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भारत सरकार (GOVERNMENT OF INDIA)
रेल मंत्रालय (MINISTRY OF RAILWAYS)
रेलवे बोर्ड (RAILWAY BOARD)

No. 2015/Sig/SF/1 **New Delhi, Dt.18 .04.2024**

PCSTEs
Zonal Railways
CORE/Prayagraj,
KRCL, Metro/Kolkata

Sub: Preventive maintenance module for reduction of Signal Failures.

East Central Railway (ECR) has introduced a preventive maintenance module for the reduction of Signal Failures. ECR during presentation on 12.04.2024 mentioned about substantial improvement in Signalling system availability after implementation of the module in Danapur division. Details of this module are attached herewith for reference.

2. All Zonal Railways are requested to take up the similar exercise across their divisions and share their valuable inputs regarding above mentioned preventive maintenance module. Please take help from East Central Railway in case of any clarification.

Encl. As above.

18/04/2024
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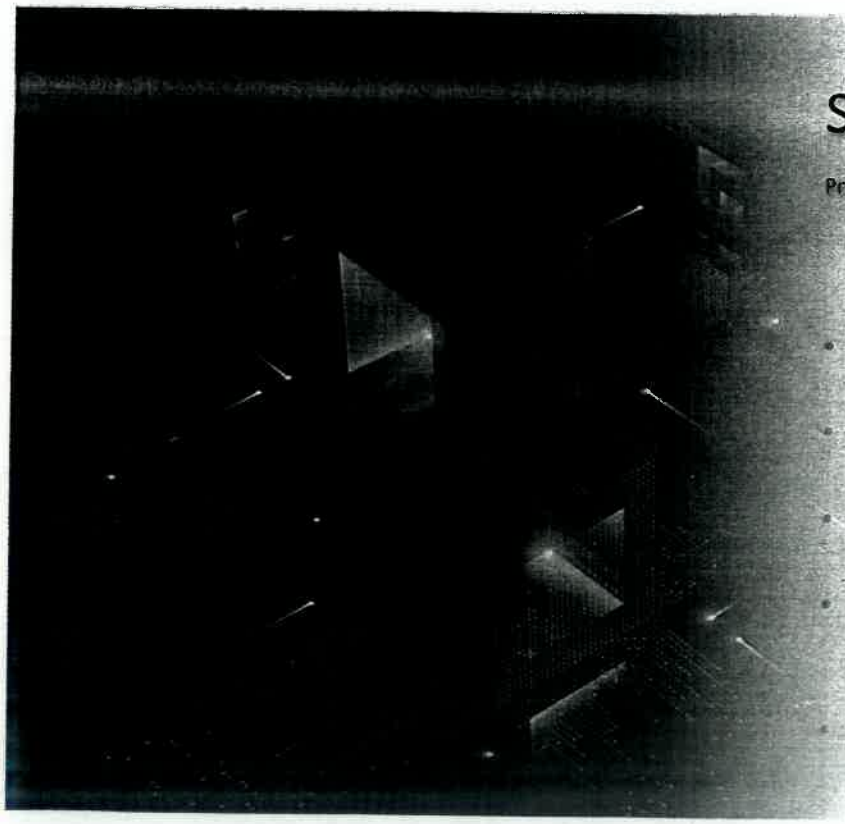
E.C.R. INNOVATIONS

