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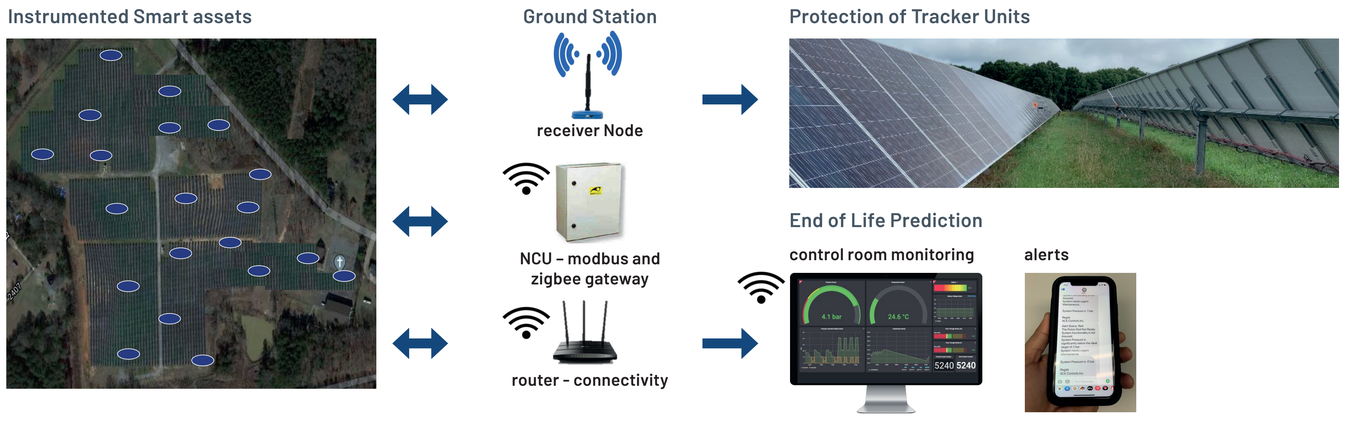
SMART ENERGY MANAGEMENT SYSTEM FOR USE WITH PV SOLAR TRACKER SYSTEMS

"a smart system to protect solar trackers"

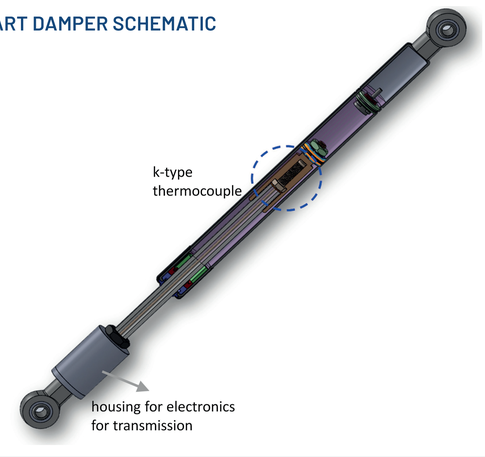
PROBLEM STATEMENT

- The effect of wind energy hitting the solar arrays can different across rows as it approaches from different directions.
- Vortex Shedding created by wind energy can cause up to "5x" times more damage compared to the prevailing straight-line wind
- Current dampers designs have no indication of effective damping rate during normal operation and may fail when effective damping is required (i.e., during high wind event). Labor intensive visual inspections required that may not provide correct feedback of acceptable operating condition.
- Weather stations provide macro level information about field wind conditions, depending on number of stations dispersed throughout a field and the data is indirect. Indirect data can lead to unnecessary stowing or no stowing when it was necessary.

