Current transformers

Overview standardization

CIGRE B5 – Workshop Stroomtransformatoren
22 November 2011
Marc Achterkamp
(KEMA TIC en lid NEC38)
How thinks to be up to date with (inter)national standardization of instrument (current) transformers?

– Yes = Green

– No = Red
Current transformer standardization

Content of the presentation

• Standardization instrument transformers

• Standardization current transformers

• Standardization protection relays

• Liaisons within standardization
Standardization Instrument Transformers

- IEC TC38 / CENELEC CLC TC38 / NEN NEC38
  - IEC : International standardization
  - CENELEC : European standardization
  - NEN : Dutch standardization

- Scope
  “Standardization in the field of AC and/or DC current and/or voltage instrument transformers, including their subparts like (but not limited to) sensing devices, signal treatment, data conversion and analogue or digital interfacing.”
Standardization Instrument Transformers

- Transition from IEC 60044 into IEC 61869
- Initiated by standardization work of non-conventional and digital instrument transformers
- New structure more in line with general IEC look
# Standardization Instrument Transformers

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<td>Additional requirements for current transformers</td>
<td>IEC 60044-1 IEC 60044-6</td>
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<td>Additional general requirements for electronic instrument transformers and low power stand alone sensors</td>
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<td>Digital interface for instrument transformers</td>
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## Standardization Instrument Transformers

### Actual status November 2011

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<th>Standard</th>
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<td>IEC 60044-1 Ed. 1.2</td>
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Standardization Instrument Transformers

- Technical reports

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<tr>
<td>IEC/TR 61869-103 Ed. 1.0</td>
<td>The use of instrument transformers for power quality measurement</td>
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Standardization Current Transformers

- IEC 60044-1 Instrument transformers – Part 1: Current transformers
- IEC 60044-6 Instrument transformers – Part 1: Requirements for protective current transformers for transient performance
Standardization Current Transformers

- IEC 60044-1 Instrument transformers – Part 1: Current transformers
  - Definitions
  - Normal and special service conditions
  - Ratings
  - Design requirements
  - Classification of tests
Standardization Current Transformers

- Classification of tests
  - Type test
    - Short time current test
    - Temperature rise test
    - Lightning impulse test
    - Switching impulse test
    - Wet test for outdoor type transformers
    - Determination of errors
    - Radio interference voltage test
Standardization Current Transformers

- Routine test
  - Verification of terminal markings
  - PF withstand test on primary winding
  - Partial discharge measurement
  - PF withstand test on secondary windings
  - PF withstand test, between sections
  - Inter-turn overvoltage test
  - Determination of errors
Standardization Current Transformers

– Special tests
  • Chopped lightning impulse test
  • Measurement of capacitance and dielectric dissipation factor
  • Multiple chopped impulse test on primary winding
  • Mechanical test
  • Measurement of transmitted overvoltages
Standardization Current Transformers

- Determination of errors
  - Measuring current transformers
    - Current error and phase displacement (1), 5, 20, 100 and 120% $I_p$ at 25% and 100% $S_r$
    - Instrument security factor $I_{exc}$ measured at $U_{emf}$
Standardization Current Transformers

- Determination of errors
  - Protective current transformers Class P
    - Current error and phase displacement
      100% $I_{p_r}$ at 100% $S_r$ and pf of 0,8 ind.
Standardization Current Transformers

- Determination of errors
  - Protective current transformers Class P
    - Composite error
      - Direct method
        \( I_{p_{ALF}} \) at 100% \( S_r \) and \( pf = 0.8 \) ind.
      - Indirect method
        \( I_{exc} \) measured at \( U_{emf} \)
Standardization Current Transformers

- Determination of errors
  - Protective current transformers Class PR – limited remanence factor
    - Determination of remanence factor Kr
    - Determination of secondary loop time constant \( (T_s) \)
    - Determination of secondary winding resistance \( (R_{ct}) \)
Standardization Current Transformers

- Determination of errors

  - Protective current transformers Class PX – low leakage reactance

- Proof of low reactance by drawing or by composite error measurement
Standardization Current Transformers

- IEC 60044-6 Instrument transformers – Part 1: Requirements for protective current transformers for transient performance
  - Definitions (class TPS, TPX, TPY, TPZ)
  - Ratings and performance requirements
  - Methods of specification
  - Marking of rating plate
  - Tests
Standardization Current Transformers

- Tests
  - Type test
    - Turns ratio error or steady state ratio error and phase displacement
    - Determination of secondary winding resistance
    - Determination of excitation characteristic
    - Determination of remanence factor
    - Calculation of secondary loop time constant
Standardization Current Transformers

– Type test (continued)
  • Errors at limiting conditions
  • Determination of the factor of construction

– Routine test
  • Errors at limiting conditions
  • Determination of the factor of construction

– Special test
  • Verification of low leakage flux design
Standardization Current Transformers

- IEC 61869-1 Instrument transformers – Part 1: General requirements
- CDV IEC 61869-2 Instrument transformers – Part 2: Current transformers
Standardization Current Transformers

– Definitions
– Normal and special service conditions
– Ratings
– Design and construction
– Tests
– Rules for transport, storage, erection, operation and maintenance
– Safety
– Influence of products on the natural environment
Main difference between IEC 60044-1/-6 and IEC 61869-1 and CDV IEC 61869-2

- IEC 61869-2 will be product standard for current transformers
- For general requirements reference is made to IEC 61869-1
- Transient performance protective current transformers included in IEC 61869-2
Standardization Current Transformers

– New additional test items:

• Type tests
  – Electromagnetic compatibility (EMC)
  – Degree of protection by enclosure (IP)
  – Enclosure tightness at ambient temperature
  – Pressure test for the enclosure
Standardization Current Transformers

• Routine tests
  – Enclosure tightness at ambient temperature
  – Pressure test for the enclosure

• Special tests
  – Internal arc fault test
  – Enclosure tightness at low and high temperatures
  – Gas Dew point test
  – Corrosion test
  – Fire hazard test
Standardization Current Transformers

– Sample tests
  • Lightning impulse test recommended
  • Test program agreed between purchaser and manufacturer
Standardization Protection Relays

- IEC TC95

  - In the process of development of functional test standards for many functions, e.g.
    - IEC 60255-121 Distance protection
    - IEC 60255-151 Over/under current protection
    - IEC 60255-167 Directional current protection
    - IEC 60255-178 Power swing protection
    - IEC 60255-179 Reclosing
    - IEC 60255-187 Differential protection
Standardization Protection Relays

- CDV IEC 60255-121 ?? PWI ??
  - CT requirements shall be given by manufacturer ($E_{alreq}$)
  - Cases considered close-in reverse fault, close-in forward fault, zone 1 underreach and zone 1 overreach
  - Procedure on how to dimension CT is given
Liaisons within standardization

- Liaisons between
  - TC 8X - System aspects of electrical energy supply
  - TC13 Equipment for electrical energy measurement and load control
  - TC38 Instrument transformers
  - TC85 Measuring equipment for electrical and electromagnetic quantities
  - TC95 Measuring relays and protection equipment
  - TC57 Power systems management and associated information exchange
End sheet

Thank you for your attention.

Questions?