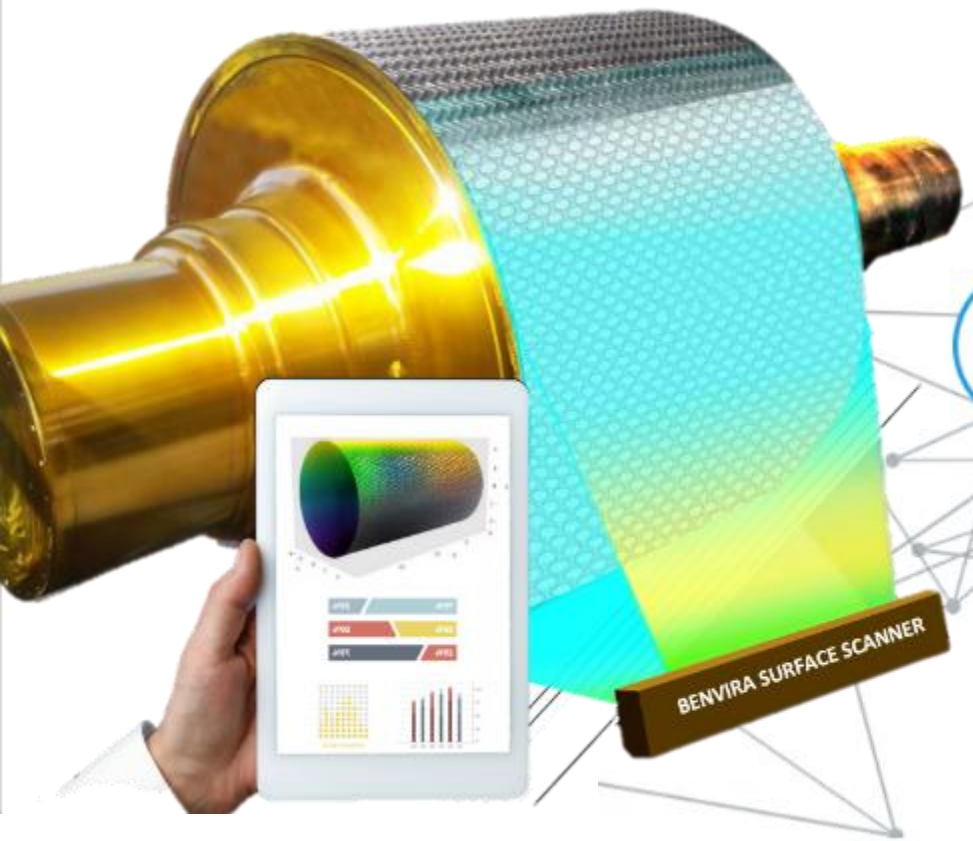
BENVIRA
FORWARD ALGORITHMS

An Online Monitoring and Metal Detection System for HPGR



DON'T REACT TO THE FUTURE:
BE PREPARED FOR IT

An Online Monitoring and Metal Detection System for **HPGR**

BENVIRA
FORWARD ALGORITHMS

WHAT ? Is BENVIRA

WHY ? BENVIRA

HOW ? It WORKS

ONLINE WEAR READINGS

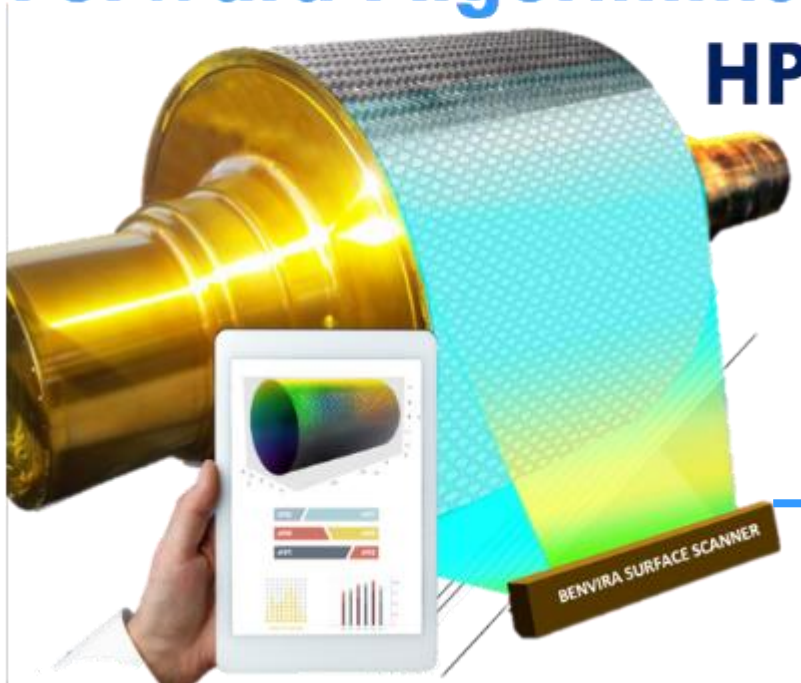
KEY COMPONENTS

METAL DETECTION

MILESTONES ACHIEVED

BENVIRA @ UTCL SKCW

A Forward Algorithms for HPGR



What is BENVIRA ???

BENVIRA
FORWARD ALGORITHMS

- Industrial IOT – Develops own Sensing Technology & Predictive Algorithms.
- Customized Solutions.
- End to End.
- Uses Direct Approach instead of Deductive Approach for wear measurement.
- Valuable Actionable Insights.
- Timely actions that help prevent breakdown/downtime.

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Why BENVIRA ???

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- Custom made sensors + Proprietary Predictive Intelligence algorithms that will help you predict the unpredictable.
- For the first time in World - Online Surface Wear Measurement while the Mill is in Operation.
- Work closely with clients as per their requirements.

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How it Works !!!

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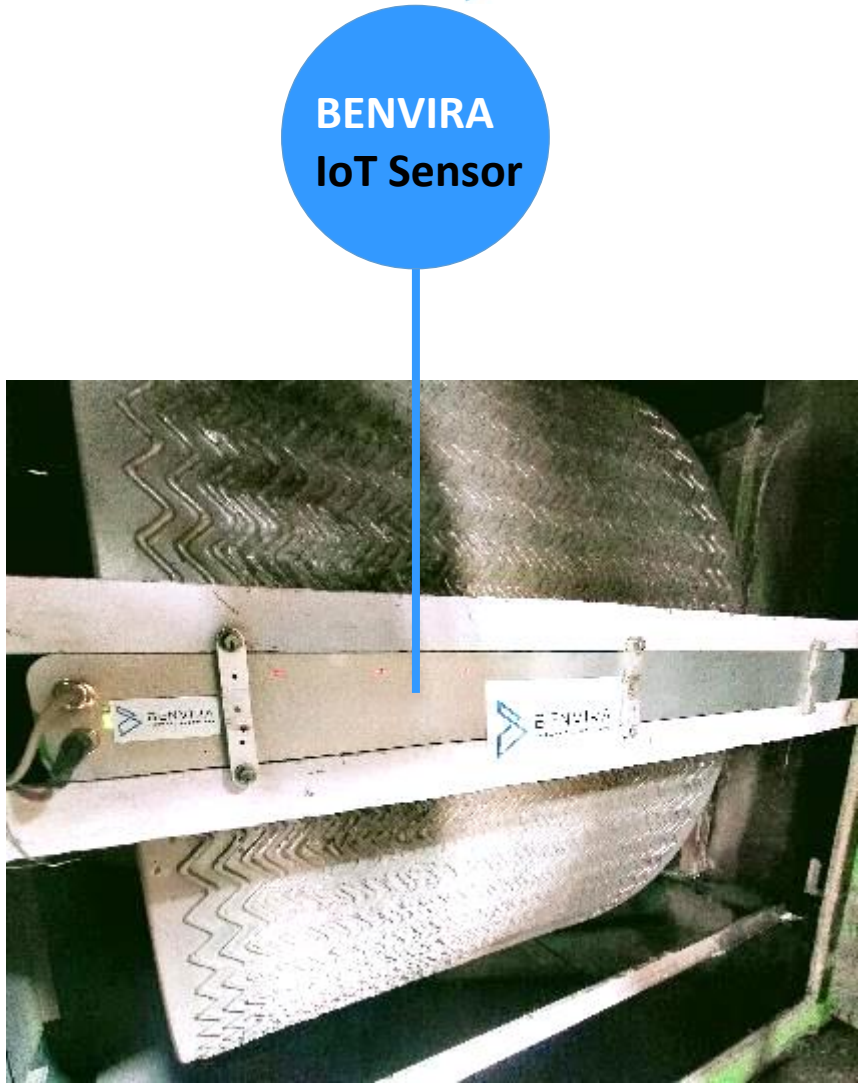
- **Principle of Working**
- The IoT sensor emits a sonic pulse and calculates the distance depending upon the time taken by the return pulse to travel back after reflecting from the desired rollers surface, when rollers in rotation.
- Wear will cause a change in the distance measured. High points or low points will be shown on the Dashboard.
- All this happens while Mill is in Operation.



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IoT Sensors for surface wear measurement

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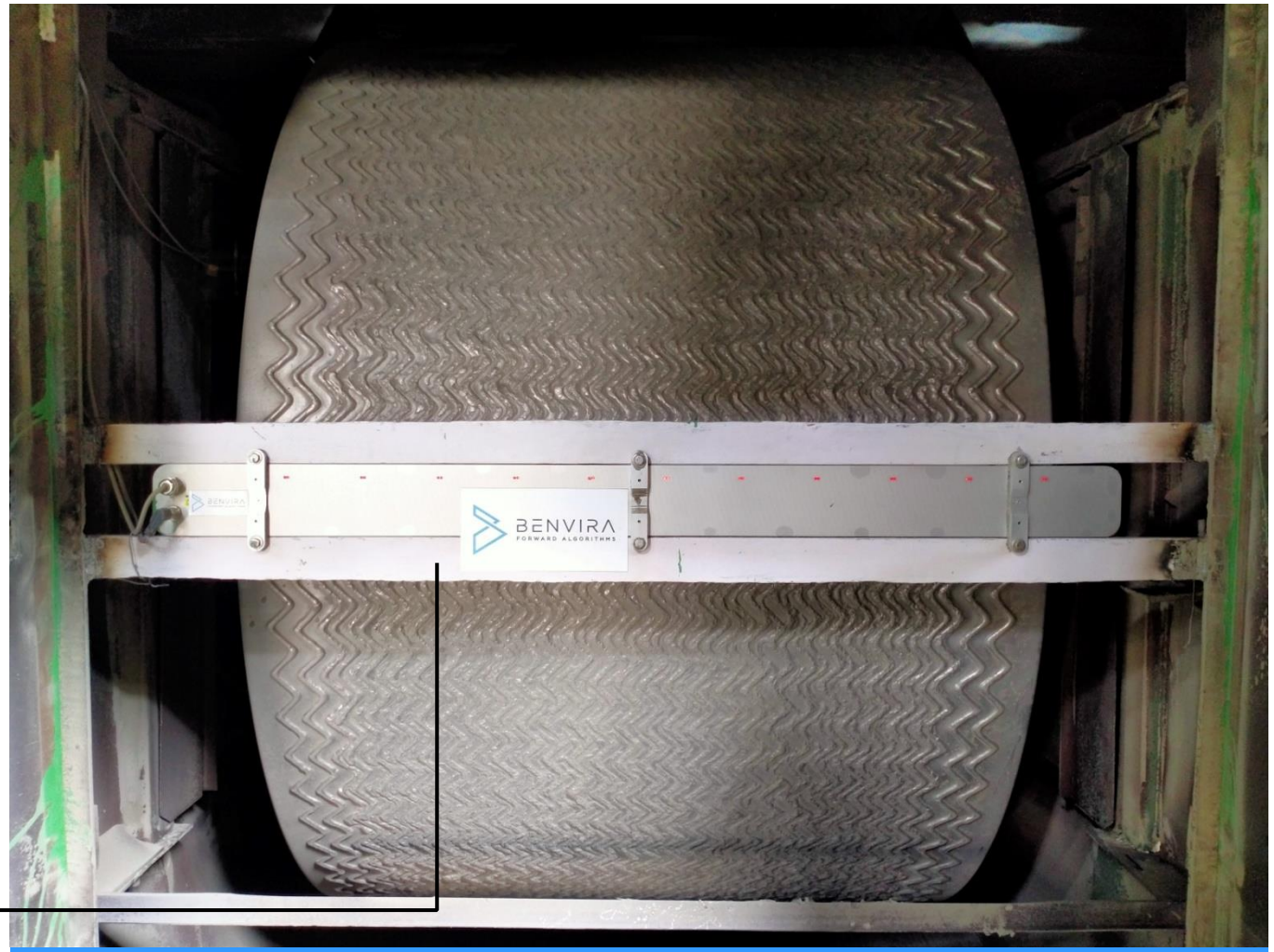
FIXED ROLLER



MOVABLE ROLLER

IoT Sensors / Surface Scanner

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How it Works !!!

