Minutes of Meeting

WG: C37.09 Standard Test Procedure for AC High-Voltage Circuit Breakers with Rated Maximum Voltage above 1000V

Chair: Xi Zhu
Vice Chair: Victor Hermosillo
Secretary: Mike Skidmore

Session #1 - Tuesday April 24th, 2018 (8:00-9:45 AM)

Location: Lake Buena Vista, FL
Participants: 30 Members
57 Guests
(47 total members in WG - Quorum requirement met)

Call to Order, Introductions, sign-in

Session #1 attendance list circulated and the chair asked all attendees to sign the roster and provide affiliation if not noted on the roster.

IEEE-SA patent policy compliance

Chair discussed IEEE-SA Patent Policy Compliance and showed slides. During the meeting, he made a verbal call for patents to the working group. No participants raised any concerns for a potential patent claim during the meeting. Patent policy was described, nobody was aware of any restrictions.

MOM for Portland, ME Posted and e-mail 10/17/2017
Chair entertained a motion to have meeting minutes approved for Fall 2017 Meeting approved
Move: Sushil Shinde
Second: Dean Segmon
MOM unanimously approved.

Review of Project Status

Initial ballot completed (July 26-August 25, 2016)
80% approved (84 affirmative votes), 88% returned (114 votes), 492 comments
1st Recirculation (March 28 – April 12, 2017)
87% approved (96 affirmative votes), 91% returned (118 votes), 128 comments
2nd Recirculation (December 1 - 22, 2017)
94% (106 affirmative votes), 91% returned (118 votes), 84 comments

New documents available in IEEE-SA Central Desk Website:
https://ieee-sa.imeetcentral.com/login?eid=&rurl=%252Fhome%252F

Doc 000 - Master WG Document List
Doc 163 – Portland Meeting Minutes
Doc 166 – Recirculation 2 Comment Dispositions
Doc 167 – Working document of D3.5

Chair:
Reminder that documents are available at IEEE-SA central desk website.
Latest document D3.5 redline will be the one discussed today (document 167). Some comments still need to be addressed. Disposition to comments on 2nd recirculation have also been posted on the website.

Quorum
Membership count: 42 members listed on table. Will need count to see if we have quorum. Count was 27 at start of meeting, **quorum was reached.** Quorum increased during meeting, final count was 30/42 members.

Neil McCord, chair of C37.100.2 asked if he will be added as the WG member since C37.09 chair asked him to check the existing capacitive current switching contains any error. The intension is to keep capacitive current switching clauses in C37.09 and make corrections on errors as found. Chair confirmed that he is added as a WG member of C37.09.

Project Outlook
Chair presented project outlook.
Original PAR expires December 2017.
PAR extension approved on June 15, 2017 to Dec. 31, 2018. (Refer to 6/20/17 email)
Current standard C37.09-1999 expires December 31, 2018.

Chair presented the following plan:

- Finalize Recirculation 2 comment dispositions (we have a few left to be discussed in this meeting). Plan to complete comment disposition during this meeting.
- Target is to have 3rd Recirculation in one month (May of 2018).
- Submitted second request with specifics regarding IEC copyright (regarding limit of <10% IEC content). Expectation is that standard will be OK with IEC. Section related to arcing time was presented to both IEC and IEEE. IEC 62271-100 is now published and includes this content. Several tables and all figures were remade to differentiate content.
- Possible 4th Recirculation, plus coordination and alignment with PC37.04 in July 2018.

- Submission to RevCom September 1, 2018. Likely the summer 2018 will be the last meeting before standard is submitted to RevCom.

Remarks regarding changes made to last draft

Updates since las Meeting in Portland Oregon include the following:
New figures and tables to reduce IEC content.
Resolution to comments have been implemented in text.

Open Item Discussions
References for this meeting are:

Draft 3.0 of PC 37.09 balloted in 2nd recirculation (Doc. 159d)
Disposition details for 2nd recirculation (Doc 166)

84 comments, half editorial. Preliminary dispositions sent to ballot group and WG members and guests on April 22, 2018. Chair listed items to be discussed in the meeting. Asked group members to bring to attention of Chair any additional items they would like to propose for discussion. Discuss 10 comments from 2nd recirculation.

