ARC Energy and Eco Solutions
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Date:

To,

Subject: Trail at ______________________Sugar Factory,

0-day controlled study plan — 5 days pre-dose baseline vs. 5 days continuous dosing of ARC Energy "Plas Plus" (1 L/ton bagasse)

Dear

Per your direction, below is the updated plan: collect **five full days of pre-dose data** and compare against **five full days of continuous Plas Plus dosing** at **1.0 L per 1.0 ton of as-fired bagasse**. The design emphasizes tight normalization (load, moisture, O_2 setpoints) and statistical comparison across matched operating windows.

1) Objective & success criteria

Objective: Quantify the impact of Plas Plus on boiler/cogen performance, combustion quality, emissions, fouling, and economics by comparing **Baseline (Days 1–5)** vs **Dosed (Days 6–10)**.

Primary success criteria (sustained, normalized improvement vs. baseline; hit ≥2):

- ↑ Boiler efficiency or ↓ specific fuel (kg bagasse/ton steam) by **≥2–5%**
- ↑ Steam-to-fuel ratio (kg/kg) by **≥2–5%**
- ↑ Net export power (kWh/ton cane or kWh/ton bagasse) by **≥2–5%**
- ↓ Unburnt carbon in ash (LOI) by **≥15–30%**
- ↓ Excess air / stack O_2 at constant CO by **≥5–10%**
- ↓ Stack/economizer outlet gas temperature by **≥5–15 °C**
- ↓ Sootblowing frequency / fouling indicators

2) Schedule (11 days total)

Day 0 – Setup/Calibration: Instruments check, sampling kits, MSDS/HSE briefing, data templates.

Days 1–5 – Baseline (no additive): Normal operation; collect continuous DCS and scheduled lab samples.

Days 6–10 – Dosed (continuous): Start **Plas Plus @ 1.0 L/ton**; maintain for 5 consecutive days.
Note: If an unplanned outage ≥4 h occurs, extend dosing period to keep five full operating days.

Day 11 – Wrap-up: Coupon retrieval, photo logs, debrief, data freeze.

3) Dosing method (Days 6–10)

Rate: L/h = bagasse feed (tph) × **1.0**.

Injection: Spray manifold onto main bagasse conveyor (pre-feeder) with fine-cone nozzles; ensure uniform wetting without slippage.

Controls: Manual setpoint review hourly (or link to weighfeeder signal if available).

HSE: PPE, spill tray, eyewash; locked IBC; 15-min toolbox talk.

4) Parameters to collect & compare (same list for both phases)

4.1 Boiler & combustion (DCS; 1-min trends preferred)

Steam flow (tph), drum pressure, main steam temp; feedwater & deaerator temps

Bagasse feed (tph); feeder speed; **bagasse moisture %** (hourly lab; NIR if available)

Flue-gas O_2 (%), CO (ppm), CO_2; NO_x/SO_2 if available

Furnace exit, economizer outlet, APH outlet, and stack gas temperatures

Draft; FD/ID fan loads (kW), damper positions; sootblowing events and ΔP across bank/APH

Blowdown % and conductivity/TDS

Auxiliary power in boiler house (fans, feeders, ESP/multicyclone)

4.2 Fuel quality (lab; both phases)

Proximate: Moisture, VM, FC, Ash — **3×/day** (start/mid/end; composite each)

Ultimate: C, H, N, S, O — **Day 2 and Day 9** composites

GCV (as-received & dry): 2×/day

Ash chemistry (Na_2O/K_2O, Cl, SiO_2, Fe_2O_3, CaO, MgO) — **Day 4 and Day 9**

4.3 Ash & deposits

Fly/bottom ash **LOI (unburnt C%)** — **1 per steady window**

Daily fly/bottom ash mass if recorded; photos of color/texture

Deposit coupons in econ/APH zone (installed Day 0; retrieve Day 11) + SEM/EDS on scraped samples (Baseline vs Dosed)

4.4 Turbine & power balance

Gross & net kW/kWh; condenser vacuum; export kWh

KPIs: **kWh/ton cane**, **kWh/ton bagasse**, specific bagasse per MWh

4.5 Environmental & housekeeping

ESP/Multicyclone DP; visible plume notes (fixed times daily)

