SYNERDIS GROUP COMMON SPECIFICATION OF MV SWITCHGEAR AND CONTROLGEAR (RMU) FOR MV/LV SUBSTATIONS

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ABSTRACT

This article presents the SYNERDIS Group common specification of MV switchgear and controlgear (RMU) for MV/LV substations. The scope, main objectives and benefits expected from that new specification are initially presented. The article approaches then choices for actual and future functions regarding Smart Grids. Lastly, it presents harmonization of type tests and requirements for conformity assessment.

INTRODUCTION

A project named SYNERDIS was created to find synergies and possibilities of harmonization between the following Utilities :
ERDF (France), DEMASZ (Hungary), SSE (Slovakia), EnBW (Germany) and UK Power Networks (the UK).

The project was composed of several Task Forces, dedicated to different topics. One of these Task Forces was in charge of specifying MV switchgear and controlgear for MV/LV substations.

SCOPE, MAIN OBJECTIVES AND BENEFITS EXPECTED FROM THE "RMU" TASK FORCE

This specification concerns MV switchgear and controlgear from the compact type, insensitive to its environment (RMU), dedicated to be used :

- In public and private substations ;
- Without or with motorisation ;
- For renewal and new substations.

By all Utilities represented in the SYNERDIS Project.

Main objective is to write a common RMU specification, based on IEC standards, with :

- Harmonization of functional requirements, by respecting specific context of each Utility ;
- Integration of future functionalities (smart grids) ;
- Consideration of environmental criteria.

In the same way, the goal is to harmonize :

- Type tests and grouping of tests ;
- Requirements for the conformity assessment.

Benefits expected from this work are :

- Safety improvement ;
- Quality improvement ;
- Eco design.

HARMONIZATION OF FUNCTIONAL REQUIREMENTS FOR ACTUAL NEEDS

First of all, by participating to the Working Group in charge of revision of IEC 62271-200 "AC metal - enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV", it has been decided to write the common specification by using the same organisation than the new IEC standard document.
Then, based on feedback and best practices of all utilities, and by exchanges with manufacturers, harmonization was decided on the main following requirements :

- Insensitivity to environment (flooding for example) ;
- Protection of operators and the general public (internal fault tests) ;
- Possibility of busbar extension (to allow evolution of the network) ;
- No imposition of breaking and insulation technology (SF6, vacuum, …) ;
- Expected life time : 40 years (control modules : 15 years)
- Definition of common functions for public substations ;
- Access to MV conductors function integrated to RMU ;
- Data exchange ;
- Environmental criteria.

And harmonization for :

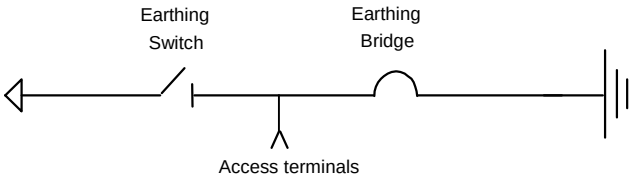
- Dimensions ;
- Rated characteristics.

Analyse of manufacturers offer

More and more manufacturers developed MV switchgear and controlgear from the compact type (RMU). Busbar extension possibility or insensitivity to environment are now standard functions of such equipment, because more and more users want to dispose of a reliable equipment for 30 or 40 years which allow evolution of the network.
For the same objectives, all Utilities have required those functions in this specification.

Access to MV conductors function

This function is needed to make tests on MV cables or phases identification. If the industrial standard solution proposed by European manufacturers is to use test rods screwed to the rear of MV connectors, some Utilities require a system integrated to RMU (now considered by IEC 62271-200).
In this specification, it has been decided to require such an integrated system in accordance with the diagram below :



The following table summarize the advantages of this technical solution regarding several aspects : safety, reliability, responsibility and availability.

Safety	No access to MV cable compartment needed ➔ Withstand to internal arc still available
	Connection of test devices on access terminals with earthing switch closed ➔ Work on MV active parts earthed
	In case of an eventual re-supplying (eRDF : use of a so-called "pavé de terre" device), withstand to a short circuit current (12.5 kA / 1 s).
Reliability	No work on MV plugs
	Torque specified by RMU manufacturer to reconnect earthing bridge
Responsibility	Each RMU is equipped with its own access
Availability	Many manufacturers

Environmental criteria

To limit impact on environment of their activities, all Utilities take care about the influence of MV Switchgear and controlgear on the environment by :

- Eco-design study requested ;
- Disposal of equipment at the end of its life (procedure to be used for the recovery of the SF6 gas).