SMART ENERGY MANAGEMENT – NODE MAP

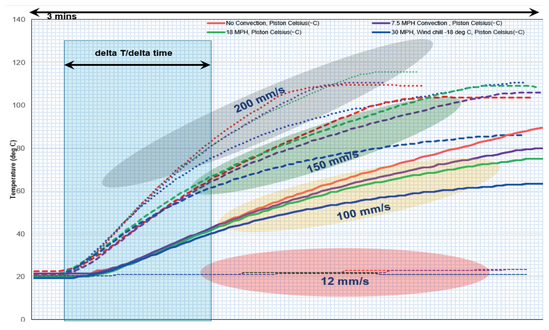


SMART DAMPER SCHEMATIC



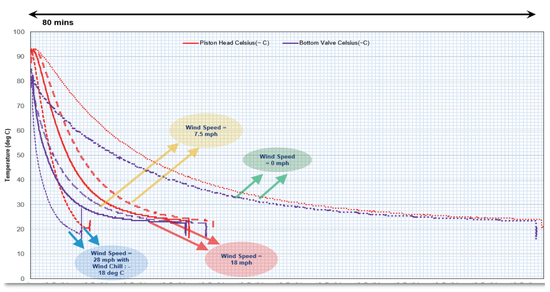
EVALUATION OF DIFFERENT SENSING TECHNOLOGY FOR SMART DAMPER

Technology	Cost	Reliability	Accuracy	Cycle Counter	Oil Leakage	Oil Characterstics	Wear-Tear of Seals	Design Complexity	Wind Gusts
Thermocouple	low	Good	Good	Algtm	Algtm	Good	Good	Med	Algtm
Thermocouple + Humidity	low	Best	Good	Algtm	Algtm	Good	Good	Med	Good
Thermocouple + Humidity+Weather API	low	Best	Good	Algtm	Algtm	Good	Good	Med	Best
Thermocouple+Weather API	low	Good	Good	Algtm	Algtm	Good	Good	Med	Good
Thermocouple+Weather API + MEMS	high	Best	Good	Good	Good	Good	Good	Med	Best
Pressure	high	Good	Good	Good	Good	Good	No	Med	Algtm
Pressure + Humidity	high	Best	Good	Good	Good	Good	No	Med	Good
Pressure + Humidity+Weather API	high	Best	Good	Good	Good	Good	No	Med	Best
Force	high	Good	Good	Good	Algtm	Algtm	No	Med	No
Linear Positon	high	Good	Good	Good	Algtm	Algtm	No	Med	Algtm
Linear Position (Position Sensing Self Centering Damper)	high	Good	Good	Good	Algtm	Algtm	No	Low	Algtm
Thermocouple + Humidity+Linear Position	high	Good	Good	Good	Algtm	Good	Best	Med	Best
Proximity Switch	low	Ok	Good	Good	Algtm	Algtm	Algtm	Low	Algtm
Hall Sensor	high	Good	Good	Good	Algtm	Algtm	Algtm	Med	Algtm
Potentiometers	high	Good	Good	Good	Algtm	Algtm	Algtm	Med	Algtm



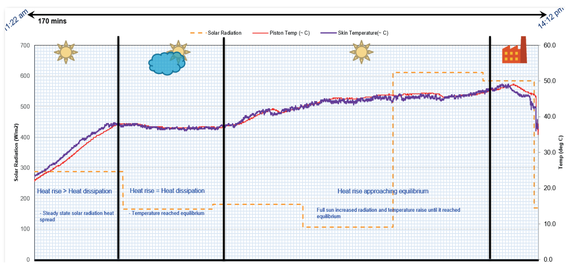
HEAT RAISE DUE TO HARMONICS

- Rise in temperature generated due to harmonics with respect to wind speed is clean data for algorithms to compute panel protection
- Rise in temperature of damper is not influenced by external weather conditions.



HEAT DISSIPATION DUE TO CONVECTION

- Heat dissipation for the piston mounted thermocouple is lower compared to the thermocouples mounted on the external wall (ex – Bottom Valve, Main seal etc.). This indicates the sensitivity of measurement
- System is insulated to convection



HEAT RAISE DUE TO RADIATION

- Solar radiation will have limited impact on the Solar Damper – solar radiation increase in damper temperature (0.01 deg C/ sec) is negligible when compared to heat raise due to kinetic energy absorption (1.125 deg C/sec).
- system is insulated to solar radiation

WHY SMART ENERGY MANAGEMENT SYSTEM?

PANEL PROTECTION

- determine harmonic events experienced in a tracker unit
- move the panels to a position of reduced harmonic condition and capture sunlight for power generation (or) park the panels to a standard stow position

DAMPER END OF LIFE INDICATION

- measure the health of a damper
- notify/alert operator in case of possible failure of damper

OPTIMIZATION OF SOLAR TRACKERS

- input data on structural loads for optimization and design of efficient solar arrays

FEATURES

- solar panel protection algorithms
- end of life determination
- historical data analytics
- modbus integration
- wireless communication
- remote monitoring
- edge and cloud computing
- alerts and notifications
- expandable and extendable system

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