Raquel J. Webster
Senior Counsel

December 21, 2016

BY HAND DELIVERY & ELECTRONIC MAIL

Luly E. Massaro, Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

RE: Docket 4513 – In Re: Proceeding to Establish a Pilot Metering Proposal for Municipal-Owned Streetlights
National Grid's Status Report

Dear Ms. Massaro:

I have enclosed National Grid's[1] status report regarding the Street Light Metering Pilot in the above-referenced docket.

Thank you for your attention to this matter. If you have any questions, please contact me at 781-907-2121.

Very truly yours,

Raquel J. Webster

Enclosure

cc: Docket 4513 Service List
Leo Wold, Esq.
Steve Scialabba, Division

[1] The Narragansett Electric Company d/b/a National Grid.

40 Sylvan Road, Waltham, MA 02451
T: 781-907-2121 ■ raquel.webster@nationalgrid.com ■ www.nationalgrid.com

Certificate of Service

I hereby certify that a copy of the cover letter and any materials accompanying this certificate was electronically transmitted to the individuals listed below.

The paper copies of this filing are being hand delivered to the Rhode Island Public Utilities Commission and to the Rhode Island Division of Public Utilities and Carriers.

Joanne M. Scanlon

December 21, 2016
Date

Docket No. 4513 - National Grid – Streetlight Metering Pilot Proposal
Service List updated 11/16/15

Name/Address	E-mail Distribution	Phone
Raquel Webster, Esq. Thomas Teehan, Esq. National Grid 280 Melrose Street Providence, RI 02907	Thomas.teehan@nationalgrid.com; celia.obrien@nationalgrid.com; Joanne.scanlon@nationalgrid.com; Jeanne.lloyd@nationalgrid.com; John.walter@nationalgrid.com; Raquel.Webster@nationalgrid.com;	781-907-2121 401-784-7288
Karen Lyons, Esq Dept. of Attorney General 150 South Main St. Providence, RI 02903	Klyons@riag.ri.gov; Jmunoz@riag.ri.gov; dmacrae@riag.ri.gov; john.spirito@dpuc.ri.gov; James.lanni@dpuc.ri.gov; joseph.shilling@dpuc.ri.gov; Al.contente@dpuc.ri.gov; Steve.scialabba@dpuc.ri.gov;	401-274-4400 Ext. 2218
Richard Hahn Daymark Energy Advisors One Washington Mall, 9th floor Boston, MA 02108	rhahn@daymarkea.com;	
Seth H. Handy, Esq. (for RILCT / WCRPC) HANDY LAW, LLC 42 Weybosset Street Providence, RI 02903	seth@handylawllc.com; lightsmart@tds.net;	401-626-4839
Dan Beardsley, Executive Director RI League of Cities and Towns (RILCT) One State St., Suite 502 Providence, RI 02908	dan@rileague.org; peder@rileague.org;	401-272-3434
Jeff Broadhead, Executive Director Washington County Regional Planning Council (WCRPC) 344 Main St., Suite 202 Wakefield, RI 02879	jb@wcrpc.org;	401-792-9900
Chris Kearns, Chief Program Development RI Office of Energy Resources (OER)	Christopher.Kearns@energy.ri.gov; Marion.Gold@energy.ri.gov;	401-574-9113

One Capitol Hill, 4th Fl. Providence, RI 02808	Nicholas.Ucci@energy.ri.gov; Danny.Musher@energy.ri.gov;	
Daniel W. Majcher, Esq. (for OER) RI Dept. of Administration Division of Legal Services One Capitol Hill, 4th Fl. Providence, RI 02908	Daniel.majcher@doa.ri.gov;	401-222-8880
R. Daniel Prentiss, P.C. (for EERMC) Prentiss Law Firm One Turks Head Place, Suite 380 Providence, RI 02903	dan@prentisslaw.com;	401-824-5150
S. Paul Ryan (EERMC)	spryan@eplaw.necoxmail.com;	401-289-0184
File an original & 10 copies w/: Luly E. Massaro, Commission Clerk Public Utilities Commission 89 Jefferson Blvd. Warwick, RI 02888	Luly.massaro@puc.ri.gov; Cynthia.WilsonFrias@puc.ri.gov; Todd.bianco@puc.ri.gov; Alan.nault@puc.ri.gov;	401-780-2017

The Narragansett Electric Company
d/b/a National Grid

Street Light Metering Pilot

Status Report No. 2

December 21, 2016

Submitted to:

Rhode Island Public Utilities Commission
RIPUC Docket No. 4513

Submitted by:

nationalgrid

INTRODUCTION

On July 1, 2015, the Rhode Island Public Utilities Commission (PUC) approved The Narragansett Electric Company d/b/a National Grid's (National Grid) Street Light Metering Pilot (the Pilot), with certain modifications. The final approved Pilot resulted from nearly a year of negotiation and discussion with Rhode Island municipalities and the state Office of Energy Resources (OER) regarding the scope and costs of the Pilot, which resulted in agreement on many, but not all, aspects of the Pilot.[1] The parties submitted the remaining issues to the PUC for decision, and the PUC's July 1, 2015 order required National Grid to make certain revisions to the Pilot. National Grid submitted the revised Pilot in compliance with the PUC order on July 27, 2015.

The final approved Pilot established a two-stage process, with each stage comprised of two phases. Stage 1-Phase 1 called for laboratory testing of metering equipment. Stage 1-Phase 2 provided for field testing of metering equipment to be installed as part of a separate pilot project by the Rhode Island Department of Transportation (DOT). Stage 2-Phase 1 involved the determination of how information collected from the metering equipment could be accurately and securely integrated into National Grid's data management and billing systems (the IS Services Analysis). Stage 2-Phase 2 was to be a comparative analysis of the metering data versus National Grid's unmetered consumption calculations and the preparation of a final report on the results of the Pilot. The total estimated cost for the Pilot was $246,000. That cost estimate included an estimated cost of $45,000 for the IS Services Analysis. The Pilot schedule estimated completion within approximately one year. The PUC approved National Grid to "recover the costs associated with the metering pilot from all street lighting customers." PUC Order No. 22413 at 11.

On February 22, 2016, National Grid submitted Street Light Metering Pilot, Status Report No. 1 to inform the PUC about the progress of the Pilot. At that time, National Grid alerted the PUC to "unanticipated obstacles beyond its control that have caused delays and added modest additional costs to the Pilot." As of Status Report No. 1, National Grid estimated that it could still finish the Pilot within the originally contemplated timeframe, but estimated an increase in the Pilot budget of $23,450 for a total Pilot budget of $269,450.

Since Status Report No. 1, National Grid has faced continued difficulties beyond its control that have prevented it from completing the Pilot as approved by the PUC. Although National Grid has done everything it can to keep the Pilot moving forward and to complete as much of it as

[1] The PUC ordered the creation of the Pilot in Docket 4442 in its Report and Order entered on October 31, 2014 following a decision in Open Meetings held on July 25, 2014 and August 7, 2014.

possible, National Grid has been unable to complete the Pilot under the timeframe and within the budget originally approved.

This Status Update sets forth: (1) the aspects of the Pilot that National Grid has completed and the results of that work to date, (2) the aspects of the Pilot yet-to-be completed and the reasons those aspects have not yet been completed, (3) the cost-to-date for the Pilot, broken down by category, (4) the anticipated additional costs for the completion of the Pilot, and the reasons for those additional costs, (5) the changes to the Pilot necessary due to factors beyond National Grid's control, and (6) the anticipated time necessary to complete the Pilot.

Since August, National Grid has been discussing the status of the Pilot with the municipalities and OER in an attempt to reach agreement on a proposal to the PUC for modifications to the Pilot. National Grid has provided the municipalities and OER with all the information they have requested, but to date there has not been a consensus on how to proceed. Specifically, the municipalities and OER have expressed concern about the proposed increased costs for the IS Services Analysis and have questioned whether the Pilot should be completed in light of results that National Grid shared from the Stage 1-Phase 1 laboratory testing.

To avoid increased costs from additional delays and in an effort to ensure that it complies with the PUC's orders regarding the Pilot, National Grid is providing this status update. Through this status update, National Grid requests that the PUC approve modification to: (1) the Pilot timeline, (2) the Pilot budget, and (3) the Stage 1-Phase 2 field testing. Additionally, if the PUC approves National Grid's cost recovery of the additional necessary costs, then National Grid agrees that it will explore whether there are other applications of the findings from the Pilot that would justify seeking cost recovery from customers other than Street Lighting customers in other dockets through other rates.

COMPLETED ASPECTS OF THE PILOT

Laboratory Testing

The only aspect of the Pilot that is complete is the first portion of the Stage 1-Phase 1 laboratory testing. Although this portion of Stage 1-Phase 1 took longer than anticipated for numerous reasons, including, among other things, difficulty obtaining metering equipment from the manufacturers on a timely basis, National Grid, working with TESCO (the Company's contracted testing laboratory), has completed bench testing in an effort to verify the metering manufacturers' accuracy claims. With TESCO, National Grid developed a battery of tests based on ANSI standards that were performed on four different nodes. National Grid gained valuable information from this bench testing.

The results of these tests were mixed. The Test Specification document detailing the tests that were performed is attached as Exhibit 1. Graphs depicting the results of each test are attached as Exhibit 2. National Grid has not yet fully analyzed the test results and prepared a full report on the results. As such, these results are preliminary.

Although National Grid has not been able to complete many aspects of the Pilot, it nevertheless has gleaned some insights from its work on the Pilot to date. A Summary of Key Observations to Date is attached as Exhibit 3.

INCOMPLETE ASPECTS OF THE PILOT

End-To-End Meter Farm Testing

The Stage 1-Phase 1 laboratory testing also included the creation of a meter farm for an "end-to-end performance examination of the network communication platforms to assess the complexities and limitations of each element of the integrated system[.]" National Grid has not yet completed this aspect of Stage 1-Phase 1 because of difficulties with node equipment and performance issues with network service providers. These issues have now been overcome and National Grid is able to begin moving forward with this meter farm testing.

Field Testing

National Grid has not yet begun the Stage 1-Phase 2 field testing. The Pilot called for National Grid to use the DOT project sites to conduct field testing to minimize costs. The plan included field testing at three specific DOT locations where it planned to install LED streetlights: (1) Exit 7 off of Interstate 295, (2) the Interstate 295/Route 146 North and South Projects, and (3) certain Park and Ride Locations. To date, National Grid has not accessed any DOT field locations to conduct this testing. DOT did not install the LED lights for its project on the timeframe and in the manner originally expected when the Pilot was developed and approved. Additionally, commissioning delays associated with DOT's SSN communication network prevented National Grid from receiving the information necessary to access the data from its field installations.

Moreover, even if the technical obstacles are surmounted, National Grid still would not be able to access data from the field installations because DOT has not signed the memorandum of understanding (MOU) with National Grid necessary to move forward with the project. Although DOT has repeatedly assured National Grid that a signed MOU is forthcoming, National Grid cannot predict when, or even if, it will be able to begin conducting field testing on the DOT installations.

IS Systems Analysis

Although National Grid has not completed all of Stage 1 of the Pilot, it has worked to progress the Stage 2-Phase 1 IS Systems Analysis. The purpose of this aspect of the Pilot is to insure that the new street light metering technology can be incorporated into National Grid's existing information systems by identifying the work that will need to be done to facilitate integration. To that end, National Grid has: (1) identified the systems that would be impacted, (2) identified the system requirements to integrate the data, (3) determined necessary changes to the system architecture to facilitate the integration, and (4) developed a high level design for the impacted systems. National Grid still must complete several additional steps before the IS Systems Analysis is complete. A document reflecting the complete scope of the IS Systems Analysis, including identification of the tasks completed to date, is attached as Exhibit 4.

This aspect of the Pilot has been more complicated and time-consuming than originally anticipated. As National Grid's personnel have worked on this analysis, the scope of the systems impacted has been larger and more diverse than expected, and the identification of the solutions to allow for the integration has been more complicated than anticipated. The complexity of the analysis has resulted in higher costs than originally budgeted. Consequently, National Grid has postponed further work on this aspect of the Pilot pending approval by the PUC for recovery through rates of the higher-than-expected costs.

Metered v. Non-Metered Rate Comparison and Final Report

National Grid has not yet begun this aspect of the Pilot because information from the field testing and the completion of the IS Systems Analysis is necessary before any such work can begin. Specifically, National Grid cannot perform an analysis of whether the non-metered street light rates are reasonable in comparison to metered rates if it cannot gather data from field testing. Similarly, National Grid cannot prepare a final report on the overall Pilot until it receives data and results from all phases of the Pilot.

COSTS TO DATE

National Grid has incurred $363,577 in total costs for the Pilot to date. Those costs fall into the following categories:

Project Management	$193,368
Administrative & General	$0
Individual Meter Testing – TESCO	$73,756
IS Systems Analysis	$96,453

National Grid's costs for Project Management, Individual Meter Testing, and IS Systems Analysis all are in excess of the originally budgeted costs. As explained in greater detail below, the Project Management costs are higher because the Pilot has taken longer than originally planned. As explained above, the IS Systems Analysis costs have exceeded budget to date (and will continue to increase) because the complexity and scope of the potential integration of the metering technology with National Grid's existing systems has been greater than anticipated.

Finally, the Individual Meter Testing costs are higher than original budgeted for several reasons:

- **Hardware Costs**. National Grid had to purchase some of the metering equipment for testing that it did not originally expect to purchase because of changes in the nature of the DOT project, with which National Grid has been working to coordinate on the Pilot. Subsequent rehandling of these products to comply with the Pilot also added additional costs. These materials costs totaled $20,500.

- **Third-Party Contract Costs**. Because of delays in the ability to commence field testing and a change in the DOT's plans regarding its network service providers, National Grid had to expand the scope of services provided by TESCO in performing the meter farm testing. This broadened scope of services was necessary to be able to test all the types of equipment incorporated into the originally approved Pilot. The cost for this additional scope of services is $18,500.

ADDITIONAL NECESSARY COSTS

National Grid estimates that it will need to incur additional costs in four areas.

First, National Grid will incur additional project management costs. For each additional month of the Pilot, National Grid must pay its third-party Project Manager at the rate of $14,500 per month. The Project Manager costs are necessary even during times when Pilot activity is slowed or halted to keep the Pilot moving forward. National Grid estimates that it will require at least an additional 5 months to complete the Pilot after receiving approval from the PUC to move forward. Thus, National Grid will likely incur at least an additional $195,000 in costs for project management beyond the original budget.