FUTURE FUNCTIONS AND CONSTRUCTION DESIGN

Future functions

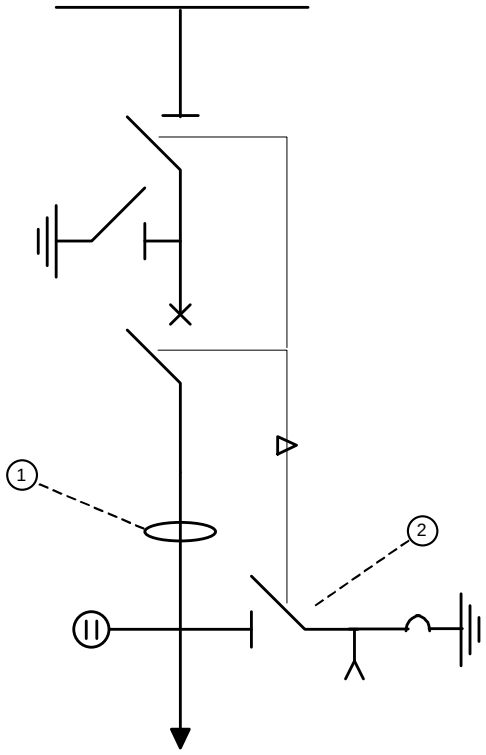
To contribute to Smart Grids development, functions needed are :

- Monitoring ;
- Fault detection ;
- Diagnostics for failure prevention ;
- Communication medias : … MV PLC ;
- Motorization of MV switches or circuit-breakers ;
- Automation functions for faster fault localization and faster supply restoration ;
- Extra indications : flooding, station door open, MV/LV Transformer temperature …

Depending on the case, three types of automation can be accomplished :

- Manual remote control ;
- Automatic remote control ;
- Automatic local control (self-healing).

For automation purpose, a " Circuit – Breaker Incoming Feeder " Functional Unit has been specified, complying with the following diagram :



Key :

1 Current transformer for protective device.

2 Earthing switch with integrated "Access to MV conductors" function.

Future construction design

Because of historical reasons and normal evolution of MV/LV substations, those substations are traditionally composed of :

- MV switchgear ;
- MV/LV transformer ;
- LV cabinet.

And for motorisation or automation purpose, some other equipments can be added as :

- Remote terminal unit (RTU) ;
- Current transformers ;
- Fault detectors ;
- Other "boxes" with complementary functions ;
- Etc.

Finally, it doesn't seem industrial and feedback shows that mistakes are currently made during installation and connection of these equipments, which can be furnished by different suppliers. It has direct consequences on network quality and reliability. And search of responsibility in case of malfunctions are generally difficult.
That's why we consider substations must be re-designed, considering MV switchgear and controlgear as the first step because of its strategic situation. Indeed, it is situated as the interface point between network and substation. Finally, for reliability and quality improvement, it has been decided to propose a new design of MV switchgear and controlgear.

All "intelligent" functions are requested to be integrated inside the RMU, with specified limits of integration because of :

- Different life time expected depending on the components ;
- Possible generic failures of components.

