



Feasibility **REPORT OF "KAVACH"** **IMPLEMENTATION IN** **INDIAN RAILWAYS.**

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भारतीय रेल
Indian Railways

Feasibility Report

for

**“Provision of Train Collision Avoidance
System (KAVACH) along with two 24 Fiber
OFC backbone in sections between Pt.
Deendayal Upadhyay (DDU) and
Pradhankhunta (PKA) of the East Central
Railway”**



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ABBREVIATIONS:

Abbreviation	Description
AIP	Approval In Principle
ATP	Automatic Train Protection
BIU	Break Interface Unit
DCF	Discounted Cash Flow
DEMU	Diesel Electrical Multiple Unit
DMI	Driver Machine Interface
DRACAS	Defect Reporting and Corrective Action System
EMU	Electrical Multiple Unit
GTKM	Gross Tonne Kilometre
IBS	Intermediate Block Signal
IR	Indian Railways
LC	Level Crossing
LED	Light Emitting Diode
LHS	Limited Height Subway
LP	Loco Pilot
LTCAS	Locomotive Train Collision Avoidance System
MCB	Miniature Circuit Breaker
MEMU	Mainline Electric Multiple Unit
MMTS	Multi Modal Transport System
NTKM	Net Tonne Kilometre
OHE	Over Head Equipment
PSR	Permanent Speed Restriction
QCRA	Qualitative Cost Risk Analysis
RAM	Reliability, Availability and Maintainability



Abbreviation	Description
RFID	Radio Frequency Identification
RIU	Remote Interface Unit
ROB	Road Over Bridge
ROR	Rate of Return



1. EXECUTIVE SUMMARY:

1.1 Background

Indian Railways is experiencing phenomenal growth in gross turnover. Since 1950 Railways Passenger Kilometre, Freight Train Kilometre, Revenue earning freight traffic (NTKM), Gross Ton Per Km (GTKM), Wagon and Coach utilization is continuously increasing. In the year 2012-13, Indian Railways joined the exclusive club of billion-ton freight loading countries with China, Russia and USA. In terms of Passenger Km carried, IR is second largest passenger carrier in the world next only to Chinese Railways. Despite its phenomenal growth in terms of traffic, there has been no substantial improvement in the average speed of passengers as well as freight trains.

“In order to reverse this trend, Indian Railways has embarked upon the speed enhancement plan along with removing the capacity constraints by doubling, tripling and quadrupling of railway sections”.

Although performance of the Indian Railways on the safety front is showing continuous improving trend with zero passenger casualty during 2019-20 & 20-21. Yet in view of the enhancement of speed, doubling, tripling and quadrupling of track, this safety performance without any technical aid to loco pilots is difficult to sustain. Signal Passing at Danger, Breach of Block rules and failure to observe the prescribed speed by loco pilots are potential hazards.

“In order to mitigate the risks arising out of these incidents and provide aids to loco pilots for confident driving at higher speed, Indian Railways has planned to deploy the Modern Train Control System on its entire network in a time bound manner.”

In this context successful trial of indigenously developed Automatic Train Protection system has been carried out in 265 Kms section on Secunderabad Division of South



Central Railway. In addition to this, further deployment of this system in contiguous section of Bidar – Prabhani, Manmad – Parbhani - Mudkhed – Secunderabad – Dhone – Guntakal (1200 RKMs) has been sanctioned and the work in that section is ongoing successfully.

Encouraged with the results, a conscious decision to have all Modern Train Control system works with indigenously developed Train Collision Avoidance System (TCAS) now named as **KAVACH** has been taken.

1.2 Project Overview

The section under consideration of this FEASIBILITY REPORT i.e. Pt. Deendayal Upadhyay – Manpur – Pradhankhunta (DDU-MPO-PKA), of East Central Railway, which is a part of the Delhi - Howrah HDN (High Density Network) Route, has to be provided with the ATP system “KAVACH” (TCAS) under “Mission Raftar” for increasing the speed to 160 kmph from the present 130 kmph and enhancing safety at the same time.

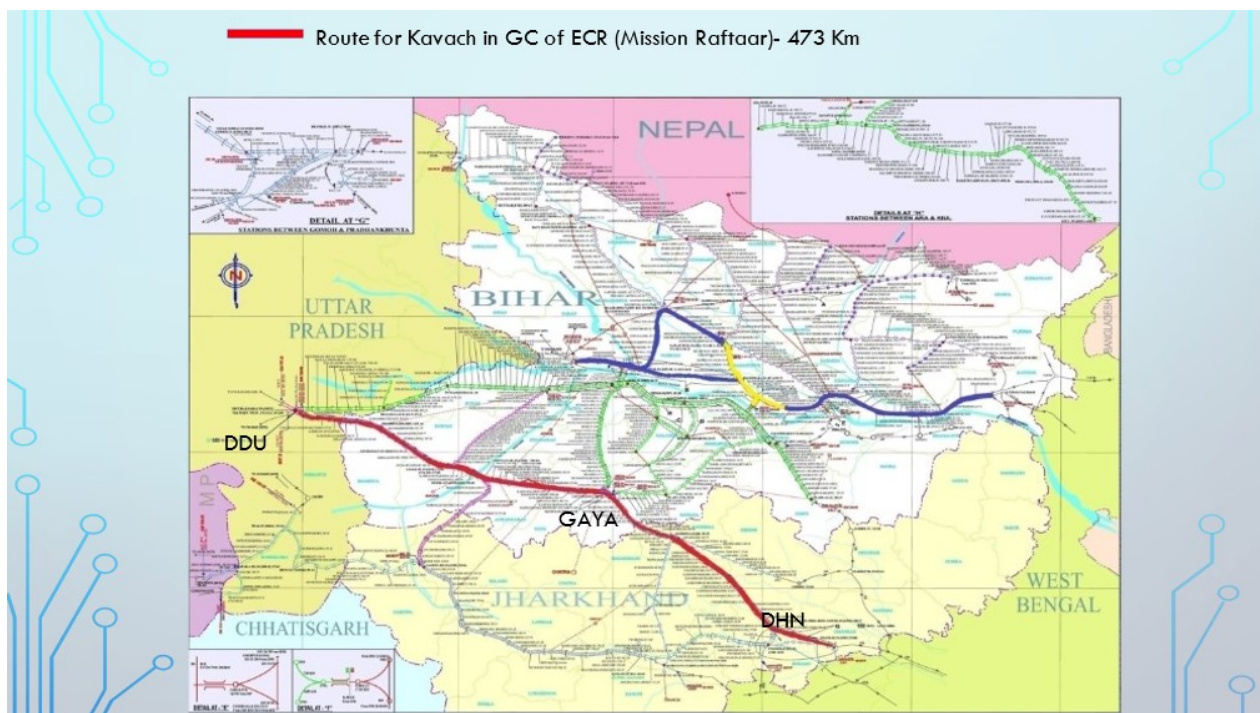
Delhi- Howrah route of Indian Railway is one of the busiest routes on Indian Railways. Of this Deendayal Upadhyay to Pradhankhunta section of ECR is a major component. ECR though is only 5% of Indian Railways but it carries 10% of traffic of IR.

On this busy route, it will enable the Loco Pilots of KAVACH fitted Locomotives to take the experience and advantage of confident driving in a continuous long stretch of about more than 411 Kms of DDU-MPO-PKA section on East Central Railway which is the site of this Project.

1.3 Project Location and description of section

The Deendayal Upadhyay - Manpur- Pradhankhunta (DDU – MPO – PKA) section of DDU & DHN Division, East Central Railway is a part of Delhi – Howrah HDN Route of Indian Railways.

The section is of 408.750 Route Km length and passes through the state of Uttar Pradesh, Bihar, Jharkhand running parallel to major rivers like Ganga. and their tributaries. The terrain of the section is mostly flat with ruling gradient of 1 in 200. The section is mostly in the gangetic plains with alluvial soil as the major soil type.



The section comprises of 69 way side station and 8 Junction station totaling to 77 numbers of stations, 79 numbers of Level crossing Gates and 07 Intermediate Block Signals and carries mix traffic of all kinds, viz. freight, mail / express, passenger and suburban trains.

Number of Passenger and freight trains in one direction and maximum permissible speeds of various categories of trains in the section are given in table below.

Table 1.1

SN	Type of Train	Numbers	Maximum Permissible Speed (KMPH)
1	Express	49	130
2	Passenger	10	100
3	DEMU	00	95
4	MEMU	12	100
5	EMU	0	96



SN	Type of Train	Numbers	Maximum Permissible Speed (KMPH)
6	Freight	90	100

The Site of the Railway Project comprises the section commencing from km 672.65 to km 640.73 i.e. the 32 kms length is in the State of Uttar Pradesh, from km 640.73 to km 464.40 i.e. the 176 Km length is in the State of Bihar, from km 464.40 to km 261.31 i.e. the 203 Kms length is in the State of Jharkhand in the East Central Railway . The land and other structures comprising the route length of the Railway Project comprises the section in two parts as described below:

1. RAILWAY : East Central Railway
2. DIVISION : Pt. Deendayal Upadhyay & Dhanbad Divisios
3. SECTION : From Km 672.65 to 261.31
4. LENGTH of Section : 411.340 Kms
5. Max Speed : 130 Kmph
6. No. Of Lines :

A. Quadruple Lines: Nil

B. Triple Lines:

S.No	Section Name	Km	Remark
1.	Pt.deendayal Upadhyaya-Dehri-on-Sone	118	The middle line is reversible line from DDU to Dehri-on-Sone.

C. Double Line:

S.No	Section Name	Km	Remark
1.	Dehri-on-Sone - Manpur	92	This is a Double line section.
2.	Manpur - Pradhankhunta	203	This is a Double line section

D. Single Line : NIL

E. Any Other : There is a double line of DFCCIL running parallel from DDU to

Dehri-on- sone.

F. Electrification : The Total Route is Electrified

G. Block Working :

1. Absolute Block Working: Is throughout the section
2. Automatic Signaling Directional: Nil.
3. Automatic Signaling Bi Directional: Nil.

H. A sub – section wise detail of the Route, including the sub – section length, Singe / Double / Triple / Quad Line details, RE / Non RE details, number of Stations, IBS, Auto section signals and number of LC gates are tabled below:

Table 1.2

SN	Div	Sub-Section	Sec. Length (Rkm)	Single/ Double Line	RE/ Non-RE	Stations (Nos.)	IBS (Nos.)	Absolute block working (KMs)	LC Gates (Nos.)
1	Pt. Deendayal Upadhyay Division	Pt.deendayal Upadhyaya-Dehri-on-Sone	118	T/L (middle line is reversible)	RE	20	1	118	13
2		Dehri-on-Sone - Manpur	92	D/L	RE	15	1	92	28
3	Dhanbad Division	Manpur - Pradhankhunta	203	D/L	RE	40	3	203	38

1.4 Project Objectives

Safe and incident free operation of trains not only results in satisfied customers but improve the productivity of costly fixed and movable assets, viz. track, OHE, signalling systems, locomotives, rolling stock and human resources. Automatic Protection System (ATP) contributes to achieve above objectives of a transport system.



KAVACH is an indigenously designed Automatic Train Protection system in line with the vision of Hon'ble PM of "Aatma Nirbhar Bharat" and "Make in India" initiative. KAVACH would benefit Indian Railways enhancing its performance in a cost-effective way through improvements in both safety and efficiency. At times when Railway control systems around the world has traditionally evolved in response to external pressures (such as accidents, technology advancements, customer satisfaction etc.), Modern train control systems such as KAVACH are an important milestone in Indian Railways' "VIKAS YATRA". Implementation of KAVACH will play a significant role in safer and efficient working of trains on Indian Railways.

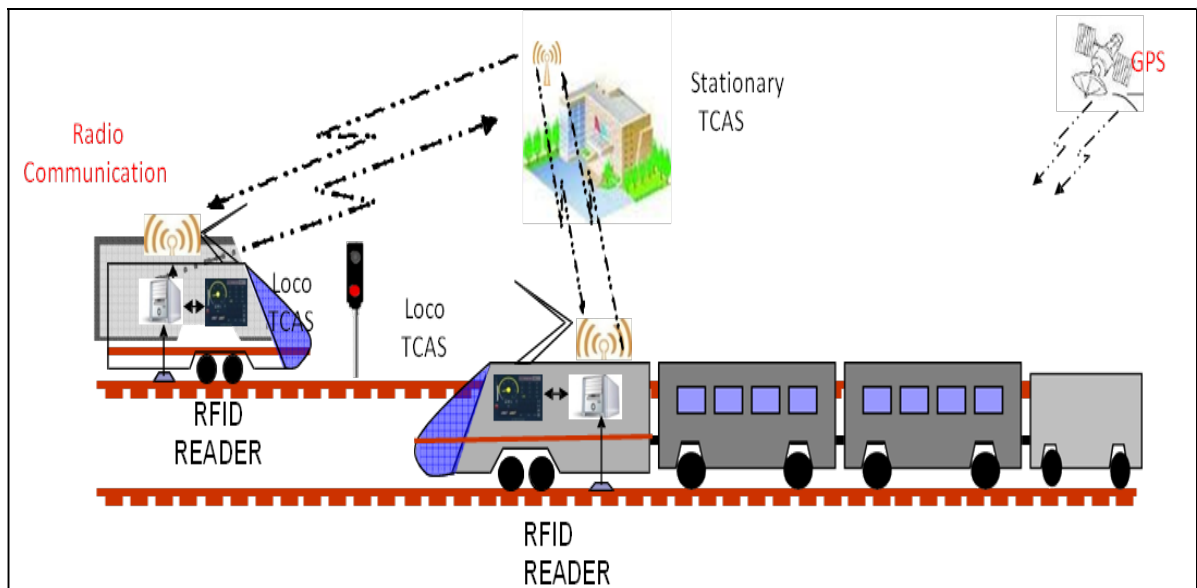
1.5 Features of KAVACH

Train Collision Avoidance System KAVACH is an indigenous Automatic Train Protection System validated to SIL 4, highest level of Safety Integrity, developed by RDSO. The system alerts the Loco Pilot while approaching the signal about their aspects, Permanent Speed Restrictions (PSR) and requires him to acknowledge the warning in case of over speeding. In case the Loco pilot does not responds, the system initiates the brake application after a pre-defined delay. Salient features of the system are as follows:

- System is interfaced with existing signaling system and provides continuous update of Movement Authority.
- Prevention of Over speed: Section Speed & Loco Specific Speed
- Displays aspect of Signal on the DMI in the Locomotive.
- Manual SOS facility both from Loco and from Station in case of emergencies.
- Prevention of Side-collision, Head on collision, Rear end collision under certain specified conditions.
- Protection of roll back/ forward and reverse movement.
- Automatic whistling in the approach of LC Gates.

Components of KAVACH

The Train Collision Avoidance system shall comprise of track side equipment including Stationary TCAS Unit and On-board equipment.



The Trackside subsystem shall be comprised of

- Stationary TCAS Unit to Interface with Signaling at Station EI / RRI / panel or LC Gate or IB or LSCs of Auto Signaling
- Tower and Antennae along with the Radio Equipment.
- RFID tag.

The On-board subsystem shall be comprised of

- Loco TCAS Vital Computer
- RFID readers consisting of two RFID Reader Antenna in hot standby
- Loco TCAS Radio Unit consisting of two Radio Modems in hot standby with separate cables and antennae for each radio or LTE unit.



- d. Driver Machine Interface (DMI) for each locomotive CAB or one DMI for each Driving motor coach of EMU/DMU/MEMU/DEMU etc.
- e. Brake Interface Unit (BIU), where required.

The Communication Back – Bone: The System will also require a Back – Bone of a Optical Fiber Network in redundancy for the connectivity of the various Stationary Station TCAS / LC & IB TCAS / RIUs units in the Automatic Signaling section as per requirement.

The details of KAVACH technology are given in Annexure A.

1.6 Factors For Project Engineering

During execution of the project a number of important aspects are to be looked into and planned well in advance. The important planning parameters for KAVACH are:

1. Radio Tele-Communication Sub System UHF/LTE
2. Requirement Of Towers, Tower Structure & Location
3. The Signaling Interface Options
4. Building Requirement if any
5. Communication Back Bone
6. Priority Of Provision Of Loco TCAS and DMI location
7. Maintenance Strategy



1.7 Brief Scope of the Work:

The KAVACH (TCAS) shall be provided to cover entire section from Pt. Deendayal Upadhyay (DDU) (672.65 Km) to Pradhankhunta (PKA) (261.31 Km) section of East Central Railway.

Design, Supply, Installation, Testing and commissioning of

- a. On Board TCAS equipment in locomotives.
- b. Track side Stationery TCAS equipment at station / LC TCAS / RIU s in Block section along with associated works including RFID Tags
- c. Laying of OFC cable as communication Back Bone.
- d. Design and Installation of Telecom Towers
- e. Building works as per requirement.

The Train Collision Avoidance System to be procured and installed shall conform to RDSO Specification No. RDSO/SPN/196/2012 version 3.2 or latest.

1.8 Utility Shifting:

While executing the KAVACH work on the section, some of the critical works are like OFC cable laying, Tower erection, additional Relay rooms etc. All these work may require small works of utility shifting specially the existing cables on specific sites.

1.9 Impact of the Project KAVACH:

Land acquisitions are normally a major component of Infrastructure projects. In Project KAVACH the basic land requirement may arise due to installation of new Towers for UHF communication requirement and for construction of buildings for STCAS equipments at the stations and in the Block Section. Apparently in the concerning section under discussion DDU-MPO-PKA, no Land acquisition is



required. However in case at a later stage if this requirement comes up, the same will have to be responsibility of the Zonal Railways and not the contractor.

Project KAVACH as an additional aid to the Loco Pilots is definitely going to enhance the Passenger safety as it monitors continuously the speed and Movement Authority and takes over in case of abnormalities.