CO spike counts at steady load (stability proxy)

Incidents: feeder choking, hopper buildup, conveyor carryback

4.6 Economics

Specific fuel: kg bagasse/ton steam; kg/MWh

Additive use (dosed days): L/day; cost/day

Benefits: bagasse saved, extra export kWh, sootblowing time avoided, cleaning deferral

5) Data quality, normalization & matched windows

Steady windows: target **≥2 windows/day**, each **≥120 min** with drift limits

Steam flow ±3%; O_2 ±0.4% abs; stack temp ±5 °C

Match windows by **load band** (±5%), **bagasse moisture band** (±2% abs), and **ambient** (temp/RH) as far as practical.

Keep **O_2 setpoint constant** within each window; change only between windows.

Use **same sootblowing regime** across phases (or record deviations precisely).

Exclude windows with major disturbances (trips, analyzer downtime) and replace with additional matched windows.

6) Analysis & comparison approach

Compute KPIs per window (both phases):

Boiler efficiency (direct/indirect), steam-to-fuel (kg/kg)

Specific bagasse/ton steam; specific bagasse/MWh

Net kWh/ton cane & kWh/ton bagasse

Excess air (%), O_2 (%), CO (ppm, spikes/hour)

Stack loss proxy (T_gas, O_2), ash **LOI (%)**, fouling proxies (ΔT across APH/econ; sootblow frequency)

Normalize KPIs for moisture and load using either:

Regression/ANCOVA with bagasse moisture, load, and ambient as covariates, or

Ratio-to-baseline at matched bands (preferred when bands are tight).

Statistics: two-sample **t-test** (or Mann-Whitney if non-normal) across matched windows Baseline vs Dosed; effect size with 95% CI.

Operational stability: compare σ (std. dev.) of steam flow/pressure and CO spikes/hour.

Economics:

Bagasse saved/day = (Baseline specific − Dosed specific) × steam produced (or MWh)

Value/day (₹) = (bagasse saved × ₹/ton) + (extra export kWh × tariff) − (additive L/day × ₹/L)

7) Roles & responsibilities

ARC Energy: Dosing design, on-site supervision (Days 6–10), QA/QC on sampling, data integrity checks, analytics & report.

Factory team: Operations, access to DCS data, weighbridge/feeder records, lab sampling/testing, safety & permits.

8) Sampling & chain of custody

Pre-label containers (Date-Time-Point-Operator); composite per window.

Chain-of-custody log; seal splits; retain for 7 days post-trial.

Prefer NABL-accredited methods (record IS/ASTM on certificates).

9) Acceptance criteria for data windows

A window is **valid** if: load band matched, analyzer online, no major intervention, drift limits respected, and full sampling set (moisture + ash LOI) obtained.

10) Deliverables

Executive summary (2 pages): Pass/fail vs success criteria; headline % gains and ₹/day impact.

Technical report: Methods, raw data appendix, matched-window tables, normalization approach, statistical tests, plots, ash/deposit photos & SEM/EDS notes, **recommendations** (dose optimization, rollout plan).

Operational aide: Simple dosing chart (tph → L/h), lessons learned for SOP.

Quick reference — Parameter × Frequency matrix (both phases)

Area	Parameter	Method	Frequency
Fuel	Bagasse rate (tph)	Weighfeeder/DCS	1-min
Fuel	Moisture (%)	Oven/NIR	Hourly + per window
Boiler	Steam flow/press/temp	DCS	1-min
Flue gas	O_2 (%), CO (ppm)	Online analyzer	1-min
Flue gas	Gas temps: FEG, Eco, APH, Stack	DCS	1-min
Air	Draft, FD/ID kW, dampers	DCS	1-min
Ash	**LOI (unburnt C %)**	Lab	1 per window
Power	Gross/Net kW, export kWh	DCS/meter	1-min; daily total
Fouling	ΔP bank/APH; sootblow events	DCS/log	Event-based
Chemistry	Blowdown %, TDS	DCS/Lab	1 per window
Economics	kWh/ton cane & bagasse	Calc	Daily

If you approve this 5-day baseline + 5-day dosing design, we will proceed with Day 0 setup and lock the matched window bands and data templates with your team.

Respectfully,

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