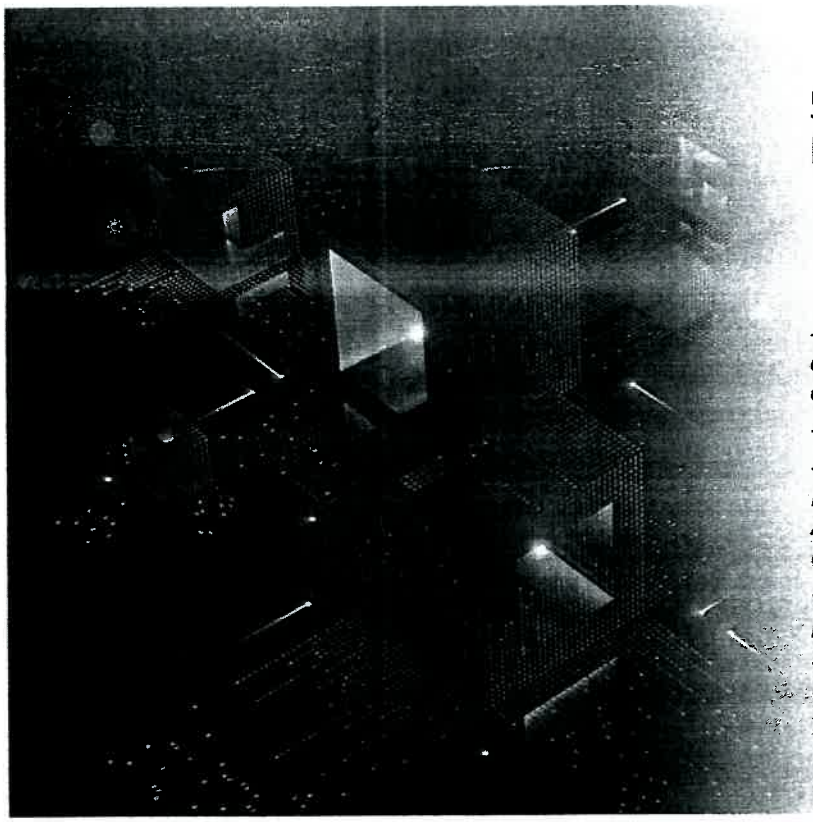
Pilot Projects | Danapur Division



Signal Failures

Problem Statement

- Relay failures **without any logical explanation.**
- Point machine failures inspite of proper maintenance.
- Signal LED replacements too frequently done without reasons.
- **No system of checking** if maintenance activities have been carried out.
- Sudden failures of entire panels and assets without any warning.



5. PMM(ST) - Preventive Maintenance Module

- All essential circuits have been connected to data-logger and they in-turn been networked to central server in control room.

- ELD has also been provided at all stations.

- This data has further been mapped & co-relations defined on Microsoft BI platform (with AI analysis algorithm) to deduce codal life of assets as per actual operations.

- Also, scheduled maintenance exceptions and pattern changes can be derived from the system.

- Further, maintenance schedules and inventory management is also being done from these reports.

5. PMM(ST) - Preventive Maintenance Module

Report 1: Relays

Concept of vital relays is already documented but not prevalent or not scientifically based.

Now with datalogger records, relays which have completed > 15 lakh or > 10 lakh operation can be listed and replaced before they tend to fail.

Last 9 months failures on DNR showed that **73%** of these failures (pure relay failures) could be avoided by replacing mere 1473 relays across the division.

STATION-WISE STATUS OF RRI / EI / PI / IBH									Today	31/12/24
Sl No.	INITIAL INSTALLATION					Years since commissioning	7623	893	1473	
	Station / IBH	RRI / EI / PI / IBH	Make of EI / RRI / PI	Date of Commissioning	Total No. of Sig. Route		Count of relays <25	Count of relays <12.5	Count of relays <life	Relays completed operation life on date
1	KCA	PI	DELTRON	14/04/02	11	22.7	170	10	48	1 GNPR, 1RECR, 1TPR, 4GNR, 52 WLPR, 52WLR, 5DECR, 5RECR, 7DECPR, 7DECR, B1PR2-DDU, BLR-DDU, BLR-SLD, BPNR-DDU, BPNR-SLD, D1-1HHECR, D1-6HHECR, D2-1DECPR, D2-1DECR, D2-1DR, D2-1HECR, D2-1HHECR, D2-6 DECPR, D2-6DECR, D2-6DR, D2-6HECR, D2-6HHECR, D4UNR, DN KCA-EOC AXL ONE UNIT, FR1-DDU, FR2-DDU, G(N)NCR, G-30 KNLP2R, G-30 KNLR, G-30 ZNPR, G/U/W/G(N)XR, G30KLNPR, G30NR, G30ZNR, G30ZR, GBNR, GNCR, TGTNR-DDU, TGTXR-DDU, TGTZR-DDU, UNCR, WNCR, WXR
2	SLD	PI	DELTRON	28/07/09	19	15.4	210	6	15	12 T1PR, 53 NLR, 53 WLPR, 53 WLR, BLR KCA, BPNR DHA, BPNR KCA, FR1 DHA, FR1 KCA, FR2 DHA, G-31 LKR, G-31 ZR, G/DN DIST DECPR, GNNCR, SMR FAIL

5. PMM(ST) - Preventive Maintenance Module

Report 2: Point Machine

Replacement of point machines in 8 yrs on the busy routes with >200 operation per day exists but the identification in field is lacking.