The execution of TCAS project does not involve major civil works. As such there are no major Environment concerns.

1.10 Cost Estimation:

The proposed cost of the work is Rs. 151.211 Crores. Details of this cost are elaborated in the Cost Estimate section.

1.11 Project Risk and Assumptions:

Qualitative Cost Risk Analysis (QCRA) with the objective of identifying the projects risks for the KAVACH project with all stake holder is to be done post contract award identifying significant risks to the achievement of the project objectives

1.12 Project commissioning schedule:

It is proposed to complete the deployment of KAVACH system in 417 RKMs of the section within 24 months after award of the contract. Different milestones of the project are detailed in the Project Schedule.



2. PROJECT OBJECTIVES:

2.1 Need for deployment of the ATP system

Assets used in railway applications are required to be more and more reliable and safe. The use of computer-based train protection systems is nowadays widespread, as it has been proven to be the most effective, if not the only practicable way to pursue such hard requirements.

Traditionally, train operations in Indian Railways have relied on the train drivers/loco pilots reacting to indications displayed to them by line-side semaphore or color light signals. During the 168 years of the train operations on Indian Railways, drivers' failures to appropriately respond to the line side signals aspects have led to a number of accidents, some causing very huge loss of life and property.

A majority of train accidents caused by Signal Passing at Danger (SPAD) are attributed to the human error (Loco pilots). Momentary loss of concentration, lack of alertness, assumption of signal aspect, judgement error and overconfidence of loco pilots are among the common reason for occurrence of SPAD. Indian Railways reports on average of 50 cases of SPAD each year (based on the data from 2016 to Mar 2021). Such SPAD cases can create highly unsafe condition and may lead to highly unsafe conditions and collisions.

In response to the continuing need to reduce risks arising out of SPAD, Breach of block Rules and over speeding, an ATP systems have been envisaged.

2.2 Ensuring Safety in Train Operation

KAVACH, the Indian ATP system continuously monitor actual train speed and enforce adherence to a commanded speed pattern in case the loco pilots fail todo so. This commanded speed pattern or allowable speed profile is based on the information received from the wayside signalling subsystem. In case of an

erroneous or late intervention by the loco pilot, who interacts with the system by a Driver Machine Interface (DMI), the on-board control system automatically commands the braking procedure, directly acting on train-borne apparels via a specific interface, namely the BrakeInterface Unit (BIU).



For various reasons, although mainly because of track geometry (curvature, etc.), it is necessary to limit the speed at which trains may travel over certain sections of the railway. These places are subject to what are termed 'Permanent Speed Restrictions' (PSRs). Non-compliance to the designated PSR in the section or yard by loco pilots can often result in derailment, damage to rolling stock or unacceptable discomfort to passengers.

KAVACH has been developed to enforce speed limits, including permanent speed restrictions. KAVACH initiates an intervention through warning message to Loco pilots if over speeding is detected. If the driver fails to react in the stipulated time, braking is initiated to bring the speed within allowable limits. Driving is still manual but speed limits are always enforced.



2.3 Improving Train Running Performance

In Northern part of the country, a large number of trains are affected every year during foggy weather in winter months. Poor visibility of signal aspect to loco pilots forces Loco pilots to drive the train at very low speeds even when line clear is granted and signal aspect is Proceed. Such slow speeds results in congestion along the route, train bunching and loss of capacity on the network.

KAVACH displays the aspect of signal ahead on the Driver Machine Interface Unit installed in the loco pilot's cab and conveys the signal indication even when the signal visibility becomes impaired due to foggy weather. The Movement authority monitored by KAVACH controls the safe distance for which the Loco pilots can run the train based on signalling information. This enable Loco Pilots to drive trains even during heavy fog. Loco Pilot can run the KAVACH equipped train confidently.

The delays in clearing the section can be reduced and punctuality performance of trains can be improved through installation of KAVACH system in fog prone regions of Indian Railways.

2.4 Supportive Objectives

The loco pilots suffer from tremendous stress at both personal and organizational level. This tremendous pressure over a long period of time reduces their cognitive capabilities including level of alertness. KAVACH is an additional aid to loco pilots which help them control the train when they are notable to take prompt action and respond in stipulated time. One additional feature of KAVACH which is an assistance to Loco pilots is the Automatic Whistling at Level Crossing Gates.

The Drivers of approaching trains should whistle continuously from the time they pass whistle boards to the time they cross the level crossing. This puts additional load on LP and ALP to continuously give whistle when approaching Level crossing gates.



KAVACH has an in-built feature in which automatic whistling is activated on passing the RFID tag installed on the track and demarcated for this purpose. When the KAVACH equipped trains passed over the gatetag (in KAVACH equipped section) on approach of a level crossing gate, continuous/intermittent whistling is activated till the train crosses the level crossing.

2.5 Speed requirements (SEM para):

As per Para 7.8.9 of SEM, Chapter 7 (Essentials of Signaling), for speeds of 160 Kmph it is essential to have an ATP system. This is due to the fact that at higher speeds it becomes difficult for the loco Pilot to continuously concentrate on line side signal aspects. As such one of the objectives of project KAVACH is as an enabler to run trains at 160 Kmph.



3. DETAILS OF THE SECTION:

3.1 Route details:

The TCAS Line side Equipment has to be provided in the various Yards and Block sections and to be interfaced with the Signaling of the Station.

For the section under consideration i.e. DDU-PKA, the details of the Various Yards: Station Name, Station Code, Chainage, Standard of Signaling, Type of Interlocking (EI, RRI, PI), Number of Lines and No. of Routes, Junction or not etc. which will require interface with TCAS are detailed in the table below:

Table 3.1a

S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RRI				
Pt.deendayalUpadhyaya- Manpur Section of DDU Division							
1	DDU	III-R	RRI (Metal to metal) Siemens	672.65	12	1071	Y
2	FOC/DDU	III-R	CPI (Metal To Carbon) Siemens-II	670.00	4	20	
3	GAQ	III-R	EI (Siemens-II)	666.00	6	132	
4	IBH Dn Line	III-R	CPI (Metal To Carbon) British Type)	661.00	2	2	
5	CDMR	III-R	EI (Siemens-II)	657.45	5	66	
6	SYJ	III-R	EI (Siemens-II)	649.02	5	46	
7	KMS	III-R	CPI (Metal To Carbon) British Type	640.73	5	34	
8	DCX	III-R	CPI (Metal To Carbon)	634.40	3	12	



S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RRRI				
			British Type				
9	DGO	III-R	EI (Siemens-I)	629.20	7	50	
10	BBU	III-R	EI (Siemens-II)	620.14	5	111	
11	MTGE	III-R	CPI (Metal To Carbon) British Type	614.70	3	44	
12	PSE	III-R	EPI (Metal To Carbon) British Type	606.77	5	42	
13	KTQ	III-R	EPI (Metal To Carbon) British Type	597.91	5	46	
14	KVD	III-R	CPI (Metal To Carbon) British Type	591.43	3	2	
15	SSG	III-R	EPI (Metal To Carbon) British Type	586.20	5	44	
16	KMGE	III-R	CPI (Metal To Carbon) British Type	580.52	4	29	
17	SSM	III-R	EI (Siemens-I)	572.64	6	163	Y
18	KWD	III-R	EPI (Metal To Carbon) British Type	559.24	5	90	
19	PHE	III-R	EI (Siemens-II)	557.00	3	119	
20	DOS	III-R	RRRI (Metal to metal) Siemens	554.80	8	162	



S.NO	STATION			No Of Lines	No of Routes	Junction or Not	
	NAME	INTERLOCKING					Chainage
		STD	EI/PI/RRRI				
21	SEB	III-R	RRI (Metal to metal) Siemens	549.04	10	258	Y
22	CPBH	III-R	EI (Siemens-II)	543.64	2	2	
23	AUBR	III-R	EPI (Metal To Carbon) British Type	538.24	5	44	
24	PES	III-R	EPI (Metal To Carbon) British Type	529.29	4	30	
25	BHKH	III-R	EI (simens-II)	524.76	3	10	
26	JHN	III-R	EI (Siemens-II)	518.30	3	22	
27	DORD	III-R	CPI (Metal To Carbon) British Type	515.06	2	2	
28	RFJ	III-R	EPI (Metal To Carbon) British Type	507.12	4	27	
29	IBH	III-R	CPI (Metal To Carbon) British Type	498.00	2	2	
30	IMGE	III-R	CPI (Metal To Carbon) British Type	490.00	4	18	
31	GRRU	III-R	EPI (Metal To Carbon) British Type	491.17	4	18	
32	PRY	III-R	EPI (Metal To Carbon) British Type	485.22	4	13	



S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RRI				
33	KSTA	III-R	EPI (Metal To Carbon) British Type	478.08	4	18	
34	GAYA	III-R	RRI (Metal to metal) Siemens	469.64	10	545	Y
35	MPO	III-R	EI (Kyosan)	464.40	6	84	Y

Table 3.1b

S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RR				
Manpur- Pradhankhunta Section of DHN Division							
	MPO	III-R	EI (Kyosan)	464.40		84	Y
1	BNF	III-R	EI (Kyosan)	457.35	6	79	
2	IBH	III-R	To be commissioned	452.17	2	2	
3	TKN	III-R	EPI (Metal To Carbon) British Type	449.72	2	20	
4	BNSL	III-R	CPI (Metal To Carbon) British Type	443.86	2	2	
5	PPR	III-R	EPI (Metal To Carbon) British Type	437.30	4	23	
6	IBP No-10	III-R	IBH (Metal To Carbon)	431.15	2	2	
7	GAP	III-R	CPI (Metal To Carbon) British Type	425.54	4	47	



S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RR				
8	YGM	III-R	CPI (Metal To Carbon) British Type	422.20	2	2	
9	BSCR	III-R	CPI (Metal To Carbon) British Type	417.73	2	2	
10	NGY	III-R	CPI (Metal To Carbon)	414.06	2	2	
11	DLW	III-R	CPI (Metal To Carbon) British Type	410.14	4	14	
12	LBZ	III-R	CPI (Metal To Carbon) British Type	405.42	4	2	
13	GJD	III-R	EPI (Metal To Carbon) British Type	403.45	6	51	
14	IBP No.-9	III-R	IBH (Metal To Carbon)	398.92	2	2	
15	KQR	III-R	EPI (Metal To Carbon) British Type	393.55	8	57	
16	LRB	III-R	CPI (Metal To Carbon) British Type	388.79	2	2	
17	HRE	III-R	EPI (Metal To Carbon) British Type	384.29	4	18	
18	IBH-SH	III-R	CPI (Metal To Carbon) British Type	379.23	2	2	
19	SMND	III-R	EI(Siemens-II)	376.54	4	39	



S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RR				
20	YDD	III-R	CPI (Metal To Carbon) British Type	371.81	4	2	
21	PSB	III-R	EPI (Metal to carbon) British Type	367.17	4	14	
22	DSME	III-R	CPI (Metal To Carbon) British Type	360.62	2	2	
23	CBH	III-R	EI (Siemens-II)	355.73	4	37	
24	KSHR	III-R	CPI (Metal To Carbon) British Type	350.91	2	2	
25	HZD	III-R	CPI (Metal To Carbon) British Type	345.17	6	31	
26	GRBH	III-R	CPI (Metal To Carbon) British Type	339.90	2	2	
27	CCK	III-R	EI (Siemens-II)	335.43	4	36	
28	KRMB	III-R	CPI (Metal To Carbon) British Type	331.09	2	2	
29	CBD	III-R	EPI (Metal To Carbon) British Type	327.34	4	18	
30	CEME	III-R	CPI (Metal To Carbon) British Type	323.83	2	2	
31	PNME	III-R	EPI (Metal To Carbon) British Type	318.10	5	33	



S.NO	STATION				No Of Lines	No of Routes	Junction or Not
	NAME	INTERLOCKING		Chainage			
		STD	EI/PI/RR				
32	NMG	III-R	EI (Siemens-II)	310.51	4	32	
33	BLME	III-R	CPI (Metal To Carbon) British Type	304.99	2	2	
34	GMO	III-R	RRI (Metal to metal) Siemens	300.15	16	572	Y
35	IBP No.-3	III-R	IBH (Metal To Carbon) British Type	295.67	2	2	
36	MRQ	III-R	EI (Siemens-II)	290.68	4	33	
37	NPJE	III-R	CPI (Metal To Carbon) British Type	285.51	2	9	
38	TET	III-R	CPI (Metal To Carbon) British Type	280.01	5	22	
39	BLI	III-R	CPI (Metal To Carbon) British Type	274.61	2	2	
40	DHN	III-R	RRI (Metal to metal) Siemens	270.80	15	333	Y
41	DOKM	III-R	CPI (Metal To Carbon) British Type	265.80	2	2	
42	PKA	III-R	CPI (Metal To Carbon) British Type	261.31	6	30	Y



3.2 Other Signalling details:

Other than the Station Yard, the TCAS is required to interface with the Signaling Installation in the various Block section. The details of type of Block Signaling in the section under consideration are described below.

Automatic Block Signaling: NIL

Block Sections with IB: (2 + 5) 5 IBH

Absolute Block Signalling: The section is completely Absolute block Signaling section with signals provided at every stations.

This **will** require interfacing of the absolute section Signals with TCAS, with the help of RIUs or LC / IB TCAS units placed in absolute section Relay Huts. There are in all 77 Stations with 75 number of Block sections having 07 numbers of IBHs in the Block sections as detailed Given in table 3.1a and b.

Table 3.2: Nil

3.3 Level Crossing Gates: The section has a number of manned Level Crossing Gates which are both Interlocked and Non – Interlocked. In case of Interlocked Level Crossing Gate the same will have to be interfaced with the ATP system by either with the LC TCAS or with the help of RIU to the nearest station.

Also in case of both Interlocked and Non Interlocked gates the auto whistling feature of the TCAS needs to be activated before the LC gate.

The details of the Level Crossing Gates on the section viz Block section, LC number, Chainage, Classification of LC, TVU of the LC gate and if Interlocked or not are given in the table below. However, in this section all the LC gates are in automatic signaling territory.



Table 3.3

Level Crossing Gate Details						
S.NO	Block Section	LC NO.	Chainage	Class	TVU	Interlocked or Not
DDU- MPO Section (DDU Div)						
1	Ganjkhwaja - Pt. Deendayalupadhyay	LC- 83 B	669.53	B	450256	Yes
2	Ganjkhwaja - Pt. Deendayalupadhyay	LC – 81 C	667.93	C	6163	Yes
3	ChandauliMajhwar - Ganjkhwaja	LC-78 C	661.19/21	C	96744	No
4	Saiyadraja- ChandauliMajhwar	LC-76 A	657.21/23	B	496446	Yes
5	Saiyadraja- ChandauliMajhwar	LC-76 C	656.9/11	C	29853	Yes
6	Saiyadraja- ChandauliMajhwar	LC-75 A	653.19/21	C	50707	No
7	Karamnasa- Saiyadraja	LC-72 B	649.5/7	S	131593	Yes
8	Karamnasa- Saiyadraja	LC-73 B	649.15/17	B	25776	Yes
9	Karamnasa- Saiyadraja	LC-72 A	647- 25/27	A	361050	Yes
10	Karamnasa- Saiyadraja	LC-74 A	651.17/19	C	48222	Yes
11	Danaichna halt- Karamnasa	LC-70 A	644.5/7	C	56891	Yes
12	Kurda-Pusauli	LC-55	605.25/28	C	98011	No
13	Pahleza- Karmabad	LC – 36 B	559-15/17	C	154466	Yes



Level Crossing Gate Details						
S.NO	Block Section	LC NO.	Chainage	Class	TVU	Interlocked or Not
14	Anugrahnarayan – ChirailaPauthu	LC-31 C	538.29/31	C	13431	Yes
15	Anugrahnarayan – ChirailaPauthu	LC-30 B	536.12/14	B	729636	Yes
16	Anugrahnarayan – ChirailaPauthu	29 C	531.52	C	1845	No
17	Baghoikusa-Phesar	LC – 28 B	528.25/27	C	32103	Yes
18	Baghoikusa-Phesar	LC-27 A	527.66	C	5289	No
19	JakhimBagohikusa	LC – 27 C	525.23/25	C	2952	Yes
20	Jakhim Bagohikusa	LC-26 C	524.776	C	12792	Yes
21	JakhimBagohikusa	LC-24C	522.21/23	C	14760	No
22	JakhimBagohikusa	LC – 23 C	519.7/9	C	16974	Yes
23	JakhimBagohikusa	22	514.11/13	C	14630	No
24	JakhimBagohikusa	21	513.5/7	C	15561	No
25	Jakhim Bagohikusa	20C	510.13/15	C	12502	No
26	Ismalilpur - Rafiganj	LC- 19 Spl	506.5/7	S	194403	Yes
27	Ismalilpur - Rafiganj	18	505.15/17	C	10001	No



Level Crossing Gate Details						
S.NO	Block Section	LC NO.	Chainage	Class	TVU	Interlocked or Not
28	Ismalilpur – Rafiganj	LC- 17 B	504.3/5	C	46580	Yes
29	Ismalilpur – Rafiganj	16	502.0/1	C	13563	No
30	Ismalilpur – Rafiganj	15	500.0/1	C	12193	No
31	Ismalilpur – Rafiganj	14	497.1/3	C	13167	No
32	Ismalilpur – Rafiganj	13C	495.13/15	C	8246	No
33	Ismalilpur – Rafiganj	12C	493.11/13	C	6783	No
34	Guraru – Ismalilpur	LC – 11 Spl	491.27/29	C	193992	Yes
35	Guraru – Ismalilpur	9C	489.15/17	C	10507	No
36	Paraiya- Guraru	LC – 8 B	488.7/9	B	41230	Yes
37	Paraiya- Guraru	7C	486.3/5	C	11837	No
38	Paraiya- Guraru	6	479.60	S	413304	Yes
39	Gaya Jn - Kastha	LC – 4 C	473.0/1	A	427167	Yes
40	Gaya Jn - Kastha	4	472,98	C	22524	No
41	Manpur – Gaya Jn	LC – 71 A	468.16/18	A	1257701	Yes
MPO- PKA (DHN Div)						