Additional comments sent to chair after recirculation 2 to be discussed: Two comments from John Webb, One comment from Denis Dufournet

Comment #60 from Ted Burse

Chair asked Mr. Burse to clarify his comment since subclause p) was revised in the previous meetings and was thought to be a WG decision. Mr. Burse's opinion is that a customer will not accept a test below the value, suggests that no negative tolerance should be allowed for impulse tests (BIL, SIL)

Jim McBride: IEEE Standard 4 - 2013 page 59 says +/-3% tolerance for impulse voltage magnitude, does not requires to be above. It is based on uncertainty of measurement system which is in this order on magnitude. The C37.09 can choose to keep only requirement above. The purpose of the test is to achieve the standard required value.

Victor Savulyak (KEMA). Laboratory aims to test 100%. Some clients take advantage of tolerance and request to target 97% for the test.

John Webb: IEEE Std. 4 tolerances allow differences in values measured, given that there are measuring uncertainties.

Anne Bosma: Should be careful not to mention corrected test voltage because internal solid insulation, internal SF6 gas insulation and vacuum interrupters need to be tested to uncorrected values.

Jim McBride: There are other considerations: slight variation due to k factor allowance, sometimes wave-shapes get oscillations, overshoot while testing equipment such as transformers. There is inherent variability that is not associated with charging voltage. Agree with philosophy of average should be over.

John Webb motion not to accept negative tolerance Neil McCord second, 20 to keep, 9 to remove, 1 abstain.

Disposition: Working Group voted to maintain text requiring average impulse test value to be above specified value.

R02-14 Subclause 4.8 TRV Tests from Anne Bosma

Anne Bosma: 'TRV tests' do not exist, during power tests a short-circuit current is interrupted and a TRV is applied across the switchgear. In addition TRV is not a rating.
Denis Dufournet: This clause refers to C37.04 and C37.06.1 for TRV parameters. Reader may be confused thinking that there is a test for only TRV. Breaking tests involve current interruption and an associated TRV. C37.04 makes clear that TRV is not a rating, TRV is associated with short-circuit current interruption. Subclause 4.8 was needed because of this wording in the old version of the standard and can now be removed.

John Webb: Delete the clause but relocate second paragraph (1034-1035) which provide useful reference to C37.06.1 for fast TRV applications. Karl Schuetz seconds motion. 25 in favor, 3 against, 2 abstained. Passed. Who initiated this motion?

Disposition: Remove subclause 4.8, move reference to C37.06 to other section.

R02-18 Comment Regarding Voltage Check after Power Test from Anne Bosma

Anne Bosma: 5 shots required by IEC with no breakdown instead of 3x9. Well established procedure. Initially proposed as only 80% AC withstand but limitation in lab to obtain voltage for higher maximum rated voltages.

John Webb, Do we need to define this new procedure 5/0?

Denis Dufournet: If common test you should have the same condition check. Need to add five shots and all have to be withstands with both polarities. Take the text for IEC 62271-100.

Clarification needs to be made to explain the IEC test procedure is to pass the 5 impulse test without failure. If there is a flashover in the five impulse test, the test is failed.

Anne Bosma makes motion to make above changes, John Webb second. 24 in favor, 0 oppose 5 abstain.

Resolution was to incorporate 5 shot series in voltage check with impulse voltage.

R02-21 and 22: Rapid Operation Duty Regarding Mechanical Endurance Procedure from Anne

Anne Bosma: The rapid operation duty in mechanical endurance is not aligned with standard operation duty of O-0.3s-CO-3min-CO, request to delete it from the endurance duty table. For circuit breakers with pre-insertion resistors this rapid operation duty may damage the circuit breaker.

Karl Schuetz: Has seen cases of conductor galloping in which the breaker reaches this frequency of operation. Also, during commissioning breaker is operated frequently. In addition, would like to have information in the test report regarding frequency of operation during mechanical endurance test.

Pat DeLillo: We have these requirement in the field during commissioning, also frequent operation during production test.
Chair: The requirement is in C37.04 section 5.12.3. C37.09 is obligated to do the test to meet C37.04's requirement.

