

Annex M Underground Transformers & Network Protectors Subcommittee

March 23, 201
Atlanta, Georgia

Chair: Dan Mulkey
Vice Chair: George Payerle

M.1 Meeting Administration

Introductions – The meeting was called to order at 11:00 AM in the Atlanta 4-5 rooms of the Sheraton Hotel in Atlanta, Georgia. Introductions were made and sign-in sheets were routed.

Quorum – The members were listed on the screen and by a show of hands, it was determined that there was a quorum with 16 of the 18 members in attendance.

Approval of Minutes – The minutes from the Fall 2015 meeting in Memphis, Tennessee were approved with the changes noted in the working group reports below. They were motioned for approval by Said Hachichi and seconded by Bill Wimmer. The subcommittee approved these without opposition.

Members and Guests --There were 16 members and 20 guests in attendance. Their names can be found in the AM system. Six guests requested membership, and post meeting John Crotty, Robert Stinson, Joshua Verdell, Mike Thibault, David Walker, and David Blew were approved as members.

The chairman, Dan Mulkey, mentioned that work is continuing on the RFID meeting check in system. He also said that he had attended all of the working group meetings in the UTNP subcommittee and that all seem to be functioning very well.

M.2 Working Group and Task Force Reports

M.2.1 C57.12.23 Working Group Report – Single-Phase Submersible Transformer

Alan Traut, Chairman, Adam Bromley, vice-chair.
Revision due date: **3/19/2019**
PAR Approval Date: **8/21/2014**
PAR Expiration Date: **12/31/2018**

Introductions – The meeting was called to order and everyone was asked to introduce themselves. Rosters were sent around.

Quorum – We had 49 attendees, 27 members (out of 32), 22 guests with 8 of those requesting membership (we will check attendance records), which gave us enough members to establish a quorum.

Approval of Agenda – Motion: Said Hachichi, Second: Mike Shannon, unanimous

Approval of Minutes – Motion: Justin Pezzin, Second: Fred Friend, unanimous

Chair Report – Al talked about when the PAR expires and how long we have to complete our work. PAR expires December 31, 2018. 10-year life cycle of the standard is December 31, 2019. Al mentioned that we should be fine to meet that deadline. We would like to send to ballot in the fall meeting of 2017.

Old Business

Al reviewed the results from the survey regarding the tank dimensions for various kVA sizes. Survey questions and results are as follows:

Are these overall diameters appropriate for the manhole sizes in use?

What minimum clearance is required to lower a unit through a 36" manhole?

Are there differences if a unit is loop feed vs. radial feed?

Should the dimensions be based on kVA and/or voltage (BIL)? If so, please provide suggestions.

If you have the equivalent requirements in your user specifications, eg, clause, table, drawings, please provide in your response to this survey.

14 responses received with 4 abstaining

Manufacturer response that 36" max overall diameter is achievable with 250kVA but height would be 60". Also suggest a table of max dimensions by kVA

Manufacturer response that 39" max overall diameter is achievable.

User response that 35" should be limit on 250kVA to fit 36" manhole. Also suggest overall height limit of 66"

User response supports 36" max (42" manhole) for 250kVA and 58" height limit.

User response by kVA range:

- 25-100kVA, 29" max diameter, 46" max height
- 101-167kVA, 31" max diameter, 47" max height
- 250kVA, 35" max diameter

User response that there should be one max diameter and height for all units, not by kVA or voltage.

User response that 250kVA units are installed in a 48" enclosure and 36" limit is ok. Max dimensions should be based on kVA alone.

Tom Holifield brought up the fact that 39" is the maximum number; why would we go less when a lot of utilities have manholes at 39-40". Giuseppe, Taz, Dan, and Brian all discussed why we would specify 35" vs. 39" for 250 kVA units. Giuseppe Termini made a motion to make the maximum diameter 36", Alex Macias seconded. 7 approve. 9 opposed. 4 abstentions. Motion fails.

Tom Holifield made a motion to change maximum dimensions 36" to 39" for 250 kVA units. Jermaine Clonts seconded. 15 approve. 3 oppose. 4 abstentions. Motion is approved.

Giuseppe mentioned utilities' challenges with existing infrastructure and asked why we have a maximum diameter that is different for 167 kVA and 250 kVA.

Dan Mulkey made a motion to add language to first sentence that states 36" max diameter for enclosure opening is only for 167 kVA and below and to add maximum of 42" for 250 kVA. Ron Stahara seconded. 19 approve. 0 opposed. Motion approved. New language from approved motions is as follows:

Construction of the units shall be such that they can be lifted and lowered into place in a suitably designed and constructed enclosure having a minimum diameter of 910 mm (36 in) for 167kVA and below, or 1067 mm (42 in) for 250kVA. To allow for cabling space and proper air flow for cooling, the transformers covered by this standard shall not have overall diameters in excess of 760 mm (30 in) for sizes 100 kVA and smaller, or overall diameters in excess of 840 mm (33 in) for 167 kVA, or overall diameters in excess of 990 mm (39 in) for 250 kVA.