Level Crossing Gate Details						
S.NO	Block Section	LC NO.	Chainage	Class	TVU	Interlocked or Not
42	Bandhua - Manpur	LC - 67 A	462.20/22	A	1523126	Yes
43	Tankupa- Bandhua	LC-40C T	456.25/27	C		Yes
44	Gurpa – Paharpur	LC- 39C T	437.21/23	C		Yes
45	Gurpa – Paharpur	LC – 38 A	434/11-9	B1		No
46	Yadugram-Gurpa	LC – 37 B	426/3/5	B2		Yes
47	Koderma - Gujhandi	LC-36 C	404.27/29	C		No
48	Koderma - Gujhandi	LC-35 C	402.25/27	C		Yes
49	Hirodih-Koderma	33 C	387.23/25	C		No
50	Hirodih-Larabad	32 C	384/31-385/01	C		Yes
51	Sarmatar-Hirodih	LC-31 C	382.7/9	C		Yes
52	Sarmatar-Hirodih	30 C	378.12/14	C		Yes
53	Sarmatar-Hirodih	LC-29 C	375/23-25	C		Yes
54	Sarmatar-Hirodih	28C	372.19-21	C		Yes
55	Dasara-Parasabad	LC-27 C SPL	366.10/12	B1		Yes



Level Crossing Gate Details						
S.NO	Block Section	LC NO.	Chainage	Class	TVU	Interlocked or Not
56	Dasara-Parasabad	LC-26 C	365.15/17	C		No
57	Chaubey-Dasara	LC-25C	360.17 /19	C		Yes
58	Keshwari-Chaubey	LC-24C	355.13/15	C		Yes
59	Keshwari-Chaubey	23C	354.13/15	C		No
60	Keshwari-Chaubey	22C	349.21/23	C		No
61	Keshwari-Chaubey	21C	348.9/11	C		No
62	Hazaribagh-Keshwari	LC-20 Spl	345.32/34	S		Yes
63	Chichaki-Garia Bihar	19C	336/31- 337/01	C		No
64	Karamabad-Chichaki	LC-18 A	334.39/41	A		Yes
65	Chaudhribandh- Karmabad	LC-17C	327/29-31	C		Yes
66	Parasnath-Chegro	16 C	322.7/9	C		No
67	Nimiaghat- Parashnath	LC-14 Spl	316/42- 317/02	S		Yes
68	Nimia Ghat- Parasnath	13 B	314/9-11	C		No
69	Nimia Ghat- Parasnath	12C	311.25/27	C		No

Level Crossing Gate Details						
S.NO	Block Section	LC NO.	Chainage	Class	TVU	Interlocked or Not
70	Bholidih-Nimiaghat	LC-11C	309.19/21	C		Yes
71	Bholidih-Nimiaghat	10 Spl.	306/11-13	C		No
72	Gomoh-Bholidih	10 A	303/9-11	A		Yes
73	Tetulmari-Nichitpur	7C	283.16/18	C		No
74	Tetulmari-Nichitpur	6C	281.4/6	C		No
75	Bhuli-Tetulmari	5C	278.18/20	C		No
76	Bhuli-Tetulmari	4C	277/22-24	C		No
77	Bhuli Halt - Tetulmari	LC-2 Spl	274.18/20	S		Yes
78	Pradhankhanta-Dokra	17C	265.17-19	C		Yes
79	Pradhankhanta-Dokra	16C	264.9/11	C		No

NOTE: Some of the LC Gates are to be **eliminated**. Parallel design strategy shall be followed for these Level Crossing gates.

3.4 Details of Spare Contacts in Existing Relay rooms

The ATP system “KAVACH” (TCAS) works on top of Existing Signaling system, taking Input from it and utilizing the same for Automatic Train Protection. Presently in the referred section we have Electronic/Panel/ Route Relay Interlocking at all the stations from DDU-PKA.

There are two possibilities of taking the signaling input from the signaling system. Directly through EI using a SIL 4 protocol converter or by using relay contacts of the concerned relays which are ECRs, NWKRs / RWKRs & TPRs. Presently the OEMs have not developed protocol converters as such the provision of taking inputs from relays is being planned.

However, it is recommended that inputs to be initially planned with Relay based system and in due course migrate to protocol converters as and when they are developed.

The availability of Spare contacts in existing ECRs, NWKRs / RWKRs and the TPRs of the relays in various Relay Rooms of stations, Relay Huts and Level crossing gates are enumerated in the table given as Annexure B.

The table also indicates the availability of space for Relays in Relay racks, provision of Relay racks and the TCAS station equipment in these Relay Huts.

NOTE 1: For the relays having no spare contact, the contacts wired for Data loggers shall be spared for TCAS working for opening repeater relays & the contact of repeater shall be proved in Data logger.

NOTE 2: It is preferred to take direct inputs from EI (at Data Level) instead of using relay interfacing for speedy execution as well as to enhance the reliability of the system.

3.5 SERVICE BUILDING: At number of locations the availability of Space in Relay Room / Relay Huts for the TCAS equipment is not there, a separate additional Service Building of suitable size (6X4 or 4X4 sq. m.) will be required to be constructed just besides the Existing service building. The tentative locations are indicated in the table below:

Table 3.4



S.NO	STATION NAME	AVAILABILITY OF SPACE FOR		BETWEEN STATIONS
		RELAY RACK	STCAS / RIU	
Pt.deendayalUpadhyaya- Manpur Section of DDU Division				
1	Pt.dindayalupadhaya	Available	Available	
2	Flyover cabin	N/A	N/A	
3	Ganjkhwaja	N/A	N/A	
4	IBH Dn Line	N/A	N/A	
5	ChandauliMajhar	N/A	N/A	
6	Saidraja	N/A	N/A	
7	Karamnasa	N/A	N/A	
8	Dhanaicha-BH	N/A	N/A	
9	Durgawauti	N/A	N/A	
10	Bhabhua Rd.	N/A	N/A	
11	Muthani	N/A	N/A	
12	Pusauli	N/A	N/A	
13	Kudra	N/A	N/A	
14	Khurmabad Rd.-BH	N/A	N/A	
15	Shiusagar Rd.	N/A	N/A	
16	Kumahu	N/A	N/A	
17	SasaramJn	N/A	N/A	
18	Karwandia	N/A	N/A	
19	Pahleza	N/A	N/A	
20	Dehri-on-sone	Available	Available	
21	SonnagarJn	Available	Available	
22	ChirailaPauthu-BH	N/A	N/A	
23	Anugrah Narayan Rd.	N/A	N/A	
24	Phesar	N/A	N/A	
25	BagohiKusa BH	N/A	N/A	
26	Jakhim	N/A	N/A	
27	Deo Rd. BH	N/A	N/A	
28	Rafiganj	N/A	N/A	
29	IBH	N/A	N/A	
30	Ismailpur	N/A	N/A	



S.NO	STATION NAME	AVAILABILITY OF SPACE FOR		BETWEEN STATIONS
		RELAY RACK	STCAS / RIU	
31	Guraru	N/A	N/A	
32	Paraiya	N/A	N/A	
33	Kastha	N/A	N/A	
34	Gaya Jn	Available	Available	
35	Manpur Jn.	N/A	N/A	
Manpur - Pradhankhunta Section of DHN Division				
36	Bandhua	N/A	N/A	
37	Tankuppa	N/A	N/A	
38	Bansinala BH	N/A	N/A	
39	Paharpur	N/A	N/A	
40	IBP No.10	N/A	N/A	
41	Gurpa	N/A	N/A	
42	YadugramBH	N/A	N/A	
43	Banskatwa BH	N/A	N/A	
44	Nathganj BH	N/A	N/A	
45	Dilwa	N/A	N/A	
46	Lalbagh	N/A	N/A	
47	Gujhandi	N/A	N/A	
48	IBP No.9	N/A	N/A	
49	Koderma	Yes	Yes	
50	Larabad BH	N/A	N/A	
51	Hirodih	N/A	N/A	
52	Sharamatanr	N/A	N/A	
53	Yadudih	N/A	N/A	
54	Parasabad	N/A	N/A	
55	Dasarah BH	N/A	N/A	
56	Choubey	N/A	N/A	
57	Keshwari BH	N/A	N/A	
58	Hazaribagh Rd.	N/A	N/A	
59	Garea Bihar BH	N/A	N/A	



S.NO	STATION NAME	AVAILABILITY OF SPACE FOR		BETWEEN STATIONS
		RELAY RACK	STCAS / RIU	
60	Chichaki	N/A	N/A	
61	Karamabad BH	N/A	N/A	
62	Chaudhuri Bandh	N/A	N/A	
63	Chegro BH	N/A	N/A	
64	Parasnath	N/A	N/A	
65	Nimiaghat	N/A	N/A	
66	Bholidih	N/A	N/A	
67	Netaji Subhas Chandra Bose Gomoh	N/A	N/A	
68	IBP No.3	N/A	N/A	
69	Matari	N/A	N/A	
70	Nichitpur-H	N/A	N/A	
71	Tetulmari	N/A	N/A	
72	Bhuli BH	N/A	N/A	
73	Dhanbad	Yes	Yes	
74	Dokra BH	N/A	N/A	
75	PradhankhuntaJn	N/A	N/A	

N/A: Not Available

3.6 TELECOMMUNICATION DETAILS :

3.6.1 GSM-R based MTRC: For secure & reliable communication the whole section is equipped with GSM-R based Mobile Train Radio Communication with Optical fiber as back bone to MTRC and control communication. For the purpose Telecom Towers ranging from 30 m to 100 m are provided throughout the section. The details of the same are in Table 3.5

3.6.2 Optical fiber Cable: The section from DDU-PKA is equipped with 01 numbers of 24 fiber Optical fibre cable and the signalling circuits between Stations are working over these OFC alongwith Centralised Control and MTRC communication.



3.6.3 Telephones and VHF Sets: All Block Stations on the route have been provided with Railway & BSNL Telephones along with 25W VHF sets. Also 5 Watt hand held Walkie-Talkie sets have been provided to Loco Pilots and Guards of all Mail / Express and Goods Trains

3.6.4 Exchanges: Railway Telephone Network comprising Electronic Exchanges with ISDN are available for administrative communication requirements.

3.6.5 Communication Towers: The location of Existing Towers, the height of Existing towers and the type of antennas already existing on these towers are indicated in the table below:

Table 3.5

S.N O	STATION	Availabi lity of TOWER	Location of TOWER		Height of Tower (Mtrs)	Type / Size of Existing Antenna	Presence of Any Airport, Wireless Stn., etc.
			Latitude	Longitude			
Pt.deendayalUpadhyaya- Manpur Section of DDU Division							
1	Pt.dindayalupadhaya	YES	25.2807	83.1211	30		
2	Flyover cabin	YES	25.2861	83.1716			
3	Ganjkhwaja	YES	25.2744	83.1833	30		
4	IBH Dn Line	YES					
5	ChandauliMajhar	YES	25 ⁰ 15'44.7"	83 ⁰ 16'9.2"	35		
6	Saidraja	YES	25.2538	83.3506	30		
7	Karamnasa	YES	25 ⁰ 14'19.38"	83 ⁰ 25'38.25"	35		
8	Dhanaicha-BH	YES	25 ⁰ 13'34.15"	83 ⁰ 29'41.08"	30		
9	Durgawauti	YES	25 ⁰ 12'24.02"	83 ⁰ 32'26.26"	35		
10	Bhabhua Rd.	YES	25 ⁰ 10'18.23"	83 ⁰ 37'19.57"	30		
11	Muthani	YES	25 ⁰ 8'22.33"	83 ⁰ 39'50.43"	30		



S.N O	STATION	Availabi lity of TOWER	Location of TOWER		Height of Tower (Mtrs)	Type / Size of Existing Antenna	Presence of Any Airport, Wireless Stn., etc.
			Latitude	Longitude			
12	Pusauli	YES	25°5'47.14"	83°43'24.53"	30		
13	Kudra	YES	25°2'54.56"	83°47'48.18"	30		
14	Khurmabad Rd.-BH	YES	25°1'14.4"	83°51'6.91"	30		
15	Shiusagar Rd.	YES	24°59'6.99"	83°53'56.03"	30		
16	Kumahu	YES	24°57'58.95"	83°58'21.69"	35		
17	SasaramJn	YES	24°57'19.37"	84°1'16.2"	30		
18	Karwandia	YES	24°57'2.42"	84°5'36.9"	30		
19	Pahleza	YES	24°56'7.39"	84°8'51.37"	30		
20	Dehri-on-sone	YES	24°54'50.36"	84°11'22.24"	30		
21	SonnagarJn	YES	24°53'15"	84°13'15"	35		
22	ChirailaPauthu-BH	YES	24°51'37.01"	84°17'06.77"	29		
23	Anugrah Narayan Rd.	YES	24°51'16.43"	84°19'56.61"	35		
24	Phesar	YES	24°50'39.57"	84°25'15.44"	30		
25	BagohiKusa BH	YES	24°50'21.03"	84°27'58.55"	30		
26	Jakhim	YES	24°49'43.8"	84°31'40.88"	35		
27	Deo Rd. BH	YES	24°49'19.35"	84°34'02.66"	29		
28	Rafiganj	YES	24°49'5.03"	84°38'7.87"	35		
29	IBH	YES					
30	Ismailpur	YES	24°48'50.63"	84°43'34.77"	30		
31	Guraru	YES	24°48'35.79"	84°47'39.46"	30		
32	Paraiya	YES	24°48'34.3"	84°51'13.13"	30		
33	Kastha	YES	24°48'8.1"	84°55'20.83"	35		



S.N O	STATION	Availabi lity of TOWER	Location of TOWER		Height of Tower (Mtrs)	Type / Size of Existing Antenna	Presence of Any Airport, Wireless Stn., etc.
			Latitude	Longitude			
34	Gaya Jn	YES	24°48' 18"	84°59'1.2"	30		
35	Manpur Jn.	YES	24°48'18.96"	85°2'47.12"	30		
36	Bandhua	YES	24°45'7.15"	85°4'2.9"	30		
37	Tankuppa	YES	24°42'9.89"	85°7'22.1"	30		
38	Bansinala BH	YES	24°39'53.79"	85°9'48.37"	30		
39	Paharpur	YES	24°37'26.37"	85°12'32.81"	30		
40	IBP No.10	YES					
41	Gurpa	YES	24°33'33.1"	85°18'10.29"	30		
42	YadugramBH	YES	24°32'30.10"	85°19'38.49"	30		
43	Banskatwa BH	YES	24°32'45.75"	85°22'11.21"	30		
44	Nathganj BH	YES	24°31'49.65"	85°23'22.70"	30		
45	Dilwa	YES	24°32'21.72"	85°24'57.75"	90		
46	Lalbagh	YES	24.5091	85.4479	30		
47	Gujhandi	YES	24°29'48.69"	85°27'53.58"	40		
48	IBP No.9	YES					
49	Koderma	YES	24°26'1.03"	85°31'57.29"	45		
50	Larabad BH	YES	24°24'21.78"	85°33'53.46"	30		
51	Hirodih	YES	24°22'57.10"	85°35'56.95"	30		
52	Sharamatanr	YES	24°20'37.69"	85°39'35.75"	30		
53	Yadudih	YES	24°19'47.61"	85°42'12.09"	30		
54	Parasabad	YES	24°18'23.97"	85°44'29.21"	40		



S.N O	STATION	Availabi lity of TOWER	Location of TOWER		Height of Tower (Mtrs)	Type / Size of Existing Antenna	Presence of Any Airport, Wireless Stn., etc.
			Latitude	Longitude			
55	Dasarah BH	YES	24°16'22.76"	85°47'34.47"	35		
56	Choubey	YES	24°14'11.98"	85°49'4.59"	35		
57	Keshwari BH	YES	24°12'25.9"	85°51'8.41"	30		
58	Hazaribagh Rd.	YES	24°10'28.40"	85°53'39.60"	30		
59	Garea Bihar BH	YES	24°7'53.55"	85°54'47.13"	35		
60	Chichaki	YES	24°6'43.69"	85°56'53.85"	55		
61	Karamabad BH	YES	24°4'52.26"	85°58'16.45"	30		
62	Chaudhuri Bandh	YES	24°3'16.90"	85°59'33.12"	40		
63	Chegro BH	YES	24°1'46.90"	85°0'50.44"	30		
64	Parasnath	YES	23°59'9.12"	86°2'26.24"	35		
65	Nimiaghat	YES	23°55'42.61"	86°4'56.02"	40		
66	Bholidih	YES	23°53'52.29"	86°7'9.26"	30		
67	Netaji Subhas Chandra Bose Gomoh	YES	23°52'18.34"	86°9'23.38"	55		
68	IBP No.3	YES					
69	Matari	YES	23°50'21.32"	86°14'30"	35		
70	Nichitpur-H	YES	23°49'26.70"	86°17'36.50"	40		
71	Tetulmari	YES	23°48'51.59"	86°20'42.29"	30		
72	Bhuli BH	YES	23°48'6.54"	86°23'43.79"	30		
73	Dhanbad	YES	23°47'39.52"	86°26'2.29"	30		
74	Dokra BH	YES	23°46'56.26"	86°28'48.9"	30		
75	Pradhankhunta Jn.	YES	23°46'16.82"	86°31'16.54"	30		

3.6.6 Tunnels

Communication need not be mandatory in tunnels except for those which are on

immediate approach (distance corresponding to 30 seconds at highest permissible speed of any TCAS equipped train at that spot) of a signal. Leaky feeder cable type communication arrangements are to be made available in such tunnel. The details of the tunnels in the section for the purpose are listed in table below:

Table 3.6

Tunnel No	Block Section	Chainage		Length of Tunnel
		From	To	
1	Baskatwa - Nathganj of DHN Div	415.485 - 415.725		238.35 mtr
		415/35	415/21-	
2	Baskatwa - Nathganj of DHN Div	414.721 - 414.914		190.19 mtr
		414/45	414/33	
3	Dilwa Stn. limit of DHN Div	410742 - 410.850		107.62 mtr
		410/31	410/21	

3.7 Power Supply Details:

While the KVACH (TCAS) is installed at Stations and in interlocked LCs of Block Section, power supply requirement will be there. It is planned to use existing IPS and conventional power supply where ever available. However certain locations may require augmentation of Power supply, addition of DC to DC converters etc at stations and LSCs. For 220 V AC supply it is planned to use existing AT available. The details of Power supply, Type of equipment, capacity and loading details are given in Table as Annexure C.

