A new representation of conventional hydropower in unit commitment economic dispatch models to support resource adequacy and reliability studies

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The Western U.S. relies heavily on hundreds of water-dependent power plants, with hydropower and fresh surface water dependent thermo-electric plants accounting for over 60% of generating capacity. The Western Interconnect overlays 11 States, over three different electricity market areas, and 9 large river basins with tens of unconnected watersheds as well as tens of coordinated watersheds. Such complexity requires computational tradeoffs for the representation of the water-energy dependencies, including a centrally controlled unit commitment and economic dispatch as well as an offline representation of hydropower’s availability and operations. Benchmark hydropower representations for application to resource adequacy studies include i) fixed daily time series and ii) a parameterized monthly representation involving three constraints: a monthly energy target, and hourly minimum and maximum generation. The representations are derived for one year and under average water conditions. We propose a large-scale approach to represent medium-term (weekly) hydropower flexibility for grid-scale reliability studies, as driven by weekly water availability. Using a combination of hydrological models, reservoir operation schemes, and statistical tools, we develop datasets of hydropower plant-specific weekly energy targets, with weekly minimum and maximum hourly generation, for multiple years with varying water conditions. The assumption – and computational tradeoff - is that water availability guides the weekly operations and range of daily operations, leaving enough flexibility for the power system optimization to accommodate intra-day, week days and weekends load variations. We present the hydropower datasets and evaluate how this new representation influences the simulated contribution of hydropower to grid operations as part of resource adequacy and reliability studies.