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Government of India, Ministry of Power

GOVERNMENT OF INDIA
MINISTRY OF POWER

ASPIRE Programme

Accelerating Smart Power & Renewable Energy in India

SUMMARY REPORT

DOMESTIC STUDY TRIP OF

BALRAMPUR CHINI MILLS LIMITED (BCML)

HOSTED BY:

BALRAMPUR CHINI MILLS LIMITED
HAIDERGARH, UTTAR PRADESH

22 MARCH, 2024

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Industrial Decarbonisation and Energy Efficiency
Knowledge Sharing Platform

Contents

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Abbreviations & Acronyms

ASPIRE	Accelerating Smart Power and Renewable Energy in India
BCML	Balrampur Chini Mills Limited
BEE	Bureau of Energy Efficiency
DCS	Distributed Control System
ETP	Effluent Treatment Plant
ESP	Electrostatic Precipitator
FFE	Falling Film Evaporator
FCDO	Foreign, Commonwealth and Development Office
GESI	Gender Equality Social Inclusion
IEED	Industrial Energy Efficiency and Decarbonisation
MW	Mega Watt
STP	Sewage Treatment Plant
SEC	Specific Energy Consumption
TCD	Tonnes of Cane per Day
TPH	Tonnes per Hour
UPPCL	Uttar Pradesh Power Corporation Limited
VFD	Variable Frequency Drive
DCs	Designated Consumers
DCH	Direct Contact Heater
DISCOMs	Distribution Companies
DCS	Distributed Control System
ETP	Effluent Treatment Plant
ESP	Electrostatic Precipitator
FFE	Falling Film Evaporator
FCDO	Foreign, Commonwealth and Development Office
GESI	Gender Equality & Social Inclusion
GHG	Greenhouse Gases
HVAC	Heating, Ventilation, and Air Conditioning
HPH	High-Pressure Heater
HT	High-Tension
H^2	Hydrogen
ISMA	Indian Sugar Mills Association

BACKGROUND

India is the largest producer of sugar in the world, having an annual output value of ~**INR 800 billion** (~**GBP 7.6 billion**)[1]. The sugarcane and sugar sector are the country's second-largest agro-based industry, after cotton. The industry is witnessing significant expansion, with ~**642** sugar factories, collectively capable of yielding ~**35** million metric tons (MMT) of sugar[2]. Uttar Pradesh, Maharashtra, and Karnataka account for over **70%** of the country's total sugar production. While most sugar mills typically operate with crushing capacities ranging from **600** to **5,000** tonnes of cane per day (TCD), there's a noticeable trend of expansion, with some mills even surpassing the **20,000** TCD mark[3]. In the 2021-22 sugar season, **522** units were operational[4] with **60%** of the operational mills located in Uttar Pradesh (highest share in national production) and Bihar.

The sugar industry not only supplies raw materials to the alcohol and beverage sectors but also contributes to fuel blending, aiding in green fuel production and reducing crude oil imports. India surpassed its target of **10%** ethanol blending with petrol ahead of its schedule in 2022 and now aims to achieve **20%** blending by 2025 under the National Biofuel Policy.[5]

By-products of sugar industry

(i) Cogeneration: ~**300** kg of bagasse (a residue from sugar extraction process) is produced per tonne of sugar which can further be converted to ~**130** kilo Watt hour (kWh) of power. India's sugar industry has a total installed co-generation capacity of **~4,200** MW, with integrated mills exporting **~75%** of the co-generation power to grid post captive consumption.[6]

(ii) Ethanol: a key by-product for integrated sugar mills is primarily derived from molasses, a by-product of the sugar industry.

Energy efficiency and decarbonisation potential

As per a study by the Indian Institute of Technology Bombay (IIT Bombay), production of one tonne of sugar releases greenhouse gas (GHG) emissions equivalent to **324** - **834 kg** of carbon dioxide. Sugarcane cultivation accounts for significant GHG emissions in the entire life cycle of sugar production. Coal-based electricity consumption for irrigation and application of chemical fertiliser and cattle manure lead to this high level of emissions. Sugarcane milling accounts for **6-7%** of the emissions, while cogeneration of electricity from bagasse accounts for **2-3%**.[7]

The sugar sector is now expected to be brought under the ambit of the Bureau of Energy Efficiency's (BEE's) flagship Perform Achieve and Trade (PAT) scheme. As per the Ministry of Power's (MoP) notification dated 6th June 2023, units of sugar plants[8], having energy consumption of **10,000** metric tonne of oil equivalent (MTOE) per year or above will qualify as a Designated Consumer (DC) in Sugar Sector. As per a recent study, the overall energy consumption of this sector is estimated to be **20.28** million MTOE and **~100** sugar plants are expected to be included as DCs under the PAT scheme[8].

