

Then Versus Now: A Comparison of Total Scheme Complexity

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Abstract

Today's protection engineer is not at a loss for things to do. New and retrofit projects along with added system requirements have increased the workload for designing, setting, installing, and maintaining protection systems. It is not uncommon for engineers to look back at the "good old days" with nostalgia.

This paper performs a component-by-component and line-by-line comparison of protection schemes from the electromechanical, solid state, microprocessor, and integrated microprocessor eras. For a complete line protection system, the comparison includes the protection relays, auxiliary logic, SCADA interface, setting, wiring, and testing (both periodic and scheme).

Recognizing that engineers want only the best, yet practically attainable, protection system, this paper includes measurement and calculation of reliability, cost, maintenance, and performance, as well as the manpower effort, to bring a scheme online. Fault-tree analysis techniques are used to bring numerical values to scheme comparisons.

Finally, observations regarding functional requirements of "old" and "modern" systems allow engineers and management to evaluate technological effectiveness of overall control systems. Manpower (effort) allocations for different aspects of these protection, control, and automation schemes are presented as a tool to determine the efficiency of the path our industry has walked from the early 1980s to the present.

Discussion Points

1. This is a new comparison of what schemes really looked like (and still do for old schemes still in service) in 1980 and now. It addresses the question, Have we really improved?
2. Hard science and numerically measured component counts, mean time between failure (MTBF), and maintenance indicator values are used to show progress or the lack of it.
3. The paper reminds us of the roots of our profession and the value of innovations, while helping us keep an eye on our main objective of providing reliable and secure protection and control systems.