Case Study – Verde Creek

Solutions Provided – Post Occupancy Commissioning

The Verde Creek Ranch project is located in a remote area of the Texas Hill Country, near Medina, TX. As such, electricity provided from the grid can be unreliable. This was made very clear when the winter storm of February 2021 encased most of Texas in several inches of ice and snow, crippling the state's power grid. Verde Creek was designed to have power back up systems but this failure exposed several weak points as the system did not perform as expected. In the spring of 2021, Engineered Projects Consulting was asked to perform a post occupancy evaluation to address this as well as several other issues including HVAC performance, humidity issues, and higher than expected electricity bills. The issues and their solutions are detailed below.

Solar Power and Back-Up System

During the power outage that was caused by the winter storm, power from the Tesla battery back up system was exhausted very quickly and the home was left completely without power. It was expected that the solar panels would recharge the battery and provide power to the home when the sun was shining, but none of this system performed as expected. Additionally, it was discovered that critical systems such as the water well were not on circuits that were connected to the battery back up. EPC worked with the supplier of the solar and battery back up system to determine if the panels and battery were working as intended and to make changes, if necessary.

It was discovered that the Tesla battery system had been set to a "storm" mode that only allowed the battery to discharge down to an 80% level. This meant that when the power did go out, only 20% of the 27 kWh available was sent to the house as back up power, which didn't last very long. EPC recommended changing that setting so the battery could send all of the power it had stored to the house in the case of a power outage, and then recharge from the solar panels. EPC also provided analysis of electrical use data to advise the client on how much power they had available so they could carefully manage usage when relying on the battery back up.

The solar power production system was found to be operating as designed. However, the system was undersized for actual client use. The model that had been used to size the system only predicted occasional occupancy. In reality, the home was being operated as if it was occupied 100% of the time regardless of if anyone was there or not. EPC recommended adjusting setpoints for HVAC systems and turning off domestic hot water circulation pumps when the home was unoccupied to achieve an electrical use pattern closer to what the original model had predicted.

For the critical systems that were not backed up, it was ultimately decided that a whole home generator was the best solution. The existing electrical system architecture made it difficult to tie the battery back up to the panel that powers the well. The combination of a generator, solar panels, and the battery back up system would provide a very robust solution to extended power outages.

HVAC Performance Issues

EPC reviewed the HVAC system design and installation to determine the cause of the issues experienced. Primarily, fan noise and the inability for the client to make adjustments were the major complaints. Humidity levels had also been a concern since construction had been completed due to issues with the wood floors. EPC worked with the design engineering firm and the installation contractor to make adjustments that reduced fan noise and also to give the client more adjustment capabilities.

Humidity in the various spaces had been monitored and tracked by the ranch manager since the issue with the floors was discovered. There did not seem to be any low humidity problems based on the data provided. However, we did find one space that had periodic issues with high humidity. Duct leakage seemed to be the main cause as well as a bathroom exhaust fan that was often left on. EPC recommended repairing the duct work and adding a timer for the exhaust fan.

High Electric Bills

With the solar system and high efficiency design, it was expected that this home would achieve a “Net Zero” energy goal. The original energy model predicted that with limited occupancy, the home should produce more power than it consumed over the course of a typical year. However, increased occupancy, extreme weather, and other factors led to the client receiving larger than expected electric bills.

EPC worked with the supplier of the solar panels and Tesla battery system to provide post occupancy energy (POE) analysis. This was done using a circuit level monitoring system which let us see exactly where power was being used and where this differed from model predictions. It was quickly determined that energy use associated with the HVAC systems and water heating were the main culprits.

The HVAC system was being operated as if the home was occupied 100% of the time. This was partially due to the inability to remotely adjust and monitor space temperatures as well as concern for space humidity and damage to furnishings and art. EPC recommended installing hardware that would allow remote adjustment and monitoring which would facilitate increasing space temperature setpoints during the summer.

The excessive energy use associated with the water heaters was found to be caused by circulation pumps that were running constantly. This was causing the water to cool as it circulated through the system which caused the water heaters to run to heat the water back up. Originally, the circulation pumps were intended to operate intermittently based on user demand, but this system was eliminated and the pumps were set to run constantly. Turning the pumps off resulted in a 90% reduction in daily water heater energy use.

Energy consumption was reduced by over 25% by making adjustments to the HVAC operation strategy and turning the hot water circulation pumps off when the home was unoccupied. However, it was ultimately determined that more solar power production may be needed to offset the actual energy use vs what the model predicted due to differences in how the home is actually used by the client.