Second, National Grid will incur additional costs to complete the IS Systems Analysis. These costs cover the labor for the National Grid personnel to be dedicated to completion of this analysis. National Grid's team leader on this aspect of the Pilot estimates that it will cost an additional $177,000 in excess of the original budget to complete the IS Systems Analysis.

Third, National Grid expects that it will likely incur $10,000 in labor costs for the field testing phase of the Pilot. Originally, National Grid did not expect to incur any costs associated with field testing because of the plan to use the DOT installations. Because of the changes to the DOT's plans, National Grid now expects that, even if it is able to use the DOT installations for field testing, it will still need to install certain equipment to be able to achieve the mandated Pilot goals. Additionally, National Grid proposes that the PUC approve an alternate approach to field testing if it is unable to resolve the pending issues that are impeding the collaboration with DOT. Specifically, National Grid has discussed with TESCO a plan to conduct simulated field testing at a cost of $19,500. This simulated field testing would provide National Grid with sufficient information to assess the reliability of the technology in the real-world environment and to determine whether the non-metered rates are reasonable when compared to metered rates. This additional cost would be contingent on the failure of efforts to collaborate with DOT. As such, the additional costs for field testing would be either: (a) $10,000 in labor for equipment installation, or (b) $19,500 for simulated field testing – not both.

Fourth, National Grid has not yet incurred the budgeted $5,000 in costs for the preparation of the Stage 2-Phase 2 Billing Comparison study. Therefore, those costs will be in addition to those incurred to date.

The original budget for the Pilot was $246,000. To date, National Grid has incurred $363,577 in Pilot costs. National Grid estimates that it will incur between $421,000 and $430,500 in additional costs beyond the original budget to complete the Pilot for a total Pilot cost of between $667,000 and $676,500. A chart showing a comparison between the original budget and the proposed amended budget is attached as Exhibit 5.

All the additional costs are reasonable and necessary to achieve the mandated Pilot goals. National Grid, therefore, requests that the PUC authorize National Grid to incur these costs and recover them through rates charged to street lighting customers through the mechanism previously approved. National Grid, however, commits that it will explore whether any of the lessons learned from the Pilot are applicable outside of the street lighting context and will assess whether some of the costs can be recovered through other rates from other customers through other dockets.

CHANGES TO THE CONDUCT OF THE PILOT

Field Testing

National Grid will not be able to complete field testing on the DOT project installations as originally planned. The purpose of the original scope was to ensure that National Grid had tested the two different networks and four different nodes, as well as to allow National Grid to

experience the operation of the metering technology in varying environments. National Grid proposes to modify the scope of the field testing as follows:

- Continue to collaborate with DOT, but receive on-line data only using data from their in-service system (which only has a single network service provider), and attempt to receive modified operating schedule data within Park and Ride locations for a limited time.

With this proposed modification, National Grid expects it will be able to field test three different nodes on the SSN network.

Further, National Grid proposes an alternate plan in the event that its ability to work with DOT continues to be delayed, such as in the event the parties are unable to reach an agreement on the memorandum of understanding. National Grid has asked TESCO, the third-party performing the laboratory testing for National Grid, to prepare a proposal to perform simulated field testing to mimic real-world conditions. If National Grid is unable to begin the full scope of field testing necessary using the DOT project locations by January 1, 2017, then National Grid requests that the PUC authorize it to engage TESCO to perform this simulated field testing using tested nodes and control systems with sample LED luminaires purchased by National Grid to ensure that it completes the Pilot on the timetable proposed in this motion. Although the simulated field testing would not be a perfect substitute to the real-world field testing planned in the Pilot, it would permit National Grid to gather data and information beyond the simple laboratory testing to assess how the equipment performs in stressed conditions. Moreover, this alternate plan will incorporate the second network service provider, CIMCON, with associated nodes to achieve diversity of multiple data providers per the previously approved scope of the Pilot.

These proposed changes are necessary because National Grid must be able to conduct field testing on multiple network providers using multiple nodes. Potential municipal customers will not be restricted to purchasing a particular system or a particular node. Consequently, National Grid must gather sufficient information from the Pilot to be able to incorporate a representative sample of metered streetlights customers may purchase.

ANTICIPATED PILOT COMPLETION

Currently, National Grid estimates that it will take 5 months for it to complete the Pilot once it receives approval from the PUC to incur and recover additional costs and is able to commence field testing (or simulated field testing, if necessary). Additionally, it will take about 5.5 months (concurrent with the 5 months mentioned above) from the date of PUC approval to proceed to complete the I.S. Systems Analysis portion of the Pilot.

ORIGINATING GROUP:	ORIGIN DATE:	REVISION DATE:	NO. OF SHEETS:
TESCO ENGINEERING	**19-Feb-2016**	**19-Sep-2016**	**9**

Test Specification
for

nationalgrid

Photocell Node Bench Testing
Project 8594
10/21/2016 - Rev 4A - Revised for Select Limited External Distribution

SHEET NO.	1	2	3	4	5	6	7	8	9	10
REVISION	-	-	-	**3**	-	**4**	**1**	**3**	**3**	**3**

APPROVED:
Originator: John Williams
DATE: 19-Feb-16

APPROVED:
Electrical:
DATE:

APPROVED:
Project Mgr.: John Williams
DATE: 19-Feb-16

Revision 4A Note:

Two independent network platform providers were used to provide communications interfaces to the nodes.

Table of Contents

1 Purpose

Define all test equipment, procedures, and documentation specifications for the photocell node bench testing to be performed by Tesco for National Grid - RI.

2 Definitions, Acronyms and Abbreviations

Abbreviation	Definition
A	Amperes
AC	Alternating Current
ANSI	American National Standards Institute
DPT	Digital Power Technologies (Power supply mfg.)
MTB	Meter Test Board
PF	Power Factor
THD	Total Harmonic Distortion
V	Volt
VT	Voltage Transformer
Wh	Watt-hour

3 Test Equipment Specifications

3.1 Meter Test Board (MTB)

The Tesco MTB is a four socket unit capable of simultaneously testing 4 meters. It is ANSI C12.20 compliant and uses a NIST traceable 3 phase reference standard.

3.1.1 Main Components

- 3.1.1.1 Digital Power Supply - DPT 024 Series 3 phase source.
  - 3.1.1.1.1 Frequency Accuracy - +/-0.02Hz
  - 3.1.1.1.2 Voltage Set point accuracy - 0.5%
  - 3.1.1.1.3 THD <0.5% Linear load
  - 3.1.1.1.4 Phase Resolution - 0.01 degree
  - 3.1.1.1.5 Current Accuracy - 0.5%
- 3.1.1.2 Reference standard - Radian RD-30-201
  - 3.1.1.2.1 .04% accuracy class
  - 3.1.1.2.2 Serial Number 301510
  - 3.1.1.2.3 Calibration date: 04/20/15

3.1.1.2.4 Calibration certificate detailing results and NIST traceability available upon request. (Internal Tesco Link to Cal Cert)

3.1.1.3 Programmable Logic Controller – Automation Direct, Productivity 3000 series

3.1.1.3.1 Main unit controller that is responsible for setting up the power supply, monitoring voltages and currents, and counting reference standard energy pulses.

3.1.1.4 Socket adapter – by Tesco

3.1.1.4.1 This unit adapts a 7 pin standard photocell socket to a standard metering socket.

3.1.1.4.2 Design details available upon request.

3.1.1.5 Network Service Provider #1 – portable communication adapter between PC and nodes fitted with Network Service Provider #1's communication hardware.

3.1.1.6 Network Service Provider #2 – portable communication adapter between PC and nodes fitted with Network Service Provider #2's communication hardware.

4 Test Specifications

4.1 This section is meant to adhere as closely as possible to ANSI C12.20.

4.2 For the purposes of these tests, the node meter function will be treated as an ANSI socket meter form 1S.

4.3 Test Conditions

4.3.1 Temperature: 23°C, +/- 2°C

4.3.2 Rated voltage (120VAC): +/- 1%

4.3.3 Rated frequency (60Hz): +/- 1Hz

4.3.4 Test Amperes (1.5/10AAC): +/- 1%

4.3.5 Unity Power factor (0°): +/- 2°

4.3.6 Nodes will be temperature stabilized before testing

4.4 Prior to each test set performed, the nodes will be energized for a 5 minute warm-up period.

4.5 Tests to be performed

4.5.1 ANSI C12.20 – Test number 1: No Load

4.5.1.1 The node with only the voltage circuit energized shall not register one equivalent rotation in watthours (for nodes with a metering pulse) or 1 watthour in 10 minutes.

4.5.2 ANSI C12.20 – Test number 2: Starting load

4.5.2.1 The node shall operate continuously with a load current of .01A at its lowest rated voltage.

4.5.3 ANSI C12.20 – Test number 3: Load performance

4.5.3.1 Each node will be tested at 120V and 10A. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.5.3.2 Each node will be tested at 120V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.5.4 ANSI C12.20 – Test number 4: Effect of variation of power factor for single element meters.

4.5.4.1 Each node will be tested at 120V and 10A, with 0.5 lagging power factor. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.6 Optional tests that can be performed (time permitting)

4.6.1 ANSI C12.20 – Test number 5: Effect of variation of voltage

4.6.1.1 Each node will be tested at 120V and 10A. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.1.2 Each node will be tested at 108V and 10A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.1.

4.6.1.3 Each node will be tested at 132V and 10A. The performance of each node will be documented

under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.1.

4.6.1.4 Each node will be tested at 120V and 1.0A. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.1.5 Each node will be tested at 108V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.4.

4.6.1.6 Each node will be tested at 132V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.4.

4.6.2 ANSI C12.20 – Test number 6: Effect of variation of frequency (note that all previous testing is done at 60Hz)

4.6.2.1 Each node will be tested at 120V, 10A and 60Hz. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.2.2 Each node will be tested at 120V, 10A and 58.8Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.1.

4.6.2.3 Each node will be tested at 120V, 10A and 61.2Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.1.

4.6.2.4 Each node will be tested at 120V, 1.0A and 60Hz. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.2.5 Each node will be tested at 120V, 1.0A and 58.8Hz. The performance of each node will be documented under this condition. Comparison will

be made in each case to the reference accuracy listed in 4.6.2.4.

4.6.2.6 Each node will be tested at 120V, 1.0A and 61.2Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.4.

4.6.3 In addition to the ANSI specified tests, perform multiple accuracy tests per node type at +/-15% and +/-20% voltage variations.

4.6.4 In addition to the ANSI specified tests, perform multiple accuracy tests per node type at 0.5A and 15A.

4.7 Testing method

4.7.1 Network Service Provider #1 Communication method

4.7.1.1 This method will be used on all nodes for all tests listed in sections 4.5 and 4.6.

4.7.1.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.1.3 Each node will be energized with potential only.

4.7.1.4 Each node will be registered through Network Service Provider #1's network using their portable communications adaptor.

4.7.1.5 An initial Wh query will be done on each node and recorded in the data collection spreadsheet.

4.7.1.6 The testing parameters will then be set in the MTB. The MTB will be set to run a Demand test, with the interval set to a value which should register at least 1,000Wh on both the nodes and the reference standard (i.e. for 120V, 1.00 PF, 10A test, the time interval will be set to (1,000*60)/(120*10) = 50 minutes).

4.7.1.7 At the end of the interval, the number of Wh from the reference standard will be recorded, along with the ending Wh readings from each of the four nodes.

4.7.1.8 The percent accuracy will then be given by the ratio of Node Wh/Reference Standard Wh.

4.7.2 Meter Pulse method

4.7.2.1 This method will only be used on nodes that have a metering IR pulse output on all the tests listed in sections 4.5 and 4.6, and will be done in addition to the method described in section 4.7.1

4.7.2.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.2.3 Each node will be energized with potential and load current so that the metering pulse will be activated.

4.7.2.4 Each node's metering pulse pickup assembly (part of the MTB) will be aligned with the metering pulse output.

4.7.2.5 The testing parameters will then be set in the MTB. The MTB will be set to run a Full Load, Light Load, or Power Factor test, depending on the requirements of the test.

4.7.2.6 At the end of the test, the registration value will be read directly from the MTB.

4.7.3 Network Service Provider #2 Communication method

4.7.3.1 This method will be used on all nodes fitted with the Network Service Provider #2's communication hardware for all tests listed in sections 4.5 and 4.6.

4.7.3.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.3.3 Each node will be energized with potential only.

4.7.3.4 Each node will be registered through Network Service Provider #2's network using their communication software.

4.7.3.5 An initial Wh query will be done on each node and recorded in the data collection spreadsheet.

4.7.3.6 The testing parameters will then be set in the MTB. The MTB will be set to run a Demand test, with the interval set to a value which should register at least 1,000Wh on both the nodes and the reference standard (i.e. for 120V, 1.00 PF, 10A test, the time interval will be set to (1,000*60)/(120*10) = 50 minutes).

4.7.3.7 At the end of the interval, the number of Wh from the reference standard will be recorded, along with

the ending Wh readings from each of the four nodes.

4.7.3.8 The percent accuracy will then be given by the ratio of Node Wh/Reference Standard Wh.

5 Documentation

5.1 The results of each of the aforementioned tests will be documented in a fashion that will first sort the information based on the test performed.

5.2 Each test result will be further sorted by node manufacturer.

5.3 Each test result will be listed and if multiple tests were performed based on the same criteria, due to a test procedural fault, or due to a repair required to the testing equipment; those tests will be listed together, with a notation as to the reasons why the additional test was required.

5.4 Each test result will (at a minimum) list the following information:

5.4.1 Test name and description (as listed in sections 4.5 and 4.6 above)

5.4.2 Test conditions (as listed in section 4 above)

5.4.3 Manufacturer name

5.4.4 Node serial number or other identifying information.

5.4.5 Expected test result or acceptable result.

5.4.6 Actual result

5.4.7 Units

5.4.8 Notes – this will be a section that will be used in the case where the tester observes a notable condition that existed prior to, during, or after the test was performed.

5.5 Each section will be followed by an additional notes section that will be used to summarize the findings and will be kept to observable facts.

5.6 Finally, the report will contain a summary of all testing performed, observed information not included in the otherwise presented data, and a clearly indicated section for opinions and recommendations.