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- There are total 33 modules on a single surface scanner which take approximate 33000 readings in one revolution. It works at 50Hz.
- This system converts the Cylindrical Surface of the Rollers into a Wear Map.
- X axis – shows readings of 33 modules.
- Y axis shows wear readings across 360 degree of Roller.
- Entire Roller Surface is divided into Pixels of 30mm x 30mm.
- The system generates the wear measurement by taking the Average Readings as per below,

- Average of Maximum Reading
- Average of Minimum Reading
- Average of Average Readings

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BENVIRA's First Ever Project

@ UTCL, Sikandarabad !!!

Online Readings on Dashboard !!!

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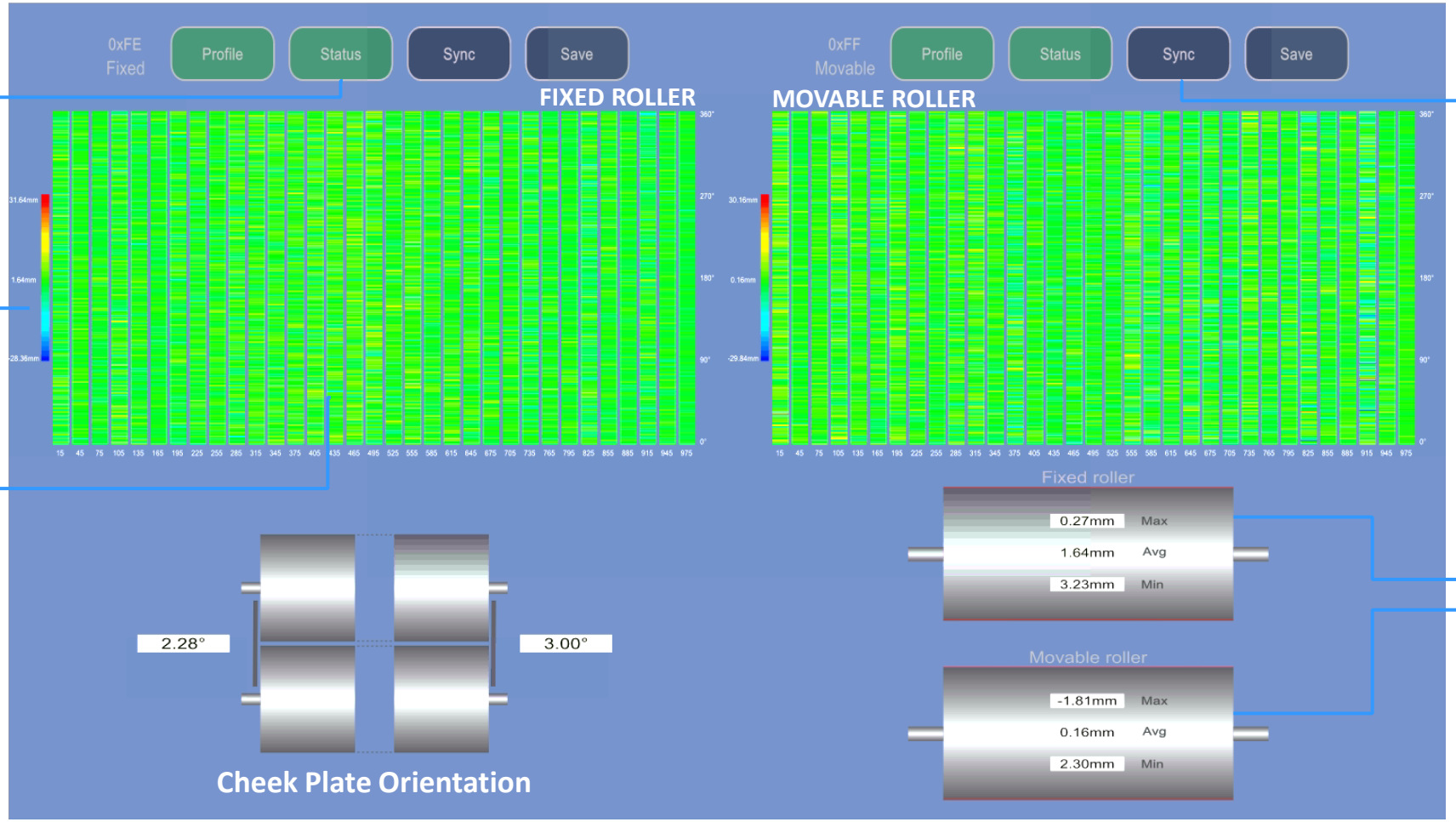
Healthy Signals of Different sensors



Synchronization OR Roller Rotation

Surface Wear on Rollers- Color Representation

Overall Surface Wear

Green- The wear is within parameter

Red- Severe Wear up to 30 mm

Blue- "-ve" wear up to 28 mm

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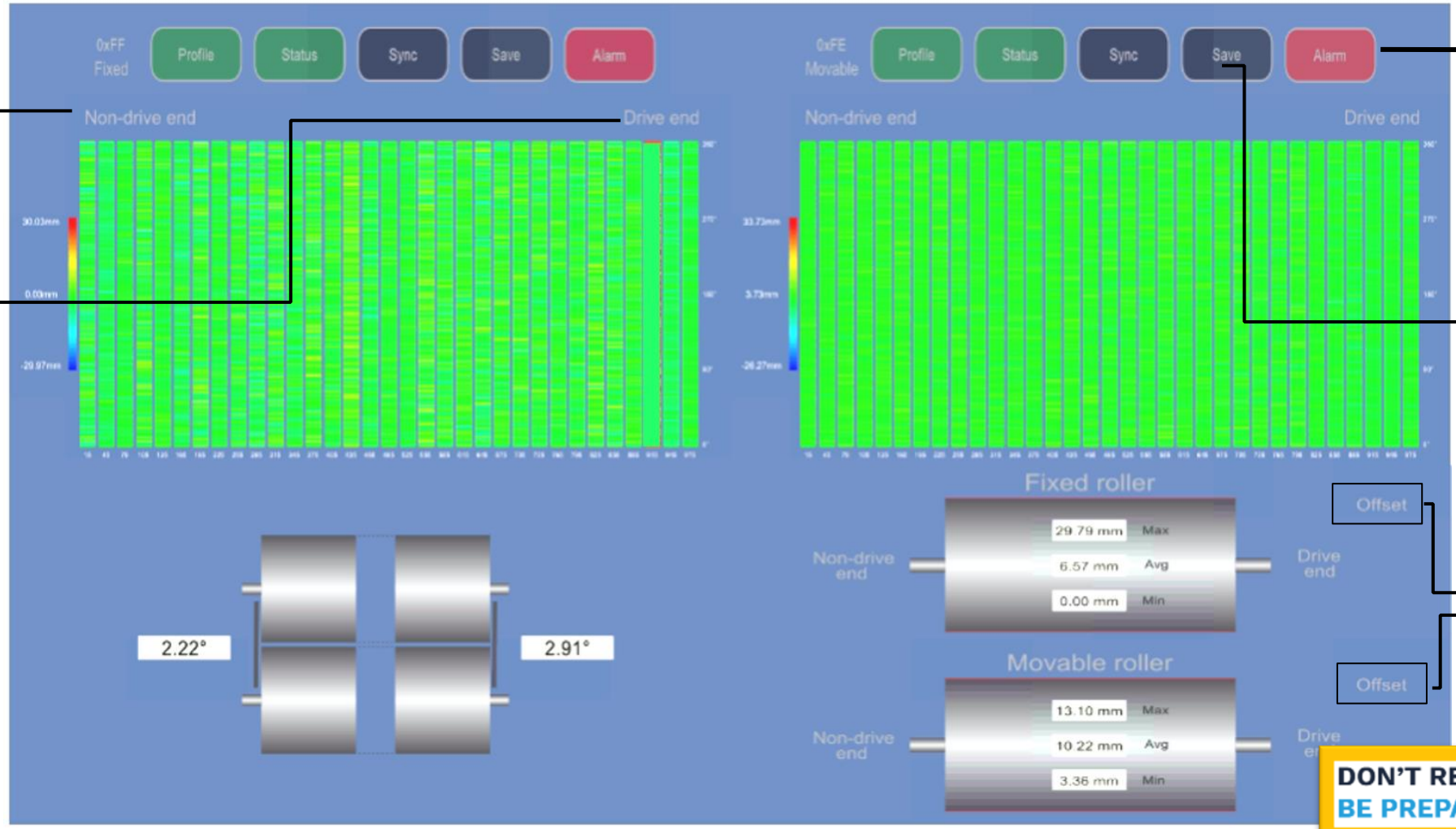
New Developments !!!

Informative Dashboard for Online Readings



Rollers End i.e. Drive End & Non Drive End

Warning Alarm for Periodic Maintenance

Data can be saved At an Instant

OFFSET Buttons To see Zero day readings and current readings

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Online Readings on Dashboard !!!

