

# Digitalization Offerings to Cement Industry

## AI Pyro + AI Mill

**INNOMOTICS**

A Siemens Business

May 2024

# AI\* based Digital Solutions for Cement

- 1. AI Pyro Operations**
  - Coal Reduction & fuel ratio stabilization along with AFR usage
- 2. AI Mill Operations**
  - Power Savings & Increase in Throughput thru' stable operations
- 3. SiDAD**
  - Comprehensive plant-wide visibility for precise decision making
- 4. Anomaly Detection – Preheater**
  - Early detection of Cyclone jamming
- 5. Anomaly Detection – Wagon Tippler**
  - Early detection of Breakdowns & Cycle time reduction

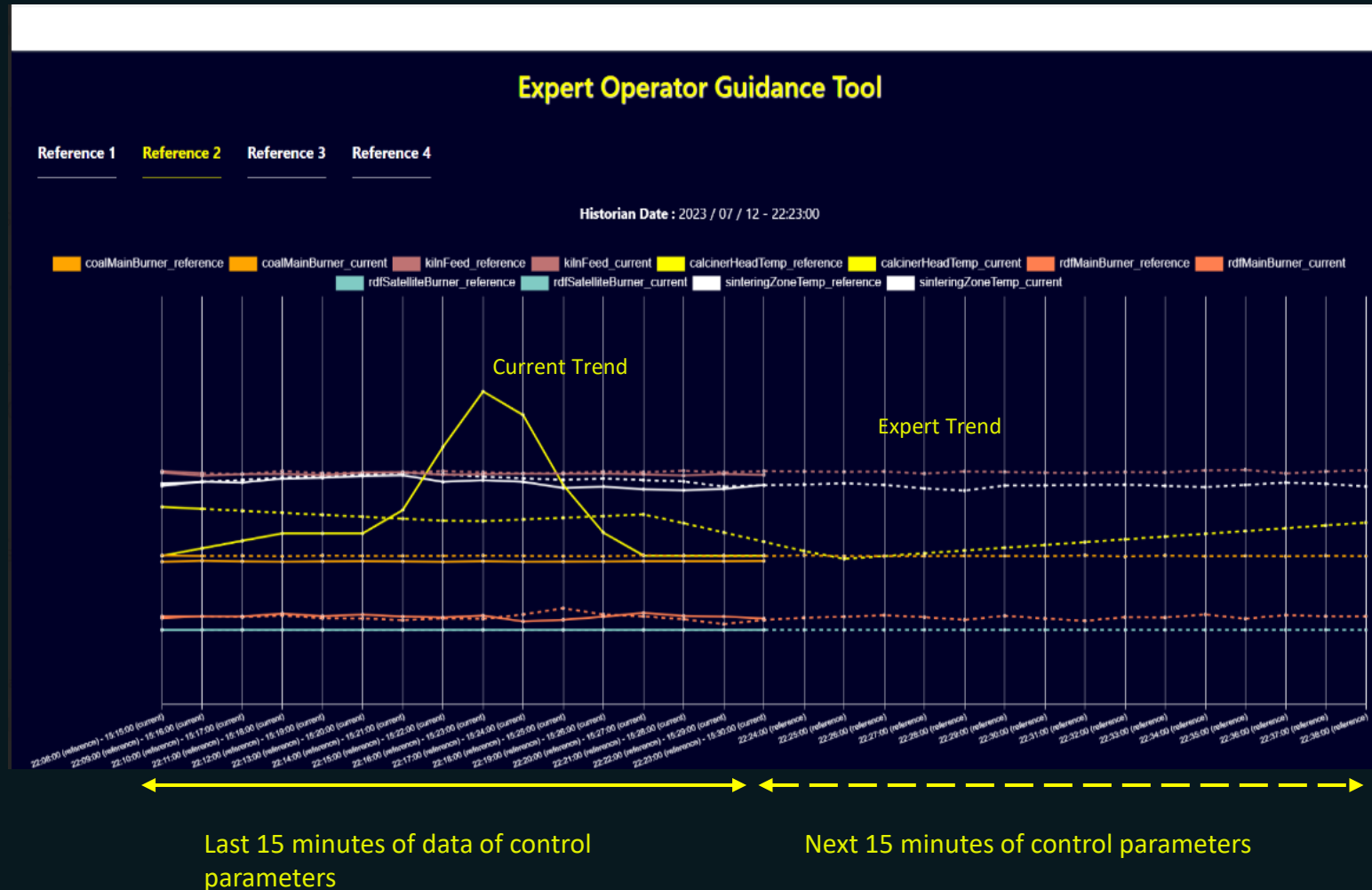
# AI Pyro Operation - Supports Operator to maintain Process Stability and Efficient Operation

## Benefits

|   |   |
|---|---|
| Stability                                 | Ensuring all Temperature, pressures ,are within operating range ,<br>Optimizing ID fan speed and pressure after preheater   |
| Coal reduction                            | Identifying optimum points where coal can be reduced  |
| Fuel ratio stabilization with coal vs AFR | Set point for Step-by-step moderation of AFR/Coal is carried out by AI thereby maintaining the required heat at calciner and Kiln .   |
| Good Quality + Increased Production       | Any change in control parameter is carried out by ensuing the Alite and Free lime are within operating range<br>Potential to increase Kiln Feed thereby increasing production |
| Energy Savings                            | Optimizing Fans at cooler, AI can achieve energy savings  |
| Preheater Jamming reduction               | AI observes SO3 and Chloride formation , material temperature and pressures<br>Changes AFR accordingly thereby preheater jamming occurrence is reduced                        |
| Optimize Workforce                        | Best Expert available for 24 Hours  |