3.8 Details of Bridges / ROBs / RUBs /LHS

As already discussed in Chapter I, KAVACH project requires laying of OFC cable as well as tower erection. The cable will have to be laid across various Bridges, ROBs and RUBs. The site has a number of these enroute and they are as listed below:

Table 3.7

Details of Bridges / ROBs / RUBs /LHS / ROR Bridge			
S.NO	Item	Numbers	Details

Details of Bridges / ROBs / RUBs /LHS / ROR Bridge			
S.NO	Item	Numbers	Details
1.	Important Bridges	NIL	
2.	Major Bridges	38	As in Annexure D
3.	Minor Bridges	749	As in Annexure E
4.	ROBs	50	As in Annexure F
5.	RUBs / LHS	113	As in Annexure G

3.9 The site also includes a no. of “**Transmission lines crossing**” the right of way. The details of the same are given in the table as Annexure H.

3.10 Electrification Details: Presently the section under consideration is a 25 KV AC Traction system which has TSS, SP and SSP as detailed below:

Table 3.8

A. LOCATION OF TSS					
S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
1	ECR	BIHAR	KTQ/TSS	KTQ-PSE	598.35
2	ECR	BIHAR	RFJ/TSS	IMGE-RFJ	507.03

Table 3.9

B. LOCATION OF SP					
S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
1	ECR	U.P	CDMR/SP	CDMR-GAQ	659.5
2	ECR	BIHAR	SSM/SP	SSM-KMGE	574.30
3	ECR	BIHAR	PES/SP	PES-DKMN	530.03
4	ECR	BIHAR	GRRU/SP	PRY-GRRU	488.81

Table 3.10

C. LOCATION OF SSP					
S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
1	ECR	U.P	DDU-I/SSP	DDU-GAQ	672.85



C. LOCATION OF SSP					
S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
2	ECR	U.P	SYJ/SSP	SYJ-KMS	647.85
3	ECR	BIHAR	DGO/SSP	DCX-DGO	629.85
4	ECR	BIHAR	BBU/SSP	DGO-BBU	621.11
5	ECR	BIHAR	MTGE/SSP	PSE-MTGE	613.58
6	ECR	BIHAR	PSE/SSP	PSE-KTQ	605.35
7	ECR	BIHAR	KTQ/SSP	KTQ-KVD	594.8
8	ECR	BIHAR	SSG/SSP	SSG-KVD	586.85
9	ECR	BIHAR	KMGE/SSP	SSG-KMGE	581.42
10	ECR	BIHAR	KWD/SSP	KWD-PHE	564.45
11	ECR	BIHAR	PHE/SSP	KWD-PHE	560.2
12	ECR	BIHAR	AUBR/SSP	CPBH-AUBR	539.32
13	ECR	BIHAR	JHN/SSP	BHKH-JHN	520.25
14	ECR	BIHAR	DEO-ROAD/SSP	RFJ-DORD	512.93
15	ECR	BIHAR	IMGE/SSP	RFJ-IMGE	499.15
16	ECR	BIHAR	PRY/SSP	GRRU-PRY	485.45
17	ECR	BIHAR	MPO/SSP	SICY-MPO	463.83

However the work of 2 X 25 KV Electrification, in connection with the works of “MISSION RAFTAR to achieve 160 Km/h” the TSS, SP and SSP new locations are detailed below and are likely to be completed by xx.xx.2023

Table 3.11

D. LOCATION OF TSS for new 2 X25 KV



S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
1	ECR	BIHAR	GAYA/TSS	GAYA-KSTA	472/08-12
2	ECR	BIHAR	SEB/TSS	CPBH-SEB	549/29-31
3	ECR	BIHAR	KMS/TSS	DCX-KMS	640/06-10
4	ECR	Jharkhand	Matari	MRQ-GMO	291/09 -
5	ECR	Jharkhand	Hazaribagh Road (Existing)	Keshwari - HZD (HZD West)	346/03 - 346/07
6	ECR	Jharkhand	Gujhandi	DLW-GJD (GJD west)	404/19 - 404/15

Table 3.12

E. LOCATION OF SP for new 2 X25 KV					
S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
1	ECR	BIHAR	RFJ/SP	IMGE-RFJ	505/11-13
2	ECR	BIHAR	KTQ/SP	KVD-KTQ	597/13A-17A
3	ECR	Jharkhand	Pradhankhanta	CAM - DHN (PKA east)	260/17 - 260/21
4	ECR	Jharkhand	Parasnath	PNME - CEME (PNME West)	319/7 - 319/11
5	ECR	Jharkhand	Hirodih	HRE- SMND (HRE East)	383/04 - 382/25
6	ECR	Jharkhand	Paharpur	PRP - GAP (PRP East)	434/15 - 434/11

Table 3.13



F. LOCATION OF SSP for new 2 X25 KV					
S.No	Railway	STATE	Name of TSS	Section / Route	Chainage
1	ECR	BIHAR	GRRU/SSP	PRY-GRRU	489/19-21
2	ECR	BIHAR	JHN/SSP	JHN-BHKH	519/17-19
3	ECR	BIHAR	PES/SSP	BHKH-PES	528/15-19
4	ECR	BIHAR	KWD/SSP	PHE-KWD	564/14-18
5	ECR	BIHAR	SSM/SSP	SSM-KMGE	575/7A-9A
6	ECR	BIHAR	SSG/SSP	KMGE-SSG	585/29A-25A
7	ECR	BIHAR	MTGE/SSP	PSE-MTGE	613/17A-13A
8	ECR	BIHAR	DGO/SSP	BBU-DGO	629/15A-11A
9	ECR	U.P	CDMR/SSP	SYJ-CDMR	656/31A-657/3A
10	ECR	U.P	DDU/SSP	DDU -BHK	1107-1111
11	ECR	ECR	Jharkhand	Dhanbad	PKA - BLI (DHN East)
12	ECR	ECR	Jharkhand	N.S.C.B Gomoh JN.	GMO-NMG (GMO west)
13	ECR	ECR	Jharkhand	Chaudharibandh	CDB-KRMB (CDB West)
14	ECR	ECR	Jharkhand	Chaube	CBH - HZD (CBH East)
15	ECR	ECR	Jharkhand	Koderma	GJD – KQR (GJD east)
16	ECR	ECR	Jharkhand	Gurpa	PRP- Yadugram (East)
17	ECR	ECR	Jharkhand	Bandhua	TKN – MPO (BNF East)



3.11 Details of Permanent Speed Restrictions in DDU-MPO-PKA section:

A number of Permanent speed restrictions are prevailing on Up & Down Line and on 3rd line on DDU-MPO-PKA section. The same will be monitored by the KAVACH. The details of these speed restrictions are given in table below:

3.11.1 Details for the Up Line are as follows

Table 3.14

STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN/UP LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
1	Ganjkhwaja – Pt. Deendayal upadhyay	Up	668.522	670.422	80	1900	0.71	
		Up	666.378		120			
2	ChandauliMajhwar – Ganjkhwaja	Up	659.707		130			
3	Saiyadraja-Chandauli Majhwar	Up	651.573		130			
4.	Karamnasa-Saiyadraja	Up	649.876		145			
		Up	646.116		145			
5.	Danaichna halt- Karamnasa	Up	643.370		130			
		Up	631.532		145			
		Up	629.654	630.257	145	603	0.02	
6.	Bhabua Road- Durgawati	Up	621.341		145			



STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN/UP LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
7.	Kumahu – Shiusagar Road	Up	581.478		130			
		Up	573.527		130			
		Up	571.830		150			
		Up	571.500		130			
8.	Karwandia-Sasaram	Up	565.725	566.500	150	775	0.02	
9	Pahleza –Karwandia	Up	561.131	562.000	130	869	0.08	
10.	Pahleza- Karmabad	Up	556.560		135			
11.	Dehri on Sone-Pahleza	Up	549.040	554.000	75	4960	2.11	
12	Jakhim – Bagohikusa	Up	524.446		130			
		Up	510.390		150			
13.	Ismailpur – Rafiganj	Up	505.466	505.500	130	34	0.00 3	
		Up	493.370		150			
14.	Paraiya- Guraru	Up	482.140		150			
		Up	477.291	478.110	100	819	0.18	
15.	Gaya Jn – Kastha	Up	472.403		130			
16.	Manpur – Gaya Jn	Up	466.800	469.000	60	2200	1.38	
		Up	465.500	466.166	80	666	0.25	
		Up	462.710	463.000	90	463	0.08	



STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN/UP LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
MPO- PKA Section								
17.	Manpur- Bandhua	Up	463/00	464/00	90	1000	0.29	
18	Gurpa -Gujhandi	Up	422/7	425/13	100	2430	0.55	
		Up	418/1	422/7	80	4600	1.73	
		Up	408/15	418/1	66	9950	5.32	
		Up	407/15	408/15	80	1000	0.38	
19	Gujhandi-Gurpa	Up	406/19	407/15	70	960	0.46	
		Up	405/19	406/19	80	1000	0.38	
		Up	403/15	405/19	100	1850	0.42	(Chg. Train)
20	Gujhandi-Gurpa	Up	403/15	425/13	55	21980	15.7 4	AB Train
21	Koderma – Gujhandi	Up	398/21	399/15	120	940	0.12	
22	Hazaribagh Stn Limit	Up	344/19	346/01	100	1820	0.41	
		Dn	344/20	342/24	120	1960	0.25	
23	Chichaki-Hazaribagh Road	Up	342/23	344/19	120	1960	0.25	
		Up	339/23	340/07	120	840	0.11	
24	Chaudhribandh- chichaki	Up	333/05	334/35	100	1300	0.29	
		Up	331/21	332/19	100	980	0.22	
25	Chaudhribandh station Limit	Up	327/21	328/05	100	840	0.19	
26	Parasnath station limit	Up	317/03	317/27	110	240	0.04	



STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN/UP LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
27	Nimiaghat-Parasnath	Up	316/03	317/03	120	1000	0.13	
28	Nichitpur-Gomoh	Up	290/25	291/11	110	860	0.15	
29	Dhanbad Station Limit	Up	270/17	271/15	30	980	1.59	
30	Dhanbad for all run through trains via main line	Up	270/03	270/11	80	80	0.03	
31	Pradhankhunta- Dhanbad	Up	261/29	264/25	120	2960	0.37	
32	Pradhankhunta station limit	Up	261/25	261/29	65	40	0.02 2	
33	Chhota Ambana- Pradhankhunta	Up	260/17	260/21	85	40	0.01	

3.11.2 Details of PSR of the 3rd Line are listed below:

Table 3.15

STATEMENT OF PERMANENT SPEED RESTRICTIONS (DDU-MPO)								
Reversible (3 rd Line) LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
1	Ganjkhwaja – Pt. Deendayal upadhyay	Reversible	666.377	667	115	623	0.09	
		Reversible	665.549		130			
2	ChandauliMajhwar – Ganjkhwaja	Reversible	657.475		130			
		Reversible	657.304		130			
3	Saiyadraja-Chandauli Majhwar	Reversible	657.068		130			
4.	Karamnasa-Saiyadraja	Reversible	649.817	650.000	140	183	0.010	
		Reversible	648.878		130			
		Reversible	648.728		130			
		Reversible	648.495		130			
		Reversible	646.065		140			
5.	Danaichna halt-Karamnasa	Reversible	629.678	630.000	150	322	0.01	



STATEMENT OF PERMANENT SPEED RESTRICTIONS (DDU-MPO)								
Reversible (3 rd Line) LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
6.	Kumahu – Shiusagar Road	Reve rsible	581.475	581.475	150			
		Reve rsible	573.135	573.135	150			
		Reve rsible	571.759	571.759	150			
		Reve rsible	571.498	578.498	150	7000	0.18	
		Reve rsible	570.380	570.380	150			
7.	Karwandia-Sasaram	Reve rsible	565.808	566.500	150	692	0.02	
8	Pahleza –Karwandia	Reve rsible	564.630	564.630	150			
9.	Dehri on Sone-Pahleza	Reve rsible	556.056	556.500	135	444	0.03	

3.11.3 Details of PSRs for the Down Line are listed below:



Table 3.16

STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
1	Ganjkhwaja – Pt. Deendayal upadhyay	Dn	675.500	676.240	50	740	0.61	For movement from DN Yard via North line to holding line.
		Dn	669.000	670.382	65	1382	0.76	
		Dn	667.000	667.840	50	840	0.69	
2	ChandauliMajhwar – Ganjkhwaja	Dn	660.051		130			
3.	Karamnasa-Saiyadraja	Dn	650.285		145			
		Dn	646.466		145			
4.	Danaichna halt- Karamnasa	Dn	643.687		145			
		Dn	632.000	632.374	145	374	0.02	
		Dn	630.167		145			
5.	Bhabua Road- Durgawati	Dn	621.960		145			
6.	Kumahu – Shiusagar Road	Dn	581.528		130			
		Dn	574.500	576.189	150	1689	0.04	
		Dn	573.527		130			
		Dn	572.000		130			



STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
		Dn	571.810		150			
7.	Karwandia-Sasaram	Dn	566.000	567.205	150	1205	0.03	
8.	Pahleza- Karmabad	Dn	556.860		150			
9.	Dehri on Sone-Pahleza	Dn	551.000	554.000	80	3000	1.13	
10	Jakhim – Bagohikusa	Dn	524.798		150			
		Dn	510.500	510.868	140	368	0.02	
11.	Ismailpur – Rafiganj	Dn	506.000	506.331	130	331	0.03	
		Dn	493.685		150			
12.	Paraiya- Guraru	Dn	482.700		150			
13.	Gaya Jn – Kastha	Dn	472.858	472.924	65	66	0.04	
		Dn	470.000	470.900	30	900	1.46	
14.	Manpur – Gaya Jn	Dn	468.000	469.426	60	1426	0.89	
		Dn	466.505		130			
		Dn	463.500	464.198	100	698	0.16	
MPO- PKA Section								
15.	Manpur- Bandhua	Dn	464/06	462/28	100	1780	0.40	
16	GurpaStn Limit	Dn	426/24	425/26	90	980	0.29	
17	Gurpa -Gujhandi	Dn	425/14	416/22	80	8920	3.35	
		Dn	416/22	410/18	66	6040	3.23	



STATEMENT OF PERMANENT SPEED RESTRICTIONS (RAJDHANI ROUTE) (DDU-MPO-PKA)								
DN LINE								
S. No.	Section	Line	Location		P S.R KM PH	Distance (Mtrs)	Time Loss (mts)	Reason for restriction
			From	To				
		Dn	410/18	407/16	80	3020	1.14	
18	Gujhandi-Gurpa	Dn	406/20	403/16	60	3040	1.90	
		Dn	406/20		80			
		Dn	425/13-	403/15	55	21980	15.7 4	(i) AB Train
19	Gujhandi-Koderma	Dn	399/16	399/22	120	60	0.01	
20	Koderma – Hirodih	Dn	385/24	384/18	110	1100	0.19	
21	Chaube Station Limit	Dn	355/12	355/06	80	60	0.02	
22	Hazaribagh Stn Limit	Dn	346/02	344/20	100	1820	0.41	
23	Chichaki-Hazaribagh Road	Dn	344/20	342/24	120	1960	0.25	
		Dn	340/0	339/24	120	760	0.01	
24	Chichaki Station Limit	Dn	335/14	334/26	100	880	0.20	
25	Chaudhribandh- chichaki	Dn	333/32	331/22	120	2100	0.26	
		Dn	328/04	327/20	120	840	0.11	
26	Parasnath station limit	Dn	317/28	317/4	120	240	0.03	
27	Nimiaghat-Parasnath	Dn	317/04	316/04	120	1000	0.13	
28	Dhanbad Station Limit	Dn	271/06	270/44	50	620	0.51	
29	Chhota Ambana- Pradhankhunta	Dn	260/30	260/08	120	220	0.3	

3.11.4 Details of PSRs for the 4th Line in the section are as below: Nil

Table 3.17: Nil

3.12 Details of The Locos on ECR:

The On Board Loco TCAS Equipment shall be fitted on selected Locomotives in nominated Loco sheds of Indian Railway along with UHF radio system for communication between On Board TCAS equipment in Loco & Station TCAS equipment all along the route.

The tentative holding of Locomotives with ECR is appended here under:

Table 3.18

Type of Loco	MPS in Kmph	No. Of Locomotives			
		ELS/GOMO	ELS/DDU		TOTAL
WAP-4	140		42		42
WAP-7	140	57			57
TOTAL		57	42		99

The various type of Locos based on type of braking i.e Conventional (IRAB), E-70 and CCB will require to have different type of BIUs. The tentative percentages of Locos of different type of Locomotives on ECR are also detailed below:

Table 3.19

S.No	Type of Loco Motive	Approximate Qty (Gomoh Base)	Approximate Qty (DDU Base)
1	Conventional (IRAB)		42
2	E – 70	37	
3	CCB	20	



3.13 Plans and Drawings – SIPs, Gradient details etc.

Existing Signal Interlocking Plan (SIP) of all stations and Block sections in DDU-MPO-PKA Section of Pt. Deendayal Upadhyay & Dhanbad Division of East Central Railway are attached with EPC tender on e-platform i.e. www.ireps.gov.in.

