

**Working Group PC57.91 Guide for Loading Mineral-Oil-
Immersed Transformers and Step-Voltage Regulators**
Meeting Minutes

April 27, 2021, 3:45 PM – 5:00 PM (EST)

Virtual Webex Meeting

1. The Chair made his opening remarks and proposed a meeting agenda.
2. The chair requested unanimous approval of the Spring 2021 Meeting Agenda as emailed prior to the meeting by acclamation (subject to quorum being present later in the roll call). The agenda was approved unopposed.
3. **Call for Patents:** The chair asked if anyone was aware of any patents and there were none claimed.
4. **Copyright Policy:** The IEEE copyright policy was reviewed.
5. Establishment of quorum- Number of Current Members = 53; Number of Members Present in Meeting= 31; Quorum Present = 58.5 % and with a total number of 85 attendees (see attached list) at the meeting.
6. The chair requested unanimous approval of the Fall 2020 Meeting Minutes (as posted on the IEEE TC Website) by acclamation. The meeting minutes was approved unopposed.
7. **Chair- David Wallach:** The chair informed the group that on December 4, 2020 a Webex meeting was held (minutes emailed to working group) to discuss PAR extension and path forward. The minutes of the Dec 4, 2020 was approved by a subsequent electronic ballot send to the members of the working group. The chair stated that the members present in the December 4, 2020 meeting voted to submit a 2-year PAR extension. The extension request was submitted on March 29, 2021 for the June 15, 2021 NESCOM agenda. If approved, the PAR will expire on Dec 31, 2023. We will need to go for a straw ballot by Fall 2022 and then submit the revised guide for final approval in Oct 2023. The current draft 3 document of the PC 57.91 guide is posted on the TC.

The chair opened the floor to continue the discussion on interchanging Clause 7 with Annex G, a topic that was taken up in Fall 2020. In his opinion, he felt that Clause 7 should be retained in the guide since many utilities were still following Clause 7.

Discussion on interchanging Clause 7 and Annex G:

Tim Raymond felt that this was long overdue. The Annex G requires some revisions, but it is particularly useful for short duration over-load, but we need to keep Clause 7 in the existing document somewhere. The Annex G requires uses a bottom oil rise model developed in the late 1990s but in reality, the overload numbers are not changing much. When we have the data for bottom oil rise, it is advantageous to use Annex G model.

Chair: We need to rename Clause 7 like a classical model or something.

Tim R: My background is with PT Load software. We always called it bottom and top oil models.

Chair: We could consider calling Clause 7 as top and Annex G as bottom oil models.

Wally Binder: Will we run into copyrights issues with using PT Load terms?

Tim Raymond offered offer to get the copyright issue with EPRI clarified for our guide use if this working group had any concerns.

Jason Varnell wanted to know the basis behind swapping Annex G with Clause 7.

Chair: With the improvements being made to Annex G, it may be beneficial if we have bottom oil temperature.

Tim R: He stated that the bottom oil rise model in Annex G model considered two main improvements. It is recognized that duct oil temperature rises faster than the bulk oil temperature. Clause 7 was based upon winding rise over bulk oil temperature but did not include rapidly rising duct oil temperature. In reality, the hot spot temperature rises faster than what the Clause 7 model predicts. The bottom conductor temperature rises more rapidly than the top conductor when there is a step change in the loading. There are a couple of ancillary corrections that need to be made. Clause 7 assumes that increased resistance and losses is offset by decrease in viscosity and thereby more cooling. This applies to cooling in oil directed flow Transformers. There are significant improvements with the Annex G model.

Jason V pointed out that Annex G requires a lot more inputs to perform these calculations. His concern was that users will need to have many input values to perform these calculations. While it is true that oil temperature adjacent to the hot spot conductor in the winding is higher than the top oil temperature, in some models the hot spot temperature is calculated using hotspot gradient over top oil rise. He was concerned about making changes to the current methodology and the impact those changes will have in making overload calculations using Annex G.