# AI Pyro Operation - Supports Operator to maintain Process Stability and Efficient Operation


## First Deliverable : Digital Database : Expert Operator Guidance Tool - 6 – 7 weeks



- All the changes made by the operator in the control parameters to optimize the process are recorded in digital format
- Guides operator to take appropriate step by step action for a particular condition.
- Provide operator with multiple option and operator can choose anyone of them
- Operator can refer to this tool anytime for any situation.
- Measurement of the technological parameter and trend monitoring of their changes necessary for controlling the equipment
- Tool will assist operator like Expert.

# AI Pyro Operation

## Second Deliverable : AI Digital Simulator : Operator can simulate any condition – 5 – 6 Weeks



### DIGITAL PROCESS SIMULATOR

**Total Similar Patterns**  
20

**Total Coal Consumed**  
264.95 (tons)

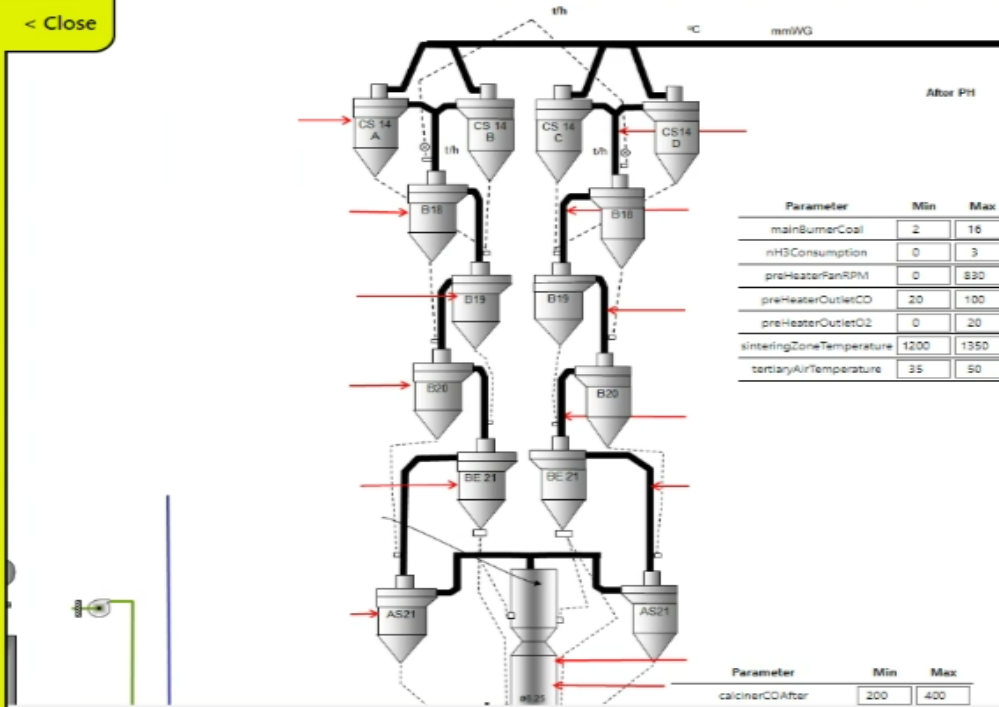
**Total AI Optimized Coal**  
260.00 (tons)

**Total Savings**  
1.87 (%)

SUBMIT

| #  | Parameters                     | Min      | Max      | Mean     |
|----|--------------------------------|----------|----------|----------|
| 1  | calcinerCOAfter                | 332.00   | 376.00   | 357.00   |
| 2  | calcinerCoal                   | 18.00    | 23.00    | 20.00    |
| 3  | calcinerO2After                | 2.00     | 4.00     | 2.00     |
| 4  | calcinerOutletAfterPressure    | -104.00  | -65.00   | -81.00   |
| 5  | calcinerOutletAfterTemperature | 889.00   | 939.00   | 902.00   |
| 6  | kilnFeed                       | 502.00   | 603.00   | 553.00   |
| 7  | kilnInletNOx                   | 426.00   | 750.00   | 615.00   |
| 8  | kilnInletO2                    | 2.00     | 19.00    | 8.00     |
| 9  | kilnInletPressure              | -35.00   | -26.00   | -30.00   |
| 10 | kilnInletTemperature           | 1,033.00 | 1,087.00 | 1,057.00 |
| 11 | kilnMainDriveCurrent           | 808.00   | 995.00   | 873.00   |
| 12 | kilnRPM                        | 3.00     | 4.00     | 4.00     |
| 13 | mainBurnerCoal                 | 12.00    | 14.00    | 13.00    |
| 14 | nH3Consumption                 | 1.00     | 1.00     | 1.00     |
| 15 | preHeaterFanRPM                | 648.00   | 766.00   | 704.00   |
| 16 | preHeaterOutletCO              | 65.00    | 79.00    | 74.00    |
| 17 | preHeaterOutletO2              | 2.00     | 4.00     | 3.00     |
| 18 | sinteringZoneTemperature       | 1,212.00 | 1,324.00 | 1,248.00 |
| 19 | tertiaryAirTemperature         | 41.00    | 44.00    | 43.00    |