Also, there are points which as per statistics cannot last for more than 4yrs. However, such points are only 60 nos (<15 yrs) on a division like DNR.

Interestingly, all points replaced in last 3 months had completed their codal life as per no of operations and not years.

S. No.	Station	SIGNAME	Relay Count	3 lakh operation in no of years
1	PHULWARISHARIF	56 WLPR	6087	4.05
2	TEKABIGHA	52B RWPR	5918	4.17
3	KHUSURUPUR	56 WLR	5424	4.55
4	PHULWARISHARIF	52WLPR	5350	4.61
5	KHUSURUPUR	51 WLR	5228	4.72
6	BARH	31KNLR	5187	4.75
7	TEKABIGHA	54 WLPR	5169	4.77
8	KARAUTA	51 WLPR	4912	5.02
9	KARAUTA	56 WLPR	4799	5.14
10	GIDHAUR	57WLPR	4714	5.23

5. PMM(ST) - Preventive Maintenance Module

Report 3: Axle counter – One unit Failure

Units failing frequently can be identified and checked for anomalies like non-compatible cards, versions, grounds, etc.

Axle counter one unit fail

STATION	SIGNAME	Relay Count
GULZARBAGH	RJPB-GZH AXC DN ONE UNIT FAIL	5536
GULZARBAGH	PNC-GZH UP AXC ONE UNIT FAIL	5408
PATNA	BKG-PNC UP AXC ONE UNIT FAIL	5240
GULZARBAGH	GZH-RJPB UP AXC ONE UNIT FAIL	5062
BAKHATIYARPUR	UP BKP-L-ATL AXC ONE UNIT FAIL	5002
TEKABIGHA	UP BKP-TKBG AXC ONE UNIT FAIL	4840

Report 4: IPS Failures

Frequent alarms have been known to show, SMR faults, local supply voltage issues, loose wirings, battery issues, dead batteries, etc.

IPS failures in 30 days - poor contacts & faults

S. No.	STATION	SIGNAME	Relay Count
1	BANSIPUR	CALL S-T	83002
2	BANSIPUR	MAINS FAIL	83001
3	JAMUI	CALL S/T	32971
4	JAMUI	SMR FAIL	32961
5	TAL	CALL S AND T	6289
6	TAL	SMR FAIL	6285
7	MANANPUR	Call SandT	6143
8	KIUL	SMR FAIL	4364
9	KHUSURUPUR	SMR FAIL	3566
10	KHUSURUPUR	CALL S AND T	2938

Report 5: Trach circuit Relays

Track circuit relays having completed > 10 lakh operations

5. PMM(ST) - Preventive Maintenance Module

Report 6: LED Signal Life

Signal LED lamps are being replaced every 8-10 yrs though only 20% of these need replacement before 25yr life of EI/PI/RRI.

These now can be identified and replacements can be done in a planned manner instead of blanket replacements.