Low Voltage terminals task force (section 7.2.2). Jermaine discussed the recommendations made by the task force including the addition of voltage ratings. We could add a note to the table that tells the user the

H spade can be used for any of the kVA sizes, when specified. Al suggested that we put this into the draft so that we can review and vote on it at the next meeting. The table as presented is shown below:

Secondary terminals	Low-Voltage Ratings (V)	kVA Ratings
2/0 AWG Copper Cable	120/240, 240/120, 240	25 - 37.5
	240/480, 480/240, 480	25 - 75
	120	-
	277, 347	25 - 50
	600	25 - 100
4/0 AWG Copper Cable	120/240, 240/120, 240	50
	240/480, 480/240, 480	100
	120	25
	277	-
	347	75
	600	-
500 kcmil copper	120/240, 240/120, 240, 277	75-100
	240/480, 480/240, 480	167
	120	37.5 – 50
	240, 277	75-100
	347	100
	600	167-250
H Spade	120/240, 240/120, 240, 277, 347	167-250
	240/480, 480/240, 480	250
	120	75-167
	600	-

*The connection between the secondary bushings and the cable shall be fully insulated and sealed to prevent the entrance of moisture.

Tank materials – we wanted to look at requirements added to 12.24 and see if we want to include similar language in 12.23. Dan Mulkey suggested that we can't make a tank with copper bearing steel with

sufficient thickness to survive in the submersible environment. Dan made a motion to adopt the three conditions included in 12.24 but that we change copper bearing steel minimum requirement to 409 SS. Second – Alex Macias. Mike Hardin suggested that we add “as a minimum” to the first sentence. Brian asked if that is clear. Discussion led to an amended motion for material requirements: add other steel materials to first sentence and make all vault environments part of the same paragraph. Amendments to the motion and the motion approved unanimously. This motion puts the following language into the draft:

Material requirements

The transformer tank, including walls, cover, bottom, and auxiliary coolers shall be constructed of 409, 304L or 316L stainless steel.

For transformers continuously submerged, it is recommended the user installs cathodic protection or specifies 304L or 316L stainless steel.

For transformers subjected to cycling between wet and dry conditions, or subject to highly corrosive mineral content, it is recommended the user installs cathodic protection or specifies 316L stainless steel.

The group ran out of time and had to table the remaining agenda items.

Adjourned at 10:45 am. We will meet at the Fall 2016 meeting in Vancouver, Canada.

M.2.2 C57.12.24 Working Group Report – Three-Phase Submersible Transformers

Giuseppe Termini, Chairman; George Payerle secretary

Revision due date: **6/17/2019**

PAR Approval Date: **11/9/2011**

PAR Expiration Date: **12/31/2017**

The meeting was called to order at 9:30 AM, March 21, 2016 in the Georgia 2,3 Room of the Sheraton Atlanta Hotel in Atlanta, GA. Introductions were made and an agenda was presented. The meeting was attended by 24 members and 41 guests. Membership stands at 25, and with 24 members present, there was a quorum. Six (6) guests requested membership. The Chairman stated that attendance at 3 consecutive meetings was necessary for membership. Any member missing 2 meetings in a row would be dropped unless the Chairman was notified with a valid justification for missing the meetings.

George Payerle acted as recording secretary. Minutes from the previous meeting in Memphis, TN were presented. Al Traut a motion to approve the minutes, Brian Klaponski seconded it, and the motion was approved unanimously.

The Chairman stated that the PAR has been extended to two (2) years and it will expire on December 31, 2017. However, the Chairman would like to complete the standard revision work within one year. The results of the balloting process were discussed. There were 89 interested individuals in the ballot group of which 81 casted a vote; this represents 91% participation. We received 75 affirmative votes, 4 negative votes with comments and 2 abstentions. This represents 94% approval rate. Fifty-two (52) comments received of which 16 must be satisfied. Prior to this meeting, Corey Morgan led the effort to incorporate the comments received from the balloting process into Draft D6.