< Close



- Operator can simulate any conditions
- Operator can identify the best operating points for a particular condition
- Provide can define the strategy for production increase, reduction of coal
- Kind of Digital Twin

# AI Pyro Operation

## Third Deliverable : AI Pyro Process Model : 4 -5 weeks

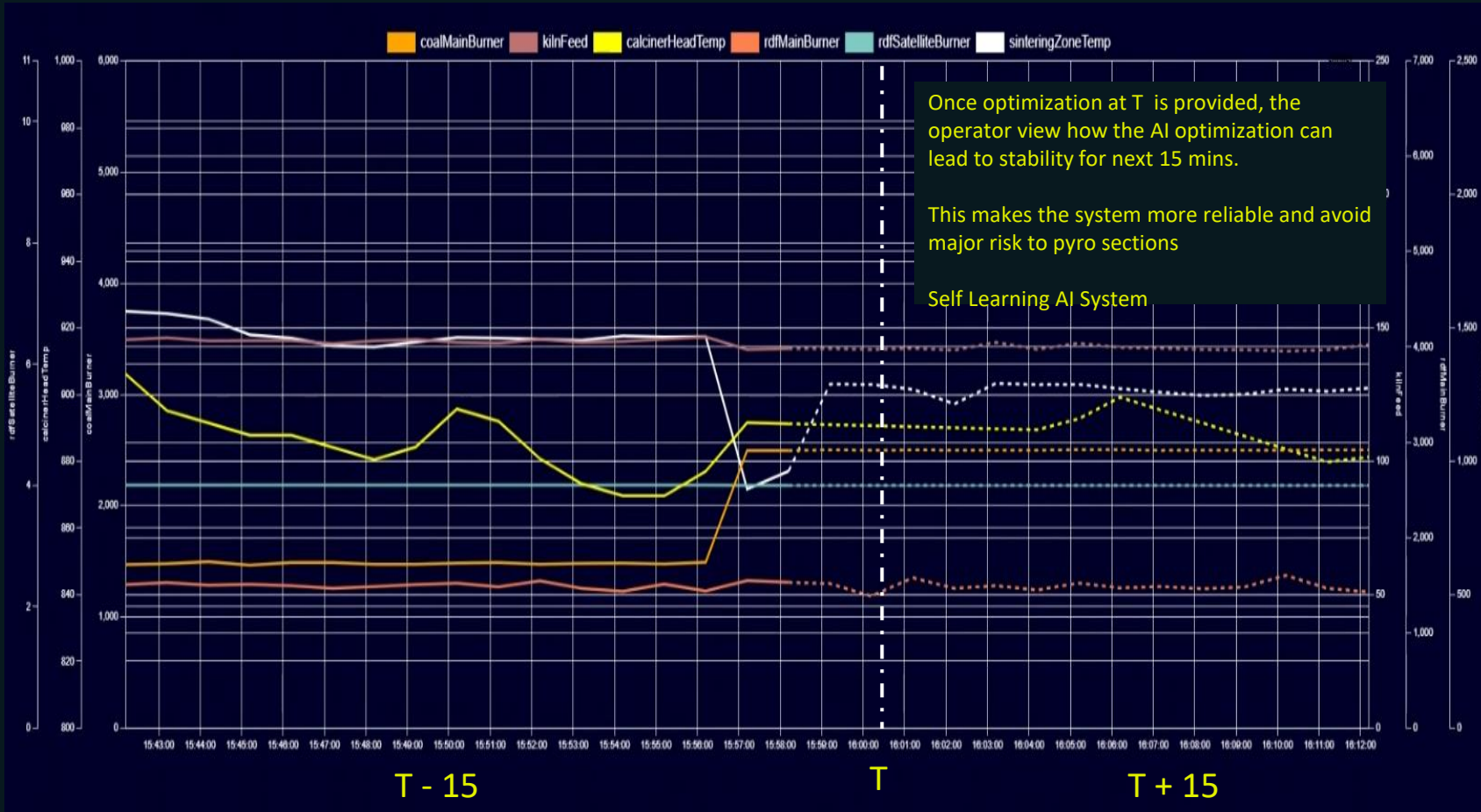


- Coal Main burner is reduced from 1001 to 380 kg/h
- Increase in RDF Main Burner from 2613 to 2695 kg/h
- Kiln Feed can be increased from 134.51 to 135.15 thereby increasing production
- Sintering Zone temperature will be stable based on the Recommended fingerprint for next 30 mins