Report 7: Panel Button Life

Report 8: ELD Failures

Signals needing replacement <25 yrs

Station	Asset No	Relay Name	Lit Time in 15 Days	Total Hours	No of yrs for completing 1 lakh hrs
CHAURA	UID	UID-DECR	14d 23h 21m 36s 254ms	359	11.45
CHAURA	UID	UID-HECR	14d 22h 53m 1s 410ms	358	11.48
DANAPUR	SH228	SH228 RECR	14d 20h 8m 56s 939ms	356	11.54
PATALIPUTRA	S07	07 RECR	14d 20h 42m 43s 973ms	356	11.54
DANAPUR	SH226	SH226 RECR	14d 19h 33m 47s 882ms	355	11.58
KIUL	D46	D46-HECR	14d 19h 47m 37s 541ms	355	11.58
DANAPUR	SH214	SH214 RECR	14d 18h 49m 50s 880ms	354	11.61
DANAPUR	SH216	SH216 RECR	14d 18h 15m 29s 419ms	354	11.61
DANAPUR	SH234	SH234 RECR	14d 18h 21m 43s 157ms	354	11.61
CHAURA	DID	DID-HHECR	14d 17h 11m 47s 345ms	353	11.64
DANAPUR	SH201	SH201 RECR	14d 17h 24m 43s 380ms	353	11.64
DANAPUR	SH219	SH219 RECR	14d 17h 11m 52s 631ms	353	11.64
JHAJHA	SH252	SH252RECR	14d 17h 36m 25s 912ms	353	11.64
JHAJHA	SH256	SH256RECR	14d 17h 26m 21s 863ms	353	11.64
JHAJHA	SH246	SH246RECR	14d 16h 34m 55s 128ms	352	11.67
SACHIWALAY	DID	DID_HECR	14d 16h 18m 24s 506ms	352	11.67
DANAPUR	SH213	SH213 RECR	14d 15h 23m 55s 376ms	351	11.71
JHAJHA	SH222	SH222RECR	14d 15h 40m 54s 749ms	351	11.71
KIUL	S22	22RECR	14d 15h 39m 38s 378ms	351	11.71
DANAPUR	SH224	SH224 RECR	14d 14h 45m 38s 756ms	350	11.74
JHAJHA	SH208	SH208RECR	14d 14h 19m 49s 399ms	350	11.74
JHAJHA	SH216	SH216RECR	14d 14h 5m 27s 627ms	350	11.74
JHAJHA	SH233	SH233RECR	14d 14h 19m 32s 468ms	350	11.74
JHAJHA	SH235	SH235RECR	14d 14h 54m 34s 321ms	350	11.74
KIUL	S46	46RECR	14d 14h 28m 31s 238ms	350	11.74
PATALIPUTRA	S05	05 RECR	14d 14h 34m 8s 976ms	350	11.74
PATLIPUTRA	S03	03 RECR	14d 14h 3m 28s 347ms	350	11.74
DANAPUR	SH206	SH206 RECR	14d 13h 44m 0s 158ms	349	11.78
KIUL	S36	36RECR	14d 13h 28m 54s 783ms	349	11.78
RAJANDRANAGAR	S18	18 RECR	14d 13h 26m 18s 95ms	349	11.78
DANAPUR	SH209	SH209 RECR	14d 12h 4m 56s 375ms	348	11.81
DANAPUR	SH230	SH230 RECR	14d 12h 36m 54s 593ms	348	11.81
JHAJHA	SH207	SH207RECR	14d 12h 0m 34s 439ms	348	11.81
DANAPUR	SH241	SH241 RECR	14d 11h 48m 3s 652ms	347	11.84

5. PMM(ST) - Preventive Maintenance Module

Report 6: LED Signal Life

Report 7: Panel Button Life

Panel buttons have been known ot get stuck and misbehave. On cross-check more than 47% of the cases have been those of buttons having been operated more than 15 lakh times as per data logger report.

They can be planned for mid life replacement before they misbehave or fail.

Report 8: ELD Failures

Panel Button Life

Station	Relay Name	Relay Count	codal life in yrs
DANAPUR	CZ SHGNCR1	63731	1.93
DANAPUR	CZ GNCR1	63634	1.94
DANAPUR	CZ UNCR1	63032	1.96
DANAPUR	WZ SHGNCR1	58976	2.09
DANAPUR	WZ MNGNCR1	58974	2.09
DANAPUR	WZ GNCR1	58921	2.09
DANAPUR	WZ UNCR1	58770	2.10
DANAPUR	EZ MNGNCR1	52667	2.34
DANAPUR	EZ SHGNCR1	52661	2.34
DANAPUR	EZ GNCR1	52563	2.35
DANAPUR	EZ UNCR1	52033	2.37
DANAPUR	CZ WNCR1	44637	2.76
DANAPUR	WZ WNCR1	38580	3.20
JHAJHA	EZUNCR1	32163	3.83
JHAJHA	EZMNGNCR1	32140	3.84
JHAJHA	EZSHGNCR1	32133	3.84
JHAJHA	EZGNCR1	32111	3.84
DANAPUR	CZ GNCR	31879	3.87
DANAPUR	EZ WNCR1	31468	3.92
DANAPUR	CZ UNCP1R	31008	3.98
DANAPUR	WZ GNCR	27328	4.51
DANAPUR	WZ UNCR	27026	4.56
JHAJHA	WZUNCR1	27012	4.56
JHAJHA	WZMNGNCR1	27010	4.56
JHAJHA	WZSHGNCR1	26978	4.57
JHAJHA	WZGNCR1	26957	4.57
RAJANDRANAGAR	GNCR	26103	4.72
JHAJHA	EZWNCR1	23406	5.27

5. PMM(ST) - Preventive Maintenance Module

Report 6: LED Signal Life

Report 7: Panel Button Life

Report 8: ELD Failures

ELD has been installed at all station on DNR division. They clearly indicate the particular wire or cable that is drawing more than normal current indicating clearly that a particular cable is punctured or bound to fail now.