Disposition: Comment is rejected.

R02-86: Reference to C37.06 to be replaced by C37.04 Comment from John Webb

John disagreed with preliminary disposition by CRG to reject this comment since some of the values in original C37.06 have been revised when being migrating into C37.04.

Disposition: change disposition to revise and make reference to C37.06 where appropriate.

Session #2 - Tuesday April 24th, 2018 (10:15-12:00 PM)

Location: Lake Buena Vista, FL
Participants: 28 Members
47 Guests
(47 total members in WG - Quorum requirement met)

Chair asked any new members or guests not in session #1 to introduce themselves.

Session #2 attendance list circulated and the chair asked all attendees to sign the roster and provide affiliation if not noted on the roster.

Continue Discussion of Comments

R02-93 and 94 Comment from Hua Ying Liu
Hua Ying Liu (SCE) Does not agree with tolerance 5% of required average rms value in lines 1065-1066.

Denis Dufournet: The wording in D3.0 is a results of email discussions in Oct. and Nov. of 2017 involving Roy, Hua and Denis. This is what can be achieved in power laboratories. T10, T30 and T60 have tolerances in current. Question is for T100s, compromise was accept 5% instead of repeating test. During power tests lab has to anticipate decrease in magnitude. Particularly difficult to get precise values due to generator characteristics.
Standard refers to prospective/inherent value not actual values. There is interaction between the test object (circuit breaker), usually the prospective value is decreased by the breaker. Different for direct or synthetic circuits. C37.81 and IEC 62271-101 both allow negative tolerances, the latter is referenced by C37.09. During direct testing there is a reduction as breaker interacts. In synthetic circuit there is the influence of the test object and the auxiliary breaker.

Jan Wisker (Siemens). There are some circuit breakers that can have significant effect on short-circuit current. tolerance is applied on prospective value.

Victor Savulyak (KEMA) Arc voltage is smaller for vacuum circuit breakers, so there is less effect on short circuit current.

Mauricio Aristizabal: Measured current is technology dependent, influence of breaker may be significant.

John Webb: Clarify that tolerance is applicable to prospective current. Need the tolerance as manufacturer both negative and positive. For example, if current loop exceeded more than +5%

then request lab to repeat test if object failed. The current version of the standard 1999 does not address tolerances.

Hua Ying Liu (SCE) C37.09-1999, 4.8.3 page 25, item b states: ”Test current is equal to the maximum rated rms symmetrical interrupting current”.

Pat DeLillo Understand effect of the breaker, reduction may be due to limitations in the source. May be an issue in legal environment if tested current is lower.

Emir Khoshravi (BC Hydro) Understand that there is influence of breaker on measured parameters.

Joanne Hu: Prefer to see tolerance on plus side only.

H. Heirmeier (ABB): The test voltage and current will be affected by the breaker arc voltage in the laboratory but also in the real network. It can be calculated, a system with a short circuit (e.g. 63 kA) will have the current reduced by the breaker arc voltage. The test is always setup to meet the current magnitude requirement.

Arben Buffy: There is also a DC component in symmetrical tests, which should be <20%, this is more significant than the +/- 5%.

Jeffrey Brogdon. As a user I care about the prospective current at the instant of contact part.

John Webb (ABB): The prospective short-circuit current should be equal to the rated short-circuit current.

Anne Bosma (ABB): Insert prospective short-circuit current in line 1061. Line 1172 talks about prospective current also.

Denis Dufournet proposes to add “This is the prospective short-circuit current” in line 1062. Then change the test in 1065 to 1068 to state that the current must be equal or larger than the rated short-circuit current.

John Webb (ABB): Later on, for accumulation, should also mention that currents T60 +/- 10% can be accumulated.

Proposal to add in 1061 and 1062, “The prospective rms value of the short circuit current to be interrupted by a circuit breaker shall be determined at the instant before contact separation.”

In 1065 to 1068 only allow equal or greater than the rated short-circuit current for T100s. Keep 10% tolerance for T60, T30, T10.