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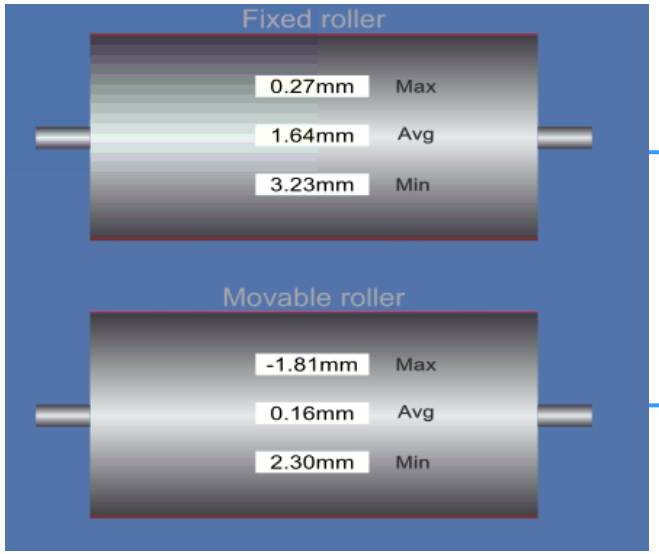
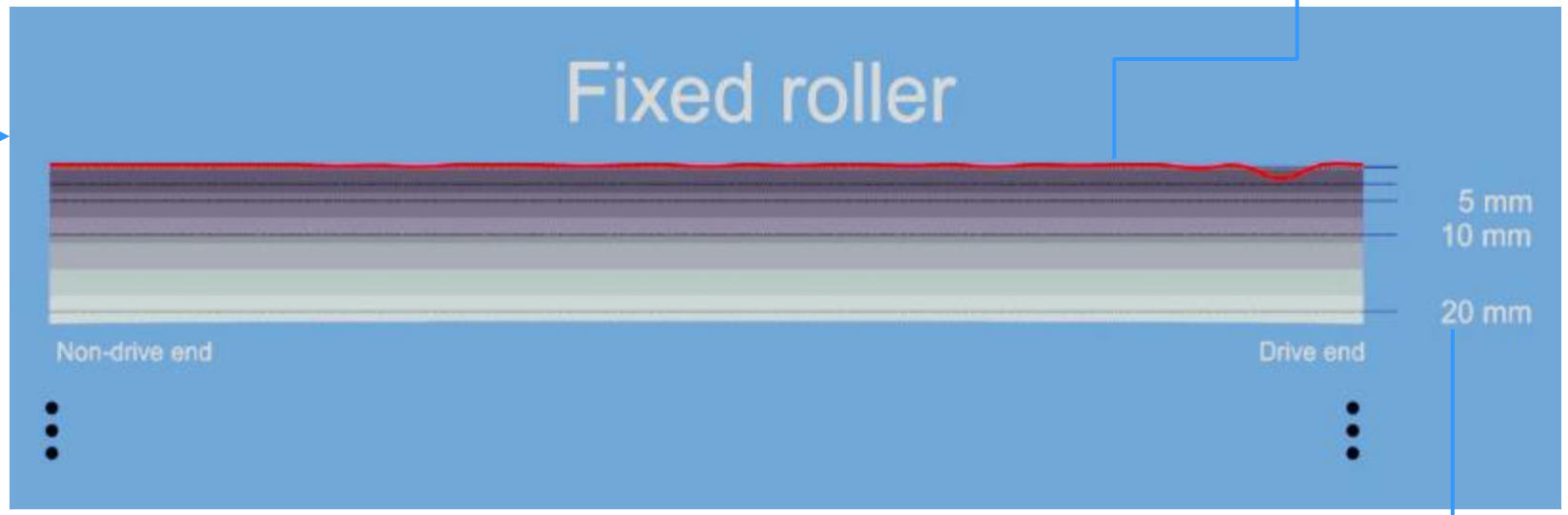
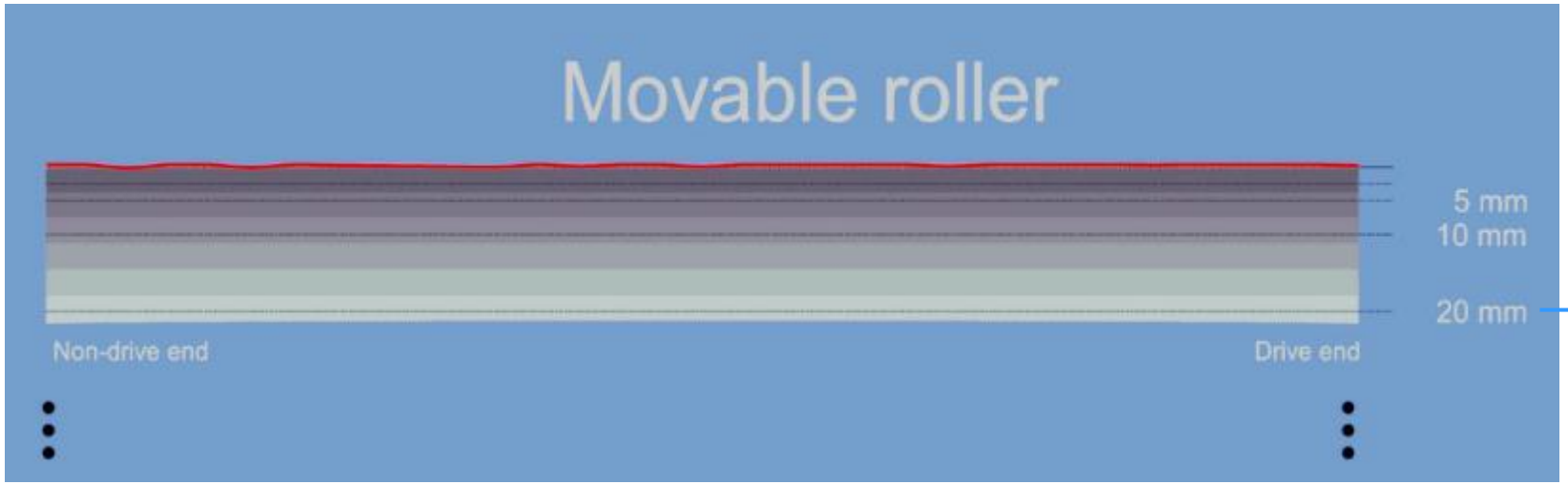
Graphical Representation of Surface Wear on Rollers



Red Curve shows wear pattern





Depth of wear up to 20 mm

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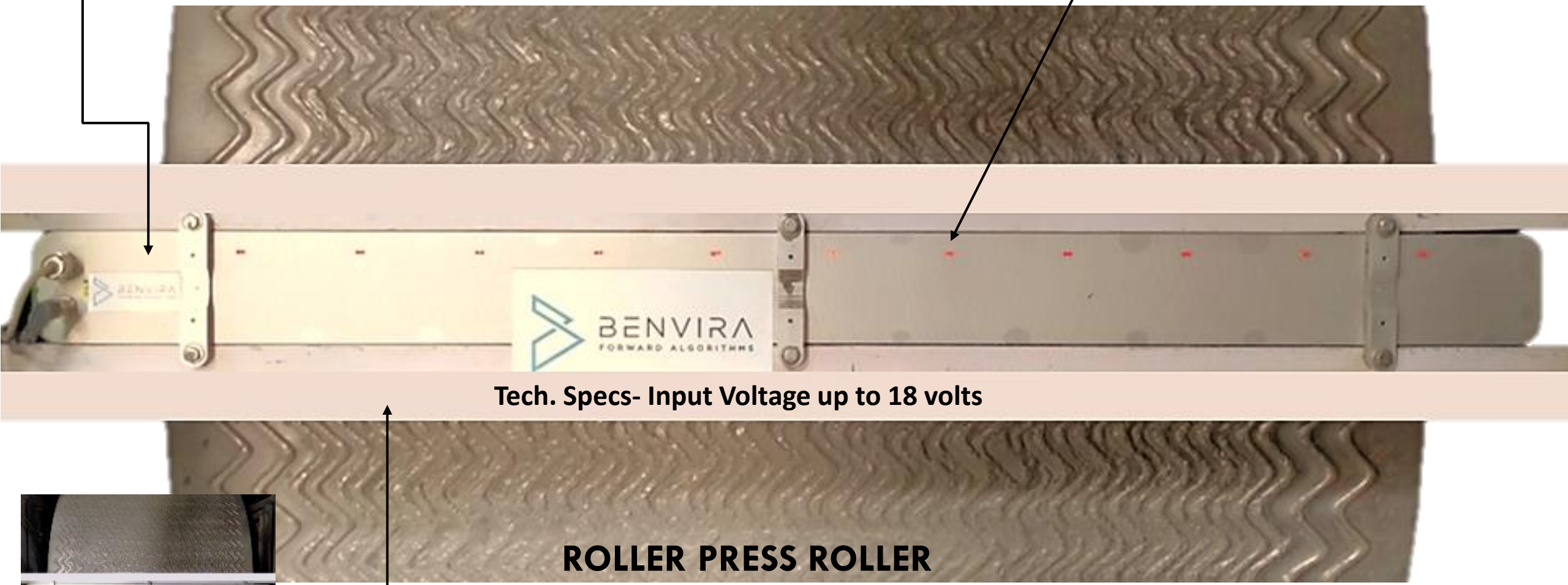
Key Components !!!

IoT Sensors for surface wear measurement

Sensing Modules



Tech. Specs- Input Voltage up to 18 volts

ROLLER PRESS ROLLER

DON'T REACT TO THE FUTURE:
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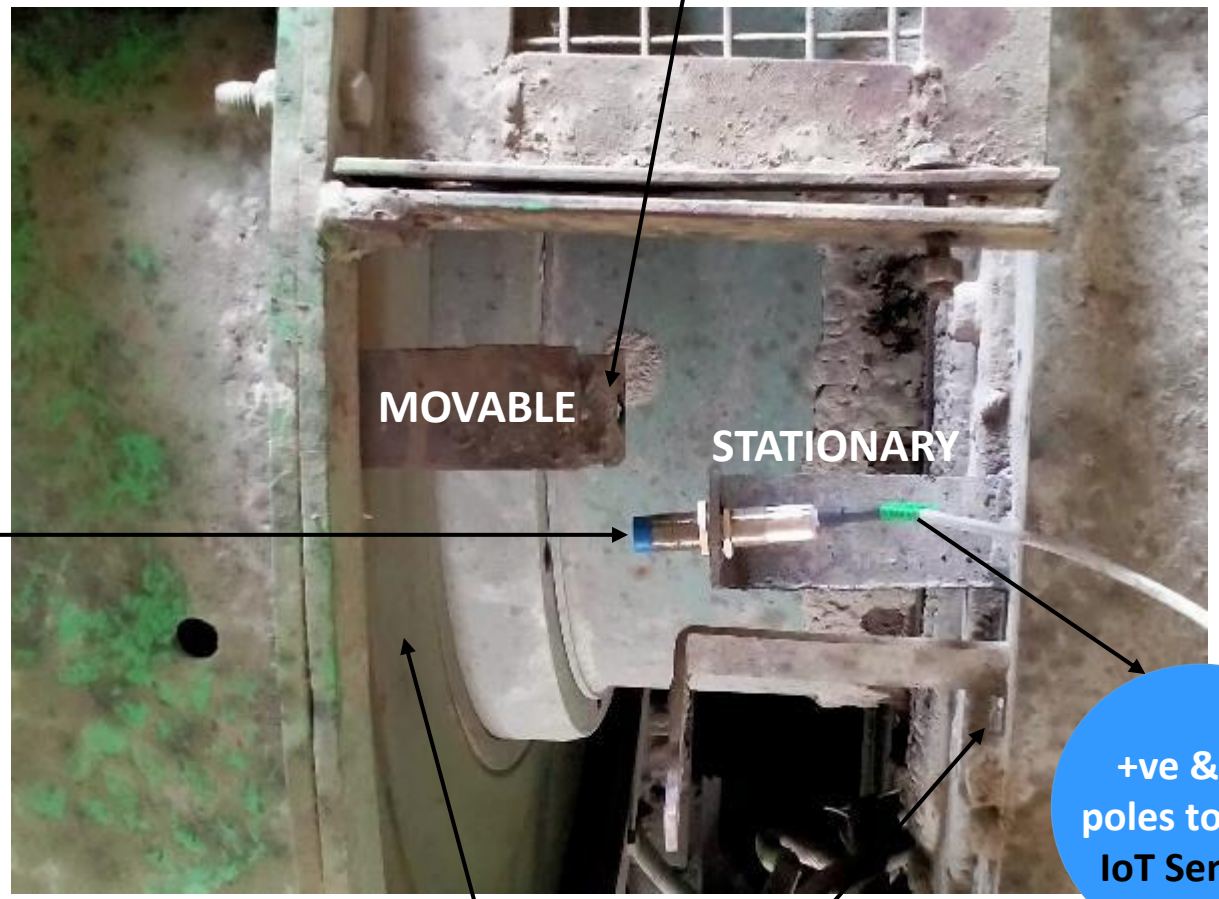
Key Components !!!