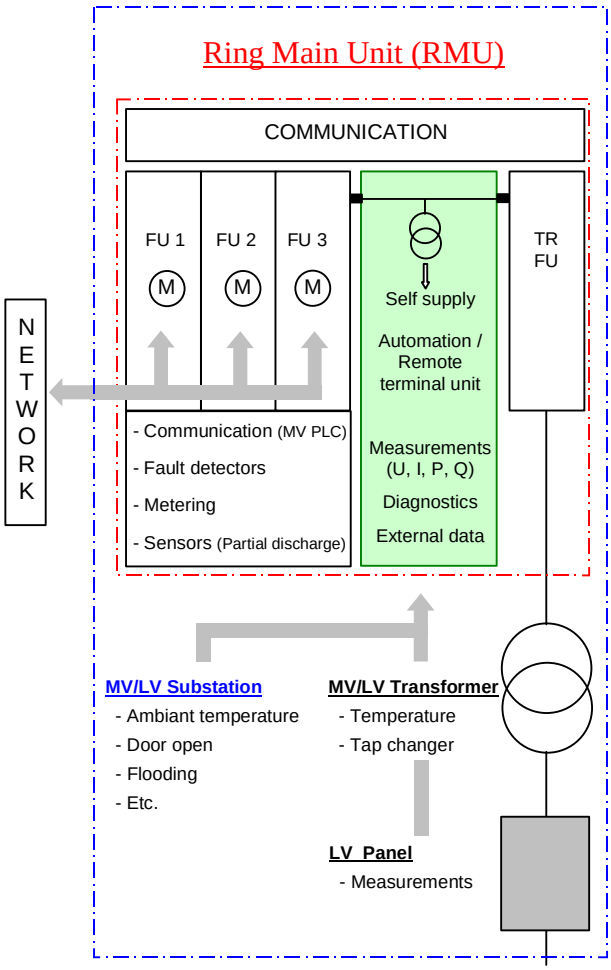
Profiting of the possibility of busbar extension, it has been specified a so-called **"Smart grids" Functional Unit (FU)** integrating all these functions :

- Remote terminal unit (RTU) and automatisms ;
- Internal (between FU) and external communication functions ;
- Diagnostics functions (of network and equipments from MV/LV substations) ;
- External data : Substation door open, flooding, MV/LV transformer and ambient temperatures …;
- Current, Voltage, Active power, Reactive power information ;
- MV/LV Auxiliary transformer for self-supply of LV components.

Using and exchanging with functions integrated in other Functional Units :

- Motorization of switches or circuit-breakers ;
- Fault detectors ;
- Current and voltage measurements ;
- MV PLC interfaces ;
- Diagnostics sensors (Partial discharge …).

The following diagram presents the new design :



HARMONIZATION OF TYPE TESTS AND REQUIREMENTS FOR THE CONFORMITY ASSESSMENT

Type tests

Majority type tests comply with IEC standards, with some additional points.
Regarding internal fault tests, ERDF and Demasz require :

- Prototypes without SF6 where the dielectric of the enclosure is replaced by air at atmospheric pressure (for realistic and environmental aspects) ;
- 2 possibilities of arc initiation : by non breaking or with a fuse wire (as IEC 62271-200), depending on design and construction, to be in realistic conditions.

For all Utilities, the specification require common grouping of type tests, like for example :

- Mechanical endurance tests ;
- Tightness test for sealed pressure systems ;
- Short-time withstand current and peak withstand current tests ;
- Verification of making and breaking capacities.

Requirements for the Conformity Assessment

The common process is based on :

- Identification documents ;
- Kick off review of the product ;
- Type testing (including all tests required by the reference specification) ;
- Credibility documents ;
- Temporary authorisation for use ;
- Experiment on the network ;
- Factory audit ;
- Final authorisation for use ;
- Samples.

Kick off review before testing

As soon as identification documents are available and prototypes have been manufactured, the supplier has to arrange a meeting with Utility representatives (technical expert in charge of products and EDF R&D representative if needed). The purpose of this initial review is to :

- Check the identification documents ;
- Make a visual inspection of prototypes, to verify they comply with specification requirements ;
- Get the agreement of the Utility with the means of testing ;
- Agree with the testing planning ;
- Agree with provisional date for the end of testing.

Type testing

In order to demonstrate that MV switchgear and controlgear comply with the requirements of the Technical Specification, type tests can be performed regarding three possibilities :

- Either having the tests performed under the control of EDF R&D ;
- Or having the tests performed in external accredited laboratories, under the control of a third party Certification Body ;
- Or to combine both possibilities.

following agreement between the manufacturer and the Utility.

Temporary authorisation for use

As soon as credibility documents are accepted by the Utility, a temporary authorisation for use is granted and MV switchgear operation on network may start.

Experiment in the field

The first items delivered will be under a special surveillance during several months. If problems are encountered, the Supplier pledge that he will remedy to that problem on the whole number of equipments delivered over these several months. This doesn't prevail on the guaranty clauses of the contract.

Final authorisation for use

At the end of the experiment period and as far as no problem has been encountered, a final authorisation for use is issued by the Network Division of the Utility.

The process can be summarized as follow :