13°C lower than their shorter off-the-shelf companions in the test circuit.

Connector #12 (JT3) showed the lowest Delta T at 87°C, compared to 127°C in the case of the other 3 Jumper Terminals. At an average temperature of 201°C, this particular connector was the hottest of the group, which can be attributed to the fact that it was connected directly to the control conductor, unlike the other 3 jumper terminals that were connected to dead end fittings. The connection to a dead end fitting more accurately represents actual field installation conditions for jumper terminals. This connector showed no increase in temperature over the course of the test.

B. Thermal Imaging

Thermal images were examined for variations in temperature on the surfaces of the connectors as well as between the two readings. Overall, these images indicate that the temperature on the outer surfaces of the connectors was uniform and no identifiable hot spots were evident in the area where the connector and the conductor were in contact.

Fig. 5 shows the thermal image of Connector #8 (DE2) at 305 cycles while Fig. 6 shows the same at 505 cycles. This connector was one of those indicating the greatest increase in temperature relative to its laboratory companions. These images reveal minor temperature increases from the first to the second reading but, consistent with the images of the other connectors, no hot spots are visible.

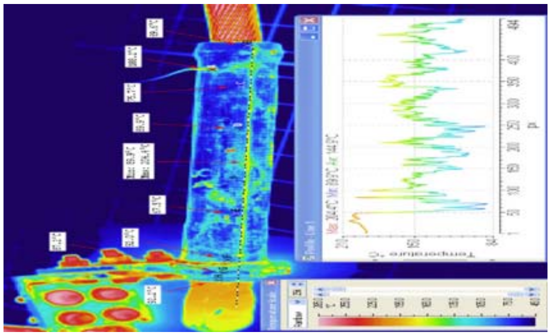

Fig. 5: Thermographic Image after 305 cycles
Connection #8 (Dead End #2)

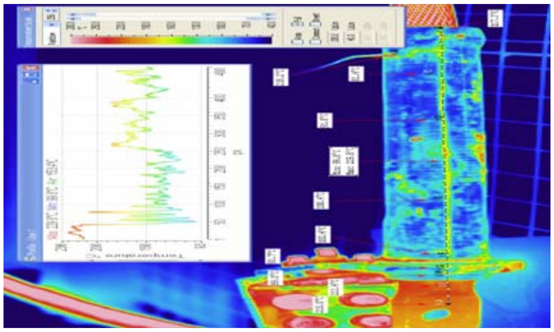

Fig. 6: Thermographic Image after 505 cycles
Connection #8 (Dead End #2)

C. Electrical Performance

Electrical performance of each connector was monitored by measuring resistance using an ohm-meter. An increase in resistance would appear as a rising curve against number of cycles, indicating possible degradation with aging, while a horizontal line would suggest electrical stability. Overall, the electrical performance of the tested connectors was consistent with the observed trends in Delta T.

Table 3 presents a ranking of the tested connectors based on a subjective assessment of the curve of resistance against number of heat cycles for each connector. Of the 15 connectors tested, 6 were judged as “excellent” because they showed little or no increase in resistance, 4 were judged as “good” because they showed a nominal increase in resistance and 5 were labeled “questionable” because they showed an increase in resistance over the course of the test. However, it should be stressed that, although these figures may suggest a trend, they are insignificant in relative terms.

TABLE 3
CONNECTORS RATED BY ELECTRICAL PERFORMANCE

Con. #	Key	Rating
3	JT1	Excellent
13	JT4	Excellent
6	JT2	Excellent
12	JT3	Excellent
11	LDE2	Excellent
5	LDE1	Excellent
1	LFTJ1	Good
10	DE3	Good
15	FTJ4	Good
9	FTJ3	Good
7	FTJ2	Questionable
14	DE4	Questionable
4	FTJ1	Questionable
2	DE1	Questionable
8	DE2	Questionable

Connector #8 (DE2) recorded the largest increase in resistance, rising from 60.0 μΩ (micro-ohms) to 73.8 μΩ throughout the test. The smallest increase in resistance was indicated by Connector #3 (JT1), with a rise from 58.0 μΩ to 58.2 μΩ.

