



IEC/TC OR SC: <b>TC 85</b>	SECRETARIAT: <b>China</b>	DATE: <b>2019-02-15</b>
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### A. TITLE AND SCOPE OF TC

#### A.1 Title

The title of TC85 is **Measuring Equipment for Electrical and Electromagnetic Quantities**

#### A.2 Scope

To prepare international standards for equipment, systems, and methods used in the fields of measurement, test, recurrent test, monitoring, evaluation, generation and analysis of steady state and dynamic (including temporary and transients) electrical and electromagnetic quantities, as well as their calibrators. Such equipment includes:

- devices for testing the effectiveness of protective measures and safety of power distribution systems and connected equipment;
- Insulation monitoring devices and insulation fault location systems for unearthed IT systems;
- devices for Condition Monitoring of transmission, transformation and distribution equipment or system for reliable energy supply;
- monitoring and measuring systems used for more efficient use of available energy sources (for Energy Efficiency purposes, network monitoring, grid power quality monitoring, demand side power quality monitoring, ...);
- electrical measuring transducers, signal generators, recorders together with their accessories.

NOTE: Product safety aspects are covered by TC 66, where applicable.

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#### A.3 Background

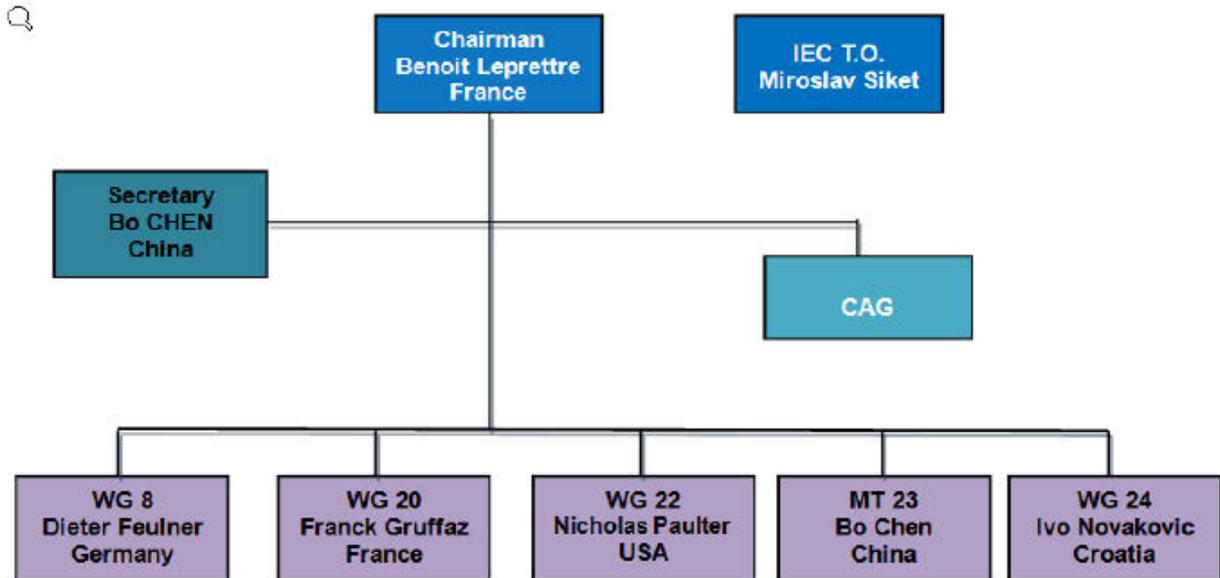
TC 85 was transferred from SC 13B (Electrical Measuring Instruments) and established in 1983. In 1992, the original TC 66 was absorbed by TC 85; while a new subcommittee, SC 66E, was established that later become TC 66 that had the responsibility for the measuring, control and laboratory equipment.

### B. MANAGEMENT STRUCTURE OF THE TC

TC85 works are carried out by three working groups, one maintenance team and three CAGs:

- WG 8: *Measuring and monitoring equipment for testing protective devices in energy distribution systems;*
- WG 20: *Equipment for measuring and monitoring of steady state and dynamic quantities in Power Distribution Systems;*

- WG 22: *Waveform Parameter Measurement*;
- MT 23: *Revision of IEC 60051 series: Direct acting indicating analogue electrical measuring instruments and their accessories (Parts 1-9)*;
- AG CAG : *Chairman's Advisory Group*;



### C. BUSINESS ENVIRONMENT

The business environment has gone through fundamental changes in recent years.