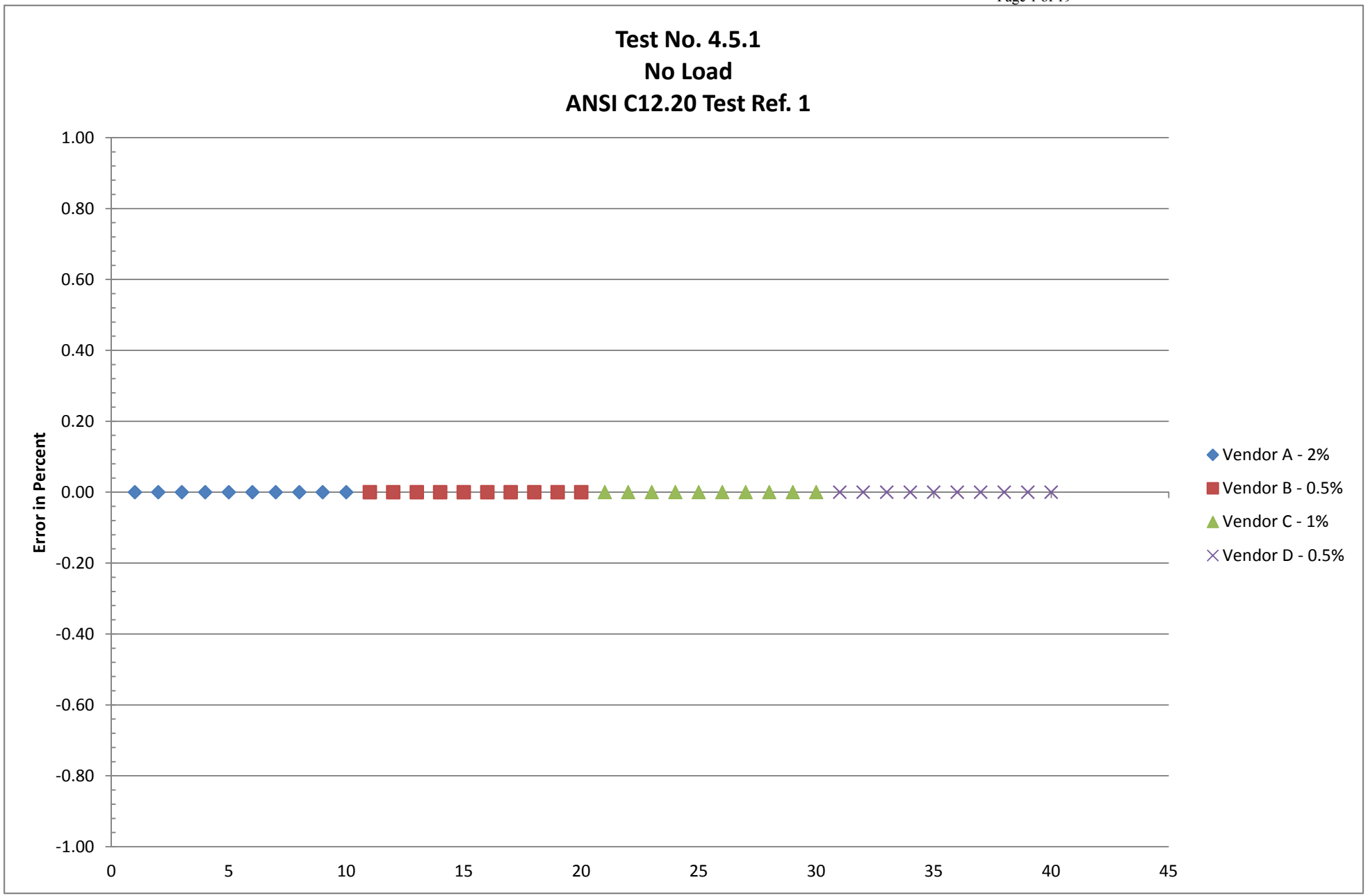
6 Reference Documents

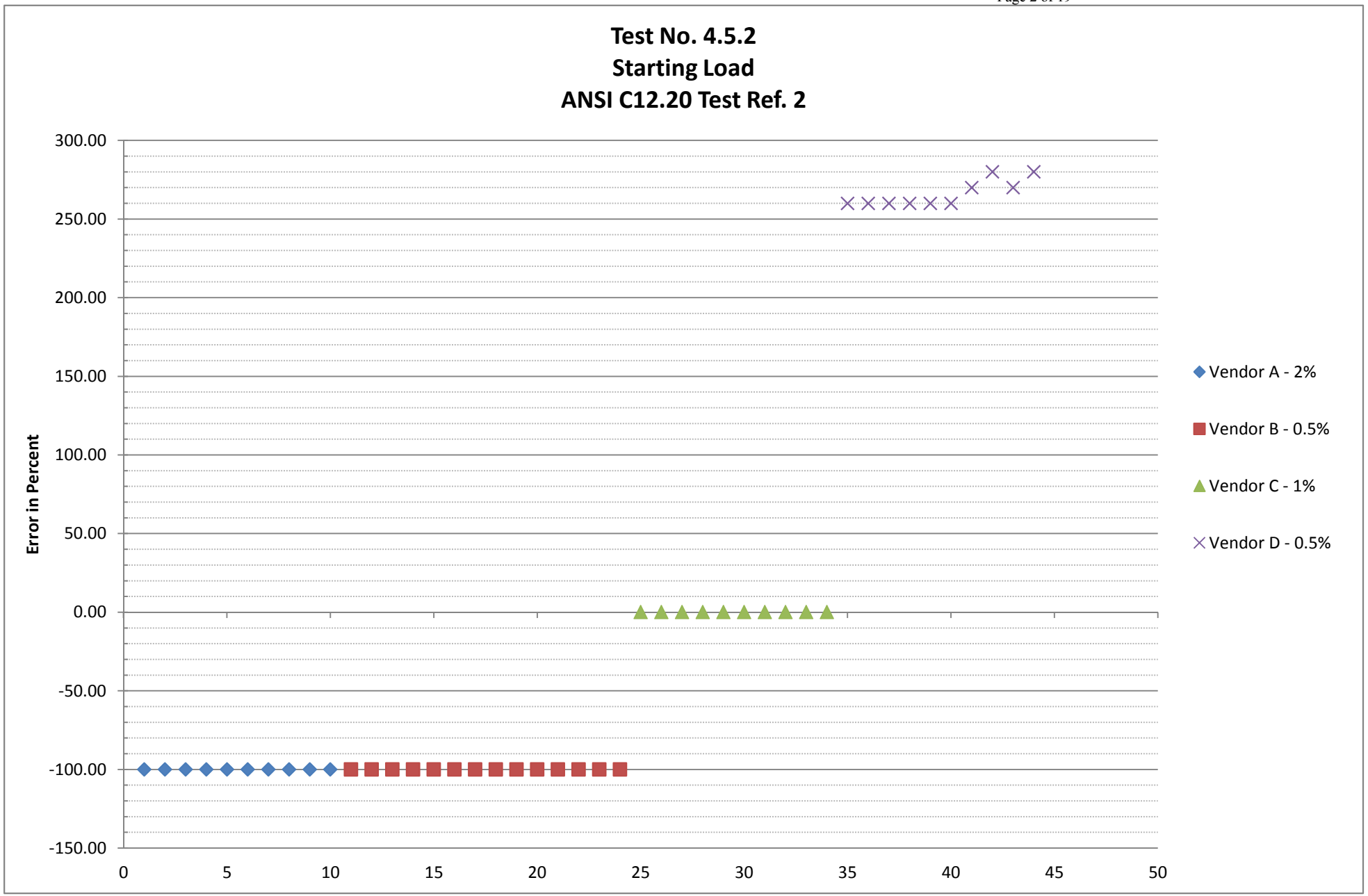
6.1 ANSI C12.20 Specification – see Link to ANSI webstore