R02 – 95 and 96 Comments from Hua Ying Liu

Denis Dufournet: The energy in the loop cannot be too low during T100a test. Limit of the product of the loop duration times the peak value should be 90% or greater. In the test the characteristics of the generator do not allow an exact combination of peak current and loop duration. This an increase in requirement in IEC, in the past it was 0.9x0.9=0.81. This was increased to 0.90%= 95%x95%.

Hua Ying Liu (SCE) This is an arbitrary number, why pick 90%?

Pat DeLillo: Legal issues with testing under the rated values in case of safety issues. As a user it is important to get a device that can meet requirements. Margins on equipment are being reduced.

John Webb: In reality laboratory cannot provide both the peak value and loop duration exactly during a test. If both parameters have to be exceeded, lab may not be able to comply with test parameters.

Chairman: Tolerances are needed in testing, test laboratories have limitations.

Anne Bosma: Test laboratories do not have the same time constant as the network. In the past circuit breakers were undertesting. Laboratories aim for the closest possible loop characteristics. Manufacturers and laboratories do not intentionally aim for the low tolerance. In the field the breaker sees lower current and lower TRV.

Victor Savulyak (KEMA): Test laboratory perspective. We aim for a loop that complies with the requirement based on perspective current. Discuss with customer and do not allow a subsequent loop that does not comply.

Denis Dufournet: Cannot assume that requiring a higher tolerance will result in worst case for SF6 insulated circuit breakers.

Leslie Falkingham: Are we happy to set the limit to 90%. Higher energy in the loop is worst case for vacuum circuit breakers.

Joh Webb (ABB) Problem is that if product of current magnitude and loop is at 99% then test has to be repeated if there is no negative side tolerance. Sometimes even requesting over

100%, the laboratory may not meet. Does not agree with invalidating a test that Is close enough. This is a new procedure which is difficult to achieve.

Helmut Heiermeier (ABB): In the past, no one measured loop peak and time duration, the only consideration was the current at contact separation. The energy in the loop was disregarded.

Jan Wisker (Siemens): +/-3% is not enough tolerance for a test laboratory to meet.

Proposal:

The following text to be added to sub-clause entitled "Arcing time for three-phase test duty T100a""For test duty 100a the product of the prospective value of the loop duration by the peak value must be equal or higher than100% of the product of the specified values. Refer to Table 2 and Table 3."

Comment after Recirculation 2 ballot from John Webb

4.9.2.12

John Webb: Minimal enclosures. For interruption only for removable component in metal enclosed or metal-clad switchgear shall be tested with minimum volume enclosure. Peak withstand and short-time current.

Byron: Add close and latch test could be added.

John Webb: accepted.

Resolution: Eldridge Byron and John to work and submit in two weeks.

Comment after Recirculation 2 ballot from John Webb

John Webb pointed out that with the change of short circuit testing duties from 3 Os to O-t-CO-t'-CO, the current D3.0 misses an important clause and propose to add:

> *For ease of testing, it is permissible to omit the making operations for test-duties T10, T30 and T60 and complete a series of three opening operations provided the time intervals required by the rated reclosing duty is maintained. Tests performed to the requirements of reclosing duty satisfy the requirements for standard (non-reclosing) duty.*

Proposal accepted and will be included in the D4.0.

Comment after Recirculation 2 ballot from Denis

Denis D. and Eldridge Byron: TRV parameters for single phase fault test is not clear in existing D3.0. Propose to add a new clause:

4.9.4.5 Single-phase fault test duties T100s and T100a

These tests are intended to demonstrate the capabilities of the circuit breaker for interrupting a single phase-to-ground fault under the most severe switching condition for the circuit breaker. Single-phase fault duties T100s 1ph and T100a 1ph in Table 1 are single-phase tests made at 58% of the maximum rated voltage (or Ur / √3).

