COMPERATIVE WORK STUDY

OF

DIESEL SHED LUDHIANA (LDH)

HAVING HIGHEST BENCHMARK MPR WITH

DIESEL SHED GUNTAKAL (GTL)

HAVING LOWEST BENCHMARK MPR

2018-19

WORK STUDY TEAM

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Central Planning Cell
Northern Railway
Headquarters Office,
Baroda House, New Delhi

EXECUTIVE SUMMARY

This study was allotted to Central Planning Cell, HQ Office by Rly Board vide letter No 217/E&R/2 (1)/1 dt 02.04.2018 to compare activities centers having highest and lowest benchmark MPR at DSL Shed Ludhiana (LDH) and DSL shed Guntakal (GTL)

STAFF POSITION

The total sanctioned and on roll strength of DSL Shed Ludhiana (LDH) and DSL shed Guntakal (GTL) staff is as under:-

STAFF:	DSL Shed LUDHIANA (LDH)	DSL Shed GUNTAKAL (GTL)
Sanction Strength	**1237**	**602**
On Roll	**1039**	**564**
Vacancy	**198**	**38**

LOCO HOLDING:

LOCO HOLDING	DSL Shed LUDHIANA (LDH)	DSL Shed GUNTAKAL (GTL)
	192	**124**

SYNOPSIS

Locomotive is one of the important parts of a train which hauls the train at a desired level of speed. In past, steam locomotives were used in railway to transport the passengers as well as freight traffic from one point to another. In 60's the dieselization of traction were introduced on busiest routes with a view to improve the speed of railway transport. In the year 2000, the steam locos were totally phased out and now a day's all the trains are hauled by Diesel or Electric locomotives. In 1962, India imported 72 WDM-4 diesel locomotives from General Motors, USA and homed at diesel shed Mugalsarai for providing necessary maintenance to these locomotives. But due to reduction of steam locos and increase in railway traffic, requirement of diesel locomotives were increased. To meet this goal, Indian Railway introduced state manufactured diesel locomotives WDM-2 at Diesel locomotives works, Varanasi. This study deals with Review of Diesel Loco shed activities which are essentially required for maintenance and upkeep of these locomotives. The maintenance of diesel locomotives are carried out by different diesel loco sheds over the entire Indian Railways.

Due to various innovations/modernizations and system developments, the various maintenance activities need to be streamlined with a view to effect economy in expenditure with improved manpower productivity. This study was allotted to Central Planning Cell, HQ Office by Rly Board vide letter No 217/E&R/2 (1)/1 dt 02.04.2018 to compare activities centers having highest and lowest benchmark MPR at DSL Shed Ludhiana (LDH) and DSL shed Guntakal (GTL)

The team visited both the shed and critically examined its workload. The team kept the periodicity of various maintenance schedules, modifications being incorporated, geographical conditions, existing working conditions and bench mark/norms as laid down by Railway Board into consideration.

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1.0.0 INTRODUCTION

1.1.0 Diesel Loco Shed LDH is one of the biggest shed on the Northern Railway. The entire rail network of FZR division comprises of both electric and diesel locomotives. The trains are hauled by diesel/Electric locos towards Amritsar, Jammu Tawi, Ambala, Moradabad and Delhi direction.

1.2.0 The Diesel loco shed LDH provides reliable diesel locos for hauling mail/exp, passenger and freight trains over Northern Railway. To keep the diesel locos in good running condition, this shed carried out inspection as well as periodic schedules and out of course repairs. The periodicities of maintenance schedules have been enhanced and notable innovations/modifications are being incorporated in design feature of diesel locos along with replacement of components/parts. This has resulted in lesser maintenance efforts and more reliability but the staffing pattern has not been changed yet.

Diesel shed Guntakal was commissioned on 30.08.1964 with 11 YDM4/4A Locos imported from M/S MLW/Canada as initial holding and was inaugurated by Shri H.D. Singh, GM/SR. The present loco holding is peaked with 124 locos. The present shed Berthing Capacity is 14 BG locos.