# AI Pyro Operation

## Trusted AI Optimization

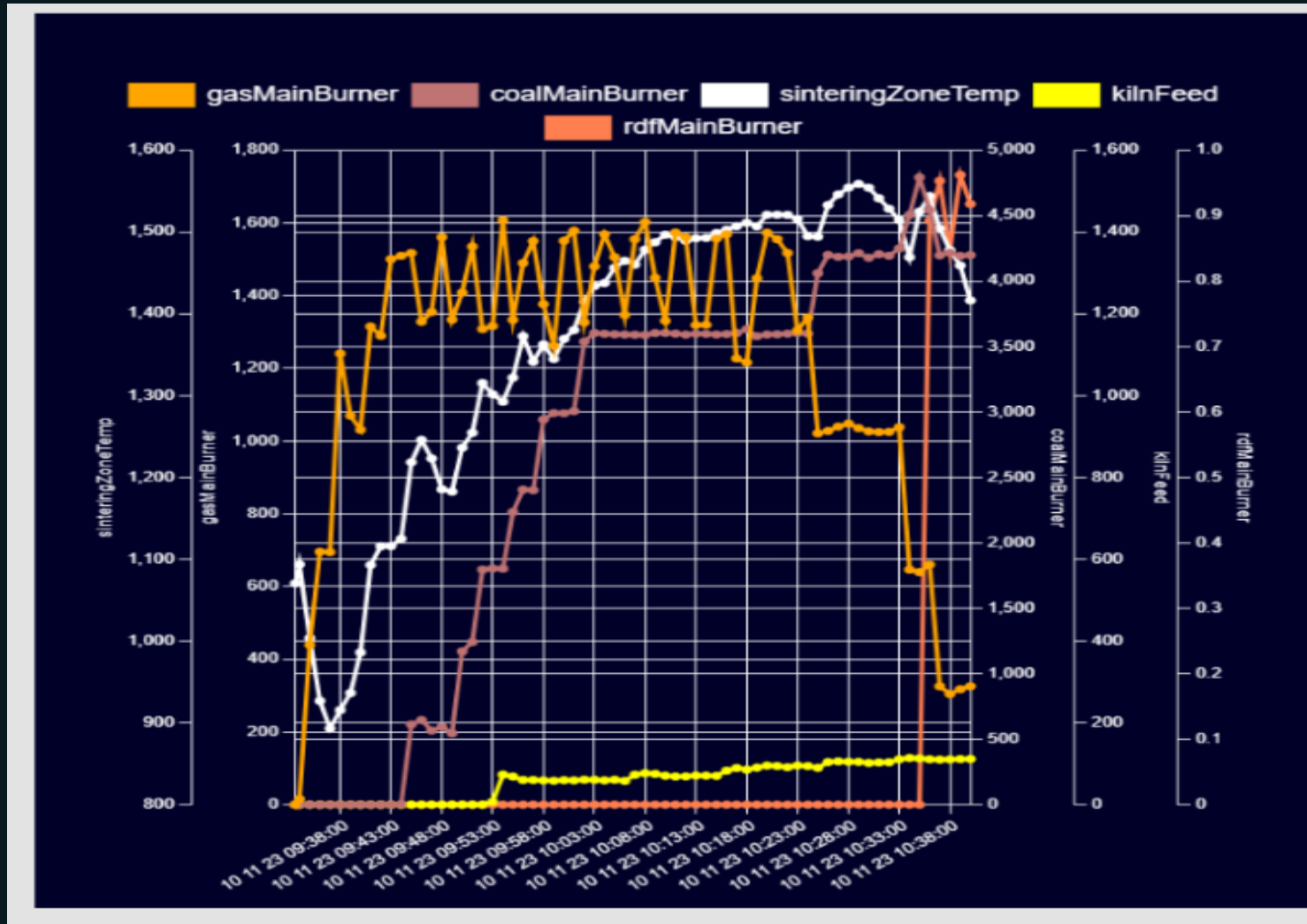


From a large data points, our AI Optimization picks up only data points that leads to stability for next T + X hours.

For every step change in control parameter, our AI analyze its impact on Process parameters .

# AI Pyro Operation

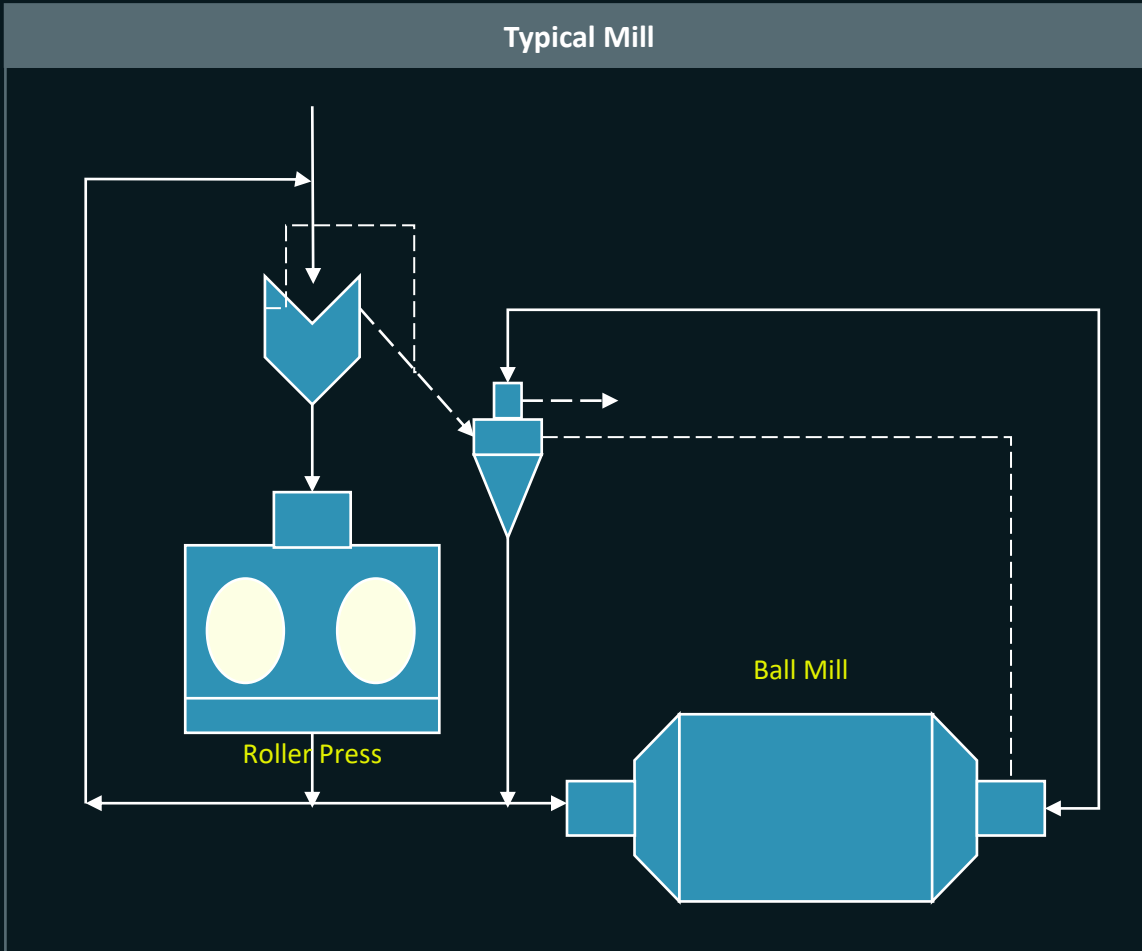
## Kiln Startup - For every Light up, Time saving ≈ 30 Mins