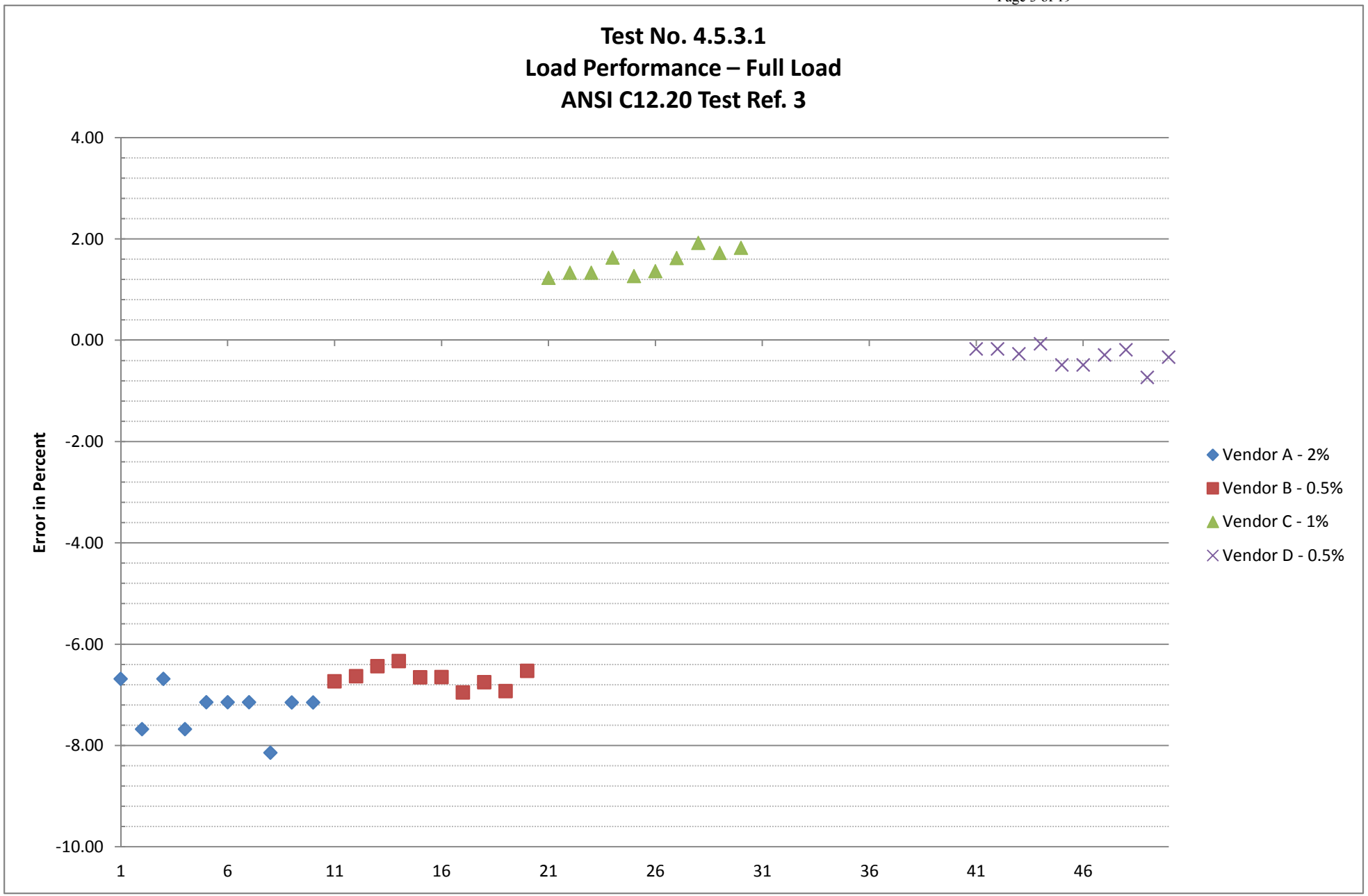
7 Revision Record

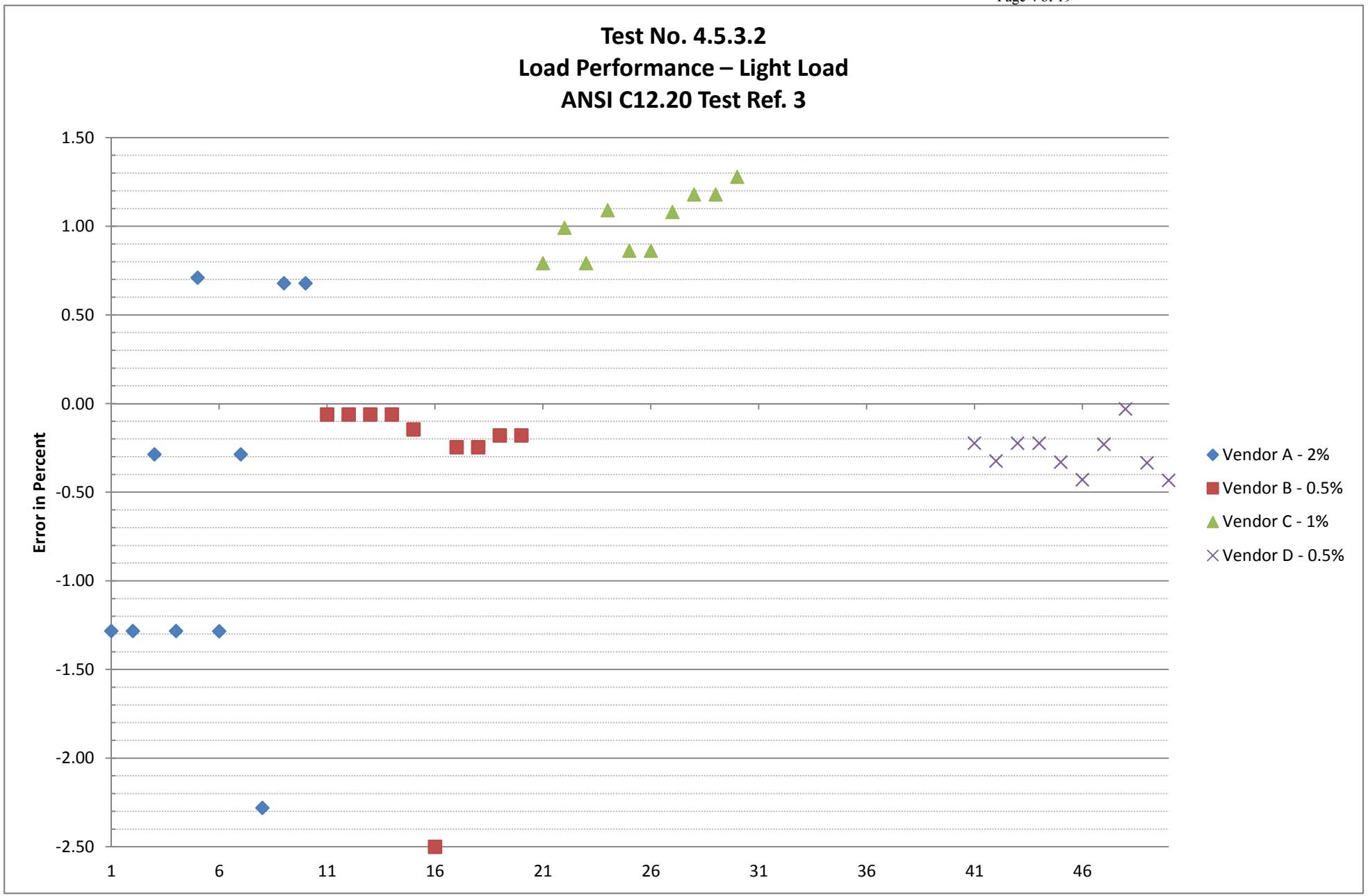
Revision Record

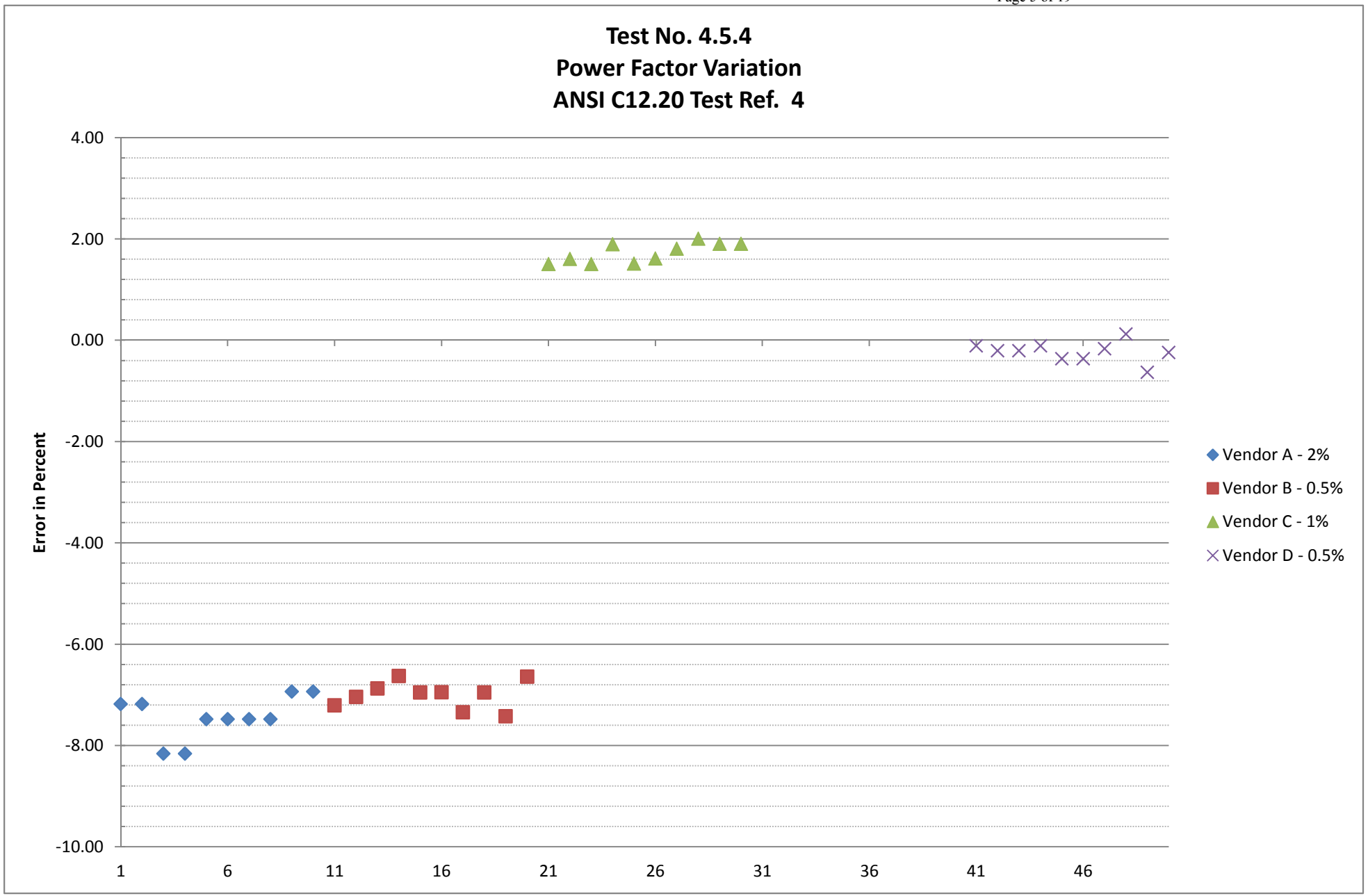
REV	ECN:	REVISION DESCRIPTION:	APPR:	REL:
-	N/A	Draft	JFW	2/17/16
1	N/A	Added section 6 – reference documents Added section 4.6.3 – additional voltage variations	JFW	3/3/16
2	N/A	Revised section 3.1; added (MTB) reference Revised section 3.1.1.2.4; changed displayed text for internal hyperlink Revised section 3.1.1.5; was FTU Revised section 4.3.4; was 15AAC Added section 4.6.4	JFW	3/4/16
3	N/A	Added section 3.1.1.6 Added section 4.7.3	JFW	3/10/16
4	N/A	Revised section 4.6.2; Test 6 was Test 5	JFW	9/19/16
4A		Revised for Select Limited External Distribution – by E. Bonetti	EPB	10/21/16

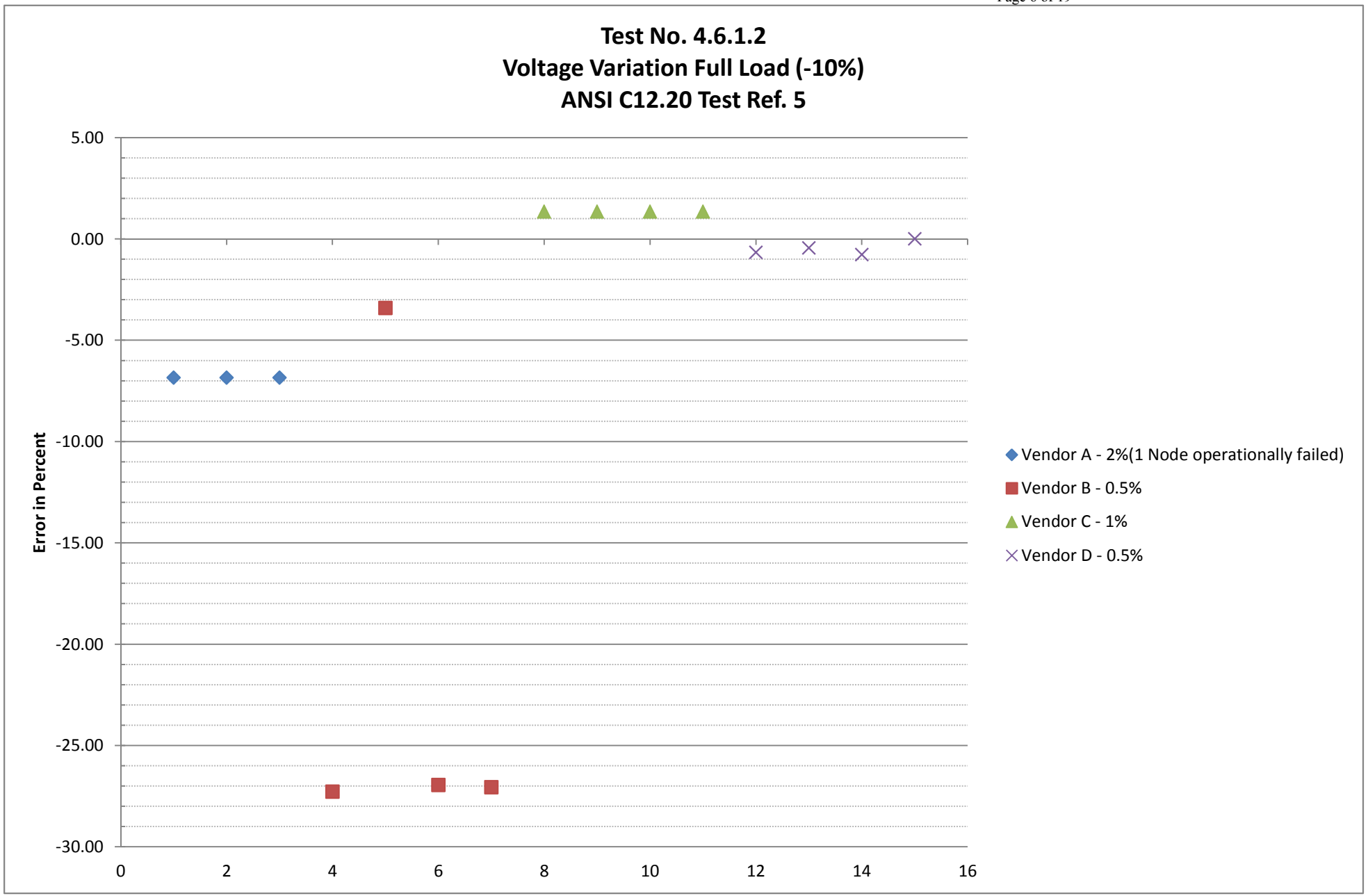


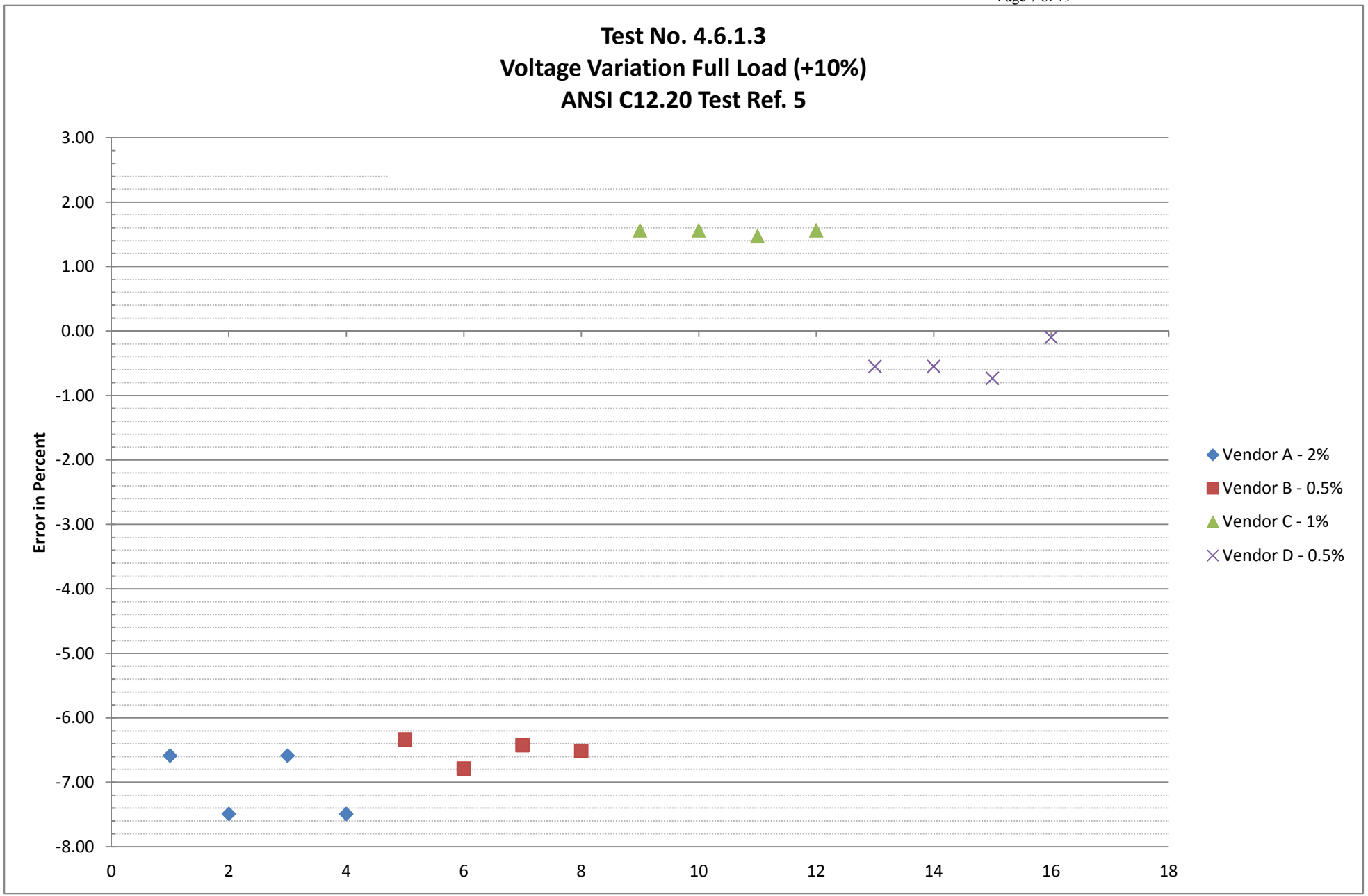

Test No. 4.5.2
Starting Load
ANSI C12.20 Test Ref. 2
Error in Percent
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
0
5
10
15
20
25
30
35
40
45
50
Vendor A - 2%
Vendor B - 0.5%
Vendor C - 1%
Vendor D - 0.5%