The TRV for T100s 1ph is derived in the following way from the TRV specified for T100s:

For circuit breakers with U_r less than 100kV, a two-parameter TRV is specified having

-a peak $u_{c\ 1ph}$ equal to u_c specified for T100s divided by the first-pole-to-clear factor

-a time $t_{3\ 1ph}$ equal to t_3 specified for T100s divided by the first-pole-to-clear factor

For circuit breakers with U_r equal or higher than 100kV, a four-parameter TRV is specified having

-a voltage $u_{1\ 1ph}$ equal to u_1 specified for T100s divided by the first-pole-to-clear factor

-a time $t_{1\ 1ph}$ equal to t_1 specified for T100s divided by the first-pole-to-clear factor

-a peak $u_{c\ 1ph}$ equal to u_c specified for T100s divided by the first-pole-to-clear factor

The other related TRV parameters are derived as indicated in Table 2 of IEEE Std C37.04.

The test circuit for T100a is the same as for T100s, the TRV for T100a is adjusted automatically as function of current asymmetry.

Proposal accepted and will be included in the D4.0.

Chair thanked Denis for his participation. He is retiring and may not continue his participation in the group.

Recirculation will be sent with changes.

Meeting was adjourned.

Meeting Roster for Session #1 and Session #2 – Lake Buena Vista, FL

First Name	Last Name	Role	Company	Session #1 4/24/2018	Session #2 4/24/2018
Syed Shahab Uddin	Ahmed	Guest	Siemens Energy Inc		
Roy	Alexander	Member	RWA Engineering		
Natasha	Alvarado	Guest	IEEE Standards Association		
Mauricio	Aristizabal	Member	ABB	X	X
Brad	Armstrong	Guest	Meramec Instrument Transformer Co.	X	
Koustubh	Ashtekar	Guest	Eaton Corporation		
Aasim	Atiq	Guest	Siemens Industry		
Roy	Ayers	Guest	Nashville Electric Service		
Katrin	Baeuml	Guest	Schneider Electric		
William	Bane	Guest	Nashville Electric Service		
Herman	Bannink	Guest	KEMA Netherlands	X	X
Paul	Barnhart	Guest	Underwriters Laboratories		
Amildo	Barrio	Guest	Parsons		
Jerry	Baskin	Guest	Federal Pacific		
George	Becker	Guest	POWER Engineers	X	X
Robert	Behl	Guest	ABB		X
Jean-Marc	Biasse	Guest	Schneider Electric		
Stan	Billings	Member	John S Billings Consulting		
Marcus	Bonner	Guest	GE		
Anne	Bosma	Member	ABB AB	X	X
Douglas	Brandt	Guest	Eaton Corporation		
Cody	Brehm	Guest			
Andrew	Brignac	Guest	Entergy	X	
Jeffrey	Britton	Guest	Phenix Technologies, Inc.		
Jeffrey	Brogdon	Guest	Georgia Transmission	X	X
Steven	Brown	Guest	Allen & Hoshall		
Raymond	Browning	Guest	FirstEnergy Corp.		
John	Brunke	Guest	Dr. John H. Brunke, P.E.		
Arben	Bufi	Member	Hitachi T&D Solutions, Inc.	X	X
Ted	Burse	Guest	Powell Industries, Inc	X	
Eldridge	Byron	Member	Schneider Electric	X	X
Donald	Cantrelle	Guest	Georgia Power		
Gilbert	Carmona	Guest	Southern California Edison		
Stephen	Cary	Member	GE Energy Management	X	X
Steven	Chen	Member	Eaton Corporation	X	X
Wayne	Cheng	Guest	B C Hydro		
Vincent	Chiodo	Guest	HICO	X	
Jeonghwan	Cho	Guest	HICO America		