The Existing Gradient details of the section from Pt. Deendayal Upadhyay to Pradhankhunta are attached as Annexure –J.

The Standard drawings of various Locos showing the location where Loco TCAS and DMI are to be installed are provided at RDSO web site.

4. Factors For Project Planning

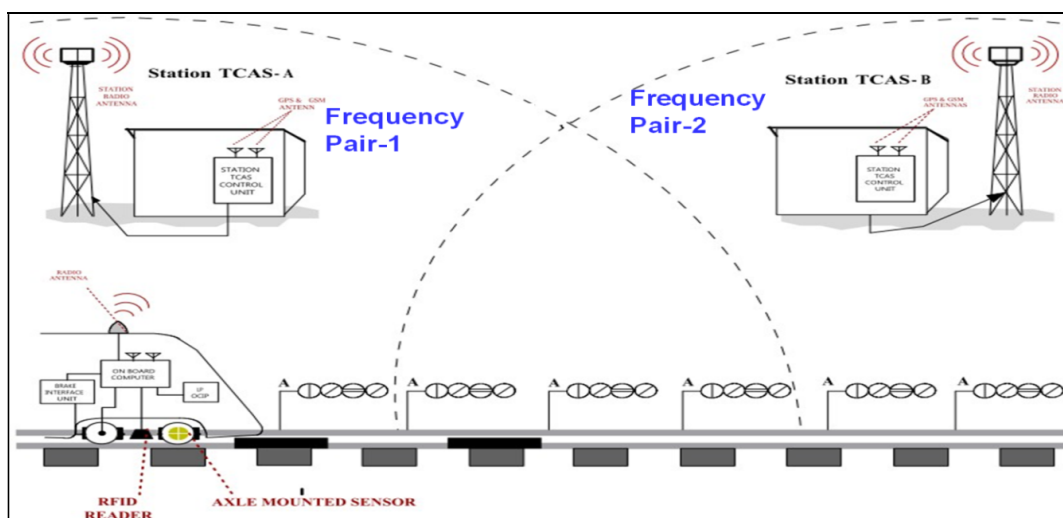
4.1 Specifications and future developments:

The Train Collision Avoidance System to be procured and installed shall conform to RDSO Specification No. RDSO/SPN/196/2012 version 3.2 OR LATEST.

Draft Specifications RDSO/SPN/196/2020 Version 4.0 is under development stage and is likely to be finalized soon. The project envisages to commission finally based on Version 4.0 also.

4.2 RADIO TELECOMMUNICATION SUB - SYSTEM: The indigenous ATP system KAVACH (TCAS) is a system based on continuous updating of “MA” (Movement Authority), which requires continuous radio communication in “Communication Mandatory Zone”.

For an Automatic Signaling territory the mandatory zone extends throughout the section. Presently the RDSO specification specifies use of UHF frequency based system and the section concerned is having GSM-R based MTRC system. In view of GSM-R being out dated, presently the section is being planned with the UHF frequency based system which can be at a later stage capable to migrate to LTE-R once it is implemented on IR.



4.3 TOWER PLANNING:

4.3.1 Additional REQUIREMENT OF TOWERS: Due to the requirement of continuous update of MA (Movement Authority) and the section having Automatic Signaling throughout, *proper Radio Signal Strength will play a very important role for success of the project.*

As such it is planned to have an initial software based simulation of Received signal strength (RSSI survey) so as to correctly judge the numbers, location and height of towers required for present UHF based communication. The initial survey report is also a part of this FEASIBILITY REPORT as Annexure - I. It is planned to have a MINIMUM fade margin of 30dB.

Subsequently a detailed survey is proposed by the successful contractor on the project. These towers are also required to be planned in such a way so as to have a smooth transition to LTE based future KAVACH.

In order to economize on the cost of the project and make use of the existing facilities, the use of existing MW and MTRC towers is also suggested. However care needs to be taken for ensuring the effective tower height available for use of TCAS radio Equipment.



4.3.2 TOWER STRUCTURE: Based on experience of South Central Railway and North Central Railway ongoing projects, it is proposed to have site specific tower structure preferably Lattice type or in certain cases Monopole type. The structure can be suitably designed by the contractor, duly approved by a 3rd party before being approved by IR. The norms followed by IR need to be taken care by the contractor. Certain standard designs of super-structure and sub-structure of the tower are available on RDSO site, the same can also be utilized.

4.3.3 LOCATION OF TOWERS: A detailed survey is required to be done in the initial phase of the project to assess the strength of Radio Communication in the nominated KAVACH section based on which the location and height of the additional Towers is required to be planned.

The towers at the Stations are already existing or are to be planned at the station where not existing. However in the Block section in order to have proper signal strength of UHF in the project initially and latter on of LTE – R additional towers will be required. All the additional towers in mid section will have to be planned adjacent to LSC / LC gates following all the Railway norms and regulations. As such the survey will have to be done taking due care of this.

4.4 SIGNALING INTERFACE:

The ATP system “KAVACH” (TCAS) works on top of Existing Signaling system, taking Input from it and utilizing the same for Automatic Train Protection. Presently in the referred section we have Electronic Interlocking / Panel Interlocking / Route relay interlocking at all the stations from DDU-MPO-PKA Absolute section.

There are two possibilities of taking the signaling input from the signaling system. Directly through EI using a SIL 4 protocol converter or by using relay contacts of the concerned relays which are ECRs, NWKRs / RWKRs & TPRs. Presently the OEMs have not developed protocol converters as such the provision of taking inputs from relays is being planned.

As such it is planned to initially use Relay contacts of the concerned relays and in due course migrate to protocol converters as and when they are developed.

4.5 Requirement for Building :

The Train Collision Avoidance system as discussed above will require Interfacing with the Existing Signaling system, wherein the Equipments will be required to be placed in The Existing Relay Rooms of the Absolute section. However, at number of places the existing Relay Room may not have proper space for provision of Relay Racks, TCAS equipment, Power supply augmentation etc. Hence, a detailed survey will be required for this and the scope of work will also need to include the same.

4.6 Communication backbone:

The ATP (Automatic Train Protection) System will also require a **Back – Bone of an Optical Fiber Network in redundancy** for the connectivity of the various Stationary Station TCAS with LC & IB TCAS and LSCs with the help of RIUs (Remote Interface Units) in the Automatic Signaling section as per requirement.

In order to achieve this, two numbers of minimum 24 core OFC cables are required to be laid, one on each side of the track for connecting the RIUs / LC TCAS to the



Station TCAS as per requirement. In ECR, Telecom OFC is running parallel to track on the whole of the section.

For the section under consideration, it is decided that for Automatic Train Protection System two 24 Fiber OFC cables will be laid throughout the section with space diversity with "RING REDUNDANCY". This OFC cable will have to be terminated in the required stations also as a part of the scope of work. Further a detailed survey will be required for ensuring spare Optical Fibers in the existing OFC. In case the same is not available in particular section, shifting these to new OFC will be required to be planned well in advance.

4.7 Loco TCAS planning:

The Locos running on the section are required to be equipped with Loco TCAS. As it is not possible to have all the Locos equipped with Loco TCAS simultaneously, under discussion with the Electrical Department following priority has been decided for prioritizing the Locos:

- a. High Speed Locos.
- b. Mail Express Locos.
- c. All other passenger Locos.
- d. Goods Locos.

However it will also depend on availability of these Locos, as such some the priority needs to be followed as far as possible.

4.8 Maintenance Strategy

KAVACH is a new technology on Indian Railways with only some experience with South Central Railways. Being a new technology a defect liability period of additional 4 years is planned along with the life cycle maintenance contract of 15 years.

In addition to this, Training by OEMs and training centres over Indian Railways are

also being planned.

5. SCOPE OF WORK

5.1 Introduction:

The KAVACH (TCAS) shall be provided to cover entire section from Pt.Deendayal Upadhyay (672.65 Kms) to Pradhankhunta (261.31 Kms) section of East Central Railway. This Project scope includes detailed survey of the geography, geology and topography of the section, detailed design for deliverables as listed in Chapter 6, design approvals, fitment of TCAS at stations, IBSS, LC Gates as per requirement, fitment of Loco TCAS, Construction of towers including foundation, power, signaling and OFC cabling, quality check and inspection, independent safety assessment and introduction of system in service. Thereafter monitoring of performance through DRACAS (Defect Reporting and corrective Action System), corrective actions required if any to achieve the performance criteria and maintenance support.

Works to be done by all wings of the railways including approval, sanctions, Quality inspections and Acceptance tests:

- a. Bridge Engineering: Substructure and Superstructure design of towers.
- b. Traction (Electrical): Loco TCAS fitment in Electrical Locomotives.
- c. Traction (Diesel): Loco TCAS fitment in Diesel Locomotives.
- d. S&T: Radio Link design, STCAS design and installation and all associated activities as per deliverable listed in Chapter 6 of this document.

Works to be done by the contractor including arranging statutory approvals as per labour laws, local regulations etc, requirement of land on rent to enable the work execution in railway land or access to railway land shall be defined in the Contract Requirements, i.e., scope descript of the tender to be floated.



The Train Collision Avoidance System(KAVACH) to be procured and installed through this tender shall conform to RDSO Specification No. RDSO/SPN/196/2012 version 3.2 or latest at the time of opening of Bid.

5.2 Survey:

5.2.1 RSSI Survey: Though a preliminary RSSI Signal strength survey report is attached at Annexure - I. However as communication is one of the most important part for success of the project, a detailed RSSI survey is required to be done in the initial phase of the project to assess the strength of Radio Communication in the nominated TCAS section based on which the location and height of the additional Towers is required to be planned.

5.2.2 Aerial Drone Survey: The project scope also includes the aerial drone survey for entire track profile so as to have the mapping of all signals enroute for provision of RFID tags.

5.2.3 Survey for cable route plan: Cable Route plan is to be prepared and approved before starting of cable trenching and laying as per the scope of works.

5.2.4 In case the spare Fibres are not available in the Existing OFC, a survey report needs to be prepared where in sections need to be identified where the circuits on these fibres need to be transferred to new OFC.

5.2.4 Survey for Civil works: A detailed site survey is required for firming up the locations of the additional Towers (preferably near LSCs and Level crossing for Block section), requirement of additional Building structures and any requirement of utility shifting.

5.3 Design of Station / LC TCAS and RIUs

The scope also incorporates design of station specific TCAS Table of controls, TCAS RFID TIN Layout, RFID Tag Data, Wiring diagrams for TCAS relay interface, Equipment Layout diagrams of STCAS, Radio and Loco TCAS Equipment. It also includes power supply arrangement design, Radio link design including the design of Towers with foundation if required. The Tower design if required need to be



certified by a 3rd party. Standard Tower design available on RDSO site can also be used.

5.4 Provision of Additional Building and Towers:

The scope includes the provision of additional rooms of suitable size, wherever there is no space in the existing relay rooms. These specifications need to be specified. Further based on the RSSI survey there might be a requirement of additional Towers, the scope also includes the provision of these additional Towers, preferably of 30 to 40 metres high keeping in view of future requirement of LTE – R.

Tower may also be required at a location where existing tower is available but is required to be replaced as per design. At these locations dismantling of existing tower and relocation of existing equipment of the tower will also be covered in the Scope of works.

5.5 Provision of Track side KAVACH (TCAS):

Stationery TCAS equipment to be installed in this project will be from Pt.Deendayal Upadhyay (672.65 Kms) to Pradhankhunta (261.31 Kms) section of East Central Railway. This includes 77 Way side station and 8 Junction stations. The scope of project KAVACH on the section includes the supply, installation, testing and commissioning of

1. Station TCAS for interfacing with Station Signalling,
2. LC TCAS and RIUs for interfacing with Signalling in the Block section.
3. UHF communication arrangement at these locations so as to enable STCAS to talk to the Loco TCAS.
4. Provision of RFID Tags on the track as per the design.
5. Provision of the SMOCIP at the stations for SOS functioning.

6. Enhancement of power supply as per requirement.

5.6 Installation of LOCO TCAS

5.6.1 The On Board Equipment (Loco TCAS) shall be fitted on selected Locomotives in nominated Loco sheds of Indian Railway along with UHF radio system for communication between On Board TCAS equipment in Loco & Station TCAS equipment all along the route.

Test bench is also to be provided in nominated Loco Sheds of IR. The scope of this project covers provision of Loco TCAS on 60 Locomotives.

5.6.2 BRAKE INTERFACE UNIT: The Brake Interface Unit (BIU) is an integral part of Loco TCAS. It shall be capable of giving following three levels of brake commands for train braking:

- i. Normal Service Brake (NSB) command (not applicable for EMUs and other self propelled vehicles)
- ii. Full Service Brake (FSB) command
- iii. Emergency Brake (EB) command.

The various type of Locos based on type of braking i.e Conventional (IRAB), E-70 and CCB will require to have different type of BIUs.

5.7 Provision of 24 Fibre OFC with path redundancy on Existing:

Remote Interface Units of the Block section are required to be connected in ring fashion so that they shall be able to connect to station TCAS even in case of failure of Main Path. For this purpose, two new 24 Fiber OFC shall be laid, out of these 24 fibers, 6 fibers shall be used for signalling purpose (4 working + 2 Spare). Separate OFC shall be laid from the nearest joint in existing OFC to extend it to RIU hut.



The scope also includes Supply, laying of HDPE pipe of size 40/33 mm duct using open trench of 1.2 m depth or Horizontal Directional Drilling at a depth of 3 mtr or more and blowing of 24 Fiber OFC cable, splicing of OFC cable in the entire section, dropping & termination of 06 fibre at each station / OFC Hut / Auto hut etc and balance 18 fibers at Major Junction / Important stations as per requirements.

5.8 Provision of Network Management System:

The scope also includes provision of a Network management system at DDU and DHN Test Room. It includes extending the required E1 channel from the given place in the OFC room or connecting through Dark fibre with associated Hardware & Software of Modems, Optical Network Unit with interconnecting Cables/ Pig Tails & Wiring. It also includes OFC cable laying & Termination / U/G Splicing as required up to nearby place for Dark Fibre / E1 channel as required. The E1 channel will be provided by the Zonal Railways.

5.9 Certification by ISA:

The scope of the project incorporates a proper certification by an “Independent Safety Assessor” (ISA) after the testing and commissioning of the entire section from DDU to PKA or a workable part of the section.

5.10 Training of Railway Officers / Staff : The Contractor shall provide and complete the training to the personnel of the Authority in diagnostic, trouble shooting, repairing, operation and maintenance of the installed signalling and telecommunication equipments Like TCAS and OFC for not less than 600 man days as mutually decided by Authority and Contractor at required place(s). The training shall be completed before the issuance of the Provisional Certificate/ Completion Certificate

6. DELIVERABLES:



- 6.1** Detailed design necessary for justifying the chosen sub systems like Radio, towers, Transmission media other than Radio, Remote Interface units (RIU), Brake interface units and construction to take place.
- 6.2** RAM Plan showing how the reliability, Availability and Maintainability is addressed on this project.
- 6.3** System RAMS Assessment to support the RAM Plan.
- 6.4** Programme on DRACAS (Defect Reporting and Corrective Action System) to report failures and track the corrective actions.
- 6.5** Survey & Mapping Report to confirm the location and features details already furnished and its fitness for detailed design.
- 6.6** General and Detailed Design:
 - 6.6.1 Buried Service Records (Pipes and Cables)
 - 6.6.2 Cable Routing strategy and Route Plan detailing routing strategy for all cables and to demonstrate the method of achieving full diversity.
 - 6.6.3 Cable schedule showing cables across all sub systems including termination and jumpering details.
 - 6.6.4 TCAS Table of Control.
 - 6.6.5 TCAS RIFD Tin Layout.
 - 6.6.6 RFID Tag Data.
 - 6.6.7 Wiring Diagram (TCAS Relay Interface)
 - 6.6.8 Equipment layout Diagram (STCAS and Radio)
 - 6.6.9 Locomotive TCAS Equipment Layout Diagram including Locomotive Desk.
 - 6.6.10 Radio link Design.
 - 6.6.11 Power Supply Scheme.
 - 6.6.12 Redundant Communication Scheme.
 - 6.6.13 Earthing Diagram showing earthing across all sub systems.
- 6.7** Engineering Assurances:



6.7.1 Design Risk Log: Records of identified risks and assumptions and interdependencies identified during the design process and approval.

6.7.2 Design Compliance Certificate: Confirmation that the design complies with the requirements and later in the project lifecycle that the installation complies with the design.

6.7.3 Inter Disciplinary Review Records.

6.7.4 Inter Disciplinary Check Certificate.

6.7.5 Master Records Register: Register of Master Records that are signed copies of the working installation.

6.7.6 Entry into Service Strategy showing how entry into service will be carried out with a checklist of deliverables.

6.7.7 Testing Plan and Commissioning Strategies including Pre-Commissioning Checklists.

6.7.8 QA Certification including all inspection and test records of all sub systems and integrated system.

6.7.9 Test Certificates: Records who has tested to which specification and the results. Should not use general terms.

6.8 Functional Train Collision Avoidance System as per latest RDSO Specification No. RDSO/SPN/196/2020, version 4.0 at all Stations, Intermediate Block Signals, Absolute Signals, LC Gates and Locomotives with all subsystems including communication.

6.9 ISA certification and approved Application Safety Case for the project before introduction of services.

6.10 As Built Designs (Tower including foundation, STCAS, IBS, LC Gate, LTCAS) that describes the assets that has been installed.