Proximity Sensors for rotational synchronization

Tech. Specs- NO Type; 8 to 24 v; 3 wire



Installed between Shrink Disc and Bearing Housing area

DON'T REACT TO THE FUTURE:
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Key Components !!!

Control Panel

Power Supply
230 VAC to 24 VDC
Current Voltage- 16 VDC

CPU
for data handling

Input from IoT
sensors

24 x 7 Internet Supply

TB & MCB

DON'T REACT TO THE FUTURE:
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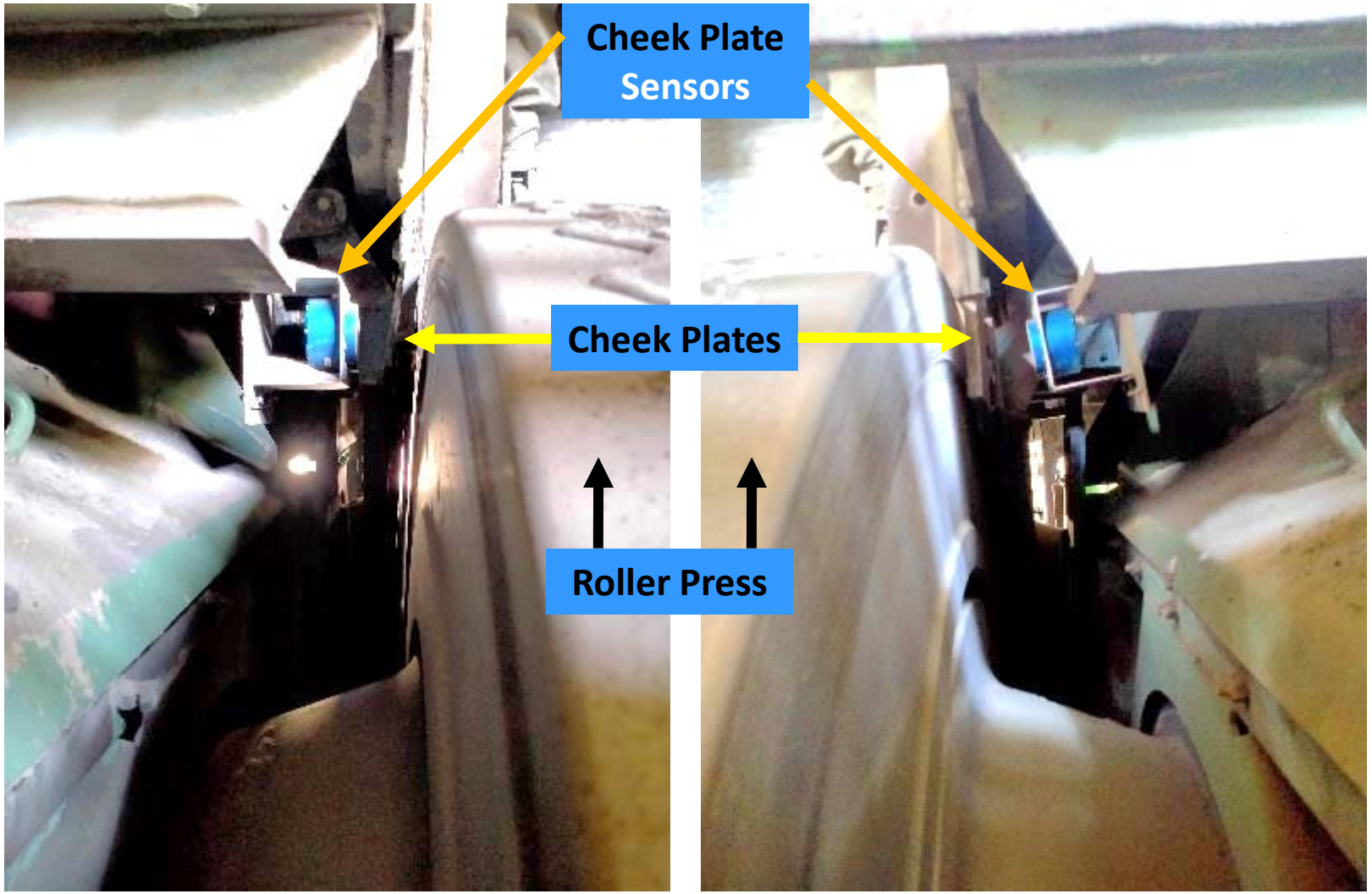
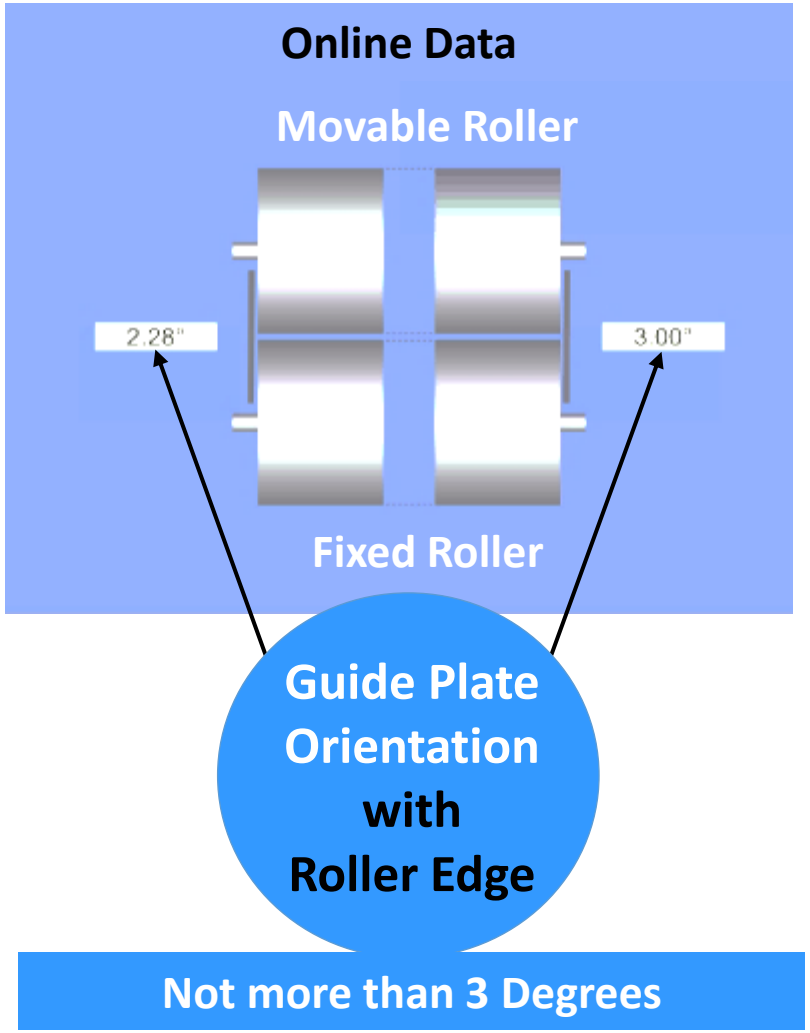
Key Components !!!

Guide Plate or Cheek Plate Sensors





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New Developments !!!

24x7 | Un-Inturrupted Power Supply

- We have faced a several sudden power cut issues at site. As this BENVIRA system needs continuous power supply every time and the mini UPS 600 mA is not capable enough to give the power backup more than 30 mins.
- Taken the 24 hrs continuous power supply for the backup from the plant itself (Load Centre UPS).
- Its been a month that our system doesn't gets Switched Off even because of sudden power cut.

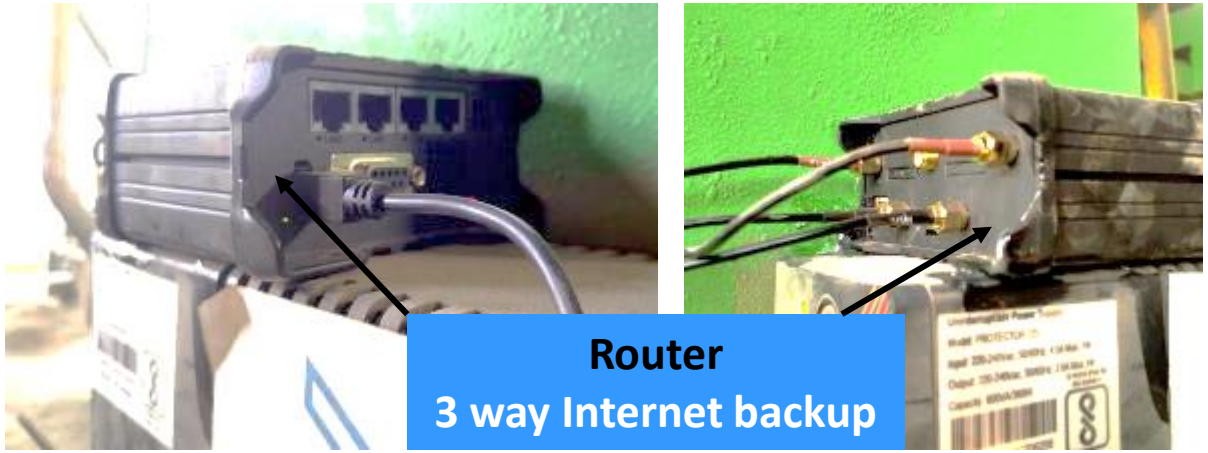
Industrial UPS @ Plants Load Centre

Single Pair Armored Wire-4.5 sq.mm

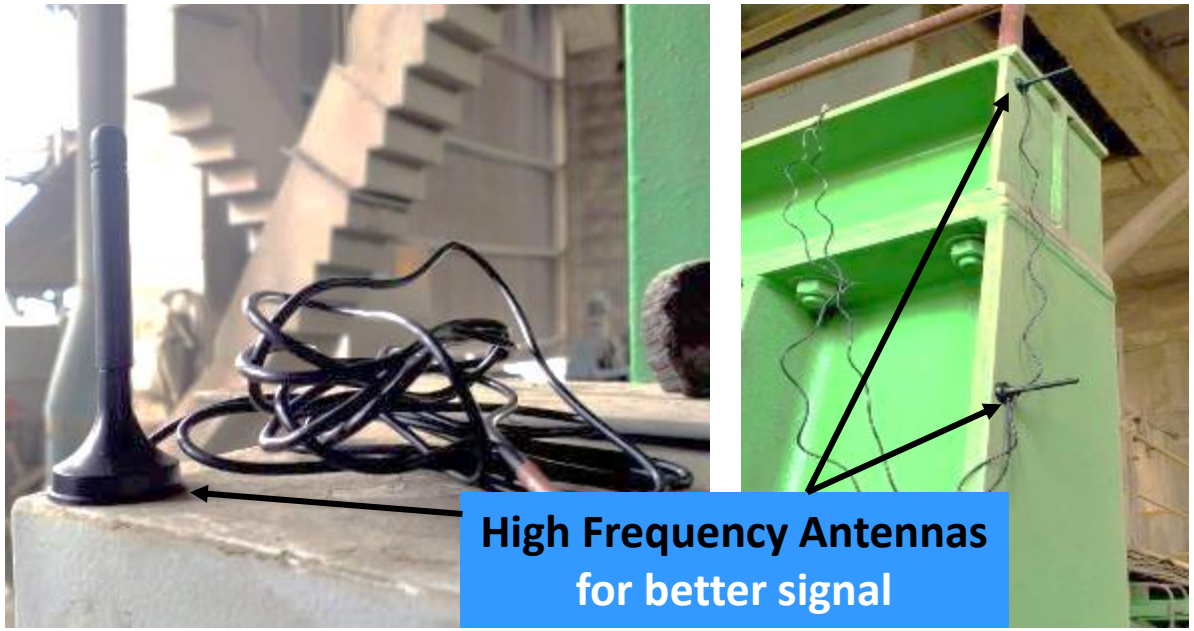
Supply to BENVIRA Control Panel

New Developments !!!

