NorthWestern Energy
Delivering a Bright Future

August 11, 2015

Ms. Kate Whitney
Utility Division
Montana Public Service Commission
1701 Prospect Avenue
PO Box 2022601
Helena, Montana 59620-2601

Re: Docket Nos. D2013.5.33/D2014.5.46 Electric Tracker
Updated Response to MEIC-44a in MEIC Set 4 (044-059) Data Requests

Dear Ms. Whitney:

Enclosed for filing is a copy of NorthWestern Energy's updated response to MEIC-44a in MEIC Set 4 (044-059) data requests. This response will be hand delivered to the Montana Public Service Commission and the Montana Consumer Counsel. This response will also be mailed to the service list in this docket, e-filed with the PSC, and emailed to counsel of record.

Should you have questions please contact Joe Schwartzenberger at (406) 497-3362.

Sincerely,

Pam LeProwse

Pam LeProwse
Administrative Assistant

CERTIFICATE OF SERVICE

I hereby certify that a copy of NorthWestern Energy's updated response to MEIC-44a in MEIC Set 4 Data Requests in Docket Nos. D2013.5.33/D2014.5.46 has been hand delivered to the Montana Public Service Commission and to the Montana Consumer Counsel this date. These will be e-filed on the PSC website, e-mailed to counsel of record, and served on the most recent service list by mailing a copy thereof by first class mail, postage prepaid.

Date: August 11, 2015

Pam LeProwse

Pam LeProwse
Administrative Assistant
Regulatory Affairs

Docket Nos.
D2013.5.33/D2014.5.46
Service List

Al Brogan
NorthWestern Energy
208 N. Montana Ave Suite 205
Helena MT 59601

Charles Magraw
501 8th Ave
Helena MT 59601

Dr. Thomas M. Power
920 Evans Ave.
Missoula MT 59801

Joe Schwartzenberger
NorthWestern Energy
40 E Broadway
Butte MT 59701

Tracy Lowney Killoy
NorthWestern Energy
40 E Broadway
Butte MT 59701

Sarah Norcott
NorthWestern Energy
208 N Montana Ave Suite 205
Helena MT 59601

Kate Whitney
Public Service Commission
1701 Prospect Ave
P O Box 202601
Helena MT 59620-2601

Robert A Nelson
Montana Consumer Counsel
111N Last Chance Gulch Ste 1B
P O Box 201703
Helena MT 59620-1703

Matthew Gerhart
Earthjustice
705 Second Ave. Suite 203
Seattle WA 98014

Jenny Harbine
Earthjustice
313 E. Main St.
Bozeman MT 59715

Monica Tranel
Montana Consumer Counsel
P.O. Box 201703
Helena MT 59620-1403

John W. Wilson
JW Wilson & Assocaties
1601 N. Kent Ste 1104
Arlington VA 22209

William W. Mercer
Holland & Hart
P O Box 639
Billings MT 59103--0639

David A Schlissel
Schlissel Technical Consulting
45 Horace Road
Belmont MA 02478

John Alke
NorthWestern Energy
208 N Montana Ave Suite 205
Helena MT 59601

NorthWestern Energy
Docket D2013.5.33/D2014.5.46
Electric Tracker

Montana Environmental Information Center/Sierra Club
Set 4 (044-059)

Data Requests received March 11, 2015

MEIC-44 Subject: 2013 Unit 4 Generator Overhaul
Witness: Mike Barnes

a. Please provide all documents in NorthWestern Energy's possession that discuss the Unit 4 generator overhaul conducted in May and June of 2013. This request is limited to documents that were created from May 1, 2013 to January 23, 2014.

b. Please provide copies of all documents in Northwestern Energy's possession that assess or evaluate the performance of Siemens and/or its personnel during the May/June 2013 Unit 4 overhaul.

RESPONSE (April 1, 2015):

a. NorthWestern objects in part to this data request because it seeks irrelevant information. Pursuant to Rule 26(b)(1) of the Montana Rules of Civil Procedure ("M. R. Civ. P."), a party may only obtain discovery "relevant to any party's claim or defense" and that "appears reasonably calculated to lead to the discovery of admissible evidence." The Commission adopted M. R. Civ. P. 26 in its administrative rules. *See* ARM 38.2.3301. Discovery is irrelevant if it "has no bearing on [the] legitimate issues" in the docket. *Henricksen v. State*, 2004 MT 20, ¶ 44, 319 Mont. 307, 84 P. 3d 38. In *Henricksen*, the Supreme Court affirmed the district court's decision to deny the State's discovery requests for the other party's financial documents, school transcripts or personnel records since the issue to be decided by the court involved the party's mental and emotional states and not a claim for lost earnings or lost earning capacity. *Id.*

Before the Commission in this docket is NorthWestern's electricity supply tracker. As required by law, the Commission established an "electricity cost recovery mechanism" that permits NorthWestern "to fully recover prudently incurred electricity supply costs." *See* Mont. Code Ann. § 69-8-210(1). In this matter, NorthWestern filed applications requesting permission to track certain electricity supply costs incurred during two tracker years.[1] Specifically, the applications pertained to electricity supply costs incurred from July 1, 2012 to June 30, 2014. In Order No. 6925f in Docket No. D2008.6.69 ("Order"), the Commission granted NorthWestern the right to include its interest in Colstrip Unit No. 4 ("CU4") in rate base as an electricity supply resource. Additionally, in that Order, ¶¶ 260-61, the Commission permitted NorthWestern to track costs from CU4 incurred in a tracker year. NorthWestern's applications in this docket include requests to track the following variable costs related to CU4: fuel costs, property taxes, demand-side

[1] The Commission consolidated NorthWestern's 2013 Electricity Supply Tracker docket with its 2014 Electricity Supply Tracker docket. *See* Notice of Commission Action issued May 12, 2014.

MEIC-44 cont'd

management lost revenues, and carrying costs. This docket also includes a request to recover certain replacement power costs resulting from an outage at CU4 that occurred in the second half of 2013.

This data request seeks information that is not relevant or reasonably calculated to lead to discovery of admissible evidence because the request seeks documents that discuss the Unit 4 generator overhaul conducted in May and June of 2013. The issues in an electricity supply tracker docket involve requests to recover electricity supply costs that have been incurred during a tracker period. With respect to the replacement power costs incurred during the tracker period involved in this docket, the Commission must determine if the costs were prudent. In order to determine if the replacement power costs were prudent, the Commission must look to see what NorthWestern knew or should have known at the time the costs were incurred. In response to this question, NorthWestern has copies of the daily outage reports and the May 2013 Owners' meeting minutes that were provided by PPL during the May and June 2013 planned overhaul. These reports, however, contain information about other work performed on the unit during the overhaul, work which is unrelated to the generator work performed on the unit. This information is unrelated to the outage that occurred in 2013. Thus, some of the information sought in this data request unequivocally has nothing to do with, nor does it have any legitimate bearing on, the outage at CU4 or the other issues in this docket. As such, it will not lead to admissible evidence regarding the outage or what NorthWestern knew or should have known with respect to the outage, and therefore it is not relevant and the Commission should sustain NorthWestern's partial objection.

Without waiving said objection, see the daily outage reports and the May 2013 Owners' meeting minutes responsive to this request in the "MEIC-44" folder on the attached CD. Please note that the not relevant information described above has been redacted. Additionally, PPL Montana has informed NorthWestern that if the above partial objection is overruled and NorthWestern is required to produce unredacted versions of the attached reports, it will claim confidentiality as to the information.

b. See the FM Global report provided in response to Data Request MCC-017.

UPDATED RESPONSE (August 11, 2015)

a. See attached. Ronald Halpern provided this document to NorthWestern on August 5, 2015.

SIEMENS

PPL MONTANA, LLC

COLSTRIP

Unit Number: 4

Service Event: 2013-05-10 to 2013-06-07
Serial Number: 13A5421-1
Frame Type / Building Blocks: 4316RT4
Job Number: 0ZBT13017603

Generator Stator, Exciter & Rotor Inspection

Report Written By: Frederick Clickner

District Service Manager: Carl Redman

CUSTOMER FINAL REPORT

Siemens Energy, Inc. Proprietary Information
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce, or use otherwise without written consent of Siemens Energy, Inc.
©2013 Siemens Energy, Inc.

TABLE OF CONTENTS

1. Work Summary
2. Attachments
   2.1 Datasheets
   2.2 Photographs
   2.3 Miscellaneous Attachments

Siemens Energy, Inc. Proprietary Information
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce, or use otherwise without written consent of Siemens Energy, Inc.
©2013 Siemens Energy, Inc.

Historical Record Of Revisions

Revision No.	Date	Comment

1. Work Summary

Siemens Energy Inc., dispatched a Field Service Engineering specialist to the PPL Montana, LLC, Colstrip, Unit 4 plant site to conduct inspections of the generator stator, exciter and rotor. This outage consisted of a partial stator rewedge, implementation of FSP 370 inspection, and exciter refurbishment.

The following report described outage findings and recommendations.

2. Attachments

2.1 Datasheets

Siemens Energy, Inc. Proprietary Information
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce, or use otherwise without written consent of Siemens Energy, Inc.
©2013 Siemens Energy, Inc.

1. INTRODUCTION

On May 10, 2013, Siemens Energy Inc. personnel arrived at the PP&L Colstrip Unit 4 site to perform the following work scope:

- Generator Stator Crawl Through Inspection FIP 358 and FSP-370 Testing.
- Exciter Rotor and Stators, Visual Inspection and Limited FSP-370 Testing.
- Generator Stator Winding Main Lead Bolting Hardware Inspection
- F.O.V.M. Inspection and Functional Testing
- SMCAS Examination of the Stator Core
- Flux Probe Signal Evaluation
- Stator Slot Re-wedge

Additional work included:

- Application of 8 kits of wicking resin on the Exciter End Parallel Ring Bracing
- 25% Stator Re-wedge
- Minor Exciter End Step Iron Etching
- Replacement of 15 defective Exciter Fuses
- Replacement of one (1) exciter diode at the No. 20 outboard module location and replacement of two (2) diodes at the No 10 & 20 inboard module location.
- Re-silver Plating of all Main and Neutral Air Side Flex Connectors

All of this work was performed in parallel with a turbine outage.

2. OUTAGE PERSONNEL

2.1 Outage Personnel / Customer

Name	Job Description
Tary Hanson	Mechanical Project Engineer
Doug Rust	Electrical Project Engineer
Eric Petritz	Supervisor, Maintenance

2.2 Outage Personnel / Siemens

Name	Job Description
Carl Redman	Project Director
Dana Johnston	District Service Manager
Tom Kucera	Project Manager
Fred Clickner	Generator Lead Engineer Day Shift
Patryk Ruchniak	Generator Engineer Night Shift
Evan Niemann	Engineer E.I.T.
Tad Ladzinski	Chief Winder
Rand Hauser	GS Winder
Mark Kvorjak	GS Winder
Esteban Perea	GS Winder
Coy Coulson	Bump Test Engineer

3. GENERAL

This unit is an indoor, hydrogen inner-cooled, two-pole steam turbine generator. The stator windings are water cooled stator coils utilizing an early version of the Rigiflex bracing system. The rotor is a zone cooled winding configuration. The Mark III brushless exciter is air cooled.

The unit has the following nameplate data:

Ratings given are for 75 psig maximum hydrogen pressure

Generator Serial Number……85P500
MVA 819
Stator Voltage..... 26000
Stator Amperes..... 18187
Power Factor 0.95
Rotor Amperes 6202
Exciter Voltage 400
Phases 3
Hertz 60
RPM 3600
Temperature Rise at.....60 psig Hydrogen with 46ºC Maximum cold gas.
Will not exceed 50ºC For Stator
Will not exceed 64ºC For Rotor
Exciter Serial Number 89P501
Exciter Frame Size 6A
Exciter Rating (Amps) 6563
Exciter Rating (KW)……2625

The stator is wound with Thermalastic insulated coils. The machine was placed in service on December 15, 1985. This turbine generator is operated as a base load machine. Over the last operating cycle, no unusual events were reported with regards operational condition of the machine.

Several maintenance inspections have been performed by Siemens personnel over the past 10 years. In the Spring of 2003, maintenance stator winding repairs, implementation of OMM 099 was completed on the exciter end of the stator as well as a generator rotor change out to the current rotor S.O. 93P424R. In the Spring of 2006, an exciter inspection and eventual refurbishment were performed. This outage also included a complete generator inspection and line and neutral high voltage bushing replacement, RTD and TC terminal board refurbishment, application of wicking resin to the end windings, and the addition of phase lead support block. Refurbished CT current transformers were also installed.

The generator and exciter were completely disassembled for this inspection. A FME fence was constructed around the entire generator. A zone 1 FME area was set up at the generator to log all tools in and out.

4. TESTS PERFORMED

4.1 Generator Stator Tests

High Voltage Tests

- Dielectric Absorption
- Leakage Voltage
- DC Maintenance Level Over Potential

Low Voltage Tests

Insulation Resistance Measurements of:

- Each Winding Phase
- RTDs and Thermocouples
- Through Bolts
- Core Support Plates

Resistance Measurements of:

- Each Winding Phase
- RTDs
- Thermocouple Continuity

Mechanical Tests

- Wedge Tightness Evaluation
- Core Length Measurements
- Building Bolt and Through Bolt Torque Check

4.2 Generator Rotor

Electrical Tests

- Insulation Resistance
- Winding resistance Test
- Rotor Winding Pole Balance

Mechanical Tests

- Radial Lead Stud Pressure Test

4.3 Specialty Tests

4.3.1 Stator Windings Water Evacuation and Dry Out

The stator windings were drained and vacuum-dried prior to beginning any generator work. Once the winding were dry, a 3 psig Nitrogen blanket was placed on the winding internal water carrying components to prevent corrosion.

4.3.2 SMCAS (EL-CID)

Prior to any of the 'old' stator slot wedges being removed, and after the new wedges were installed, an Electro Magnetic Core Imperfection Detection Test (EL-CID/SMCAS) of the stator core iron was performed. Three small areas in the EE steps iron were addressed during the second test. Both tests yielded acceptable results.

4.3.3 Fast Fourier Analysis (Bump test) of the series and phase connect as well as the phase rings.

4.3.4 Fiber Optic Vibration Monitor System Functional Check

4.4 Exciter Tests

Insulation Resistance Measurements of:

- RTDs and Thermocouples
- Field Windings
- Armature Windings
- PMG Windings

Diode Fuse Resistance Measurements

Pole Balance and Impedance Calculations of Field Windings.

Thermocouple and Ground Detector Lead Continuity Check.

Resistance Measurements of:

- RTDs
- Field Windings
- PMG Windings
- Armature Windings

5. INSPECTION

5.1 Generator Stator

5.1.1 Exciter End Inspection

In general, the overall condition of the stator windings was found in good condition. The end winding basket was slightly oily. Otherwise, the winding was found clean with the typical insulating material debris in the corners of the lower lying areas of the stator frame.

Due to the oil in the end winding area, all relative movement was manifested in greasing.

Virtually, no greasing was noted between coils and diamond spacers viewed. Very minor greasing was identified between strain blocks and top and bottom coils.

Minor greasing was identified between the outer coil support ring and the parallel ring bracing, and between the parallel rings and there individual braces.

The phase and series connection taping was visually inspected for greasing, dusting or sponginess. All areas viewed were found tight with no puffiness or tape separation, or dusting noted.

All exciter end primary water Teflon hoses and clamping mechanisms were inspected and found in good condition. The primary water manifold was found in good condition with no indications of movement at the attachment points noted.

The parallel ring clamping assemblies were tight, with minor greasing.

The parallel ring support ring was found tightly fitted on the parallel ring stub ends. The radial supports were tightly fitted to the support ring with only minor greasing. The welds between frame and metal supports were inspected for distress. No evidence of damage was noted.

The main and neutral lead bushings were found slightly oily on the gas side. Otherwise, they were found in satisfactory condition. There were no signs of porcelain insulator cracking. There was no sign of greasing, gas or oil leakage on the interface of porcelain to flange seal inside and outside of the lead box. There was no indication of movement or looseness associated with the bushings or their mounting hardware.

All 6 main lead and main lead cleats were inspected. All insulation was found in good condition, except for T4. The insulation on this connection was soft and “puffy”. Otherwise there was no sign of voltage leakage or puffy insulation noted on the remaining connections. The T4 connection insulation was stripped and re-insulated.

Connection T3 and T6 were un-insulated to perform a visual inspection, torque checked as well as a feeler gauge check of the main lead connection hardware, per TA 98-012. Results of the torque check and feeler gauge test yielded acceptable results. This inspection required removal of one side of the lower main lead cleat. After re-insulation, the cleats were re-installed using new ny-lock nuts and locking hardware. The nuts were tightened prior to securing the tab washers. No further action was required. The silver plating at the T3 and T6 connections appeared to be in satisfactory condition.

5.1.2 Stator Core

A carefully visual inspection of the stator core was performed shortly after the rotor was removed. The intent of this inspection was to identify any damaged core iron or areas of thermal degradation. No mechanical or thermal damage was noted in the body iron.

The laminated end shield also appeared in satisfactory condition. There was no visual evidence of hot spots or significant mechanical damage. There was no evidence of blockage of the core’s radial ventilation paths.

The tightness of the through bolts and building bolts was evaluated by conducting a torque break away check of 4 bolts at locations, 3, 6, 9, and 12 o’clock. All torque values were within the acceptable limits. No additional core tightening was required.

Wedge acoustic tap testing revealed many loose wedges throughout the core. Approximately 20 wedges showed any indication of minor greasing. The loose wedges were located in slots 1, 2, 5, 6, 26, and 28 and were generally located at the turbine end. There was no evidence of wedge filler and coil side filler migration.

In addition, the step iron on both the TE ad EE was also carefully inspected for damage. The TE and EE step iron had the typical “dings” most likely from past maintenance and or prior stator slot re-wedging.

Multiple SMCAS/EL-CID tests were performed on the stator core to verify the integrity of the inter laminar insulation.

5.1.3 Turbine End Inspection

The Turbine End, end windings were also found very oily. Oil covered the inner areas of the end winding basket. Oil was also present approximately 3 feet into the bore.

Otherwise, the TE was found in good condition. No greasing or dusting that would have indicated relative movement was noted. All coil blocking and bracing was found tight, in place.

All turbine end primary water Teflon hoses and clamping mechanisms were inspected and found in good condition. The primary water manifold was found in good condition with no indications of movement at the attachment points noted.

All series connection taping was visually inspected for greasing, dusting or sponginess. All areas viewed were found tight with no puffiness or tape separation, or dusting or greasing noted.

The banding that secures the TC wires to the manifold was found loose in several locations. The old banding was removed and new resin saturated banding was installed.

5.2 Generator Rotor Inspection

The generator rotor was inspected to the extent possible due to assembly. Overall the rotor was found in good condition. The viewable areas of the end windings were found slightly oily. No notable indications of heating or relative movement identified.

The end winding bracing blocks were intact and showed no evidence of relative movement. The end turn insulation was intact in the areas viewed. There was no notable end turn displacement on either the TE or EE ends of the rotor winding. There were no damaged and/or loose insulation components identified.

The lead and stud assemblies were in good condition. The stud assemblies and axial leads appeared to be tight with all components in tact. The two radial lead seals passed the pressure test at 200 psig.

Oxidation was noted on the coupling vertical face. This oxidation was only superficial and was removed with Scotch Brite.

The balance weights that are located in a groove in the zone ring were inspected. Ten sets of zone ring balance weights were found with excessive radial movement from 0.0625 to 0.250 inches. The weights were secured by tightening the tabs against the weights.

6.0 TEST RESULTS

6.1 High Voltage

6.1.1 Dielectric Absorption

Dielectric absorption tests were made on each phase at a test potential of 15 KVDC during the high potential test. The results of these tests are shown in the datasheet section. These sheets also show the method of calculation for the conduction component of the total current. By subtracting the conduction component from the total current, a straight line curve of the pure absorption current for the test was obtained. The ratio of the absorption currents at 1 and 10 minutes and the polarization index are shown on the datasheets. The absorption ratio was determined using a computer and used to determine a schedule of times for the application of higher voltage in 3 KV steps to 57.46 KVDC.

6.1.2 Leakage Voltage

The results of the leakage voltage test are shown in the datasheet section. This test was applied to each phase following the dielectric absorption test by increasing the voltage in 3 KV steps according to the time schedule selected through the absorption ratio. This schedule was calculated to maintain a constant proportionality between the test voltage and absorption current. Any deviations from a straight line curve may be interpreted as pure conduction current. If these breaks become very sharp, they may be used as an indication of serious trouble or impending failure of the insulation. It is expected that most insulation tested over the range from 15 KV to 57.46 KV will show some increases in leakage current due to surface creep and ionization at the higher voltages.

6.1.3 DC Overpotential Tests

The results of the 57.46 KV overpotential tests are shown below. These results are equivalent to those which would be obtained by applying 57.46 KVDC to the windings for 10 minutes. These leakage values were indicative of clean insulation with a relatively high level of dryness and were satisfactory for normal risks of service.

Phase	KVDC	Leakage Current	Insulation Resistance
T1 T4	57.46 Kv	32 microamperes	1,796 megohms
T2 T5	57.46 Kv	28 microamperes	2,052 megohms
T3 T6	57.46 Kv	20 microamperes	2,873 megohms

6.2 Low Voltage Tests

6.2.1 Winding Insulation Resistance

A test potential of 5000 VDC was applied to each stator winding phase for a period of ten minutes. This was done prior to high potential testing. The following satisfactory results were obtained for the final test.

Insulation Resistance Gigohms

Phase	1 Minute	10 Minutes	P.I.
T1 T4	13.0	70.9	5.37
T2 T5	12.2	64.4	5.23
T3 T6	13.0	74.8	5.72

6.2.2 Thermocouple Insulation Resistance

The insulation resistance of the insulated thermocouples was measured at a potential of 500 volts D.C. to ground. The results of this test were satisfactory as all readings were 200 megohms or greater.

6.2.3 RTD Resistance Measurements

The D.C. resistance of each RTD was measured using a digital Kelvin bridge. The results of these readings are shown in the datasheet sections along with calculations showing a comparison between each element. The test results show the RTDs in satisfactory condition.

6.2.4 Thermocouple Continuity

The continuity of all thermocouples was verified by measuring their cable resistances with an ohmmeter. All resistance readings were satisfactory.

6.2.5 Through Bolt Insulation Resistance

The insulation resistance of all stator through bolts was measured several times during the core tightening process using a 1000 volt D.C. potential to ground. The results of the final tests were satisfactory as all readings were 36 megohms or greater.

6.2.6 Winding Resistance

The D.C. resistance of the stator winding was measured using a Digital Kelvin bridge and the following satisfactory results were obtained:

Phase Resistance at 19.9 ̣C Resistance at 20ºC

T1 - T4	0.009200 Ω	Corrected to 20ºC	0.0111010 Ω
T2 - T5	0.0091800 Ω	Corrected to 20ºC	0.0110768 Ω
T3 - T6	0.0092000 Ω	Corrected to 20ºC	0.0111010 Ω

6.3 Mechanical Tests

6.3.1 Wedge Tightness Evaluation

During the last outage in 2009, it was determined that approximately 5% of the stator core would require re-wedging. This was based on the tap test performed by the FastGen robot. During this outage, the spring deflection measurement were taken at the 7 test wedges per slot and found to be acceptable. However, after a tap test of the complete stator that several slots had loose wedges and should be re-wedged. Below is a list of the wedges that were replaced.

Generator Service Engineering recommends that the following be re-wedged. The slots contain 35 individual wedges. Wedges are numbered from EE to TE.

Slot #	Wedge #'s
1	Entire slot
2	Entire slot
4	23-35
5	Entire slot
8	1-2
10	21-35
13	1-12
17	34-35
20	16-35
22	19-35
23	1-22
24	14-35
25	12-35
26	19-35
27	1-3 & 20-35
28	29-35
31	33-35
33	34-35
36	21-35

6.3.2 Core Length Measurements

The axial length of the stator laminated core was measured using a (steel tape) the core length was 259-5/8 inches at the 3 and 6 o'clock positions, and measured 259-3/4 inches at the 9 and 12 o'clock positions. This length is short compared to the design dimension. This data was recorded on FQA Form 93-1.

6.4 Specialty Tests

6.4.1 EL CID Test (SMCAS)

Electromagnetic core imperfection detector (EL CID) tests were performed on this core: one before slot wedge removal and one after core tightening and installation of the new slot wedges and fillers). An additional partial scan was performed with new equipment due to high levels of noise in the post traces. This partial scan verified no issues with original equipment, thus first post SMCAS reading are accurate. This test determines if imperfections in the stator core interlaminar insulation system are of a magnitude that may cause localized heating and subsequent degradation of the core during normal operation. This test involves exciting the core with a weak magnetic field in such a manner as to cause current to flow between any stator core laminations that are shorted. A pickup device, which is sensitive to axial current, is then moved over the core lamination teeth to detect any possible current flowing through the interlaminar insulation imperfections (shorts).

The output of the test equipment gives a direct reading of the magnitude of the current flowing through a short. The full core was scanned during each of the ELCID/SMCAS tests and each slot/tooth charted on a plotter. The results of the final test showed that all areas examined met Siemens specifications. However, 3 areas on the EE step iron revealed indications slightly above the 100 milli amp threshold. In these areas, the individual laminations were scrapped to ensure individual lamination definition and separation. The areas at slot 28 required minor etching. A re-scan of the 3 areas yielded acceptable results.

6.4.2 Fast Fourier Analysis Techniques (Bump) Test

Prior to any repairs or modifications a Fast Fourier Analysis test was performed on the stator end windings to verify the resonant frequencies of the stator phase leads and end windings were away from the natural electromechanical running frequency. Based on this test, no recommendations were made. Please consult the FFA Test Engineer's report for test results.

6.4.3 Fiber Optic Vibration Monitoring System Light Loss Measurements

Light loss measurements were recorded for each fiber optic sensor cable assembly at the preamplifier enclosures. The test showed that each sensor cable assembly had acceptable light loss 12 dbm. However, the card in slot No. 1 is defective.

8.0 MAINTENANCE AND REPAIR PROGRAM

The repairs performed on the generator consisted of:

- Stator winding dry-out
- Approximately 25% re-wedge
- Verification of 2 main lead connection hardware boltings
- Parallel ring attachment bracing bolting torque check
- End winding support bracing torque check
- Re-insulation of 3 main lead connections

- Air gap mounted flux probe wire repair
- Re-silver plating of the air side main and neutral flex connectors
- Tightening of balance weight keepers in zone rings

9.0 SUMMARY AND RECOMMENDATIONS

A rewind is scheduled for this stator within 3 years. Until that time, it is recommended that yearly crawl-through inspections be performed.

When a new flux probe is installed, it is recommended that a larger size support tube be used at the exciter end going from the air gap down through the coils and end winding. It is very difficult to pull through and reconnect the flux probe cable with the current support tube size.

The generator terminal board hydrogen cooler warm gas RTD number 53 is found in the control room as TE59. This RTD is working correctly and is not the source of plant issues with DCS number 53.

It is recommended that an exciter refurbishment be scheduled to update the exciter at the same time a stator rewind is performed. It is recommended that the broken screen areas at the diode wheels be repaired.

Exciter cold air RTD 32 located under the coupling end cooler had a higher neutral leg reading than the other RTDs. It is not yet known if this was affecting the control room readout. The 30 series numbers used on the exciter terminal board are transposed into 50 series numbers on the plant DCS. At this time there is a temperature error introduced in the plant wiring going to the DCS for RTD 32. If exciter temperatures have a problem following the resolution of the plant systems, the next place to troubleshoot will be the intermediate termination block located under the exciter coupling end cooler. This block serves both RTD 32 and RTD 34.

10.0 PCMs

2-13-009312	Generator/Exciter Couplings Surface Rust
2-13-009624	EL-CID Results
2-13-009649	Bump Test Results
2-13-009681	Generator Inspection Findings
2-13-009765	Damaged Flux Probe
2-13-010008	Main Lead Insulating Material
2-13-010070	Colstrip U4 Stator Past and Present Wedge Tightness Evaluation Recommendations
2-13-010191	EL-CID Indications on the EE Step Iron
2-13-010027	Loose Balance Weights In Zone Rings

11.0 BRUSHLESS EXCITER

Introduction

The exciter work was performed during the scheduled generator outage. Major repairs included an overhaul to the exciter diode wheels. This work was performed in parallel with a generator/turbine inspection.

12.0 GENERAL

This unit is an indoor hydrogen inner-cooled steam turbine generator. The Mark III brushless exciter is air cooled. The Frame 16 exciter has the following nameplate data:

The exciter was completely dismantled for this inspection. The exciter rotor was removed. The exciter air coolers were not removed and baffles were removed. The electrical connectors were opened to provide for testing of the exciter components.