Most of the measuring instruments or their functions that are used for the measurement of electrical and electromagnetic parameters are more integrated into automatic measurement-control or continuous monitoring-control systems as parts/modules of the system than has been done previously.

The scope of TC 85 addresses not only single functional instruments but also multi-functional instruments or systems (for instance, the measuring system and the measuring-control system).

The business on which TC 85 focuses its attention has already **extended from** the generation, measurement and calibration of basic electromagnetic quantities (which were used mainly in the laboratory) **to** the measuring and monitoring of electrical, electromagnetic and condition quantities of transmission, transformation and distribution equipment or system, which are relevant for electrical safety, for protective measures and/or for electrical performance.

For IT systems, in addition to the product standard for monitoring the protective measures in low voltage distribution systems, a product standard for the rapid localization of insulation faults is also provided and maintained to ensure the protection targets in this special application. Newly emerging requirements due to technology trends such as electro-mobility and LVDC are taken into account here.

Communication interfaces for remote data acquisition and exchanging information have become increasingly important.

Worldwide markets:

- For measuring instruments covered by IEC 60051: The estimated worldwide market is higher than 80 M€. It is used by over 50 companies mainly in Asia/Pacific (China and Japan). Geographic segmentation of the instruments: 60% Asia/Pacific, 40% Europe and America.
- Equipment covered by IEC 61557 is used by over 40 companies mainly in the Asia/Pacific region, the Americas and in Europe.
- The worldwide market for products covered by IEC 61557-12 is at least 150 M€. Geographic segmentation of the products: 33% Asia/Pacific, 33% Europe, 33% America.

- The worldwide market for other IEC 61557 standards should be at least 200 M €.
- The estimated worldwide market for Power Quality Instruments (PQI) covered by IEC 62586 is at least 40 M€. It is used by over 20 companies mainly in Asia/Pacific, America and Europe. Geographic segmentation of the instruments: 20% Asia/Pacific, 30% Europe and 50% America. The market growth and the regional demand for PQI are coming from "power quality assessment" applications.
- The worldwide market for products covered by IEC 62974-1 is a part of the gateway market which should be at least 500 M€.
- Waveform recorders, covered by IEC 60469 and IEC 62754(in-progress), in 2012 had an estimated world market of 890 M€ with an expected growth up to 1.5 B€ by 2019. The America, Asia-Pacific, and European markets are nominally equal, with about 10 % of the market being attributed to other regions.
- IEC 62792 describes methods for measuring the output of electroshock weapons, the market of which exceeds 80 M€ annually, includes the American, European, and Asia-Pacific markets.

NOTE: It is not the intention of this report to judge these forecasts or to quantify the growth.

#### D. MARKET DEMAND

Definition and evaluation for the performance of the equipment supported by the TC85 should be standardized to facilitate their global sales, the choice of end-users in terms of performances, safety, interpretation of the indications, and the advancement of technology.

Standards developed and maintained by TC 85 are globally recognized and used:

- by industry for the basic maintenance of industrial equipment to ensure safe operation;
- in power transmission, transformation and distribution systems for testing and monitoring of safe/reliable operation or protective measures, and for predictive diagnoses;
- by electrical utilities to ensure supply of quality power and to reduce power pollution;
- by industrial, commercial and similar use for more efficient use of available energy sources and reducing greenhouse gas emissions;
- by laboratories, testing and calibration laboratories;
- for legal metrology purposes;
- for educational purposes;
- by governments to improve the "health and safety at work".

Through the agreement with CENELEC, the TC-85-developed standards are generally adopted as European Standards (EN).

Some of the TC85 standards are listed in compliance with the European Standardization Requests (Mandates), like the Low-Voltage Directive (LVD) and the Electromagnetic Compatibility Directive (EMC).

IEC 61557 series are used for IEC-EEB scheme. Some of the current publications, such as IEC 60051, IEC 60359, IEC 61187 and IEC 61557, are being cited by TC/SCs (e.g. mainly TC 13, TC 64, TC 65, etc.) in their publications as normative references.

All Monitoring Systems like Power Quality, Power Monitoring, Residual Current Monitoring and Insulation Monitoring operate very similarly to Quality Management Systems in companies. They are independent from Operation-, Control- and Management Systems and are supervising all activities and electrical assets/equipment in a corresponding grid. Therefore, such systems can be used as "early warning systems" and are a must to analyse faults and to identify the corresponding reasons.