- Gas Main burner is increased in step-by-step manner to light up the kiln.
- Once the sintering zone temperature started increasing, Main burner coal is increased along with Kiln Feed in step-by-step manner .
- Once the sintering zone temperature becomes stable, slowly the gas main burner is decreased



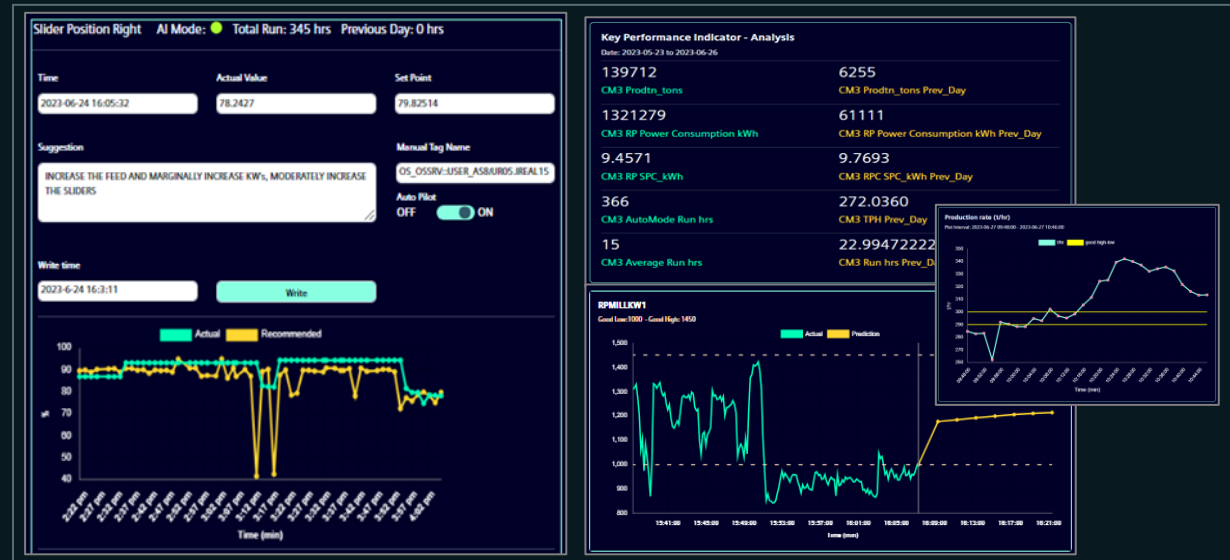
# AI Mill - Supports Operator to maintain Process Stability and Efficient Operation



## Solution at a Glance

AI Mode Mill solution to assist mill operators by providing optimal set-point to enable efficient and stable operation, thereby enhance productivity.

Identify patterns for better correlation among parameters.



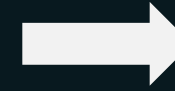
# AI Mill Operation

## Proven AI assisted Auto-pilot Mill Operation Model (1/2)

### Customer Challenge

- Lower Productivity
- High Power Consumption
- Variations in clinker feed rate, separator speed, grinding aid could proportionally impact the cement quality

