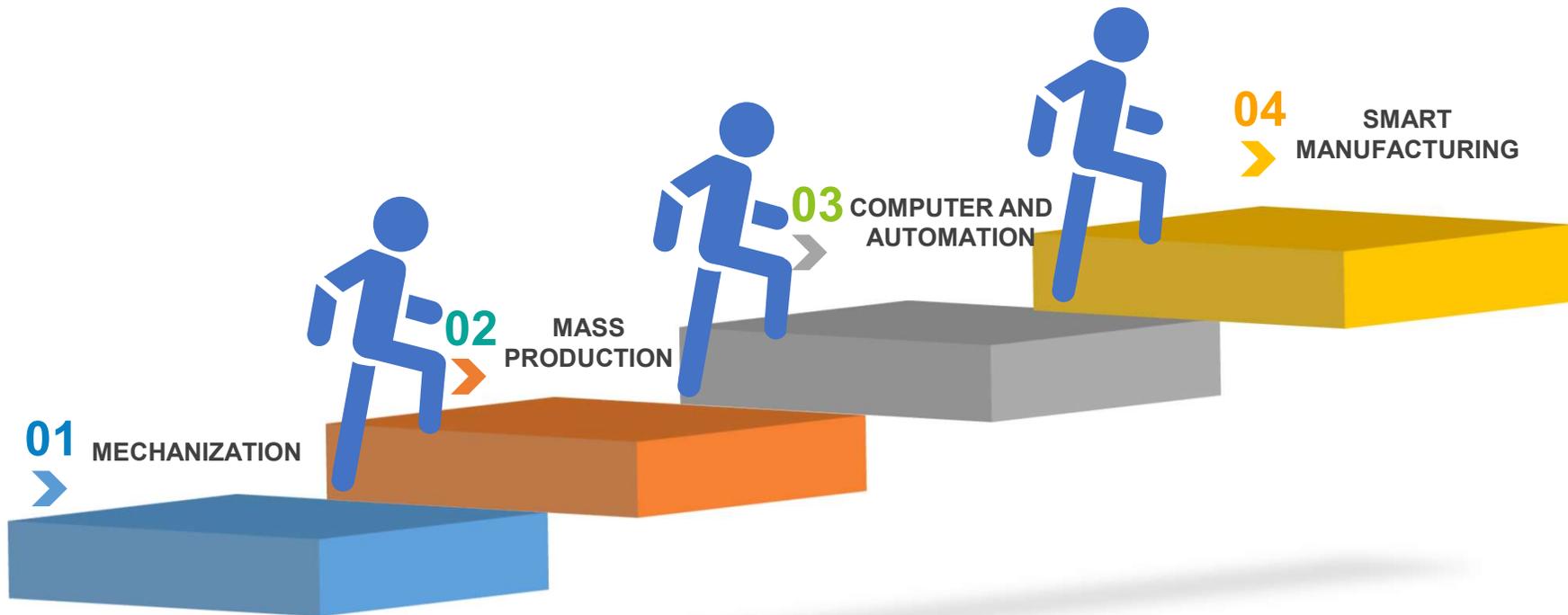


# BHEL SAMVAAD 3.0

- सहयोग से सफलता

## AI in Manufacturing Technology



9<sup>th</sup> Nov 2023

Bharat Mandapam, New Delhi

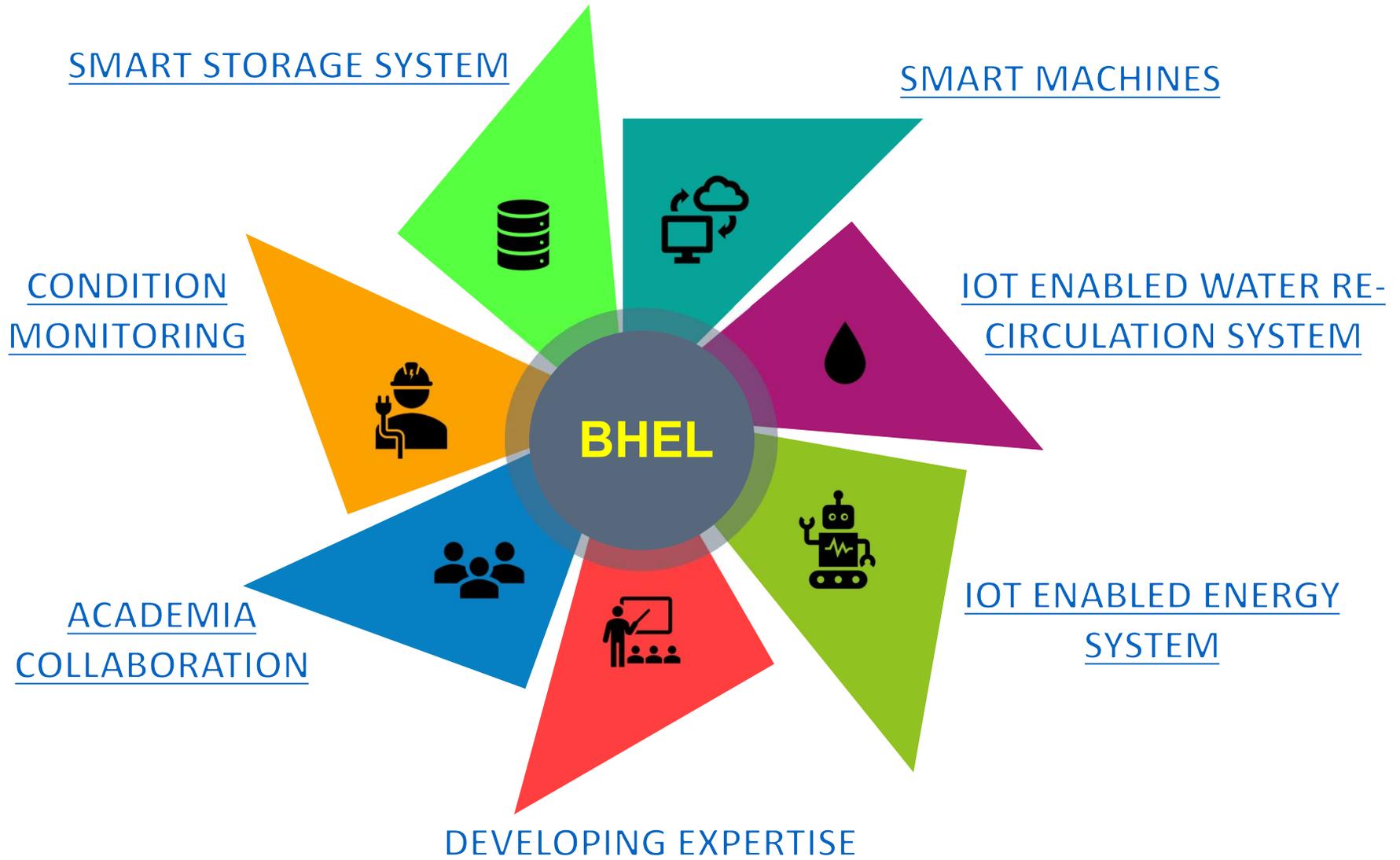
Session – AI in Manufacturing Technology



# AI in Manufacturing Technology



**BHEL.... Moving ahead with small steps.....**



## Applications - Smart Machines

- ✓ Large CNC vertical borer with table dia of 6.5m & work piece height of 7m.
- ✓ Phase-1: Discrete sensor Data collection & utilization -
  - ✓ Added 71 analog sensors to get key insights.
  - ✓ Dedicated server.
  - ✓ Generation of system generated e-mails/ SMS for alarms/ pre-alarms.
  - ✓ Display of Real time & historical trends.
- ✓ Phase-2: Controller Data collection & use -
  - ✓ Real time collection & display of critical CNC Parameters.
- ✓ Substantial reduction in machine breakdown hours (YoY basis).



Pietro Carnaghi CNC Vertical Borer machine - Turbine Shop  
HEEP, Haridwar



# Applications - Smart Machines

SIEMENS SIMATIC HMI  
Friday, August 6, 2021 3:25:42 PM

SENSOR SELECTION BASED ON SENSORS TYPE

- VIBRATION VELOCITY
- FLOW
- PRESSURE
- LEVEL
- TEMPERATURE
- CURRENT
- CONTAMINATION
- INCLINATION
- DEW POINT
- VOLTAGE
- AIR PRESSURE
- VIBRATION ACCELEROMETER
- ENERGY