IEC 62586 is widely used for devices that are used to ascertain Power Quality parameters in power supply systems and cited in many TC/SCs concerned. The devices may be installed:

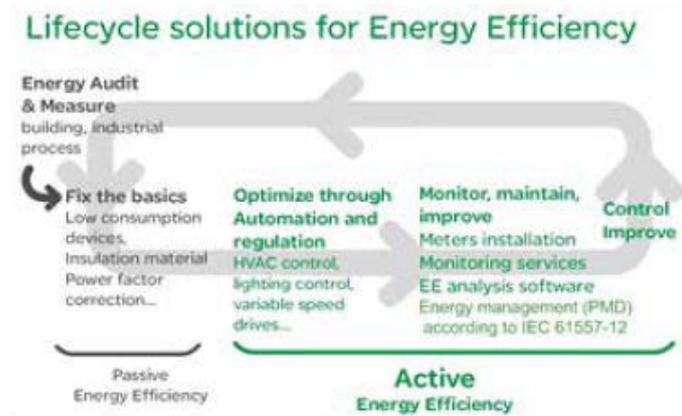
- inside a substation;
- at the interface point between the installation and the network, in order to check the compliance to the connection agreement with a network operator;

- at the point of common coupling to assess the level of Power Quality;
- inside the installation to make Power Quality surveys.

Following the up-to-date technology/demands, a revised version of IEC 60688 specifies further requirements relating to transducers whose main application is in electrical power engineering and telemetry systems.

Improving electrical energy efficiency (E3) means first to measure or monitor electrical quantities: you can't change what you don't know; you can't know what you don't measure.

Energy Efficiency projects are based on permanent and continuous measurement and monitoring.



TC 85 plans to remain active in this field.

#### Participation in TC 85 work:

Participation is mainly by members coming from manufacturers and institutes that test and calibrate instruments used for measuring, analysis, monitoring and testing.

TC 85 is lacking direct participation from representatives of the end users, the utility companies and the legal metrology bodies, although they have made contributions through the National Committees.

A larger representation from manufacturers and users being engaged in Condition Monitoring and Predictive Diagnoses for transmission, transformation and distribution networks would be desirable.

#### Application areas that are in need of stakeholder representation and contribution:

Another type of application that has recently emerged is the **control of networks** implementing a large number of Distributed Energy Sources (DER), e.g. micro grids. Most DER do not have the inertia of rotating generators. Sudden changes in the network, like the connection/disconnection of loads or generators, are likely to create large and rapid frequency variations that can create perturbations on the network.

IEC TC8 states that a solution for network stability is needed and provides guidelines and possible requirements. This network stability issue can be solved by proper measurement of the power system frequency and appropriate frequency-based control. The measurement of very short-term frequency values is a new topic because conventional measuring devices (PMD, PQI) usually measure the frequency over a time scale of 1 s to 10 s.

A trend that has been observed is the **distribution of measurement functions** in an increasing number of devices. Contactors, circuit breakers, switches, automatic transfer switches, controllers, like variable speed drives, power supplies, white products or energy-consuming appliances implement embedded measurement functions, and the measurement could be made available to the user.

Most of these embedded measurement functions do not claim compliance with any measurement standard for the following reasons:

- Lack of awareness of documentary standards on electrical measurement (energy or other quantities) and lack of the skill to test these functions
- Measurement standards like TC85's IEC 61557-12 contain product requirements (for safety, electro-

magnetic compatibility...) that are not applicable to the products implementing the measurement.

Ensuring a minimum level of quality of these measurements will facilitate the development of added-value analytics.

The trend to develop data analytics is confirmed by the emergence, a couple of years ago, of applications of **Non-Intrusive Load Monitoring** (NILM). These technologies derive value (e.g. disaggregated energy consumption, lifestyle analysis) from conventional measuring devices or dedicated sensing devices.

Finally, the increase of measurement applications and the focus being made on measurement applications will increase the number of measuring instruments of all sorts. This calls for:

- ways of assessing the durability of these instruments (reliability);
- ways of being able to characterize and compare measurements from different devices (e.g. via data models) to foster interoperability;
- ways of protecting the owner/user data (cyber security).