24x7 | Un-Inturrupted Internet Connectivity



Router
3 way Internet backup



High Frequency Antennas
for better signal

- We have given an 3 way Internet back up router for our BENVIRA system to get continuous power supply.
- If 1st Internet Supply will stopped then 2nd Internet Supply will automatically gets in action. On the same way if 2nd Internet Supply will stopped then the 3rd will gets in the action.
- So, we can get 24 x 7 Remote Access of BENVIRA system.

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Metal Detection !!!

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- Our highly efficient Metal Detector scans for tramp metal parts –
  - Both ferrous & non-ferrous
  - Both magnetic & non-magnetic.
- Scans for metal parts less than 30mm and above 15-17mm reliably without false positives.
- If not detected it may cause Irreversible damage to the rollers.
- Interlocked with the Material Rejection Mechanism via existing UTCL's Metal detector.
- Rejected Material gets filtered out from the existing Recirculation System and Permanent Magnet.
- No need of new investment for the Reject Mechanism and Recirculation system.
- This detected ferrous and non- ferrous metals then finally send to Reject Bin.

DON'T REACT TO THE FUTURE:
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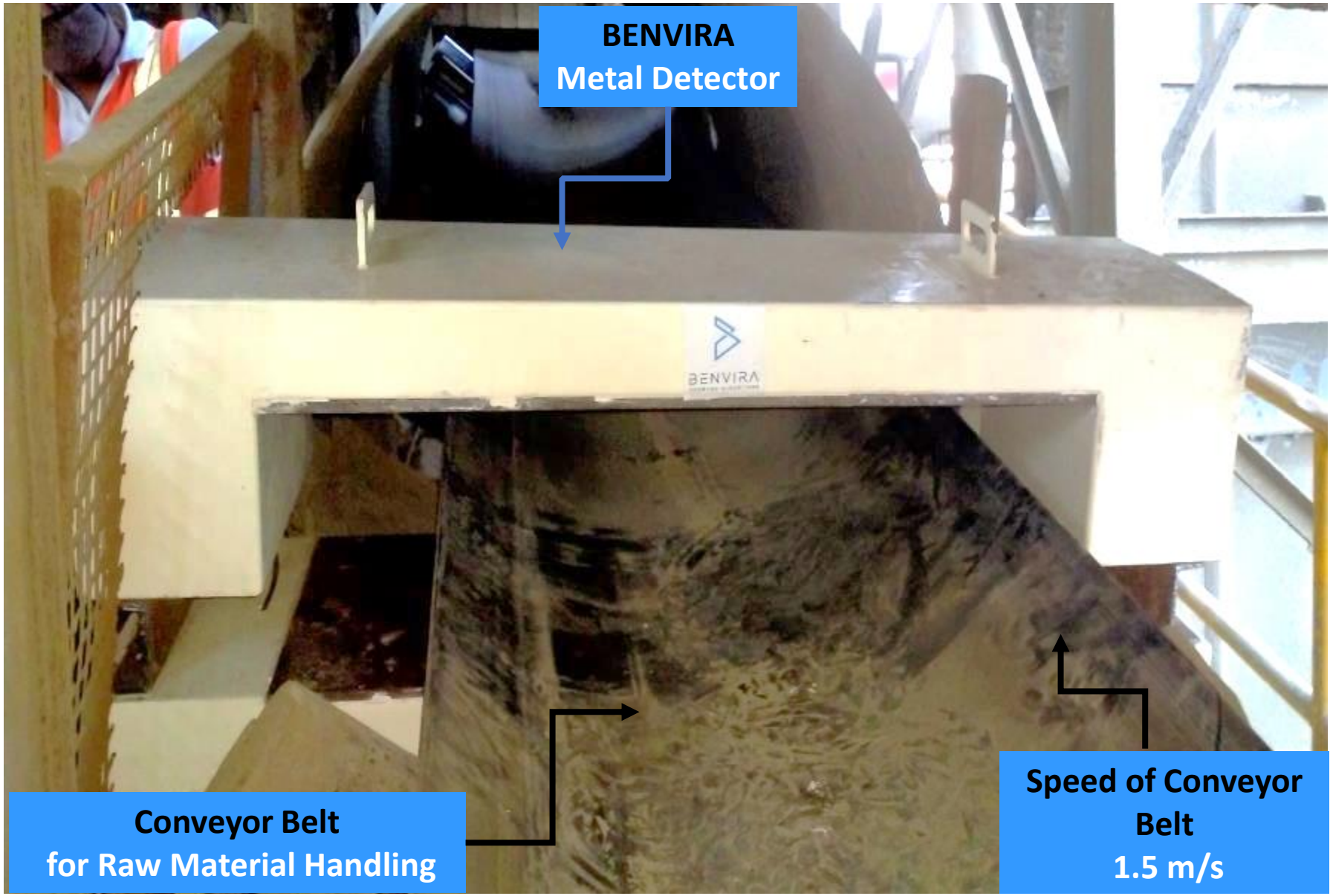
Metal Detection !!!

BENVIRA
FORWARD ALGORITHMS



This Red light will blinks along with an “Beep Sound”, if any metal passed thru the detector

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Metal Detection !!!

BENVIRA
FORWARD ALGORITHMS

- Since the successful commissioning of this system we have found plenty of Foreign Materials which are harmful for the rollers life and shown as below,

The Grinding Media and other metals of 15 to 20 mm size and above has been detected and also entrapped over Permanent Magnet

DON'T REACT TO THE FUTURE:
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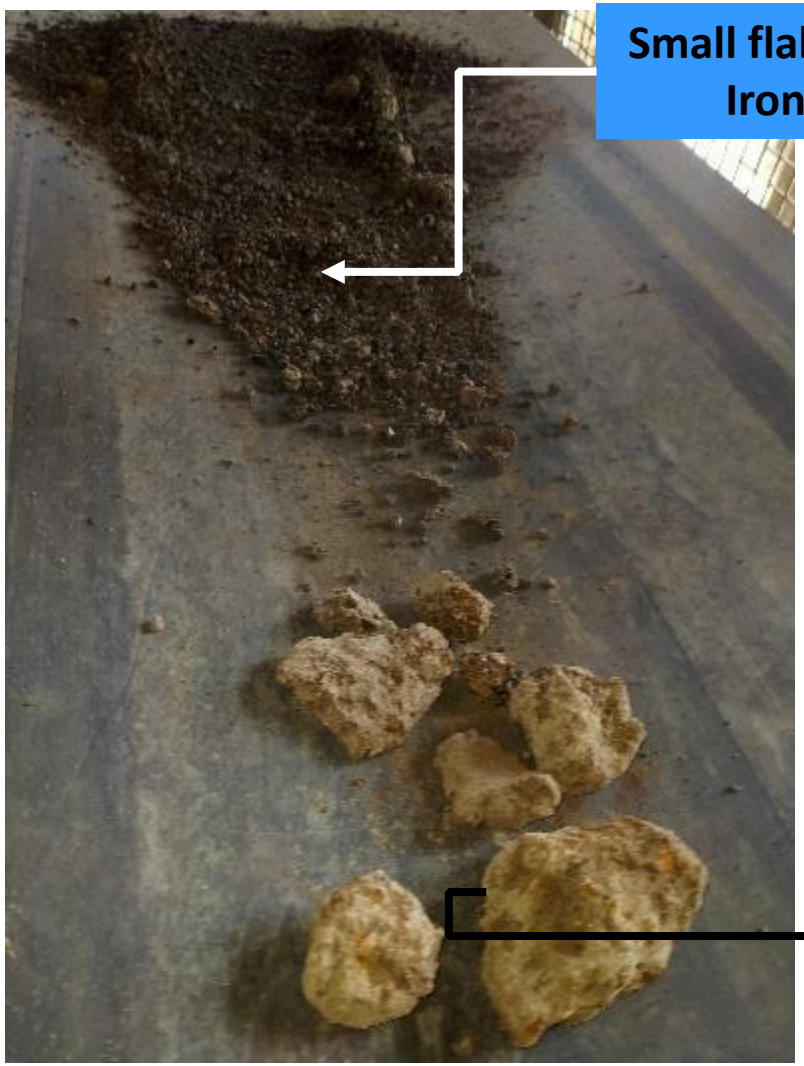
Metal Detection !!!

BENVIRA
FORWARD ALGORITHMS

- Since the successful commissioning of this system we has found a plenty of Foreign Materials which are harmful for the rollers life and shown as below,



Big chunks of Iron Ore, detected by detector, are also entrapped over Permanent Magnet

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BENVIRA METAL DETECTOR DATA AS ON NOV' 21