6.11 Maintenance

6.11.1 Report on future maintenance requirements due to proposed solutions.

6.11.2 Maintainability Study: It shall determine suitable options for access to

the Relay Room, Radio Towers, IBS and LC Gate Relay rooms and Locomotives and requirement of competent resources along with their deployment matrix.

7. ROLES AND RESPONSIBILITY OF EMPLOYER AND EXECUTIVE

7.1 Table below describes the Role and responsibility for Stations, NMS and Loco.

S.N	Item	Responsibility	Remarks
A. For each station			
1	Station number allocation	Railway & OEM	Follow RDSO TAN
3	Central location in Kilometer	Railway	Stations / LC / AH
4	Communication Mandatary Zone	Railway	For Continuous Radio Coverage
5	Stationary TCAS wise Frequency pair allocation (Pair 1 and Pair2 shall be alternative)	Railway	Fo- 441.8 MHz, Pair 1: F1/F2-456.8MHz and 416.8 MHz, Pair 2: F3/F4-466.8 MHz and 426.8 MHz
6	TIN number allocation (Track Identification Numbers)	Railway & OEM	As per RDSO TAN no STS/E/ TAN/ 5001 dated; 20.02.2019
7	RFID Tag number allocation	Railway & OEM	-do-
8	SIP (Including Stations, LC gates and IBS etc.,)	Railway	Existing SIPs are attached with EPC tender on e-platform i.e. www.ireps.gov.in .
9	Table Of Control (TOC) or Selection Table	OEM	To be prepared by Successful bidder for approval by Railways.
10	Gradient Data	Railway	As per details at Annexure J.
11	Turnout Speed Restriction Details	Railway	Can be derived from SIPs.
12	PSR information	Railway	As per Chapter 3 Para 3.10
13	Latest Working Timetable	Railway	
14	Whether LC Gate warning Tags to be provided (Yes/No)	Railway	Yes



S.N	Item	Responsibility	Remarks
15	Whether Auto Whistling feature is to be provided (Yes/No)	Railway	Yes
16	Whistling pattern	Railway	As per extant guidelines
17	Frequency slot allocation	Railway	WPC clearance also required.
18	RSSI Survey	OEM	Draft provided at Annexure I
18	Drone Survey data	OEM	To be arranged by the bidder.
19	GSM SIM Card1 Details	Railway	Reliance Jio
20	GSM SIM Card2 Details	Railway	BSNL or as decided by authority
21	Relay Contact Analysis data	Railway	As per Annexure B
22	Relay Rack Charts	Railway & OEM	Existing shall be made available by Railway. New Relay rack chart to be prepared by OEM.
23	Whether new Relay Rack is to be erected or not	OEM	Yes, Repeater relay, if any is to be opened in new relay rack.
24	Whether Circuit to be submitted as per British/Siemens Practice	Railway	As per the existing Interlocking. British in this section.
25	Cable Route Plan	OEM & Railway	To be prepared by OEM and approved by Railway.
26	Floor plan of S&T Equipment Room.	OEM & Railway	To be prepared by OEM and approved by Railway.
27	Location of RIUs	Railway	As per Table 3.2
28	Floor plan of Relay huts, if RIU is to be installed in huts	OEM	To be prepared by OEM and approved by Railway.
29	Number of RIUs for which Location boxes are to be supplied	OEM	RIUs to be installed in Brick Rooms/ building



S.N	Item	Responsibility	Remarks
30	Number of RIUs for which Power supply 230V AC is provided	OEM & Railway	Power Supply of 230 V AC will be made available, but if required to be extended
31	Proposed Location of Tower (Latitude and Longitude)	OEM & Railway	After RF/RSS survey, the tower location and tower height to be determined.
32	Design of Stationary TCAS tower and foundation	OEM & Railway	Ads per Standard design or non standard design approved by 3 rd party to be submitted for approval.
33	WPC or/and SACFA Clearance Procedure	OEM & Railway	Clearance will be taken by Railways.
34	Location of Stationary TCAS Test Benches	Railway	One for each Division
B	For each NMS :		
1	No of Stn TCAS unit in one E-1 Ring	Railway	It shall be limited to 5-7
2	Proposed connectivity of stationary TCAS at mid-section where E-1 is not available	Railway	
3	PC Configuration	Bidder	For connecting 150 number of 4-Line stations following PC configuration is recommended 1. 12 CPU CORES 2. 12 GB RAM 3. 1 TB storage for 90 days Data 4. Windows 10 or higher version
4	Static IP address of NMS	Railway	Will be provided



S.N	Item	Responsibility	Remarks
5	Internet bandwidth of 25 MBPS	Railway	Assuming 4 live consoles & 2 report generators working in parallel
6	Whether furniture for NMS is to be provided(Yes/No)	Bidder	Yes
7	Floor plan for S&T Control office for NMS	OEM & Railway	To be prepared by bidder and to be approved by Railway
8	VDU Quantity , Size & Resolution	Railway	75' (Min 4k resolution) at each station and control office
9	UPS backup for NMS	Railway	
C	For each Loco		
1	Loco Type	Railway	Tentative as per Table 3.18 & 3.19
2	Loco ID	Railway	
3	Loco Shed	Railway	
4	Type of Brake System	Railway	As per item no. 1 above.
5	Loco Wheel dia	Railway	As per item no. 1 above.
6	GSM SIM Card1 Details	Railway	Reliance Jio
7	GSM SIM Card2 Details	Railway	BSNL or as decided by CA
8	Axes for providing pulse generators	Railway	As per RDSO's fitment diagram.
9	Fitment diagrams	Railway	Fitment drawing for Onboard Eqpts in Loco are available at http://10.100.2.19/Signal/Policy
10	Interface details for auto-whistling	Railway	As per RDSO's drawings
11	Interface for Traction cut-off	Railway	As per RDSO's drawings
12	Responsible Authorities in Shed	Railway	Sr DEE/TRS or any other authority nominated by Rly
13	Location of Loco TCAS Test	Railway	



S.N	Item	Responsibility	Remarks
	Benches		

7.2 The table below gives the Roles and Responsibility for Various Factors for Design Outputs:

S.N	For each station	Responsibility	Relevant Inputs
1	RFID Tag Layout	OEM	SIP, TOC, Drone data, Tag & TIN Ids
2	RFID Tag data	OEM	RFID Tag Layout
3	Interface circuits	OEM	SIP, Contact analysis
4	TCAS Table of Control (TOC)	OEM	SIP, Tag layout, TOC
5	Station Application Data	OEM	TOC(TCAS), Tag Layout
6	Floor Plans	OEM	Drone Survey
7	Drone Data	OEM	Drone Survey
8	Stationary and Loco TCAS timeslots and frequency channel pairs	OEM	Maximum trains, Frequency allocation
9	Cable route plan, Cable core plan, Power supply diagram, Location / CTR details, Relay Contact Chart, Interface and Logic Circuits in Case of EI alteration, Circuit diagram in case of PI alteration, LC Gate Circuits, Testing reports, SWRD, SWR, GWR, VDU/ Panel Diagrams, 1W/2W/ bell test details/ Quality Audit documents/	OEM	SIP



S.N	For each station	Responsibility	Relevant Inputs
	completion plans (laminated) etc as per ECR practice		

8. COST ESTIMATION:

8.1 INTRODUCTION:

The Cost Estimation for the project have been done by including the **cost of Station TCAS** including the cost of interfacing with the existing signaling & cost of Radio Equipment for that station, **Cost of Civil engineering** works including the Tower cost & that of Building and other structure, **Cost of Equipment provided on the track** which includes the RIFD Tags cost along with equipment utilized for programming these RIFD, **Cost of the Loco TCAS** including radio Equipment cost and interface equipment with the track side RFID and the interface with the Loco Pilots,

The cost has also a **component of the Telecommunication OFC** based back bone. The Overall Cost of the project is approximately **151.211 Crores**. However this cost does not include the cost of change over to LTE – R from UHF communication in a later stage. Separate works for provision of LTE – R over IR are being sanctioned.

8.2 CIVIL ENGINEERING COST:

As envisaged for the project there is no need of land procurement for the project. The two basic components of civil Engineering costing will be provision of Towers and the provision of Building structure where there is a space constraint in the Existing Relay Room.

It is envisaged that in addition to the Existing towers of MTRC and MW additional Towers are required to be built in Block sections where the length of block section is more than 8 Km and as envisaged in the preliminary RSSI survey report (As per Annexure Xx). Also provision of shifting to LTE – R in future needs to be taken care.



For the Building works as per survey the same is required to be provided.

8.3 LINE SIDE & STATION TCAS COST:

This cost includes the cost of Supply, Installation, Testing and Commissioning of Station TCAS equipment along with associated Radio Equipment, Cost of LC TCAS equipment along with Radio Equipment required for additional Tower sites in the Block section at LSCs, Cost of the RIUs, cost of SM operation panel, cost of Relays and other accessories for interfacing with the existing signaling and cost of equipment required to program the STCAS / LC TCAS and the Test benches required for testing the TCAS.

This cost is also inclusive of RFID tags (required for knowing the position and direction of the locomotive movement) which are to be provided in duplicate at all the signals, at signal approaches and in station Yards for demarcating the point zone and the berthing track circuits, etc.

8.4 LOCO TCAS COSTING:

The cost of Loco TCAS is the cost of Supplying, installation, testing and commissioning of all the equipments to be provided on board the Locos to be used on the System.

This includes the costing of OBC (On Board Computer), DMI (Driver Machine Interface), on board radio equipments for UHF communication, GPS and GPRS communication, RFID readers, BIU (Brake Interface units) and the other accessories.

This cost will also include the test bench to be provided in the Loco Sheds and has been worked out per Loco basis and planned for 60 locos.

8.5 COST OF COMMUNICATION BACKBONE:

For efficient working of TCAS a telecom backbone of two 24 Fiber OFC are required to be laid throughout the section. This cost is also an important element of the project and includes the cost of open/ trenchless trenching along with supply and laying of HDPE pipe and a 24 Fiber OFC and using this OFC for ring redundancy along with existing OFC.

8.6 OTHER CHARGES:

The capital cost of the project also includes the WPC & SCAFA license fee for the period of the project, which latter on will be paid from the revenue. The project cost also includes the D&G charges of 16.33% and contingencies charges @ of 1%

8.7 Summary Table:

Scheme Elements	Cost Estimate (%)
Signaling works of Provision of TCAS complete.	76.31% of the Contract Price
Telecommunication work for Provision of two 24 Fibers OFC Backbone.	12.38% of the Contract Price
Civil work for provision of Service building at Stations/LC gates/IBH.	11.31% of the Contract Price
TOTAL	100 %

9. PROJECT RISK AND ASSUMPTIONS

9.1 Qualitative Cost Risk Analysis (QCRA) with the objective of identifying the projects risks for the KAVACH project with all stakeholder is to be done post contract award and risk owners identified to:

- Identify significant risks to the achievement of the project objectives
- Establish a project risk register
- Conduct an assumption analysis and identify any constraints

9.2 Each risk shall be analysed to understand the probability of occurrence and impact of the risks on the project outcome ranging from very high likelihood of occurrence / impact to very low likelihood of occurrence / impact. Few examples but not limited to these can be:

- Tower Sites near the water bodies, drains etc.
- Soil with abnormally low bearing capacity or encountering of unexpected rocks, underground water streams etc.



- Non-availability or delayed availability of a particular type of locomotive.
- WPC AND SACFA CLEARANCES: The frequency of the operation for TCAS has been defined by RDSO. The application for WPC & SACFA shall be filed by the Railway so that the license remains with Railways. The WPC and SACFA clearance are required for the use of towers and radios.
- Interoperability between various new and Existing KAVACH OEMs.

10. IMPACT ON EXISTING INTERNAL CUSTOMER

10.1 Train working by LOCO Pilot:

TCAS equipped locos are provided with Brake Interface Unit (BIU), Driver Machine Interface (DMI), RFID reader and LTCAS. In general, Loco pilot checks driving console position, load meter response, Main reservoir pressure, Brake pressure, Feed pressure and air continuity. In TCAS equipped loco, in addition to the mandatory checks mentioned above, Loco Pilot has to bring the LTCAS system into functioning at the time of starting the train. Procedure of activating LTCAS involves switching on of all MCBs, booting of DMI, operation of Isolation switch to Normal position, operation of leading/non leading switch, selection of train type and Staff Responsible Mode/ Shunt Mode depending upon the intended movement of train. This entire procedure takes 2 to 3 minutes in addition to the time required for energization of Loco. Further depending on the aspects of signals in DMI proper mode selection to be done by Loco Pilot.

10.2 Train Working by Station Master:

In TCAS equipped territories Station Master Operation cum Indication Panel (SMOCIP) is installed in SM rooms to generate and cancel SOS (Save Our Soul) messages during emergency situations. SMOCIP displays TCAS related information like number of locos in the Station's vicinity, their absolute positions and TCAS health condition such as status of Battery voltage through LED indications etc. Station Master on duty is responsible for operation of SMOCIP (Station Master Operation cum Indication Panel) and custody of keys to prevent unauthorized



operation. on receiving any message that endangers through traffic and requires stoppage of train, station master shall generate SOS and the same is to be recorded in the register. Apart from generation and acknowledgement of SOS, failure of STCAS and its restoration shall be reported to all concerned and accordingly records are to be updated.

10.3 Signalling System Maintenance

As TCAS system makes use of existing signaling relays for computing movement authority, all the maintenance requirement for existing signaling system are applicable to TCAS maintenance. In addition to maintenance of additional relays picked up for TCAS working, maintenance and monitoring of RFID tags and RIU's installed in remote locations is a vital activity. Round the clock monitoring of real time events through NMS is another crucial maintenance activity. Apart from maintenance of TCAS gears any signaling alteration work on account of shifting of points, extension of track circuits, shifting of signals, provision of additional points/track circuits/signals need to be incorporated in TCAS.

Man power requirement need to be worked out for the maintenance activities mentioned above. This can be done through assigning maintenance units to TCAS sub systems and use existing yard sticks as done in computation of man power requirement for any signal installation.

10.4 Locomotive Periodical Maintenance

Periodical maintenance of the locomotives is carried out by trip sheds and main sheds once in 45 days and 90 days respectively. The condition of the brake blocks, brake power and the pantograph are checked and cleaning of the filters is carried out at Trip sheds in general. The wheel profile, Bogie inspection & topping up of lubricants will be carried out at main sheds. The chances of interference & damage of TCAS equipment are minimal as the duration between two consecutive maintenance schedule is not very high however, TCAS maintenance team/OEM



engineers should test the system thoroughly and attend all the failures if any before putting the system in to service. Coordination between shed officials and the maintenance team of OEM is very crucial for maintenance of LTCAS.

10.5 Locomotive Periodical Overhauling

Overhauling of the locomotives is carried out approximately once in 09 years and 18 years for passenger locos and goods locos respectively. During the overhauling all the equipment & bearings except the cables are stripped out and new items will be installed. Proper care should be taken to safe guard the fitted TCAS equipment in the locomotives. Maintenance of LOCO and LTCAS has to be synchronized otherwise improper removal/handling of wiring and LTCAS sub systems during overhauling of LOCO will result into permanent damage of LTCAS. After completion of the Periodical overhauling of the locomotives, TCAS OEM engineers should test the system thoroughly and attend all the failures if any before putting the system in to service.

10.6 Track Maintenance

Functioning of TCAS involves fixing of RFID tags on tracks that determines the absolute location of loco and the track ID on which the loco is running. These RFID tags are required to be removed during PQRS and other track machine working. Hence the working of track machine in TCAS territory needs a close coordination between Civil and S&T engineers. Other than increased extent of co-ordination there is no major impact on the track maintenance as such with the introduction of TCAS

10.7 Towers Maintenance

Periodic maintenance is essential to keep the tower structures in good fettle. Technical competency is required to maintain the tower structures. Hence, Bridge inspectors need to be deployed for proper maintenance and supervision of the



towers. Outsourcing of this activity can also be an option however, supervision of maintenance, proposed to be carried out through outsourced agency, still need to be done by Bridge inspectors.

11. ENVIRONMENTAL APPRAISAL

As no major Civil works are involved, the project has no major Environmental Impact. However, the execution of TCAS project involves the excavation of earth and erection of high steel structure for radio towers and hence requires consideration about following environmental factors. These factors shall be identified for each worksite during the post contract survey and mitigation measures shall find place in the concept design.

- (i) The worksite within a floodplain and/or subject to flooding from rivers, sea, surface water or groundwater.
- (ii) The worksite in or over a watercourse or drainage channel or near the bank of a watercourse or near marine waters, on coastal areas below mean high tide or affecting navigation.
- (iii) Any river bank, ditch or a pond bank physically impacted by excavation works.
- (iv) Draining down or diversion of any water body as a result of the works.
- (v) Any geotechnical stability problems for example erosion, subsidence or landslides associated with the site.
- (vi) The project may require to clear few trees, vegetation or hedgerows on the work site or its compounds, access routes or staging areas.
- (vii) The project affecting agricultural land or impact any agricultural holding.
- (viii) Ponds within 500 metres.
- (ix) Residences, businesses, schools, medical facilities etc that could be affected by noise/ vibration and or dust/ poor air quality during construction?



- (x) Any footpath or road closures/ diversions required during project delivery.

12. STANDARDS

Following standards, codes and manuals shall be followed in the proposed work of deployment of TCAS in the section under the consideration.