1 Sugar market in India - statistics & facts | Statista
2 Sugar market in India - statistics & facts | Statista
3 BEE presentation on Sugar Sectoral Workshop
4 https://www.ideeksha.in/pages/Sugar-Basic%20info%20on%20Sectors
5 India achieved 10% ethanol blending target ahead of schedule: PM Modi - Times of India (indiatimes.com)
6 Understanding How The Indian Sugar Industry Works – Alpha Invesco
7 Simultaneous production of sugar, power generation from bagasse is environment-friendly, says IIT-Bombay study | Latest News India - Hindustan Times
8 or establishment those are under production of sugar and its variants such as white sugar, brown sugar, and liquid sugar

At present, the specific power consumption of sugar mills in India is in the range of ~**26-32** kWh/ tonne of cane produced[9]. Implementation of latest energy efficient technologies offers potential to reduce the specific power consumption of the mills to ~**22** kWh/ tonne of cane[10]

In view of the above, a study trip to Balrampur Chini Mills Limited (BCML), Haidergarh, Uttar Pradesh was organised on 22nd March 2024 under Accelerating Smart Power and Renewable Energy in India (ASPIRE)[11] programme. The study trip was jointly organised by the Foreign, Commonwealth and Development Office (FCDO), Government of UK and the Bureau of Energy Efficiency (BEE), Government of India with the support of Balrampur Chini Mills Limited (BCML). The purpose of the study trip was to demonstrate and disseminate various best practices and innovative industrial energy efficiency and decarbonisation (IEED) technologies adopted by BCML to enhance its energy efficiency and efforts to decarbonise its operations.

Objective of the Study Trip

- Demonstrate new and innovative IEED technologies implemented by BCML, Haidergarh plant, Uttar Pradesh.
- Enable industries in the sugar sector, to reduce their overall specific energy consumption (SEC) and prepare for future compliance requirements under BEE's PAT scheme
- Foster an ambitious, mutually beneficial, and outcome-focused relationship between industry stakeholders.

Highlights

- Active participation from ~30 stakeholders (including ~11% women participants) including senior officials and executives from central and state government agencies, industrial organisations, research institutions, and technology providers.
- Visit to the following key sections of the plant –
  - Tissue Culture Lab
  - Green House
  - Mill house, boiling house, food packaging area, and warehouse
  - Effluent Treatment Plant (ETP)
  - Sugar Lab
  - Control Room

9 https://www.teriin.org/sites/default/files/2021-08/Sugar_Report.pdf
10 All India seminar on latest energy efficient technologies in Indian sugar industry – organised by STAI
11 Accelerating Smart Power and Renewable Energy (ASPIRE) is a bilateral technical assistance programme being implemented by the Foreign, Commonwealth and Development Office (FCDO), Government of UK in association with the Ministry of Power and Ministry of New and Renewable Energy, Government of India. KPMG is the implementation advisor to FCDO in relation to the ASPIRE programme and Idam Infrastructure Advisory Private Limited (India) is a key consortium member.

OVERVIEW OF BALRAMPUR CHINI MILLS LIMITED (BCML)

BCML Plant, Haidergarh, Uttar Pradesh

BCML is among the leading sugar manufacturers in India with a crushing capacity of **77,500** TCD. In 2003-04, Balrampur Chini Mills Limited (BCML) established an integrated sugar complex in Haidergarh, boasting a crushing capacity of 4,000 TCD alongside a 20.25 MW cogeneration power plant fuelled by bagasse. Over time, the crushing capacity of the Haidergarh facility was ramped up to **5,000** TCD along with the addition of a **3** MW turbine generator dedicated to export surplus power.