Fig. 7 shows the electrical resistance curve for Connector #13 (JT4), one of the connectors demonstrating excellent electrical stability as indicated by a flat aging curve.

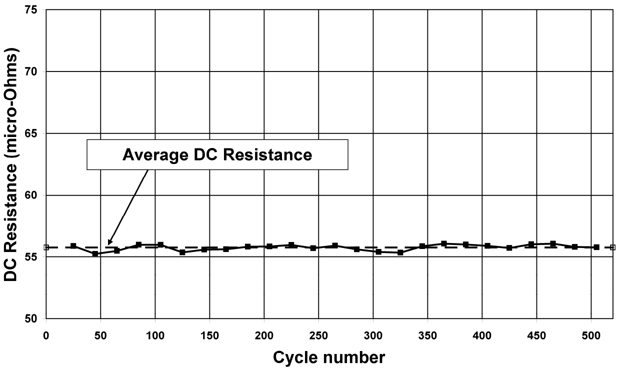

Fig. 7: Resistance vs. Heat Cycles
Connector #13 (Jumper Terminal #4)

Fig. 8 shows the resistance curve for Connector #14 (DE4), one of the connectors indicating “questionable” electrical performance because it showed a rising trend. This connector would not have passed the ANSI C119.4-2003 prescribed 5% limit if this were a conventional temperature scenario. However, after exposure to these higher temperatures, it is noteworthy that a subsequent pull-test after 505 current cycles confirmed the mechanical strength of this connector to be higher than the conductor itself.

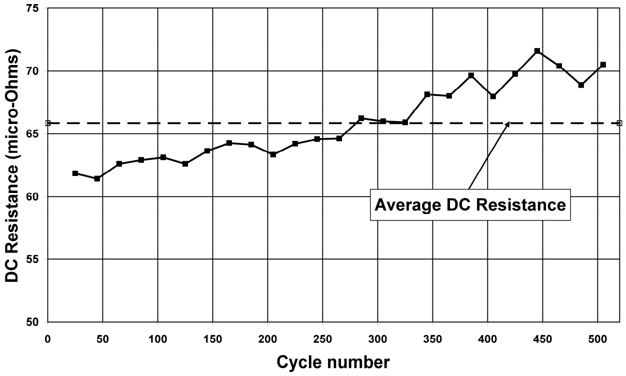

Fig. 8. Resistance vs. Heat Cycles
Connector #14 (Dead End #4)

D. Mechanical Performance

After 505 cycles, the 3 connectors showing the greatest increases in temperature and resistance were removed from the circuit and pull-tested. Maximum load was determined to be, for Connector #2 (DE1) 17,392 kgf or 116% RTS, for Connector #4 (FTJ1) 17,717 kgf or 118% RTS and for Connector #14 (DE4) 15,823 kgf or 105% RTS. In all 3 cases, the failure occurred in the conductor and not in the connector, easily exceeding the 95% RTS required by ANSI C119.4 for conventional temperatures. It is important to note that, although these connectors showed rising temperatures, their mechanical strength was not compromised.

Following the pull test, Connector #14 (DE14) was sectioned and micrographed. Fig. 9 shows a polished and etched longitudinal section of the connector in the area of the steel insert. The steel insert is a component of the connector used for ensuring a good mechanical connection with the steel strands. The dark areas show the deformation of the steel strands of the conductor. Aluminum from the body of the connector can also be seen forced into the spaces between the strands.

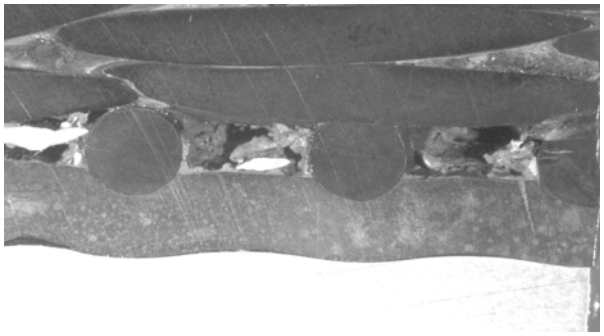

Fig. 9. Longitudinal section x 7 magnification
Connector #14 (Dead End #4)

VI. CONCLUSIONS

This test demonstrates that implosive connectors have good mechanical durability on ACSS conductor operating at 250°C above ambient temperature.