TOUCH

SIEMENS SIMATIC HMI  
Friday, August 6, 2021 3:23:37 PM

LEVEL SENSOR

- AXES HYDROSTATIC TANK: 286.24 mm
- MAIN HYDROSTATIC TANK: 375.01 mm
- TABLE HYDROSTATIC TANK: 598.49 mm

TOUCH

SIEMENS SIMATIC HMI  
Saturday, August 7, 2021 1:30:03 PM

ALARM GEARBOX OIL DELIVERY PUMP\_39M3 LOW FLOW

PRESSURE SENSOR

- HYDRAULIC OIL PUMP\_238M2: 148.62 bar
- HYDRAULIC OIL PUMP\_238M2: 139.91 bar
- OIL DEL PUMP TP\_X\_308M2: 16.71 bar
- OIL DEL PUMP TP\_Y\_408M2: 26.88 bar

TOUCH

SIEMENS SIMATIC HMI  
Saturday, August 7, 2021 1:32:49 PM

MAIN HYDRAULIC TANK LEVEL

REAL TIME: 363.44 mm

HISTORICAL

Tag connection Value	Date/time
363.425400	8/7/2021 1:33:43:299 PM

TOUCH



## Applications – Condition Monitoring

- ✓ Vibration & Temperature Monitoring System (Critical Machine Assemblies) - 6 Critical CNC Machines - Turbine Shops.
- ✓ Real time graphical display and historical data being captured.
- ✓ Generation of pre-alarm through automatic e-mails/ SMS.
- ✓ Can reset the alarm status of sensors from remote location.
- ✓ Dashboard for data visualization.



Smart sensor installed on machines

# Applications – Condition Monitoring

MAIN MENU
TURBINE SHOP
09-09-2023 16:43:14

VERTICAL BORING MACHINE  
MAKE: SCHIESS GERMANY  
TABLE DIA: 4000 MM  
WEIGHT CAPACITY: 80 TON  
MAX. TURNING HEIGHT: 4200 MM  
MAX. TURNING DIA: 5000 MM



M/c Plan No: 2-472

CNC LATHE MACHINE  
MAKE: M/s SAFOP ITALY  
SWING OVER CARRIAGE: 3500 MM  
CENTRE DISTANCE: 19000 MM



M/c Plan No: 2543

Machine Status ●

Device Status ●

Machine Status ●

Device Status ●

**LEGENDS:**

<p>Machine Status</p> <ul style="list-style-type: none"> <li><span style="color: green;">●</span> - In Operation</li> <li><span style="color: yellow;">●</span> - Idle</li> <li><span style="color: red;">●</span> - Power Off</li> </ul>	<p>Device Status</p> <ul style="list-style-type: none"> <li><span style="color: green;">●</span> - No Alarm</li> <li><span style="color: yellow;">●</span> - Pre-Alarm</li> <li><span style="color: red;">●</span> - Main-Alarm</li> </ul>
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MAIN MENU
NEW TURBINE SHOP
09-09-2023 16:42:07

CNC LATHE MACHINE  
MAKE: M/s SAFOP ITALY  
SWING OVER CARRIAGE: 1800 MM  
SWING OVER BED: 3000 MM  
CENTRE DISTANCE: 10000 MM  
WEIGHT CAPACITY: 80 TON



M/c Plan No: 1-031

CNC LATHE MACHINE  
MAKE: M/s SAFOP ITALY  
SWING OVER CARRIAGE: 1800 MM  
SWING OVER BED: 3000 MM  
CENTRE DISTANCE: 10000 MM  
WEIGHT CAPACITY: 80 TON