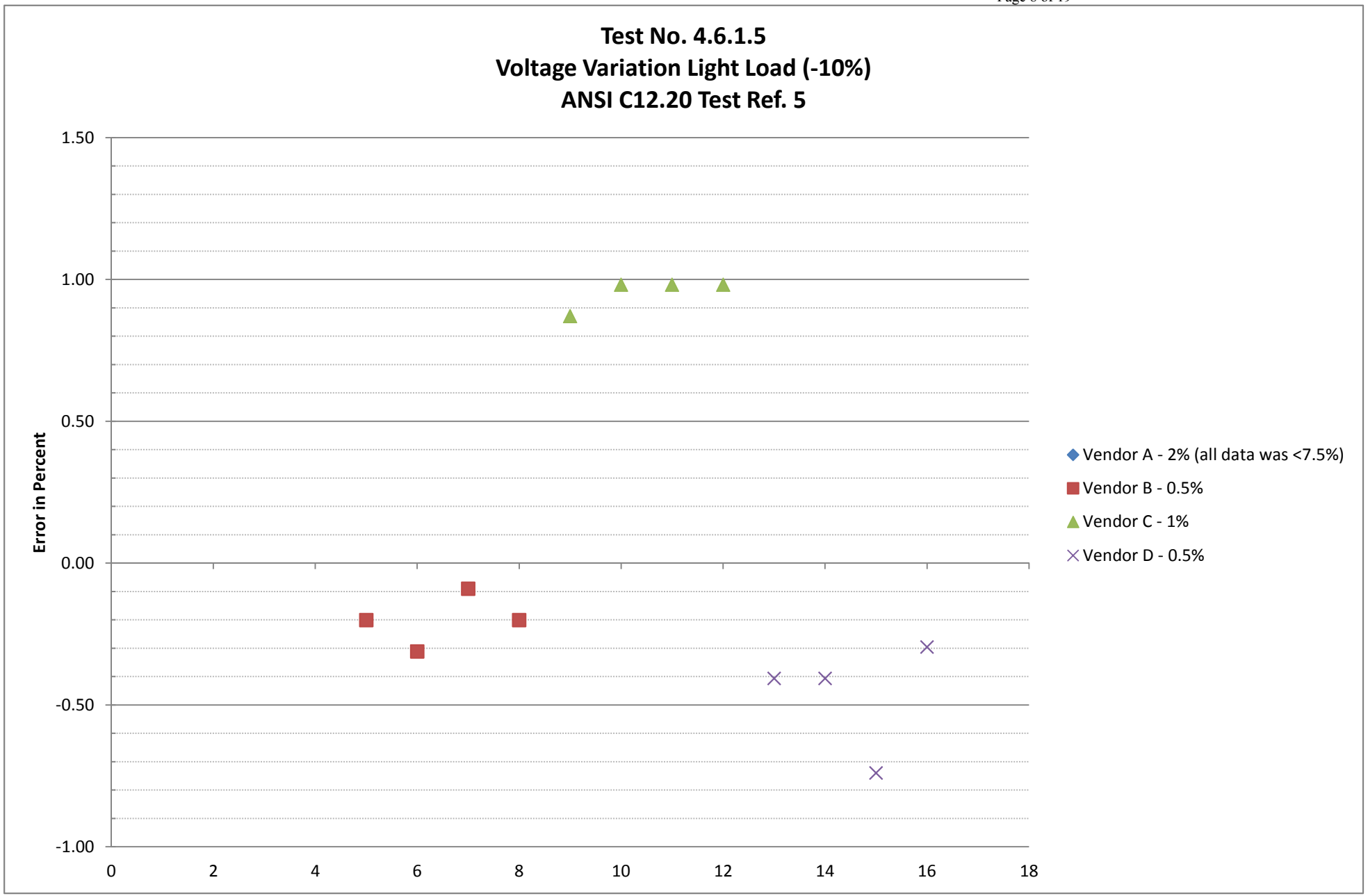


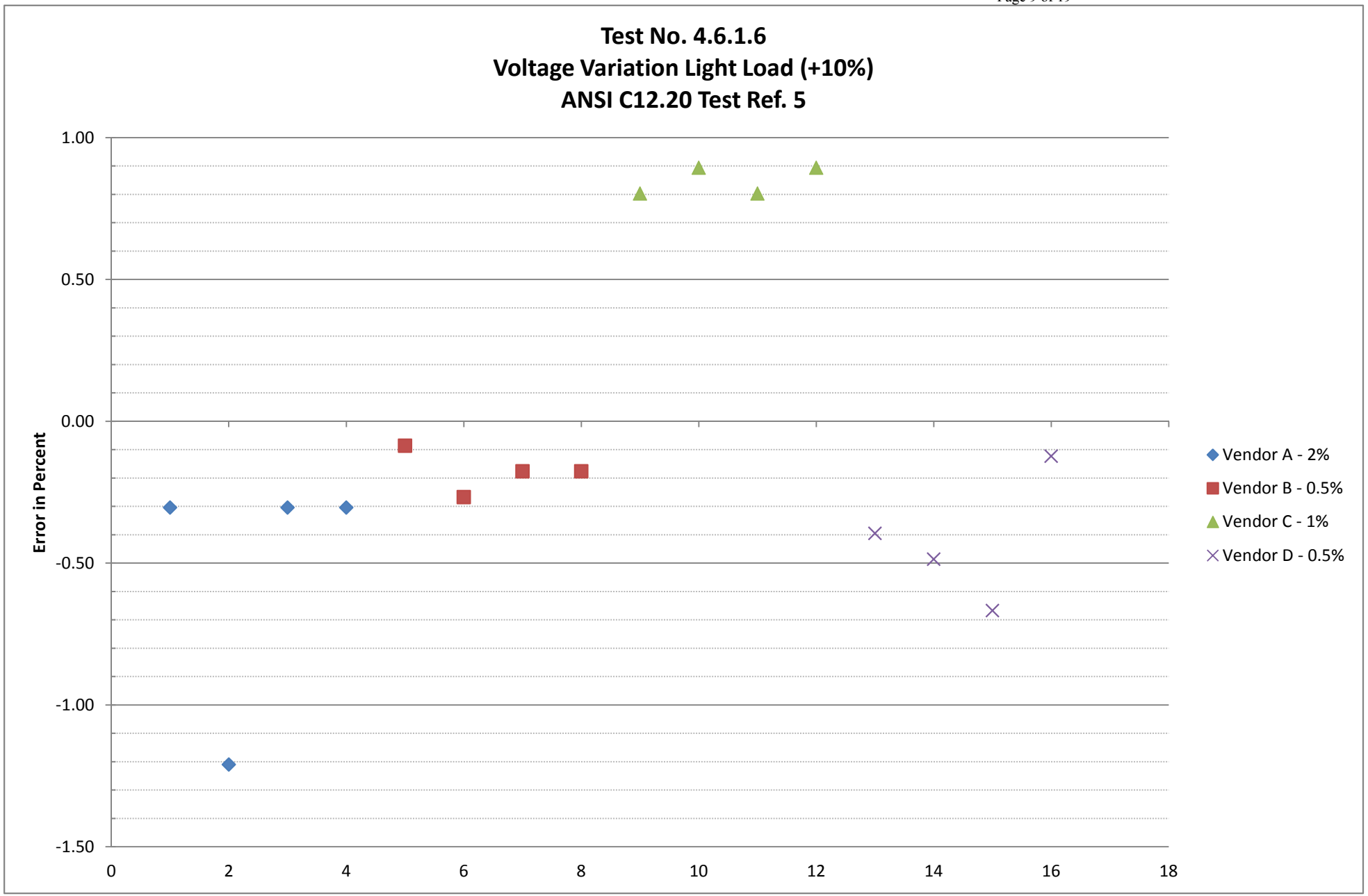


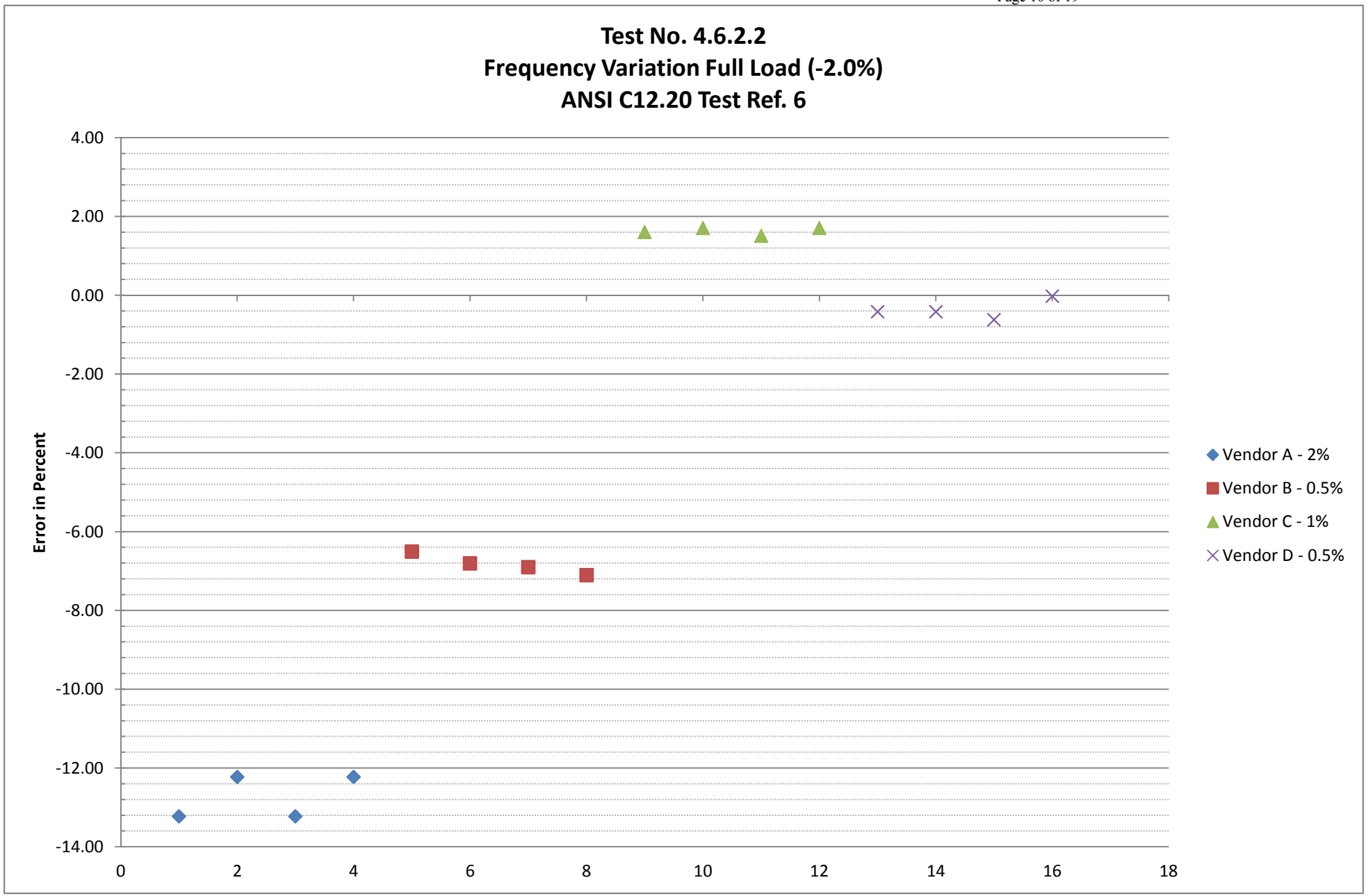

Test No. 4.5.4
Power Factor Variation
ANSI C12.20 Test Ref. 4
Error in Percent
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
1
6
11
16
21
26
31
36
41
46
Vendor A - 2%
Vendor B - 0.5%
Vendor C - 1%
Vendor D - 0.5%