...Frequent overshooting of critical parameters beyond optimum range



### Causing:

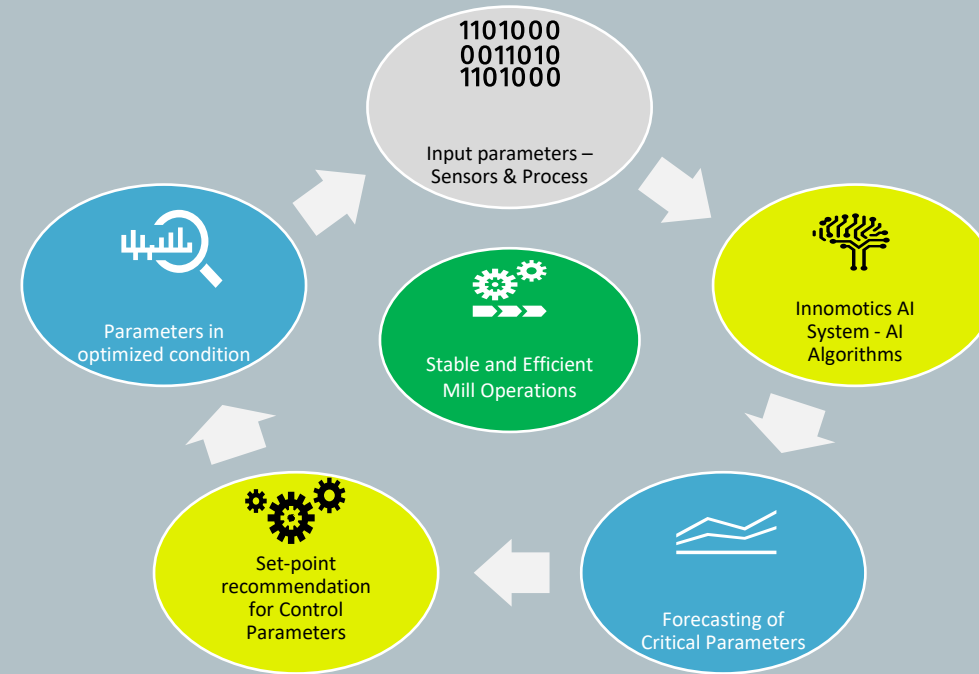
- Instable Mill conditions
- Frequent tripping of Mill
- Lower Throughput

### Our Solution

- Forecasts critical parameters and recommends set-points for control parameters
- Maintains the parameters in optimum range

### Solution Benefits

- Stable operation of Mill
- Increases productivity
- Increases operational efficiency:
  - Increases Throughput
  - Reduces Power consumption