Andrew	Chovanec	Guest	GE Power	X	X
Chih	Chow	Member	PEPCO	X	
Michael	Christian	Guest	ABB	X	X
Roggero	Ciofani	Guest	Altalink		
Robert	Cohn	Guest	Powercon Corp.		
Lucas	Collette	Member	Duquesne Light		
Dave	Collette	Guest	Mitsubishi Electric		
Lee	Cox, Jr.	Guest	Efacec		
Andrew	Crane	Guest	Consumers Energy		
Michael	Crawford	Member	Mitsubishi Electric		X
Jason	Cunningham	Guest	Hitachi HVB, Inc.		
David	Dart	Guest	NOJAPower		
Jerod	Day	Guest	Vacuum Interrupters, Inc.		
Daniel	Delfino	Guest	General Electric	X	X
Patrick	Di Lillo	Member	Consolidated Edison Co. of NY, Inc.	X	X
Jeffrey	Door	Guest	H-J Family of Companies	X	X
Denis	Dufournet	Member	Retired	X	X
Edgar	Dullni	Guest	ABB		
Bernie	Dwyer	Guest	PECO	X	X
John	Eastman	Guest	INCON		
Alexander	Ebbert	Guest	HICO America		
Ken	Edwards	Member	Consultant		
Doug	Edwards	Guest	Siemens Industry, Inc.		
Tanner	Esco	Guest	Eaton Corporation		
Leslie	Falkingham	Member	Vacuum Interrupters Limited		X
Majid	Fathi	Guest	Qualitrol		X
David	Feldmann	Guest	HICO America		
Howard	Fennell	Guest	Nashville Electric Service	X	X
Philip	Fentress	Guest	Memphis Light, Gas & Water Div		
Thomas	Field	Guest	Engergy		
Sergio	Flores	Guest	Schneider Electric Inc. USA	X	X
Robert	Foster	Guest	Megger		
Paul	Fox	Guest	Schneider Electric	X	X
Raymond	Frazier	Guest	Ameren	X	X
Richard	Frye	Guest	Eaton		
Didier	Fulchiron	Guest	Schneider-Electric		
Elizabeth	Gall	Guest	MEPPI	X	
Sivakumar	Ganesh	Guest	ENMAX Corporation		
Douglas	Giraud	Member	Powell Industries		
Anne	Good	Guest	Netshape Technologies, Inc.		
Paul	Grein	Guest	Circuit Breaker Sales, Co, Inc, -	X	X

			GroupCBS		
Martin	Greschner	Guest	HIGHVOLT Prueftechnik Dresden GmbH		
John	Hall	Guest	Tennessee Valley Authority	X	X
Jeffrey	Hanson	Guest	Schneider Electric		
Helmut	Heiermeier	Member	ABB	X	X
Christian	Heinrich	Guest	Siemens AG		
Charles	Hendrickson	Guest	Arizona Public Service Company		
Jeremy	Hensberger	Guest	Mitsubishi Electric Power Products Inc.	X	X
Victor	Hermosillo	Vice-Chair	GE Grid Solutions	X	X
William	Higinbotham	Guest	EA Technology LLC		
Tyler	Holp	Guest	Eaton		
Alexander	Hoover	Guest	Siemens Industry		
Jingxuan (Joanne)	Hu	Member	RBJ Engineering Corporation	X	
Carl	Hummel	Guest	HICO America		
Jennifer	Hunter	Guest	MEPPI	X	
Roy	Hutchins	Member	Southern Company Services	X	X
Todd	Irwin	Member	GE Grid Solutions	X	X
Carlos	Isaac	Guest	Oncor Electric Delivery		
Anton	Janssen	Guest	Liander		
Christopher	Jarnigan	Guest	Southern Company Services	X	X
Joseph	Jasinski	Guest	ITC Holdings Corp.	X	X
David	Johnson	Guest	Self-Employed		X
Cory	Johnson	Guest	Bonneville Power Administration		
Jacob	Joseph	Guest	Toshiba International Corporation		
Wolfgang	Jung	Guest	Siemens AG		
Mangu	Kang	Guest	HICO America		
Jayamali	Kasige	Guest	Crown Technical Systems		
Thomas	Keels	Guest	Salt River Project		
Nicholas	Keihn	Guest	Schneider Electric		
Amir	Khosravi	Guest	BC Hydro	X	X
JaeHyun	Kim	Guest	HICO America/Hyosung		
Jinho	Kim	Guest	HICO America		
SangTae	Kim	Guest	HICO/HYOSUNG	X	X
Hong Jun	Kim	Guest	HICO	X	X
Boris	Kogan	Guest	Schneider Electric		
Sandeep	Kulkarni	Guest	CG		
Robert	Kuntz	Guest	HICO AMERICA	X	
Carl	Kurinko	Guest	ABB Inc.		