1.3.0 This study was allotted to Central Planning Cell, HQ Office by Rly Board vide letter No 217/E&R/2 (1)/1 dt 02.04.2018 to compare activities centers having highest and lowest benchmark MPR at DSL Shed Ludhiana (LDH) and DSL shed Guntakal (GTL)

1.4.0 TERMS OF REFERENCE

The work study has been conducted under the following terms of reference: -

i) To review staff strength vis-à-vis workload.
ii) To suggest ways and means to identify redundant/unproductive activities to eliminate wasteful expenditure.
iii) To suggest ways and means to improve the efficiency and productivity of the system.

1.5.0 METHODOLOGY ADOPTED

The following method study and work measurement techniques were adopted to conduct the study: -

i) Data collection and its critical analysis.
ii) Work sampling, analytical estimation, spot observations, physical checks and yardstick in vogue, if any, to assess the performance of staff.
iii) Held discussions at various levels.

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2.0.0 STAFF POSITION:

The team collected detailed staff position of Group 'C' & 'D' maintenance staff from DSL Shed/LDH and DSL Shed GTL the summarized staff position is tabulated as under:-

Diesel Shed LUDHIANA (LDH):

S.N.	Category of Staff	S/S		O/R		Vac.	
		Gr C	Gr D	Gr C	Gr D	Gr C	Gr D
1	Supervisor Staff	102	--	66	--	36	--
2	Ministerial Staff	53	--	35	--	18	--
3	Ancillary Staff	148	73	83	93	65	+20
4	Operating Staff	26	02	06	02	20	--
5	Training School Staff	15	09	11	04	04	05
6	Canteen Staff	04	05	01	05	03	--
7	Lab Staff	22	13	12	11	10	02
8	Artisan staff	638	85	568	107	70	+22
9	Misc Staff	--	42	--	35	--	07
Total		1008	229	782	257	226	+28
Grand Total Gr c + D		**1237**		**1039**		**198**	

The above table reveals that the on roll strength of Gr 'C' & 'D' maintenance staff of Diesel Shed LDH is **1039** against the sanctioned strength **1237** and **198** posts are lying vacant.

Diesel Shed GUNTAKAL (GTL):

S.N.	Category of staff	S/S		O/R		Vacancy	
		Gr C	Gr D	Gr C	Gr D	Gr C	Gr D
1	Supervisor Staff	60	--	49	--	11	--
2	Ministerial Staff	13	--	08	--	05	--
3	Ancillary Staff	35	--	30	--	05	--
4	Operating Staff	04	02	03	--	01	02
5	Training School & Canteen Staff	--	05	09	03	+9	02
6	Misc Staff	08	04	15	04	+07	--
8	Artisan staff	413	58	342	101	71	+43
Total		533	69	456	108	77	--
Grand Total Gr c + D		**602**		**564**		**38**	

The above table reveals that the on roll strength of Gr 'C' & 'D' maintenance staff of Diesel Shed GTL is **564** against the sanctioned strength **602** and **38** posts are lying vacant.

Beside the above staff one retired SSE is re-engaged in DSL Shed GTL

3.0.0 LOCO HOLDING:

The work team collected the locomotives wise Loco holding of DSL Shed LDH and GTL which is depicted as under:

S N	TYPE OF LOCO	DSL SHED LDH	DSL SHED GTL
1	WDM3A	101	28
2	WDM2	02	--
3	WDG3A	49	62
4	WDG4D	30	09
5	WDP4D	05	--
6	WAG7(Elec loco)	05	--
7	WDM3D	--	25
Total Holding		**192**	**124**

The above table reveals that the loco holding of DSL Shed LDH and DSL Shed GTL is **192** and **124** respectively and having loco holding more than 80 loco.

4.0.0 WORKLOAD:

The main function of diesel loco shed is to maintain diesel locomotives by carrying out various schedules like T-1, T2, M2, M4/M8/M16/M20, M12, M24/M72, M48 & IOH (Minor & Major schedules) for home shed locos and repairs of foreign shed locos whenever required. The total number of different types of locos based for maintenance in DSL shed LDH & GTL IS 192 & 124 respectively. The failures of diesel loco occur during run due to various reasons despite of good maintenance practices in shed/shops. The out of course repairs given to such locomotives either of home-shed or of other sheds vary both in quantity as well as in frequency.