- (i) General Rules for Indian Railways (Open Line) 1976
- (ii) Indian Railway Signal Engineering Manual – July 2021
- (iii) Indian Railway Telecommunication Manual – September 2021
- (iv) RDSO Specification for TCAS – RDSO/SPN/96/2012, Ver. 3.2 or latest
- (v) Indian Railway – Standard Code of Practice for the Design of Microwave Towers of Self-Supporting Type – 1982
- (vi) Indian Railway – Standard Code of Practice for Fabrication and Erection of Steel Works on Microwave Towers: Self Supporting Type – 1979
- (vii) Policy on Design Basis Report / Checklist for Design of Superstructure of TCAS Tower by RDSO B&S Directorate issued vide letter No. CVS/R/DRT/TCAS, dated 11.1.2021
- (viii) EN50126: Specification and demonstration of RAMS for all railway applications
- (ix) EN50128: Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems.
- (x) EN50129: Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling.
- (xi) EN50159: Railway applications - Communication, signalling and processing systems - Safety-related communication in transmission systems.
- (xii) For other activity corresponding IS Codes shall be referred.

13. CONTRACTING STRATEGY

Following system of contracting shall be adopted.

- I. Pre – Bid survey contract for identification of most critical radio tower location, height, space and desktop survey for Received Signal Strength at various heights of antenna.
- II. Engineering, Procurement and Construction contract (EPC) for detailed survey, concept design, detailed design, installation, testing and commissioning of various subsystems, Independent Safety Assessment of the project, training, As Made designs, introduction of system into service and subsequent defect reporting and corrective action and maintenance support.

14. ON GOING WORKS IN THE SECTION

On the section discussed, a number of works for EI and LC gates are ongoing. These works are likely to be completed in various months by 2024.



ANNEXURES

Annexure A

KAVACH Technology:

1 Concept:

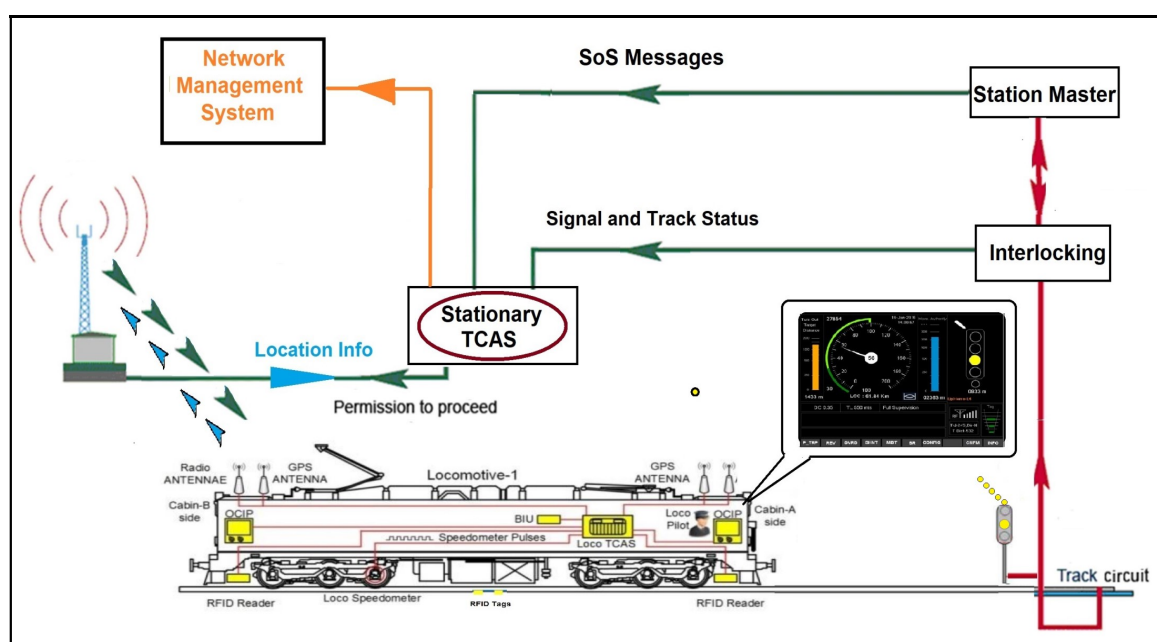
KAVACH (TCAS) is an indigenously developed Automatic Train Protection (ATP) System meant to provide protection to trains against Signal Passing at Danger (SPAD), excessive speed and collisions. It provides continuous update of Movement Authority (distance upto which the train is permitted to travel without danger). Hence during unsafe situations when brake application is necessitated, and the Crew has either failed to do so, or is not in position to do so, automatic brake application shall take place. TCAS has additional features to display information like speed, location, distance to signal ahead, Signal aspects etc. in Loc Pilot's cab and generation of Auto and Manual SOS messages (Distress messages) from Loco as well as Station unit in case of emergency situation.

2 Working of KAVACH:

The trackside sub-system of TCAS consists of RFID tags fitted on track in station section and block section for giving Trackside information to Loco TCAS unit installed in the locomotive. Portions of track including berthing tracks, point and block sections are assigned unique IDs called Track Identification Number (TIN). TIN along with RFID Tags are used to determine the direction of train.

The system also consists of Stationary TCAS unit installed at Station with radio tower to communicate with locomotives in station area. Stationary TCAS is interfaced with station interlocking to acquire real-time dynamic information related with signalling such as various signal aspects. Route information of all the signals monitored by a specific stationary TCAS unit is configured on the basis of TCAS Control Table (excluding shunt signals and overlaps). Stationary TCAS unit gets real-time information regarding Locations, Speed etc of various trains in its jurisdiction through UHF Radio Communication.

Separate Stationary TCAS unit is provided at Mid –Section interlocked Level Crossing Gate and Intermediate Block Signalling (IBS) locations if they do not come within the coverage of station radio tower. Remote Interface Unit (RIU) shall be used where remote signalling functions are required to be fetched to a nearby Stationary TCAS unit for example from end cabins /distributed interlockings or LC gate/IB coming within the radio coverage of station tower.



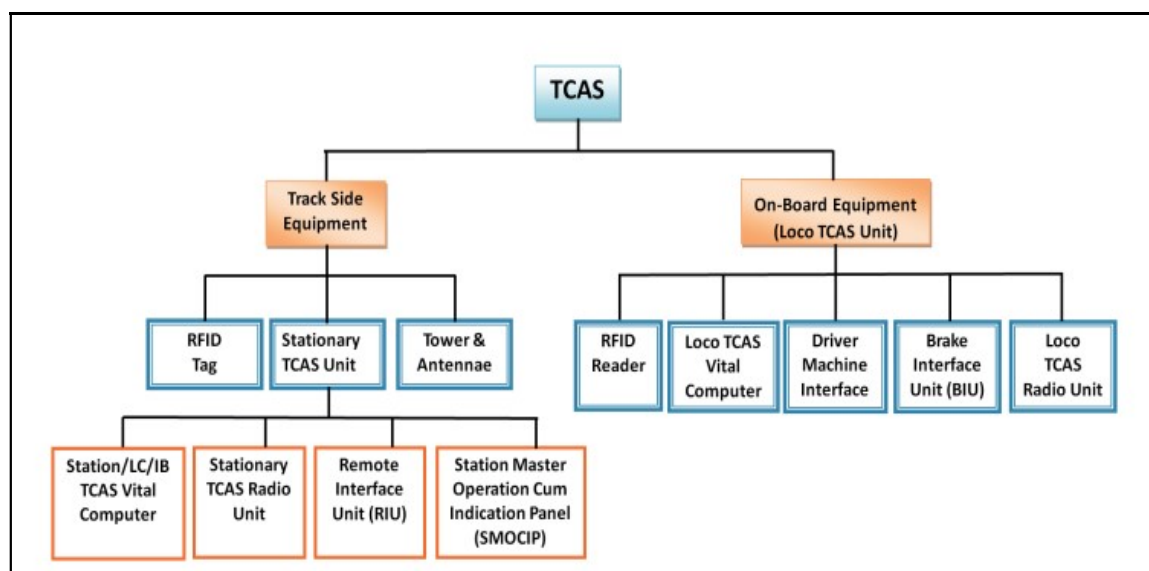
The onboard Loco TCAS unit installed in the locomotive determines the location of train by reading pre-programmed RFID Tag data with the help of RFID reader. Loco TCAS unit sets its absolute location (Approaching signal distance from the train position) and TIN as undefined (zero) before determining the direction. The direction of movement of train shall be determined, when Loco/Train has passed two RFID tags sequentially with Absolute location. Loco TCAS unit calculates the location of the train between two RFID tags dynamically based on the distance travelled from last RFID tag through speed sensing arrangement provided on Locomotive. On passing through the RFID Tag, Loco TCAS unit transmits the location and direction of the train to the Stationary TCAS unit through UHF radio antenna provided in locomotive.

The Stationary TCAS unit shall use the direction of movement of Loco/Train, to find approaching signal of the Loco/Train. Stationary TCAS unit shall then calculate the movement authority based on the signal aspect or/and track circuit status or/and route locking status, point position and the status of the berthing track circuit. Stationary TCAS unit shall then transmit the Movement Authority to the Loco TCAS in its jurisdiction in station area. The length of the movement authority is decided based on the signal aspect of the approaching Stop Signal. The Loco unit shall make speed profile/ brake curve for different situations based on movement authority, speed restriction and other information as received from Trackside sub-system. The Loco TCAS unit shall display the train speed, the permitted speed, the target distance and the target speed to the loco pilot through a Driver Machine Interface (DMI).

4.3 Components of KAVACH:

The Train Collision Avoidance system broadly comprises of following components:

(i). Trackside equipment including Stationary TCAS Unit and (ii). On-board equipment.



4.3.1 Trackside Sub-system:

(A) RFID Tag

RFID Tags provide site specific static information to Locomotive. Apart from acting as Location references, these relieve the Radio Channels and provide immediate information such as crossing the signal etc. to Loco Unit. RFID tags shall be fitted on track in station section, point zones, near Signals & track in block section for giving Trackside information to Loco TCAS unit.



The RFID tags shall be fitted on the sleepers between the rails as per guidelines given for Indian Railways. RFID tag shall be as per following specifications:

- Suitable for reliable working at train speed upto 200 KMPH (minimum).
- Frequency of operation: 865-867 MHz.
- Can be programmable with minimum 128 bits (including CRC) of user data.
- Shall be able to work even when submerged in water up to rail level.
- Under field operating conditions RFID reader antenna shall be able to read RFID tag from a vertical distance of 700 mm from bottom of RFID reader antenna to top of the rail level.

(B) Stationary TCAS Unit

Stationary TCAS Unit shall be universally suitable for various types of signalling of Indian Railways with provision of colour light signalling. By default, it shall be suitable for interfacing with Panel Interlocking and Electronic / Solid State Interlocking. Normally Stationary TCAS Unit shall be provided at Stations to cover all the trackside signals. It shall also be provided at Intermediate Block Locations (IBS) and midsection interlocked Level Crossing Gates where the radio signal coverage of station TCAS tower is not adequate.

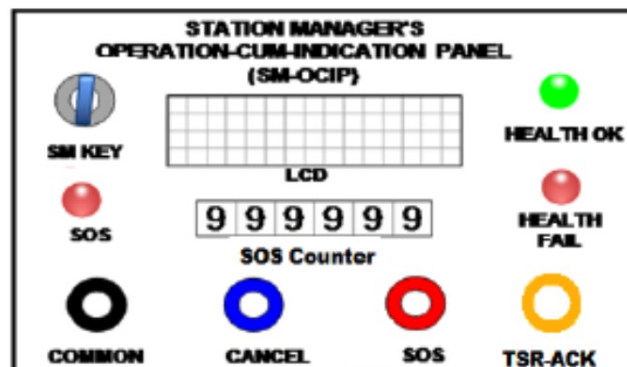


This shall be interfaced with interlocking equipment to acquire real-time dynamic information related with signalling such as various signal aspects. It has database of static signalling related information such as location & details of RFID tags and Speed Restrictions. It gets real-time information regarding Locations, Speed etc of various trains in its jurisdiction through UHF Radio Communication. On the basis of this information, it detects any emergency situation and can direct the command to Loco to take action to stop. Stationary TCAS Unit shall comprise of:

(a). Station/LC/IB TCAS Vital Computer: The Vital Computer of Station/LC/IBS TCAS Unit is a computer-based system that generates messages to be sent to the train on basis of information received from interlocking inputs and on basis of information exchanged with the Loco TCAS units.

(b). Stationary TCAS Radio Unit: Radio communication network shall be used for the bi-directional exchange of messages between Loco TCAS unit and Stationary TCAS units. Stationary TCAS Radio Unit shall have two UHF full duplex Radio modems with separate cable and antennae in hot standby mode to communicate with Loco TCAS unit.

(c). Remote Interface Unit: Remote Interface Unit (RIU) is a miniature version of STAS without radio communication unit, which captures (multiplexing) the relay information wired to it and exchanges the data with master STCAS directly without any relay interfaces. Remote Interface Unit (RIU) shall be used where remote signaling functions are required to be fetched to a nearby Stationary TCAS unit, for example from end cabin, distributed interlocking, a nearby LC Gate, Intermediate Block or Automatic Signalling section. RIU at such end cabins /distributed interlockings or LC gate/IB shall be installed if they are coming within the radio coverage of station tower. RIU is used to communicate remote signalling inputs to STCAS over OFC media.



(d). Station Master Operation cum Indication Panel (SMOCIP):

SMOCIP consists of following:

- LED Indications
- Switches
- LCD Panel
- Buzzer
- 6 digits counter which are updated on pressing of manual SOS switch
- Station Master's key.

It has the following LED Indications on the Console:

Sr. No.	LED Name	Colour	Description
1	HEALTH OK	GREEN	Indicates Station TCAS Healthy
2	HEALTH FAIL	RED	Indicates Station TCAS Un Healthy
3	SOS	RED	When SOS generated from Station

It has the following switches on the Console:



Sr. No.	LED Name	Colour	Description
1	COMMON	BLACK	Common switch to press along with SOS switch
2	CANCEL	BLUE	To cancel the SOS from station
3	SOS	RED	To generate SOS from Station

No functionality of switches is allowed without SM-KEY insertion into SM-OCIP.

(C) Tower and Antenna:

The antennae for stationary communication system at station/ IBS/ midsection interlocked Gate unit shall be combination of vertically polarized omni and/ or directional antennae.

4.3.2 On-board Sub-system (Loco TCAS Unit):

(A) Loco TCAS Vital Computer

The Loco TCAS vital computer is a system that supervises the movement of the train to which it belongs, on basis of information exchanged with Stationary TCAS units and other Loco TCAS units.

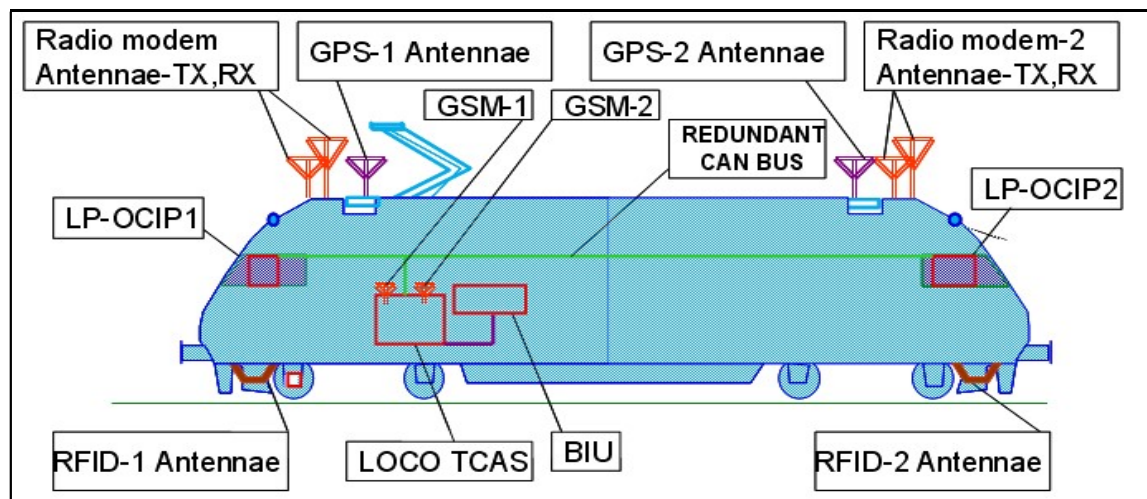
Loco TCAS vital computer shall have provision for the following:

- To interface with train interface unit & brake interface unit.
- Two Direction sensing type Speed Sensor interface for distance and speed measurement.
- To interface with RFID reader to read RFID tags fitted on the track.

- To interface with Driver Machine Interface (DMI) consisting of display arrangement buttons/ switches for operation.
- Two GSM interfaces for connectivity with centralized Network monitoring System (NMS) and Key Management System (KMS). It shall be also to be operable with LTE where LTE is provided.
- USB interface for downloading of log & other data for diagnostic purposes.

(B) Loco TCAS Radio Unit

Loco TCAS Radio Unit specifications shall be similar to Stationary TCAS Radio unit. Loco TCAS Radio Unit shall have two UHF full duplex Radio modems with separate cable and antennae in hot standby mode to communicate with Stationary TCAS unit. Loco unit Antenna shall be Omni-directional & shall have vertical polarization.



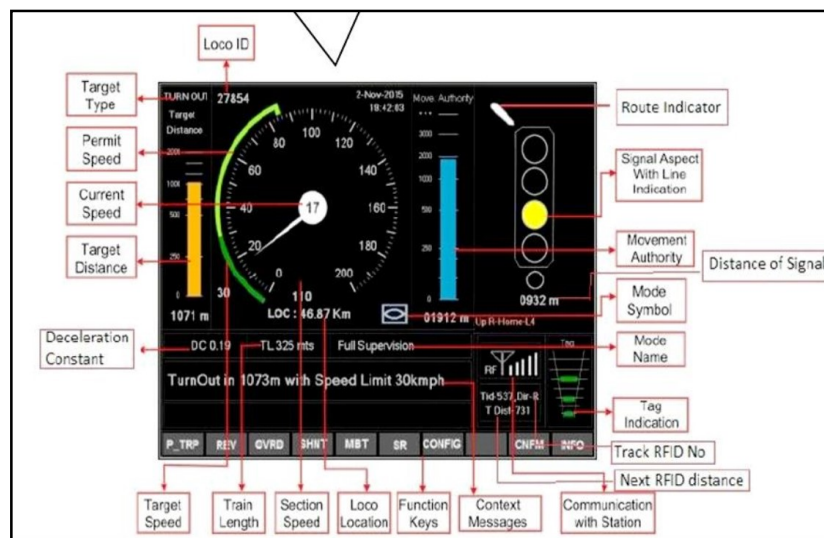
(C) RFID Reader

Each Loco TCAS unit shall have two RFID readers for getting the information from RFID tags fitted on the trackside in hot standby manner.