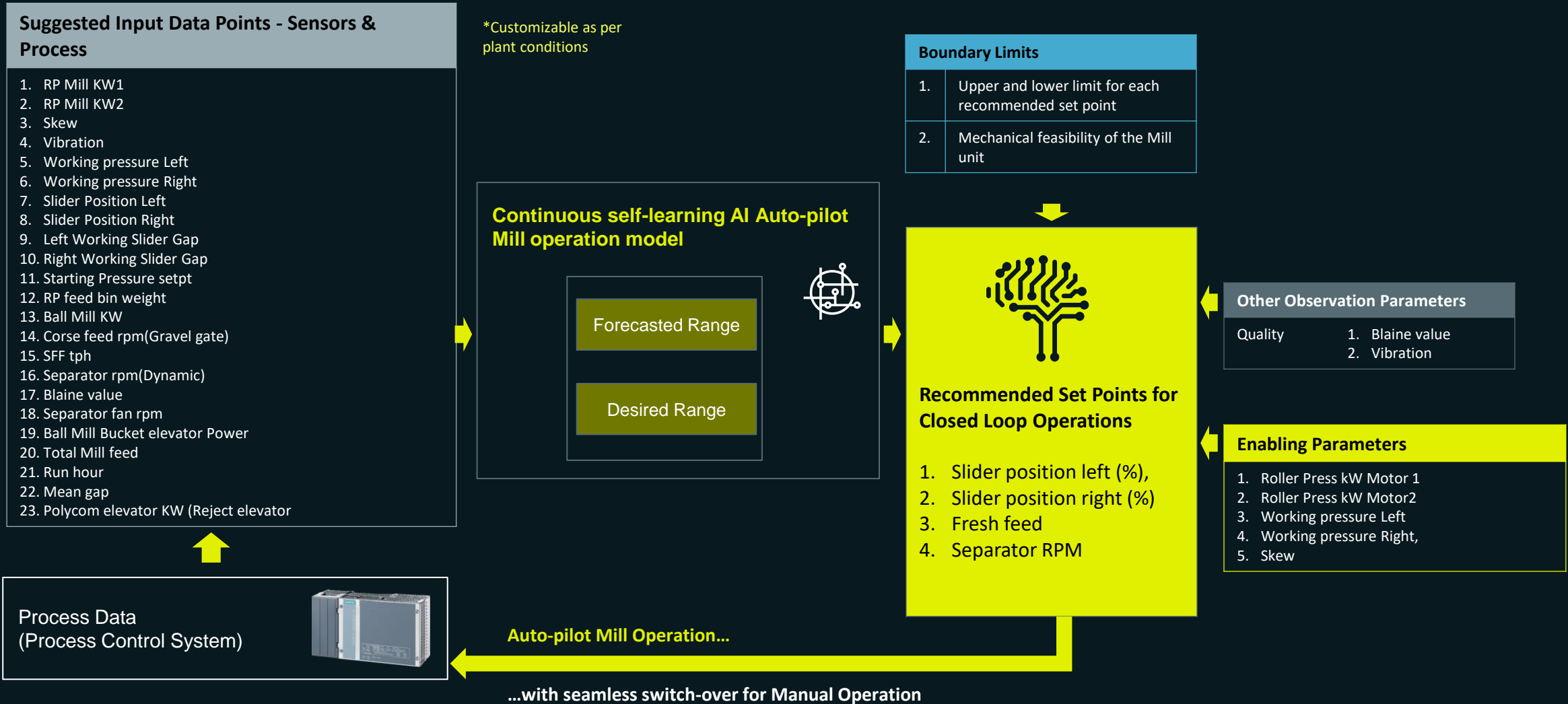


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# AI Mill Operation

## Proven AI assisted Auto-pilot Mill Operation Model (2/2)

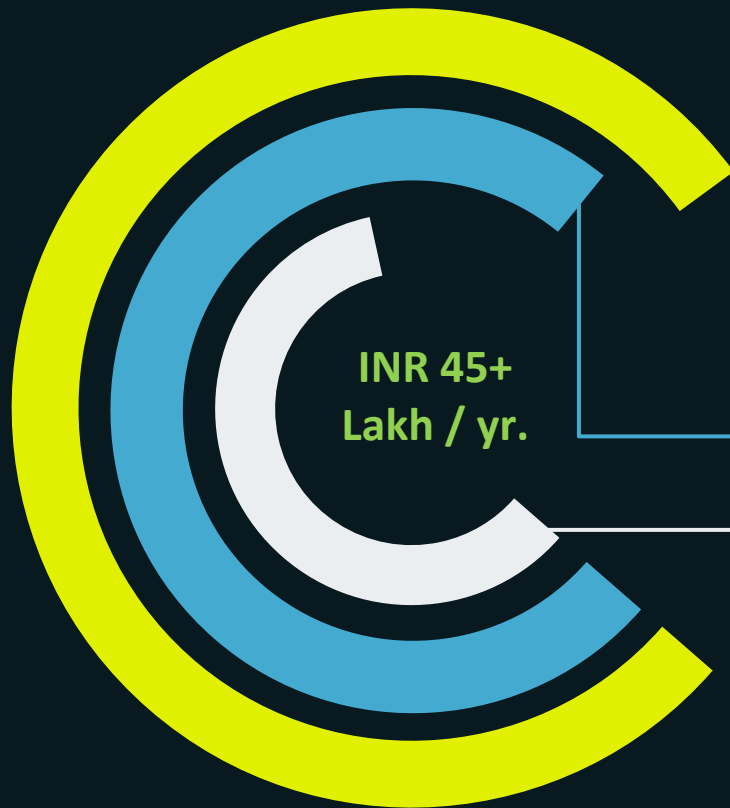


# Calculated Benefits from AI Mill Digital Solution at a Cement Plant in India

## For Cement Mill – Roller Press + Ball Mill

Based on Data (of stable conditions) observed for March 2024 (OPC 43 / 53)

| Operation Mode | Sum of Run Hrs. | Average of cmTPH  | Average of Output TPH | Average of silofeedelelevatorKW | Average of Specific Power Consumption kWh | Average of seperatorRpm |
|----------------|-----------------|-------------------|-----------------------|---------------------------------|---|-------------------------|
| Manual         | 83.29           | 284.07            | 274.46                | 79.45                           | 23.97                                     | 981.18                  |
| AI Mode        | 344.61          | 277.62            | 277.80                | 80.29                           | 23.37                                     | 950.35                  |
|                |                 | <b>Difference</b> | <b>3.33</b>           | <b>0.84</b>                     | <b>0.60</b>                               | <b>30.83</b>            |



**INR 45+  
Lakh / yr.**

**INR 30+ Lakh / yr.**

Increase in Production

OR

**INR 19+ Lakh / yr.**

Reduction in Mill Operating Hrs.

+

**INR 26+ Lakh / yr.**

Reduction in Specific Power Consumption

| Case-1 : Increase in TPD         |                         |
|----------------------------------|-------------------------|
| Full time Manual Oper. TPD       | 6038.17                 |
| Full time AI mode Oper. TPD      | 6111.51                 |
| Profit per Tonne (for Mill only) | INR 150.00              |
| Profit increase per day          | INR 11,000.75           |
| <b>Profit increase per year</b>  | <b>INR 3,300,226.24</b> |

| Case-2 : Same TPD Level           |                         |
|-----------------------------------|-------------------------|
| Reduced Run Hrs.                  | 21.74                   |
| Idle Time Hrs.                    | 0.26                    |
| No Load kWh                       | 4500                    |
| Power Saving per day kWh          | 1188.00                 |
| Power Saving per Year kWh         | 356,401.45              |
| <b>Power Cost Saving per Year</b> | <b>INR 1,960,207.98</b> |

|  |                         |
|--|-------------------------|
| Diff in Power Consumption Unit kWh                       | 0.60                    |
| Diff in Power Consumption Unit kWh with 30% Error Margin | 0.42                    |
| Power Cost Saving per Hr.                                | INR 541.17              |
| Power Cost Saving per Day                                | INR 8,658.78            |
| <b>Power Cost Saving per Year</b>                        | <b>INR 2,597,633.25</b> |

Considerations: based on current information

- Power cost per unit: INR 5.5
- Price per bag of cement: INR 300
- Days of Operation in a year: 300 days
- Mill Operating Hrs. per day: 22 Hrs.