Tim Raymond agreed that a lot more parameters were required while using Annex G. In reality, the only one piece of information you need in Annex G that you do not need in Clause 7 is the rated bottom oil rise. For everything else we can make equivalent assumptions like we already do for Clause 7. For example, in Clause 7 now, we calculate oil thermal time constant with an equation while we do not need to calculate that in Annex G. Annex G allows you to break load losses into eddy and stray losses. In reality, 90% of the time you cannot segregate eddy and stray losses. We have to assume losses to be all stray type and you will need to make some assumptions for which we could provide guidance. Annex G will provide answers for equivalent assumptions like the Clause 7 model, but it will have more flexibility,

Jason V: We focused mainly on eddy and stray losses while using Clause 7 and have used it for calculating hot spot rise for specific overload profiles while designing transformers. He felt that there may not be uniformity with OEMs using different values for inputs while using Annex G to get more desirable results.

Javier Ortega: There is an IEEE C57.169 guide that provides a procedure to determine hot spot rise and hotspot gradient. He added that C57.91 takes that information from the C57.169 guide to calculate the hot spot.

Jason V observed that Clause 7 hotspot gradient varies based upon load and the losses.

Oleg Roizman stated that Jason probably missed his presentation about Clause 7 in a previous C57.91 meeting. In that presentation, he had pointed out that Clause 7 is based upon a number of assumptions that are not valid. Annex G is based upon classical thermodynamics, heat transfer and the law of conservation of energy principals. Annex G is a classical thermal model. We need inputs like dynamic load, ambient temperature and some parameters that are fixed like losses. If we have all the parameters for the Annex G model, then we can go with it. If we do not have some information, then we need to provide guidance on what users need to do. We can use some formulae from Clause 7 to come with the parameters to address limitations of Annex G.

Jason V stated that it would be beneficial if guidance is provided to perform Annex G

calculations so that there is uniformity on how OEM's perform this calculation.

Oleg R confirmed that we will provide that guidance in Annex G.

The Chair stated that the plan is to maintain present Clause 7 top oil model as many utilities will still use this information as reference.

Patrick Picher of Hydro Quebec started a discussion about whether IEC 76-6 equations will be added to this guide or whether there will be one set of equation from IEC and the other from IEEE. Thermal overshoot is covered in this IEC guide and is simpler to use than Annex G. IEC has constants for cooling that are better than IEEE for overshoot for a load duration of 30 minutes. Unlike Annex G, the IEC guide does not require as many parameters.

Oleg R stated that he has looked at the latest IEC edition. We should provide reference to the IEC model while discussing the classical the thermal model. IEC has attempted to solve a second-order dynamic model equation. We will refer to that but there are some problems with the IEC model which will be discussed in Annex G.

Tim Raymond expressed that he has concerns using the IEC model.

Oleg R stated not only Tim, but there are many others who have concerns about the IEC model. He invited Patrick to join the task force.

Patrick P offered Hydro Quebec's help with conducting overload tests in their Hydro Quebec lab using fiber optics. He thought that it may be interesting to perform these tests to compare Annex G & IEC-76-7 models and publish the results in this guide.

The Chair noted that Oleg R has been asking for fiber optic top, bottom oil temperature and load data to validate his model and use that information in the guide revision.

Oleg R confirmed examples, block diagrams and code will be provided to demonstrate the model and for everyone to use for free. Zach Draper of Delta-X has offered to write the code for the Annex G model. The HQ lab test can provide us with an opportunity to compare different techniques.

Tim Raymond: I had an Excel sheet about most of the parameters for Annex G back then.

Dan Blaydon: He agrees with maintaining Clause 7 as a user but would like to express concern that Annex G may require OEM's to have knowledge about various inputs required to perform the calculations. He wondered whether end users will have the data, additional parameters and assumptions to perform Annex G calculations like they do now for Clause 7 for validating the information they get from the OEMs.

Tim Raymond mentioned that information like rated bottom oil rise can be obtained from the OEM's. This has been required since 2000.