Description of maintenance Schedules:

Schedule	Description of Schedule
RB	Commissioning of Rebuilt loco
POH	Commissioning of (POH) Loco
M24/M48/M72	Yearly schedule
M12	Half yearly Schedule
QLY M4/M8/M16/M20	Quarterly Schedule
M2	Monthly Schedule
T2	Trip Schedule
T1	Trip Schedule
HHP Loco:	
T360	Yearly Schedule
T90/180/270	Quarterly Schedule

4.0.1 The out turn of minor and major schedules carried out in diesel shed LDH & DSL shed GTL for the last one year i.e. APR'2017 to MAR' 2018 is given as below:-

SCHEDULE	DSL shed LDH	DSL shed GTL
WDM3A, WDM2, WDG3A, Loco:		
RB	07	04
POH	16	06
M24/M48/M72	45	42
M12	71	45
QLY M4/M8/M16/M20	279	220
M2	414	275
T2	592	349
T1	1721	1347
HHP Loco:		
T360	11	05
T90/180/270	40	15
T30/60/120/150	98	41

4.1.2 The outage of diesel shed LDH & DSL shed GTL for the last one year i.e. *APR'2017 to MAR' 2018* is given as below:-

Month/ Year	DSL shed LDH			DSL shed GTL		
	Target	Achievement	Variation +/-	Target	Achievement	Variation
April-17	147.40	161.48	14.08	96.50	99.20	2.70
May-17	147.10	158.94	11.84	97.40	101.35	3.95
June-17	145.30	150.71	5.41	99.30	100.38	1.08
July-17	145.00	147.42	2.42	99.80	102.39	2.59
Aug-17	144.00	147.20	3.20	100.20	101.79	1.59
Sept-17	144.70	147.20	2.50	100.20	104.32	4.12
Oct-17	150.90	156.19	5.29	100.20	102.08	1.88
Nov-17	150.90	154.15	3.25	100.70	101.17	0.47
Dec-17	151.50	161.01	9.51	106.50	108.14	1.64
Jan-18	154.30	167.42	13.12	106.40	110.50	4.10
Feb-18	158.00	165.19	7.19	106.40	109.58	3.18
March-18	159.70	169.06	9.36	107.50	109.72	2.22
Total	*1798.80*	*1885.97*	*87.17*	*1221.10*	*1250.62*	*29.52*
Average	*149.90*	*157.16*	*7.26*	*101.76*	*104.22*	*2.46*

The above table reveals that the targets laid down by the Rly Board are achieved successfully by the existing on roll staff at diesel shed LDH & DSL shed GTL.

4.2.0 CALCULATION OF MAN POWER RATIO (MPR):

Description	DSL Shed LDH	DSL Shed GTL
On Roll Staff	1039	564
LOCO HOLDING	192	124
MPR: (Total on roll staff/Loco Holding)	1039/192 =5.41 per loco	564/124 =4.55 per loco
MPR as Per Rly Board bench Mark	6.86	3.12

Observations:- The above deliberation reveals that the MPR of DSL Shed LDH & GTL Comes to 5.41 and 4.55 per loco respectively. While as per Rly Board's letter MPR of DSL shed LDH & GTL has been mentioned 6.86 & 3.12 per loco respectively. MPR of DSL Shed LDH is 18.90 % higher than DSL Shed GTL but less than as provided by Rly Board i.e. 6.86.

1. MPR of DSL Shed LDH is 18.90 % higher than DSL Shed GTL but less than as provided by Rly Board i.e. 6.86.

2. Activities such as Loco components cleaning shed premises cleaning and AMC's of other machineries/equipments are being done on contract basis at DSL Shed GTL which is Aprox 20-25% of total workload. While at DSL Shed LDH all these activities are being carried out departmentally.

3. MPR 4.55 per loco DSL shed GTL comprises with the Mechanical and Electrical staff deployed for loco maintenance. While it is observed that MPR 3.12 of DSL shed GTL (provided by Rly Board) calculate only taking the mechanical staff into consideration.

4. If the work study recommendations are implemented and the cleaning activities are outsourced at DSL shed LDH, **115** Gr D staff will be rendered surplus which will definitely help to improve the man power Ratio and productivity of DSL shed LDH.