Not surprisingly, the long versions of the connectors showed the best overall performance. Their added mass and area of contact predictably contribute to electrical and mechanical integrity, enabling better heat dissipation and electrical conductivity at higher temperatures.

While this test supports the conclusion that mechanical performance, in the case of implosive connectors, is not compromised with thermal aging, it also implies that existing thermal and electrical scales may be insufficient yardsticks upon which to base pass/fail assessments of high temperature connectors, at least in the newer generation of connector technology. This implies that higher standards may be necessary for this technology.

The results of this test also bring into question the methodology used for gathering data. At conventional temperatures, a particular data gathering method may be appropriate, but that method may not provide the same level of refinement needed for an equivalent appraisal at higher temperatures. This suggests that new measurement standards may also be necessary.

As much as the information derived from this test may be a useful complement for the development of a model for thermal aging of implosive connectors, it also opens a discussion about the direction in which future analysis should go in developing new standards for connector technology in the higher temperature environment.

Most of the connectors in this test indicated good thermal and electrical stability. Even those connectors that showed rising temperature and resistance passed mechanical testing with excellent results. This suggests that thermal degradation may not be taking place at the rate anticipated by the measured indicators, or at a rate or pattern similar to that experienced by conventional connectors. Caution must be exercised when considering these empirical results to try to project future performance, as this analysis clearly ventures onto new territory.

Based on the positive results obtained in this test, a second 500 cycle test has now been commenced, resuming the same current heat cycle program for a total of 1000 cycles at 250°C above ambient temperature, using 12 of the original connectors and 3 replacement connectors. This data will provide further insights towards going forward into the expanding new world of high temperature conductors.

VII. ACKNOWLEDGMENT

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IX. BIOGRAPHIES

Ciro Pasini was born in Italy on March 21, 1951. He earned his Hons B. Mech Eng., and MBA at McGill University. His career placements include Project Engineer at ESSO, Technical Director and Product & Marketing Manager at CIL, and co-founder and President of Tower Solutions Inc. While at CIL he developed and marketed a new type of explosive that would become the new standard in the industry. Having acquired the implosive connector technology from CIL/ICI, he went on to perfect it for commercial markets throughout the world and founded Implo Technologies Inc., becoming the global expert in implosive connector technology. His publications include "New Implosive Connector Technology for High Voltage Conductors", "New Generation Rapid-Response Emergency Tower (IEE AC and DC Power Transmission Conference, March 2006, UK)", "Doing Business in Brazil (Brazil Chamber of Commerce, 2005)".

Harry J. Sildva was born in Canada on November 30, 1951. He graduated from the University of Toronto with a B.Sc. Hons. and went on to earn an M.B.A. After serving a number of years as Financial Planner and advisor to senior management for the Province of Ontario, he founded a research company that now holds significant patents in the field of explosive bonding technology. Following this, he joined Implo Technologies Inc. as Business Development Manager for new technology applications and now continues in a similar role at Burndy Canada Inc.

Genti Gorja was born in Albania on May 5, 1972. He graduated from the University of Tirana with B.Sc. Hons. in Electrical Engineering. His employment experience includes Albanian Power Corporation and Implo Technologies Inc. (now Burndy Canada Inc.) where his expertise has been responsible for the development, design, testing and field support for implosive connectors. His special interests include the field application of implosive connectors in the context of power transmission systems. His training has included Energy Management in Japan and Emergency Restoration Tower design and installation at Tower Solutions Inc. Today he serves as Product Manager at Burndy Canada Inc.

Zsolt Péter earned his M.Sc. degree in Mechanical Engineering at Budapest University of Technology and Economics in Hungary in 2002. Dr. Péter has specialized expertise in the short-term dynamic thermal rating of conductors through his PhD study in ice melting methods based on Joule-heating at the University of Quebec at Chicoutimi. Dr. Péter has day-to-day responsibility for testing electric connectors and qualifying high temperature low sag conductors at Kinectrics. He is a member of the Conductors Working Group of IEEE, regularly participates in ANSI C119 meetings and is involved in the development of standards for qualifying high temperature connectors.