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| Asset | KPI No. | KPIs | Short Description | Equation (may use Basic Power Calculations) |
| Diesel Generator | 1 | Fuel Consumption | Amount of fuel that is consumed by the diesel generator. To be measured at the generator every 2 seconds. | Signal from Typhoon (DG\_Fuel\_Consumption). Sample as fast as possible.  Unit: Gallon per hour.  Data analytics to do averaging and down sampling. |
| 2 | Generator Efficiency | Ratio of the electrical output power to the fuel input power calculated at every data point.  mg [gal/hr] – fuel mass flow rate (measured on the engine dynamometer)  Diesel Energy content per gallon (139000 BTU)  1 Btu (British thermal unit) = 1055.06 J = 2.931\*10^-4 kWh = 0.293 watt- hours=Ediesel | =0.293\*139\* DG\_Fuel\_Consumption  Unit: Pin\_Fuel is: Gal/h\*139BTU/gal\*0.293Wh/BTU=kW  Unit is kW.  Vagen, Vbgen, Vcgen instantaneous phase voltage. Iagen, Ibgen,I cgen instantaneous phase currents.  Baseline: Efficiency is 25-40%. |

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| Asset | KPI No. | KPIs | Short Description | Equation (may use Basic Power Calculations) |
| Transformer | 1 | Efficiency | Ratio between the input power and the output power. Calculated at each data point. 25%, 50%, 75%, 100%. | Vap, vbp, vpc instantaneous phase voltage. Iap,Ibp,Icp instantaneous phase current of the primary side  Vas, Vbs, Vcs instantaneous phase voltage. Ias, Ibs, Ics instantaneous phase current of the secondary side |

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| Asset | KPI No. | KPIs | Short Description | Equation (may use Basic Power Calculations) |
| Battery | 1 | State-of-Charge (SOC) | The percentage of initial capacity available at a given instant in time. | Batt\_SOC is a signal from Typhoon. |
| 2 | Round Trip Energy Efficiency | Ratio of the total energy during discharging and charging Crating at 0.5 C once a month starts at SOC of 100% at its maximum voltage and discharge to 20% identified by the cut-out voltage. Then the battery is charged back at 0.5c to 100%. | V\_Batt\_Charge: Voltage  I\_Batt\_Charge: Current  T\_Charge : Time  V\_Batt\_Discharge: Voltage  I\_Batt\_Discharge: Current  T\_Discharge : Time  Do this as a test.  Charge battery from SOC =20% to 90%. Log V\_Batt\_Charge: Voltage  I\_Batt\_Charge: Current T\_Charge : Time  Discharge Battery from SOC = 90% to 20%  Log V\_Batt\_Discharge: Voltage  I\_Batt\_Discharge: Current  T\_Discharge : Time |
|  | 3 | Coulomb Efficiency | The ratio of the Ah that can be extracted from the battery during discharging, compared to Ah that enter the battery during charging. This calculation is conducted at the same time with KPI 2. | Do this as a test. |
|  | 4 | Capacity or Nominal Capacity | The columbic capacity, the total Amp-hours available when the battery is discharged at a certain discharge current (specified as a C-rate) from 100 percent state-of-charge to the cut-off voltage. Performed once a month, by charging the battery to 100% identified by the maximum voltage provided by the manufacture then discharge down to 10% (based on cut-out voltage provided by the manufacture) at 0.5C. Unit is Ampere-Hour (Ah). | Do this as a test. |
|  | 5 | State of health | The state of health is a measure of aging. It can be defined for capacity fade and power fade. Typically a battery is considered to be at its end of life when the state of health has decreased to 80%. Performed once a month | Batt\_ |

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| Asset | KPI No. | KPIs | Short Description | Python Code | Validated (Real/Sim) | Status | Equation (may use Basic Power Calculations) |
| Fuel Cell | 1 | Energy Efficiency | Since fuel cells use materials that are typically burnt to release their energy, the fuel cell efficiency is described as the ratio of the electrical energy produced to the power content |  |  |  | (HHV)  FC\_mf signal from typhoon  DC current and voltage of the fuel cell system of the fuel burned.  mf is flow rate (Kg/hr).  Hydrogen is a chemical energy carrier with a specific (chemical) energy density, which is defined by higher heating value (HHV). The mass specific chemical energy:  Base line 30% – 50% |

In the CVS file

ESS.Battery inverter.I\_Bat\_Charge = I\_Bat\_Charge

ESS.Battery inverter.V\_Bat\_Charge = V\_Bat\_Charge

ESS.Battery inverter. = this is just the path