Strategically positioned along the road connecting Haidergarh town and Pokhra village in Barabanki district, the plant operates a boiler with a nominal capacity of **120** tons per hour (TPH). The plant operates at optimal performance levels with the super heater outlet steam parameters at **87** kg/cm sq. and **515**℃. Furthermore, the plant features a high-efficiency extraction cum condensing type turbogenerator set, clocking in at **20.25** MW nominal capacity and operating with steam inlet parameters of **84** kg/cm sq. and **510**℃.

The boiler incorporates a traveling grate with electric drive, specifically designed for burning bagasse. Feed water, heated in high-pressure feed water heaters, enters the system at **170°C**. Meanwhile, the deaerator outlet water temperature is maintained at an optimal level. During the cane crushing season, the **20.25** MW turbogenerator set consumes a maximum of **102** TPH of steam to fuel its operations. Simultaneously, the **3** MW turbogenerator set generates an average of **2** MW of power through pressure reduction processes.

Mill House at BCML

Boiling House at BCML

SUMMARY OF THE STUDY TRIP TO BCML, HAIDERGARH

Haidergarh Sugar Mill is one of the key production facilities of BCML. The mill is involved in the production of sugar, ethanol, and power, leveraging advanced technology and processes to enhance productivity and efficiency. The commitment of BCML towards sustainability and innovation is reflected in its operations at their Haidergarh facility, aligning with the broader objectives of the company to maintain a leading position in the sugar industry while fostering community development and environmental stewardship.

During the study trip, participants explored several areas of the plant, encompassing the tissue culture lab, green house area, mill house, boiling house, food packaging area, warehouse, effluent treatment plant (ETP), sugar lab, and control room. The participants were provided with invaluable insights into the critical areas and processes of the plant, detailed as follows:

Tissue Culture Lab

Established in 2021, BCML's tissue culture laboratory supports in harnessing the potential of tissue culture techniques. This strategic initiative was undertaken to address several objectives including:

- Enhancing the rapid multiplication of potential plant varieties.
- Ensuring the production of disease-free seed material through meticulous meristem culture.
- Rejuvenating the seed material, particularly focusing on the '**Co-0238'** variety.

Participants at 'Tissue Culture Lab'

Green House Area

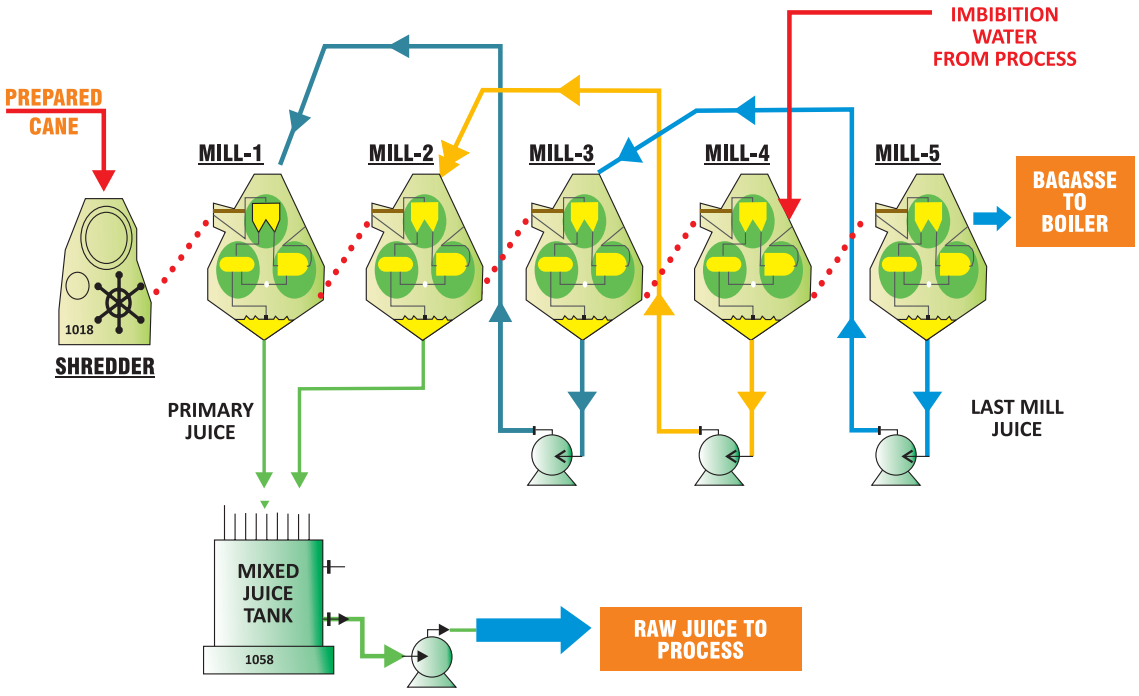
Green house area is utilised to cultivate and nurture plantlets, providing optimal conditions for growth. It offers advantages such as precise environmental control, protection from external threats, extended growing seasons, and facilitation of propagation techniques like tissue culture. Green houses play a crucial role in enhancing plantlet production, improving crop quality, and promoting sustainability in sugar cane cultivation.

