Working Group PC37.302 - "Guide for Fault Current Limiter Testing"
Sponsored by IEEE Switchgear ADSCOM
Spring Switchgear Committee Meeting
St. Pete Beach, FL

April 30, 2012
Minutes

Mischa Steurer called the meeting of the Working Group to order at 8:15 AM EDT with 19 members and guests present.

- Introductions of the attendees were made.
- WG members were reminded of the patent slides they acknowledged when registering for the meeting.
- The agenda was approved with changes.
- The minutes of our March 18, 2012 meeting were approved.
- Four conference calls have been held since the October 10, 2011 Switchgear meeting. (11/14/2011, 1/9/2012, 2/21/2012 and 3/18/2012)
- A SharePoint website is being used for our Working Group. The draft Guide document, CIGRE Reports and other pertinent IEEE and IEC Standards have been placed on the SharePoint for WG use.

  Contact Paul Bishop pcbishop@bishopgroup.org to request user name / password for the SharePoint site.

  You can access the website at http://www.bishopgroup.net/links.htm
  Click on "view" next to Advanced Electrical Power Systems
  Click "OK" on pop-up (Digital Certificate)
  Enter user name and password
  Navigate to "FCL Testing Task Force"
  Documents under "Shared Documents" can be checked out for editing.
  New documents can be uploaded but must be checked in for others to view

- A copy of the latest draft of document "IEEE PC37.302™Draft Guide for Fault Current Limiter (FCL) Testing" has been made available to the group on the share point site.
  - Writing assignments are noted therein.
  - Please send an e-mail to steurer@caps.fsu.edu if you would like to volunteer to draft a particular section.
  - New material should be added by sending changes to Tim Chiocchio at Chiocchio@caps.fsu.edu.

- Chairman's Report:
  - The next conference call will be on Monday, June 25th from 10:30 AM – 12:30 PM EDT. The IEEE Fall Switchgear Meeting will be held in San Diego, CA from October 1 - 5, 2012. We will request time on Wednesday or Friday 10/3 or 10/5 for our next face to face meeting.
  - Timeline / Vision – The PAR was requested on 4/26/2010 and expires on 12/2014. Our goal is to develop a ballot ready document for discussion at the Fall Switchgear Meeting 2012.
  - A Panel Session on "FCL Experiences and Testing" will be requested for the IEEE PES GM in July 2013. **Paul Leufkens** will organize the panel.
  - The Carried Over Action Item list was reviewed and updated:

- **OPEN –** Investigating the impact of a lightning surge current through an FCL when the FCL is in CL mode or in the transition between C mode and CL mode. This investigation should be performed by all FCL developers to provide a better understanding of test requirements. The situation to investigate is as follows: during a line-ground fault downstream of a FCL, while the FCL is limiting that fault current, a lightning strikes upstream of the FCL. It causes a surge current (typically with very high di/dt but short duration, e.g. the standard 4/20us surge current waveform) to flow through the FCL to the fault location. We want to understand how the respective FCLs will react to such a situation. **Francisco DeLaRosa** volunteered to lead this sub group and will be requesting participation from other manufacturers to provide input on their technologies.

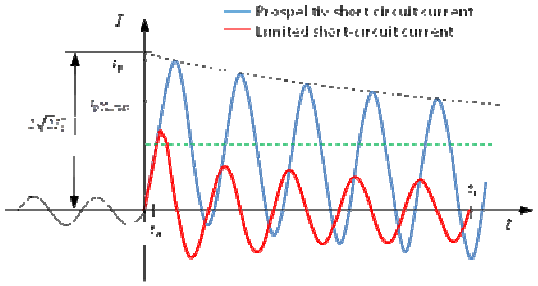
- **CLOSED – Transferred to Francisco DeLaRosa** (was: Tim MacDonald will lead the effort and coordinate with Ram Adapa and Silicon Power for the solid state FCL. Tim MacDonald lead the effort and work with Judith Schramm and Klaus Schlenga to investigate superconducting FCLs. Swarn Kalsi offered to provide input from the fuse standards on how this issue is handled).