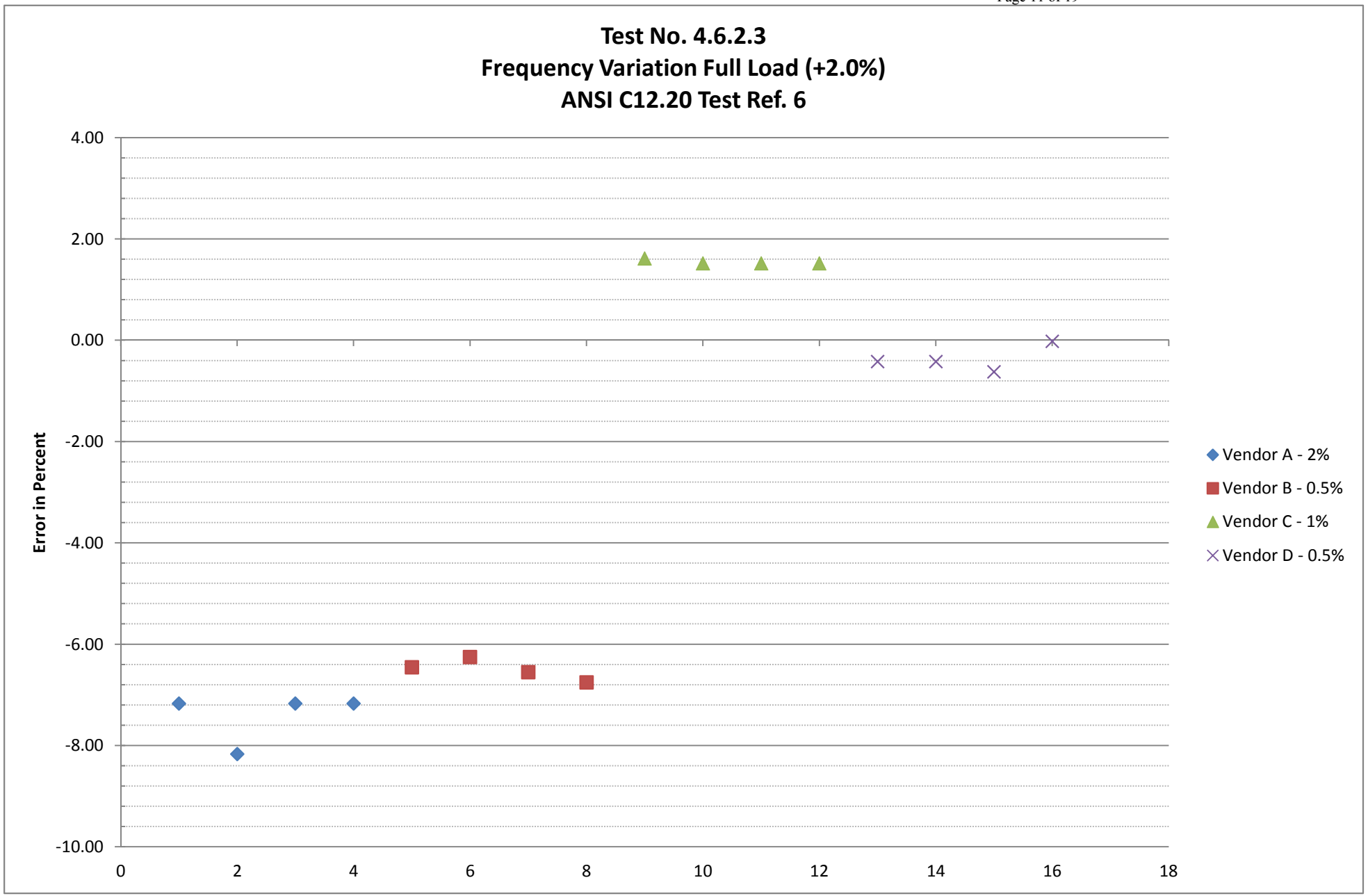


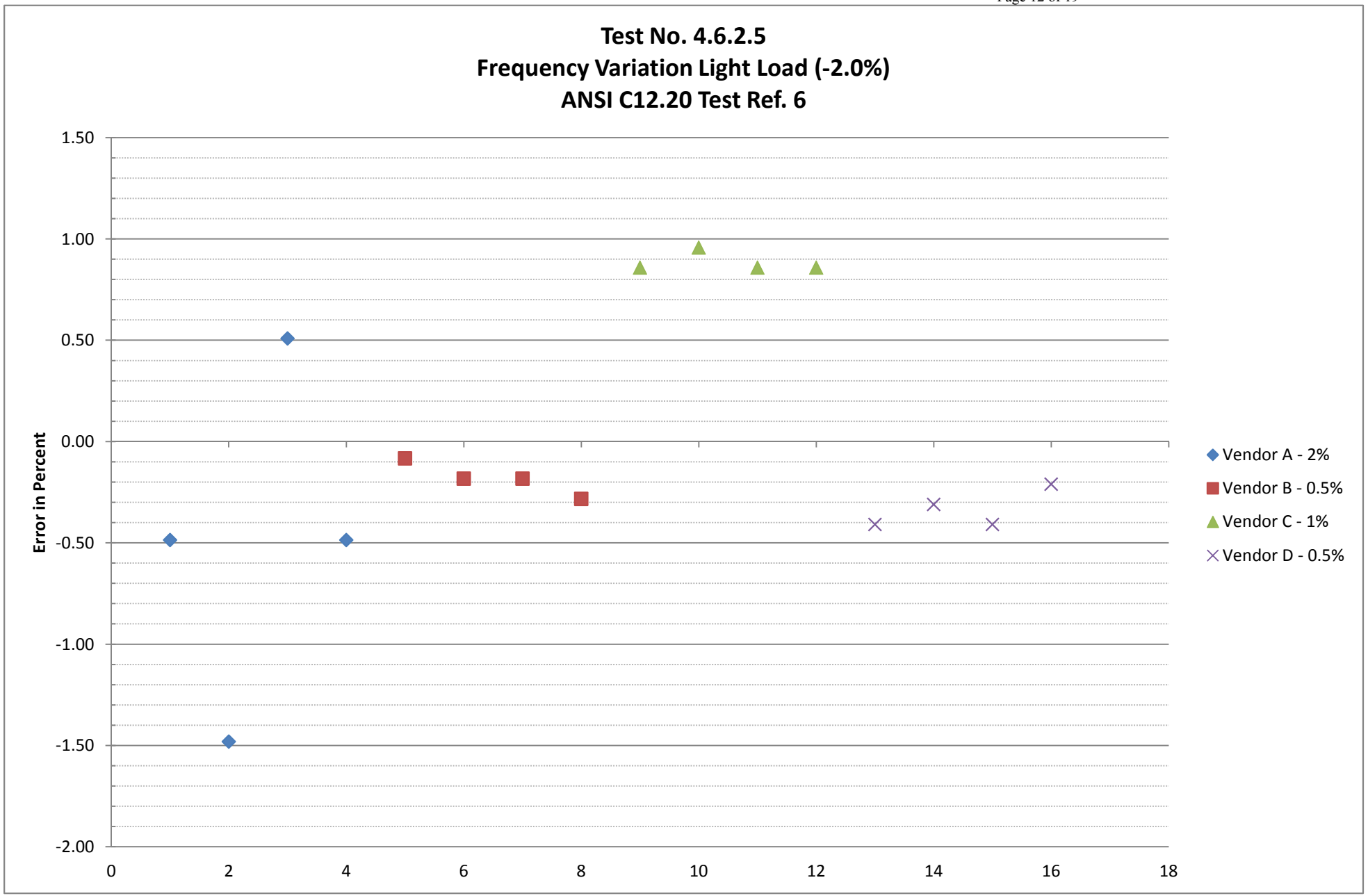


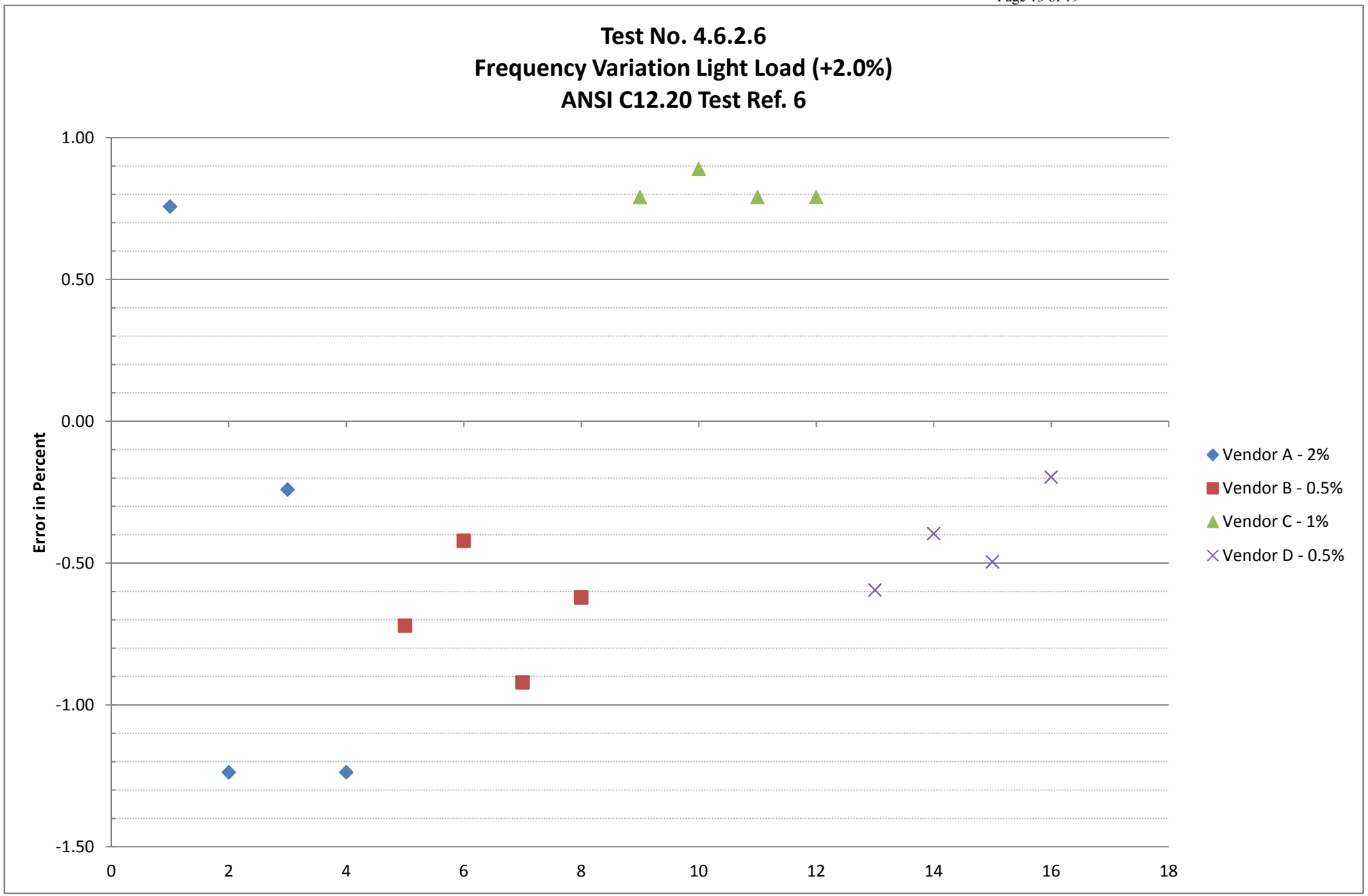


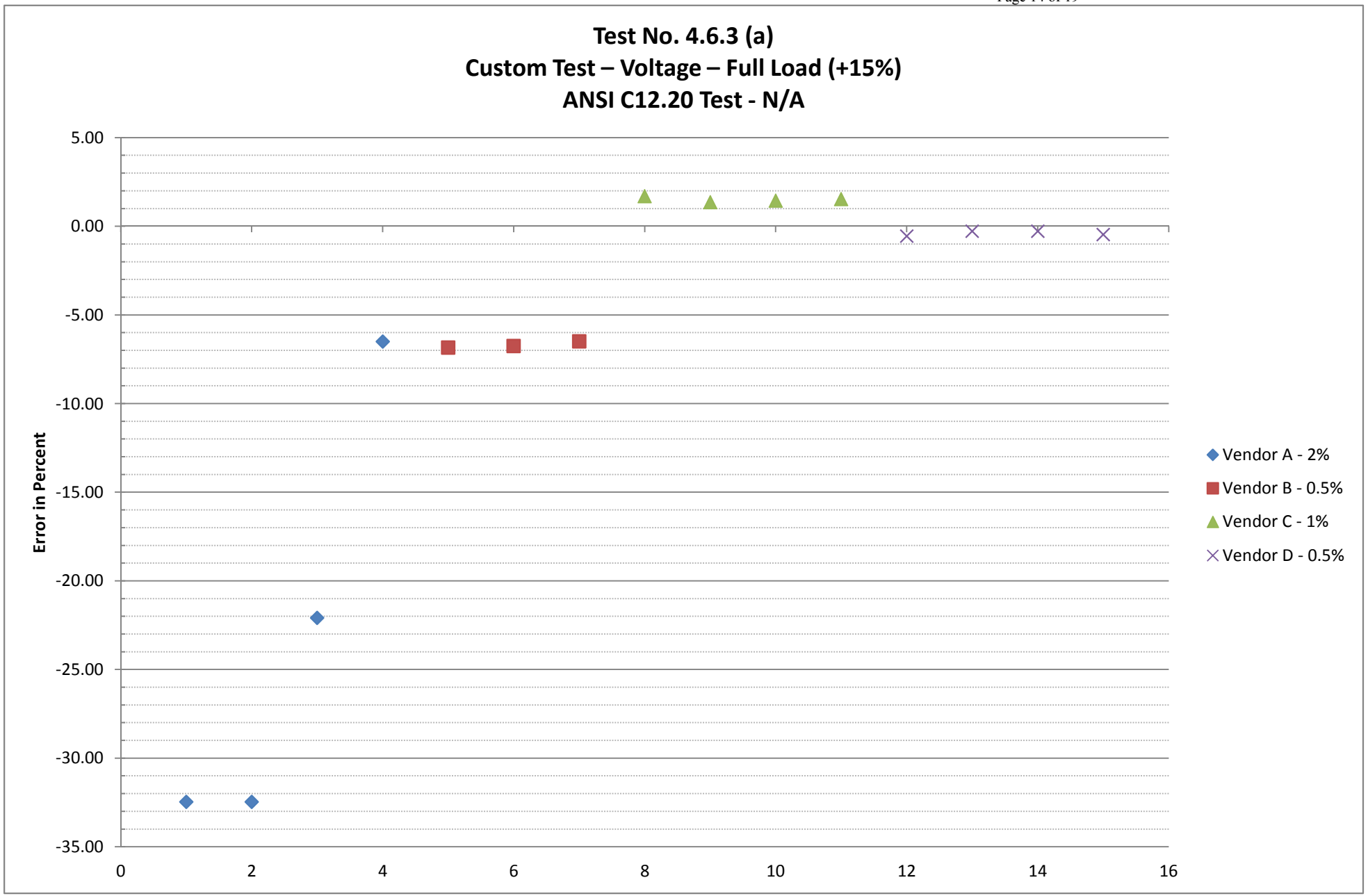


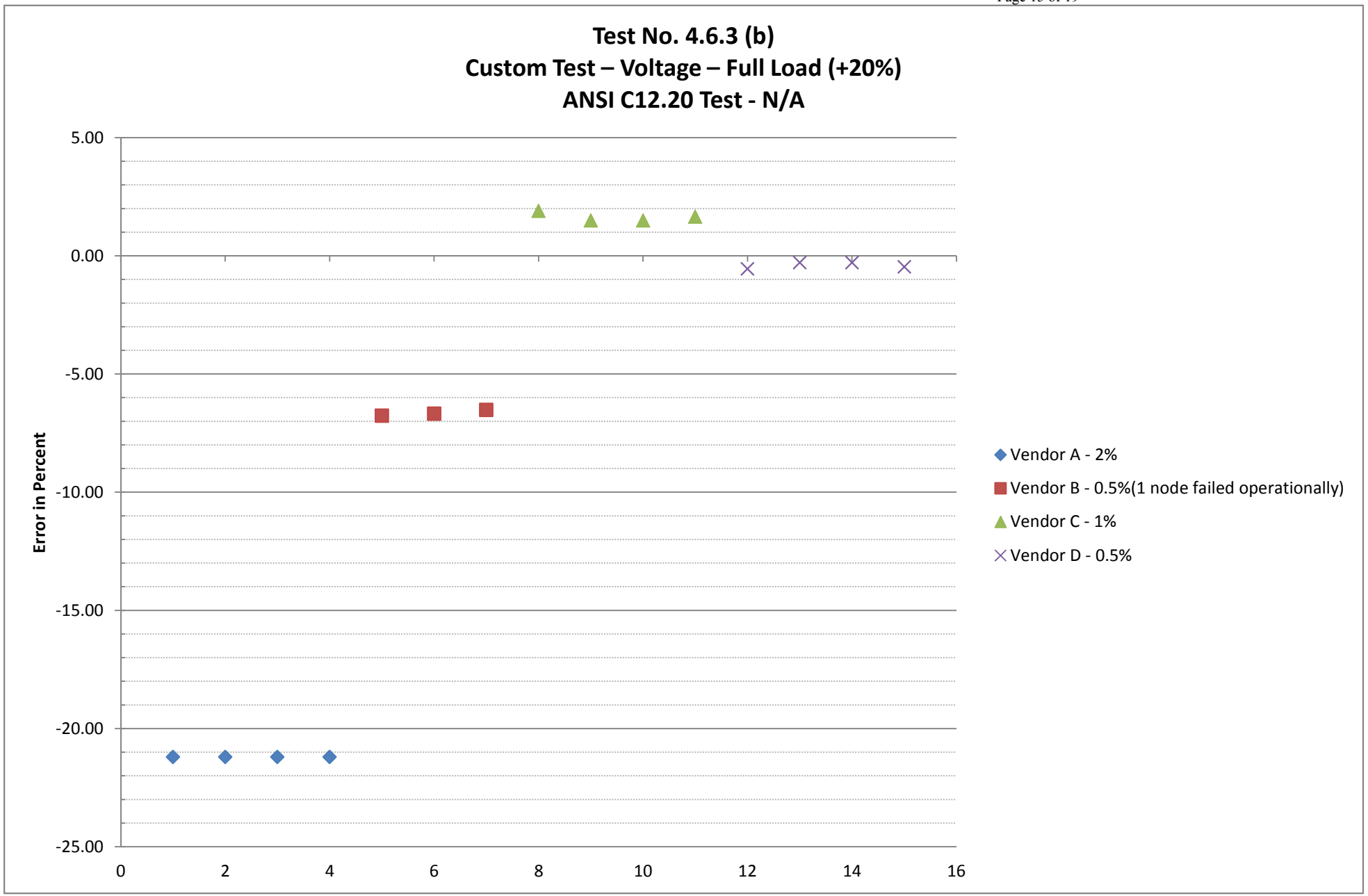


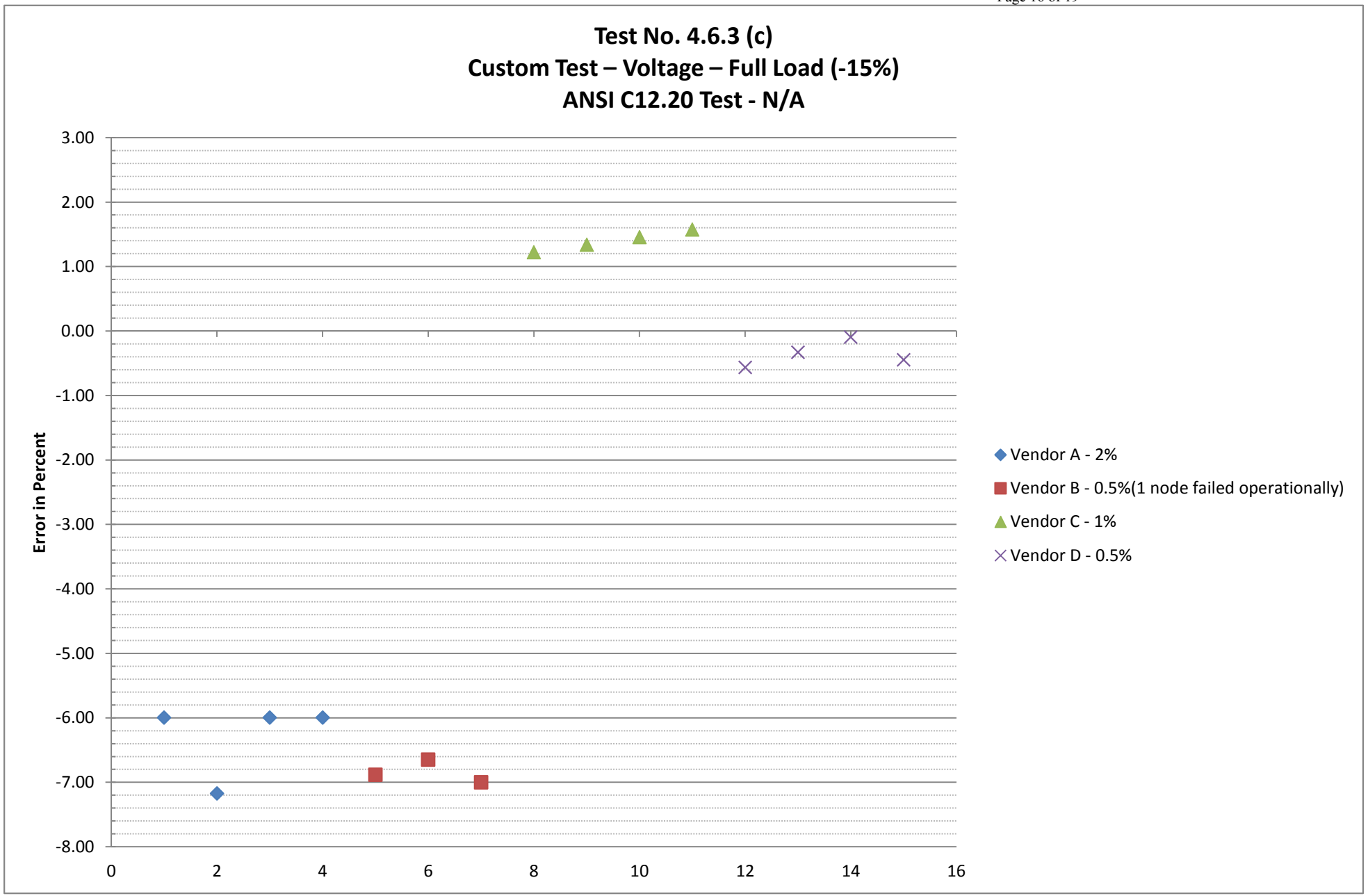

Test No. 4.6.2.3
Frequency Variation Full Load (+2.0%)
ANSI C12.20 Test Ref. 6
Error in Percent
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
0
2
4
6
8
10
12
14
16
18
Vendor A - 2%
Vendor B - 0.5%
Vendor C - 1%
Vendor D - 0.5%