Participants at the 'Green House' Area

Visit to 'Tissue Culture' Plantlets

Mill House

The **Mill House** serves as the central hub for initial processing of sugarcane. Here, the sugarcane undergoes crushing and extraction to yield juice, a primary ingredient for sugar production. While not directly involved in plantlet cultivation, the mill house indirectly supports this process by generating by-products such as bagasse, which can be repurposed as biomass energy or substrate for plant growth. A diagrammatic representation of milling process at BCML is given in the below flow chart.



Diagrammatic representation of milling process at BCML

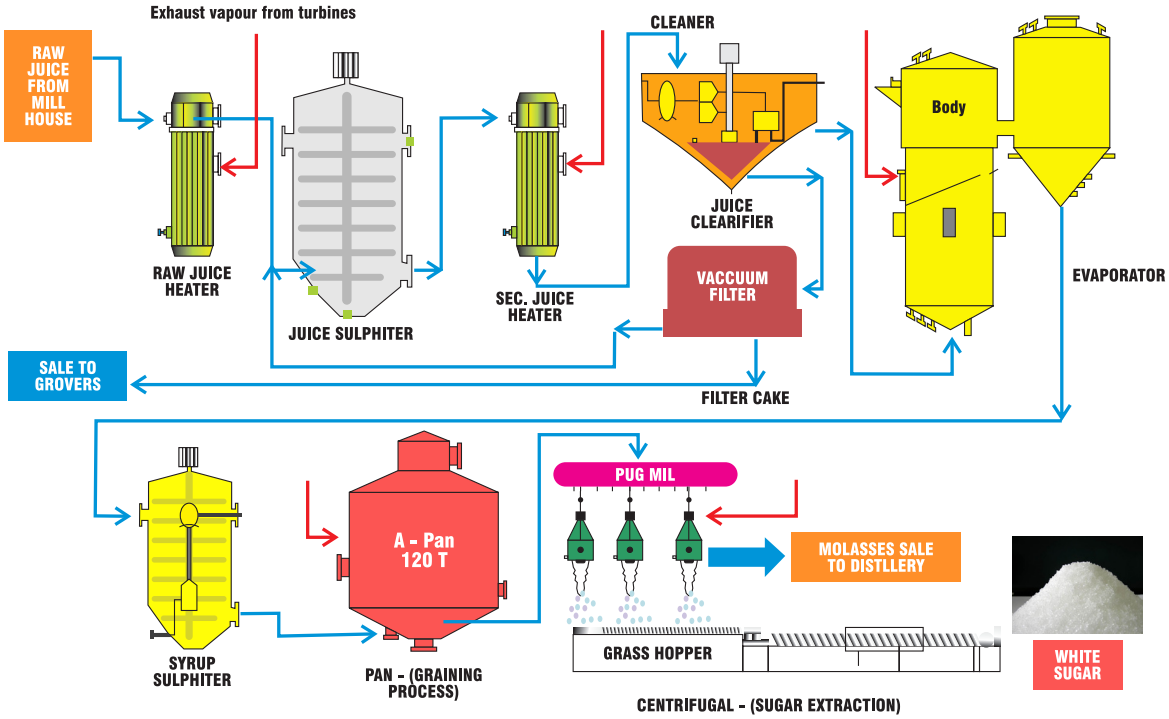
Crushing of sugarcanes

Participants at the 'Mill House'

Extraction & crushing of sugarcanes

Boiling House

The **Boiling House** plays a pivotal role in further refining sugarcane juice into sugar and other products. In the Boiling House, raw sugar is produced from the extracted sugarcane juice through a series of processes including clarification, concentration, and crystallisation. A diagrammatic representation of boiling house process at BCML is given in the below flow chart.