BENVIRA FORWARD ALGORITHMS

August' 2021 (since intsallation of IoT device)				September' 2021				October' 2021				November' 2021			
Days	Date	No. of Detections by BENVIRA	No. of detections by Existing Plant	Days	Date	No. of Detections by BENVIRA	No. of detections by Existing Plant	Days	Date	No. of Detections by BENVIRA	No. of detections by Existing Plant	Days	Date	No. of Detections by BENVIRA	No. of detections by Existing Plant
1	20.08.2021	47	12	13	1.9.2021	27	13	43	1.10.2021	8	22	73	1.11.2021	32	23
2	21.08.2021	50	32	14	2.9.2021	32	18	44	2.10.2021	34	26	74	2.11.2021	44	28
3	22.08.2021	41	38	15	3.9.2021	11	22	45	3.10.2021	12	28	75	3.11.2021	10	22
4	23.08.2021	15	14	16	4.9.2021	41	32	46	4.10.2021	52	18	76	4.11.2021	26	23
5	24.08.2021	14	9	17	5.9.2021	48	56	47	5.10.2021	47	17	77	5.11.2021	23	16
6	25.08.2021	11	12	18	6.9.2021	36	36	48	6.10.2021	49	23	78	6.11.2021	41	0
7	26.08.2021	43	32	19	7.9.2021	46	42	49	7.10.2021	24	14	79	7.11.2021	51	28
8	27.08.2021	47	38	20	8.9.2021	43	18	50	8.10.2021	24	22	80	8.11.2021	32	29
9	28.08.2021	39	44	21	9.9.2021	38	21	51	9.10.2021	44	28	81	9.11.2021	26	22
10	29.08.2021	62	58	22	10.9.2021	43	32	52	10.10.2021	51	21	82	10.11.2021	29	19
11	30.08.2021	39	47	23	11.9.2021	26	30	53	11.10.2021	22	19	83	11.11.2021	45	24
12	31.08.2021	37	18	24	12.9.2021	52	38	54	12.10.2021	50	16	84	12.11.2021	11	28
				25	13.9.2021	17	23	55	13.10.2021	55	18	85	13.11.2021	23	24
				26	14.9.2021	24	22	56	14.10.2021	43	22	86	14.11.2021	41	22
				27	15.9.2021	31	19	57	15.10.2021	10	18	87	15.11.2021	51	23
				28	16.9.2021	15	17	58	16.10.2021	14	16	88	16.11.2021	32	28
				29	17.9.2021	44	35	59	17.10.2021	43	22	89	17.11.2021	38	20
				30	18.9.2021	59	36	60	18.10.2021	50	22	90	18.11.2021	49	18
				31	19.9.2021	42	23	61	19.10.2021	14	18				
				32	20.9.2021	17	32	62	20.10.2021	22	21				
				33	21.9.2021	29	28	63	21.10.2021	10	22				
				34	22.9.2021	16	22	64	22.10.2021	31	18				
				35	23.9.2021	13	24	65	23.10.2021	35	26				
				36	24.9.2021	31	22	66	24.10.2021	48	24				
				37	25.9.2021	22	23	67	25.10.2021	50	28				
				38	26.9.2021	14	24	68	26.10.2021	44	33				
				39	27.9.2021	43	26	69	27.10.2021	18	32				
				40	28.9.2021	58	20	70	28.10.2021	16	28				
				41	29.9.2021	40	19	71	29.10.2021	33	38				
				42	30.9.2021	36	16	72	30.10.2021	25	34				
									31.10.2021	36	22				
Total Monthly Detection		445	354	Total Monthly Detection		994	789	Total Monthly Detection		978	716	Total Monthly Detection		604	397

Note:	Yellow Blocks shows where UTCLs detection is more than BENVIRA
	But overall monthly detection of BENVIRA is more than that of Existing Plant

9/23/2023

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Metal Detection Comparison between

Existing & BENVIRA systems

Site Video

Result: BENVIRA system is detecting

30 to 35 % more efficiently than the Existing

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Milestone !!!

BENVIRA
FORWARD ALGORITHMS

A visit of Cluster Head North to SKCW site

Benvira System is being explained at site to Mr. S. K. Gupta, Cluster Head, Northern India and Mr. N. P. Joshi, UH, SKCW

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BENVIRA
FORWARD ALGORITHMS

Journey of BENVIRA.....

@ UTCL, Sikandarabad

DON'T REACT TO THE FUTURE:
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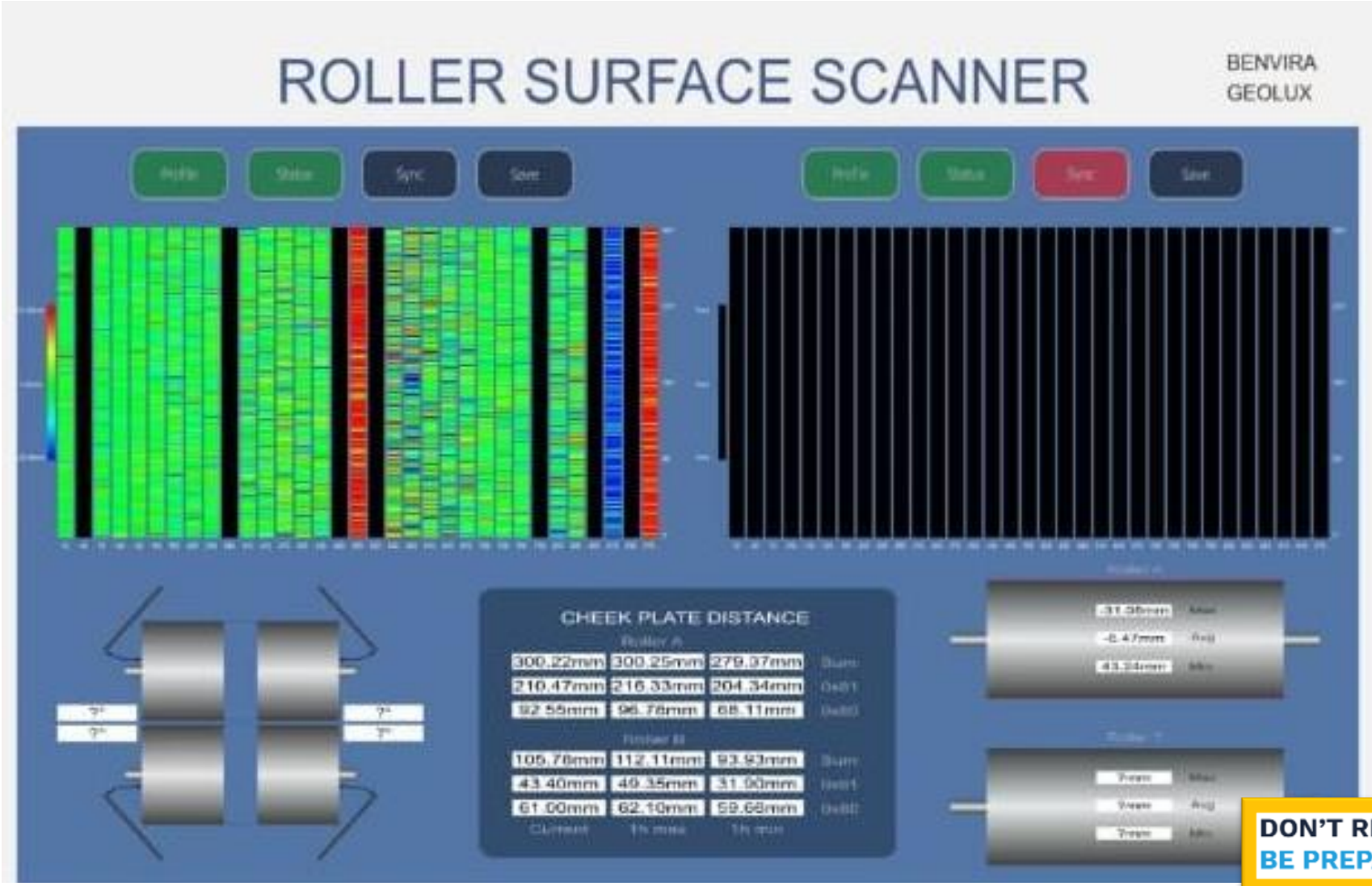
From Here.....

The Initial Readings # Errors & Deviations in the readings



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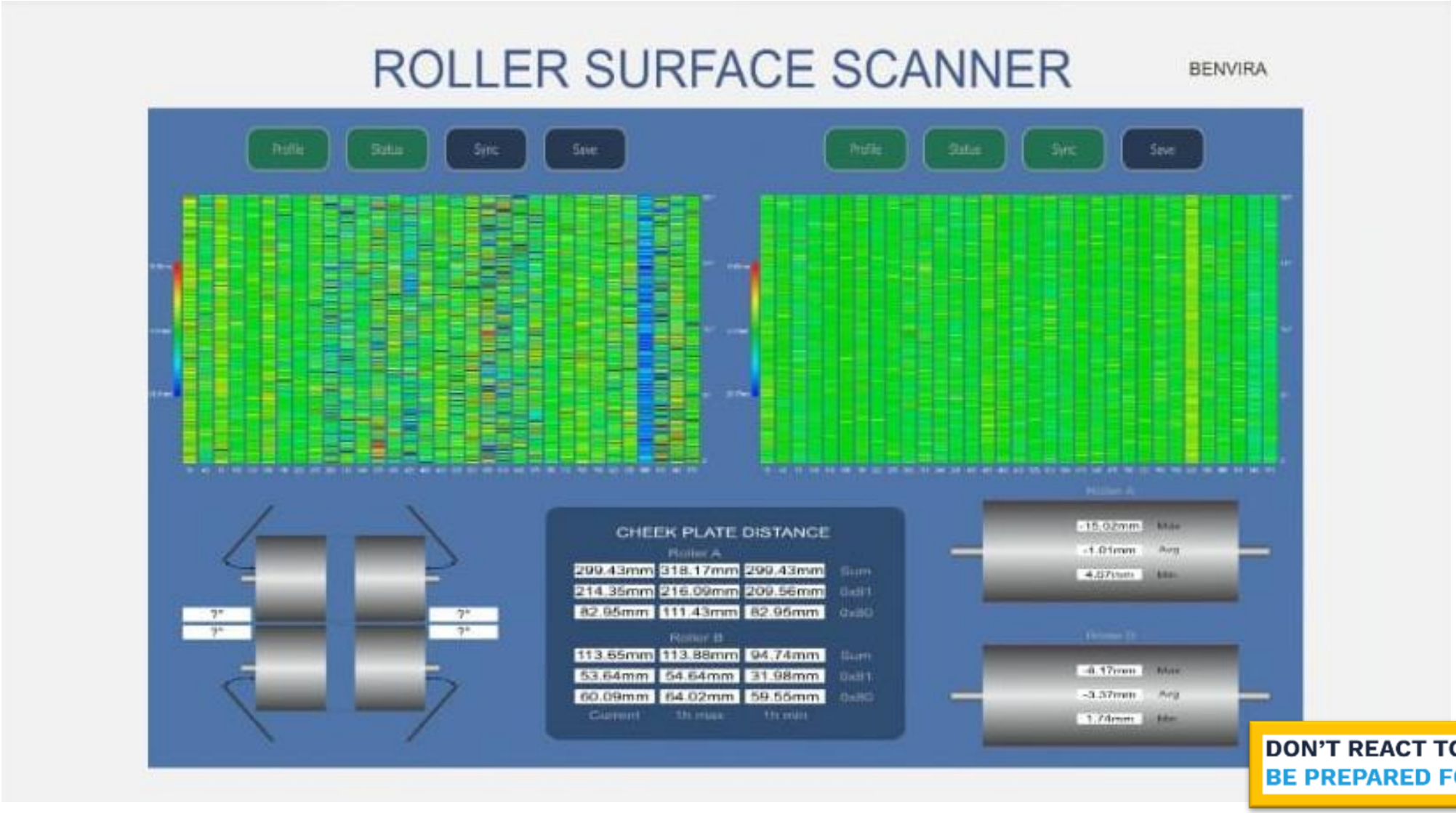
From Here.....