James	Lagree	Guest	Eaton		
Stephen	Lambert	Guest	Shawnee Power Consulting, LLC		
Scott	Lanning	Guest	S&C Electric	X	X
Carl	LaPlace	Guest	GE Industrial Solutions		
Matthew	Lawrence	Guest	Doble Engineering		
Brad	Leccia	Guest	Eaton	X	
HaeKyu	Lee	Guest	HICO America		
Shawn	Lee	Guest	HICO America		
David	Lemmerman	Guest	PECO/Exelon		X
Werner	Lesse	Guest	Siemens AG		
Paul	Leufkens	Guest	Power Projects Leufkens		
Wangpei	Li	Guest	Eaton		
Qian	Li	Guest	Powertech Labs INC.		
Hua Ying	Liu	Member	Southern California Edison	X	X
Li	Liu	Member	Eaton		
Albert	Livshitz	Member	CE Power Solutions		
Bjorn	Lofgren	Guest	Siemens Energy		
Russell	Long	Member	Retired		
Antonio	Mannarino	Guest	PSE&G		
Vincent	Marshall	Guest	Southern Company Services	X	X
Gary	Martin	Guest	Entergy		X
Ricardo	Martinez	Guest	CFE-LAPEM		
Peter	Marzec	Guest	S&C Electric Co.	X	X
Joel	Mathewson	Guest	Siemens		
Steven	May	Guest	Southern Company Services	X	X
Frank	Mayle	Guest	Technibus, Inc.		
James	McBride	Guest	JMX Services, Inc.	X	X
Neil	McCord	Member	KEC Precision	X	X
Timothy	McGee	Guest	Siemens Energy		
Steven	Meiners	Guest	GE		
Peter	Meyer	Guest	S&C Electric Company		
Dave	Mitchell	Guest	Dominion Energy	X	X
Arthur	Molden	Guest	AMEESCO		
Terry	Monahan	Guest	Schneider Electric		
Oscar	Montano	Guest	Salt River Project		
Tom	Mulcahy	Member	Dominion Virginia Power	X	X
Volney	Naranjo	Guest	GERS USA		
Raj	Nayar	Guest	Siemens Energy Inc.		
Jason	Neal	Guest	HICO America		
Jeffrey	Nelson	Guest	Tennessee Valley Authority		
Joachim	Oemisch	Guest	Siemens AG		
Ted	Olsen	Member	Retired, formerly with		

			Siemens Industry, Inc.		
Nicholas	Orlando	Guest	IEEE-SA		
Miklos	Orosz	Guest	Myers Controlled Power	X	X
Luis	Osorio	Guest	The H-J Family of Companies	X	X
Mary	Owens	Guest	Eaton	X	
Justin	Palmer	Guest	ELECTRONSYSTEM MD	X	
Molson	Parvin	Guest	CB&I		
Amit	Patel	Guest	GE		
Shawn	Patterson	Guest	US Bureau of Reclamation		
Mark	Pattison	Guest	H-J Family of Companies	X	X
Thomas	Pellerito	Member	DTE Energy	X	X
Alan	Peterson	Guest	Utility Service Corporation	X	
Andrew	Peterson	Guest	ABB	X	X
Mark	Peterson	Guest	Xcel Energy	X	X
Lise	Phan	Guest	Parcific Gas and Electric Company		
John	Phouminh	Guest	PEPCO HOLDINGS, INC.	X	X
Anton	Poeltl	Guest	ABB		
Iulian	Profir	Guest	Rockwell Automation		
Ahmad	Qasem	Guest	Bechtel		
Syed	Rahman	Guest	The United Illuminating Company		
Samala Santosh	Reddy	Guest	Powell Industries	X	X
Frank	Ricard	Guest	FirstPower Group LLC		
Anthony	Ricciuti	Member	Eaton Corporation	X	X
Bobby	Rich	Guest	Dominion Virginia Power	X	X
Dave	Riffe	Guest	Westinghouse Electric Company	X	
Julian	Rizo	Guest	Xcel Energy		
Brian	Roberts	Guest	Southern States, LLC		X
Jon	Rogers	Guest	Siemens Energy, Inc		
Ian	Rokser	Guest	Eaton Corp		
Ben	Rosenkrans	Guest	Eaton Corporation		
Leonel	Santos	Guest	Schneider Electric	X	
Roderick	Sauls	Member	Southern Company Services		
Victor	Savulyak	Member	DNV GL KEMA Laboratory	X	X
Robert	Sazanowicz	Guest	The United Illuminating Company		
Daniel	Schiffbauer	Member	Toshiba International Corporation	X	X
Carl	Schneider	Guest	Schneider Electric		
Carl	Schuetz	Member	American Transmission Company (ATC)	X	
Jon	Schumann	Guest	American Transmission		