Dan Blaydon asked whether the parameters and exponentials will be available to the end user.

Tim R confirmed that the assumptions used in the Annex G document are not much different than the default ones we currently have in the Clause 7 model. We have more parameters because we are trying to address the over-simplification in the Clause 7 model. We cannot rule the possibility of overload ratings changing while using the Annex G model. We can possibly guard against the ratings being very vastly different, but we must never stop making improvements to the models in the guide. We need to come up with a model that is technically the best and not based upon past practices.

Oleg Roizman agreed with Tim Raymond.

Tim Raymond: For Annex G, values inputs can be determined during factory tests using test methods in current IEEE standards. There are certain assumptions on how certain exponents vary with losses of that system in Clause 7. But there is information available out there which we could use to get equivalent results to Clause 7.

David Wallach stated that we do not want to discount the importance of Clause 7 but Annex G is a different way to approach overload calculation. We probably need to come up with a new nomenclature for Clause 7.

David Blaydon mentioned that by moving to Annex G you are making get the Clause 7 the alternate method.

The Chair mentioned that any member who may have information for improving Annex G and Clause 7 may please let him know. He mentioned that Oleg is leading a task force to revise Annex G. The Chair will swap the two sections physically in the guide. He emphasized the need for the WG members to stay engaged between TC meetings to get the guide finally done by end 2023. We probably need to have frequent TF meetings and WG meetings.

Oleg R mentioned that Tim Raymond, Patrick, Kayland Adams and Zach are part of this task force (Brad Staley has also volunteered to be on this task force subsequent to this meeting).

Discussion About Moving Bubble Evolution Temperature Annex A to C57.162:

The Chair mentioned that this topic was brought up at the end of the last meeting. The discussion was about whether the science behind this phenomenon belongs in C57.162 and the application part in this C57.91 guide or vice versa. It is possible that except for the example A4 in Annex A, the other parts will move to C57.162. And so, do we want to have discussion or have a motion to recommend moving parts A1 thru A3 of Annex A to C57.162 and keeping A4 in C57.91? The Chair mentioned that the C57.162 WG is supportive of this idea.

Sam Sharpless (Insulation Life Subcommittee Chair) mentioned that this was discussed in the C57.162 working group and they are supportive of this move.

The Chair added that the Insulation Life SC approval was not required if the two WGs agreed to the transfer. It seems that this transaction is a done deal.

Sam Sharpless agreed.

The Chair asked whether we now need a motion in this WG to release sections A1-A3 in Annex A to C57.162 WG, while keeping the application part in C57.91.

Oleg R: Annex A has only a couple of pages and a formula that needs correction. He agreed to handle the revision and submit it to this WG during the next meeting. But was fine with moving the science part to C57.162. We need to talk about the origins of the bubble equation in A2 of Annex A and correct that equation. The example in A4 should also be revised based on the revised equation. The equation correction will result in 10K difference at 2% moisture content.

The Chair asked if the Bibliography also needs to go to the C57.162 guide.

Oleg R agreed with that and added that there were a few additions made to it.

David Wallach again asked to hear a motion for moving the contents of Annex A to C57.162 after updating the equation and example in this guide.

Oleg R stated that no motion is required since both working groups have agreed to moving the science Annex A to C57.162. It was agreed in the C57.162 WG to add a dynamic angle to the Bubble Equation along with uncertainties and the science behind it. He stated that Tom Prevost the Chair of C57.162 was good with that and so we there is no need for a motion at all.

Sam S stated this topic was included as an item in the Fall 2020 minutes SC meeting and it was agreed that C57.91 will retain the equation and example while the science and theory will be moved to C57.162. This was discussed in the C57.162 WG yesterday.

Oleg R confirmed that the bubble equation with its assumptions will be covered in Annex A of C57.91 while the section in C57.162 will be quite different.

Sam S stated he is good with not moving a motion as long as both the C57.91 and C57.162 WG chairs are coordinated about what their respective contents are going to be.

David Wallach mentioned that in the last WG meeting Tim R was hesitant to give the

bubble equation to another Guide.