Diagrammatic representation of boiling house process at BCML

Participants at 'Boiling House'

Food Packaging and Warehouse

After the sugarcane juice undergoes boiling and filtration to extract sugar, the resulting solution is subjected to another filtration process prior to reaching its final product stage. This additional filtration step is crucial for removing granular impurities, ensuring the purity and quality of the sugar. Once the sugar is packaged, it is stored in the warehouse for subsequent export.

Participants at the 'Packaging Area'

Visit to 'Warehouse'

Effluent Treatment Plant (ETP)

The Haidergarh sugar mill has seamlessly integrated an ETP featuring a **lamella clarifier** alongside an advanced Sewage Treatment Plant (STP). This combined system ensures comprehensive wastewater management, effectively treating both process effluents and sewage. The treated water from these facilities is then stored in lagoons, serving a dual purpose of storage and redistribution for agricultural irrigation.

Participants at 'ETP'

Lagoon for irrigation

Sugar Lab

The sugar lab in the plant is a center for quality control, testing, process optimisation, and research and development. The lab ensures that sugar products meet standards, improves efficiency, and drives innovation.

Visit to the 'Sugar Lab'

Control Room

The entire monitoring and control of all aspects of sugar production is undertaken through the plant's control room. It facilitates overseeing the processes, adjust equipment operations, ensures safety, analyses data for optimisation, and serves as a communication centre for coordination and response to any issues. Its primary purpose is to maximise efficiency, maintain product quality, and ensure safety throughout the facility.

Participants in the 'Control Room'

Key IEED measures implemented by BCML, Haidergarh

BCML Haidergarh sugar mill has implemented several measures to enhance it's energy efficiency and to enable decarbonisation of it's operations. Some of the measures include:

- Implementation of a centralised distributed control system (DCS) system for sugar and power plant operations.
- Adoption of electrostatic precipitator (ESP) and bag filters to control air pollution effectively.
- Utilisation of VFD for fans and motors to ensure efficient operations and conserve energy.
- Integration of energy efficient motors into their processes.
- Implementation of an ETP equipped with lamella clarifiers and advanced STP configurations.
- Adoption of falling film evaporator (FFE) technology to enhance steam economy in the boiling house.

'Balram app' (accessible on basic smartphones as well), is developed by BCML for sugarcane farmers in UP state. Some of the key features of the platform include:

- Delivers essential updates to farmers, including real-time information on cane supply tickets and comprehensive payment histories.
- Provides valuable tools such as a fertiliser calculator that aids farmers in accurately determining the necessary amount of fertiliser for optimal soil fertility.
- Offers insights into crop diseases and their prevention, thereby promoting agricultural awareness and increasing productivity.

FEEDBACK FROM THE PARTICIPANTS

- **~100%** of the participants responded that they were more than satisfied with the outcomes of the study trip.[12]

- **~100%** of the participants rated the quality and content of the delivery during the study trip as more than satisfactory.[12]

- During the study trip, participants particularly appreciated the mill house and boiling house sections, where they observed the sugar production process firsthand. Participants also appreciated the efficiency of the centralised control system, which allowed for real-time monitoring and adjustment of operations at BCML, Haidergarh. These sections provided valuable insights into sugar production, technology, and environmental consciousness.

"Overall experience of the study trip was very good"

- Mr. Shubham Dubey, Senior engineer

Triveni Engineering

"The study trip was very informative and we will try to implement similar measures in our plant"

- Mr. Gyan Prakash Singh, Sr. Manager

KM Sugar Mills Ltd.

12 provided a 7+ rating on a scale of 10.

CONCLUSION

Group photograph of participants during the study visit to BCML, Haidergarh

The response to the study trip has been positive with significant participation from senior officials from BEE, executive leadership of leading Indian sugar industries, and technology providers from India. The study trip achieved its goal of giving national organisations a stage to witness the operations of new and innovative IEED measures implemented and the challenges faced in the implementation of the same. The study trip successfully promoted GESI through the participation of women employees from BCML. It is expected that this study trip will have a demonstrable and long-lasting on-field impact in due course of time. Further, to keep up the momentum, following activities are envisaged under the ASPIRE Programme to enable wider adoption of IEED measures and technologies by Indian sugar industries to achieve their net-zero targets:

- Provide support including B2B interactions/ webinars to large energy-intensive industries (including sugar sector) to support in identifying technologies & solutions, and technology suppliers for enhanced adoption of IEED interventions.
- Create more discussion forums to facilitate the exchange of knowledge and information.