UNIT IDENTIFICATION

Exciter
Shop Order 85P0501
kW 2625
Volts.....400
Temp Rise .....60° C
Amps.....6563
I.B. No. 21059
RPM.....3600

13.0 SUMMARY OF WORK PERFORMED

A complete inspection and test program was performed on the Colstrip U4, brushless exciter during this outage.

The exciter is a Single Wheel, Mark III, Brushless Exciter. A secure, well organized work area was setup per Siemens FIP 373, and the work on the diode wheels commenced on May 11th, 2013. This work was performed by two Siemens technicians under the supervision of a Siemens engineer.

14.0 INSPECTION

This exciter was found in acceptable condition. There was minor layer of fly ash and coal dust that covered the diode wheels and diode wheel components. Also, the coupling mating face had similar surface oxidation to the generator rotor coupling. This oxidation was also removed with Scotch Brite.

14.1 Brushless Exciter Inspection

All outboard fuses were unbolted at the diode wheel and the center module bolt loosened in order to remove the complete module. After removal of the diode wheel components, all diode wheel components were cleaned in citrus-based solvent.

The silver plating on the conducting surfaces of all diode wheel components were cleaned and inspected. The plating was found in good condition.

The radial lead studs on the exciter rotor were in satisfactory condition.
The rotating magnets-fan assembly, bearing journal, and AC armature were dirty but otherwise in satisfactory condition.

After all the components were removed from the diode wheels, the individual components were electrically tested. The interior of the wheels were then cleaned in prep for component installation.

15.0 TESTS PERFORMED

15.1 Diode Wheels

Diode Leakage Current Measurement
Diode Forward and Reverse Resistance Measurement
Fuse Resistance Measurement
Capacitor Capacitance Test
Capacitor Charge Test
Diode Wheel Insulation Resistance Measurement
Diode Wheel Component Insulation Resistance Measurement

15.2 Exciter Rotor

AC Armature Winding DC Resistance Measurement
AC Armature Winding Insulation Resistance Measurement

15.3 Exciter Frame

PMG Armature DC Resistance Measurement
PMG Armature Insulation Resistance Measurement
AC Stator Winding DC Resistance Measurement
AC Stator Winding Insulation Resistance Measurement
AC Stator Field Pole Drop Measurement

16.0 DIODE WHEEL TESTS

With 1000 Volts DC momentarily applied to each diode in the reverse bias direction, the leakage current was measured and recorded. All diodes had leakage currents under the 45 mA limit, Except for diodes on Modules 10 and 20 on the inboard wheel and Module 20 on the outboard wheel. These diodes were replaced with new components.

16.1 Diode Forward and Reverse Resistance Measurement

The front to back ratio of each diode was measured and recorded using an analog ohmmeter. All diodes except Modules 10 and 20 on the inboard wheel and Module 20 on the outboard wheel had satisfactory readings.

16.2 Fuse Resistance Measurement

The internal resistance of each diode fuse on both wheels was measured and recorded using a DLRO. Nine inboard and five outboard fuses had unacceptable internal resistance readings. These fuses were replaced with new fuses.

16.3 Capacitor Capacitance Test

The capacitance of each capacitor in the diode modules was measured with a digital low voltage capacitance tester. Capacitors on assembly 8-inboard, assembly 12-inboard, assembly 10-outboard and assembly 24-outboard were defective and were replaced with new capacitors from the customer stock. All others were found within the acceptable specified limits.

16.4 Capacitor Charge Test

The charge rate of each capacitor in both wheels was checked with an analog ohmmeter on the Rx10,000 scale. Capacitors on assembly 8-inboard, assembly 12-inboard, assembly 10-outboard and assembly 24-outboard were defective and were replaced with new capacitors from the customer stock. All other capacitors read within the acceptable limits.

16.5 Diode Wheel Insulation Resistance Measurement

After the diode wheel was cleaned, the insulation between the wheel and the exciter shaft was meggered at 500 Volts DC and read 100+ Megohms.

16.6 Diode Wheel Component Insulation Resistance Measurement

During reassembly of the components in the diode wheel, the insulation resistance of each module was meggered between the module and diode wheel. This test was performed after the heat sinks were connected to the heat sink connector and tightened down on the heat sink insulation. All sets read greater than 500 megohms at 500 Volts DC.

17.0 EXCITER ROTOR TESTS

17.1 AC Armature Winding Resistance Measurement

The resistance of each phase of the AC armature winding was measured from the phase post connection points in the diode wheel using a DLRO with the following results. Each parallel conductor was tested and read a comparable value. Resistance measurements ranged from 1,320 to 1,348 micro ohms.

17.2 AC Armature Insulation Resistance Measurements

The insulation resistance of the AC armature winding was meggered between the winding and the exciter rotor and read 21.8 gigohms after 1 minute at 500 Volts DC. This test was performed prior to reassembly of the diode wheel.

18.0 EXCITER FRAME TESTS

18.1 AC Stator Field Pole Drop and Impedance Measurement

A pole drop test was performed on the AC field poles by applying 119 Volts AC to the field leads and reading the voltage drop across each half to the midpoint connection at the stator split. The current was measured so that the winding impedance could be calculated. See Datasheet 87-1 for details.

18.2 AC Stator Winding Resistance Measurement

The resistance of the AC field winding was measured using a DLRO. See Datasheets 87-1 for details.

18.3 AC Stator Winding Insulation Resistance Measurement

The insulation resistance of the AC stator winding was meggered between the winding and the exciter frame and read 291+ gigohms after 1 minute at 500 Volts DC.

18.4 PMG Armature Winding Resistance Measurement

The resistance of each phase of the PMG armature winding was measured using a DLRO:

Phase	R at 20° C	R at 75° C
T10-T20	0.01002 milliohms	0.0117 milliohms
T10-T30	0.01078 milliohms	0.0126 milliohms
T20-T30	0.01075 milliohms	0.0125 milliohms

19.0 REPAIRS

The defective capacitors, at No. 8 module-inboard, No. 12 module-inboard, No. 10 module-outboard and No. 24 module-outboard were replaced with spare module from the customer's stock. The weight of the replacement module was matched to within +/- one gram of the module it replaced. The 15 diode fuses with high internal resistances were replaced with all new fuses of the same style from the customers stock. The weight of each fuse was matched to within one gram of the fuse it replaced.

20.0 REASSEMBLY

After all testing and repairs were completed, reassembly of the diode wheels began to follow the procedure in FP-373. A thorough inspection of the diode wheels was performed during reassembly to ensure their cleanliness and freedom from foreign objects.

21.0 SUMMARY AND RECOMMENDATIONS

Following this overhaul, this exciter should be in excellent condition to return to normal service.

Standard preventive maintenance practices should be continued, such as the removal of the air ducts from in front of the diode wheels during scheduled outages of sufficient duration to test fuse resistance and make a visual inspection of the diode wheel components.

WINDING RESISTANCE MEASUREMENTS

CUSTOMER: **PPL**

STATION/UNIT: **Colstrip 4** S.O. NO.: **85P500**

TEST INSTRUMENT: **Kelvin Bridge** INSTRUMENT S/N: 7800329-10000587

CALIBRATION DUE DATE: **4-29-2014**

TESTER: Fred Clickner/Evan Niemann DATE: **5-22-2013**

STATOR TEMPERATURE 20.8 °C

PHASE	AS READ (OHMS)	CORRECTED TO 75° C (OHMS)	2009 Values Corrected (OHMS)
T1 - T4	0.000920	0.0012294	0.0011274
T2 - T5	0.000918	0.0122454	0.0011216
T3 - T6	0.000920	0.0123074	0.0011261

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

STATOR WINDING INSULATION RESISTANCE MEASUREMENTS

CUSTOMER: **PPL** S.O. NO.: **85P500**

STATION: **Colstrip** UNIT NO.: **U4**

INSPECTOR: **Fred Clickner** DATE: **June 2, 2013**

TEST EQUIPMENT INFORMATION:

TEST INSTRUMENT: **AVO Megger** CALIB. DUE DATE: **April 29, 2014**

INSTRUMENT NO.: 7800208-10012234 TEST VOLTAGE: **5000 VDC**

TEMPERATURE OF WINDING: **22.0°C** SCALE MULTIPLIER: **N/A**

	INSULATION RESISTANCE (GIGOHMS)		
MINUTES	**$T_1 – T_4$**	**T_2 - T_5**	**T_3 - T_6**
.25	3.2	.2	3.3
.50	6.8	6.6	7.0
.75	10.2	10.2	9.8
1.0	13.0	12.2	13.0
1.5	18.8	17.4	18.5
2.0	23.6	21.7	23.2
2.5	27.9	26.2	27.7
3.0	32.7	29.2	32.0
4.0	39.2	36.2	39.0
5.0	45.6	41.4	46.3
6.0	51.4	46.6	52.4
7.0	56.8	51.7	58.7
8.0	62.0	55.9	64.0
9.0	66.2	60.4	69.8
10.0	70.9	64.4	74.8
P.I.	**5.37**	**5.23**	**5.72**

P.I. = The polarization index is the ratio of the ten minute insulation resistance to the one minute insulation resistance. This ratio should be greater than 2.0 before proceeding with the high potential tests.

P.I. = R_{10}/R_1

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

GENERATOR HIGH POTENTIAL TEST DATA

GENERAL INFORMATION:

CUSTOMER: PPL STATION/UNIT: Colstrip
STATOR VOLTAGE (NAMEPLATE): 26000 S.O. NO.: 85P500

TEST EQUIPMENT INFORMATION:

TEST INSTRUMENTS(S): AVO Megger S/N: 78000208-10(CALIB. DUE DATE: 4/29/2014
Von DC Hi Pot S/N: 7800454-100(CALIB. DUE DATE: 4/1/2014

WINDING INSULATION RESISTANCE @ 2500 VDC: MIN. P.I. >=2

T1-T4: 85 megohms P.I.: 6
T2-T5: 70.4 megohms P.I.: 5.5
T3-T6: 71.6 megohms P.I.: 5.6

CONDUCTIVITY OF STATOR COOLING WATER: _____ (FOR A.C. ONLY)

ENVIROMENT CONDITIONS:

BAROMETRIC PRESSURE: 26.67 TEMPERATURE: 23 C
RELATIVE HUMIDITY: 50

METER CORRECTION/VERIFICATION:

TEST VOLTAGE (CALCULATED): 57 KV CORRECTION FACTOR: 0.894
CORRECTED TEST VOLTAGE: 63.792 KV SPHERE GAP SETTING: 0.874 inches
METER VOLTAGE OF FLASHOVER AT SPHERE GAP: 57000 1ST
57000 2ND
57000 3RD

WINDING TEST DATA:

T1-T4: 32 (final leakage current)
T2-T5: 28 (final leakage current)
T3-T6: 20 (final leakage current)

COMMENTS:

TESTER(S): Patryk Ruchniak DATE: 5/18/2013

© Siemens Energy, Inc.
Field Quality Assurance Form 76-2 Rev. 3
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc

GENERATOR HIGH POTENTIAL TEST DATA

CUSTOMER: PPL STATION/UNIT: Colstrip 4

STATOR VOLTAGE: 26000 S.O. NO.: 85P500 TESTER(S): Patryk Ruchniak

DATE: 5/18/2013

DIELECTRIC ABSORPTION DATA			
PHASE	T1 - T4	T2 - T5	T3 - T6
TEST VOLTAGE	15 kV	15 kV	15 kV
MINUTES	MU-a	MU-a	MU-a
0.5	1.00	1.40	1.20
0.75	1.00	1.00	1.20
1	1.00	1.20	1.00
1.5	1.00	0.80	0.80
2	0.80	1.20	0.40
2.5	0.90	1.00	0.80
3	0.60	0.80	0.40
3.5	0.80	0.40	0.20
4	0.60	0.40	0.40
5	0.40	0.40	0.20
6	1.00	0.20	0.40
7	0.80	0.40	0.40
8	0.80	0.40	0.40
9	0.50	0.20	0.40
10	0.40	0.40	0.20
PI (I1/I10)	2.50	3.00	5.00
AR	1	2	12

LEAKAGE DATA								
PHASE T1-T4			PHASE T2 - T5			PHASE T3 - T6		
kV	TIME	MU-a	kV	TIME	MU-a	kV	TIME	MU-a
15	10'-00"	0.4	15	10’-00"	0.4	15	10’-00"	0.2
18	13’-44”	0.4	18	13’-14”	0.8	18	14’-10”	0.3
21	16’-53”	0.3	21	15’-56”	1	21	17’-47”	1.2
24	19’-42”	0.2	24	18’-17”	1.2	24	21’-02”	0.8
27	22’-14”	0.4	27	20’-24”	1.2	27	24’-01”	2
30	24’-34”	0.8	30	22’-19”	1.8	30	26’-46”	1
33	26’-43”	1.2	33	24’-04”	1.8	33	29’-23”	1
36	28’-45”	2.2	36	25’-42”	2.2	36	31’-50”	1.4
39	30’-38”	2.4	39	27’-12”	2.4	39	34’-08”	1.4
42	32’-25”	4	42	28’-37”	4.4	42	36’-20”	2
45	34’-07”	4.8	45	29’-57”	5	45	38’-26”	2.4
48	35’-43”	7	48	31’-12”	10	48	40'-26”	2.4
51	37’-14”	13	51	32’-23”	13	51	42’-21”	8.4
54	38’-41”	20	54	33’-31”	19	54	44’-11”	14
57	40’-05”	32	57	34’-35”	28	57	46’-57”	20

© Siemens Energy, Inc.
Field Quality Assurance Form 76-2 Rev. 3
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

STATOR WINDING INSULATION RESISTANCE MEASUREMENTS

CUSTOMER: PPL S.O. NO.: 85P500
STATION: Colstrip UNIT: 4
TESTER(S): Patryk Ruchniak DATE: 5/18/2013

TEST EQUIPMENT INFORMATION:

TEST INSTRUMENT: AVO Megger CALIB. DUE DATE: 5/18/2013
INSTRUMENT NO.: 7800208-10012234 TEST VOLTAGE: 2500 Volts D.C.
TEMPERATURE OF WINDING: 22.6

INSULATION RESISTANCE (MEGOHMS)			
MINUTES	T1 - T4	T2 - T5	T3 - T6
.25	3.04	3.08	3.18
.50	7.84	6.82	6.55
.75	10.9	10	9.94
1.0	14.1	12.8	12.7
1.5	20.1	17.9	17.6
2.0	25.5	22.4	22.2
2.5	30.3	26.6	26.2
3.0	35	30.3	29.9
4.0	43.6	37.2	37
5.0	51.6	43.6	43.6
6.0	59	49.7	49.7
7.0	66.1	55.2	55.5
8.0	72.8	60.6	61.2
9.0	79.2	65.6	66.4
10.0	85	70.4	71.6
P.I.	6.03	5.5	5.64

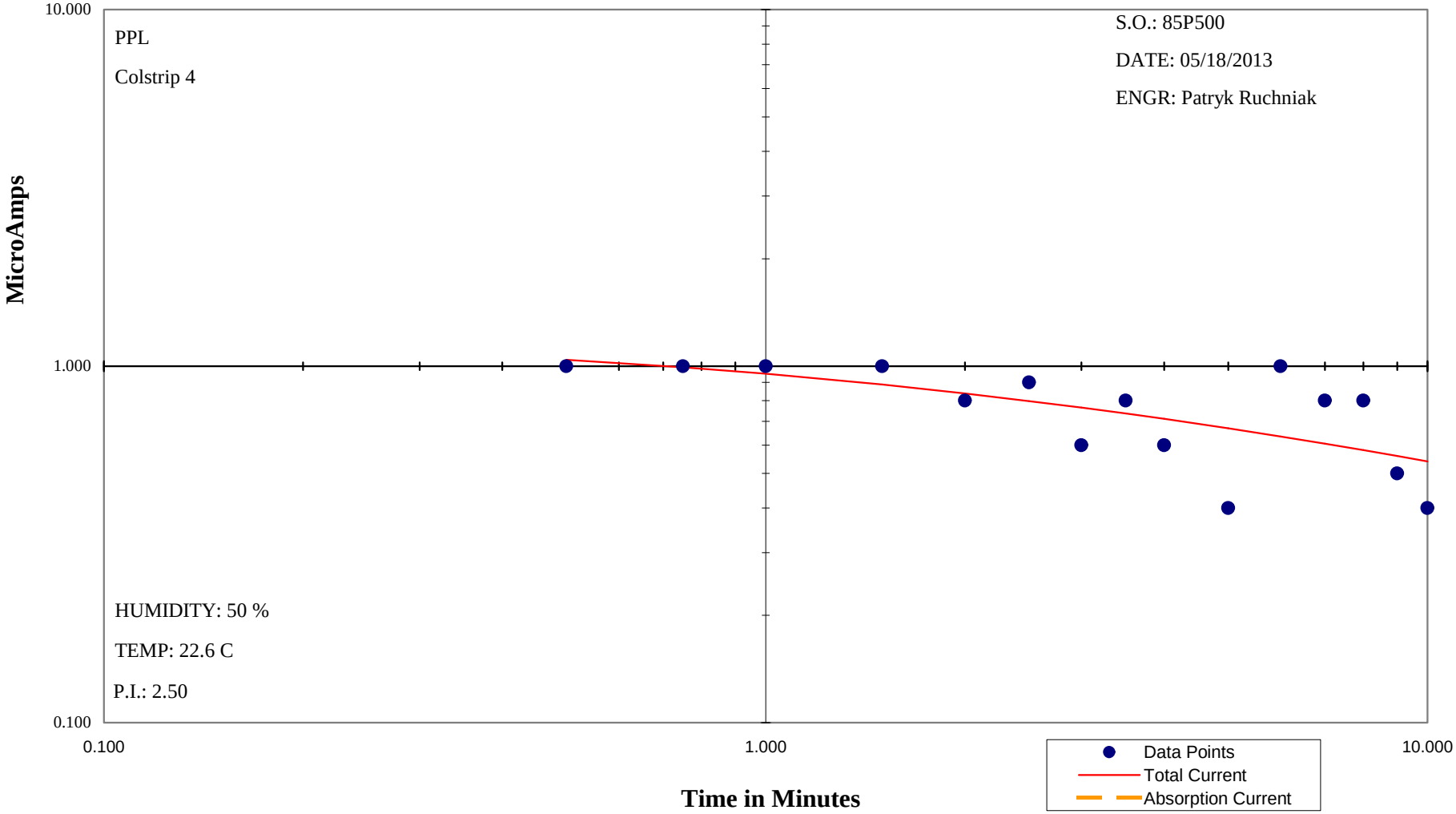
P.I. = The polarization index is the ratio of the ten minute insulation resistance to the one minute insulation resistance. This ratio should be greater than 2.0 before proceeding with the high potential tests.

© Siemens Energy, Inc.
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SIEMENS

DIELECTRIC ABSORPTION CHARACTERISTICS

Curve: 1 VOLTS: 15 kV PHASE T1-T4

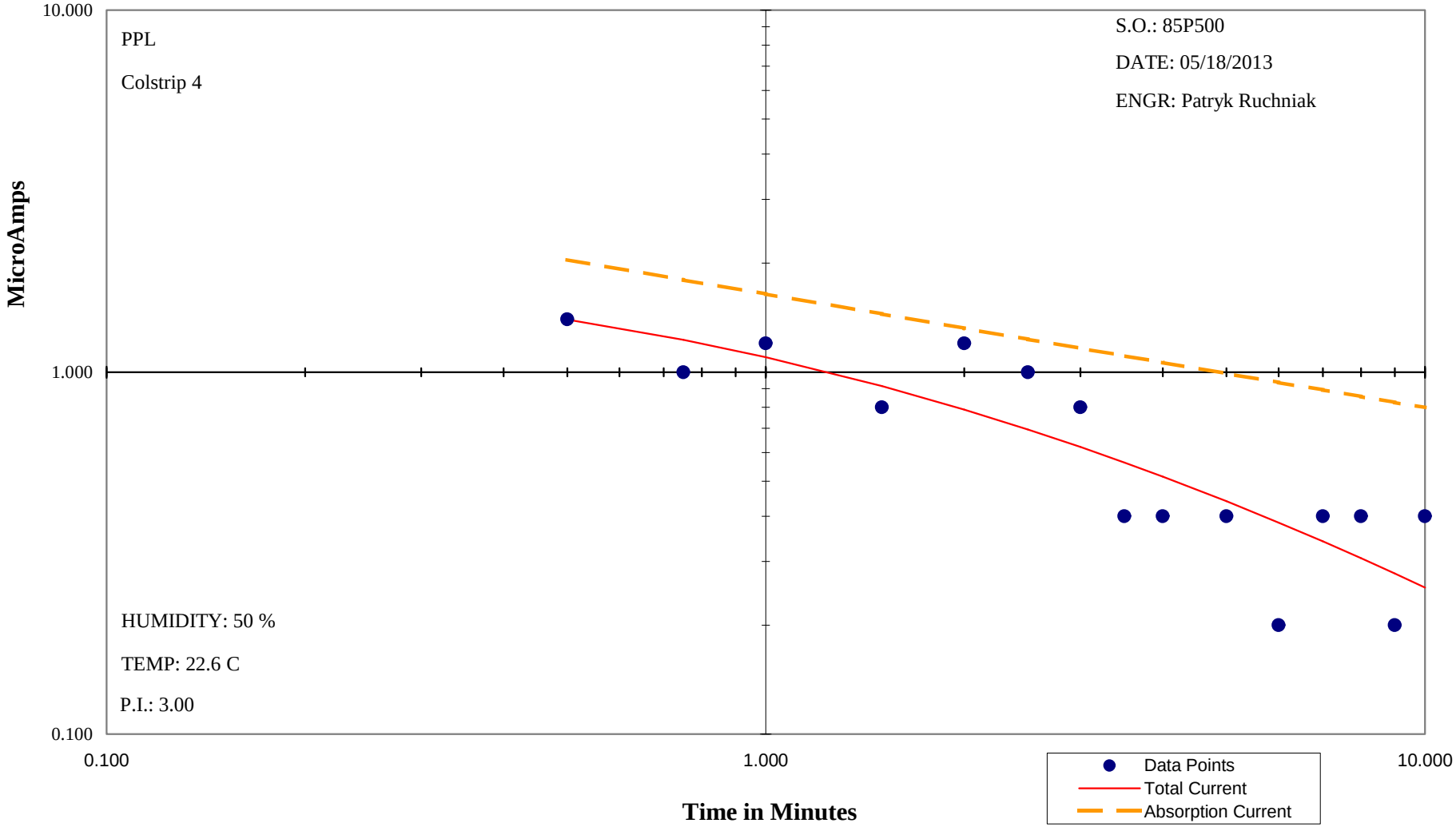


© Siemens Energy, Inc.
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SIEMENS

DIELECTRIC ABSORPTION CHARACTERISTICS

Curve: 2 VOLTS: 15 kV PHASE: T2-T5

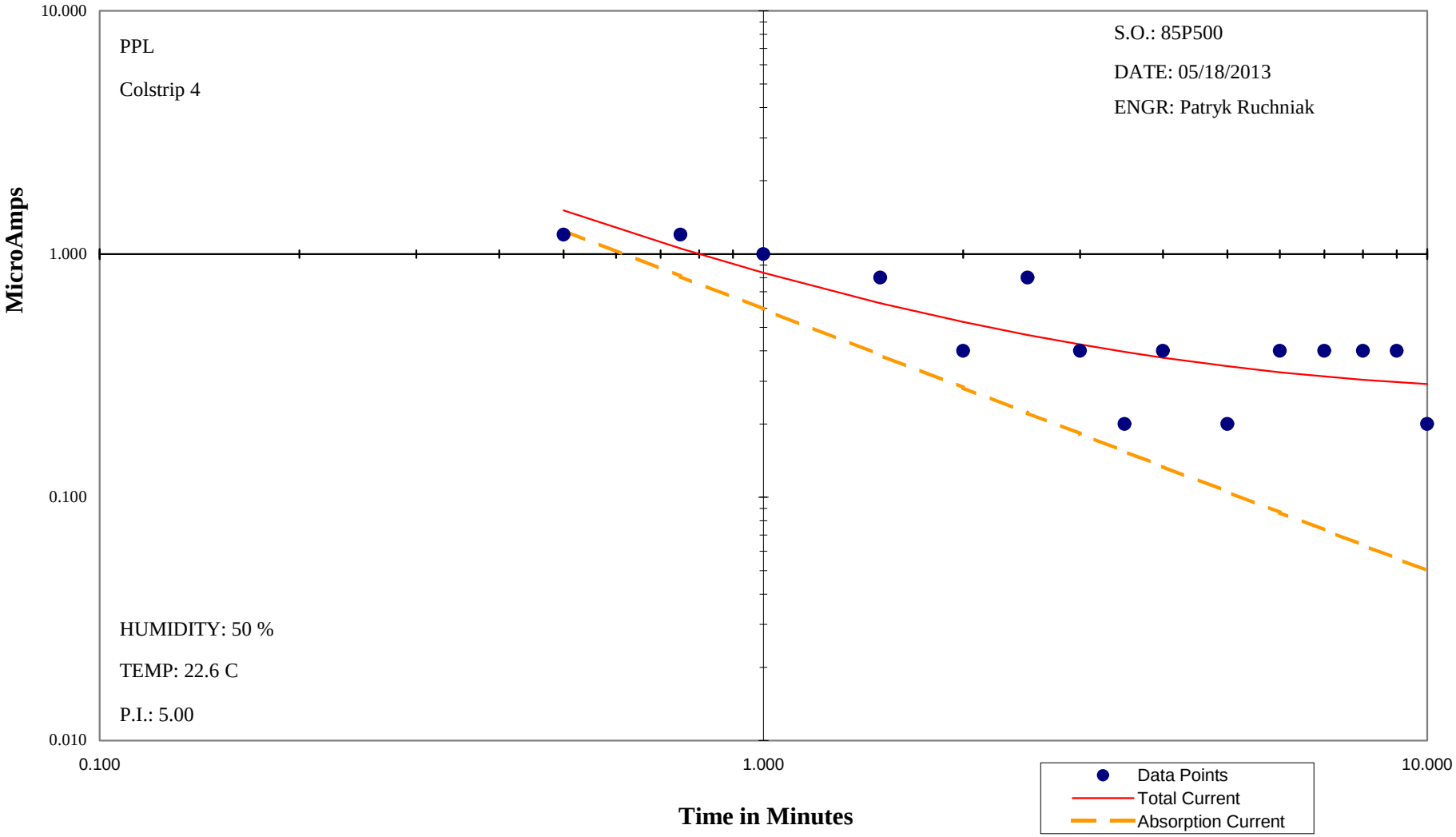


© Siemens Energy, Inc.
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SIEMENS

DIELECTRIC ABSORPTION CHARACTERISTICS

Curve: 3 VOLTS: 15 kV PHASE: T3-T6

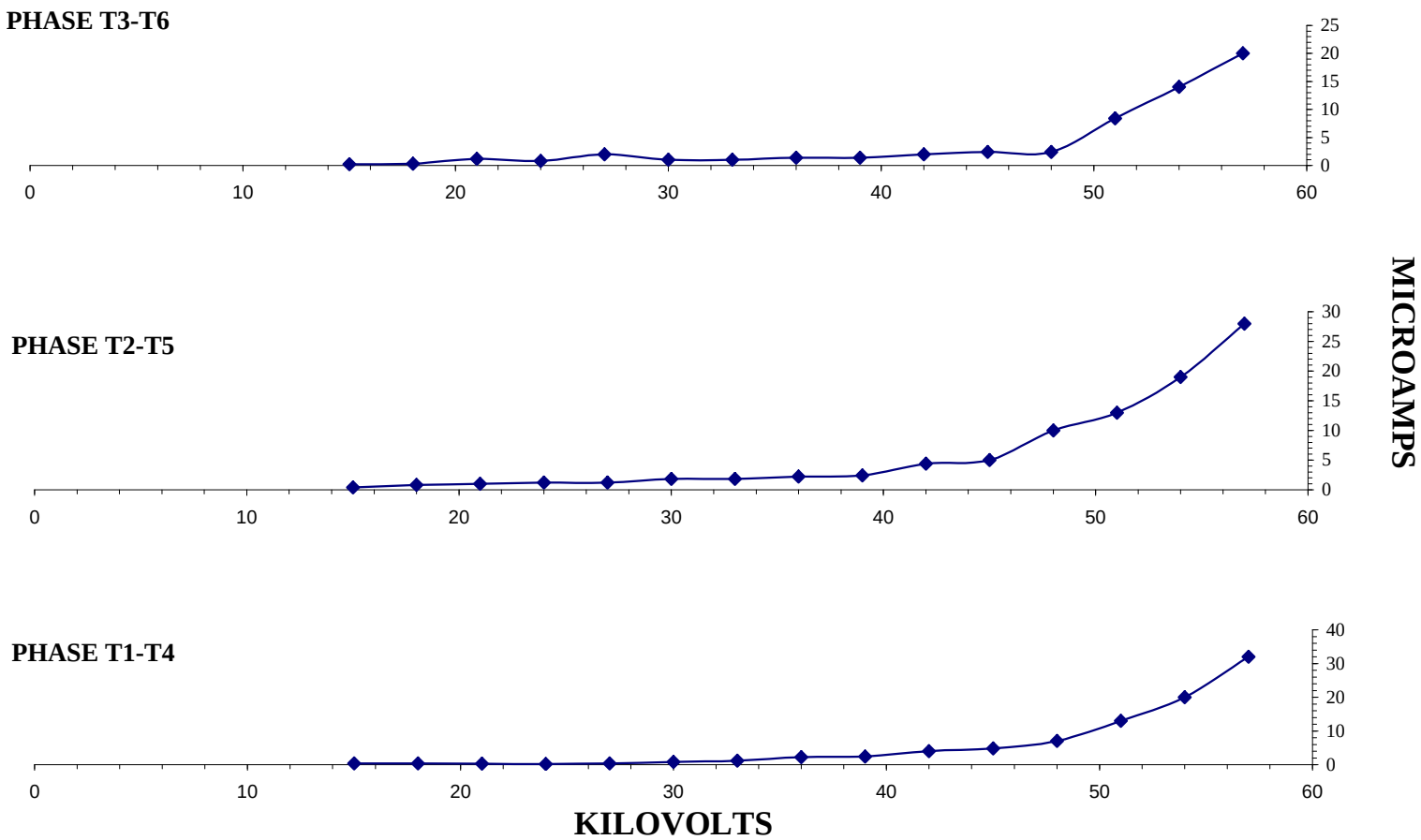


© Siemens Energy, Inc.
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SIEMENS

LEAKAGE VOLTAGE

PPL, Colstrip 4



© Siemens Energy, Inc.
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

RESISTANCE TEMPERATURE DETECTOR TESTING

CUSTOMER: PP&L Montana DETECTOR: PLATINUM 100 OHM U.S.

