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According to the document “Solid State Power Substation Technology Roadmap” from U.S. DOE Office of Electricity. There are many types of Solid-State Transformers with different ratings and architectures. One of the commonly used structures is shown in Figure 1, which includes three stages. The first stage is from the fundamental frequency HVAC to HVDC. The second stage is DC-to-DC stage, which transforms HVDC to HFAC, and goes through a high frequency transformer, then transforms medium HFAC to LVDC, DAB (Dual-Active Bridge) is commonly used in this stage, for soft-switching commutations, low cost, and high efficiency. The third stage is from LVDC to fundamental frequency LVAC. One benefit of this design, compared to a conventional line frequency transformer, is the ability to use a high frequency link that enables significant size and weight reductions at the same power rating. In addition to the increased power desity, these power electronic systems can provide a range of capabilities depending on their design and configuration. However, it is important to note that the HF transformer is not mandatory in an SST design, and other device architectures are possible, just like shown in the paper #10264.

There are many advanced functions and features of these systems include allowing bidirectional power flow, providing active and reactive power control, and providing voltage, phase, and frequency control including harmonics.

According to the roadmap, SST systems can include filters or snubber circuits to minimize the impact of abnormal conditions. Some other systems use a hybrid design with an analog transformer alongside the solid-state devices to respond to overload situations.For power semiconductor modules, numerous efforts are underway to improve packaging and thermoal management through the use of high-temperature materials. By increasing the temperature rating of a power module also increase its reliability because it provides a higher margin for overload and fault conditions.

Figure 2 is a list of proposed SSTs and their capabilities regards to harmonic emissions and overload as 2020.