Contribution ID: **6** Type: **Abstract TEC2ZERO**

Curative Congestion Management Service Models for Examination of their Signal Transmission Reliability

The move towards carbon-neutral electrical energy generation poses new tasks for the electrical transmission grid (>200 kV). Investment into curative congestion management is one viable alternative as per the InnoSys 2030 project [1], in order to not only bridge the gap towards large-scale expansion of the transmission grid, but also to reduce costly preventive redispatch measures. These innovative, curative congestion management measures require signals to be passed between sensors, actors and control centers within the grid reliably, using a communication network operated by transmission system operators [2, 3]. Interpreted as a service to be delivered by the communication network, it is possible to define communication models. These models –if applied to a set of sensors detecting a congestion, a set of actors solving the congestion, and a grid control center supervising the curative measure –predict how the communication is facilitated in detail when conforming to the specific model's boundary conditions and parameter set. This communication sequence is then used to algorithmically create reliability block diagrams, which in turn deliver reliability figures for the observed service through analysis, e.g., via minimal cut sets [3].
This contribution expands upon the already abstractly defined sequence model for curative congestion management, of which the Single-Pass Model (only one possible measure per contingency) for Special Protection Schemes has already been specifically defined, including how a reliability block diagram is derived from it [4]. Here, the remaining centralized variant of the Single-Pass Model is defined similarly, and then both are used to define the centralized and Special Protection Scheme Multi-Pass Models (multiple sequential backup measures per contingency). All models are compared through a fictional communication network, inspired by a real counterpart operated by a real transmission system operator. Advantages and disadvantages when implementing the curative congestion management service according to each model are highlighted.

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Track Classification: Future Technologies: Energy Efficiency