5.0.0 Comparison of Different cleaning Activities being carried out at DSL Shed GTL and DSL Shed LDH

S No	Sections components	DSL Shed GTL	DSL Shed LDH
I. Cylinder Head, Piston & Valve Lever Assembly Section			
Cleaning of:			
1	Cylinder heads	Out-sourced	Departmental
2	Cylinder Head valves, spring, retainers and collets.	Out-sourced	Departmental
3	Pistons	Out-sourced	Departmental
4	Connecting rods & bottom caps		
5	Connecting rod bolts & nuts		
6	Gudgeon pins		

7	Valve lever cap screws	Out-sourced	Departmental
8	Supports		
9	Push rods		
10	Yokes		
11	Springs		
12	Rocker arms		
13	Rocker arm beds		
14	Shaft		
II. Power Pack Section:			
Cleaning of			
1	Tappet FIP and sump door covers	Out-sourced	Departmental
2	All bolts		
3	FIP support dummies		
4	Strong backs		
5	Dummy doors		
6	Exhaust manifolds		
7	Water raiser legs		
8	Water jumpers& inlet elbows		
9	Water header raiser pipes		
10	Water header outlet pipes		
11	Cyclonic panels		
12	Heat shield		
13	3″ Victaulic and armored couplings & retaining clamps		
14	Lube oil strainer housing	Out-sourced	Departmental
15	Camshaft vibration damper housing		
16	Cam gear covers		
17	Governor bed		
18	OST housing		
19	C.C. Motor inlet & out let pipes		
20	Carbody filters		
III Turbo Section: Cleaning of			
1	After cooler Assembly	Out-sourced	Departmental
2	Gas inlet casing		
3	Turbo inlet casing		
4	Air outlet casing		
5	Chimney		
6	Cyclonic beams distance piece		

7	Bladed shaft, Impeller		
IV Pumps and blowers overhauling Section: Cleaning of			
1	Water pump & lube oil pump	Out-sourced	Departmental
2	Relief regulating valve and by-pass valve		
3	Lube oil cooler		
4	RTTM & FTTM blower		
5	Horizontal & Universal shaft		
6	Right angle gear box		
7	Radiator fan & stand		

V.Pumps and blowers assembly Section Cleaning of			
1	Bolts and Nuts	Out-sourced	Departmental
2	Water & Lube oil pipe lines		
3	Half round mesh		
4	Round Mesh & Top Mesh		
5	Radiator and side grills		
6	Stay rods		
7	Dresser and Victaulic couplings		

VI. Expressor and Compressor Section: Cleaning of			
A	Expressor:		
1	Flexible and fast coupling	Out-sourced	Departmental
2	Crankcase		
3	Liners & Pistons		
4	Connecting Rods & Heads		
5	Sleeves& Valves		
6	Inter cooler heads		
7	Air intake filters		
8	Inter cooler		

B. Compressor: Cleaning of:			
01	Flexible and fast coupling	Out-sourced	Departmental

02	Crank case		
03	Liner & pistons		
04	Connecting rods & heads		
05	Sleeves & valves		
06	Inter cooler heads		
07	Air intake filters		
08	Inter and After coolers		
VII. Air Brake Section: Cleaning of:			
1	MR tanks	Out-sourced	Departmental
2	F2 Feed valve		
3	Distributor valve		
4	C2 Relay valve		
5	Additional C2 relay valve		
6	A9 Automatic brake valve		
7	SA9 independent brake valve		
8	28 VAB valve		
	Sanders		
10	BP & FP angular cocks		
11	Auto drain valves		
12	J filters		
13	HS-4 valve		
14	Pressure Regulator		
	Sub Total		
VIII. Under truck section: Cleaning of:			
1	Gear case & gears (Pinion & bull gear)	Out-sourced	Departmental
2	Bottom & top slack adjusters, Equalizing beams, springs		
3	Comp. Beams, Equalizers and links		
4	Axle box bearing		
5	Axle box, wheel discs		
6	Traction motor frames external surface		
7	Bogie frames		

IX. Traction Alternator: Cleaning of:			
Sl.No	Section Name & material	Out sourced	Departmental

	description		
1	Partition Wall		
2	Jelly cover		
3	Hood		
4	Traction Alternator external surface cleaning		
5	Traction Alternator pit		
X. Traction Motor: Cleaning of:			
1	Traction motor external surface cleaning	Out sourced	Departmental
2	Pinion		
3	End Shields CE&PE		
4	Bearing retaining collar		
5	Outer bearing caps CE & PE		
6	Inner caps PE		
7	Inspection covers		

