# Milestone 1 - Identify a Problem to Solve

## 1 | Use Case Title: Applying Autonomous AI to protect “Solar Tracker Panels” in case of a “Harmonic event”

## 2 | Use Case Overview *(<=100 words) Provide a brief description of the use case and the system that your autonomous AI will improve.*

In the current scenario, the farm operator uses an anemometer and forecasting tools to decide harmonic events and park all the trackers in the park irrespective of monitoring active harmonics experienced by the tackers. Each row in the solar tracker experiences different levels of harmonics due to vortex shedding and it becomes inefficient (false stow strategy) for the farm to park all the trackers instead of isolating the affected trackers.

Current scenarios cause inefficiency in the production of electricity and do not perform an accurate job of protecting the trackers.

## 3 | Use Case Value *(<=100 words) Explain the value of improving the performance of this system.*

**Insurance companies**

a) insurance claim savings (10x Millions of USD/year)

- The risk profile of renewable energy assets continues to change, with the average weather-related solar loss almost 2400% higher than the average non-weather-related solar loss in 2019.

**Solar Farms**

a) protection of tracker equipment per incident: $31,000

b) improved savings (power generation):

- Current Stow strategy: up to 25% of electricity generation is lost (maximum): some 1,500 USD per day

c) on-demand health monitoring: benefits of saving inspection time

## 4 | Current Methods *Select and explain the current methods used to control or optimize the system*

|  |  |  |
| --- | --- | --- |
|  | **Method** Check all that apply | **Description** |
|  | Human Operator / Engineer | 1. Currently, a field operator is responsible for looking at the wind forecast and parking the panels in case of any forecast gust. 2. Field inspections by walking across the solar park to check for any equipment replacement (e.g. Oil leaks from the damper, panels making noise, etc). |
|  | Expert System | 1. wind speed information is stored in a database and rules are defined to park the trackers at a particular angle in case of a wind event |
|  | Control Theory (PID, MPC) | 1. PLC-based PID system which gets anemometer sensor values and parks all the trackers in stow position within 10 seconds. |
|  | Optimization Techniques |  |
|  | Other |  |

## 5 | Limitations of current methods *Select and explain the limitations of current methods*

|  | **Limitation**  Check all that apply | **Description** |
| --- | --- | --- |
|  | Ability to control well across scenarios/conditions | * Unable to predict harmonic event due to vortex shedding * PID controller is configured by rules and decision-making is not accurate * Applying the same strategy to trackers which are not impacted by harmonic events. |
|  | Multiple or changing optimization goals | * Wind direction is a major influencer compared to wind speed in creating the harmonics * Wind direction (with low wind speed) can cause more harmonics on the tracker compared to a mild/medium gust. |
|  | Human Operator /  Engineer Limitations  May include  · Difficulty managing many variables and dimensions  · Difficulty adapting to changing conditions  · Large performance discrepancy between novice and expert operators  · Inconsistency across expert operators | * Solar farms are huge, and it is a challenge to maintain the entire farm * Experience and skills are required to know the state of the tracker * It is not viable to apply the same rules across trackers |
|  | Uncertainty in the measurement of the inputs or the process makes it difficult to control or optimize. |  |
|  | Time to develop a control or optimization system is prohibitive |  |

**Milestone 1 – Ends Here**

The remainder of this worksheet (Part 2) can be completed after you have finished the “Learning the Solution” module (which includes course items 3.1 to 3.4).

# Milestone 2 - Identify Autonomous AI Components to Use

For this week’s milestone, we will continue working on the proposal for an autonomous AI that you began last week. This week, you will propose an autonomous AI solution, determine which of the components you’ve learned about the system will include, and explain the autonomous AI superpowers that your autonomous AI brain will exhibit.

*You may want to update Sections 1 & 2 with any new insights you’ve gained.*

## 6 | Autonomous AI Overview *(<=100 words) Briefly describe how your proposed autonomous AI would improve the process.*

The primary objective of applying an Autonomous AI brain to the use case is to:

- determine harmonic events experienced in a tracker unit

- move only the affected trackers to a position of reduced harmonic condition and capture sunlight for power generation (or) park the panels to a standard stow position.

- predict and prevent unscheduled maintenance.

## 7 | Optimization Goal *List and describe the key performance indicators that will define control/optimization of the system (Example: maximize (throughput)*

a) Maximize Electricity production

b) Minimize fault stow strategy

c) Maximize equipment lifetime

## 8 | Autonomous AI Components *Select and explain the automation methods your AI will use.*

|  | **Method**  Check all that apply | **Description** |
| --- | --- | --- |
|  | Math (control systems) | * PLC-based PID control system which will park the trackers based on a preset wind speed (eg, wind speed greater than 20 mph for over 5 mins) then move the trackers to stow position within 10 secs. |
|  | Menus (optimization) | * Incremental angle and freedom of movement for trackers |
|  | Manuals  (expert rules and systems) | * Store and identify the rows and nodes by unique identifier (or) ID * Rules on the angle at which the tracker needs to be parked * Degrees of movement |
|  | Machine learning |  |
|  | Deep reinforcement learning | * Learn from different patterns and responses: for example wind direction, wind speed * Measure the electricity loss/savings and try to maximize electricity production * Learn the wind patterns throughout the year |

## 9 | Autonomous AI Superpowers *Select the superpowers that your autonomous AI brain will exhibit and explain how they will lead to an improvement in the process.*

|  | **Superpower**  Check all that apply | **Description** |
| --- | --- | --- |
|  | Makes human-like decisions | * Parking panels in stow position based on harmonic events * Decision on scheduling maintenance |
|  | Perceives, then acts | * Looks for electricity generation at different angles throughout the day and applies rules when a harmonic event occurs * Observes human intervention in case of error |
|  | Learns and adapts | * Learns electricity savings from different positions over time |
|  | Spots patterns | * Harmonic events about rows * Vibration * Oil leakage – vision system |
|  | Infers from experience | * Wind from a particular direction impacts rows in a certain position |
|  | Improvises and strategizes | * Learns optimal angle over time by experimenting with angle Vs. electricity savings |