

ABSTRACT

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Industrial automation has been widely used in power substations. In this context, the IEC 61850 standard provides for the utilization of redundancy in the data link layer, in order to increase the frame reception probability. Two protocols described in IEC 62439-3 have this goal: PRP (Parallel Redundancy Protocol) and HSR (High-availability Seamless Redundancy). This dissertation aims to evaluate the availability of four power substation automation architectures without the utilization of data link layer redundancy protocols and with the utilization of PRP and HSR protocols. The reliability block diagram method was used for all architectures and afterwards the MTTF and availability calculations were performed. Sensitivity analysis for all components, in all architectures, complements the study. The calculations demonstrate that in 100% of the cases, the utilization of PRP and HSR increases the availability of the analyzed architectures. The calculations demonstrate yet that the utilization of redundancy protocols allied to the repair during the mission allows classifying all architectures in the higher availability class according to the CEI IEC 870-4. The sensitivity analysis of the components demonstrates that, independent of the protocol that was used, the availability with repair of the architectures is very sensitivity to the availability of the power supply, bay control units, Ethernet interfaces, and switches.

Keywords: Availability; Architecture; Automation; Protocol; PRP; HSR.