- **OPEN – Judith Schramm** will review literature to recommend lightning voltage waveshapes for liquid N_2 based insulation systems. The literature review is in progress. She will contact **Tim MacDonald** to invite participation. Mischa Steurer mentioned that Isidor Sauers at ORNL has done extensive research in this area (his email address is in the distribution list)

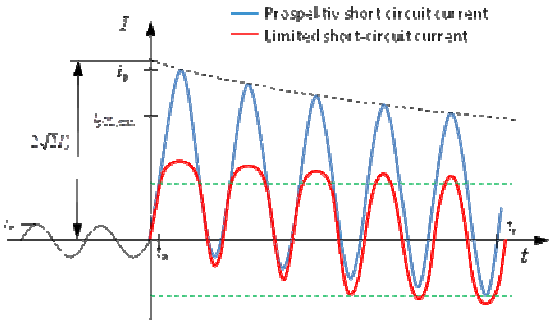
- **OPEN – Jim van de Ligt** volunteered to investigate fuse standards IEEE 37.41 regarding "rated minimum breaking current" (test duty 3).

- Waveform SubGroup met on April 29 prior to our WG meeting (minutes attached). Judith Schramm provided an overview of their work and recommendations. After discussion, a motion was made by Jim van de Ligt, seconded by Franco Moriconi to adopt the following FCL type definitions which are in accordance with the work by CIGRE WG A3.23:

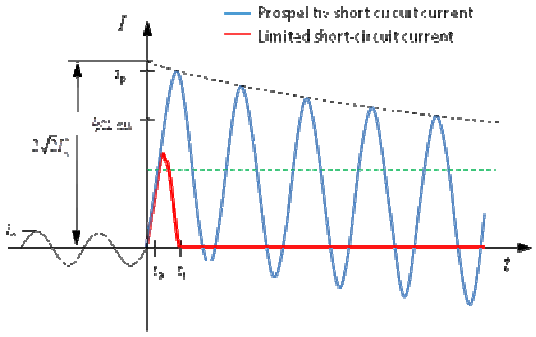
  - **Type A:** FCL without interruption
    A1) producing a current waveform which can be adequately described by power frequency and dc components after transitioning into current limiting mode.



  - A2) producing a current waveform which, after transitioning into current limiting mode, requires additional parameters or information besides the power frequency and dc components during each current loop



- **Type B:** FCL with interruption during the prospective peak fault current loop



The motion passed with no opposition.

- Document Review – Tim Chiocchio reviewed the document and **new authors (shown below)** were appointed for some sections. The goal is to have a ballot ready document containing at least the first priority sections for discussion at our fall 2012 meeting.
  - Section Chairs:

    First priority
    - 6.1 "Power Frequency Voltage Withstand" (Jim van de Ligt)
    - 6.2 "Lightning Impulse Voltage" (Francisco De La Rosa)
    - 6.5 "Partial Discharge" (Francisco De La Rosa)
    - 6.7 "Continuous Current" (Tim Chiocchio)
    - 6.8 "Short-time Withstand Current" (Andreas Brandt)
    - 6.10 "Current Limiting" (F. Moroconi, P. Deo, T. Shah)
    - 6.11 "Recovery" (**Judith Schramm**)
    - 6.14 EMC – (**Andreas Brandt**)

    Second priority
    - 6.3 "Switching Impulse Voltage" (Joanne Hu, Jim van de Ligt)
    - 6.4 "Chopped-Wave Voltage Impulse" (Tim Chiocchio)
    - 6.6 "Control Circuit Voltage Withstand" (Jim van de Ligt)
    - 6.9 "Harmonic Distortion" (Francisco De La Rosa)
    - 6.13 Protective Device – (Jim van de Ligt)
    - 6.15 Audible – (Gil Carmona)
    - 6.16 "Vibration" (Andreas Brandt)
    - 6.17 Polarity – (Jerry Earl)
    - 6.18 Visual Inspection – (**Paul Leufkens**)
    - 6.19 FCL Technology -- Specific Tests (Tim Chiocchio)
    - Section 7 - Production (Routine) Tests – (Jim van de Ligt)
    - Section 8 – Field Tests – (Pat DiLillo)

- Comments on DRAFT Document
  - Gil Carmona provided a list of comments which were reviewed by the WG and will be addressed in the next draft.
  - Richard Koevoets also provided some comments. He is invited to participate in the next conference call to discussion his comments.