M/c Plan No: 1-033

Machine Status ●

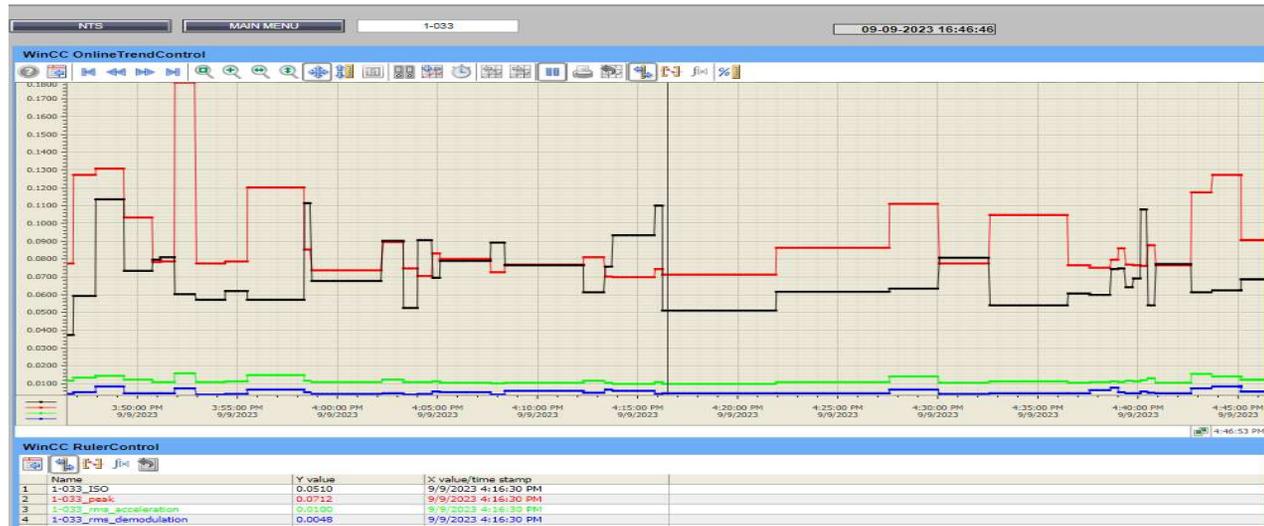
Device Status ●

Machine Status ●

Device Status ●

**LEGENDS:**

<p>Machine Status</p> <ul style="list-style-type: none"> <li><span style="color: green;">●</span> - In Operation</li> <li><span style="color: yellow;">●</span> - Idle</li> <li><span style="color: red;">●</span> - Power Off</li> </ul>	<p>Device Status</p> <ul style="list-style-type: none"> <li><span style="color: green;">●</span> - No Alarm</li> <li><span style="color: yellow;">●</span> - Pre-Alarm</li> <li><span style="color: red;">●</span> - Main-Alarm</li> </ul>
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## Academia Collaboration

- ✓ BHEL in collaboration with academic institutions developed a solution for conversion of Old/Legacy Machines into Smart machines.
- ✓ Project includes:
  - ✓ Design & fabrication of hardware for collection of data from sensors.
  - ✓ Development of Graphic user interface (GUI).
- ✓ Storage of sensor data on Laptop/ PC along with provision for queries.
- ✓ Report Generation Facilities on dashboard.



Developed Hardware (PCBs)



Hardware Simulation in Lab



## Applications - Smart Storage System

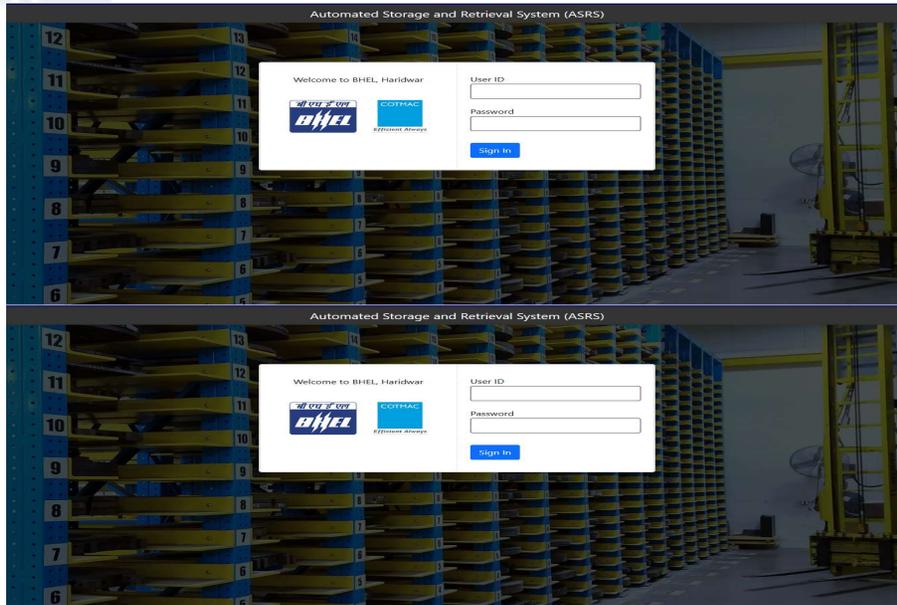
- ✓ Cost-effective solution for BHEL's own product with IOT/ Industry 4.0 integration.
- ✓ Wireless Communication (in metallic environment) between Stacker Crane and Operator Station.
- ✓ Developed HMI screens for machine operations.
- ✓ Display of Real time & historical trends at remote location.
- ✓ Diagnostic and Maintenance Friendly Setup using Smart HMI and PLCs.