Timely replacement can avoid almost 23% of outdoor gear failures as per last 3 months data.

ELD failures by gear and station

STATION	SIGNAME	Relay Count
GULZARBAGH	BIPR1 RJPB	3653
BARH	24V DC AXL DN ELD	2154
BARH	POINT ELD	1077
CHAURA	AXC 2 ELD	332
CHAURA	SIG GHR ELD	332
CHAURA	SIG JMU ELD	332
CHAURA	TRACK GHR ELD	332
CHAURA	TRACK JMU ELD	332
JHAJHA	ELD EZ 110 SIG-2	302
GULZARBAGH	INT 24V ELD	198
JHAJHA	ELD EZ 24V EXT TPR	104
JHAJHA	ELD WZ 110 SIG-3	88
JHAJHA	ELD EZ 60V DC EXT TPR	59
JHAJHA	ELD EZ 110 DC PT	53
DANAPUR	5BX-110 TRACK EAST	46
JHAJHA	ELD EZ 60DC INT	44
JHAJHA	ELD EZ 110 SIG -1	42
DANAPUR	6BX-110 TRACK WEST	37
KIUL	110V AC TRACK UP	37
DANAPUR	B-60V NDKR/RDKR WEST	36
JHAJHA	ELD EZ 60V DC WKR	35
BARH	24V DC EXT UP ELD	33

5. PMM(ST) - Preventive Maintenance Module

Report 9: Fire Alarms (30 days)

Shows whether tested or not and also those malfunctioning and generating too many alarms.

Station Wise Relay Operational Count **Fire Alarm - excess trigger or no testing...**

STATION	SIGNAME	Relay Count
BARHIYA	FIRE ALARAM	168
PATLIPUTRA	FIRE ALARM	8
DADPUR	FIRE ALARAM	2
PATALIPUTRA	FIRE ALARM	2
PHULWARISHARIF	FIRE ALARM	2

Report 10: Relay Room Door (30 days)

Shows whether scheduled maintenance has been carried out or not and also if any RR is being misused by staff by frequent opening.

Relays room doors not operated in last 30 days

STATION	SIGNAME	No of Days not operated
PUNARAKH	SRH DOOR LOCK	30
	WRH DOOR LOCK	30

Report 11: Crank Handles (30 days)

Shows whether tested or not and whether maintenance done or false entries made.

Crank-handle not taken pout >30 days

STATION	SIGNAME	No of Days
PUNARAKH	CH-9-EZYR	60
KARAUTA	CH6 ZPR	58
KARAUTA	CH4 ZPR	56
ATHMALGOLA	CH4KNLR	30
ATHMALGOLA	CH4ZYR	30

5. PMM(ST) - Preventive Maintenance Module

Report 12: Gate Operation

Count of gate operations gives a clear indication of gates which are opening too frequently and those which are not being opened at all.

This insight along-with issues of Gate-Jam by road traffic yields an optimal action plan for gate closure, gate widening, interlocking planning, ROB/ Underpass, etc.

Station	Relay Name	Relay Count	operations per hour
KHUSURUPUR	G-31 LXLR	6289	8.7
PHULWARISHARIF	G31KNLPR	5339	7.4
KHUSURUPUR	G-32 LXLR	5046	7.0
BARH	31KNLR	4853	6.7
TAL	2 LCPR	2034	2.8
HATHIDA	31_LXRPR_F	1836	2.6
MANANPUR	P-56 KNLR	86	0.1
BARH	31SB KNLR	4	0.0

Report 13: Routes not used in 30 days

Report indicates routes, lines and assets that may be redundant and discarded. Alternately, these lines are fraught with track circuit failures due to rust and mud on track.