Next conference call will be held on Monday, June 25th from 10:30AM to 12:30 PM EDT.

The meeting was adjourned at 5:30 PM EDT.

Submitted by:
Frank Lambert

Approved by: Mischa Steurer

Waveform Subgroup Meeting
Sunday, 29th April 2012,
1p.m. to 5p.m.
Compass Room, Trade Winds Island Resort, St. Petersburg, FL, USA

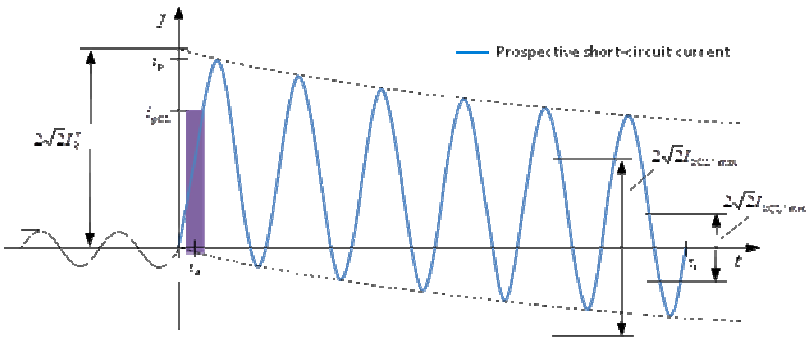
Minutes

Participants: Andreas Brandt; Christian Schacherer; Joachim Bock; Judith Schramm; Tim Chiocchio

Topic: Goal of the meeting was to classify the different FCL concepts into operational types as a proposal for the working group meeting on Monday 30th April 2012. The minimum goal of the meeting was the proposal of the operational types indication.

Results from the subgroup meeting:

Prospektive Fault Current:



Acc. to IEC 60909-0:
i_p – peak current of prospective fault current value
I_k – initial symmetrical short circuit value (RMS)
t_d – fault duration

Limitation values:
i_{pCL} – limited peak fault current value
I_{kCL} –limited initial symmetrical short circuit vaulue (RMS)

t_{dCL} – limiting fault duration
t_r – recovery time

Rated values – acc. to IEC 60909-0:
U_r - rated power frequency voltage
U_{max} – max. power frequency voltage
I_r – rated nominal current
f – frequency (e.g. 60 Hz)
X/R – ratio of system reactance to system resistance ($\kappa = 1.02 + 0.98 \cdot e^{-3R/X}$ acc. to IEC60909-0 chapter 4.3.1.1)
t_k – rated duration of short circuit
I_k – Rated short-time withstand current

I_p – Rated peak withstand current

- Proposal of the classification categories (A, B, C or 1, 2, 3 or I, II, III or α, β, γ or others) :

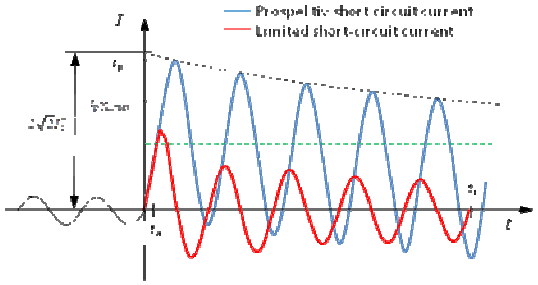
Cirgre definition:

Type A: without interruption

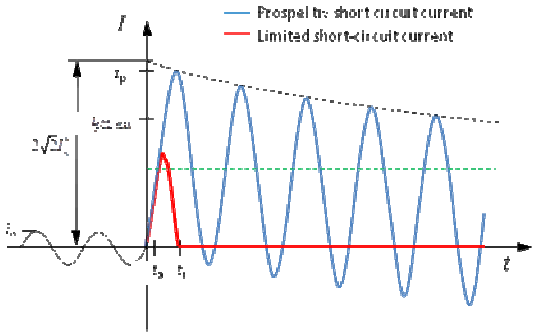
Type B: with fault current interruption

Possible definition:

Type A: low impedance normal with transitioning to linear current limiting impedance (in first quarter cycle)



Type B: limit and turn off during first current zero crossing



Type C: FCL devices which do not fall into other than that mentioned