BENVIRA
FORWARD ALGORITHMS

The Initial Readings # Errors & Deviations in the readings



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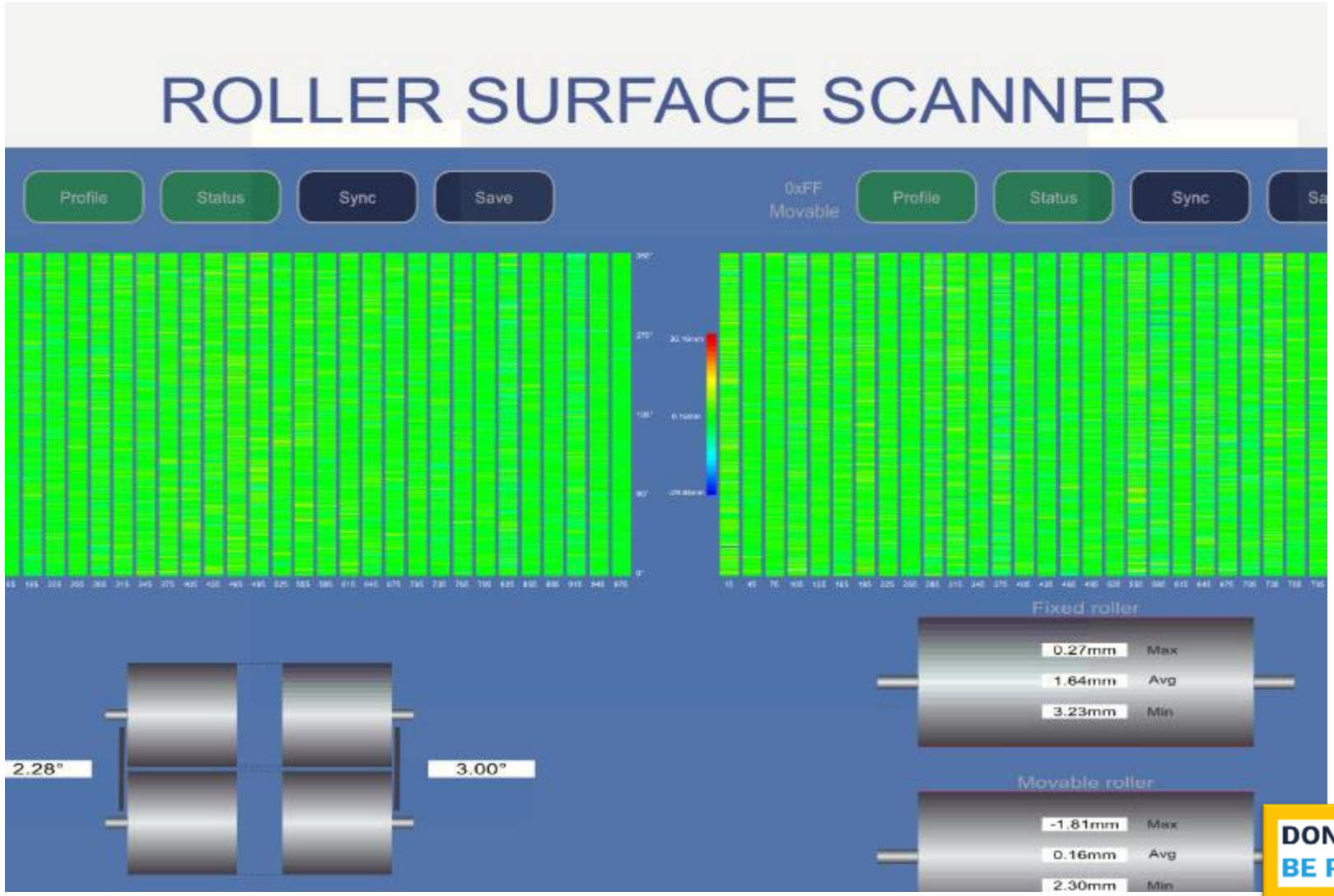
Where we are.....

Readings as on date # Accuracy achieved



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FORWARD ALGORITHMS

Verification of…..

Current Off-line Wear & On-line

Wear readings … as on Dec' 21

DON'T REACT TO THE FUTURE:
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Offline Readings as on Dec' 21

BENVIRA FORWARD ALGORITHMS

Fixed Roller

POLYCOM® HPGR roll-body wear-measurement report

DIFFUSION Innovative superconditioning solutions

Code word:	DEL RPR-19007					Date:	6.12.2021				
Order no.:	SK/CMP/8295000821 dtd.26-12-2018					Name:					
Item no./Planus:						Note:	Size- 1710 x 1100 mm				
Roll-body punched-in number:	GP 88851 4000137503- pos 001						Date of Installation- 6.11.2019				
Operating hours:	9300 hrs	on:	Dec' 2021								
Place of Installation:	☑ Fixed roll		☐ Floating roll								
Roll-body material / width:	☑ Compound casting		☐ Bainite		☐ Forged		☐ Other:			Width [mm]:	1100
Measuring:	☐ First profiling (zero measurement)		☑ Inspection		☐ Before profile care		☐ Bevor grinding		☐ Before new profiling		
	☐ Unprofiled (zero measurement)				☐ After profile care		☐ After grinding		☐ After new profiling		

Measuring point		Drive end			*(Please always check: Measuring point 1 = Drive end! Measuring bar = Adjust always in same position parallel to Roll body surface!)*							Non-drive end
		1	2	3	4	5	6	7	8	9	10	11
Distance from end (drive end) [mm]		20	20 + m	20 + 2*m	20 + 3*m	20 + 4*m	20 + 5*m	20 + 6*m	20 + 7*m	20 + 8*m	20 + 9*m	20 + 10*m
Measuring position (drive end) [mm]		20	126	232	338	444	550	656	762	868	974	1080
0° (Reference point, roll-body stamp area)	$X_{Roll\ body}$ [mm]	130.0	138.0	140.0	141.0	142.0	143.0	143.0	143.0	145.0	144.0	135.0
	$X_{Profiling}$ [mm]	127.0	136.0	138.0	139.0	139.0	140.0	141.0	141.0	143.0	143.0	132.0
180°	$X_{Roll\ body}$ [mm]	131.0	138.0	139.0	140.0	141.0	143.0	144.0	144.0	146.0	143.0	136.0
	$X_{Profiling}$ [mm]	125.0	134.0	137.0	138.0	138.0	141.0	141.0	141.0	144.0	140.0	133.0
Circumference measurement [mm]			5335		5320		5295		5296		5340	
Diameter [mm]			1698		1693		1685		1686		1700	

In the case of a profiled roll body, the dimension $X_{Profilng}$ and the dimension $X_{Roll\ body}$ must be measured at the points that are closest to the measuring point. In relation to this, the minimum dimension $X_{Profiling}$ (highest point of the profiling) and the maximum dimension $X_{Roll\ body}$ (lowest point of the erosion) must be measured.

$X_{Roll\ body}$: = Distance between measuring device and roll-body surface or hardfacing surface

$X_{Profiling}$: = Distance between measuring device and profiling

$$m = \frac{(\text{Roll width} - 40\text{mm})}{10} =$$

Average Diameter Now- 1694 mm Compared to Zero Wear Reading Was-1699 mm

So, Total Wear- 5 mm on tool point & 10 mm over circumference

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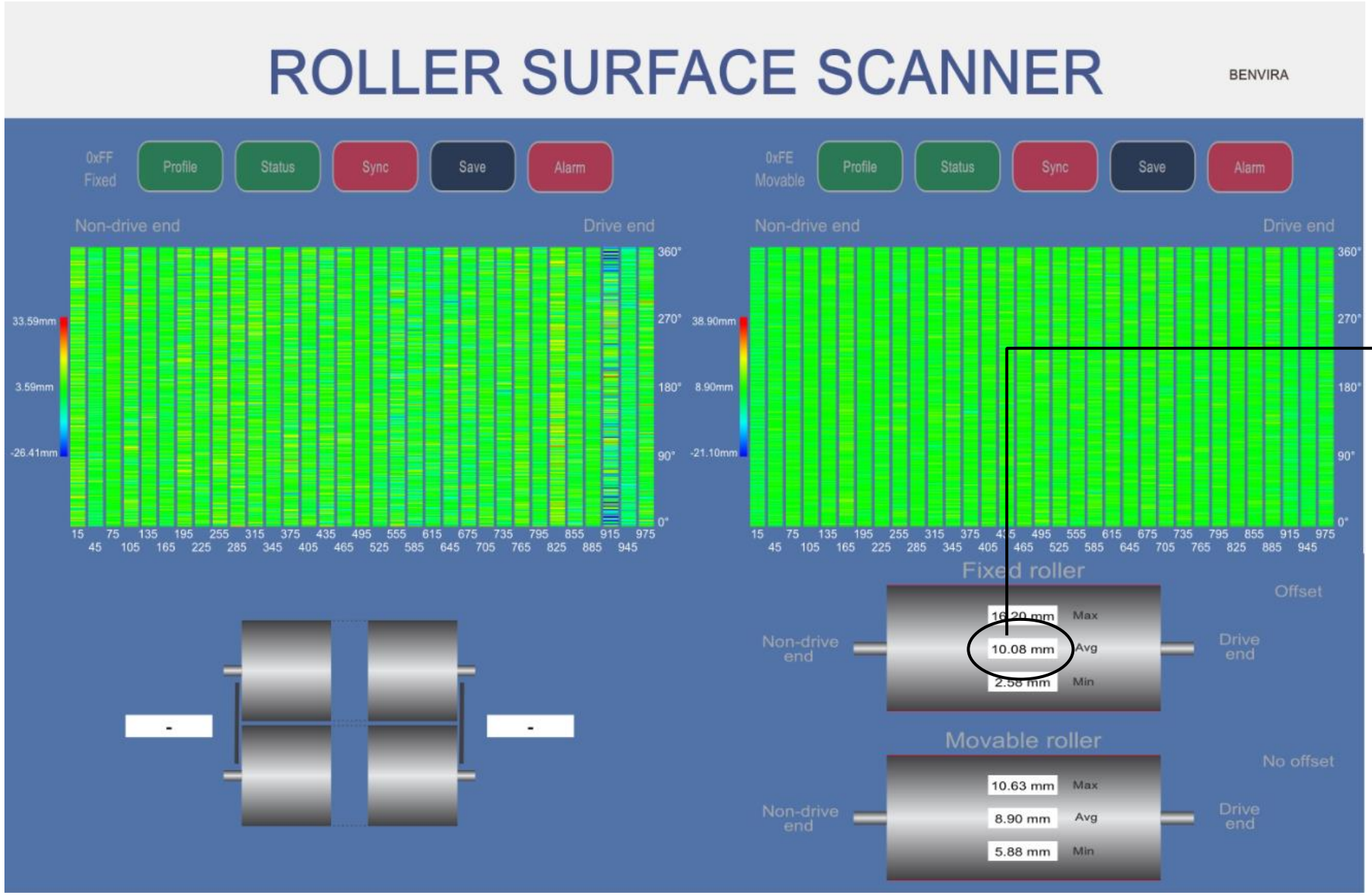
Online Readings as on Dec' 21