5.0.1 OTHER RUNNING CONTRACTS AT DSL SHED GTL AND LDH:

S No	Description of Work	DSL shed GTL	DSL shed LDH
1	Maintenance of Fire extinguishers for a period of 2 yr	Out Sourced	By Departmental staff
2	AMC of Spectrometer	Out Sourced	By Departmental staff
3	AMC of Dynamic balancing machine	Out Sourced	By Departmental staff
4	AMC for ETP (Effluent Treatment Plant)	Out Sourced	By Departmental staff
5	Overhauling of Actuator Unit M-96	Out Sourced	By Departmental staff
6	Overhauling of Actuator Unit M-48	Out Sourced	By Departmental staff
7	Maintenance of control unit	Out Sourced	By Departmental staff
8	Lorry transport contract	Out Sourced	By Departmental staff
9	Washing and ironing of linen at DTTC (Diesel Traction Training Center)	Out Sourced	By Departmental staff
10	Hazardous waste disposal	Out Sourced	Out Sourced
11	MEP 660 (Maintenance of electrical panel)	Out Sourced	Out Sourced
12	AMC for CNC under floor wheel lathe (BG) for five yrs	Out Sourced	Out Sourced
13	Maintenance of IMS (Information Management system)	Out Sourced	--

5.0.2 Section wise cleaning activity and involvement of staff in DSL shed LDH:

S No.	Section	Cleaning Activity	Staff involved for cleaning activities
1	Mail	Cleaning of engine room, exp room, radiator room, gen room & driver cabin etc. of outgoing loco	6
2	Goods	Cleaning of engine room, exp room, radiator room, gen room & driver cabin etc. of outgoing loco	4
3	QLY/HLY	Cleaning of engine room, exp room, radiator room, gen room & driver cabin etc. of outgoing loco	2
4	Out of Course	Cleaning of loco parts as and when required	3
5	Drawing/Planning	--	--
6	Diesel Training Centre	Housekeeping of Training Centre	2
7	Fabrication	Cleaning of components	1
8	Misc. (Cylinder head, radiator section, Turbo, Expresser, Car body, FIP, Lube oil cooler, after cooler)	Soaking, Cleaning & air blowing of Cylinder head=4 radiator section=2 Turbo =1 Expresser=1, Car body=6, FIP=1 Lube oil cooler=1 after cooler=1	17
9	Bills	--	--
10	Spare Cell	Housekeeping of premises	1
11	Mill Wright	Cleaning of components	2
12	Air Brake	Cleaning & air blowing of components	2
13	Sub Assembly (piston)	Soaking, Cleaning & air blowing of components	2
14	CTA	--	--
15	Washing Line	Air blowing, Washing and steam blowing of locomotives.	12
16	Bogie	Soaking, jet washing and cleaning of bogie frames	2
17	Lab		--

18	YLY	Cleaning of engine block, radiator room, exp room, and gen room etc.	8
19	Control	Housekeeping of premises	1
20	Hostel	Housekeeping of premises	2
21	Battery	Cleaning of battery box, cells	1
22	Test Room	Cleaning of components	2
23	T/M Section	Cleaning of components, rotors, stators etc.	2
24	Power	Housekeeping of premises	1
25	Painter/Carpenter	Cleaning of components	1
26	Speedometer		-
27	Fuel	Cleaning of fuel tank	1
28	Machine Shop/wheel lathe	Cleaning of chips after tyre turning of wheels	3
29	DSL Shed premises	Cleaning and housekeeping of DSL Shed premises, disposal of hazardous waste.	37
Total			**115**

The above table shows that **115** Gr D staff is involved in the cleaning activities in the different sections of the DSL shed LDH. During visit at DSL shed GTL it was observed that similar activities are being carried out on contract basis successfully. It is proposed that possibility of outsourcing be explored for different type of cleaning activities where safety is not directly involved at DSL shed LDH. If the cleaning activities are outsourced **115** Gr D staff will be rendered surplus which will definitely help to improve the man power productivity and MPR of DSL shed LDH.