Tim Raymond stated that he was outvoted in many meetings on moving bubble evolution to C57.162. He feels that it is a natural fit for this guide, but he is OK if it is covered in a different IEEE document.

Oleg R remarked that Annex A was a normative and not an informative reference.

David Wallach confirmed that no motion is required, and we are going to revise Annex A, He will coordinate with Tom Prevost of C57.162 so that they can pick up more in-depth treatment of this topic.

Sam S summarized that he will report to the subcommittee that the bubble equation is being discussed by the C57.91 and the C57.162 WGs and the bubble equation topic will be split up between these two guides.

Discussion About Revising Annex I and Clause 5:

David Wallach mentioned in a previous WG meeting there was a discussion about Annex I and Clause 5 needing to be revised with respect to the presence of oxygen in oil like the latest IEC guide. He asked if there is going to be treatment of this topic elsewhere. Recent research indicated it's impact on DP / Tensile strength.

Oleg R stated that if C57.162 does not look into it, then we need to decide if we want to treat it in this guide. Clause 5 revision could be done by somebody else.

Tim R stated he could take a look at Clause 5 and Annex I and if there are specific things to be looked at then Oleg could provide that input.

Oleg R stated that we need to deal with terms like expected life, normal life, normal life expectancy, normal insulation life and life expectancy etc. in these sections. We need to get some consistent terminology defined and the life expectancy term should not be used. These are statistical terms and transformers are normally taken out of service before their end of life.

Tim R agreed that there are things that can be tightened up and brought in line with other standards and documents. This can be tricky since there is a lot of historical perspectives for many of these terms.

The Chair asked if there were volunteers to help Tim R clean it up. Zach and Kayland Adams offered to help Tim with revising Clause 5 (Kumar Mani subsequently volunteered after this meeting).

David Wallach: We should plan to have a WebEx working group meeting in June and October this year to see how the drafting is going and to iron out any possible conflicts.

8. Unfinished and New Business: There was none.

9. Adjournment

The meeting was adjourned at 11:53 AM [WDT]. The chair mentioned that a survey will be sent out in June regarding location preference for the Fall 2020 meeting whether it will be Virtual or in person at Milwaukee.

Chair: David Wallach

Vice-Chair: Javier Arteaga

Secretary: Kumar Mani

Meeting Attendance and Membership Status gathered from the WebEx Quorum Poll:

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
James Dukarm	Delta-X Research Inc.		X	
Kayland Adams	SPX Transformer Solutions, Inc.		X	
Mickel Saad	Hitachi ABB Power Grids	X		
Zack Draper	Delta-X Research Inc.			X
Ismail Guner	Hydro-Quebec			X
Taylor Gray	Not known		X	
Dmitriy Klempner	Southern California Edison			X
Sebastien Riopel	Electro Composites ULC		X	
William Boettger	Boettger Transformer Consulting LLC		X	
J.Dennis Marlow	DenMar TDS Transformers		X	
Roger Hayes	General Electric	X		
Peter Zhao	Hydro One	X		
Gilles Bargone	FISO Technologies Inc.	X		
Afshin Rezaei-Zare	York University			X
Patrick Picher	Hydro-Quebec IREQ			X
YaquanBill Li	BC Hydro		X	
Brad Staley	Salt River Project	X		
Juan Castellanos	Prolec GE	X		
David Calitz	Siemens Energy	X		
Steve Jordan	Not known			
Matthew Mcfadden	Oncor Electric Delivery			