Average Reading- 10.08 mm

DON'T REACT TO THE FUTURE:
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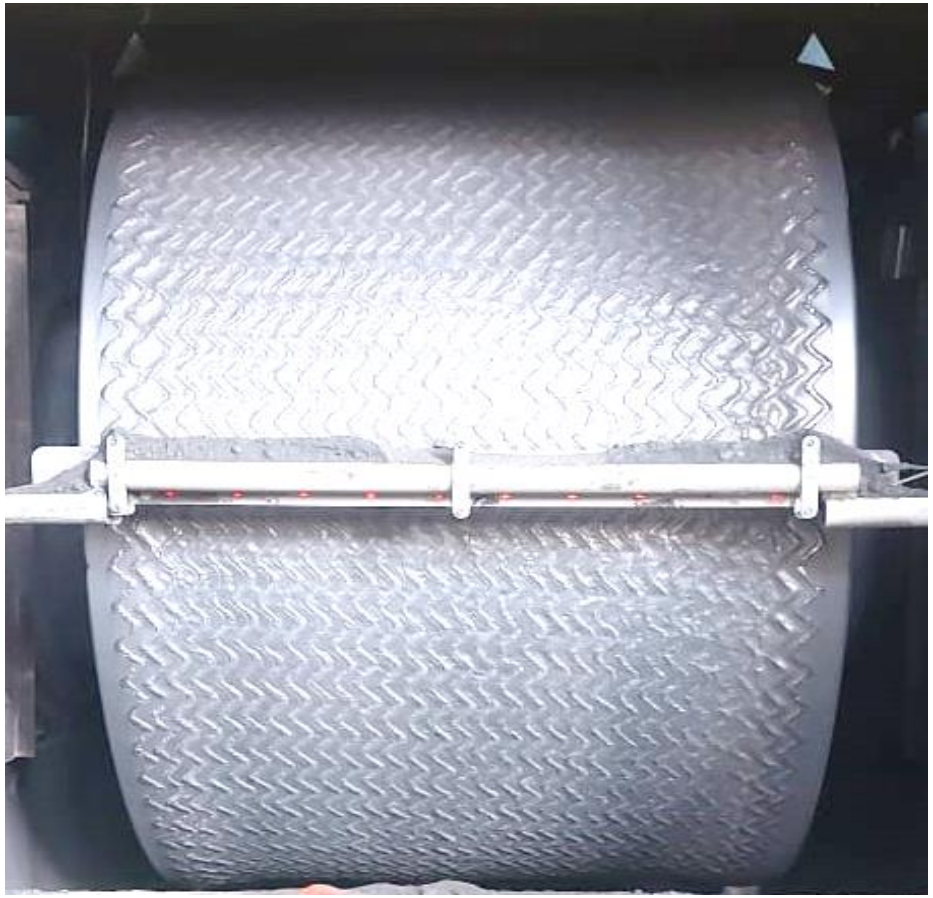
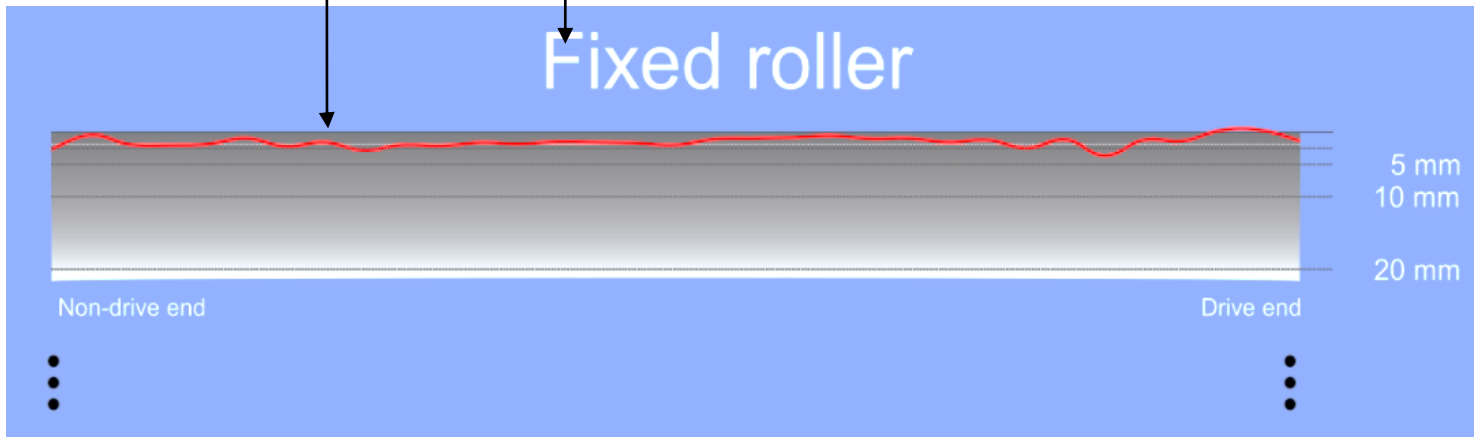
Offline View & Online Reading Comparison

as on Dec' 21

Fixed Roller





DON'T REACT TO THE FUTURE:
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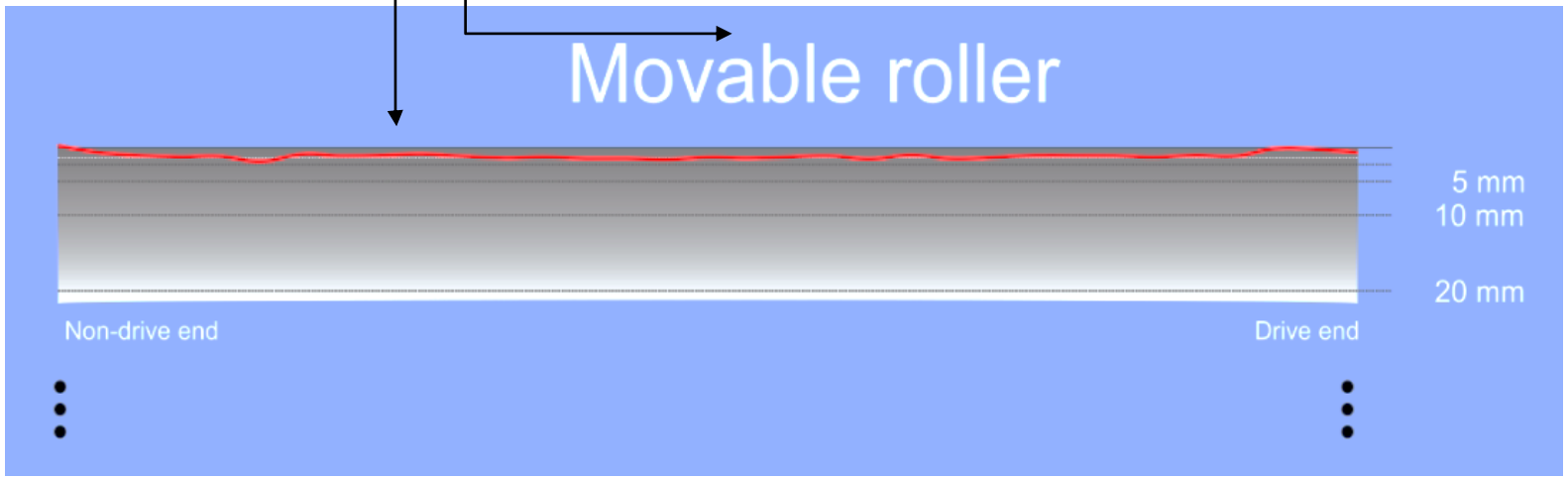
Offline View & Online Reading Comparison

as on Dec' 21

Movable Roller



DON'T REACT TO THE FUTURE:
BE PREPARED FOR IT

How this system will improve the Reliability and Longevity of Rollers

Reducing stress of the rollers

- ✓ By having better metal detection system. This will lead to significantly increase life-time of the rollers.
- ✓ 30-35% better metal detection is expected to increase life-time by a similar amount.

Providing live, on-line readings

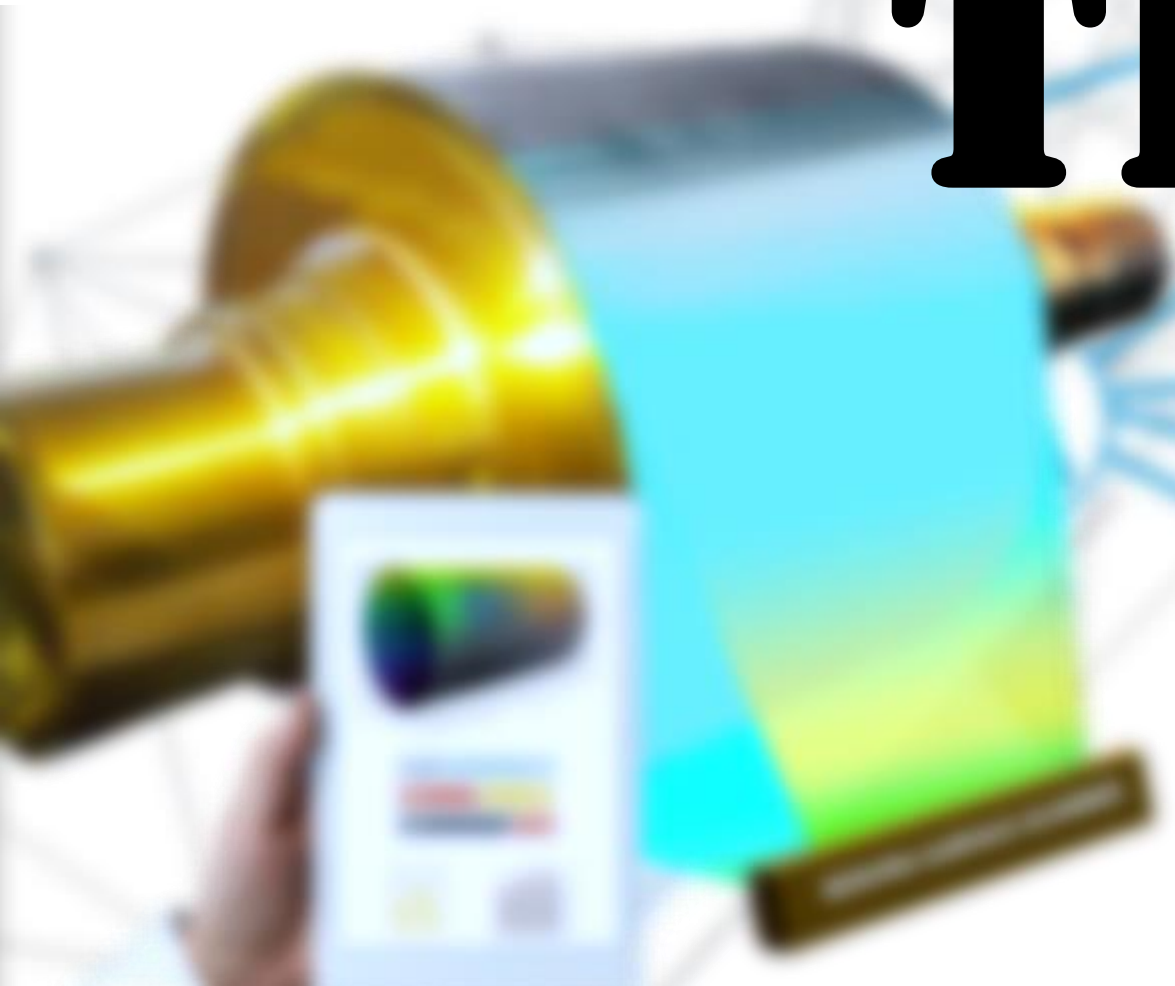
- ✓ We have developed algorithms that get readings of 0.1mm least count with noise (due to vibrations) of 10-15mm.
- ✓ By having live, on-line readings, some problems can be spotted as soon as they occur (thanks to our alarm system). For example:
  - if wear and tear is higher than some threshold, we sound the alarm
  - if cheek plates are not in a position, we show that in real time

Doing predictive analysis

- ✓ We aim to collect readings and record roller types, and feed that data into our AI system in order to predict when the rollers will be worn out. This will enable the user with outputs like:
  - within next 1,000 hours, the wear and tear is expected to be below the threshold - that is the roller will be good with 90% certainty we predict that within next 2,000 hours, the wear and tear will be too high, above the given threshold.

BENVIRA
FORWARD ALGORITHMS

THANK YOU



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