Device substitution based on IEC61439 requirements
Introduction

The IEC 61439 series of standards have replaced the IEC 60439 series for defining requirements for LV switchgear and Controlgear Assemblies, and have introduced methods of verification other than by testing in certain, defined circumstances. One such area is the substitution of devices incorporated in functional units within the Assembly. This has led to some confusion and uncertainty within the industry. This paper seeks to clarify the subject of device substitution and verification of compliance of Assemblies with substituted devices.

IEC 61439-1 introduced the concept of design verification by comparison with a reference design as one of the options to confirm compliance to the standard based on original tests completed.

This document will describe the requirements of IEC 6149 alongside challenges to the industry to apply the requirements including intellectual property concerns.

Device substitution is a process applicable to the standards IEC 61439-2 Power Switchgear and Controlgear Assemblies (PSC) and IEC 61439-3 distribution boards. (DB) The requirements are defined in clause 10.10.3.5 and Annex O.5.

IEC61439-1 device substitution requirements

Clause 10.10.3.5 describes requirements for substitution.

It says that a device verified by testing in the Assembly may be substituted with a similar one provided that the temperature rises of the terminals and the power loss are no higher (when tested to the device’s product standard) than for the device tested in the Assembly. Also, the physical arrangement within the functional unit should be unchanged. A footnote to the clause reminds readers to consider other requirements such as for short-circuit capability, in addition to the thermal requirements above.

Annex O.5 Design rules, further clarifies requirements and expands on the concept of a series. It mentions strict design rules must be observed but states that substitute devices can be from the same or a different manufacturer. It restates the requirements of clause 10.10.3.5 for power loss, terminal temperatures and physical arrangement.

These requirements suggest that substitute devices can be of the same or different make and series from the ones verified by testing within the Assembly. However, the following restrictions apply:
1) When devices are tested in accordance with their own product standard, terminal temperature rise test results and power losses must not be higher than for those of the original device. This means that test results for both the original and the proposed substitute devices to their own product standards must be available as part of the device substitution verification. Device manufacturers may be reluctant to provide this data, particularly for the purpose of enabling alternative devices to theirs being substituted in an Assembly. The data used should be from an authoritative source such as an ILAC-member accredited laboratory.

2) The physical arrangement within the functional unit and the rating of the functional unit shall be maintained. This means that the proposed substitute device should be of similar physical shape and size, including consideration of enclosure, terminal positions and sizes, creepage and clearance distances, arc chutes, operating handle etc.

3) The NOTE under clause 10.10.3.5 is a reminder to consider other requirements, including the short-circuit verification requirements for verification by comparison with a reference design as given in Table 13. Table 13 includes 10 questions. If the answer to any question is ‘NO’ then further verification is required. Question 6 relates to short-circuit protective devices and requires these to be assessed equivalent, including of the same make and series and with at least equal short-circuit characteristics compared with the device tested in the Assembly.

The footnote ‘a’ to Table 13 clarifies further that devices of the same manufacturer but of a different series may be considered equivalent where the device manufacturer declares the performance characteristics to be the same or better.

This means that only devices from the same manufacturer can be considered (if verification of short-circuit performance is required) and then only if they have a similar arrangement and at least equal performance to the original device.

Where the original verification made use of the exemption to verification by testing as provided in clause 10.11.2, this could also be considered for verification of substitute devices.
Further guidance on device substitution

It is recognised that this is a challenging subject and the International Electrotechnical Commission (the body responsible for IEC standards) is drafting a Technical Report (17D/456/DC) to provide further guidance. This has not yet been published, but we understand that this is likely to include the following:

- Substitute devices shall be of the same type and comply with the same product standard
- Design verification of Assemblies with substituted device should be documented in a prescribed manner.
- Device substitution cannot be used to increase ratings of verified circuits.
- A minimum extent of adaptation of device connections is permitted.
- Type, size and entry position of conductors must be maintained.
- Degree of protection of the Assembly must be verified if the substitute device could influence compliance.
- Elaboration on requirements relating to temperature rise, including further options such as comparison testing of devices.
- Elaboration on requirements relating to short-circuit strength.
- Guidance for structuring the verification evidence for substitute devices.
Conclusions and issues

The following points should be considered before substituting a device in equipment previously verified to comply with IEC 61439-2 or IEC 61439-3:

- Power loss of the substitute device, when tested in accordance with its product standard, is the same or lower.

- Terminal temperature rises of the substitute device when tested in accordance with its product standard shall be the same or lower.

- Device substitution can be applied to devices of different series and different makes.

- The rating of the functional unit is maintained.

- Physical arrangement within the functional unit is maintained, including terminals, creepage and clearance distances and the position of arc chutes.

- All answers from Table 13 of IEC 61439-2 shall be positive unless verification of short-circuit performance is exempted under clause 10.11.2.

Applying the above requirements presents challenges to manufacturers. One particular challenge will be to obtain sufficient detail of testing of devices to their own standards, as device manufacturers may be reluctant to release this.

The introduction of device substitution into the standard for Assemblies may enable manufacturers to take advantage of this but in practice the requirements are very demanding. Also, it is likely that interested parties such as specifiers, consultants and utilities will develop their own requirements for verification evidence to ensure that non-tested arrangements are acceptable.

ASTA can assist and add the authority of a third party verification when presented with sufficient data describing the original and substitute devices.

ASTA will welcome applications to assist clients considering extending design verification from existing certificates to include alternative devices.

For more information on specific testing and certification information, please contact Intertek at +44 (0)1788 578435, email asta@intertek.com, or visit our website at www.intertek.com