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
Craig Colopy	Eaton Corporation	X		
Troy Tanaka	Burns & McDonnell		X	
Ryan Musgrove	Oklahoma Gas & Electric			
Emilio Morales-Cruz	Qualitrol Company LLC	X		
Eduardo Garcia	Siemens Energy	X		
Will Elliott	Prolec GE		X	
Eric Davis	Burns & McDonnell		X	
Jared Bates	Oncor Electric Delivery		X	
Kumar Mani	Duke Energy Inc.	X		
Javier Arteaga	Hitachi ABB Power Grids	X		
Bruce Webb	Knoxville Utilities Board	X		
David Wallach	Duke Energy Inc	X		
Anthony Franchitti	PECO Energy Company			
Kyle Stechschulte	American Electric Power			X
Gene Blackburn	Gene Blackburn Engineering		X	
Weijun Li	Braintree Electric Light Dept.	X		
Bruce Forsyth	Bruce Forsyth and Associates LLC	X		
Jeff Ray	JLR Consulting		X	
Evanne Wang	DuPont		X	
Timothy Raymond	EPRI	X		
Jason Varnell	Doble Engineering		X	
Jeff Schneider	Power Partners		X	
Daniel Blaydon	Baltimore Gas & Electric	X		

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
Dinesh Sankarakurup	Duke Energy Inc		X	
Jeffrey Wright	Duquesne Light Co.	X		
Javier Del Rio	Siemens Energy		X	
John K John	VA Transformers	X		
Sam Sharpless	Rimkus Consulting Group	X		
Richard Marek	Retired		X	
Rogelio Martinez	Georgia Transformers	X		
Rod Sauls	Southern Company Services		X	
Suleman Khan	Ontario Power Corp.		X	
Sanjib Som	Pennsylvania Transformer		X	
Adam Smith	Commonwealth Associates Inc		X	
Susan McNeily	Xcel Energy		X	
Lee Matthews	Howard Industries	X		
Kent Miller	T&R Electric Supply Co		X	
Mike Warntjes	Not known		X	
Raymond Curtiss Frazier	Ameren		X	
Brian Penny	American Transmission Co.		X	
Alex Quispe	Eaton Corporation	X		
Barry Beaster	H-J Family of Companies		X	
Gary King	Howard Industries		X	
Stacey Kessler	Basin Electric Power Cooperative	X		
Megan Kell	Eaton Corporation		X	
Evgenii Ermakov	Hitachi ABB Power Grids			

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
Radek Szewczyk	Specialty Products Poland			
Kerwin Stretch	Siemens Energy			X
Egon Kirchenmayer	Siemens Energy	X		
Paul Florida	Howard Industries		X	
Tom Prevost	Weidmann Electrical Technology		X	
Sukhdev Walia	New Energy Power Co.	X		
Aleksandr Levin	Weidmann Electrical Technology	X		
Tommy Eagle	SPX Transformer Solutions, Inc.		X	
Anthony Franchitti	PECO Energy Company			X
Mario Locarno	Doble Engineering			X
Anastasia O'Malley	Consolidated Edison Co. of NY		X	
Saramma Hoffman	PPL Electric Utilities	X		
Mark Tostrud	Dynamic Ratings	X		
Roger Wicks	DuPont	X		
Sheldon Kennedy	Niagara Transformer	X		
Paul Morakinyo	PSEG		X	
Oleg Roizman	IntellPower Pty Ltd	X		
Valery Davydov	Mr Valery Davydov		X	

Working Group PC57.91 Loading Guide Meeting Minutes

December 4, 2020

11:00 AM – 12:15 PM (EST)

Webex Meeting

1. The Chair made the opening remarks and proposed a meeting agenda.
2. Establishment of quorum- Number of Current Members = 52; Number of Members Present in Meeting= 18; Quorum Present = 41% and with a total number of 44 attendees (see attached list) at the meeting.
3. The meeting agenda was approved unanimously without objection.
4. **Call for Patents:** A call for patents was made and there were none claimed.
5. **Copyright Policy:** The IEEE copyright policy was reviewed.
6. **Discussions on Pathways**
 - A. The Chair reviewed with the WG that the current PAR for this standard expires on Dec 31, 2021.
 - B. The Chair reviewed with the WG that the current Guide will expire on Dec 31, 2021.
 - C. The Chair presented three initial pathways for discussion:
 - a. Continue with the present mark-up (Draft 3) with updated abstract, introduction, revision of ancillary components sentence (clause 9.2.2) and revision of bushing overload language (B.1).
 - b. Continue with the present mark-up PLUS correct bubble evolution equations and Clause 7 equation errors identified by one member.
 - c. Continue with the present mark-up PLUS correct bubble evolution equations and Clause 7 equation errors identified by one-member PLUS review the thermal models in the Guide, select most appropriate thermal models to update/present, update mathematical equations to the differential form, suggest ways to solve these equations, consider merging Clause 7 with Annex G, examples, etc.
 - D. The incoming Insulation Life SC chair supported keeping the Guide on schedule with the existing PAR then consider reopening soon after with the more extensive updates.
 - E. Additional discussion supported 6.C.c option above.
 - F. While we did not have a quorum with this meeting, we opened a Webex poll as an opinion poll for all attendees (members and guests voting):