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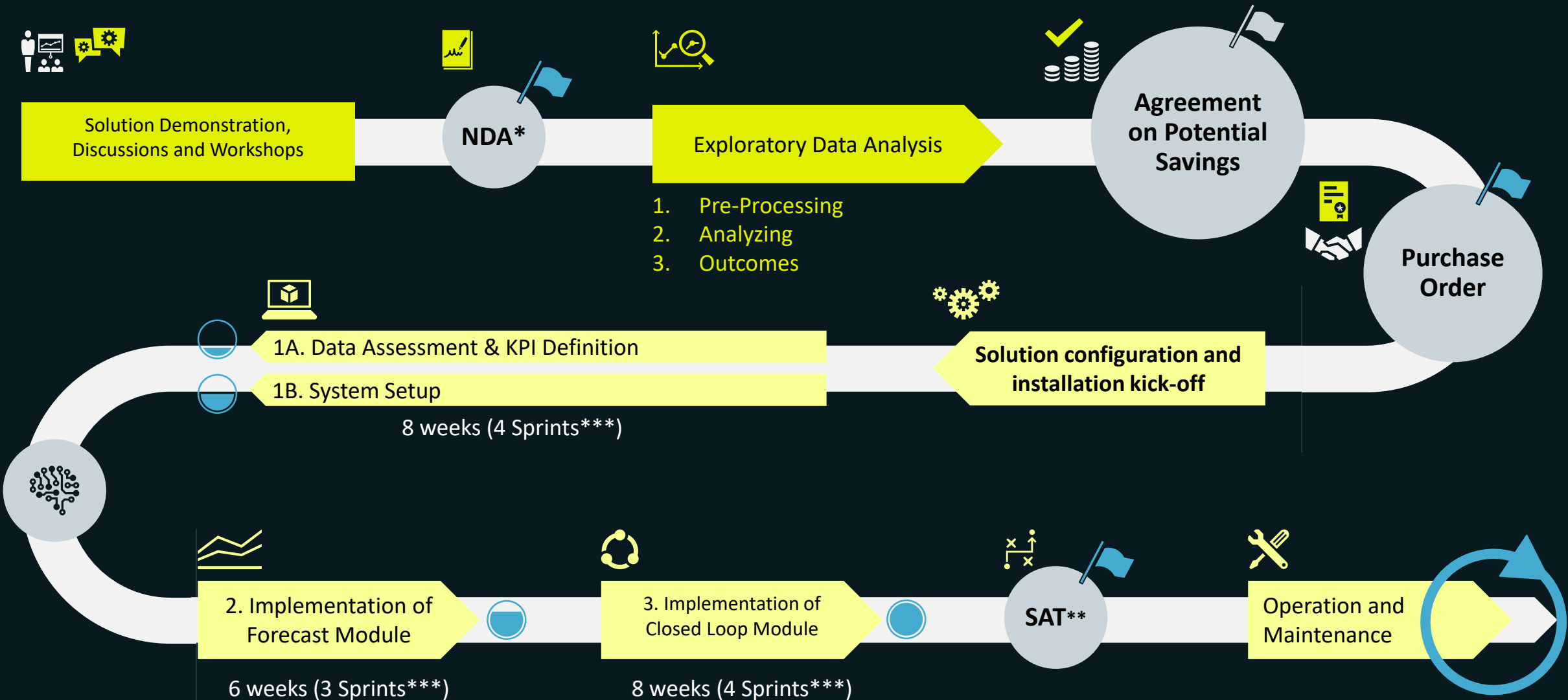
# Summary of Digitalization Offerings

| Sr. No.  | Solution                                       | Description  | Key Benefits  |
|--|--|--|---|
| <b>Stabilization &amp; optimization of processes</b>     |  |  |   |
| 1  | AI* assisted Kiln Operation                    | Stabilization & optimization of Kiln through AI* controlled operation for effective Kiln operations  | <ul style="list-style-type: none"> <li>› Improves fuel efficiency</li> <li>› Optimizes Energy consumption</li> </ul>  |
| 2  | AI* assisted Mill Operation                    | Stabilization & optimization of Mill through AI* controlled operation for effective Mill operations  | <ul style="list-style-type: none"> <li>› Increases Power Savings</li> <li>› Improves Mill Stability</li> </ul>  |
| <b>Enable decision making using predictive analytics</b> |  |  |   |
| 3  | Pre-Heater Cyclone Anomaly Detection           | AI* based anomaly detection for preheater blockage with advanced prediction  | <ul style="list-style-type: none"> <li>› Reduction in unplanned stoppages of the assets</li> </ul>  |
| 4  | Anomaly Detection in Wagon Tippler             | AI* based anomaly detection for Wagon Tippler, giving early alerts for potential breakdowns  | <ul style="list-style-type: none"> <li>› Planned maintenance instead of spontaneous repair</li> </ul>   |
| 5  | SIDRIVE IQ                                     | 24/7 condition monitoring and comprehensive fleet management of LV / MV motors & drives  | <ul style="list-style-type: none"> <li>› Proactive maintenance through detailed and early damage localization</li> </ul>  |
| <b>Integrated and Intelligent Operations</b>             |  |  |   |
| 6  | Siemens Data Acquisition & Diagnostics (SiDAD) | Comprehensive dashboarding & reporting solution which integrates with various systems and provides actionable insights required to efficiently manage plant assets, maintenance activities and energy monitoring | <ul style="list-style-type: none"> <li>› Visibility &amp; secure accessibility of real time &amp; historical data of all systems in the plant</li> <li>› Real-time visibility of the KPIs and prescription for critical variables impacting the KPIs</li> </ul> |



# Pleased to support you in Digitalization Journey

# Stepped Manner Implementation of Digitalization Projects



\* Non-Disclosure Agreement  
 \*\* Site Acceptance Test  
 \*\*\* 1 Sprint = 2 Weeks