Automated Storage & Retrieval System (ASRS) – New Blade Shop, HEEP, Haridwar



# Applications - Smart Storage System



Welcome ASRS! 20/09/2022 02:42:27 AM [Logout](#)

**Material Handling** Material Handling Filter

	Date	Time	Module	Design#	Stage#	Box#	Bin#	Quantity	Status	Position	Action
Add New Bin											
View Rack Status											Clear Search
Homing Options	25/08/2022	03:11:08 PM						4000			Edit Material+ Delete X Move
Input/Output Info	22/08/2022	11:49:15 PM						7			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						7			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						5			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						1			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						2			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						2			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						2			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						6			Edit Material+ Delete X Move
	22/08/2022	11:49:15 PM						2			Edit Material+ Delete X Move

**View Rack Status**

- Material Report
- Transaction Report
- Homing Options
- Input/Output Info
- Screen Logs
- User Management
- Settings

**Left Side**

8	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	8
7	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	7
6	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	6
5	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	5
4	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	4
3	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	3
2	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	1

**Right Side**

8	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	8
7	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	7
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3	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	3
2	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	1

■ Loaded large bin 
 □ Empty large bin 
 ■ Loaded small bin 
 □ Empty small bin

**View Rack Status**

- Material Report
- Transaction Report
- Homing Options
- Input/Output Info
- Screen Logs
- User Management
- Settings

