GE OpFlex Sliding Fuel Pressure

The existing control logic for the Trimble County Combustion Turbines includes a default constant minimum fuel pressure requirement upstream of the unit gas control valves. This constant is set to ensure adequate supply pressure over the entire range of operation from initial light off to full load. This default value is necessary during startup or shutdown to pass through the ~12% load point, but is a higher pressure than what is necessary in the normal operating range. If the pressure drops below the default value the unit will go into an automatic shutdown.

The sliding fuel pressure software replaces this default minimum pressure with logic that continuously calculates the actual required pressure at the current operating point. If the supply pressure drops below the required pressure it will utilize a load limiter function in place of an automatic shutdown. This load limiter will reduce load / output until the required pressure and current pressure match.

GE conducted an engineering study to generate an estimated required pressure curve over the entire load range for the combustion turbines. This curve was then utilized to evaluate how the units would have performed during Winter Storm Elliott with this software enhancement versus the current capability. This evaluation factors in the supply pressure drop that occurs from the Texas Gas point of connection at the Bedford City Gate to the inlet to the unit.

As shown in Chart 1, during the period of Winter Storm Elliot the sliding fuel pressure software would have allowed for a variable amount of increased capacity across the five operating units. At the point of the lowest fuel supply pressure this would have amounted to 300 MWs of capacity. Just as important, with the load limiter functionality had the units been in base load command they would have automatically followed the max capacity curve (grey curve) without risk of initiating an automatic shutdown. In comparison, the existing software would have required manual adjustment of the unit load to follow the existing capability curve (orange curve) with the risk of initiating an automatic shutdown if the pressure were allowed to drop below the default minimum fuel pressure.

Going a step further, Chart 2 illustrates the capacity capability for all six units with the existing software versus the sliding fuel pressure software across a range of supply pressures at the Texas Gas Bedford City Gate point of connection. The minimum supply pressure at the Bedford City Gate experienced during Winter Storm Elliott was 425 psig, which reduced the existing capability to ~50% capacity. However, a further pressure reduction of 20 psig would have resulted in completely losing the five units that were operating. In comparison, with the sliding fuel pressure enhancement the units could stay online operating (at a reduced load) down to 305 psig. If pressure were to drop lower than 305 psig the units would trip as they would not have enough pressure to make it through the operating mode change experienced during shutdown.

These charts were generated assuming -20 °F ambient temperature and 120 °F fuel gas inlet temperature, which yield the highest required fuel supply pressures. Operating conditions with higher ambient temperatures and / or lower fuel gas inlet temperatures would yield lower pressure requirements over the load range. Important to note that the software enhancement does not change the required pressure to make it through a startup. This means that the units must be online in the normal operating load range prior to the fuel supply pressure dropping below that critical minimum pressure for startup.