STATION/UNIT: Colstrip Unit 4 DATE: May 23rd, 2013

ENGINEER: Evan Niemann SHOP ORDER: 85P500

TEST INSTRUMENT: Minko Valhalla Kelvin Bridge INSTRUMENT S/N: Minko: N Kelvin Brid

CALIBRATION DUE DATE: Minko: 6/19/2013 Kelvin Bridge: May 3, 2014

RTD NO.	LOCATION	RESISTANCE (OHMS)			$RE = \left[\frac{R_{RY} + R_{RG}}{2}\right] - R_{YG}$ ELEMENT RESISTANCE (OHMS)	CALCUL-ATED TEMP. °C	MEASURED TEMP. °C	TEMP. DEVIATION
		R-Y	R-G	Y-G				
71	Emb RTD	108.79	108.79	0.23	108.56	21.6	22.6	1.0
72	Emb RTD	108.90	108.90	0.20	108.70	22.0	22.6	0.6
73	Emb RTD	108.80	108.80	0.19	108.61	21.7	22.6	0.9
74	Emb RTD	108.76	108.76	0.22	108.54	21.5	22.6	1.1
75	Emb RTD	108.81	108.81	0.28	108.53	21.5	22.6	1.1
76	Emb RTD	108.74	108.74	0.26	108.48	21.4	22.6	1.2
51	CG RTD	108.630	108.630	0.150	108.48	21.4	21.9	0.5
51 ATC	CG RTD	108.640	108.640	0.150	108.49	21.4	21.9	0.5
52	CG RTD	108.590	108.580	0.150	108.44	21.3	21.9	0.6
52 ATC	CG RTD	108.640	108.640	0.150	108.49	21.4	21.9	0.5
53	WG RTD	108.690	108.690	0.380	108.31	21.0	22.0	1.0

Field Quality Assurance Form 76-7 Rev. 8
Platinum - US

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclos
reproduce or use otherwise without written consent of Siemens Energy, Inc.

FIBER OPTIC TOTAL SYSTEM TESTS

CUSTOMER: **PPL** S.O. NO.: **85P500**

STATION: **Colstrip** UNIT NO.: **4**

ENGINEER: **P.Ruchniak** DATE: **5-20-2013**

TEST INSTRUMENT: Light Loss Meter INSTRUMENT NO: NK015M15-18

CALIBRATION DUE DATE: **4-26-2014**

TOTAL SYSTEM - STATIC LIGHT LOSS TEST (SYSTEM IS TOTALLY INSTALLED IN THE GENERATOR)

Sensor No.	Sensor/System Light Loss (-dB)	2006 Values
1	24.81	22.1
2	14.31	13.7
3	30.01	19.6
4	17.39	15.3
5	19.03	19.7
6	24.74	21.4
7	25.30	25.5
8	25.49	24.5
9	20.05	16.5
10	26.80	22.3
11	15.45	13.4
12	23.93	24.4

© Siemens Energy Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy Inc.

BRUSHLESS EXCITER STATOR (FIELD) WINDING TEST DATA

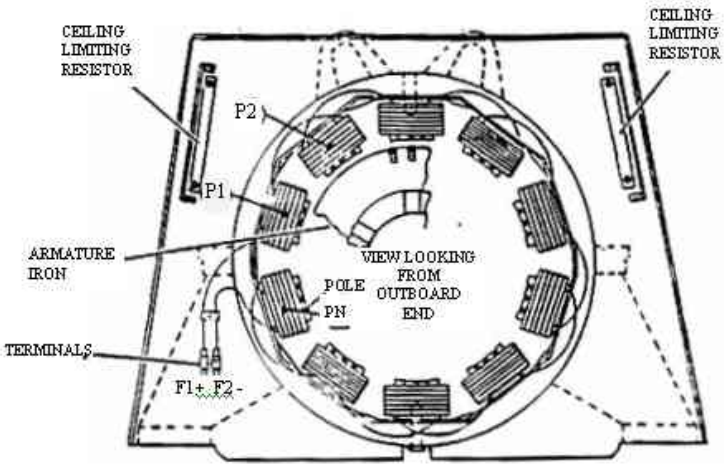
CUSTOMER: **PPL** STATION: **Colstrip** UNIT NO.: **4**

S.O. NO.: **85P500** ENGINEER: **Patryk Ruchniak** DATE: **5/13/13**

TEST INSTRUMENTS: **Kelvin Bridge** **AVO Megger** **Pole Balance** **Fluke Multi Meter**

INSTRUMENT S/N: **7800329-10000587 / 7800208-10012234 / 7800211-13534605 / 18-085E09-01**

CAL. DUE DATES: **5/3/2014 / 4/29/2014 / 4/25/2014 / 3/18/14**



AC STATOR WINDING RESISTANCE DATA		
WINDING RESISTANCE:	**0.0225**	Ω
WINDING TEMPERATURE (°C):	**26.7**	°C
CORRECTED RESISTANCE AT 75°C:	**0.02666**	Ω
ORIGINAL RESISTANCE AT 75°C:	**0.02491**	Ω
LIMITING RESISTOR RESISTANCE:	**N/A**	Ω
LIMITING RESISTOR TEMPERATURE:	**N/A**	°(C/F)
ORIGINAL LIMITING RESISTOR RES.:	**N/A**	Ω
AC STATOR WINDING INSULATION RESISTANCE		
TEST VOLTAGE:	**500**	VDC
INSULATION RESISTANCE AT 1 MIN.:	**58.1**	GΩ
AC STATOR WINDING IMPEDANCE DATA		
AC VOLTS (V):	**119.0**	
AMPERES (I):	**9.1**	
IMPEDANCE (V/I):	**13.1**	Ω

AC EXCITER POLE BALANCE DATA			
POLE NO.	VOLTAGE DROP (VAC)	POLE NO.	VOLTAGE DROP (VAC)
P1	14.53	P13	NA
P2	14.30	P14	NA
P3	14.34	P15	NA
P4	14.51	P16	NA
P5	14.93	P17	NA
P6	15.37	P18	NA
P7	15.55	P19	NA
P8	15.25	P20	NA
P9	NA	P21	NA
P10	NA	P22	NA
P11	NA	P23	NA
P12	NA	P24	NA

Key:

$R_{75°C}$ = Resistance Corrected to 75° C
Rm = Measured Resistance
T = Temperature in °C

$$R_{75°C} = R_m \left[\frac{309.5}{234.5+T} \right]$$

°C = 0.555 (°F - 32)

Field Quality Assurance Form 87-1 Rev. 6

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

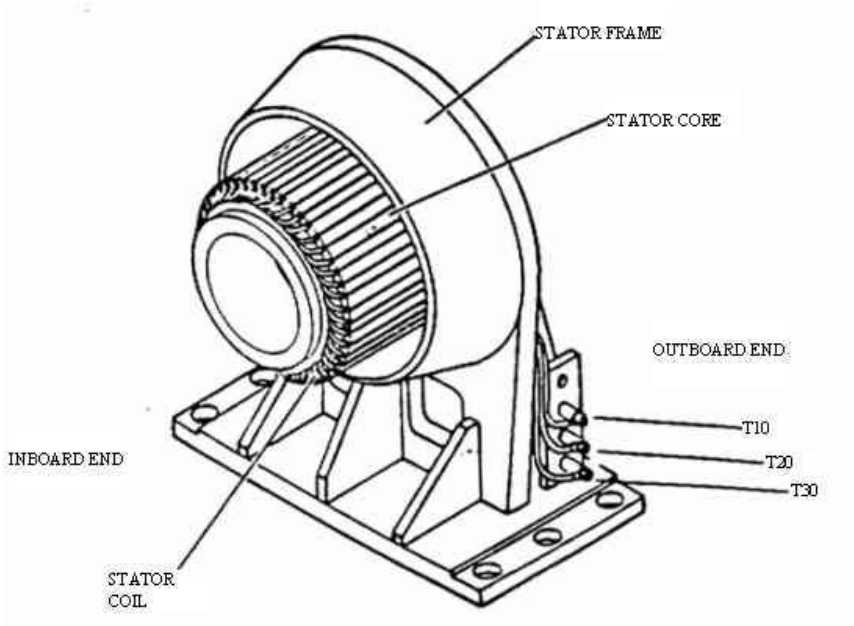
BRUSHLESS EXCITER PMG TEST DATA

CUSTOMER: **PPL** STATION: **Colstrip** UNIT NO.: **4**

S.O. NO.: **85P500** ENGINEER: **Fred Clickner** DATE: **5/14/13**

LOW RESISTANCE OHMMETER ID NO.: **7800175-10012460** CALIB. DUE DATE: **4/30/14**

HAND MEGGER ID NO.: **N/A** CALIB. DUE DATE: **N/A**



PMG STATOR WINDING INSULATION RESISTANCE DATA

	500	VDC
RESISTANCE @ 1 MINUTE:	**291**	GΩ

$$R_{75HC} = R_m \left[\frac{309.5}{234.5+T} \right]$$

°C = 0.555 (°F - 32)

R_{75HC} = Resistance Corrected to 75HC
Rm = Measured Resistance
T = Temperature in HC

PMG STATOR WINDING RESISTANCE DATA

PMG WINDING	MEASURED RESISTANCE AT **31.1** °C	CORRECTED RESISTANCE TO 75°C
T10 - T20:	**0.01002** Ω	0.0117 Ω
T20 - T30:	**0.01078** Ω	0.0126 Ω
T30 - T10:	**0.01075** Ω	0.0125 Ω

AVERAGE CORRECTED RESISTANCE TO 75°C: 0.01225 Ω

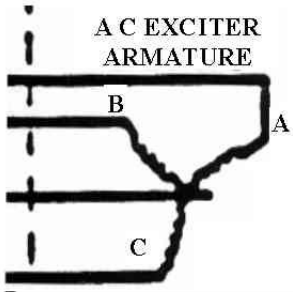
ORIGINAL / PREVIOUS AVERAGE CORRECTED RESISTANCE TO 75°C: 0.01240 Ω

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

BRUSHLESS EXCITER ARMATURE WINDING TEST DATA

CUSTOMER: **PPL** STATION: **Colstrip** UNIT NO.: **4**

S.O. NO.: **85P500** ENGINEER: **Patryk Ruchniak** DATE: **5/14/13**



TEST INSTRUMENTS	INSTRUMENT SERIAL NO.'S	CALIB. DUE DATES
AVO Megger	7800208-10012234	4/29/14
Biddle D.L.R.O.	7800175-10012460	4/30/14

ARMATURE WINDING RESISTANCE DATA

WINDING TEMPERATURE: **26.6** C

ARMATURE WINDING INSULATION RESISTANCE DATA

TEST VOLTAGE: **500** VDC

INSULATION RESISTANCE AT 1 MINUTE: **21.8** Gigohms

WINDING RESISTANCE AVERAGE CORRECTED At 75C: **0.001589 µohms**

ORIGINAL/PREVIOUS WINDING RESISTANCE AT 75 C: **0.001763 µohms**

ARMATURE WINDING RESISTANCES IN MICROHMS

LEAD NO.	RESISTANCE	LEAD NO.	RESISTANCE	LEAD NO.	RESISTANCE	LEAD NO.	RESISTANCE
1-2	**1329**	16-17	**1335**	31-32	NA	46-47	NA
2-3	**1320**	17-18	**1335**	32-33	NA	47-48	NA
3-4	**1333**	18-19	**1335**	33-34	NA	48-49	NA
4-5	**1323**	19-20	**1340**	34-35	NA	49-50	NA
5-6	**1343**	20-21	**1325**	35-36	NA	50-51	NA
6-7	**1343**	21-22	**1335**	36-37	NA	51-52	NA
7-8	**1343**	22-23	**1333**	37-38	NA	52-53	NA
8-9	**1330**	23-24	**1335**	38-39	NA	53-54	NA
9-10	**1326**	24-25	NA	39-40	NA	54-55	NA
10-11	**1343**	25-26	NA	40-41	NA	55-56	NA
11-12	**1348**	26-27	NA	41-42	NA	56-57	NA
12-13	**1`336**	27-28	NA	42-43	NA	57-58	NA
13-14	**1348**	28-29	NA	43-44	NA	58-59	NA
14-15	**1328**	29-30	NA	44-45	NA	59-60	NA
15-16	**1338**	30-31	NA	45-46	NA	60-1	NA

Field Quality Assurance Form 87-4 Rev. 6

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

DOUBLE WHEEL BRUSHLESS EXCITER MODULE / HEAT SINK INSULATION RESISTANCES

CUSTOMER: **PPL** S.O. NO.: **85P500**

STATION: **Colstrip** UNIT NO.: **U4**

ENGINEER: **F. Clicikner** DATE: **6/6/13** MEGGER ID NO.: 7800338-10000783

CALIBRATION DUE DATE: **4/5/2014** TEST VOLTAGE: 500 VOLTS D.C.

Mod./Heat Sink No.	Insulation Resistance (Megohms)	Mod./Heat Sink No.	Insulation Resistance (Megohms)
1	10 +	1	10 +
2	10 +	2	10 +
3	10 +	3	10 +
4	10 +	4	10 +
5	10 +	5	10 +
6	10 +	6	10 +
7	10 +	7	10 +
8	10 +	8	10 +
9	10 +	9	10 +
10	10 +	10	10 +
11	10 +	11	10 +
12	10 +	12	10 +
13	10 +	13	10 +
14	10 +	14	10 +
15	10 +	15	10 +
16	10 +	16	10 +
17	10 +	17	10 +
18	10 +	18	10 +
19	10 +	19	10 +
20	10 +	20	10 +
21	10 +	21	10 +
22	10 +	22	10 +
23	10 +	23	10 +
24	10 +	24	10 +

Inboard Wheel – Shaft: 420 Megohms Outboard Wheel – Shaft: 382 Megohms

Inboard Wheel – Outboard Wheel: 0 Megohms

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

BRUSHLESS EXCITER MARK III

DIODE RESISTANCE AND CAPACITOR CHARGE-DISCHARGE TEST

CUSTOMER: **PPL** S.O. NO.: **85P501**

STATION: **Colstrip** UNIT NO.: **4**

ENGINEER: **Evan Niemann** DATE: **5/21/2013**

ANALOG MULTIMETER NO.: **7800401-10001079** CALIBRATION DUE DATE: **3-11-2014**

*Check which applies: Single Wheel___**Double Wheel Outboard Wheel** _X_ Double Wheel Inboard

Note: On double wheel designs both diodes on each module are checked together as one pair.

MODULE NO.	Diode Forward Resistance (Ohms)		Diode Reverse Resistance (Megohms)		Yes/No Capacitor Discharge Check (Meter Needle Deflection)	
	INBOARD	OUTBOARD	INBOARD	OUTBOARD	INBOARD	OUTBOARD
1	6.0	7.0	+ 20 MΩ	+ 20 MΩ	√	√
2	7.0	8.0	+ 20 MΩ	+ 20 MΩ	√	√
3 (new module assembly)	6.25	6.5	+ 20 MΩ	+ 20 MΩ	√	√
4	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
5	6.0	6.25	+ 20 MΩ	+ 20 MΩ	√	√
6	6.2	6.5	+ 20 MΩ	+ 20 MΩ	√	√
7	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
8	6.0	6.1	+ 20 MΩ	+ 20 MΩ	No	No
9	5.5	6.0	+ 20 MΩ	+ 20 MΩ	√	√
10	6.5	6.5	500kΩ	+ 20 MΩ	√	√
11	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
12	6.0	6.0	+ 20 MΩ	+ 20 MΩ	No	No
13	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
14	5.5	5.5	+ 20 MΩ	+ 20 MΩ	√	√
15	6.0	6.5	+ 20 MΩ	+ 20 MΩ	√	√
16	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
17	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
18	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
19	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
20	6.0	6.0	500kΩ	500kΩ	√	√
21	6.0	7.0	+ 20 MΩ	+ 20 MΩ	√	√
22	6.5	7.5	+ 20 MΩ	+ 20 MΩ	√	√
23	7.0	6.5	+ 20 MΩ	+ 20 MΩ	√	√
24	6.5	7.0	+ 20 MΩ	+ 20 MΩ	No	No

* Inboard denotes Coupling side and outboard denotes PMG side of exciter.

Field Quality Assurance Form 99-5 Rev. 5

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

BRUSHLESS EXCITER MARK III

DIODE RESISTANCE AND CAPACITOR CHARGE-DISCHARGE TEST

CUSTOMER: **PPL** S.O. NO.: **85P501**

STATION: **Colstrip** UNIT NO.: **4**

ENGINEER: **Evan Niemann** DATE: 5/21/2013

ANALOG MULTIMETER NO.: 7800401-10001079 CALIBRATION DUE DATE: 3-11-2014

*Check which applies: ___Single Wheel _X__Double Wheel Outboard Wheel ___Double Wheel Inboard

Note: On double wheel designs both diodes on each module are checked together as one pair.

MODULE NO.	Diode Forward Resistance (Ohms)		Diode Reverse Resistance (Megohms)		Yes/No Capacitor Discharge Check (Meter Needle Deflection)	
	INBOARD	OUTBOARD	INBOARD	OUTBOARD	INBOARD	OUTBOARD
1	7.0	6.5	+ 20 MΩ	+ 20 MΩ	√	√
2	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
3	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
4	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
5	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
6	7.0	7.0	+ 20 MΩ	+ 20 MΩ	√	√
7	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
8	7.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
9	6.5	6.0	+ 20 MΩ	+ 20 MΩ	√	√
10	6.0	5.5	+ 20 MΩ	+ 20 MΩ	No	No
11	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
12	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
13	6.0	6.5	+ 20 MΩ	+ 20 MΩ	√	√
14	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
15	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
16	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
17	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
18	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
19	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
20	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
21	6.5	6.5	+ 20 MΩ	+ 20 MΩ	√	√
22	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
23	6.0	6.0	+ 20 MΩ	+ 20 MΩ	√	√
24	6.5	7.0	+ 20 MΩ	+ 20 MΩ	No	No

* Inboard denotes Coupling side and outboard denotes PMG side of exciter.

Field Quality Assurance Form 99-5 Rev. 5

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

BRUSHLESS EXCITER FUSE RESISTANCE DATA

CUSTOMER: **PPL** STATION/UNIT: **Colstrip U4** S.O. NO.: **85P500**

TEST INSTRUMENT: **D.L.R.O.** INSTRUMENT SERIAL NO.: **7800383-10012460** CALIB. DUE DATE: **4/30/2014**

FUSE IDENTIFICATION: **7811D04 850 V 670 A** MAXIMUM ACCEPTABLE FUSE RESISTANCE @ 25°C: $R_{25°C} = R_T(1.095 - .0038\ T)$

INBOARD SIDE (Readings in Microhms)				INBOARD SIDE (Readings in Microhms)			
FUSE NO.	AS READ (RT)	CORRECTED TO 25°C (R25°C)	LAST INSPECTION READING	FUSE NO.	AS READ (RT)	CORRECTED TO 25°C (R25°C)	LAST INSPECTION READING
1-1	113.000	**114.074**		13-1	114.000	**115.083**	
1-2	115.000	**116.093**		13-2	118.000	**119.121**	
2-1	124.000	**125.178**		14-1	137.000	**138.302**	
2-2	119.000	**120.131**		14-2	185.000	**186.758**	
3-1	117.000	**118.112**		15-1	118.000	**119.121**	
3-2	116.000	**117.102**		15-2	116.000	**117.102**	
4-1	117.000	**118.112**		16-1	115.000	**116.093**	
4-2	115.000	**116.093**		16-2	113.000	**114.074**	
5-1	117.000	**118.112**		17-1	115.000	**116.093**	
5-2	146.000	**147.387**		17-2	113.000	**114.074**	
6-1	113.000	**114.074**		18-1	116.000	**117.102**	
6-2	114.000	**115.083**		18-2	115.000	**116.093**	
7-1	116.000	**117.102**		19-1	116.000	**117.102**	
7-2	116.000	**117.102**		19-2	116.000	**117.102**	
8-1	122.000	**123.159**		20-1	115.000	**116.093**	
8-2	116.000	**117.102**		20-2	152.000	**153.444**	
9-1	140.000	**141.330**		21-1	117.000	**118.112**	
9-2	123.000	**124.169**		21-2	117.000	**118.112**	
10-1	114.000	**115.083**		22-1	118.000	**119.121**	
10-2	118.000	**119.121**		22-2	116.000	**117.102**	
11-1	113.000	**114.074**		23-1	130.000	**131.235**	
11-2	113.000	**114.074**		23-2	198.000	**199.881**	
12-1	116.000	**117.102**		24-1	115.000	**116.093**	
12-2	116.000	**117.102**		24-2	116.000	**117.102**	

ENGINEER: **Fred Clickner** DATE: **May 16th, 2013** AMBIENT TEMPERATURE: 22.5 °C

Field Quality Assurance Form 76-13 Rev. 5

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

BRUSHLESS EXCITER FUSE RESISTANCE DATA

CUSTOMER: **PPL** STATION/UNIT: **Colstrip U4** S.O. NO.: **85P500**

TEST INSTRUMENT: **D.L.R.O.** INSTRUMENT SERIAL NO.: **7800383-10012460** CALIB. DUE DATE: **4/30/2014**

FUSE IDENTIFICATION: **7811D04 850 V 670 A** MAXIMUM ACCEPTABLE FUSE RESISTANCE @ 25°C: $R_{25°C} = R_T(1.095 - .0038\ T)$

OUTBOARD SIDE (Readings in Microhms)				OUTBOARD SIDE (Readings in Microhms)			
FUSE NO.	AS READ (RT)	CORRECTED TO 25°C (R25°C)	LAST INSPECTION READING	FUSE NO.	AS READ (RT)	CORRECTED TO 25°C (R25°C)	LAST INSPECTION READING
1-1	117.000	**118.200**		13-1	117.000	**118.200**	
1-2	120.000	**121.231**		13-2	161.000	**162.652**	
2-1	117.000	**118.200**		14-1	115.000	**116.180**	
2-2	116.000	**117.190**		14-2	114.000	**115.170**	
3-1	116.000	**117.190**		15-1	117.000	**118.200**	
3-2	116.000	**117.190**		15-2	115.000	**116.180**	
4-1	118.000	**119.211**		16-1	115.000	**116.180**	
4-2	117.000	**118.200**		16-2	121.000	**122.241**	
5-1	116.000	**117.190**		17-1	135.000	**136.385**	
5-2	117.000	**118.200**		17-2	115.000	**116.180**	
6-1	124.000	**125.272**		18-1	114.000	**115.170**	
6-2	116.000	**117.190**		18-2	115.000	**116.180**	
7-1	118.000	**119.211**		19-1	116.000	**117.190**	
7-2	116.000	**117.190**		19-2	136.000	**137.395**	
8-1	116.000	**117.190**		20-1	118.000	**119.211**	
8-2	115.000	**116.180**		20-2	117.000	**118.200**	
9-1	119.000	**120.221**		21-1	116.000	**117.190**	
9-2	142.000	**143.457**		21-2	115.000	**116.180**	
10-1	117.000	**118.200**		22-1	116.000	**117.190**	
10-2	118.000	**119.211**		22-2	116.000	**117.190**	
11-1	118.000	**119.211**		23-1	118.000	**119.211**	
11-2	116.000	**117.190**		23-2	118.000	**119.211**	
12-1	116.000	**117.190**		24-1	117.000	**118.200**	
12-2	113.000	**114.159**		24-2	118.000	**119.211**	

ENGINEER: **Fred Clickner** DATE: **May 17th, 2013** AMBIENT TEMPERATURE: 22.3 °C

Field Quality Assurance Form 76-13 Rev. 5

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

ROTOR TESTS

CUSTOMER PPL S.O. NO.: 85P500R

STATION: Colstrip UNIT: 4

ENGINEER P. Ruchniak DATE 5-17-2013

ROTOR WINDING INSULATION RESISTANCE TEST

TEST INSTRUMENT: AVO Megger INSTRUMENT NO.: 7800208-10012234

TEST VOLTAGE: 1000 VDC CALIBRATION DUE DATE: 4-29-2013

TIME	GIGAOHMS	TIME	GIGAOHMS
15 SECONDS	3.64	4 MINUTES	42.2
30 SECONDS	7.38	5 MINUTES	51
45 SECONDS	11.4	6 MINUTES	56
1 MINUTE	14.6	7 MINUTES	65.1
1.5 MINUTES	20.2	8 MINUTES	70
2.0 MINUTES	25.5	9 MINUTES	75
2.5 MINUTES	30.1	10 MINUTES	78.7
3 MINUTES	34.1	P.I. = 10 MIN / 1 MIN =	5.39

POLE DROP TEST

POLE #1 (VOLTS)	POLE #2 (VOLTS)	POLE #3 (VOLTS)	POLE #4 (VOLTS)
47.9	49.6	NA	NA

TEST INSTRUMENT: Pole Balance Kit

INSTRUMENT NO.: 7800211-13534605

CALIB. DUE DATE: 4-25-2014

ROTOR IMPEDANCE CALCULATION (√) _____ Rotor in Stator, X Rotor Out of Stator

VOLTAGE	CURRENT (AMPERES)	CALCULATED IMPEDANCE
98.3	51.7	1.9 Ω

TEST INSTRUMENT: Pole Balance Kit

INSTRUMENT NO.: 7800211-13534605

CALIB. DUE DATE: 4-25-2014

D.C. ROTOR WINDING RESISTANCE

RESISTANCE AT 21.6 °C (OHMS)	RESISTANCE AT 75° C (OHMS)	NEW MACHINE RESISTANCE AT 75° C (OHMS)
0.0493 Ω	0.0596 Ω	0.0597 Ω

TEST INSTRUMENT: Kelvin Bridge

INSTRUMENT NO.: 7800329-10000587

CALIB. DUE DATE: 5-2-2014

ROTOR PRESSURE TEST

INITIAL PRESSURE	FINAL PRESSURE
199.83 P.S.I	199.66 PSI after 1 HRS.