Matt Ceglia stated that when Draft 6 is submitted for re-circulation, it will not require another Mandatory Editorial Coordination (MEC) review. The editorial changes will be reviewed by the IEEE editorial review board prior to publishing the final approved standard. The rest of the meeting was dedicated in reviewing the comments incorporated in Draft 6 with the following results:

- The revision year of the referenced standards will be removed except for C57.12.00 since specific sections of this standard are referenced.
- **Section 5.2** - Rick Marek stated that C57.154, in addition to provide the requirements for transformers operating at elevated temperatures, it also provides the insulation classes for distribution transformers and it is the only standard where insulating classes are actually defined. It was agreed to retain the changes in this sections as incorporated.
- **Section 6.2** Reference Temperature - Al Traut made a motion to reverse the technical change that had been made and revert back to state that the reference temperature shall be corrected to 85 degrees C. Cory seconded the motion and it was approved unanimously.
- **Figures 1 and 2** -- The metric and English symbols are not shown in the header of the table in Figure 2 as shown in Figure 1. Also, there was a discussion on whether the metric values in the header of the table in Figure 1 should be in millimeters instead of meters. Matt Ceglia stated that it was acceptable under the IEEE metrification rules to show these values in meters. It was agreed to retain the values in meters as shown in Figure 1 and add the metric and English values in millimeters and inches respectively, in the header of the table in Figure 2.
- **Section 7.5.4** - Mike Thibault made a motion to exclude aluminum material by adding the words: “Aluminum is not acceptable” between the first and second sentences of this section. Dan Mulkey seconded the motion and it was approved unanimously.
- **Section 7.1** – Brian Klaponski stated that although the changes from “mineral oil” to “insulating fluids” throughout the document were acceptable, however, the intent of this standard was to use mineral oil as the basis for insulating fluid. The Chairman suggested to add the words ‘Unless otherwise specified, insulated liquid shall be mineral oil’ at the end of the first paragraph of Section 7.1 to satisfy Brian’s comment. A motion was made by Dan Mulkey to add the suggested words. Kent Miller seconded the motion and it was approved unanimously.

Said Hachichi made a motion to approve all the changes in Draft 6 as discussed at the meeting, and as modified above. Cory seconded the motion and it was approved unanimously.

The Chairman stated that Draft D6, as modified at this meeting, will be submitted for recirculation and re-balloted.

The meeting was adjourned at 10:45 AM. The next meeting will be on October 2016 in Vancouver, BC, Canada.

M.2.3 C57.12.40 Working Group Report – Secondary Network Transformers

Brian Klaponski, Chairman; Giuseppe Termini, Secretary

Revision due date: **12/31/2021**

PAR Approval Date: **8/30/2012**

PAR Expiration Date: **12/31/2016**

The WG met on Tuesday, March 22, 2016 at 11:00 am with 18 members and 28 guests. One (1) guest requested membership.

An agenda was presented and approved; and introductions were made.

The minutes of the November 3, 2015, meeting in Memphis, TN were reviewed. George Payerle made a motion to approve the Meeting Minutes. Tas Taousakis seconded the motion and the minutes were approved unanimously.

The Chair briefly summarized the items in the Meeting Minutes from Memphis. Three individuals requested membership at the last meeting but only Will Elliott was added to the membership since he meet the criteria for membership.

The Chair stated that because of the addition of: a) Figure 2 and b) the mathematical equation in Annex B, the balloting of the draft was postponed pending the approval of the addition of these two technical items by this WG.

The Chair also stated that because the draft was not submitted for balloting, a request for a PAR extension will be submitted to allow time to ballot the standard and resolve any comments received from the balloting process.

Larry Dix expanded on the derivation of the equation in Annex B. He stated that the equation is informative for the end users, and is an approximation of the melting point of the bus bar. It was suggested to provide the reference/source of the equation in the text of Annex B. Larry stated that he will provide the reference to the Chair. Jeremy Sewell made a motion to approve the addition of the equation in Annex B. Mark Faulkner seconded and the motion was approved unanimously.

The Chair explained the rational for adding Figure 2 to the standard. The Figure adds details on the preferred and alternative location of the primary bushings. Cory Morgan made a motion to approve the addition of Figure 2. Tas Taousakis seconded the motion and was approved unanimously.

Bob Kinner made a presentation on the difference between 304L and 316L stainless steel. The presentation is summarized below:

“The difference between 304L and 316L is 2% of the chromium content is upgraded to molybdenum. Molybdenum is a chromium group metal with lower susceptibility to forming water soluble chlorides. In turn, it has an improved resistance to saltwater. In terms of welding and stress cracks, there is no advantage of one alloy over the other. To protect against welding errors, look at the welding process. Low carbon alloys mitigate carbide precipitation. Carbide precipitation removes chromium from the alloy – chromium is what makes these steels “stainless”. Austenite tends to have a large grain size, which causes a lot of internal stresses along the welds. Annealing is another way reduce internal stresses, which later lead to cracking, but this may be impractical. Welding with a filler metal containing ferrite forming alloying agents can reduce stresses along the weld lines. Ferritic grains fill the gaps between austenitic grains. Stainless 321 contains 0.4% titanium which will help with this. 309Cb contains 0.8% columbium. Please check with weld wire suppliers for material compatibility.”