ANNEXURE – Attendance Sheet

S. No	Name	Designation	Organisation
1	Mr. Dalip Kumar Tomar	Asst. General Manager	Mawana Sugar Works Mawana (Unit of Mawana Sugars Limited)
2	Mr. K. K. Jha	AEA	Padmashtdal Energy services Pvt. Ltd. New Delhi
3	Mr. Vishal Goyal	Director	Operative Save Urja Solutions Pvt. Ltd.
4	Mr. Deepak Bhawsar	DGM -Elect	Balrampur Chini Mills Limited, Mankapur
5	Mr. Virendra Kumar	AGM (Electrical)	Bajaj Hindusthan Sugar Ltd. (BHSL), Gangnauli
6	Mr. Vinay Pratap Singh	Manager (Mills)	Bajaj Hindusthan Sugar Ltd. (BHSL), Gangnauli
7	Mr. Mayakant Shukla	Energy Manager	UPSDA (UPNEDA, Vibhuti Khand, Gomtinagar, Lucknow
8	Mr. Amit Kumar	Project Associate	UPSDA (UPNEDA, Vibhuti Khand, Gomtinagar, Lucknow
9	Mr. M.V. Ramesh	VP - Cogen	NSL Sugars Ltd
10	Mr. KVVSN Murthy	GM - Operations	NSL Sugars Ltd
11	Mr. Raghavendra	Manager	NSL Sugars Ltd
12	Mr. U. S. Jaiswal	GM (Project)	K M Sugar Mills Ltd.
13	Mr. Gyan Prakash	Sr. Manager Elec. (Cogen)	K M Sugar Mills Ltd.
14	Mr. Abhishek Pandey	Sr. Engineer	The United Provinces Sugar Co. Ltd., Seorahi, Kushinagar.
15	Mr. Shivpal Yadav	Dy. CC	The United Provinces Sugar Co. Ltd., Seorahi, Kushinagar.
16	Mr. Sankalp Suman	Sr. Manager	ISMA
17	Mr. K. N. Vishwakarma	Sr. Manager	TEIL Ramkola
18	Mr. Shubham Dubey	Engineer	TEIL Ramkola
19	Mr. Rohan Kadamb	Analyst	Development Environergy Services Ltd
20	Mr. Puneet Mishra	-	BCML, Haidergarh
21	Mr. Ajay Kumar Singh	Dy. Manager	BCML, Haidergarh
22	Mr. Vikas Kumar Singh	-	BCML, Haidergarh
23	Ms. Nandini Gupta	Technician	BCML, Haidergarh
24	Ms. Shalu Vishwakarma	Technician	BCML, Haidergarh

S. No	Name	Designation	Organisation
25	Ms. Priyanka Mishra	NSI	BCML, Haidergarh
26	Mr. Tarun Kumar	-	Daurala Sugar Works, Daurala, Meerut
27	Mr. Harkirat Singh	General Manager	Daurala Sugar Works, Daurala, Meerut
28	Mr. Dhiraj Gosain	Manager	Daurala Sugar Works, Daurala, Meerut
29	Dr. Ashok Kumar	Deputy Director General	Bureau of Energy Efficiency
30	Mr. Sunil K. Khandare	Director	Bureau of Energy Efficiency
31	Mr. Ashish Ranjan Srivastava	Senior Sector Expert	Bureau of Energy Efficiency
32	Mr. Anurag Sirola	Associate Director	KPMG (ASPIRE Programme Team)
33	Mr. K. K. Chakarvarti	Sr. Advisor - IDEEKSHA	Idam Infra (ASPIRE Programme Team)
34	Mr. Dipak Khandare	Associate Director – Industrial Decarbonisation	Idam Infra (ASPIRE Programme Team)
35	Ms. Dhaarna Rawat	Consultant	Idam Infra (ASPIRE Programme Team)

FOR MORE INFORMATION PLEASE CONTACT

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