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Differences of nuclear qualified automation equipment in comparison to industrial safety automation equipment

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Extended abstract. This paper provides a review of the differences between nuclear qualified automation equipment and generic industrial safety automation equipment in the viewpoint of an end user and customer. Nuclear automation equipment are traditionally qualified in accordance with nuclear industry quality standards and application specific product requirements, including requirements for location of use, in which environmental conditions may include ionizing radiation and accident conditions. In the conventional process industries, generic functional safety certified automation products are preferred for safety critical applications and application specific requirements do not typically constrain the use of previously certified products.

The nuclear industry faces a challenge in modernizing aging automation systems and equipment, as well as in inviting equipment suppliers to supply their safety automation solutions (or equipment) for nuclear applications. In cases when tolerance for harsh environmental conditions is not needed, safety automation equipment developed according to industrial quality and safety standards can be equally applicable for nuclear applications. Especially the nuclear qualification process for automation equipment in Finland has been a significant contractual risk for automation suppliers. The objective of this paper is to provide comprehensive overview of automation equipment qualification requirements for nuclear power plants and current trends in the nuclear industry aiming for re-use of previously developed industrial safety automation equipment.

Methods for comparison include domain expert interviews and experiences and literature reviews, categorized in key topical areas which can be

recognized based on requirements of international standards as well as regulatory and utility requirements in Finland. Simplified subjective categorization was used to be able to provide more comprehensive view.

Overview of nuclear industry equipment qualification cases and categorization of qualification areas is provided, both in organizational and technical aspects. Most important aspects such as risk based and performance based approaches, probabilistic and deterministic approaches, safety classification, functional design bases, layers of protection, technical architectures and diversification and environmental conditions are compared in generic terms. Comparison is made to requirements for safety automation equipment in the conventional industry. Specific requirements for software-based equipment qualification requirements are highlighted, including also the emerging cyber security aspect. Utility owner responsibilities and activities, organizational requirements for suppliers and conformity assessment, permitting and licensing related activities are included in comparison.

The result of the overview identifies the specific requirements for qualification of automation equipment in the Finnish nuclear industry, which are part of an equipment qualification process and potentially not adequately covered in generic functional safety approaches in the conventional industries. The qualification and licensing process for automation equipment in the nuclear industry is discussed and differences to the conventional industry practices are highlighted. Finally, the significant elements to be considered in an equipment nuclear qualification process for conventional industry equipment are proposed based on the study.

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