## E. TRENDS IN TECHNOLOGY AND IN THE MARKET

### E1. Trend in Technology

The advanced functionality of measuring, monitoring, and testing equipment and instrumentation becomes possible by using the latest achievements in electronic information and communication technologies. These new technologies may affect the way requirements and testing methods are specified. The most important trends are the following:

- extended use of electronic technologies, like digital signal processing, mixed signal circuits and firmware, which may have to be updated during the life of the equipment;
- changes in network conditions and EMC environments due to the growing use of non-linear loads, power lines and radio communications. These changes require advanced measurement instruments, methods, and analyses to measure power and power quality parameters including dynamic quantities. Furthermore, better protection is needed against undue external influences.
- an increased use of interoperable communication and IT technologies, including an increased interaction and integration of systems that were formerly discrete and separated, will be common to most of the Smart Measuring technologies.

The major drivers for the waveform recorder market are increasing analog bandwidth, modularity, improvements in the user interface, interoperability, and system intelligence.

The needs for on-line Condition Monitoring are bringing TC85 into Substation Automation System based on IEC61850.

The transducers covered by new IEC 60688 have been improved by new concepts and designs that use digital data acquisition and relevant software.

In low-voltage distribution IT systems, it is important to locate the first insulation fault as soon as possible.

Also, to monitor the required performance or fault diagnosis and prediction of power transmission, transformation and distribution systems, it becomes more important to measure different electrical or non-electrical parameters due to:

- installation standards evolutions, for instance, over-current detection is now a new requirement for the neutral conductor due to harmonic content;
- technological evolutions (electronic loads, electronic measuring methods, etc.);
- end-users' needs (cost saving, compliance with aspects of building regulations, etc.);
- safety and reliability of operation of power systems and connected appliances;
- in the field of energy metering, sustainable development requirements where energy measurement, for instance, is recognized as an essential element of energy management, part of the overall drive to reduce carbon emissions and to improve the commercial efficiency of manufacturing, commercial organizations and public services;

- more complex leakage current that are expected in distribution systems and in appliances and devices that will have influence on the protective measures.

The standards produced by TC 85 must be sufficiently flexible to adapt to improvements in manufacturing processes, architectures, materials, and innovations, in order to comply with the user requirements.

## **E.2 Trend in market**

In addition to trends in technology, there are factors relevant to market trends:

- Increasing demand on safety or reliability;
- Changes in the lifecycle of measuring equipment;
- Changes in the EMC environment;
- New communication technology;
- Advancement of electronic and manufacturing techniques. This may affect the way requirements are specified and tests are performed;
- The assurance of a quality supply of power or to reduce power pollution;
- The assurance that repaired electrical equipment operate properly afterwards safely and can be used by workers or users without impairment to their safety or health at all times;
- The Increase in the use of software inside measuring instruments;
- More functions in measuring equipment are beyond the current scope of TC 85.

## **Condition Monitoring**

TC85 should consider further expanding its attention to supporting the development of measuring systems for on-line Condition Monitoring and Predictive Diagnoses of smart transmission and transformation equipment,

Although the standards developed by TC85 are not the core standards for Smart Grid or Electric Vehicle charging system, some of the TC85 standards have been playing an important supporting role for Condition Monitoring and Predictive Diagnoses, for example, the on-line measuring and monitoring of electrical safety or of the protective measures in power distribution systems.

It is not the intent of TC 85 to directly develop standards on the condition monitoring of the aforementioned products and systems not in its scope. This is clearly left to the different relevant TCs. However, TC 85 can actively cooperate in developing such condition monitoring standards at the request of other TCs, by e.g. providing support on measurement techniques for certain electrical and electromagnetic quantities.

It is also worth noting that TC 85 is responsible for several standard documents in which the notion of measurement uncertainty is central. Yet, the definition and determination procedure for the measurement uncertainty parameter are not completely defined, be it in TC 85 documents, documents from other TCs, the IEC, ISO/IEC Guide 99 or the Guide to the expression of Uncertainty in Measurement (GUM). A certain level of ambiguity remains, leaving the door open for interpretation and thereby preventing totally fair comparison.

## **DC measurement**

Direct Current (DC) is also an emerging topic and ensuring DC applications are energy efficient calls for reliable, comparable and reproducible measurements. TC 85 has been approached by TC 64 (Low Voltage electrical installations) to provide expertise on the measurement of DC quantities.

## **Short-term measurement for network control**

The measurement of very short-term electrical parameters (e.g. frequency) is an emerging topic: conventional measuring devices usually make measurements over a time scale of 1 s to 10 s. Consequently, the requirements expressed by TC8, based on recent grid code updates, for measurements on shorter time scales (typically half an AC cycle to a few AC cycles) cannot be met by classical electrical measurement devices.