STATION	SIGNAME	No of Days	STATION	SIGNAME	No of Days
ATHMALGOLA	106-OFFPECR	30	BANSIPUR	1 L4UHR	30
ATHMALGOLA	109HR	30	BANSIPUR	12 HHECR	30
ATHMALGOLA	202-ONECR	30	BANSIPUR	C1 HECR	30
ATHMALGOLA	203-OFFECR	30	BANSIPUR	C1 HR	30
ATHMALGOLA	3HHECR	30	BANSIPUR	C12 HR	30
ATHMALGOLA	C12HR	30	BANSIPUR	DSH 302 ONECR	30
ATHMALGOLA	C14-ECR	30	BANSIPUR	DSH 304 ONECR	30

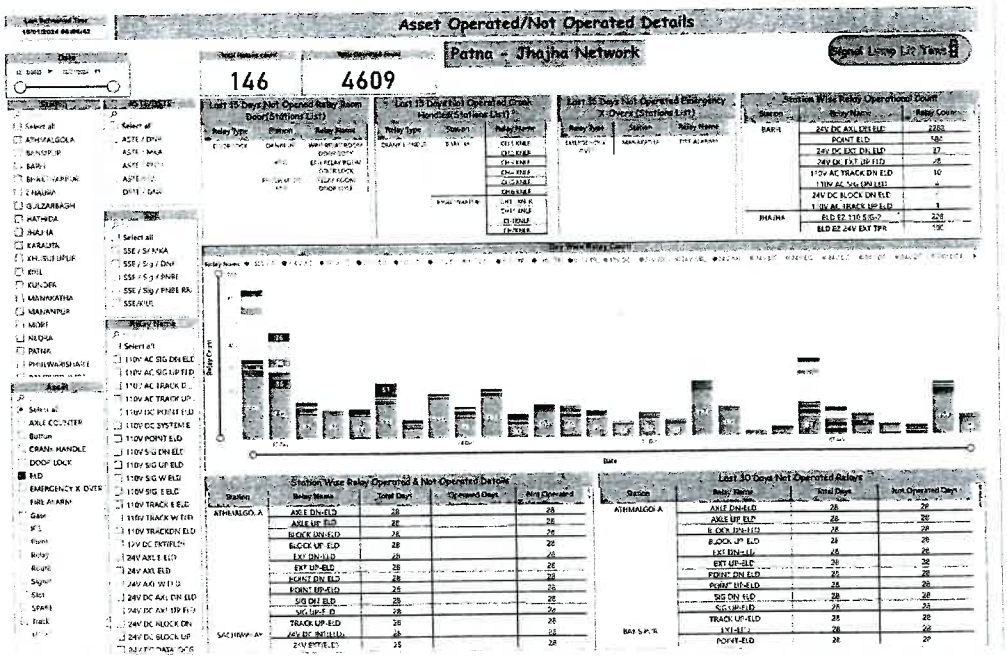
5. PMM(ST) - PREVENTIVE MAINTENANCE MODULE

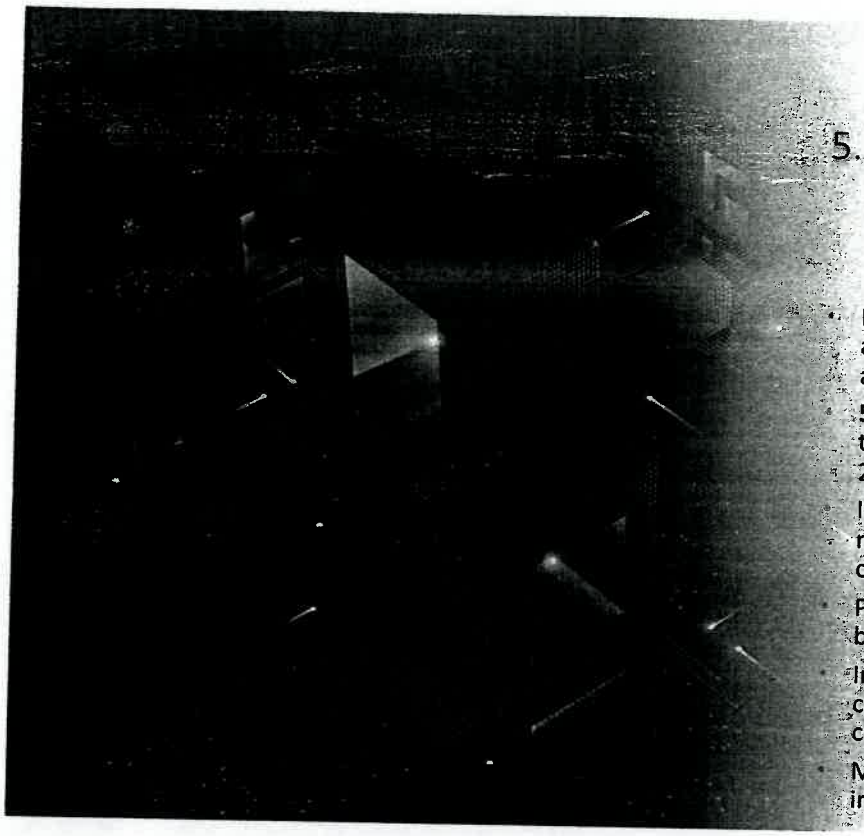
Integration & AI analytics
Preventive Maintenance, Monthly maintenance schedules, Inventory management systems.