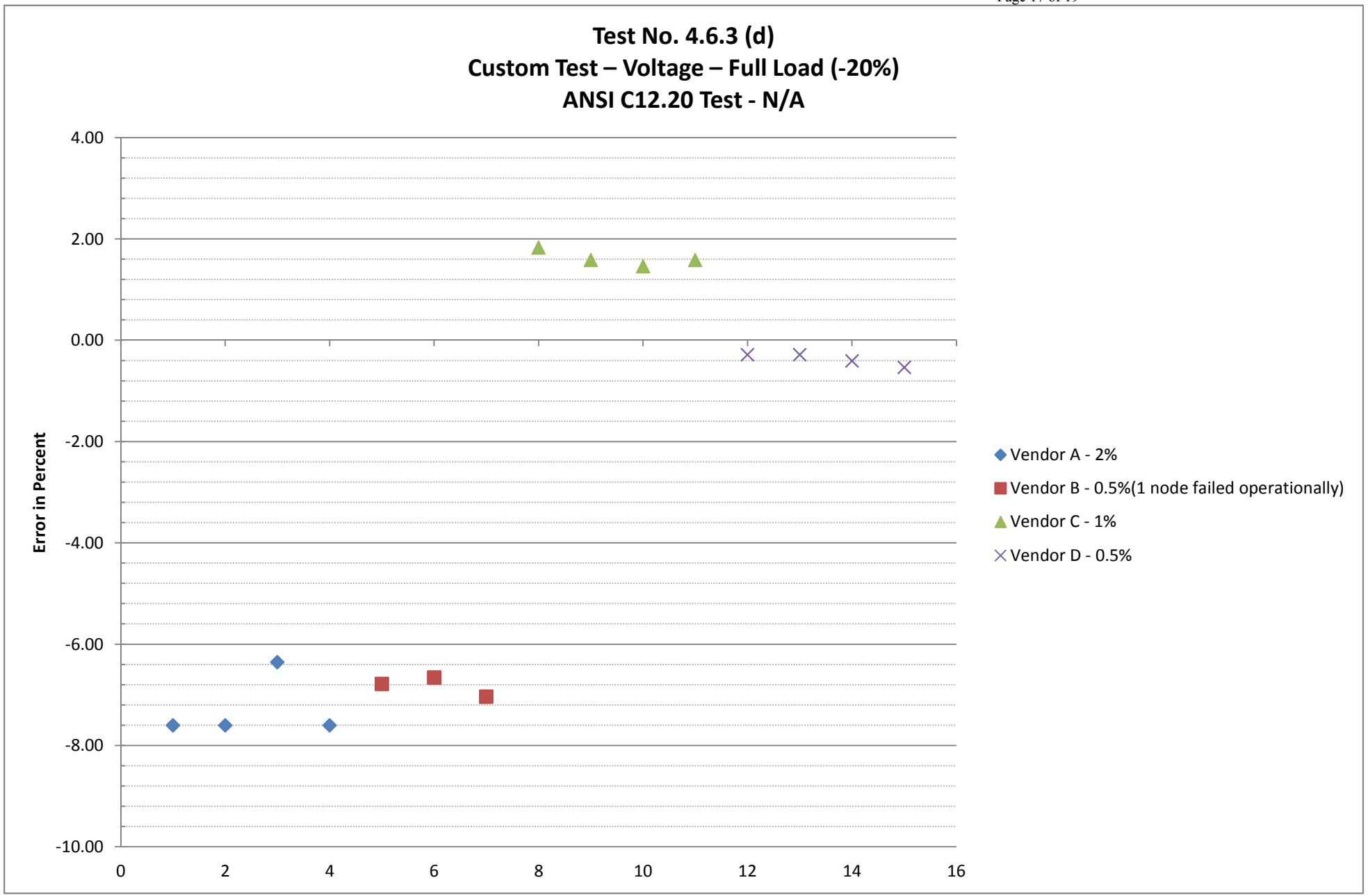


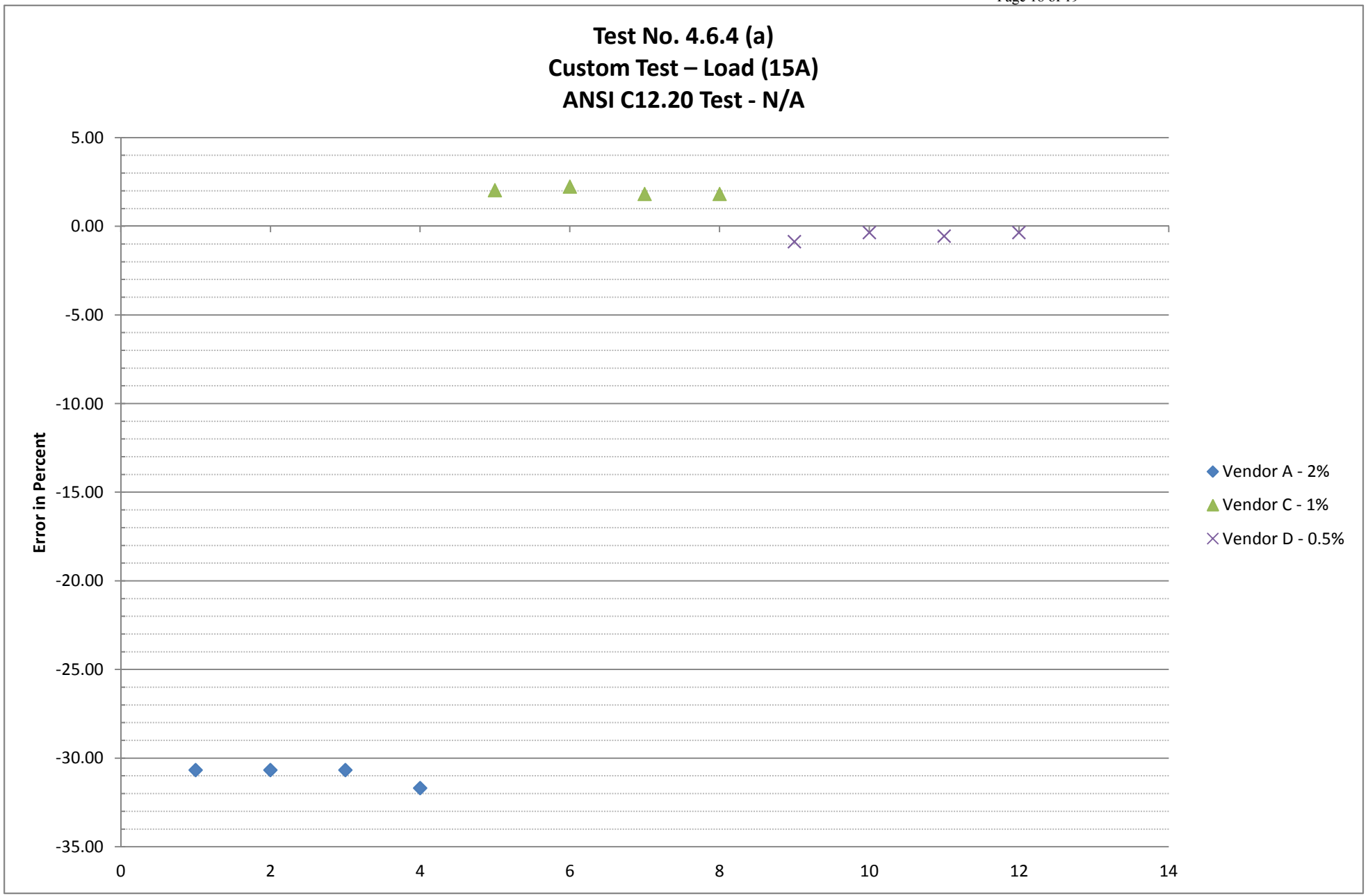


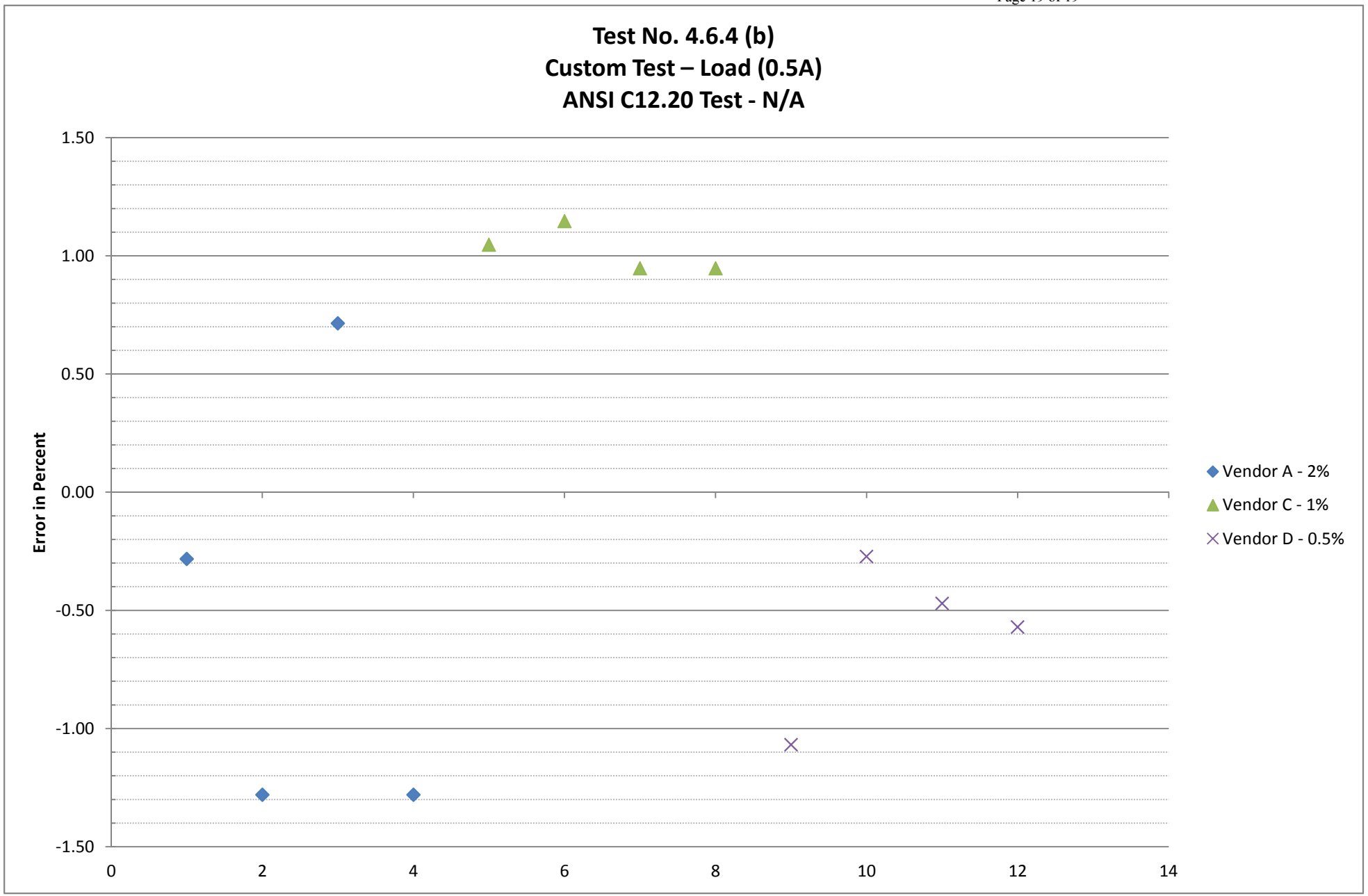

Test No. 4.6.3 (a)
Custom Test – Voltage – Full Load (+15%)
ANSI C12.20 Test - N/A
Error in Percent
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
0
2
4
6
8
10
12
14
16
Vendor A - 2%
Vendor B - 0.5%
Vendor C - 1%
Vendor D - 0.5%


Test No. 4.6.3 (b)
Custom Test – Voltage – Full Load (+20%)
ANSI C12.20 Test - N/A
Error in Percent
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
0
2
4
6
8
10
12
14
16
Vendor A - 2%
Vendor B - 0.5%(1 node failed operationally)
Vendor C - 1%
Vendor D - 0.5%




Test No. 4.6.3 (d)
Custom Test – Voltage – Full Load (-20%)
ANSI C12.20 Test - N/A
Error in Percent
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
0
2
4
6
8
10
12
14
16
Vendor A - 2%
Vendor B - 0.5%(1 node failed operationally)
Vendor C - 1%
Vendor D - 0.5%





RI Street Light Metering Pilot

Summary of Key Observations to Date
As of November 15, 2016

I. Metrology Accuracy

a. *Results of the Company's laboratory based metrology testing indicate that a significant population of the various meter devices did not achieve the manufacturer's stated accuracy/calibration claims.
    i. *Tests conducted in accordance with industry accepted meter standard testing per ANSI C12.20 standards/certification.

b. Following numerous attempts by the Company and the laboratory testing firm, node manufacturers did not produce requested independent third party laboratory metrology testing results of the IC meter chips certifying their accuracy/calibration claims. This preliminary evidence of testing sufficiency is common practice for all forms of "revenue grade" meter devices.

c. OPINION – The above two items raises significant concerns as to whether these devices would be considered "revenue grade."

II. Industry Metrology Accuracy Testing & Standards

a. Based on our research it appears that few third party independent laboratories are equipped to, or have experience/proficiency with testing this form of metrology.
    i. We have vetted more than 8 U.S. and international independent third party metrology testing laboratories. Most had little or no experience with this technology and often appeared to have little awareness of it. Except for TESCO, the laboratory that we selected, none demonstrated insight as to how to establish a suitable test environment or testing protocol.

b. ANSI standards/certifications are not in place for this specific metrology technology. They are being developed.
    i. The Company talked to individuals that are involved or affiliated with the committees that are developing the ANSI C136.xx standards/certifications for this particular technology. (C136.50 – Photo Cell type? C136.52 – Metrology integrated into ballast? C136.48 – other?) Completion of the standard(s) is anticipated in one year or more. (Lacking these standards our testing leveraged the ANSI C12.20 standards currently used for revenue grade meter testing.)

c. OPINION – Based on the above two observations in addition to the node manufacturers not producing any independent testing results (Ib. above) to support their accuracy claims, it appears that industry testing targeting this technology is not mature.

III. Collection/Storage/Transmission of Metrology Data

a. The two Network Service Providers we are testing use different, proprietary methods to interface/transmit their metered energy data to the utility.
    i. One appears to extract a spreadsheet from their interactive "dashboard" interface.
    ii. The other has two separate software applications; one for control/operations and one for energy consumption reporting, etc.

b. OPINION – The Network Service Providers "awareness" of the utilities needs appears somewhat weak and/or inconsistent. It appears that they have a stronger focus on

RI Street Light Metering Pilot
Summary of Key Observations to Date
As of November 15, 2016

providing services to the street light operators for control (e.g. on/off, scheduling, dimming, etc.) and monitoring (e.g. Luminaire state, communication failure, analog measurements).

IV. Equipment and Network Quality and Reliability

a. The Company was informed of technical issues encountered during the RI-DOT installations. For example in March 2016 we learned that the Silver Spring Access Points that had been installed at RI-DOT locations needed to be replaced. These "Gateways" that collect data from the nodes and interface with the communication network needed to be updated to a new (hardware/firmware) "instance" to properly service RI-DOT. In April we learned that these replaced devices required a "special electrical tape" that had to be ordered to properly complete their installation.

b. In early July 2016, as our laboratory was establishing the Meter Farm Test (End-to-End) environment, one of the node vendors informed us that an updated "radio card" in the nodes that they sent us MAY result in "false readings." The node vendor stated that the 40 nodes they sent us required "firmware" upgrades. To do that we needed to return them, not to the node vendor, but to the Network Service Provider – Silver Spring – to have the "firmware" re-flashed.

c. OPINION – The above two instances are just examples of technical difficulties encountered to date. There are more. They, along with issues described in previous sections above may suggest that from energy metering perspective this industry may be immature. (The technology appears more mature in providing services to support control, diagnostics, and maintenance.)

V. Other Utilities Consulted

a. Florida Power & Light totally owns and operates their wireless network system. Their focus is on street lighting operations, diagnostics and maintenance with little interest in using this technology for energy metering at this time.

b. Georgia Power is planning to use this wireless network technology for their unregulated lighting business. They plan to treat the node devices as they would any revenue grade meter that they own and operate within their electric system.

c. The City of San Diego owns the street lights and the wireless network system. They are extracting energy meter readings and providing them to the utility (San Diego Gas & Electric). SDG&E is not billing directly using the provided meter readings. They are applying the meter reads to another process within which an algorithmic application is used to calculate the energy bill.

VI. Utility I.S. Systems

a. The different ownership models present unique challenges which may have a variety of cost and system impact implications. (e.g. Random accuracy sampling/testing of nodes/controllers will likely be borne by the owners of those devices.)

b. The number of Company information systems impacted was determined to be greater than initially anticipated at the start of this investigation.

Streetlight Metering Pilot

IS Effort

The Information Services effort to support the RI Streetlight Metering Pilot project includes the following:

1. Scope definition: identification of IS systems that would be impacted if National Grid were to enable its portfolio to accommodate the metered streetlights for billing. We were unclear on which applications would be affected, and therefore projected that approximately 8 applications would be impacted. We must assess the system model without knowing who will own the various aspects of the systems (streetlight, metering device, mesh network). National Grid has identified the following most likely ownership scenarios. The IS evaluation includes looking at these systems under each scenario.

	NG Owned devices & network	Hybrid			Customer Owned
		NG owned devices; Private Company owned network	Private Co owned devices and network	Customer Owned devices; Private Co owned network	
Aggregated Data Model	N/A	NG bills Metered	NG bills Metered	NG bills Metered	NG bills Metered
Granular Data Model	NG bill Metered	N/A	N/A	N/A	N/A

2. Requirements definition: build out high level requirements in order to engage our individual application Subject Matter Experts (SME's). This also includes definition of Security requirements to accommodate interfaces to other systems.
3. Architecture Definition: determine changes necessary to the system architecture under each of the models.
4. High Level Design: create high level design for the following systems under each of the 5 ownership models. Ensure that the system flow between systems provides a cohesive system. The systems include:
    a. Security: provide security design recommendations.
    b. Billing system: our billing system currently bills for unmetered streetlights. We need to modify our system to allow for metered streetlights:however our billing system does not allow for more than 99 meters per account. Therefore a separate association system needs to be built and maintained. This has ripple effects into other systems, such as Meter Inventory, Streetlight Inventory, Bill Calculation, and Service Orders (comprised of several systems). Additionally a new module is required to summarize the streetlight usage into a single bill account since this is not how currently metered accounts are billed (where all meters are stored with the bill account within the billing system). Consideration is given to the possibility of a re-bill situation if usage information needs to be corrected, and this also depends on the ownership model and who will provide that information to National Grid for billing purposes.
    c. Bill Print
    d. GIS: Global Information System: changes needed to accommodate a meter that is not tied directly to a bill account in our customer system.
    e. CSS Orders: service orders such as new streetlight, new streetlight account, remove streetlight, update streetlight account, etc.

f. Meter Inventory, Streetlight Inventory: The changes to these systems vary depending on the ownership model. The owner of the meters is responsible for the accuracy of the usage information that is used in billing.
g. Meter Data System Information (MDSI): this system contains the meter usage information. The owner of the meters is responsible for the meter data quality as well as providing correcting any information found to be inaccurate and providing that information to the billing system in order to re-bill. If National Grid owns the meters, we are responsible for this information and would require a granular level of data to perform the quality checks. If National Grid does not own the meters, we would look for a monthly meter read (usage) per meter and system changes would be needed to accommodate this information since it cannot be stored at the bill account level as other metered accounts due to the 99 meter limit.

5. Develop cost estimates for high level designs. Review each of the designs to ensure alignment prior to estimation to ensure no rework is needed on the designs. High level estimates are needed for requirements, design, development, testing and deployment of each system, for each of the 5 scenarios.
6. Finalize timeline and cost estimates for each of the 5 ownership models. Develop overall timeline for each scenario, ensuring interdependencies are taken into account as each timeline was provided in a vacuum. Timeline and costs need to include all IS deliverables, including startup, requirements, design, testing and deployment, with oversight from project management, security and architecture.
7. Contribute to final White Paper. Provide the business (John Walter) with a summary of system changes for each of the 5 scenarios along with the National Grid IS cost and timeline for delivering each of them. Provide the assumptions made in developing the cost and timeline for each scenario.

NOTE: Items 1-4 are complete as of July 2016. Work still to be performed is items 5, 6 and 7. This work will resume if/when approved to do so by the business, and as resources are available.

The Narragansett Electric Company
Street Light Metering Pilot Project
Docket No. 4513
Revised Cost Estimate Proposal

	Original Cost Estimate				Revised Cost Estimate Proposal				Comment
Task Function	**Labor**	**Materials**	**Contract**	**Subtotal**	**Labor**	**Materials**	**Contract**	**Subtotal**	
Corporate									
Project Management	$85,000			$85,000	$280,000			$280,000	Delays & Additional 5 Months
Administrative & General	$25,000			$25,000	$25,000			$25,000	
Pacific Northwest National Laboratories (PNNL)			$0	$0				$0	
				$110,000				**$305,000**	
Stage 1 – Phase 1									
Individual Meter Testing - TESCO			$86,000	$86,000		$20,500	$86,000	$106,500	Control Node Purchase, Network Equipment & Services and Data collection issues
Meter Farm Testing – TESCO			Included				$18,500	$18,500	SSN network service issues/lease extension, additional testing/reporting & contingency
				$86,000				**$125,000**	
Stage 1 – Phase 2									
DOT Phase 1 (Exit 7)			$0	$0			$0		
DOT Phase 2 (I-296)			$0	$0			$0		
DOT Phase 3 (Park & Ride)			$0	$0	$10,000			$10,000	NG Operations – node install/removal
Cimcon Network Services			$0	$0			$0		
Silver Spring Network Services			$0	$0			$0		
				$0				**$10,000**	
Stage 2 – Phase 1									
Information Systems Studies	$45,000			$45,000			$222,000	$222,000	Functional Scope Definition System Architecture Requirements Defined End-To-End High Level Design Estimates
				$45,000				**$222,000**	
Stage 2 – Phase 2									
Billing Comparison Study	$5,000			$5,000	$5,000			$5,000	
				$5,000				**$5,000**	
			Pilot Total	**$246,000**	**Pilot Revised Total**			**$667,000**	
					Alternative TESCO Simulated Field Testing (Net Value)			+$9,500	