Business Use

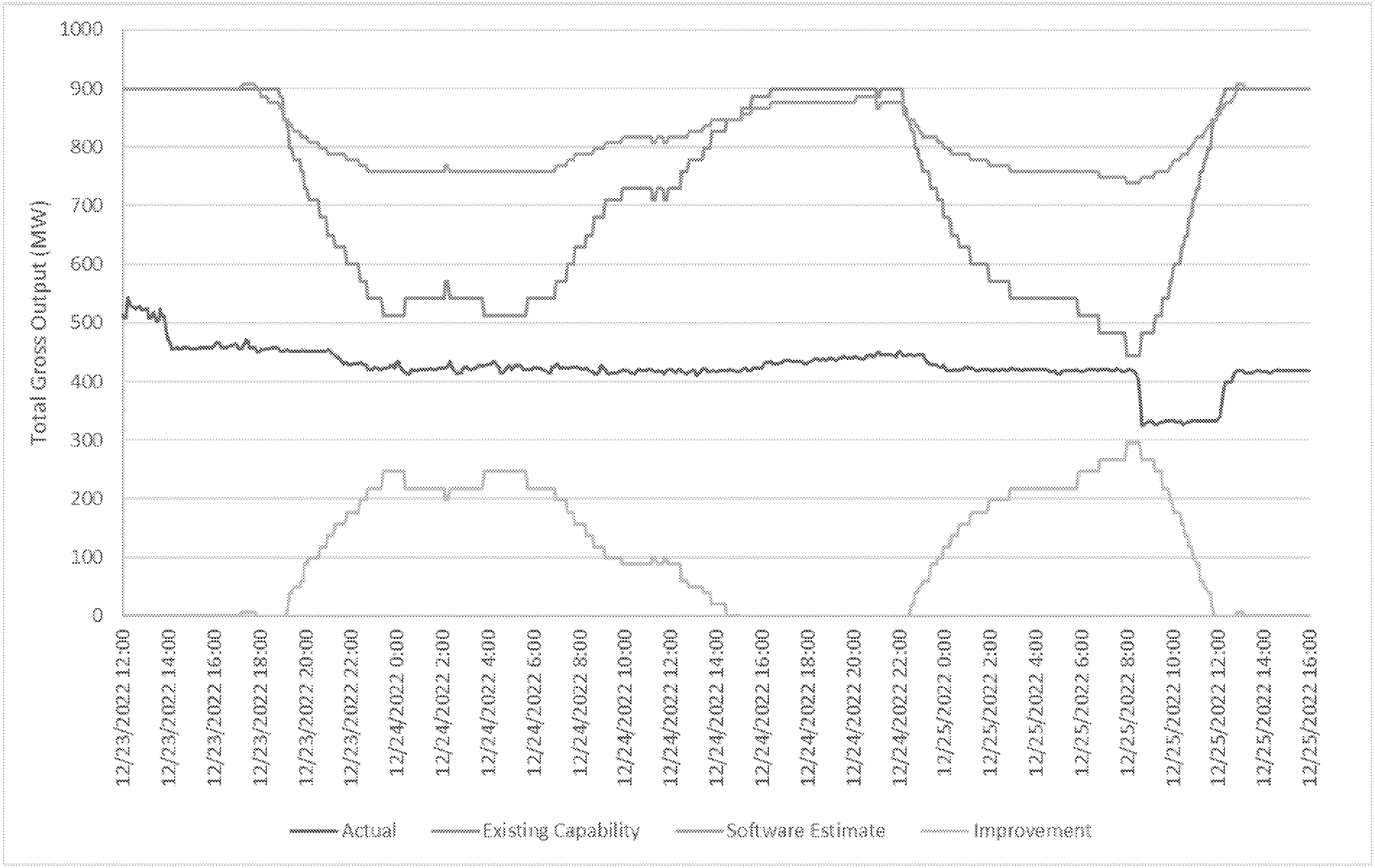

Chart 1. Existing Capability versus Software Capability During Winter Storm Elliott

Note: Chart total gross output lines based on five (5) combustion turbines operating. TC5 was offline during this time period due to the low fuel supply pressure from Texas Gas. Software estimate based on -20 °F ambient temperatures with 120 °F fuel gas temperature entering the unit.

Business Use

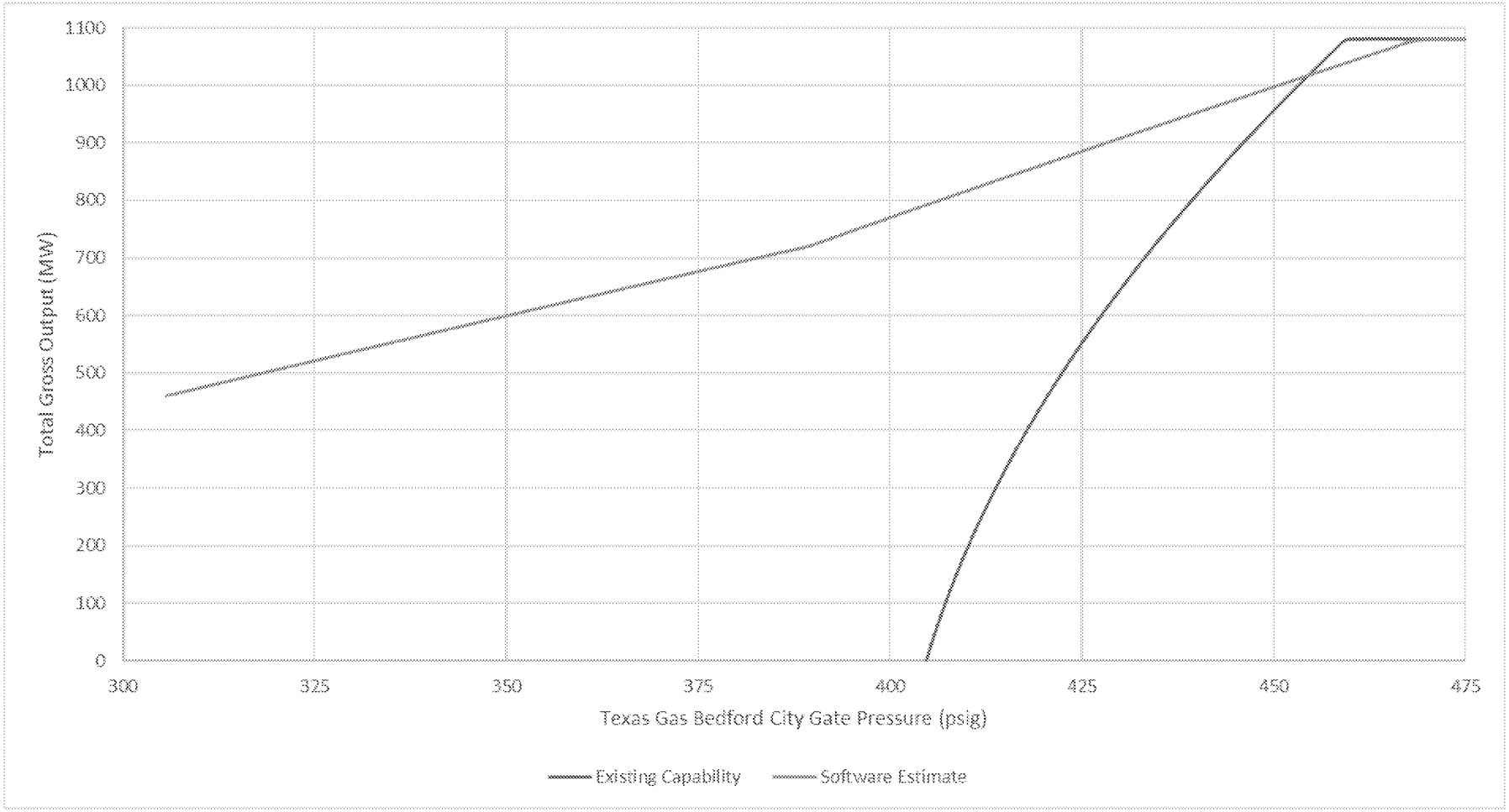

Chart 2. Existing Capability versus Software Capability Across Texas Gas Supply Pressure Range

Note: Chart total gross output lines based on all six (6) combustion turbines operating. Software estimate based on -20 °F ambient temperatures with 120 °F fuel gas temperature entering the unit.