PMM-ST

05

AI backed algorithm at Divisional level with / like COA Server for efficient maintenanc e planning and integration to existing



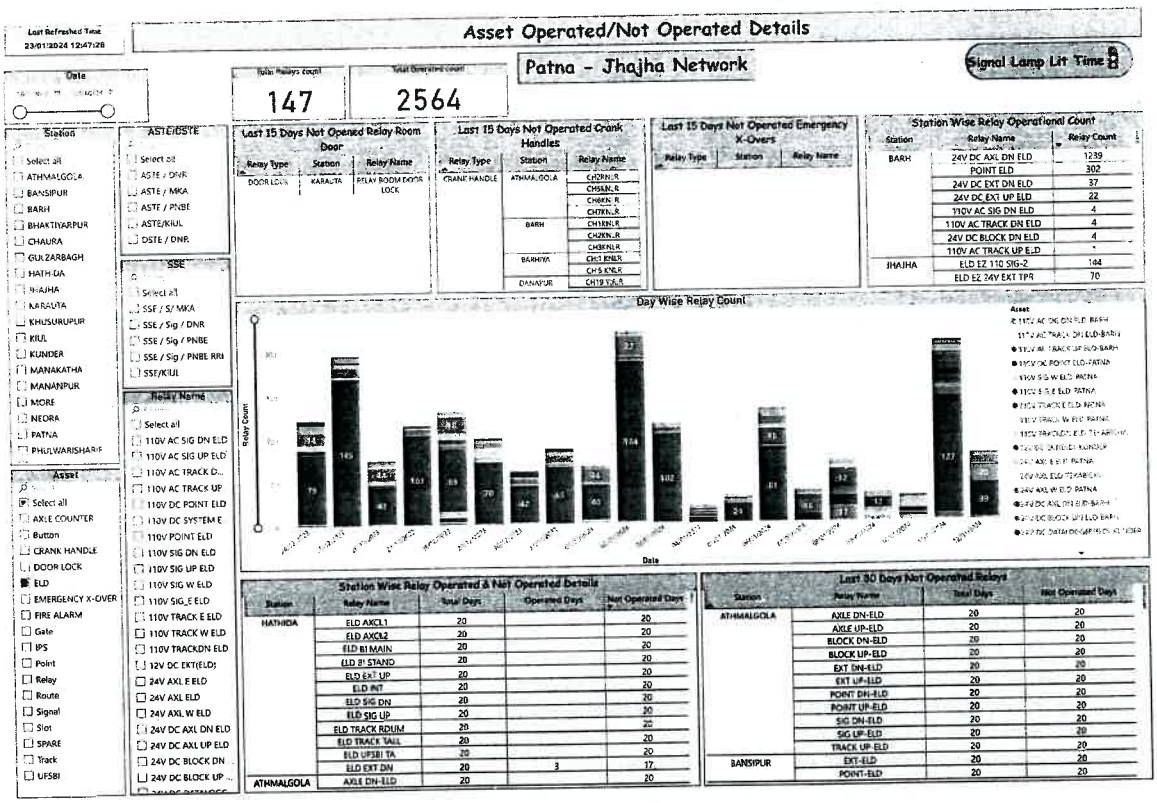


5. PMM(ST) – Ex. Summary

- Replacement of gears (life-time) based on actual usage instead of no of years. Like relays after 15 lakh operation instead of 25 yrs.
- **52 to 73%** failed gears can be replaced in time to prevent failures by replacement of mere 1 to 2% population during the life-cycle.
- In some cases, most of the gears could work for much longer due to less usage, more than compensating the cost in other cases.
- Preventive and monthly scheduled maintenance based on scientific data and algorithms.
- Inventory management and reduced inventory cost with 100% availability of spares eliminating cases of make-shift-arrangements.
- Major **upgrade on safety** aspect & mobility improvement.