Which pathway should we proceed with?	
A.Ballot guide as presently marked up	6/46 (13%)
B.Ballot guide as marked up with updates to bubble equations and clause 7 error	13/46 (28%)

C. Request extension and work to get updates to Clause 7, Annex G and differential equations	16/46 (35%)
No Answer	11/46 (24%)

7. Since a quorum was not present, we could not make a formal decision. The Chair proposed and the attendees agreed that an email poll to the members will be sent out for voting on our direction. Given the results of the poll above with “C” as the leader, only “B” and “C” options will be presented for email voting. The results of this poll will determine how we proceed in 2021.

8. Adjournment

a. The meeting was adjourned at 11:53 AM.

9. Membership: Following the meeting, Sam Sharpless requested membership and meets the qualifications so he will be added.

Chair: David Wallach

Vice-Chair: Javier Arteaga

Secretary: Kumar Mani

Meeting Attendance and Membership Status gathered from WEBEX Chat:

Bruce Webb has also dialed in on the call for the record

Malia Zaman IEEE-SA

Devki Sharma (Entergy)

Tim Raymond EPRI

Claude Beauchemin

Bruce Webb Knoxville Utilities Board

John K John ,Virginia Transformer Corp. MemberL

Wallace Binder, WBBinder Consultant

Sam Sharpless, Rimkus Consulting Group, Guest

Eric Doak D4EnergySolutions Consulting

Dinesh Sankarakurup, Duke Energy, Guest

Brian Penny (American Transmission Co.)

James Gardner, SPX Transformer Solutions

Juan Acosta, Ergon Inc

Anastasia O'Malley, Con Edison Co. of NY attended as a Guest

David Calitz - Siemens Energy - member

Patrick Picher (guest) Hydro-Québec

James Gardner, SPX Transformer Solutions

Bruce Webb KUB Member

Claude Beauchemin TJH2b Guest

George Frimpong - Hitachi ABB Powergrids

Ali Naderian ,,METSCO Energy Solutions, Member,

Devki Sharma

Tim Raymond, EPRI (Member)

Kyle Stechschulte AEP, Guest
 Don Dorris, Nashville Electric Service, Guest.
 Eric Doak D4EnergySolutions Member
 Stacey Kessler Basin Electric Power Cooperative
 Javier Arteaga - Hitachi ABB Power Grids
 John K John, Virginia Transformer Corp. I am Member.
 Daniel Blaydon - Member, Baltimore Gas & Electric
 Anatoliy Mudryk - Camlin Power, Guest
 Wallace Binder, WBBinder Consultant, WG Member
 Huan Dinh, Hitachi ABB Power Grids, Guest
 BVrain Penny (American Transmission Co.) Guest
 Florin Faur SPX, Guest
 Saramma Hoffman, PPL, Member
 Good Jobby Davide
 Dmitriy Klempner, Southern California Edison, Guest
 Mario Locarno member?
 Tim-Felix Mai, Siemens Energy, Guest
 Rodrigo Ocon , IEM-Condumex, GUEST
 Jeffrey Wright - Member
 Roger Hayes Ge Grid Solutions
 Jeffrey Wright - Member, Duquesne Light
 David Wallach, Duke Energy

Meeting Member/Guest/Attendance based upon the second poll taken during the meeting.