TEST INSTRUMENT: Digital Pressure Gauge

INSTRUMENT NO.: 78052254-13572380

CALIB. DUE DATE: 1/4/2014

Field Quality Assurance Form 91-16 Rev. 5

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

STATOR CORE LENGTH MEASUREMENTS

MAINTENANCE TIGHTENING

CUSTOMER: **PPL** S.O. NO.: **85P500**

STATION: **Colstrip** UNIT NO.: **4**

TESTER: **Clickner/Ladzinski** DATE: **5/17/2013**

DIMENSION LOCATIONS	CORE SLOT NUMBER	CORE LENGTH (INCHES) BETWEEN FINGER PLATES BEFORE TIGHTENING	CORE LENGTH (INCHES) BETWEEN FINGER PLATES AFTER TIGHTENING
3 O'CLOCK	27/28	259.625”	N/A
6 O'CLOCK	1/2	259.625”	N/A
9 O'CLOCK	11/12	259.75”	N/A
12 O'CLOCK	19/20	259.75”	N/A

Special Note:

1) Use the same instrument for all core measurements both before and after tightening.
2) Measure the core and record values to the nearest .062 inch.
3) Record where the core was measured, bottom of the slot or top of the slot. Both the bottom and top of the slot tooth top should be recorded whenever possible.
4) Measure the core length from heavy sheet to heavy sheet

Measurements taken on tooth tops of specified locations.

© Siemens Energy, Inc. “INTERNAL USE ONLY”
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

STATOR CORE MAINTENANCE TIGHTENING

CUSTOMER: **PPL** S.O. NO.: **85P500**

STATION: **Colstrip** UNIT NO.: **4**

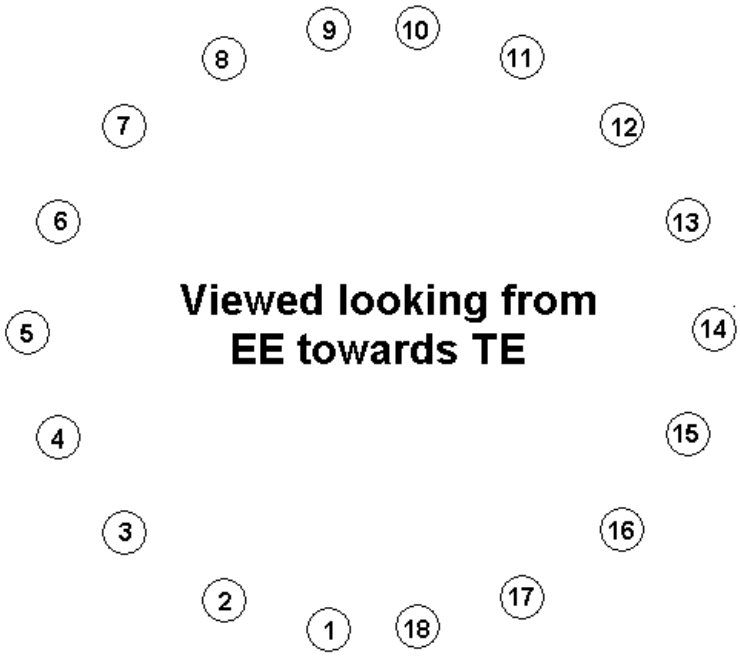
TESTER: R.Hauser, T.Ladzinski, F.Clickner DATE: **5-19-2013**

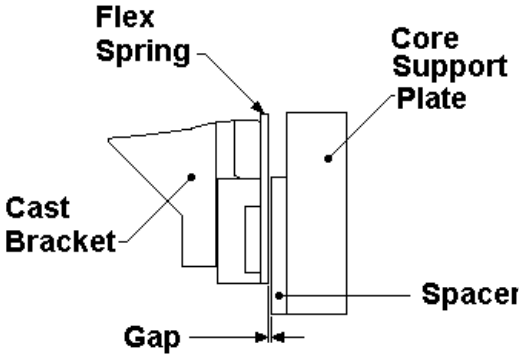
TORQUE SET NO.: **E3481** CALIB. DUE DATE: 3-29-2014

BREAK AWAY TORQUES BEFORE TIGHTENING (FT. LB)				
LOCATION	**BOLT NO.**	**THRU BOLTS**	**BUILDING BOLT E.E.**	**BUILDING BOLT T.E.**
3 O'CLOCK	6/7	886	725	725
6 O'CLOCK	14 /14	928	806	925
9 O'CLOCK	25/25	886	765	725
12 O'CLOCK	31/32	886	1004	964
AVERAGE	N/A	**897**	**825**	**835**

© Siemens Energy, Inc. "INTERNAL USE ONLY"
Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

FLEX PLATE TO CORE SUPPORT PLATE GAP MEASUREMENTS





Location Number	Gap Measured	Location Number	Gap Measured
1	0.058”	10	0.074”
2	0.058”	11	0.074”
3	0.080”	12	0.060”
4	0.070”	13	0.079”
5	0.058”	14	0.074”
6	0.058”	15	0.081”
7	0.052”	16	0.050”
8	0.080”	17	0.050”
9	0.058”	18	0.074”

AS FOUND EL CID SETUP RECORD - SMCAS PROCESSOR

CUSTOMER:	PPL	**S.O. NO.:**	85P500
STATION:	Colstrip	**UNIT NO.:**	4
ENGINEER:	Patryk Ruchniak	**DATE:**	5/18/2013

MACHINE DATA

MVA:	778	**NO. OF SLOTS:**	36
CORE LENGTH:	259.625 Inches	**STEP IRON LENGTH:**	5.188 Inches
STATOR CONDITION:	WOUND	**ROTOR IN/OUT:**	OUT
		OPERATIONAL FREQUENCY:	60 Hz

TEST CHECKLIST

- [X] CALIBRATION COMPLETED
- [X] EXCITATION LOOP ENERGIZED
- [X] RESET PHASE ON GOOD IRON

EXCITATION LOOP DATA

LOOP AMPERAGE DURING TEST: 8.03 Amps

SEARCH COIL DATA

CALCULATED SEARCH COIL VOLTAGE: 32.972375 Volts

MEASURED SEARCH COIL VOLTAGE: 32.48 Volts

THOSE PRESENT

CUSTOMER	SIEMENS
N/A	Patryk Ruchniak
N/A	N/A
N/A	N/A

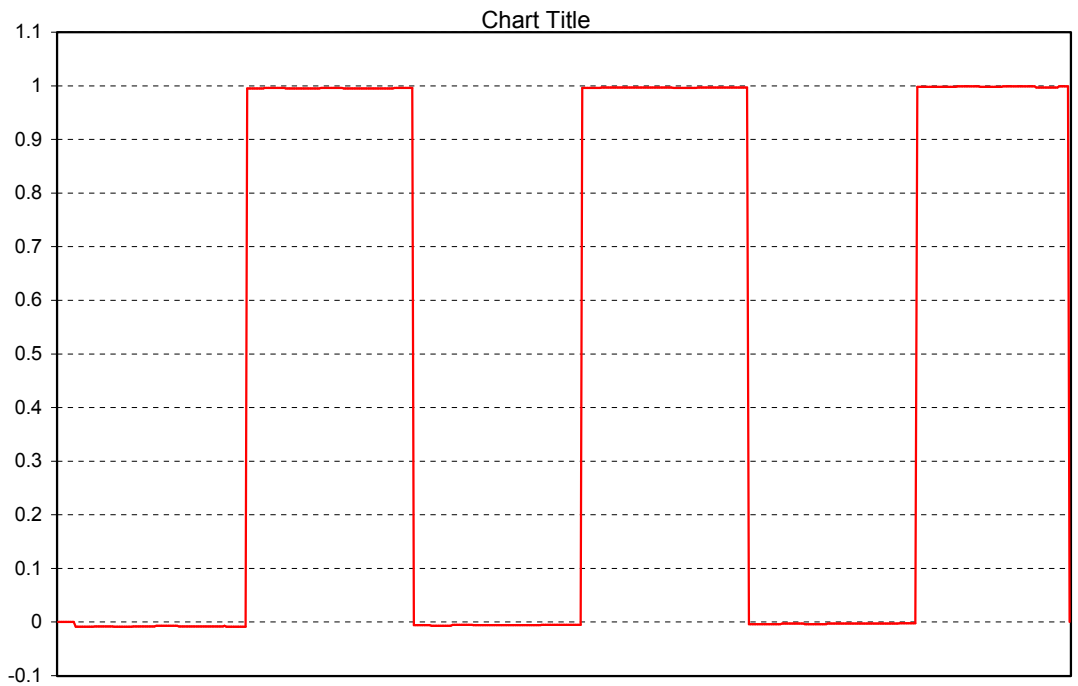
NOTES:
Reset Phase After Calibration
Reset Phase on TE for TE Step Iron

Field Quality Assurance Form 94-1 © Siemens Energy, Inc. Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SMCAS CALIBRATION DATA SHEET FOR:

CUSTOMER:	PPL	STATION:	Colstrip	UNIT:	4
SHOP ORDER:	85P500	ENGR:	Patryk Ruchniak	DATE:	5/18/2013

CAL. POINT = 1.0 Amp



CALIBRATION VALUES:

	FULL SCALE		ZERO	
PHASE CURRENT	1.00	Amps	-9.00	mA
QUAD CURRENT	8	mA	-2	mA

CALIBRATION TRACE

TEST EQUIPMENT DATA

SMCAS PROCESSOR SN:	NK403G01-11
CALIBRATION BOX SN:	NK-CB-016
CAL. BOX DUE DATE:	1/23/2014
CHATTOCK COIL SN:	SN48353
SMCAS PRE-AMP SN:	NK104G01-14
SYSTEM GAIN:	1.1026
PHASE ROTATION:	18.7 Degrees
EXCITATION FREQUENCY	60 Hz

CHECKLIST

- [X] EXCITATION LOOP OFF
- [X] POSITION CHATTOCK ON CAL BOX
- [X] SET CURRENT TO 100 mA.