**Homing Options** Machine Control Supply: On

Current Horizontal Position: 1      Current Vertical Position: 1

Machine Homing Required      Machine Gate is Closed

Machine Homing Start      Fork Left Move      Fork Right Move

Machine Homing Done      Fork Left      Fork Center      Fork Right

Position

156L

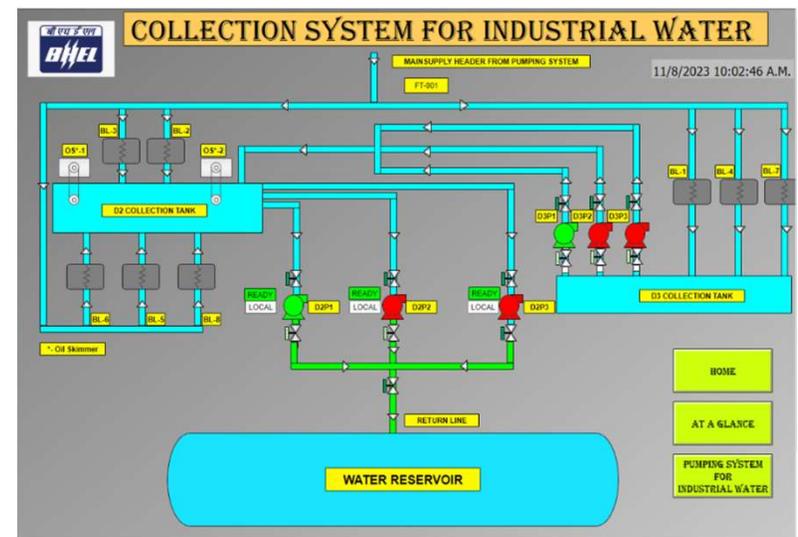
Store in P&D
Retrieve from P&D



# Applications – Water Re-Circulation System

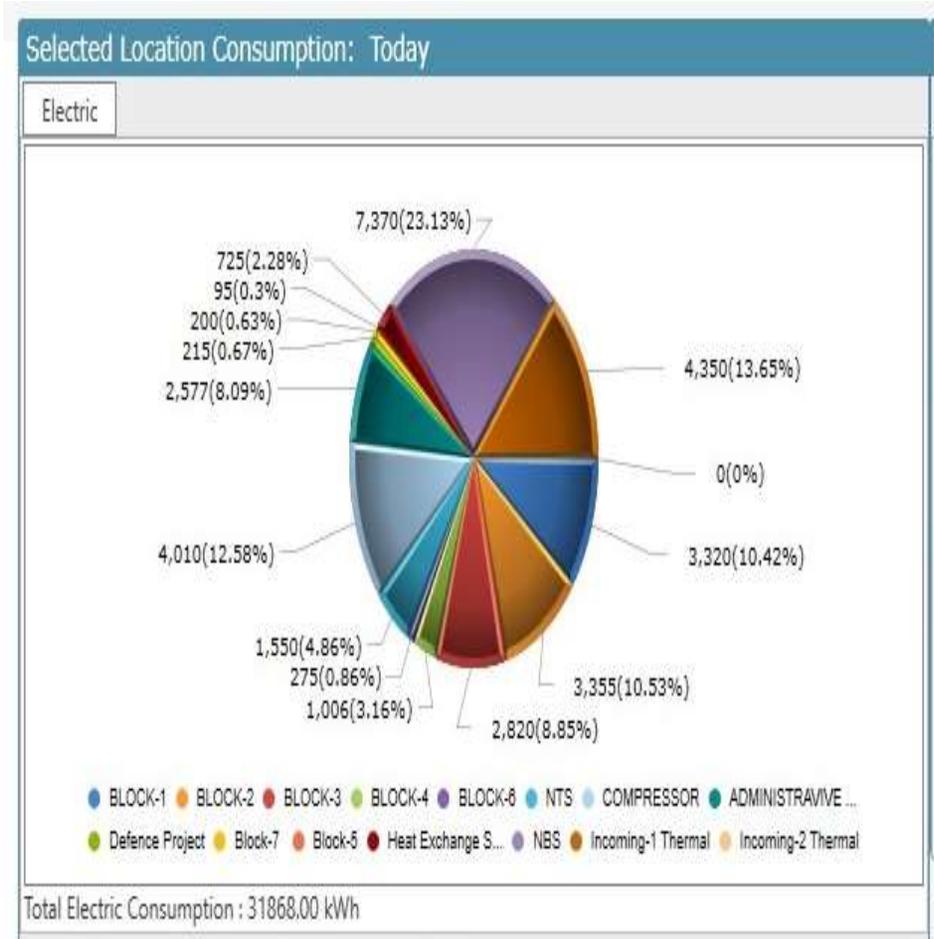


- ✓ Established a real time monitoring system for industrial water usage and its re-circulation.
- ✓ Provision of Alarms and Messages on connected devices.
- ✓ Energy Saving due to need based automatic operation.
- ✓ Reduction in ground water extraction.
- ✓ Data storage, monitoring and analysis.



## Applications – Energy System

- ✓ Real time monitoring of electricity consumption at Haridwar units.
- ✓ Automatic data logging.
- ✓ Monitoring parameters viz. Active & Reactive Power, Power factor, Maximum demand, Harmonic Analysis etc.
- ✓ Monthly, weekly & daily report generation.
- ✓ Real time trends of block-wise consumption.
- ✓ Developed Dashboard for user interface.



# Applications – Energy System

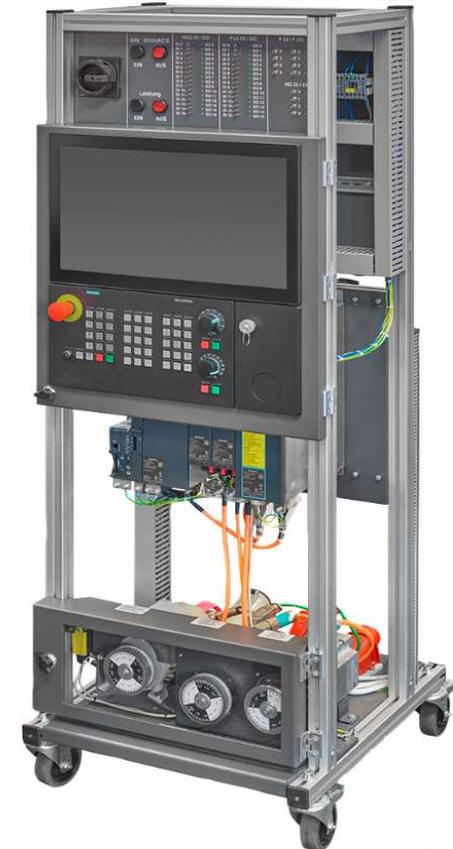


Energy Monitoring System (Dashboard)



## Developing Expertise

- ✓ BHEL is highly focusing on Skill development of its employees in advanced technologies.
  - ✓ Latest Siemens make CNC controllers for training and simulation of IIoT projects in machine environment.
  - ✓ Tie up with industry experts/ educational institutes for training modules.



*THANK YOU....*

*BACK-UP SLIDES ....*



# AI in Manufacturing Technology



## Other Initiatives under Progress

- ✓ Establishment of single connector (MPI to Ethernet Protocol) on CNC machines in HEEP, Haridwar.
- ✓ Blades Dispatch monitoring system with marking machines at HEEP.
- ✓ All new machines & CNC controllers are OPC-UA compliant.