The power system frequency has been identified as the most relevant quantity to address, but it is likely that other short-term measurements will need to be produced synchronously, e.g. voltage, current, unbalance...

TC85 can certainly contribute to the work by providing expertise on measurement, be it on measurement

methods, product requirements, performance indicators or testing. Contacts have been made with TC8 in this direction.

### **Non-Intrusive Load Monitoring (NILM)**

Accurate, standards-compliant measurements for energy efficiency, internal power quality analysis and monitoring are covered by IEC 61557-12. In the last 10 years, technologies for “disaggregating” the energy consumption have emerged.

Those technologies are referred to as non-intrusive (appliance and) load monitoring and are essentially deployed in the residential and small tertiary domains (homes, office buildings, small infrastructures...).

Nonintrusive load monitoring (NILM), or nonintrusive appliance and load monitoring (NIALM), is a process for providing estimated energy usage, e.g. by type of use (heating, cooling, ...) or type of appliance (microwave, ...) based on load signatures at a single point in the installation.

NILM systems can be used to survey the specific uses of electrical power in homes, buildings or industrial areas.

- They use data collected typically at the point of delivery, provided either by a “smart” energy meter in place, or by proprietary hardware.
- The data is processed by analytics (generally at least partially in the cloud).
- The analytics provide disaggregated energy consumption indicators to the user, e.g. energy consumed by type of usage (heating, cooling, multimedia...) and/or by type of appliance (fridge, TV, swimming pool pump...). Lifestyle analysis information can also be derived.

Because of the diversity of the different NILM offerings, there is a need to have some level of standardization to enable the different stakeholders to compare the different offerings and to improve hardware requirements in line with NILM analytics. As an example, agreeing on a classification of devices providing data to NILM analytics would allow to better connect the demand and the offering.

### **Distributed measurements**

The implementation of measurement functions in non-conventional measuring devices (switchgear, white products...) raises the question of quality of the measurement. If many products offer measurements with very different performance (accuracy, range, robustness to influence quality...) there is a risk that aggregating these measurements or using them to provide higher-level analytic functions, for example, may become very problematic.

Reference to TC85 standards offers guarantees in terms of measurement quality. IEC 61557-12 is certainly a good candidate, since it is the only standard in the IEC world covering not only the measurement of energy quantities, but also virtually all other electrical quantities, all in a single standard.

TC85 should pave the way and make IEC 61557-12 easier to use by other committees.

### **Cyber security**

Cyber security is defined as the protection of systems, networks and data and is a critical issue for all businesses as soon as data is sent to a remote device. This will be taken into consideration by TC85 within the revision of its standards.

### **Interoperability / Data Models**

TC 85 experts should consider data model aspects and proper connection to the relevant existing standards for future developments.

### **Testing and expression of performance**

Finally, since the market trend is clearly directed towards producing more measurements and using them to make relevant decisions, it is important that the performance of measurement devices be expressed without ambiguity and in a consistent manner, whenever this is appropriate.

The test conditions, test procedures and test acceptance criteria should be carefully addressed in our standards. Special attention should be paid during new developments. During maintenance, test-related specifications should be checked and, when necessary, clarified.

## **E.3 Ecological environment**

Electronic measuring equipment may have shorter life cycles due to functional obsolescence. Some types of equipment may contain batteries and other hazardous materials. Therefore, use of hazardous materials and safe disposal will become an issue to be addressed.

Improvements are always made on parameters that are measured and monitored. By providing accurate measurement on the use of electric energy, measuring equipment contributes to improve energy efficiency and power quality (for reducing power pollution) and sparing use of natural resources. Consequently, measuring equipment will contribute to the reduction of pollution.

As some of measuring devices are continuously powered, low power consumption is also important.

The liaison with IEC/TC 111 in the elaboration of environmental requirements is considered important.

#### **F. SYSTEMS APPROACH ASPECTS (REFERENCE - AC/33/2013)**

TC 85 actively promotes a communication, reciprocity and cooperation with other committees concerned.