			Company		
Moin	Shaikh	Guest	Siemens		
Jesse	Shank	Guest	POWER Engineers		
Jim	Sharkey	Guest	EPRI		X
Devki	Sharma	Member	Consultant		
Harish	Sharma	Guest	Southern Company		
Sushil	Shinde	Member	ABB Inc.	X	X
John	Shullaw	Guest	Retired		
Dean	Sigmon	Member	Eaton Corporation	X	X
Sunita	Singh	Guest	Bechtel OG&C		
Michael	Skidmore	Secretary	AEP	X	X
Christopher	Slattery	Guest	FirstEnergy	X	
Robert	Smith	Member	Retired		
Hongbiao	Song	Guest	Bechtel		
Hongbiao	Song	Guest	GE		
Erin	Spiewak	Guest	IEEE	X	
Kresimir	Starcevic	Guest	DNV GL KEMA Laboratories		
Don	Steigerwalt	Guest	Duke Energy	X	
David	Stone	Guest	DTS Technical Services		
Donald	Swing	Guest	Hubbell Power Systems		
Dragan	Tabakovic	Guest	Meramec Instrument Transformer Co.		X
Humayun	Tariq	Guest	American Electric Power		
Henk	te Paske	Guest	KEMA Netherlands		
Jey	Thayalan	Guest	Schneider Electric		
Michael	Titus	Guest	Schneider Electric		
Jean-Marc	Torres	Guest	EATON		
Jean-Marc	Torres	Guest	Eaton Corporation		
Vernon	Toups	Member	Siemens	X	
francois	trichon	Guest	schneider electric		
Karla	Trost	Guest	G&W Electric	X	
Richard	Trussler	Guest	Schneider Electric		
James	van de Ligt	Member	CANA High Voltage Ltd.	X	X
Nick	Vonfeldt	Guest	Ameren Missouri		
Michael	Wactor	Guest	Powell Industries, Inc		
Wes	Wadsworth	Member	Hitachi HVB, Inc.		
Jeffrey	Ward	Guest	Doble Engineering Company	X	X
Robert	Warren	Guest	DNV GL - KEMA Laboratories		
John	Webb	Member	ABB	X	X
Casey	Weeks	Guest	Siemens Energy	X	X
Jan	Weisker	Guest	Siemens AG	X	X
Jerry	Wen	Guest	BC Hydro	X	X
William	Wilkie	Guest	Eaton	X	

Matthew	Williford	Guest	Schneider Electric		
Barnes	Wilson	Guest	Avista Utilities		
Torsten	Wirz	Guest	ABB AG		
Joseph	Wisnewski	Guest	UL LLC		
Terry	Woodyard	Member	Siemens Industry Inc.		
Ang	Xiao	Guest	3M company		
Lisa	Yacone	Guest	IEEE-SA		
Larry	Yonce	Guest	Eaton Corporation		
Dong Sun	Yoon	Guest	HICO America		
Richard	York	Guest	Mitsubishi Electric Power Products Inc.	X	X
Li	Yu	Guest	Eaton Corporation		
Jiong	Zhang	Guest	MEPPI		
Jiong	Zhang	Member	MEPPI		
Wei	Zhang	Member	Hitachi T&D Solutions, Inc.	X	X
Xi	Zhu	Chair	GE Energy Management	X	X

'X' - individual was at the meeting in Lake Buena Vista, FL