CAL CHECK READINGS

Initial Calibration: 1.000

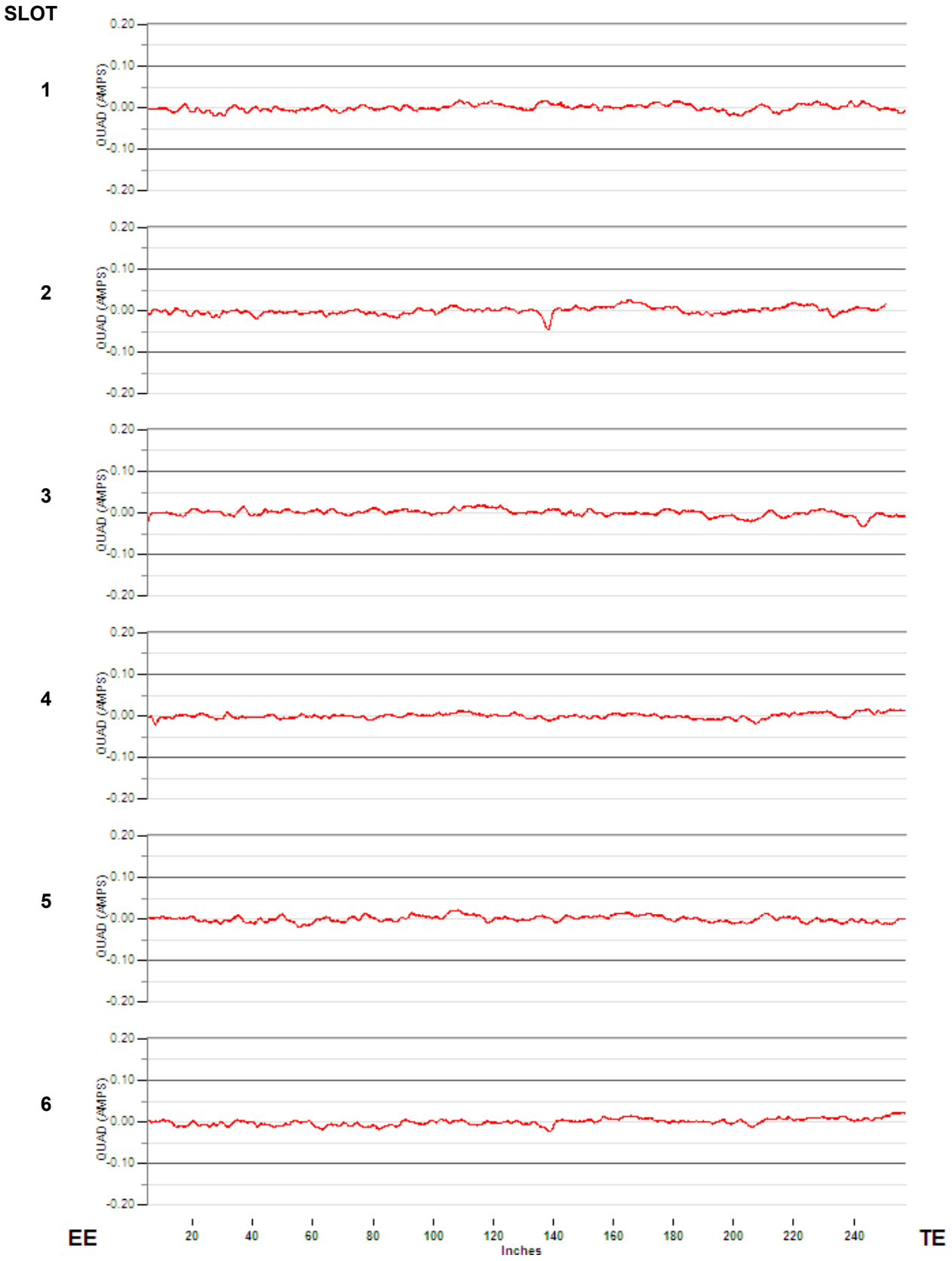
ENGINEER'S SIGNATURE _____

SIEMENS Field Quality Assurance Form 94-2

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

18-May-2013
S.O. #85P500

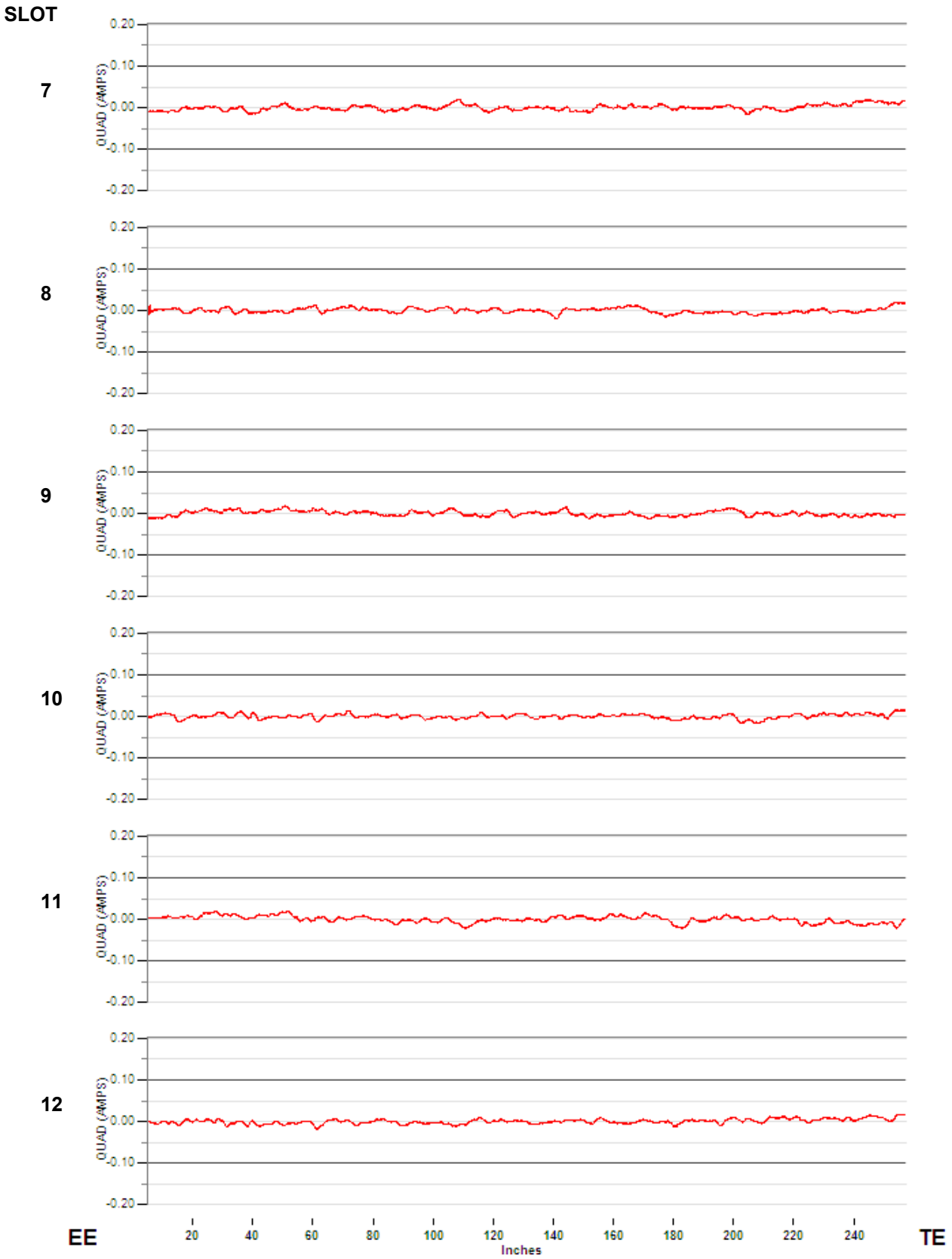


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

18-May-2013
S.O. #85P500

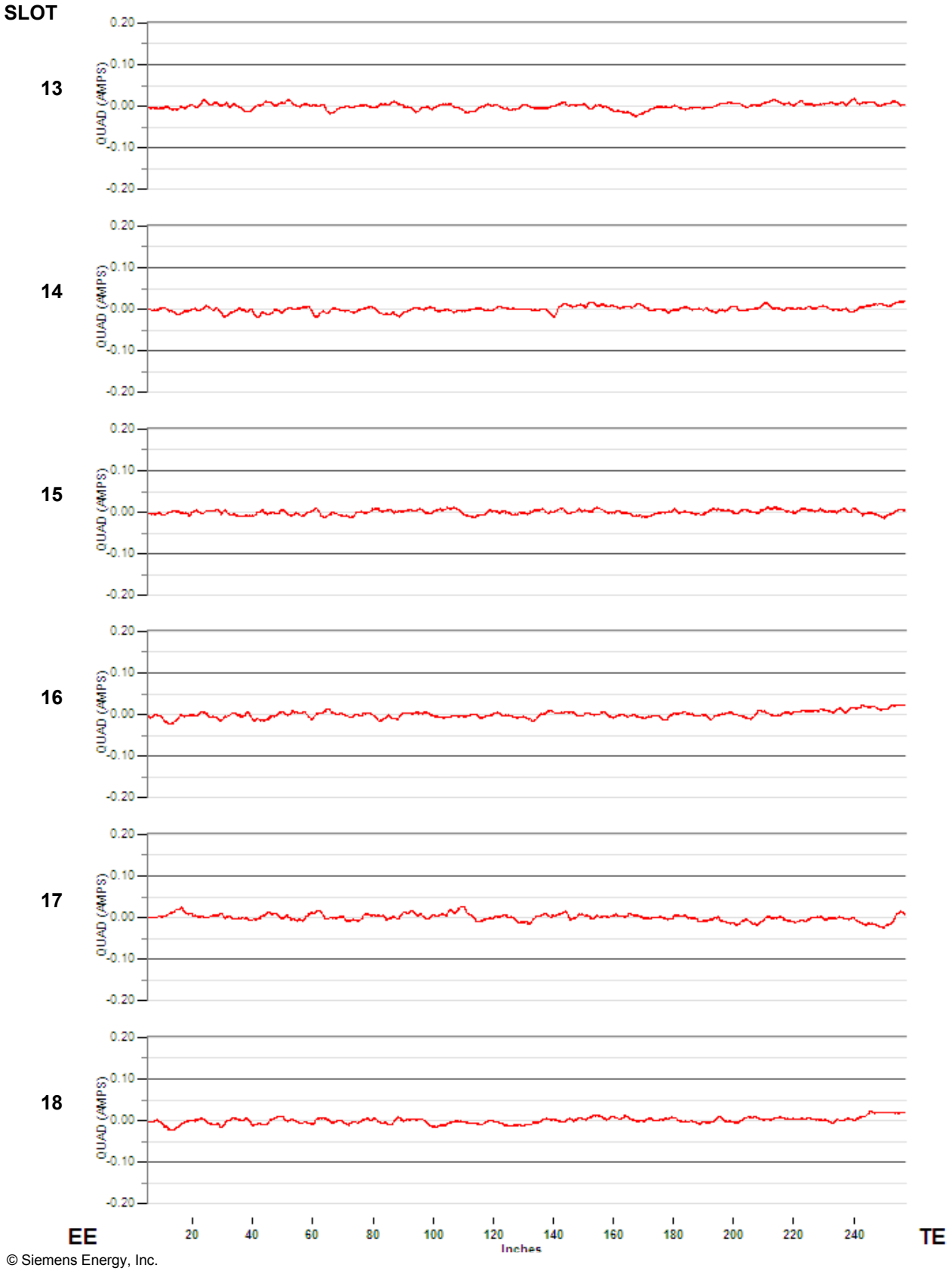


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

18-May-2013
S.O. #85P500



© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

18-May-2013
S.O. #85P500

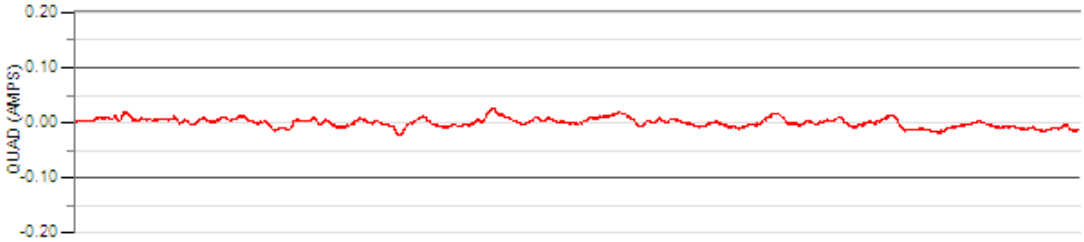
Inches

SLOT

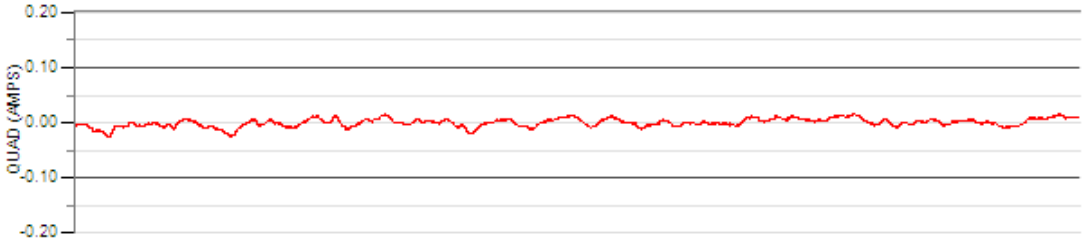
19

20

21

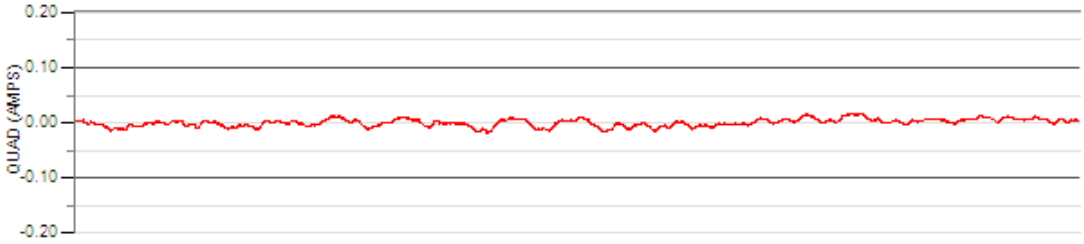


22



23

24

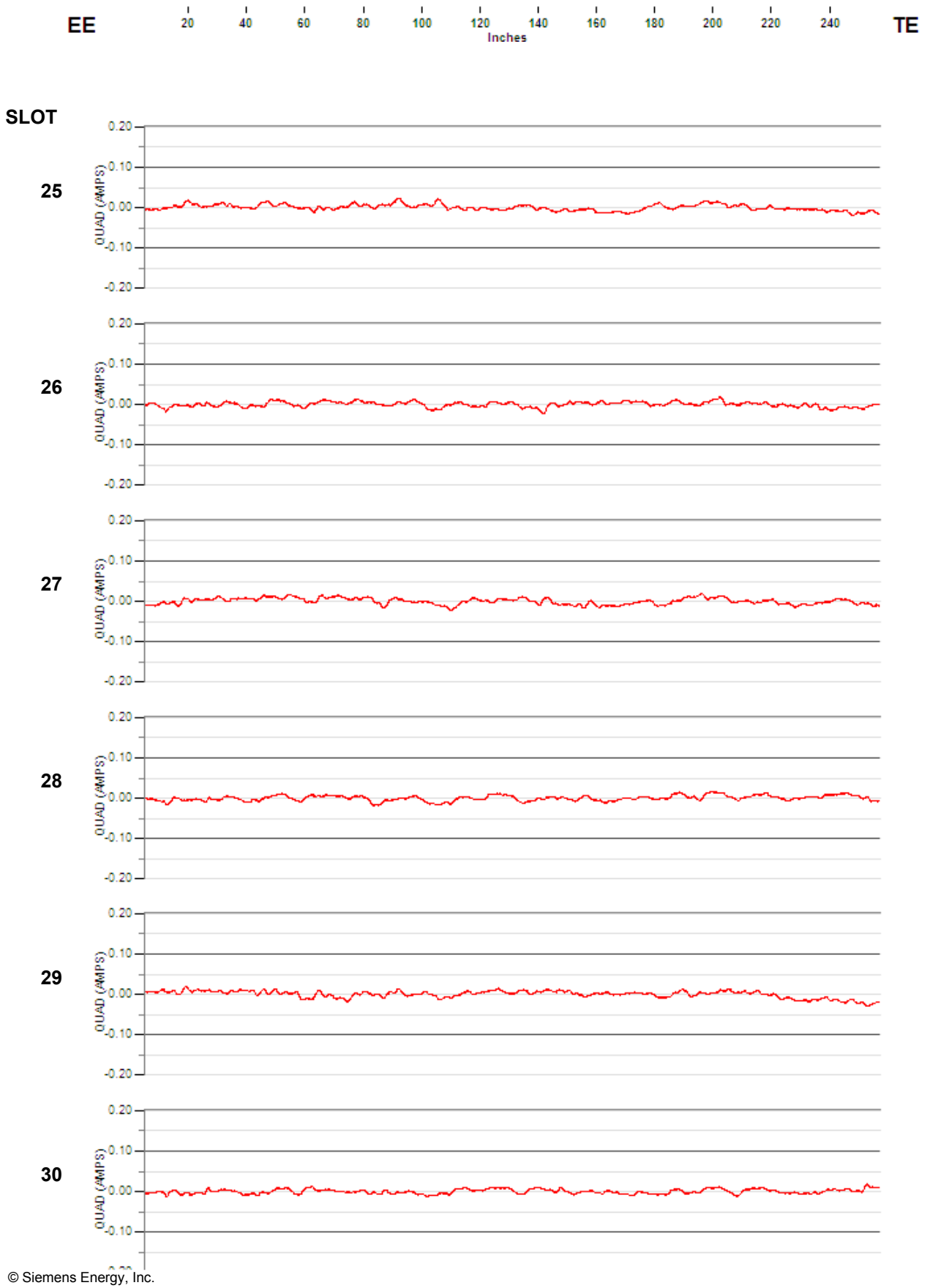


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

13-May-2013
S.O. #85P500

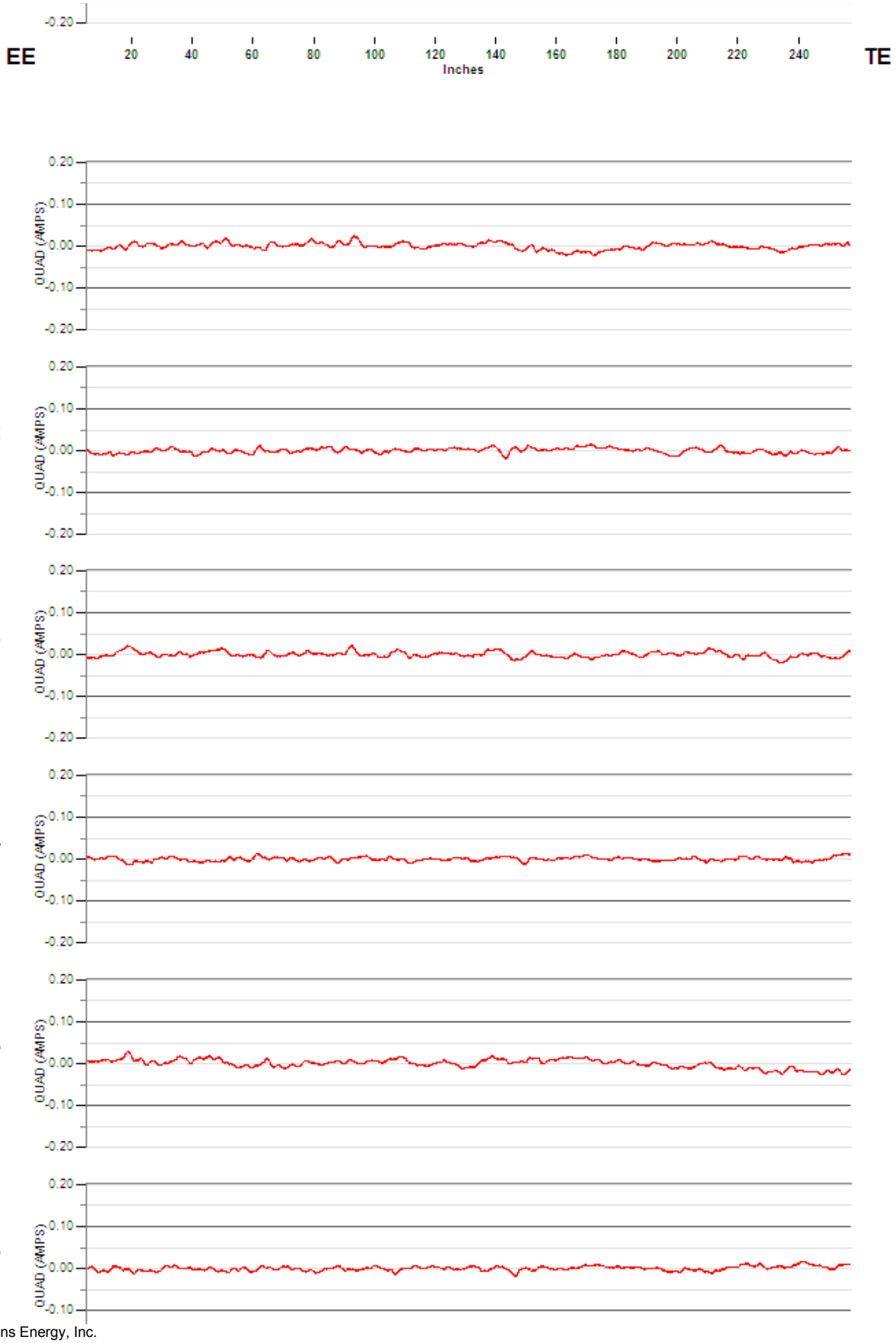


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

13-May-2013
S.O. #85P500

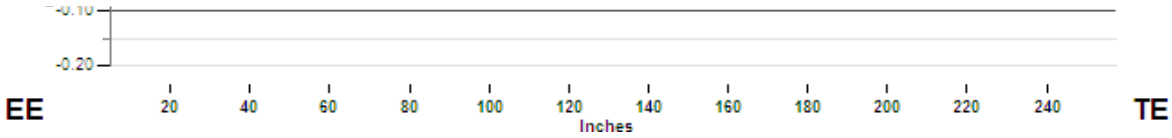


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

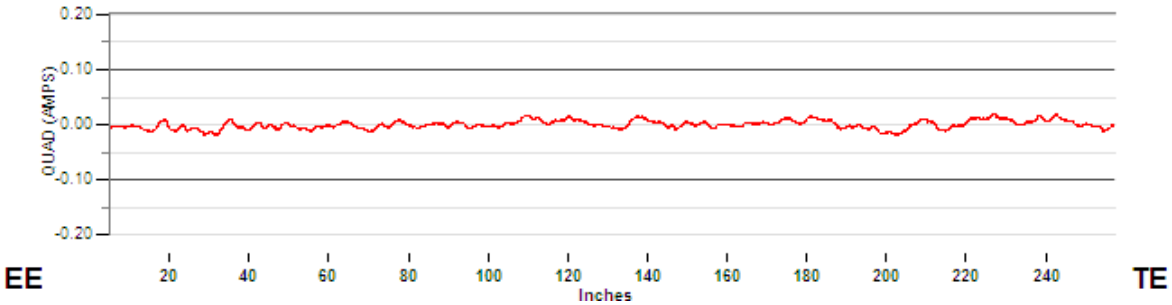
EL CID Body Iron Data
QUAD PHASE

13-May-2013
S.O. #85P500



SLOT

1



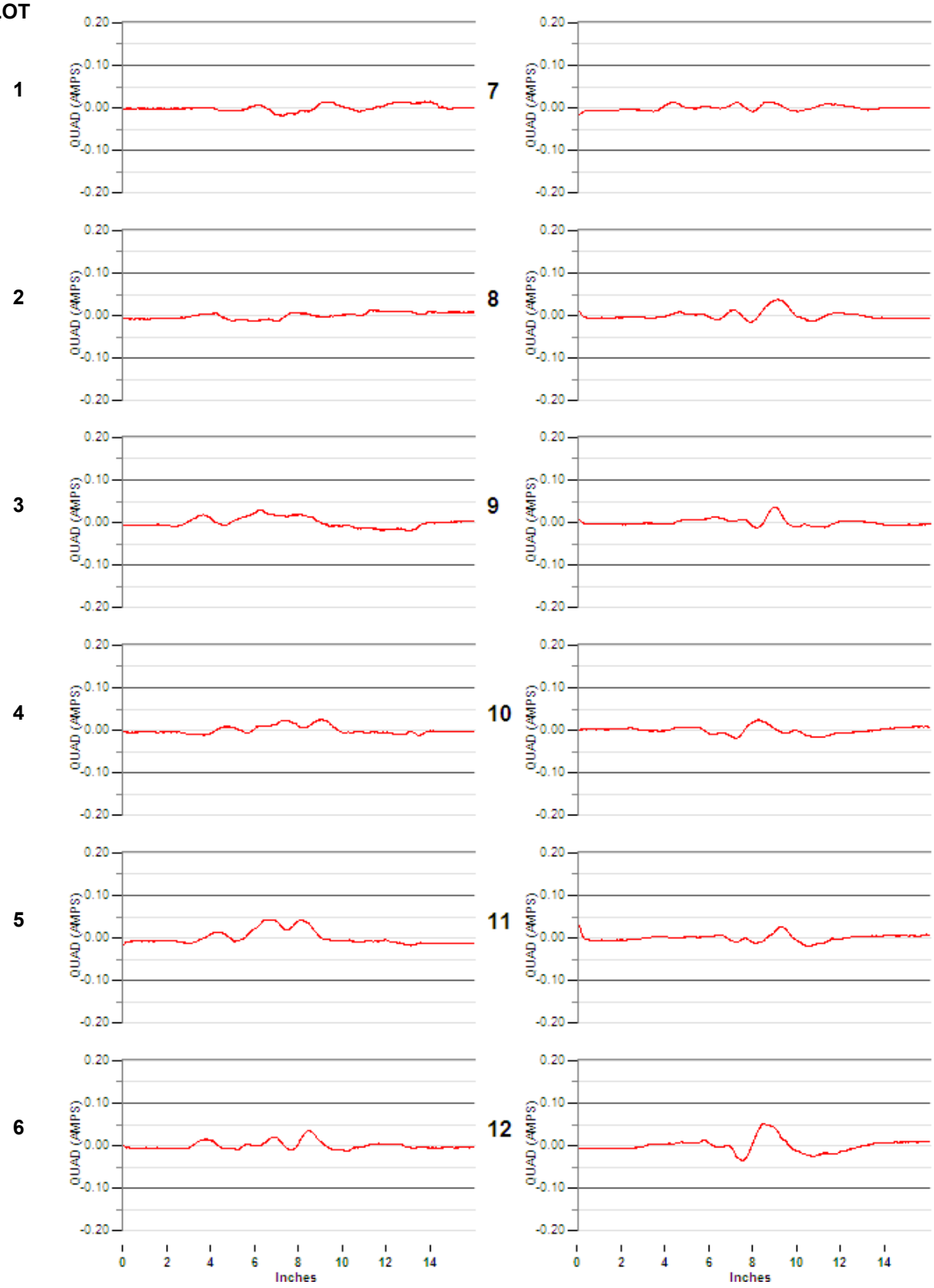
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT

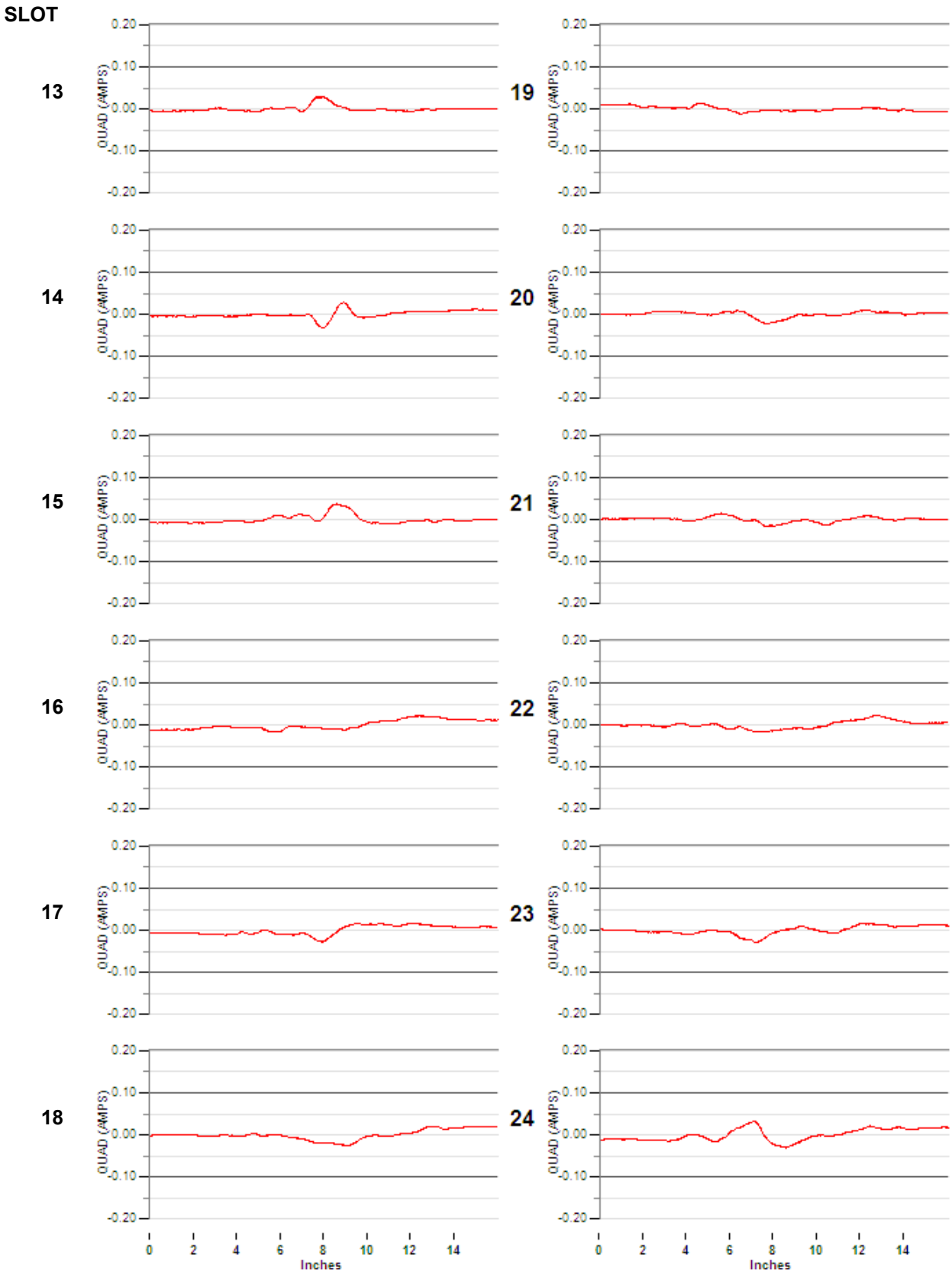


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500



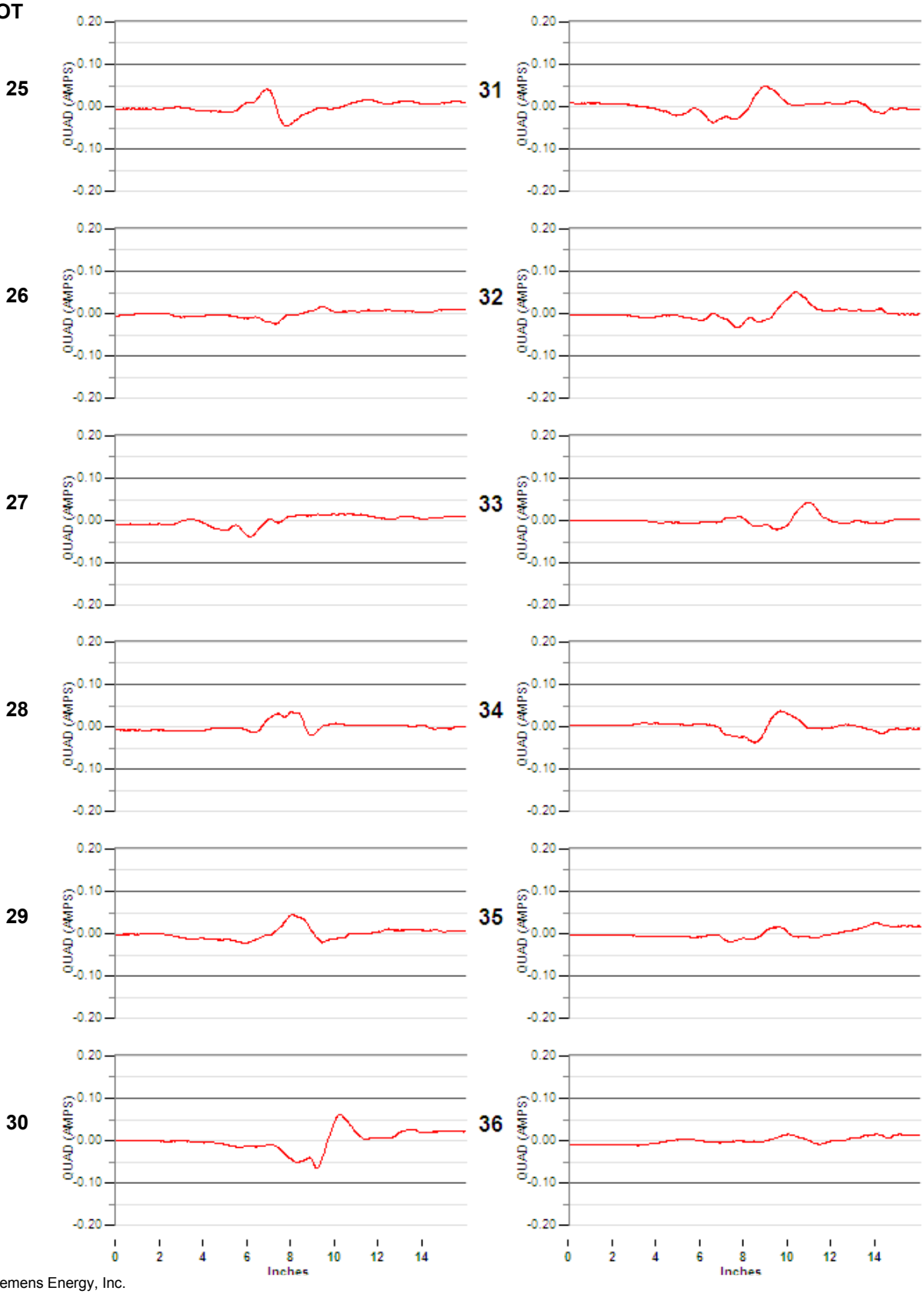
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



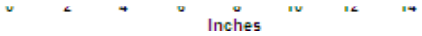
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

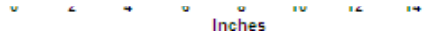
PPL
Colstrip 4

Exciter End EL CID Step Iron Data

QUAD PHASE

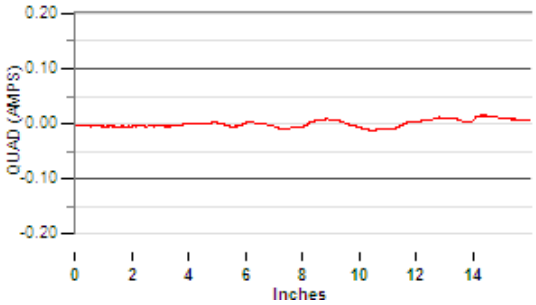
S.O. #85P500



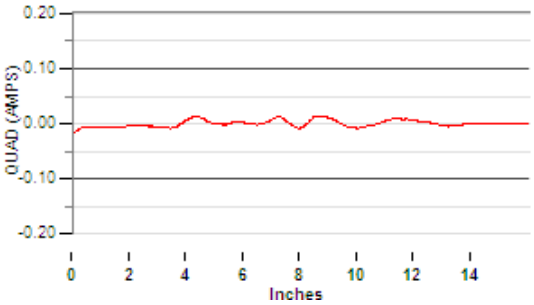


SLOT

1



7



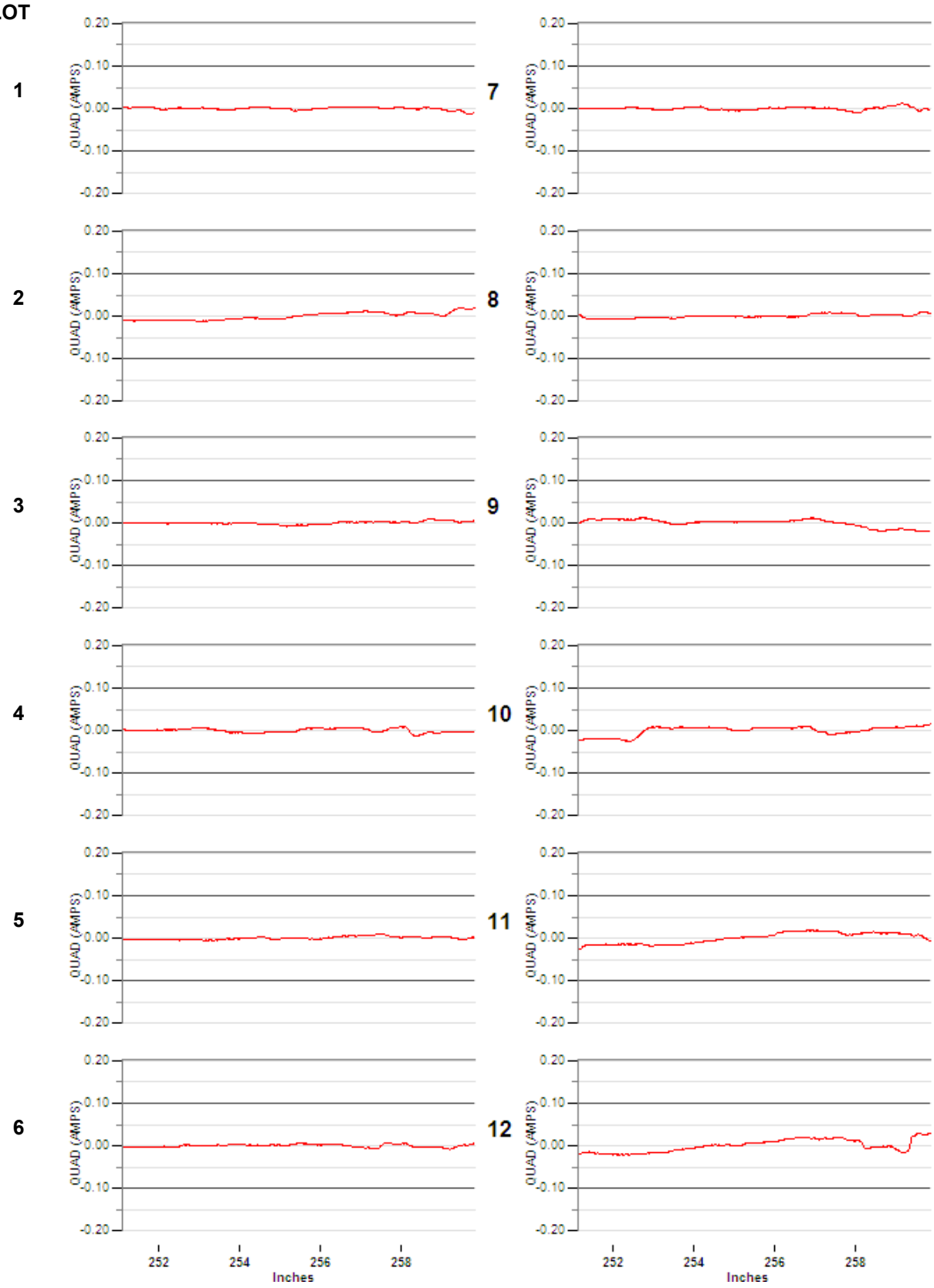
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Turbine End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



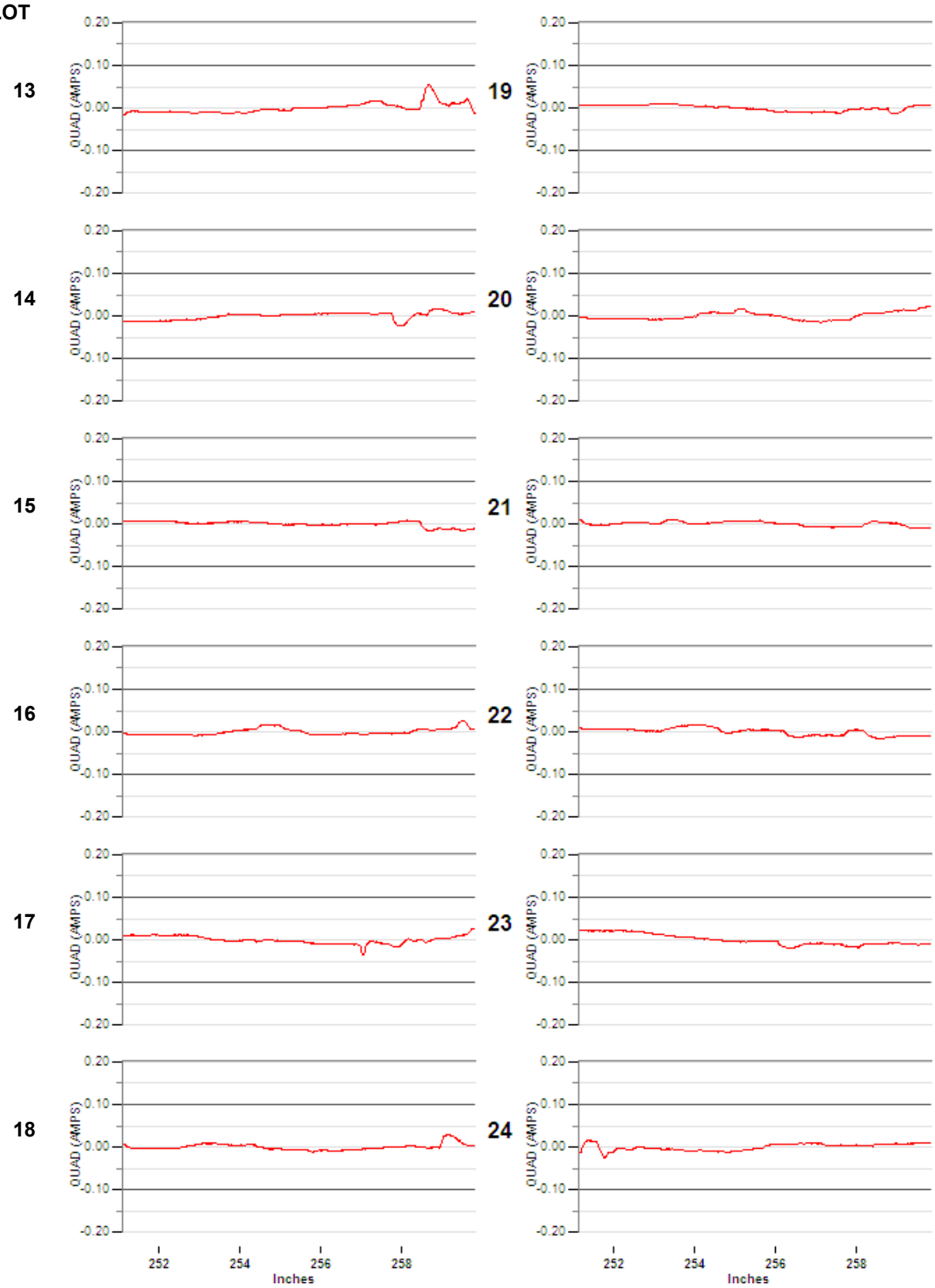
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Turbine End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



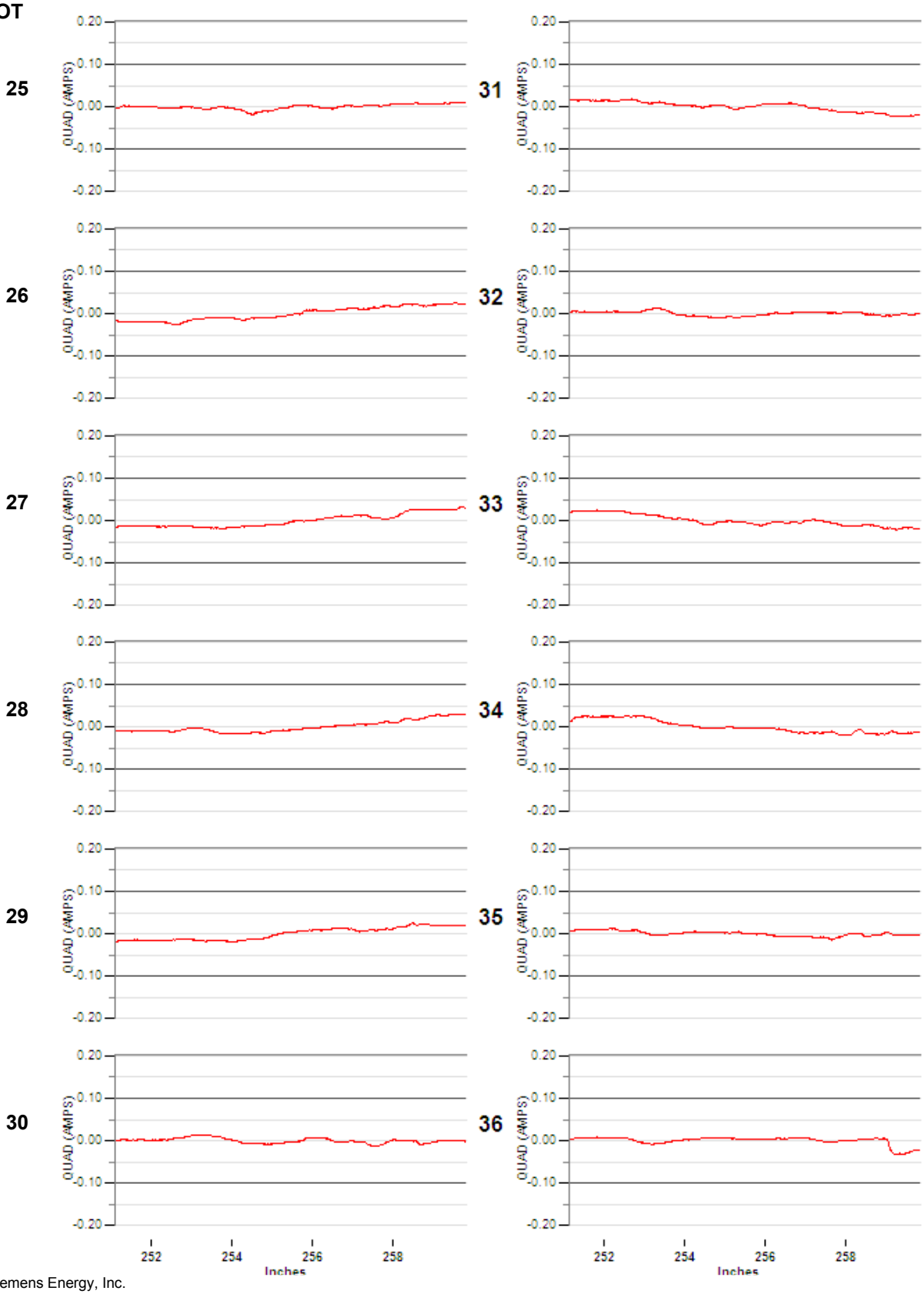
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Turbine End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