Therefore, liaisons are confirmed with:

- TC1: to co-ordinate the terms and definitions of TC85 standards for inclusion in the IEV database;
- TC13: to co-ordinate specifications for power quality functions of meters and metering functions for network analysers;
- SC23E: TC85/WG8 involves the residual current devices (RCD), and residual current monitoring devices (RCM). Hence, it is necessary to set up a liaisonship between our two TCs to make sure there is no conflict in the standards;
- TC38: to address the impact of new instrument transformers with low-voltage analogue and digital interfaces;
- TC44: to co-ordinate project IEC61557-14;
- TC61: Safety of household and similar electrical appliances
- SC62A: Common aspects of electrical equipment used in medical practice
- TC64: to co-ordinate the development of IEC61557 series;
- TC66: to address safety issues on standards for test and measurement equipment;
- SC77A: to address EMC testing methods on power quality Standards and ensure consistency and quality of measurement techniques;
- TC108: Safety of electronic equipment within the field of audio/video, information technology and communication technology
- TC111,: to address environmental issues in TC85 standards;
- SC121A: to exchange on measurement techniques used in switchgear and controlgear and make sure there is no conflict

Liaison with IEC TC8 is necessary to start addressing the topic of fast frequency measurement for network control.

#### **G. CONFORMITY ASSESSMENT**

All publications issued by IEC TC85 are made in accordance with the requirements related to the conformity assessment aspects as specified within clause 6.7 of part 2 of ISO/IEC directives.

Moreover, the publications aren't dependant or intended to be used for IEC Conformity Assessment Systems likely IECEE, IECEx, IECQ and IECRE.

TC85 standards specify requirements as well as test methods that allow repeatable and reproducible test results.

IEC 61557 series are used by IECEE-CB scheme.

**H. 3-5 YEAR PROJECTED STRATEGIC OBJECTIVES, ACTIONS, TARGET DATES**

STRATEGIC OBJECTIVES 3-5 YEARS	ACTIONS TO SUPPORT THE STRATEGIC OBJECTIVES	TARGET DATE(S) TO COMPLETE THE ACTIONS
Efforts should be made to determine the role that the TC85 should play on supporting <b>Condition Monitoring</b> of transmission, transformation or distribution equipment.	<ul style="list-style-type: none"> <li>- Establishing a new WG,</li> <li>- Limitation of the scope of the WG;</li> <li>- To list the standard projects to be developed;</li> <li>- And submit the NWIPs.</li> </ul>	Before 2019-06
To construct and perfect the standard series for monitoring and measuring systems used for Energy Efficiency purposes.	<ul style="list-style-type: none"> <li>- development of following parts of IEC 62974</li> </ul>	- Before 2020-12
To clarify the different definitions around measurement uncertainty and to better specify the uncertainty determination processes, in order to avoid misinterpreting accuracy requirements and allow fair comparison between products.	<ul style="list-style-type: none"> <li>- Exchange with other TCs (e.g. using the liaisons) to agree on a common terminology and procedure, identify discrepancies.</li> <li>- If necessary create a JWG on the subject of uncertainty determination.</li> <li>- Add reference terms in IEV</li> <li>- Publish usable information as annex to IEC 61557-12 or as a separate standard or TR.</li> </ul>	- Before 2020-12
To address the e-commerce topic (based on IEC/SC 3D works on Product data and properties for information exchange) for Power Metering and Monitoring Devices as well as for Power Quality Instruments.	<ul style="list-style-type: none"> <li>- to initiate a work on e-commerce for measuring devices (PMD and PQI)</li> </ul>	- Before 2020-12
To set up a procedure within TC85 whereby issues coming from the European Standardization Requests are considered in standard work	To address the requirement of an CENELEC Annex ZZ in the standards that are under parallel voting.	Ongoing
To maintain series of IEC 61557	To publish documents for the related parts -1 to -7, -8, -9 and -11, -14, -16)	2021
To provide the state of the art on the various electricity measurement applications, and on the related standards covering these applications	To work on a TR titled Power Measurement applications within electrical distribution networks	2019
To ensure the publications cater to the market need	To start maintenance on several publications, such as IEC 60477 Ed.1.0 and IEC 60477-2 Ed 1.0	2021
To construct and perfect standard series for Non-Intrusive Load Monitoring (NILM)	To publish a technical report or a technical specification on NILM sensors (devices providing data to be used by NILM analytics)	2021

To construct and perfect standard series for rapid measurement for network control	To provide a Technical Report or a Technical Specification in cooperation with IEC TC8 and/or SC77A.	2021
To think of a way to provide a measurement quality standard for non-conventional measuring devices (e.g. controllers, ...)	To be defined	
To think of a way to address the durability of measuring instruments	To be defined	
To think of a way to address the cybersecurity of measuring instruments	To be defined	
To think of a way to take data models into account	To be defined	
To think of a way to implement DC measurement requirements	To be defined	
To develop new part 61557-17 for non-contacting voltage indicators		2021
Note: The progress on the actions should be reported in the RSMB.		