Experiences of combined HV & EHV qualifications to IEC, AEIC and challenges IEEE 48 & 404

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The use of XLPE cable systems continues to increase in the Americas due to economies that achieved and excellent reliability for modern installations. As the use increases and becomes more widespread in the utility space the importance of qualification procedures and their applicable range of approvals becomes increases. Currently US utilities are very comfortable with the cable system approaches of the latest iterations of the AEIC & IEC standards. However the benefits of IEEE standards (48 & 404) are still used in some applications.

As described in the last Jicable Conference the combined AEIC / IEC test approach (intercalation of the most searching elements of two separate standards) is very common and well accepted by users. The combined AEIC / IEC approach has led to the speculation that it may be possible to make further combinations, for example IEEE48 with IEEE404 or IEEE48 & 404 with AEIC / IEC etc. The attraction is the allure of reduced time and cost, on a per component basis, when compared with the separate approach. Since Jicable 11 both the IEEE 48 and 404 standards have been significantly updated; such that even if a combination may previously have been attractive, the current embodiments make it much more difficult.

Thus this paper focuses on the issues associated with bringing one or more of the IEEE standards into the combination approach. Each IEEE standard includes quite different test orders, philosophies on Pre & Post tests as well as requirements for test temperatures. Although, on paper, it is feasible to add an IEEE test to the well established IEC / AEIC combination (described as a *"Super Combo Test")* the technical elements are very stretching for a laboratory / cable system. Consequently this presents a very interesting Risk / Benefit optimisation for those using this route. The optimization includes effects, which increase the risk such as: number of cycles, likelihood of missed cycles due to the complexity of the requirements, increased number of accessories, elevated voltages etc.

The paper will focus on three areas:

1. Review the current (2010 to 2014) test experience, similar to that previously reported by Pultrum et al in CIRED09, with the combined (AEIC / IEC) and separate (IEEE) tests {to the recently revised standards}. The authors find higher success rates in tests than noted in previous reports (Pultrum et al).
2. Consider the impact of the differing test factors in the standards (eg 2 hr vs 6 hr hold requirements AEIC vs IEEE), on test laboratories and cable system. There will be particular focus on the impact of the temperature transients on accessories imposed by the required currents.
3. Use of available test experience (Figure 1) to quantitatively estimate the increased risks associated with added combinations of tests and components (ie typical 2 joints in IEC vs 4 required by IEEE), thereby more clearly understanding the value optimisation.

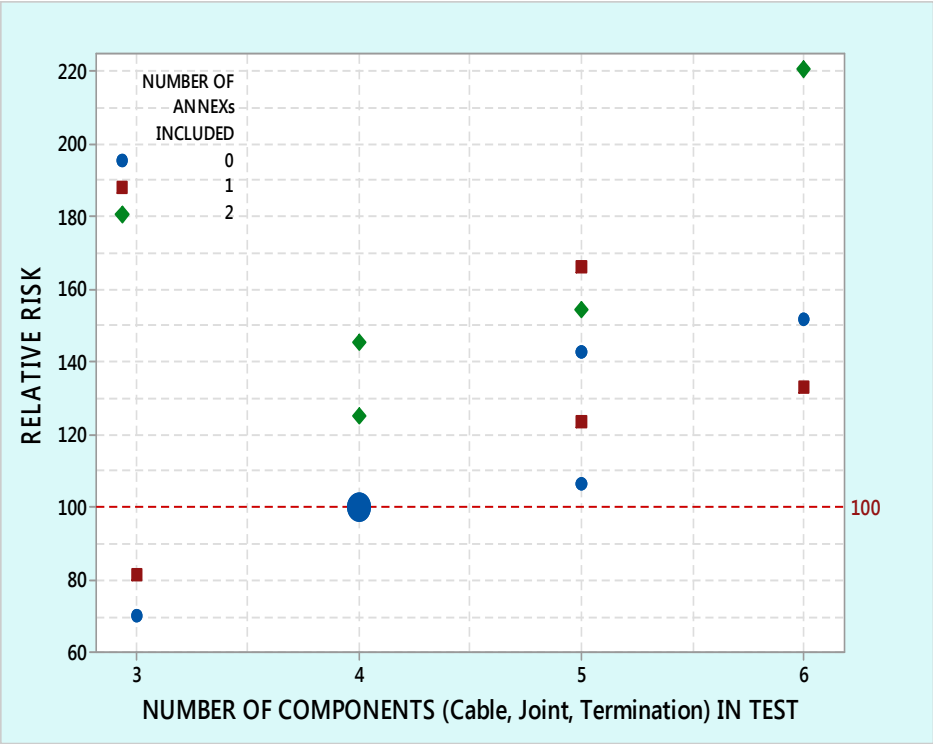

Figure 1: Anticipated Risk (current 2010 - 14) in combined AEIC / IEC tests (Cable, Joint, 2 Terminations as reference = 100) as complexity of tests increase with added components and tests (Annex's E & G in this case but could include IEEE)