bit.ly/dnrsnt

Thank You


Asset Operated/Not Operated Details
Patna - Jhajha Network
Signal Lamp Lit Time
Last Refreshed Time
23/01/2024 12:47:28
Total Relays count
147
Total Operated count
2564
Last 15 Days Not Opened Relay Room Door
Relay Type
Station
Relay Name
DOOR LOCK
KARAUTA
RELAY ROOM DOOR LOCK
Last 15 Days Not Operated Crank Handles
CRANK HANDLE
ATHMALGOLA
BARH
BARHIYA
DANAPUR
Last 15 Days Not Operated Emergency X-Overs
Station Wise Relay Operational Count
Station
Relay Name
Relay Count
BARH
24V DC AXL DN ELD
1239
POINT ELD
302
24V DC EXT DN ELD
37
24V DC EXT UP ELD
22
110V AC SIG DN ELD
4
110V AC TRACK DN ELD
4
24V DC BLOCK DN ELD
4
110V AC TRACK UP E.D
1
JHAJHA
ELD EZ 110 SIG-2
144
ELD EZ 24V EXT TPR
70
Day Wise Relay Count
Relay Count
Date
Station Wise Relay Operated & Not Operated Details
Station
Relay Name
Total Days
Operated Days
Not Operated Days
HATHIDA
ELD AXCL1
20
20
ELD AXCL2
20
20
ELD BI MAIN
20
20
ELD BI STAND
20
20
ELD EXT UP
20
20
ELD INT
20
20
ELD SIG DN
20
20
ELD SIG UP
20
20
ELD TRACK RDUM
20
20
ELD TRACK TAIL
20
20
ELD UFSBI TA
20
20
ELD EXT DN
20
3
17
ATHMALGOLA
AXLE DN-ELD
20
20
Last 30 Days Not Operated Relays
AXLE DN-ELD
AXLE UP-ELD
BLOCK DN-ELD
BLOCK UP-ELD
EXT DN-ELD
EXT UP-ELD
POINT DN-ELD
POINT UP-ELD
SIG DN-ELD
SIG UP-ELD
TRACK UP-ELD
BANSIPUR
EXT-ELD
POINT-ELD
Date
Station
Select all
ATHMALGOLA
BANSIPUR
BARH
BHAKTIYARPUR
CHAURA
GULZARBAGH
HATHIDA
JHAJHA
KARAUTA
KHUSRUPUR
KIUL
KUNDER
MANAKATHA
MANANPUR
MORE
NEORA
PATNA
PHULWARISHARIF
ASTE/DSTE
ASTE / DNR
ASTE / MKA
ASTE / PNBE
ASTE/KIUL
DSTE / DNR
SSE
SSE / S/ MKA
SSE / Sig / DNR
SSE / Sig / PNBE
SSE / Sig / PNBE RRI
SSE/KIUL
Relay Name
110V AC SIG DN ELD
110V AC SIG UP ELD
110V AC TRACK D...
110V AC TRACK UP
110V DC POINT ELD
110V DC SYSTEM E
110V POINT ELD
110V SIG DN ELD
110V SIG UP ELD
110V SIG W ELD
110V SIG_E ELD
110V TRACK E ELD
110V TRACK W ELD
110V TRACKDN ELD
12V DC EXT(ELD)
24V AXL E ELD
24V AXL ELD
24V AXL W ELD
24V DC AXL DN ELD
24V DC AXL UP ELD
24V DC BLOCK DN
24V DC BLOCK UP
Asset
Select all
AXLE COUNTER
Button
CRANK HANDLE
DOOR LOCK
ELD
EMERGENCY X-OVER
FIRE ALARM
Gate
IPS
Point
Relay
Route
Signal
Slot
SPARE
Track
UFSBI

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