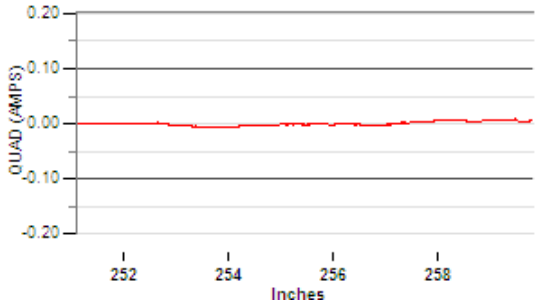
Turbine End EL CID Step Iron Data

QUAD PHASE

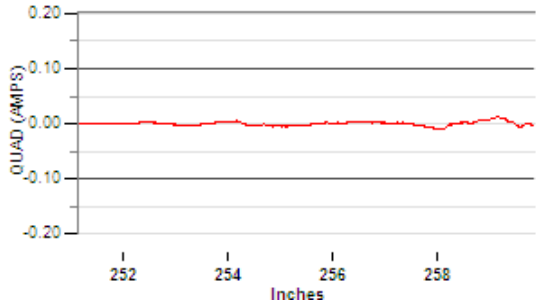
S.O. #85P500

SLOT

1



7



© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

POST EL CID SETUP RECORD - SMCAS PROCESSOR

CUSTOMER:	PPL	**S.O. NO.:**	85P500
STATION:	Colstrip	**UNIT NO.:**	4
ENGINEER:	Patryk Ruchniak	**DATE:**	5/27/2013

MACHINE DATA

MVA:	778	**NO. OF SLOTS:**	36
CORE LENGTH:	259.625 Inches	**STEP IRON LENGTH:**	5.188 Inches
STATOR CONDITION:	WOUND	**ROTOR IN/OUT:**	OUT
		OPERATIONAL FREQUENCY:	60 Hz

TEST CHECKLIST

- [X] CALIBRATION COMPLETED
- [X] EXCITATION LOOP ENERGIZED
- [X] RESET PHASE ON GOOD IRON

EXCITATION LOOP DATA

LOOP AMPERAGE DURING TEST: 8.02 Amps

SEARCH COIL DATA

CALCULATED SEARCH COIL VOLTAGE: 32.972375 Volts

MEASURED SEARCH COIL VOLTAGE: 32.30 Volts

THOSE PRESENT

CUSTOMER	SIEMENS
N/A	Patryk Ruchniak
N/A	Fred Clickner
N/A	Evan Niemann

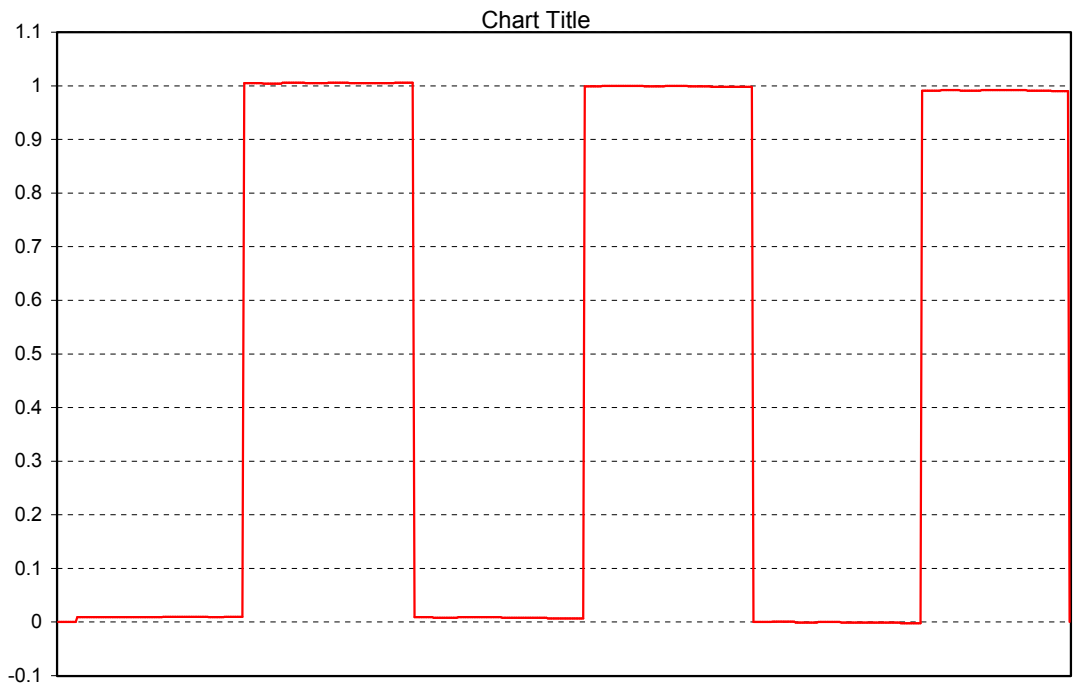
NOTES:
Reset phase due to putting chattock coil in bore
Resuming test, conducted cal check and phase reset before continuing testing.

Field Quality Assurance Form 94-1 © Siemens Energy, Inc. Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SMCAS CALIBRATION DATA SHEET FOR:

CUSTOMER:	PPL	STATION:	Colstrip	UNIT:	4
SHOP ORDER:	85P500	ENGR:	Patryk Ruchniak	DATE:	5/27/2013

CAL. POINT = 1.0 Amp



CALIBRATION VALUES:

	FULL SCALE		ZERO	
PHASE CURRENT	1.01	Amps	-2.00	mA
QUAD CURRENT	0	mA	-22	mA

CALIBRATION TRACE

TEST EQUIPMENT DATA

SMCAS PROCESSOR SN:	NK403G01-11
CALIBRATION BOX SN:	NK-CB-016
CAL. BOX DUE DATE:	5/27/2013
CHATTOCK COIL SN:	SN48353
SMCAS PRE-AMP SN:	NK104G01-14
SYSTEM GAIN:	1.1079
PHASE ROTATION:	20.6 Degrees
EXCITATION FREQUENCY	60 Hz

CHECKLIST

- [X] EXCITATION LOOP OFF
- [X] POSITION CHATTOCK ON CAL BOX
- [X] SET CURRENT TO 100 mA.

CAL CHECK READINGS

Initial Calibration: 1.000

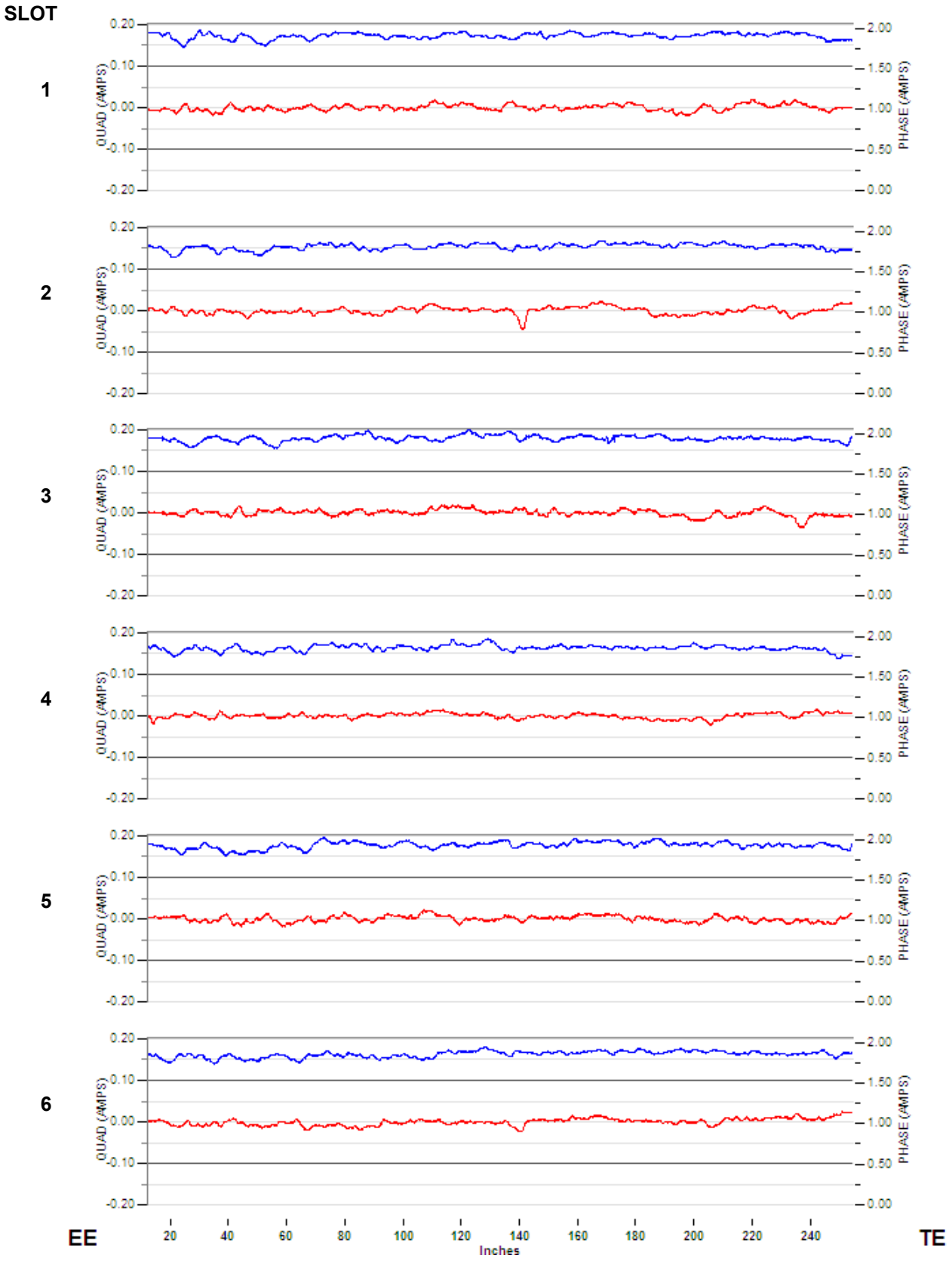
ENGINEER'S SIGNATURE _____

SIEMENS Field Quality Assurance Form 94-2

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500

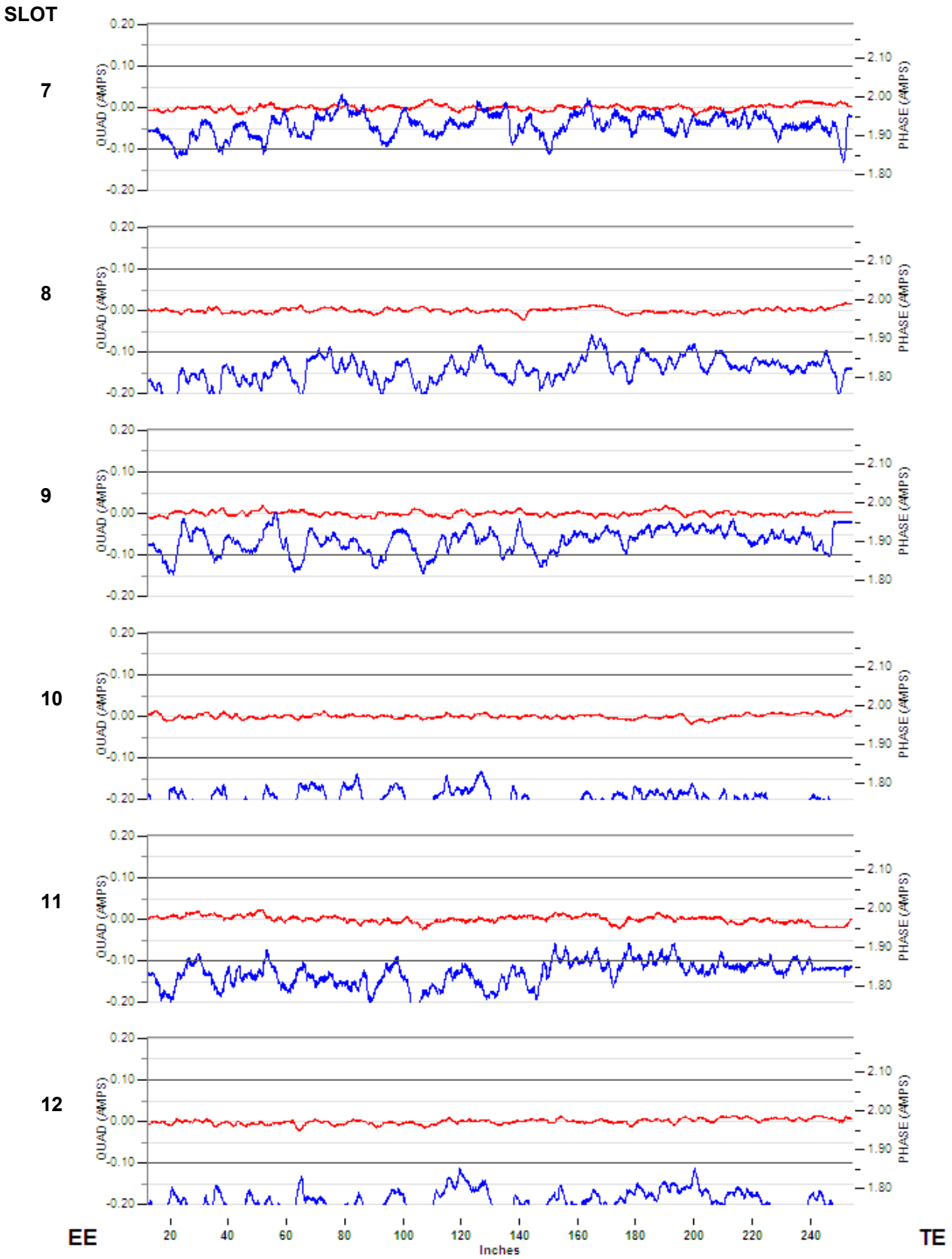


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500

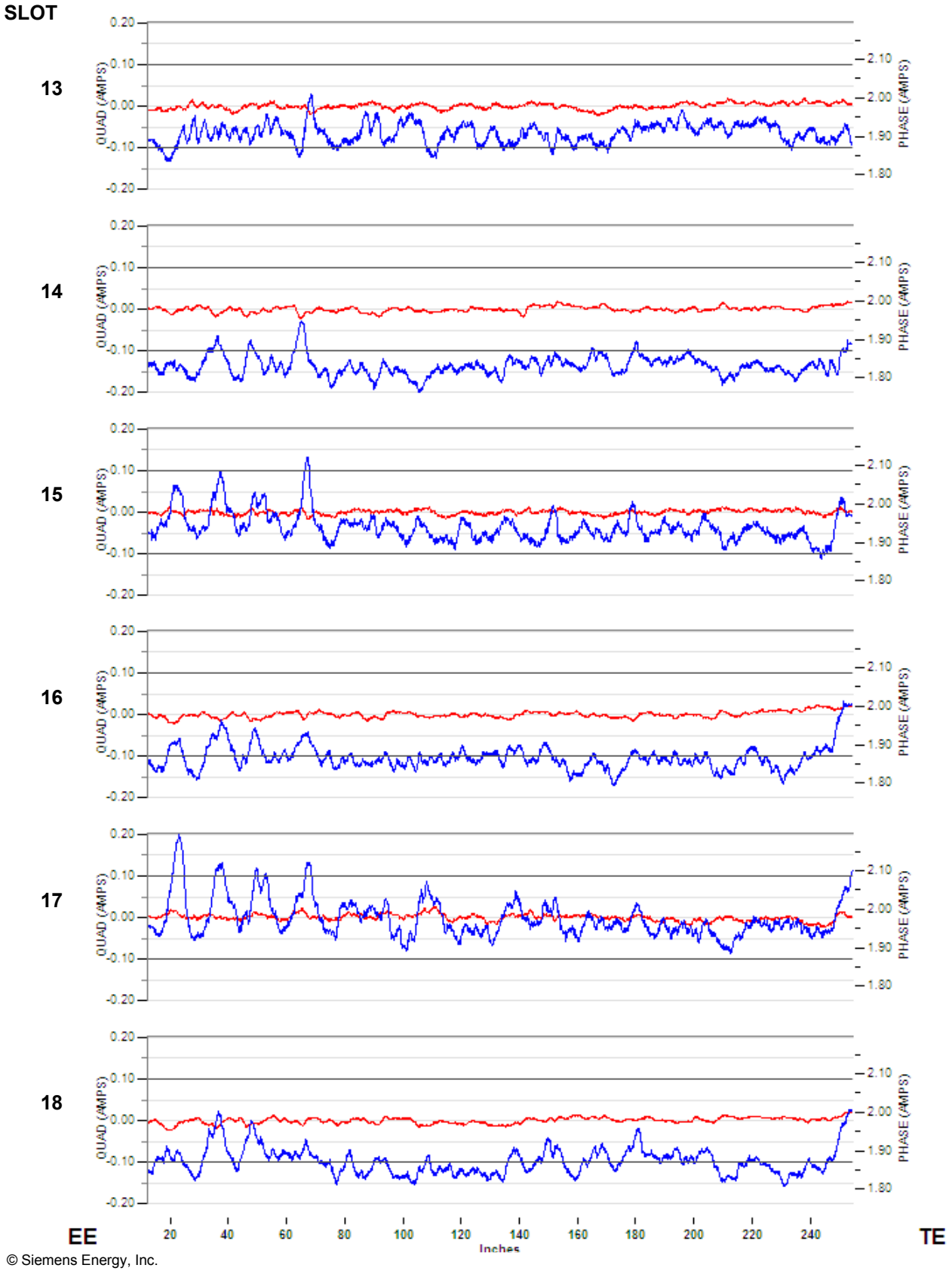


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500

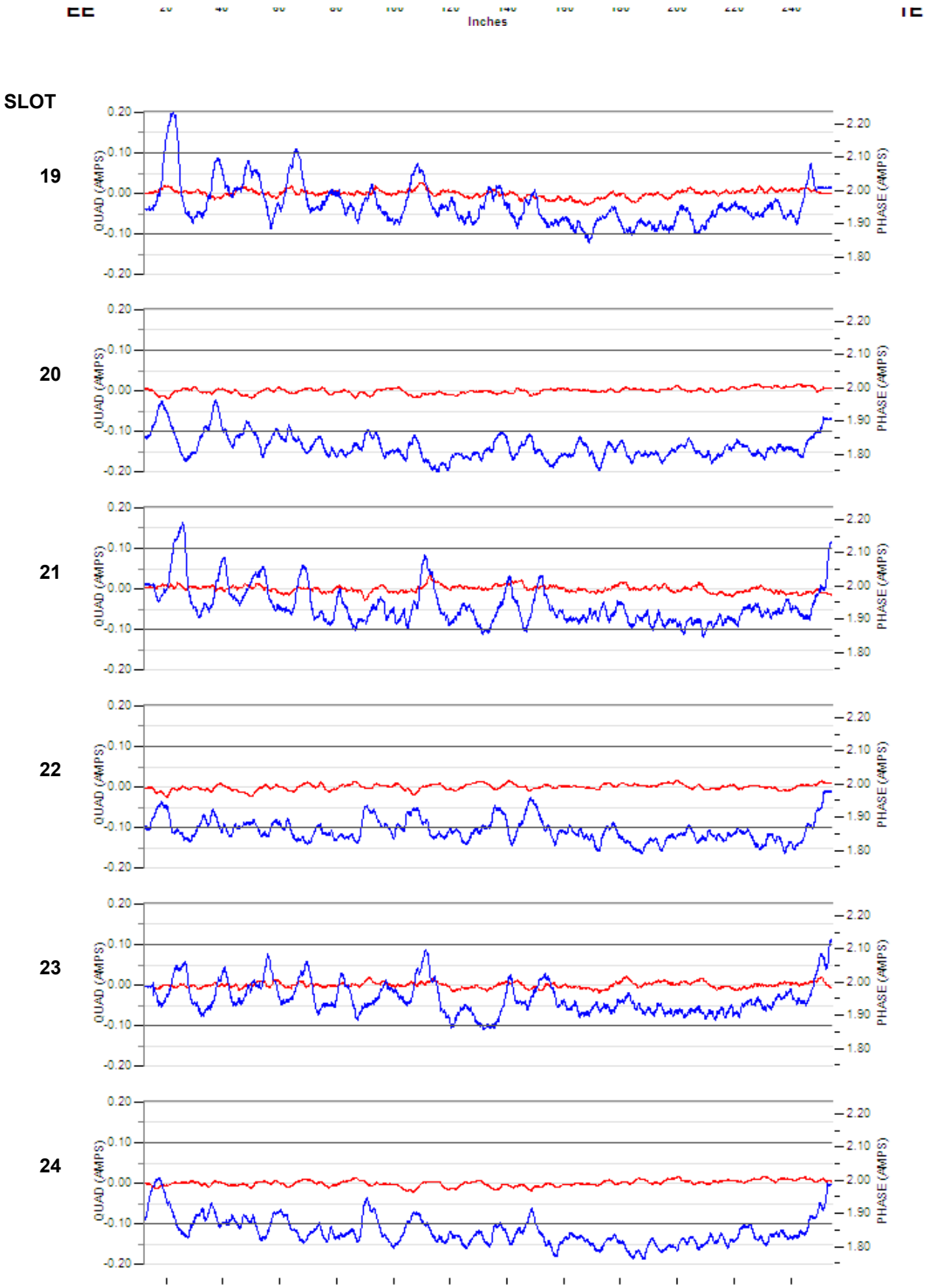


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500

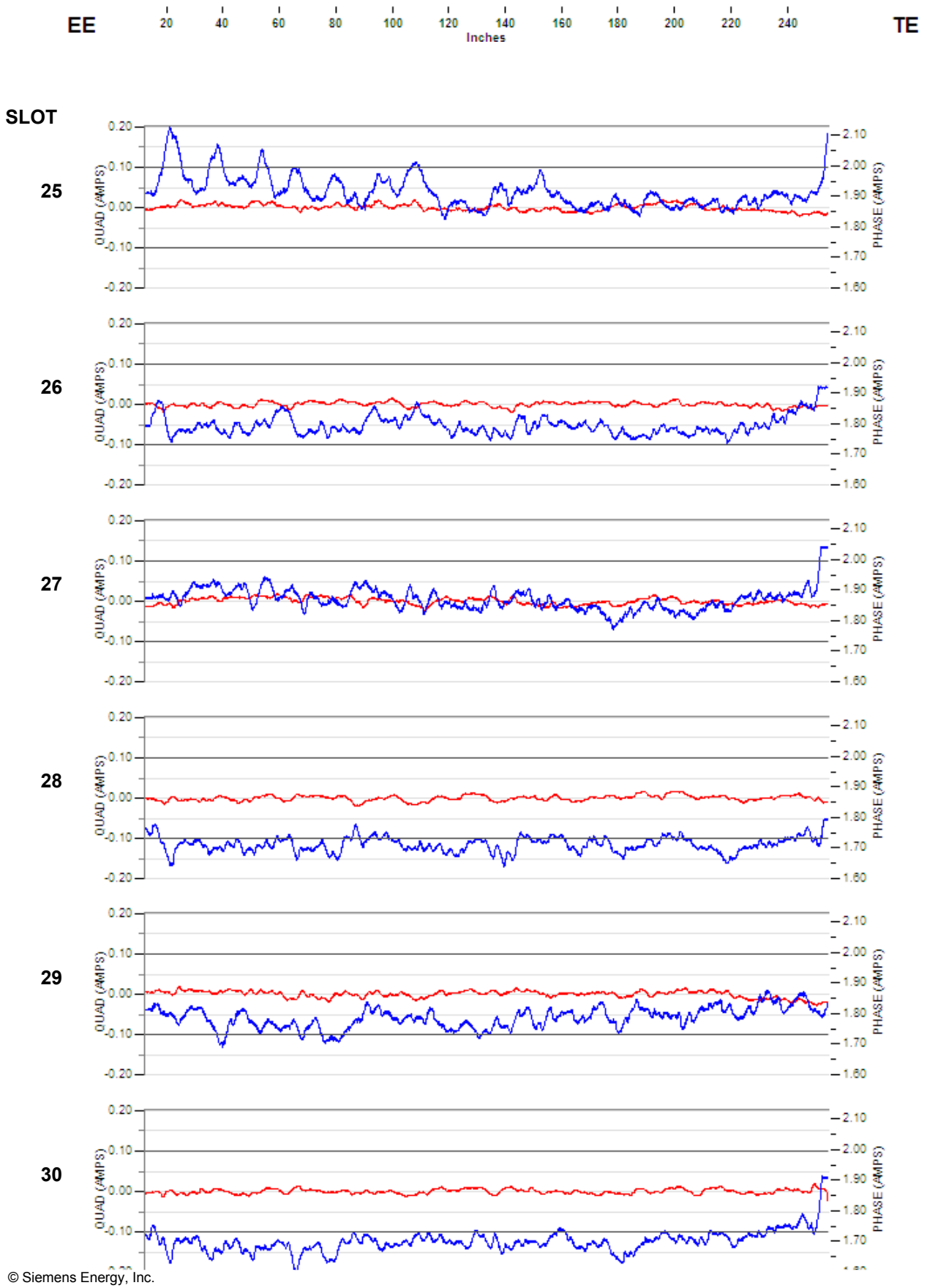


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500

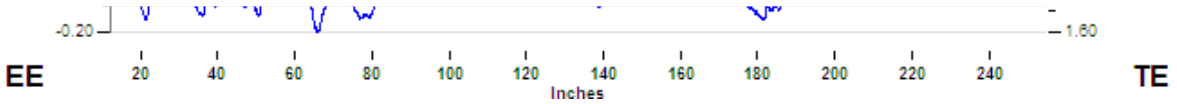


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

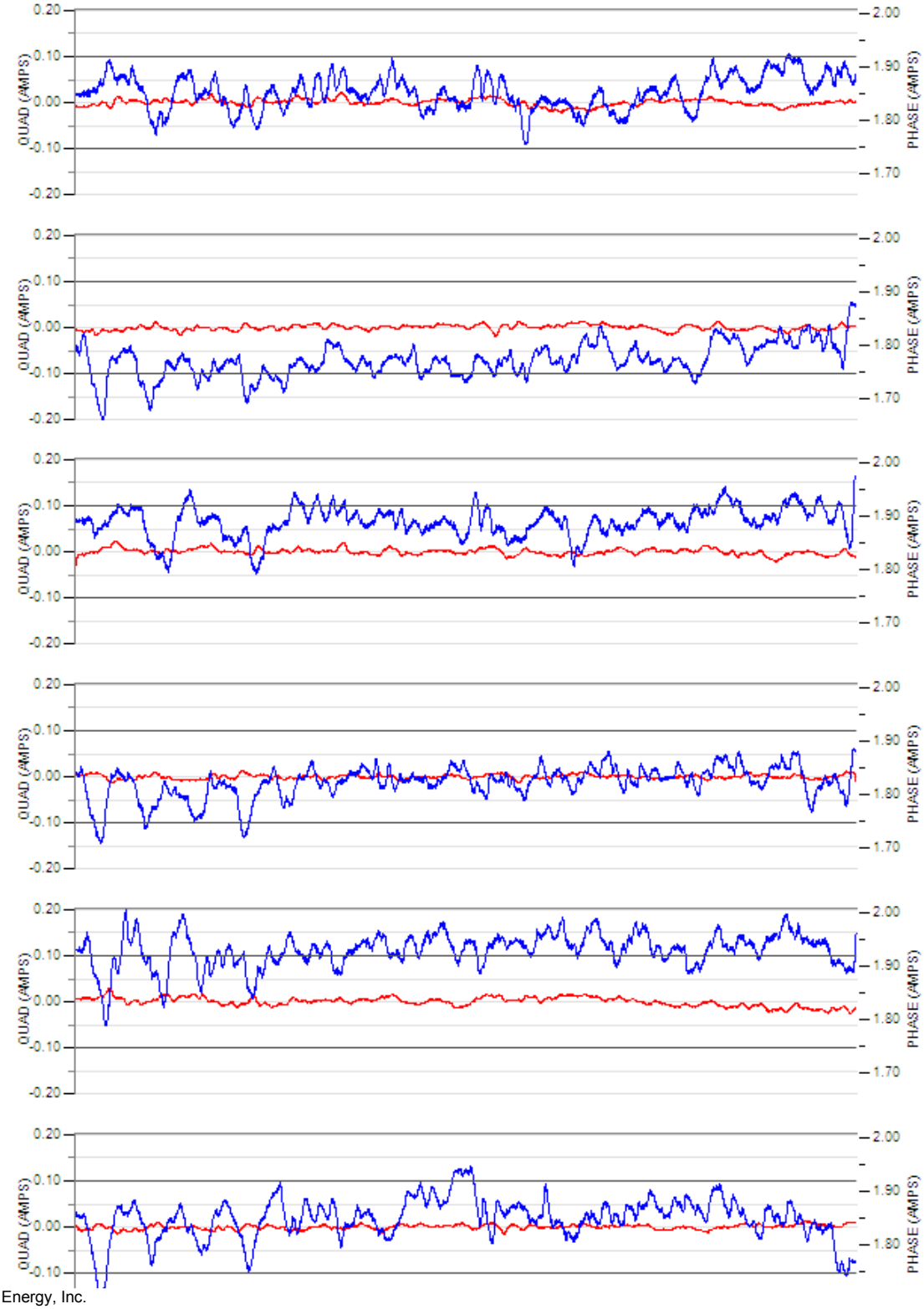
PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500