6.0.0 CRITICAL ANALYSIS:

During the conduct of study, the work study team visited diesel shed LDH of N Rly and GTL of SC Rly. During the course of review it was found that loco holding of DSL shed LDH and GTL are 192 and 124 respectively. On further review it was observed that loco component cleaning, shed premises cleaning and AMC's of other machineries/equipments at DSL shed GTL are being carried out on contract basis where as all these activities are being carried out by departmental staff at DSL shed LDH which is the main cause of difference of MPR at DSL shed GTL & LDH.

Formulae for MPR: $$MPR = \frac{\text{Total on roll staff strength}}{\text{Total loco holding}}$$

For calculation of MPR total no. of on roll staff all supervisors, ministerial, artisan ancillary staff and group "D" staff are taken in to consideration.

CONCLUSION:-

The above deliberation reveals that the MPR of DSL Shed LDH & GTL Comes to 5.41 and 4.55 per loco respectively. While as per Rly Board's letter MPR of DSL shed LDH & GTL has been mentioned 6.86 & 3.12 per loco respectively. MPR of DSL Shed LDH is 18.90 % higher than DSL Shed GTL but less than as provided by Rly Board i.e. 6.86.

1. MPR of DSL Shed LDH is 18.90 % higher than DSL Shed GTL but less than as provided by Rly Board i.e. 6.86.
2. Activities such as Loco components cleaning shed premises cleaning and AMC's of other machineries/equipments are being done on contract basis at DSL Shed GTL which is Aprox 20-25% of total workload. While at DSL Shed LDH all these activities are being carried out departmentally.
3. MPR 4.55 per loco DSL shed GTL comprises with the Mechanical and Electrical staff deployed for loco maintenance. While it is observed that MPR 3.12 of DSL shed GTL (provided by Rly Board) calculate only taking the mechanical staff into consideration.
4. If the work study recommendations are implemented and the cleaning activities are outsourced at DSL shed LDH, **115** Gr D staff will be rendered surplus which will definitely help to improve the man power Ratio and productivity of DSL shed LDH.

RECOMMENDATION:

It is proposed that possibility of outsourcing be explored for different type of cleaning activities where safety is not directly involved at DSL shed LDH. After outsourcing of cleaning activities **115** Gr D staff will be rendered surplus and the resultant surplus **115** posts should be surrendered.

FINANCIAL IMPLICATIONS: After the implementation of work study recommendations the financial implications will be as under:

S N	Location	Category	Pay Scale + Grade Pay	Monthly value per posts in ₹	Posts to be surrendered	Total annual Saving in ₹
1	DSL Shed LDH	Gr 'D'	5200-20200+ 1800	40072/-	115	5,52,99,360/-
Total						5,52,99,360/-

Anticipated recurring savings = ₹ 552.99 lakh per annum after implementation of the work study recommendations.

BEST PRACTICES OBSERVED AT DSL Shed LUDHIANA (LDH) & DSL Shed GUNTAKAL (GTL):

Best practices at dsl shed Ludhiana (LDH)

1. Development of compressor safety device.
2. Apparatus for DC supply for RUN test of traction motor.
3. Apparatus for testing centrifuge system operation.
4. Development of test kit for testing card No 254.
5. Development of stand for traction motor armature cleaning.
6. The average outage of the locomotive remains in plus i.e. +*7.26* per month in the last FY 2017-18 which is above the target given by HQ.
7. Lube oil consumption (LOC) 100/EKM LOC comes to 2.27 which shows that good control on LOC.
8. Development of Water side flushing of after cooler.
9. Development of Specific fuel consumption (SFC) measurement system
10. GF contractor feedback modification in microprocessor fitted loco's.
11. Test stand for current and voltage sensors of microprocessor based locomotives.

BEST PRACTICES DSL Shed GUNTAKAL (GTL):

1. Changing of Engine crank shaft in position without dismantling the cylinder head and power assembly.
2. 100% changing of horn check liners of bogie frame.
3. In house Cleaning of nozzle of Fuel injection pump (FIP)
4. In house Changing of Lube oil filter changed in 240 days due to introduction of centrifugal.
5. Development of stand for traction motor armature cleaning.
6. The average outage of the locomotive remains in plus i.e. +*2.46* per month in the last FY 2017-18 which is above the target given by HQ.
7. Lube oil consumption (LOC) 100/EKM LOC comes to 1.95 which shows that good control on LOC.