The meeting was adjourned at 12:10 pm with the next meeting set for Vancouver, Canada in October 2016.

M.2.4 C57.12.44 Working Group Report – Secondary Network Protectors

Bill Wimmer, Chairman, Mark Faulkner, Secretary
Revision due date: **12/31/2024**
PAR Approval Date: **3/26/2015**
PAR Expiration Date: **12/31/2019**

The meeting was called to order at 1:45 PM, on Monday, March 21, 2016 in the Georgia 2, 3 Room of the Sheraton Hotel.

(*)A total of 20 individuals attended the meeting. Membership stands at 9 members; a quorum was met on people in attendance (numerous late arrivals)

Mark Faulkner presented the meeting agenda to the WG for review and acceptance. Ed Bertolini motioned to approve the meeting agenda as presented, Dan Mulkey, seconded the motion, the motion was approved unanimously.

New Business

Continued review of comments from Lee Welch:

Discussion on external sand filled fuses / referred to Table B.4 pictures

Discussion held on including external fuses and housing

Three member users are currently specifying external fusing

- George Power (Lee Welch)
- CenterPoint Energy (Alex Macias)
- Eversource (Cory Morgan)

Individual housing vs one housing for all three fuses

- Decision to specify individual housings only

Mounting provisions

Placement fuses

Spades exiting the housing

Clearance requirements between for individual housing, external spades, and fuse within the housing

- Mulkey made reference to Table B.3 / clearances shall be reviewed

Noted that a number of end users are utilizing external fusing

- Eaton (Mark F) and Richards (Edward B) will get together to find min. dimensional requirements for publishing in the standard
- Also questioned other type of external fusing available
- Lead alloy, copper, KPR, Bussman, 5000A, 4000A, etc...

Pressurizing the fuse enclosure was discussed and deemed necessary.

- External fusing housing pressurized independent of network or
- External fusing housing pressurized thru vent hole

Table 4 AC voltage ratings:

- Why have the 500 rating?
- Eaton (Mark F) stated they test all at 600
- Richards to verify what voltage they test
- Results will determine the elimination of 250 and 500

Remote Racking

- Lee (GP) indicated that an inspection window or some means be included in the standard
- To verify visible break of contacts

- Design in place that do not require the door to be open

Sections: 10.5.4.6. / 10.5.4.7 / 105.4.8 / 10.5.4.8 / 10.5.4.9

- A discussion was held concerning the door hinges placement
- Submersible vs. non submersible
- Is the operating handle the determining factor
- It was decided to not change any section

10.5.14 Spare auxiliary contacts

- - Request made to define “dry contact”
- - include a means to provide contact status
- - Include a means to provide SCADA features in relation with remote racking

Note: It was suggested that a new section be created specific to remote racking

Under a) Eaton (Mark) to review and the determine the need to remove or keep in standard as part of the high voltage interlock transformer provisions

Under b) one contact to be closed, as known as an “a” (, remove comma) contact when the network protector is open. This is to be an available “dry” contact.

Under c) one contact to be closed, as known as an “b” (, remove comma) contact when the network protector is open. This is to be an available “dry” contact.

Next meeting:

- Vancouver, Canada

M.3 Old Business

M.3.1 SC Scope

The subcommittee voted between meetings to change the scope of this group to:

Underground Transformers and Secondary Network Equipment Subcommittee (UGTSN)

The Underground Transformers and Secondary Network Equipment Subcommittee shall be responsible for the following:

- a) Studying and reviewing the engineering aspects of:
 - Secondary network protectors
 - Liquid filled and dry-type secondary network transformers including pad-mount distribution transformers that incorporate or provide for a network protector or a network grounding switch
 - Underground distribution transformers, except for pad-mount transformers. This includes vault, submersible, and subway type distribution transformers.
- b) Developing and maintaining related standards, recommended practices, and guides for such products
- c) Coordinating with other technical committees, groups, societies, and associations as required

However, the change has not been approved yet. Hopefully it will be by the next meeting.

At the last meeting, Dan stated that we requested the PAR to be extended to 5 years and have heard nothing. The standards board’s last meeting of the year typically has a deadline for submission that occurs before the fall Transformers Committee meeting so we lose a half year automatically. It is a given that every ballot will need a recirculation. Balloting and recirculation takes a year or longer. So you really have 3 years at most, or 6 meetings to get your work done. Currently there are 4 projects that are asking for PAR extensions that would not need them if PARs lasted 5 years.

M.4 New Business

M.4.1 none

M.5 Adjournment

The meeting was adjourned at 12:30 PM with the next meeting set for Vancouver, BC, Canada on October 26, 2016.