SLOT

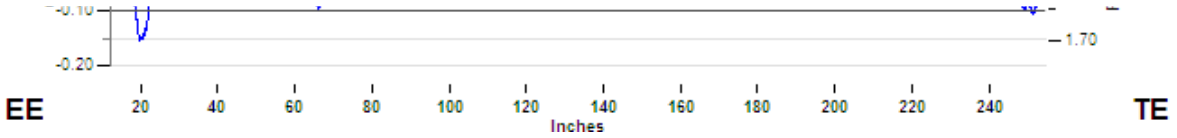


© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

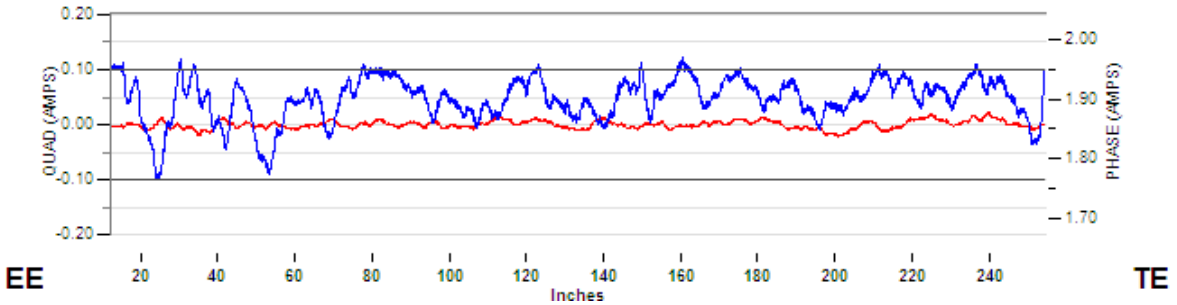
EL CID Body Iron Data
QUAD PHASE

27-May-2013
S.O. #85P500



SLOT

1



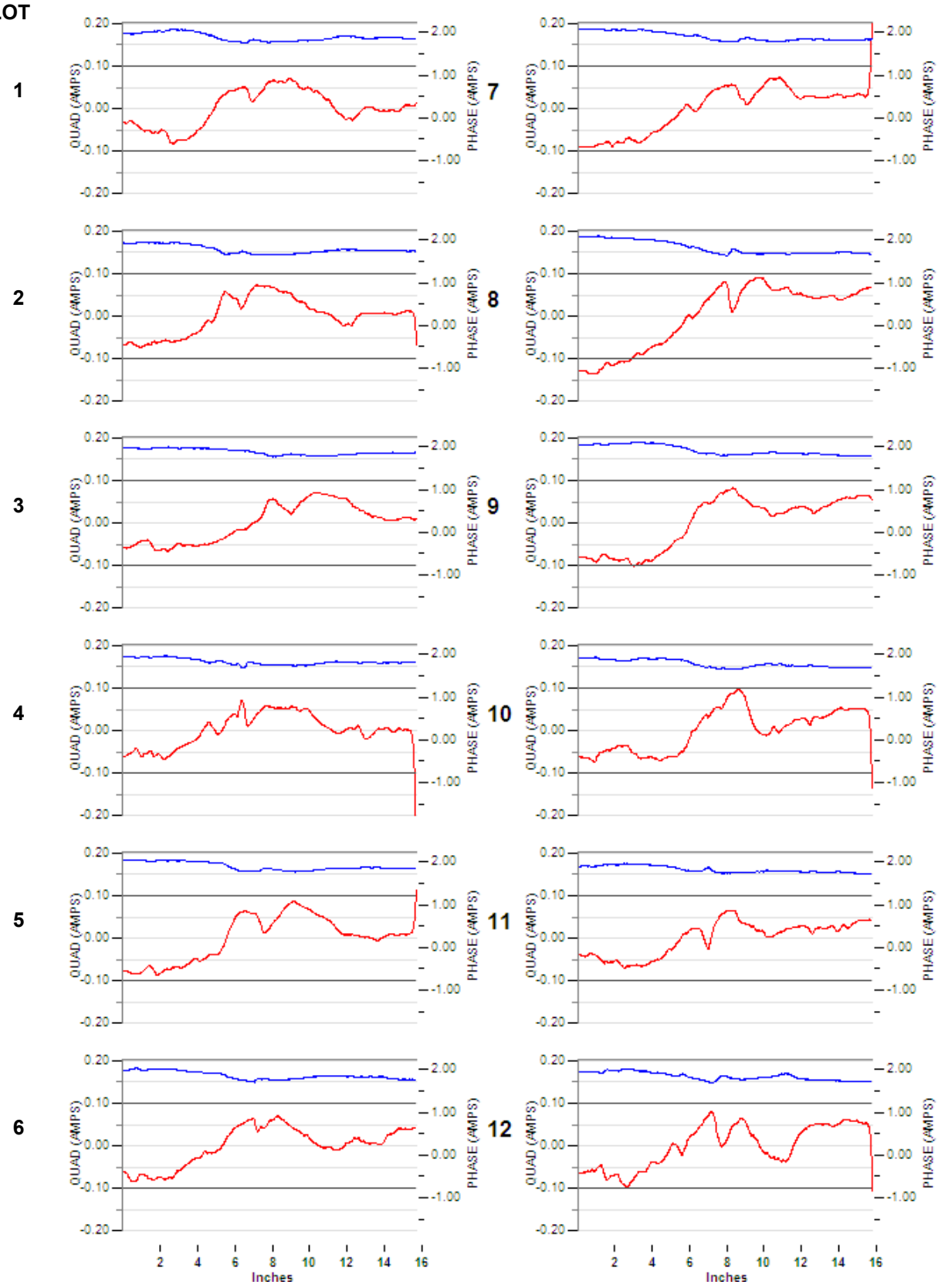
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



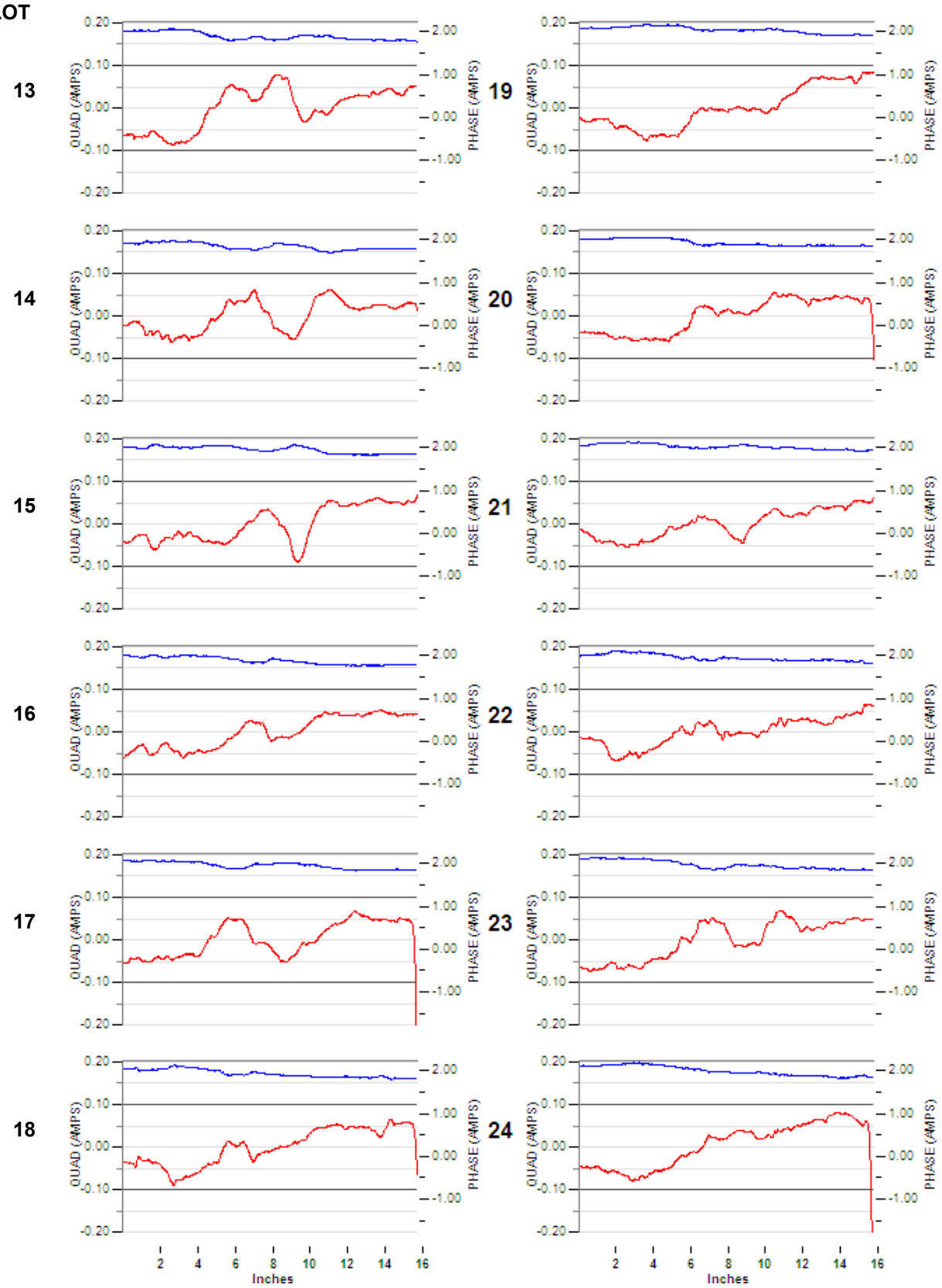
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



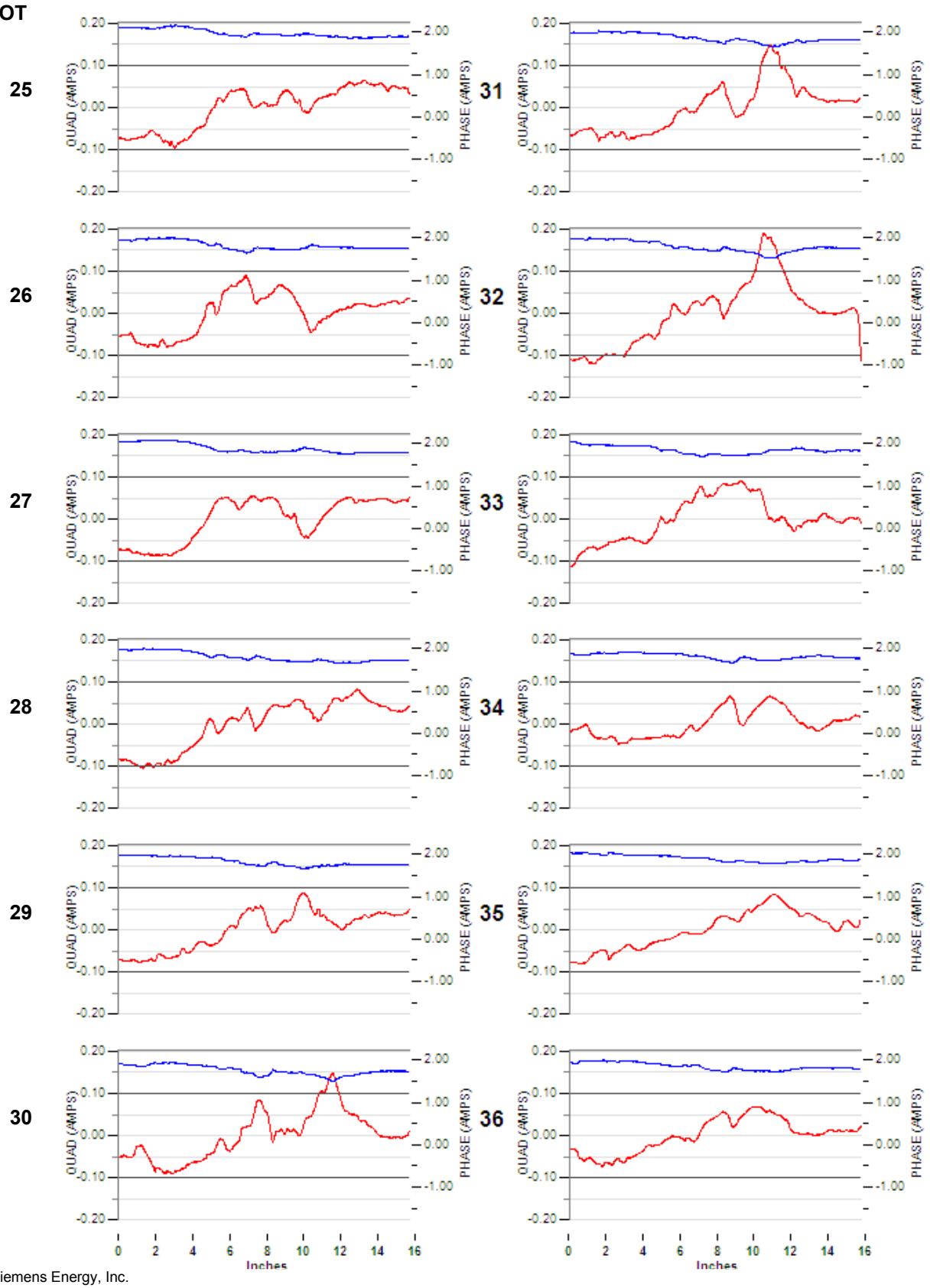
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



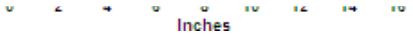
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

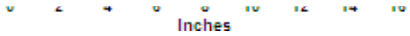
PPL
Colstrip 4

Exciter End EL CID Step Iron Data

QUAD PHASE

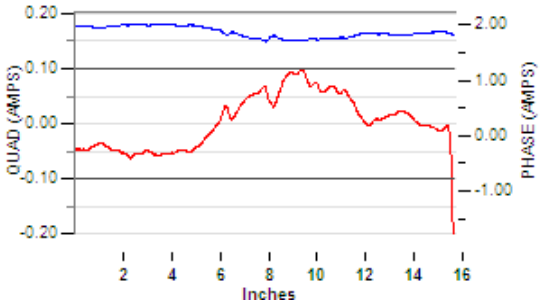
S.O. #85P500



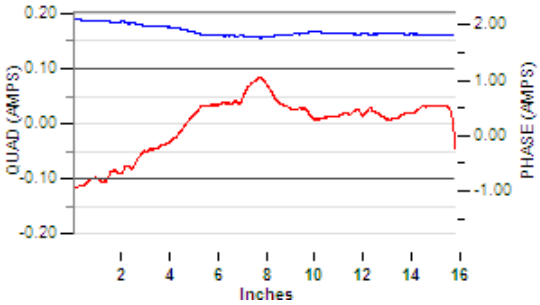


SLOT

1



7



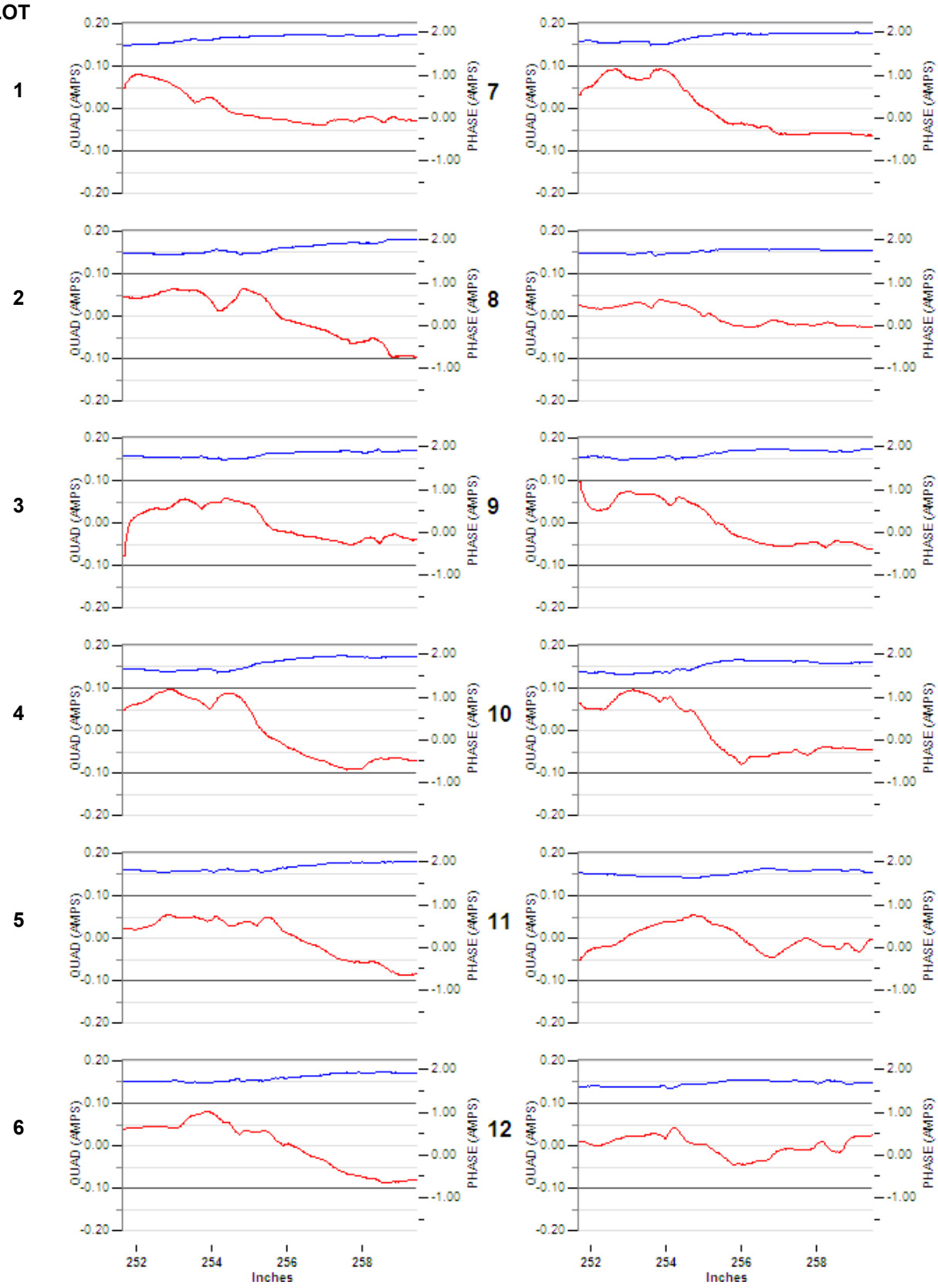
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Turbine End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



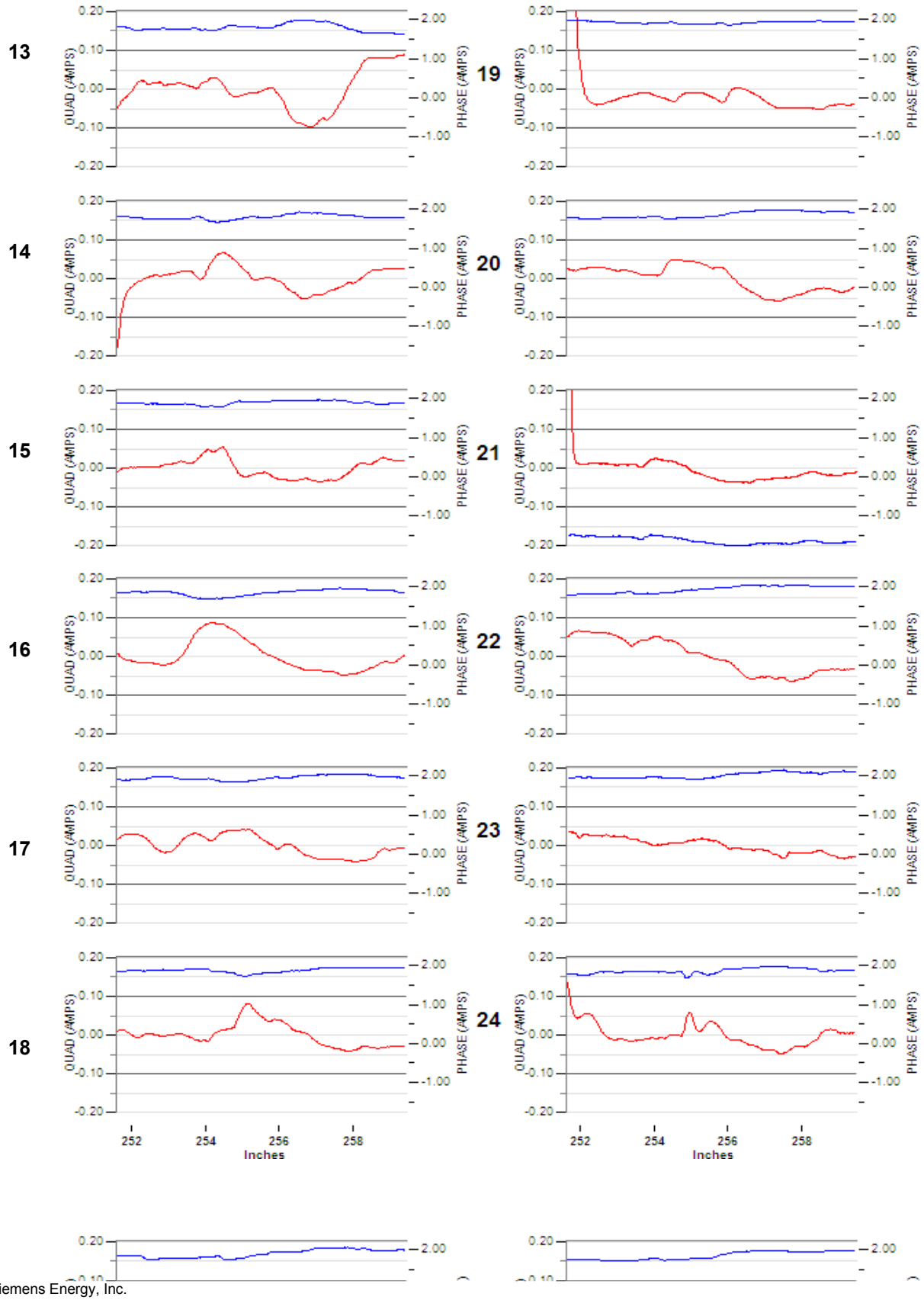
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Turbine End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



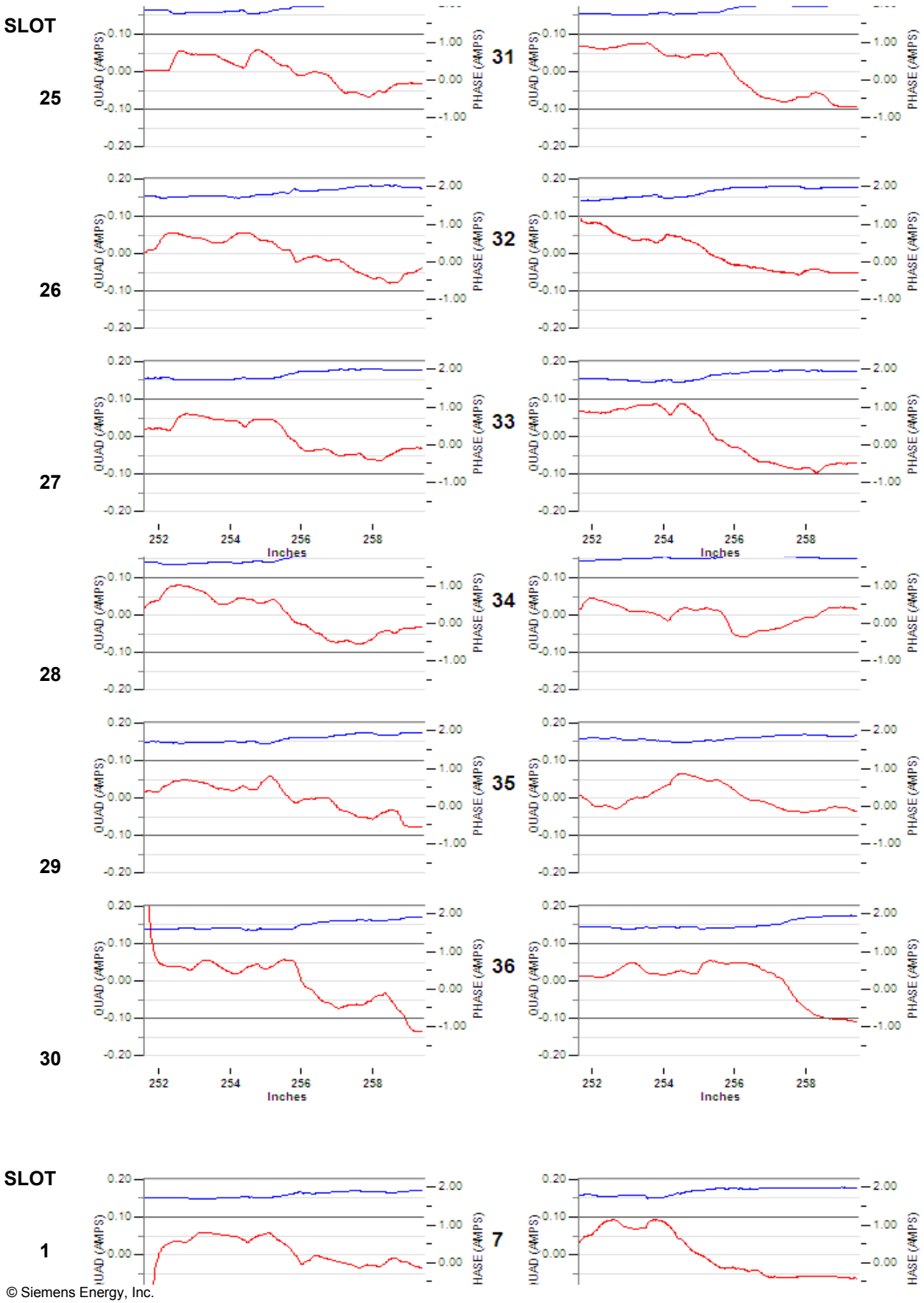
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Turbine End EL CID Step Iron Data

QUAD PHASE

S.O. #85P500



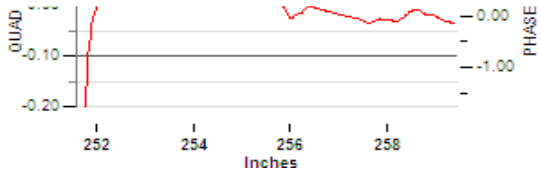
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

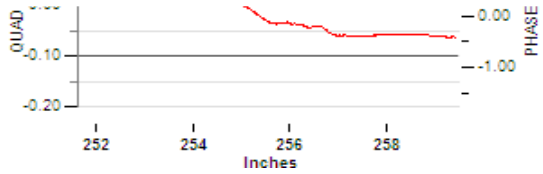
PPL
Colstrip 4

Turbine End EL CID Step Iron Data

QUAD PHASE

S.O. #85P500





© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PARTIAL POST RETEST EL CID SETUP RECORD - SMCAS PROCESSOR

CUSTOMER:	PPL	**S.O. NO.:**	85P500
STATION:	Colstrip	**UNIT NO.:**	4
ENGINEER:	Patryk Ruchniak	**DATE:**	5/29/2013

MACHINE DATA

MVA:	819	**NO. OF SLOTS:**	36
CORE LENGTH:	259.625 Inches	**STEP IRON LENGTH:**	5.188 Inches
STATOR CONDITION:	WOUND	**ROTOR IN/OUT:**	OUT
		OPERATIONAL FREQUENCY:	60 Hz

TEST CHECKLIST

- [X] CALIBRATION COMPLETED
- [X] EXCITATION LOOP ENERGIZED
- [X] RESET PHASE ON GOOD IRON

EXCITATION LOOP DATA

LOOP AMPERAGE DURING TEST: 8.17 Amps

SEARCH COIL DATA

CALCULATED SEARCH COIL VOLTAGE: 32.972375 Volts

MEASURED SEARCH COIL VOLTAGE: 32.94 Volts

THOSE PRESENT

CUSTOMER	SIEMENS
N/A	Patryk Ruchniak
N/A	N/A
N/A	N/A

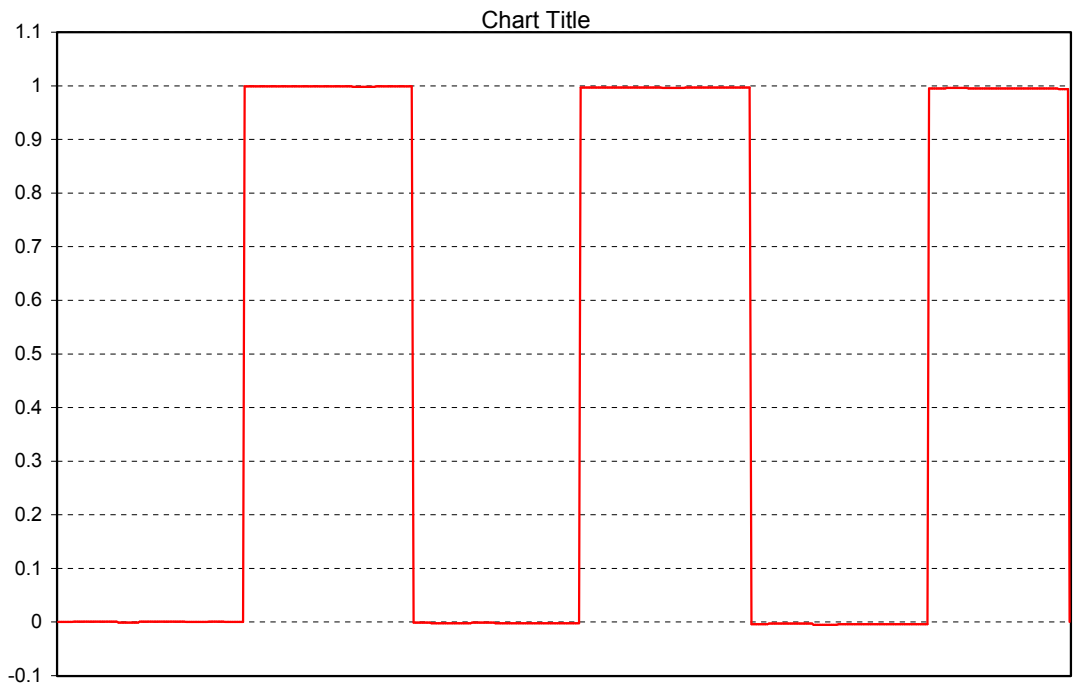
NOTES:
Begining to rescan body iron slots
Step Iron EE Reset Phase

Field Quality Assurance Form 94-1 © Siemens Energy, Inc. Use this document solely for the purpose given. Return upon request. Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

SMCAS CALIBRATION DATA SHEET FOR:

CUSTOMER:	PPL	STATION:	Colstrip	UNIT:	4
SHOP ORDER:	85P500	ENGR:	Patryk Ruchniak	DATE:	5/29/2013

CAL. POINT = 1.0 Amp



CALIBRATION VALUES:

	FULL SCALE		ZERO	
PHASE CURRENT	1.00	Amps	-5.00	mA
QUAD CURRENT	0	mA	-5	mA

CALIBRATION TRACE

TEST EQUIPMENT DATA

SMCAS PROCESSOR SN:	NK403G01-14
CALIBRATION BOX SN:	NK-CB-018
CAL. BOX DUE DATE:	5/29/2013
CHATTOCK COIL SN:	47350
SMCAS PRE-AMP SN:	NK404G01-14
SYSTEM GAIN:	0.9994
PHASE ROTATION:	20.8 Degrees
EXCITATION FREQUENCY	60 Hz

CHECKLIST

- [X] EXCITATION LOOP OFF
- [X] POSITION CHATTOCK ON CAL BOX
- [X] SET CURRENT TO 100 mA.