Are you attending as a member or a guest?

A.Member 18/44 (41%)

B.Guest 23/44 (52%)

No Answer 3/44 (7%)

A B

sam sharpless		X	
Bruce Webb		X	
Malia Zaman		X	
Terence J. Martin		X	
Kyle Stechschulte		X	
John K John		X	
Eric Doak		X	
Claude Beauchemin		X	
Wallace Binder		X	
Dinesh Sankarakurup		X	
Brian Penny		X	
Devki Sharma		X	
David Calitz Guest		X	
Patrick Picher		X	
Florin Faur		X	
jwright		X	
Roger Hayes		X	
Zack Draper		X	
Dmitriy Klempner		X	
Anastasia		X	
Ali Naderian		X	

Daniel Blaydon		X		
George Frimpong		X		
HUAN DINH			X	
Jim Graham			X	
mhammons				
Susan			X	
Sheldon Kennedy		X		
Poorvi Patel		X		
Sanjib			X	
Don Dorris			X	
Shibao Zhang			X	
Javier Arteaga		X		
Albert Sanchez			X	
Saramma Hoffman		X		
Timothy Raymond		X		
Stacey Kessler		X		
James Gardner			X	
Oleg Roizman		X		
Kurt Kainerder				
AnatoliyMudryk			X	
Tim-Felix Mai			X	
Mario Locarno				
Rodrigo Ocon			X	
David Wallach		X		

Pathway Forward

This email ballot was sent only to members and officers of WG PC57.91. Survey Monkey was used as a polling platform. While each person should only be able to vote once, there were cases where there were duplicate names entered. The individual tally by responder was pulled and where there were multiple votes by one person, the last vote entered is what was recorded. 31 of 53 members (59%) of the membership responded to the email ballot so a quorum was achieved.

Preference	Votes (Percentage)
Continue with the present mark-up PLUS correct bubble evolution equations and Clause 7 equation errors identified by one member under the existing PAR schedule (expires December 31, 2021)	13 (42%)
Continue with the present mark-up PLUS correct bubble evolution equations and Clause 7 equation errors identified by one-member PLUS review the thermal models in the Guide, select most appropriate thermal models to update/present, update mathematical equations to the differential form, suggest ways to solve these equations, consider merging Clause 7 with Annex G, examples, etc. Request a ~2 year PAR extension in 2021.	18 (58%)

December 4, 2020 Meeting Minutes Approval

	Yes	No	Abstain
I approve the draft meeting minutes as emailed for the December 4, 2020 WEBEX Call.	28	0	3

Individual Responses

Name	Q1 A (current PAR)	Q1 B (PAR Extension)	12/4 Minutes Approve	12/4 Minutes Disapprove	12/4 Minutes Abstain
David Wallach	X		X		
Kumar Mani		X	X		
Bruce Webb	X		X		
Lee Matthews	X		X		
Jeffrey Wright		X	X		
Mickel Saad		X	X		
George Frimpong		X	X		
Paul Dolloff		X			X
Stacey Kessler		X	X		
Sam Sharpless	X		X		
Tim Raymond		X	X		
Oleg Roizman		X	X		
Terrence Martin	X		X		
Ali Naderian	X		X		

Name	Q1 A (current PAR)	Q1 B (PAR Extension)	12/4 Minutes Approve	12/4 Minutes Disapprove	12/4 Minutes Abstain
Wallace Binder		X	X		
Emilio Morales-Cruz		X	X		
David Calitz		X	X		
Roger Hayes	X		X		
Daniel Blaydon		X	X		
Brad Staley		X	X		
Bruce Forsyth	X				X
John John	X		X		
Giles Bargone		X			X
Sheldon Kennedy	X		X		
Weijun Li	X		X		
Saramma Hoffman		X	X		
Eric Doak	X		X		
Rogério Verdolin	X		X		
Mark Tostrud		X	X		
Darrell Mangubat		X	X		
Steven Schappell		X	X		