CAL CHECK READINGS

Initial Calibration: 1.000
Calibration Check: 1.005

ENGINEER'S SIGNATURE _____

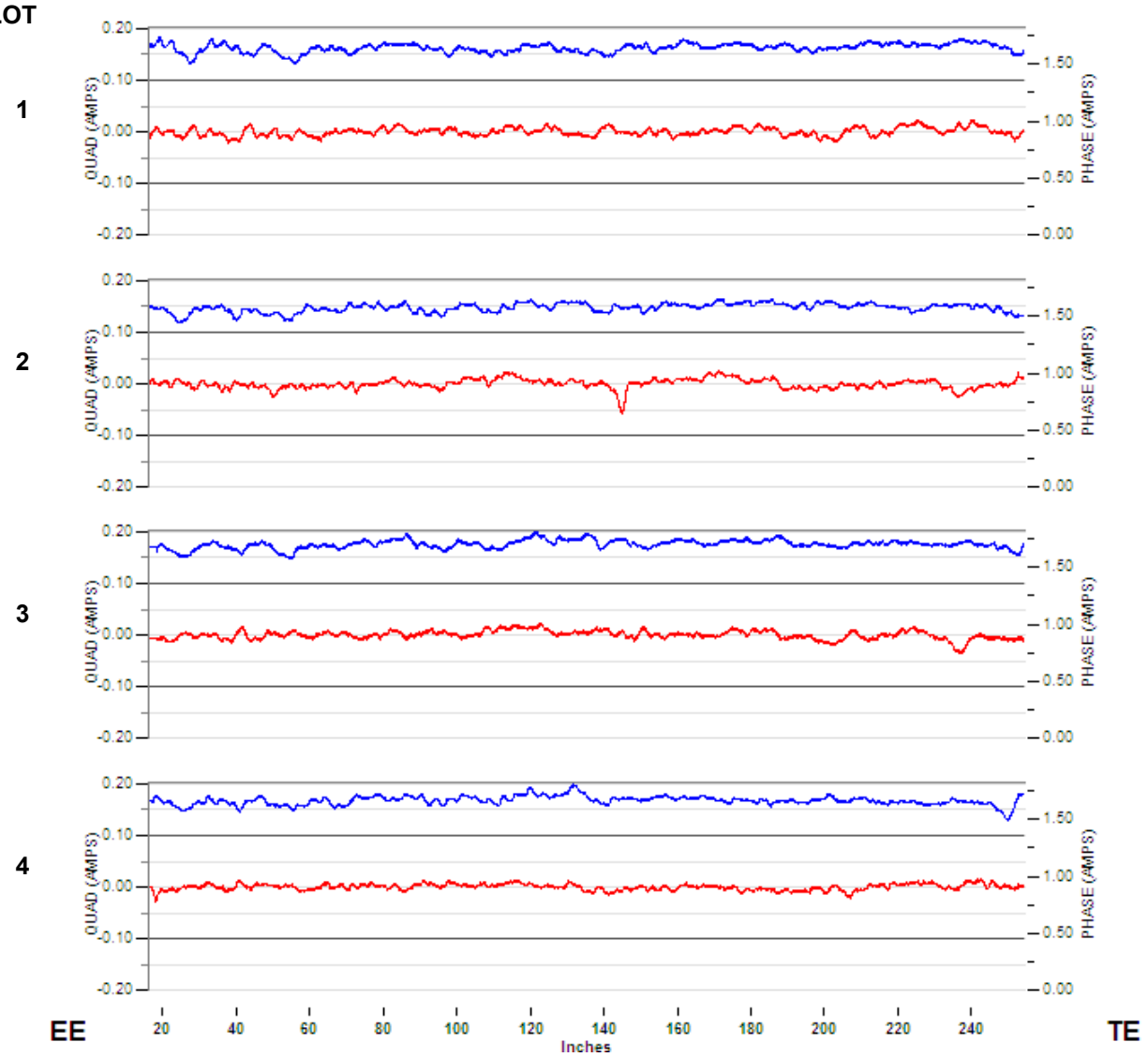
SIEMENS Field Quality Assurance Form 94-2

PPL
Colstrip 4

EL CID Body Iron Data
QUAD PHASE

29-May-2013
S.O. #85P500

SLOT



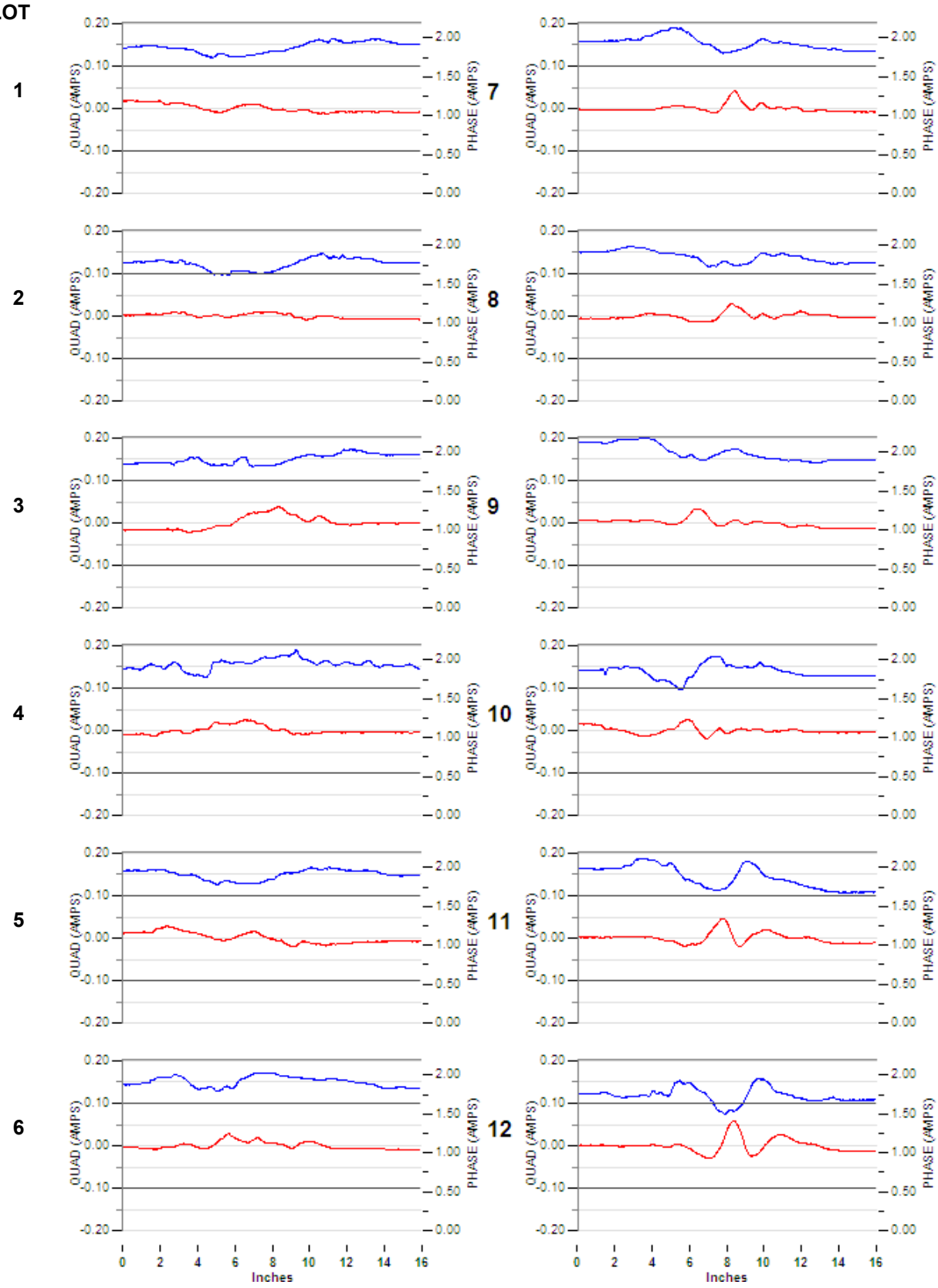
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



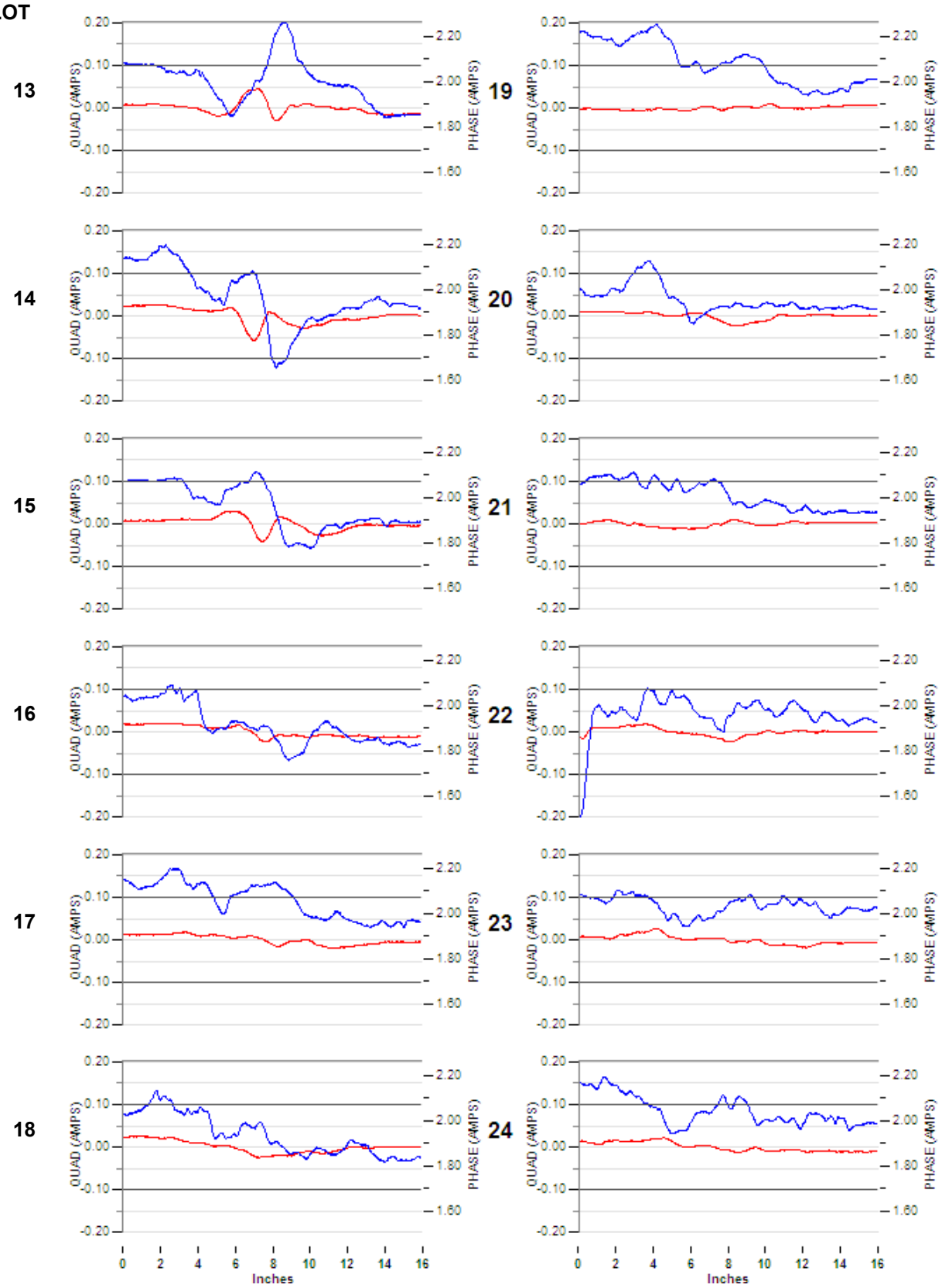
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



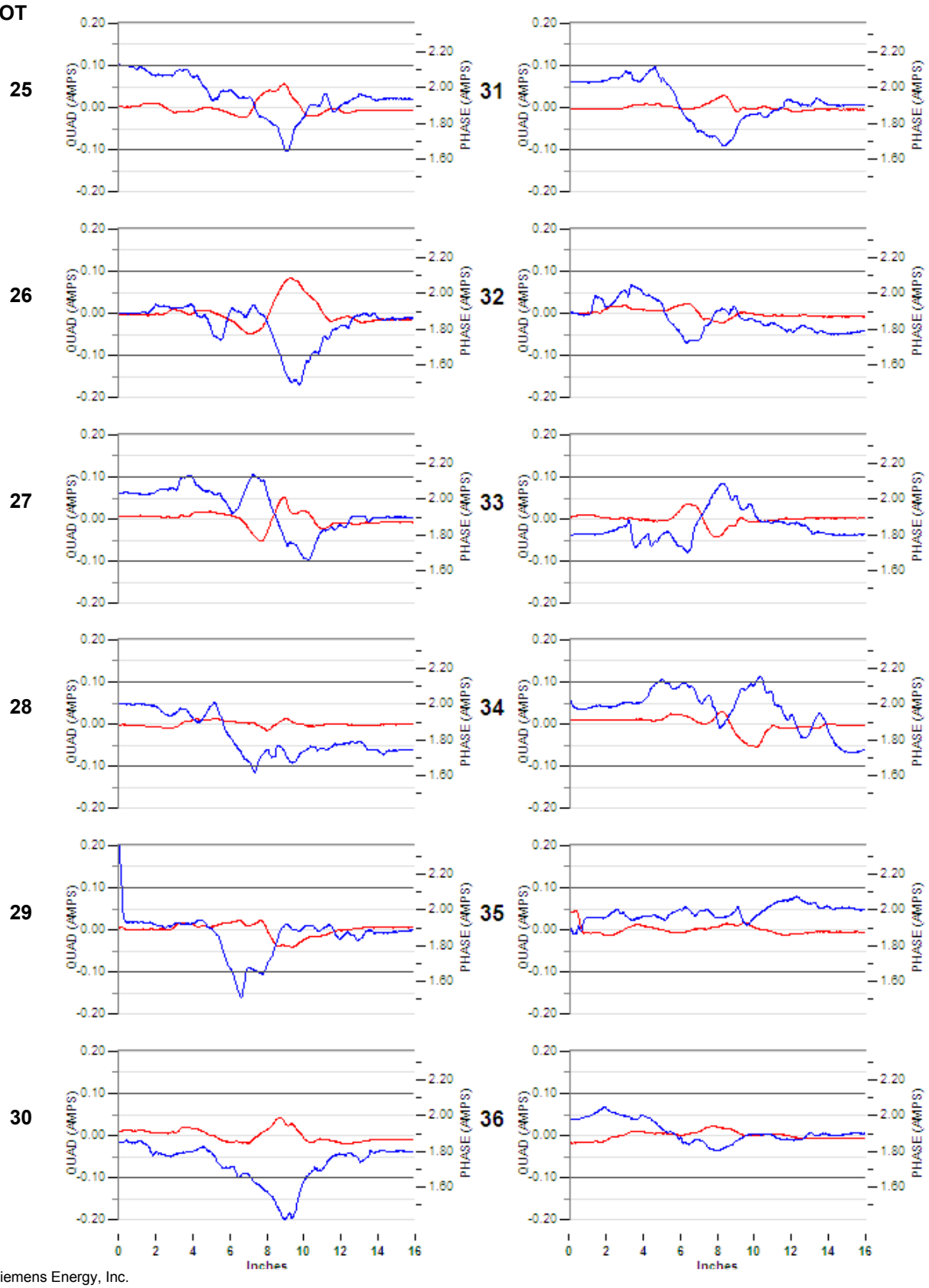
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

Exciter End EL CID Step Iron Data
QUAD PHASE

S.O. #85P500

SLOT



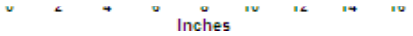
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

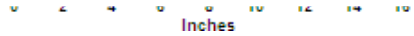
PPL
Colstrip 4

Exciter End EL CID Step Iron Data

QUAD PHASE

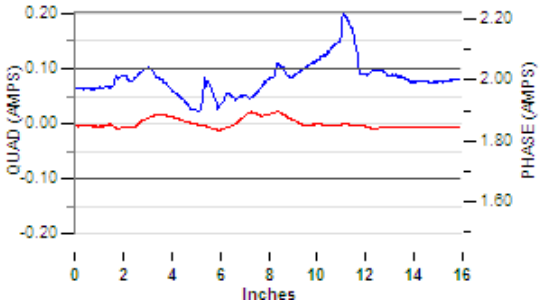
S.O. #85P500



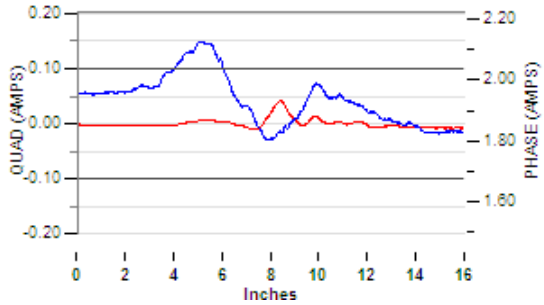


SLOT

1



7



© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

PPL
Colstrip 4

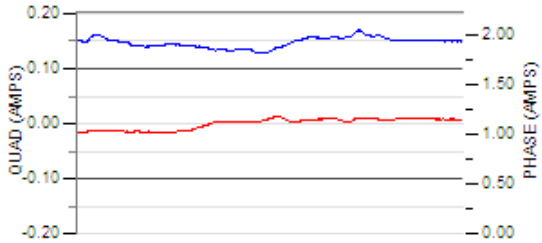
Turbine End EL CID Step Iron Data

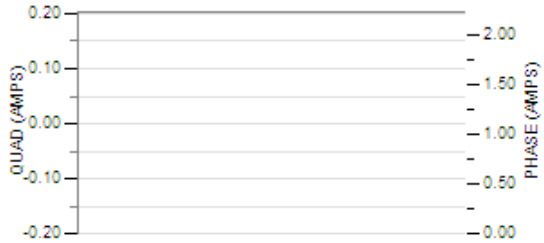
QUAD PHASE

S.O. #85P500

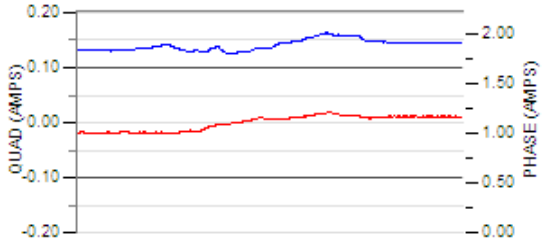
SLOT

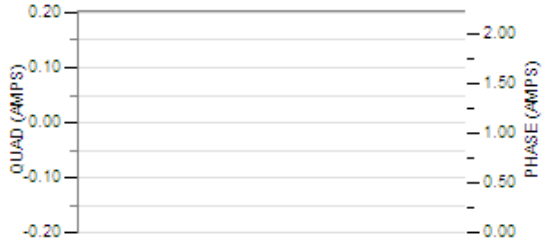
1



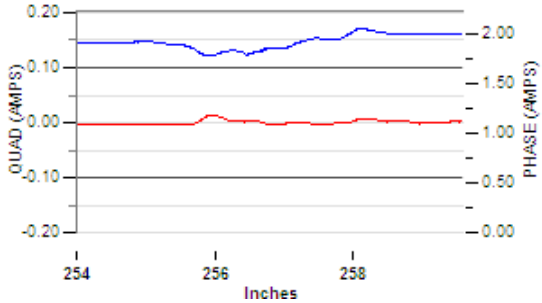


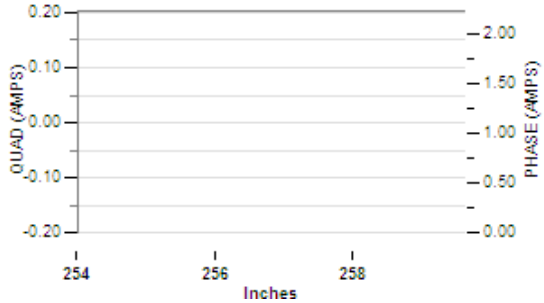
2





3





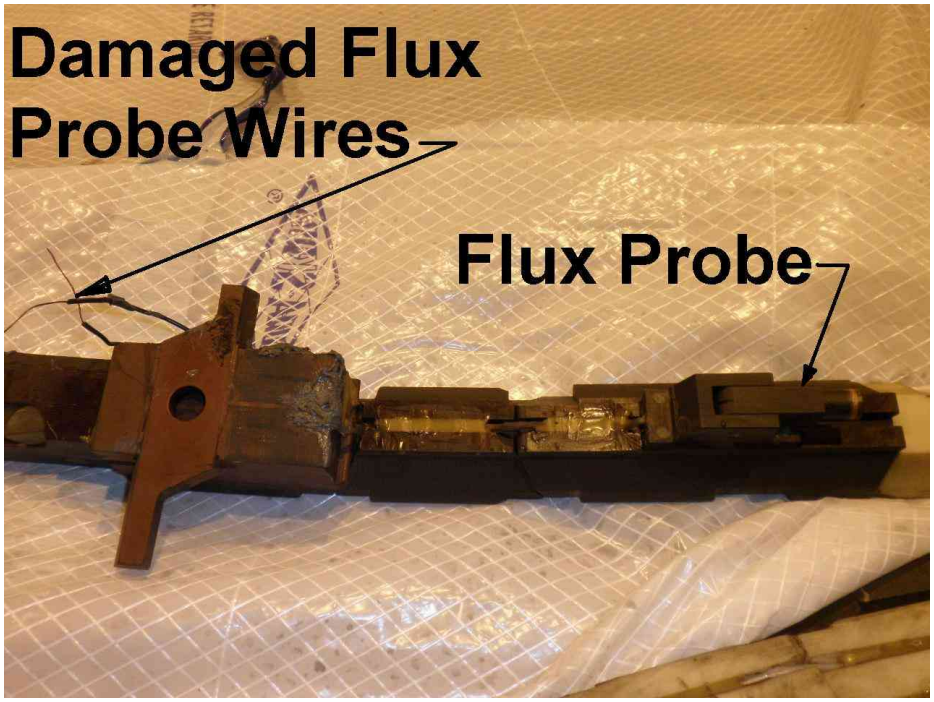
© Siemens Energy, Inc.
Field Quality Assurance Form 90-18, Rev. 2A
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce or use otherwise without written consent of Siemens Energy, Inc.

Exciter Coupling Oxidation 1

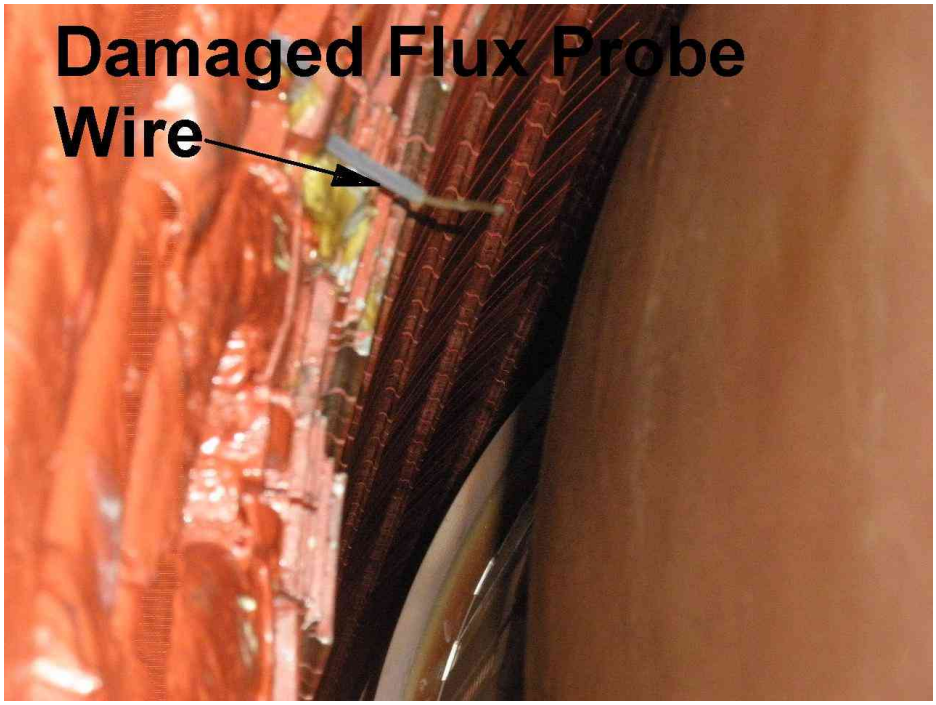
Diode Wheel

Parallel Ring Brace Greasing

Parallel Ring Greasing



Damaged Flux Probe Wire 1



Damaged Flux Probe Wire 2

2.2 Photographs

2.3 Miscellaneous Attachments

Siemens Energy, Inc. Proprietary Information
Use this document solely for the purpose given. Return upon request.
Do not disclose, reproduce, or use otherwise without written consent of Siemens Energy, Inc.
©2013 Siemens Energy, Inc.