(D) Loco Pilot Machine Interface (DMI)

Most of the information displayed is in form of Analog Displays in form of Circular Gauges (Arcs) and bars keeping ergonomics and convenience of Loco Pilots. Digital values have also been additionally displayed. Audio prompts and warnings also are implemented.



(E) Brake Interface Unit (BIU)

BIU shall apply normal, service & emergency brakes of locomotives respectively based on the type of brake command received from Loco TCAS unit. In addition to these brakes, it shall also apply Loco brake, if Loco Brake command is generated by Loco TCAS.



BIU consists of two modules:

1. Electronic Module: It consists of a Control Card having built-in air brake control logic. Control Card interfaces with Analog Input Module, Digital Input Module & Digital Output Module to monitor and control air brake application/release.
2. Pneumatic Panel: It consists of different valves, pressure transducers and manual cocks-Interfaced with IRAB system & Electronic Module for brake control purpose.

Working of BIU:

- TCAS identifies the braking requirement.
- TCAS communicates braking signal(s) to BIU.
- BIU communicates signals to existing brake system of locomotive
- BIU communicates signal for cutting off traction of locomotive
- BIU generates audio-visual indication for Loco Pilot
- BIU gives status of execution of braking command to TCAS



DETAILS OF SPARE CONTACTS & SPACE AVAILABILITY									ANNEXURE - B		
S.N O	STATI ON/LS C/IB	POINTS NWKR _s /RWKR _s		SIGNALS ECR _s		TRACK CKT TPR _s		Space in Relay Rack	Availability of Space in Relay Room		Spare in Data Logger /RTU
		Relays with Spare Contac ts	Relays without Spare Contacts	Relays with Spare Contac ts	Relays without Spare Contacts	Relays with Spare Contac ts	Relays without Spare Contacts		For Relay Rack	For TCAS	
Pt. Deendayal Upadhyay- Manpur Section of DDU Division											
1	DDU								Yes	Yes	
2	FOC/D DU								Yes	Yes	
3	GAQ								Yes	Yes	
4									Yes	Yes	
5	CDMR								Yes	Yes	
6	SYJ								No	Yes	
7	KMS								No	Yes	
8	DCX								No	No	
9	DGO								No	No	
10	BBU								No	Yes	
11	MTGE								No	Yes	
12	PSE								No	N/A	
13	KTQ								No	No	
14	KVD								No	No	
15	SSG								No	No	
16	KMGE								No	No	
17	SSM								No	No	
18	KWD								No	No	
19	PHE								Yes	Yes	
20	DOS								Yes	Yes	
21	SEB								Yes	Yes	
22	CPBH								No	Yes	
23	AUBR								No	No	
24	PES								No	No	
25	BHKH								Yes	Yes	
26	JHN								Yes	Yes	



DETAILS OF SPARE CONTACTS & SPACE AVAILABILITY									ANNEXURE - B		
S.N O	STATION/LS C/IB	POINTS NWKR/RWKR		SIGNALS ECRs		TRACK CKT TPRs		Space in Relay Rack	Availability of Space in Relay Room		Spare in Data Logger /RTU
		Relays with Spare Contacts	Relays without Spare Contacts	Relays with Spare Contacts	Relays without Spare Contacts	Relays with Spare Contacts	Relays without Spare Contacts		For Relay Rack	For TCAS	
27	DORD								Yes	Yes	
28	RFJ								No	No	
29									No	No	
30	IMGE								No	No	
31	GRRU								No	No	
32	PRY								No	No	
33	KSTA								No	No	
34	GAYA								Yes	Yes	
35	MPO								Yes	Yes	
Manpur– Pradhankhunta Section of DHN Division											
36	BNF								No	No	
37	TKN								No	No	
38	BNSL								yes	Yes	
39	PPR								No	No	
40									No	No	
41	GAP								No	No	
42	YGM								No	No	
43	BSCR								No	Yes	
44	NGY								No	No	
45	DLW								yes	No	
46	LBZ								No	Yes	
47	GJD								No	No	
48									No	No	
49	KQR								No	Yes	
50	LRB								No	Yes	
51	HRE								No	No	
52	SMND								No	No	
53	YDD								No	No	
54	PSB								No	No	



DETAILS OF SPARE CONTACTS & SPACE AVAILABILITY									ANNEXURE - B		
S.N O	STATION/LS C/IB	POINTS NWKR/RWKR		SIGNALS ECRs		TRACK CKT TPRs		Space in Relay Rack	Availability of Space in Relay Room		Spare in Data Logger /RTU
		Relays with Spare Contacts	Relays without Spare Contacts	Relays with Spare Contacts	Relays without Spare Contacts	Relays with Spare Contacts	Relays without Spare Contacts		For Relay Rack	For TCAS	
55	DSME								No	No	
56	CBH								No	No	
57	KSHR								yes	Yes	
58	HZD								No	No	
59	GRBH								No	No	
60	CCK								No	No	
61	KRMB								No	No	
62	CBD								No	No	
63	CEME								No	No	
64	PNME								No	No	
65	NMG								No	No	
66	BLME								No	No	
67	GMO								No	No	
68									No	No	
69	MRQ								No	No	
70	NPJE								No	No	
71	TET								No	No	
72	BLI								No	No	
73	DHN								yes	Yes	
74	DOKM								No	No	
75	PKA								No	No	



POWER SUPPLY DETAILS						ANNEXURE - C
S.No	STN . /LSC	MAKE	Date Of Installation	Capacity IPS 220V (Amp)	LOAD (Amp)	DC- DC converter slots
110 V DC at each stations , IBS Location & LC Gates is available . However, IPS of 4 lines configuration having RDSO Spec. No. RDSO/SPN/215/2018 Ver 2.0 or Latest along with 200AH battery set will be required to be installed at each location, where new tower is being installed.						

DETAILS OF MAJOR BRIDGES						ANNEXXURE - D							
S. No	Block section	Br. No	Location	No. of span with span length (m)									
				Span (in M)		NS2	SP2	NS3	SP3	NS4	SP4	NS5	SP5
				Span	Mtr								
1	MPO-MGS	357/A ROB	471/21-23	5	33.53	0	0	0	0	0	0	0	0
2	MPO-MGS	372	476/19-21	4	18.29	0	0	0	0	0	0	0	0
3	MPO-MGS	383	483/25-484/11	13	18.28	0	0	0	0	0	0	0	0
4	MPO-MGS	385/A	484/29-31	40	2.44	0	0	0	0	0	0	0	0
5	MPO-MGS	389/A	485/23-486/0	72	2.44	0	0	0	0	0	0	0	0
6	MPO-MGS	391	486/07-21	13	18.28	0	0	0	0	0	0	0	0
7	MPO-MGS	444/A	508/11-13	5	3.66	0	0	0	0	0	0	0	0
8	MPO-MGS	445	508/27-29	3	18.28	0	0	0	0	0	0	0	0
9	MPO-MGS	458	517/07-11	11	6.01	0	0	0	0	0	0	0	0



DETAILS OF MAJOR BRIDGES						ANNEXXURE - D							
S. No	Block section	Br. No	Location	No. of span with span length (m)									
				Span (in M)		NS2	SP2	NS3	SP3	NS4	SP4	NS5	SP5
				Span	Mtr								
10	MPO-MGS	459	517/11-15	29	3.66	0	0	0	0	0	0	0	0
11	MPO-MGS	460	517/15-17	5	6.01	0	0	0	0	0	0	0	0
12	MPO-MGS	462	519/24-28	4	18.3	0	0	0	0	0	0	0	0
13	MPO-MGS	469	521/28-30	6	6.1	0	0	0	0	0	0	0	0
14	MPO-MGS	493	534/07-09	3	18.3	1	22.8	0	0	0	0	0	0
15	MPO-MGS	494/A	534/14-16	10	2.44	0	0	0	0	0	0	0	0
16	MPO-MGS	502/A	537/18-22	15	3.66	0	0	0	0	0	0	0	0
17	MPO-MGS	504/A	538/27-31	10	3.66	0	0	0	0	0	0	0	0
18	MPO-MGS	505	538/33 - 539/01	17	3.66	0	0	0	0	0	0	0	0
19	MPO-MGS	509	540/07-13	8	18.29	0	0	0	0	0	0	0	0
20	MPO-MGS	510/A	540/26-30	12	6.1	0	0	0	0	0	0	0	0
21	MPO-MGS	524	546/27-29	2	23.16	0	0	0	0	0	0	0	0
22	MPO-MGS	533	555/27-29	3	22.86	0	0	0	0	0	0	0	0
23	MPO-MGS	535/A	556/13-14	30	1.83	0	0	0	0	0	0	0	0
24	MPO-MGS	547	562/23-25	3	6.1	0	0	0	0	0	0	0	0
25	MPO-MGS	611	593/11-15	6	18.29	0	0	0	0	0	0	0	0
26	MPO-MGS	675	630/29-	4	8.53	0	0	0	0	0	0	0	0



DETAILS OF MAJOR BRIDGES						ANNEXXURE - D							
S. No	Block section	Br. No	Location	No. of span with span length (m)									
				Span (in M)		NS2	SP2	NS3	SP3	NS4	SP4	NS5	SP5
				Span	Mtr								
			631/1										
27	MPO-MGS	676	631/13-15	4	18.29	0	0	0	0	0	0	0	0
28	MPO-MGS	677	631/27-632/1	1	6.09	0	0	0	0	0	0	0	0
29	MPO-MGS	678	632/13-19	15	8.68	0	0	0	0	0	0	0	0
30	MPO-MGS	693	641/19-21	6	8.66	0	0	0	0	0	0	0	0
31	MPO-MGS	695	642/23-29	5	11.98	0	0	0	0	0	0	0	0
32	MPO-MGS	697	643/11-13	5	8.67	0	0	0	0	0	0	0	0
33	MPO-MGS	698	643/20-24	7	8.7	0	0	0	0	0	0	0	0
34	MPO-MGS	711/A	655/19-23	16	3.66	0	0	0	0	0	0	0	0
35	MPO-MGS	713	656/13-15	12	3.66	0	0	0	0	0	0	0	0
36	MPO-MGS	717	660/01-03	8	3.66	0	0	0	0	0	0	0	0
37	MPO-MGS	412/A ROB	672/83	2	33.52	0	0	0	0	0	0	0	0
38	MPO-MGS	EF/7	670/16-18	2	9.14	0	0	0	0	0	0	0	0
39	MPO-MGS	EF/8	670/18-20	1	9.14	0	0	0	0	0	0	0	0
40	MPO-MGS	1/AF	675/01	1	15.95	0	0	0	0	0	0	0	0
41	MPO-MGS	345/A	466/21-467/15	24	30.48	0	0	0	0	0	0	0	0



DETAILS OF MAJOR BRIDGES						ANNEXXURE - D							
S. No	Block section	Br. No	Location	No. of span with span length (m)									
				Span (in M)		NS2	SP2	NS3	SP3	NS4	SP4	NS5	SP5
				Span	Mtr								
42	MPO-MGS	345	466/22-467/16	19	30.48	0	0	0	0	0	0	0	0
43	MPO-MGS	531 UP & DN	550/06-553/12	93	30.48	0	0	0	0	0	0	0	0
44	KQR-MPO	278	409	3	17.37	0	0	0	0	0	0	0	0
45	KQR-MPO	287	412	3	17.37	0	0	0	0	0	0	0	0
46	KQR-MPO	291	413	3	17.370	0	0	0	0	0	0	0	0
47	KQR-MPO	315	421	8	9.150	0	0	0	0	0	0	0	0
48	KQR-MPO	332	428	3	6.100	0	0	0	0	0	0	0	0
49	KQR-MPO	345	434	8,2	18.3,3.66	0	0	0	0	0	0	0	0
50	KQR-MPO	416	456	2,1	9.15,12.2	0	0	0	0	0	0	0	0
51	GMO-KQR	71	301	3	9.14	0	0	0	0	0	0	0	0
52	GMO-KQR	77	304	4	6.10	0	0	0	0	0	0	0	0
53	GMO-KQR	105	314	7	7.32	0	0	0	0	0	0	0	0
54	GMO-KQR	116	321	3	6.10	0	0	0	0	0	0	0	0
55	GMO-KQR	150	339	4	6.10	0	0	0	0	0	0	0	0
56	GMO-KQR	151	340	3	5.9	0	0	0	0	0	0	0	0
57	GMO-KQR	160	348	5	18.28	0	0	0	0	0	0	0	0



DETAILS OF MAJOR BRIDGES						ANNEXXURE - D							
S. No	Block section	Br. No	Location	No. of span with span length (m)									
				Span (in M)		NS2	SP2	NS3	SP3	NS4	SP4	NS5	SP5
				Span	Mtr								
58	GMO-KQR	167	352	5	18.30	0	0	0	0	0	0	0	0
59	GMO-KQR	187	364	8	18.29	0	0	0	0	0	0	0	0
60	GMO-KQR	202	374	5	18.29	0	0	0	0	0	0	0	0
61	DHN-GMO	34A	280	1	19.4	0	0	0	0	0	0	0	0
62	DHN-GMO	39	284	6	8.94	0	0	0	0	0	0	0	0

MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS1	SP1
1	MPO-MGS	335	462/19-21	2	0.61
2	MPO-MGS	336	462/19-21	2	0.61
3	MPO-MGS	337	463/09-11	2	0.61
4	MPO-MGS	338	463/39-41	1	0.91
5	MPO-MGS	339	464/27-29	1	3.66
6	MPO-MGS	340	465/05-07	1	0.91
7	MPO-MGS	341	466/01-03	1	6.096
8	MPO-MGS	342	466/01-03	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
9	MPO-MGS	343/A	466/13-15	1	9.14
10	MPO-MGS	343	466/14-16	1	9.14
11	MPO-MGS	344/A	466/19-21	1	6.096
12	MPO-MGS	344	466/20-22	1	6.096
13	MPO-MGS	346	467/19-21	1	1.83
14	MPO-MGS	346/A	467/19-21	1	1.83
15	MPO-MGS	347	467/31-33	1	1.83
16	MPO-MGS	347/A	467/31-33	1	1.83
17	MPO-MGS	348	468/13-15	1	1.83
18	MPO-MGS	349	468/13-15	1	0.61
19	MPO-MGS	350	468/35-37	1	1.83
20	MPO-MGS	350/A	468/43-45	1	1.83
21	MPO-MGS	351	470/03-05	1	1.22
22	MPO-MGS	351/A	470/03-05	1	1.22
23	MPO-MGS	352	470/05-07	1	0.91
24	MPO-MGS	352/A	470/05-07	1	1.22
25	MPO-MGS	353	470/07-09	1	0.61
26	MPO-MGS	354	470/31-33	1	1.83
27	MPO-MGS	355	471/09-11	1	0.91
28	MPO-MGS	356	471/15-17	1	0.91
29	MPO-MGS	357	471/17-19	1	0.91
30	MPO-MGS	358	471/21-23	1	1.83
31	MPO-MGS	359	472/07-09	1	0.91



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
32	MPO-MGS	360	472/13-15	1	0.61
33	MPO-MGS	361	473/17-19	1	0.61
34	MPO-MGS	362	473/01-03	1	0.61
35	MPO-MGS	363	473/05-07	1	0.91
36	MPO-MGS	364	473/11-13	1	0.61
37	MPO-MGS	365	474/09-11	1	0.61
38	MPO-MGS	366	474/27-29	1	1.83
39	MPO-MGS	367	475/05-07	1	3.66
40	MPO-MGS	368	475/07-09	1	3.66
41	MPO-MGS	369	475/11-13	1	0.91
42	MPO-MGS	370	476/05-07	1	0.91
43	MPO-MGS	371	476/05-07	1	0.91
44	MPO-MGS	373	477/00-01	1	3.66
45	MPO-MGS	374	477/17-19	1	1.83
46	MPO-MGS	375	478/29-31	1	0.61
47	MPO-MGS	376	478/31-	1	1.83
48	MPO-MGS	377	479/23-25	1	0.91
49	MPO-MGS	378	480/03-05	1	6.01
50	MPO-MGS	379	480/15-17	1	0.91
51	MPO-MGS	380	480/23-25	1	0.91
52	MPO-MGS	381	483/05-07	1	0.91
53	MPO-MGS	382	483/23-25	1	6.01
54	MPO-MGS	384	484/11-13	1	3.66



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
55	MPO-MGS	385	484/21-23	1	1.83
56	MPO-MGS	386	484/29-31	1	0.91
57	MPO-MGS	387	485/03-05	1	3
58	MPO-MGS	388	485/12-14	1	1.83
59	MPO-MGS	389	485/21-23	1	1.83
60	MPO-MGS	390	486/01-03	1	0.91
61	MPO-MGS	392	486/21-23	1	3.66
62	MPO-MGS	393	486/29-31	1	3.66
63	MPO-MGS	394	487/12-14	1	3.66
64	MPO-MGS	395	488/09-11	1	0.61
65	MPO-MGS	395/A	488/17-19	3	4.57
66	MPO-MGS	396	489/08-10	1	0.61
67	MPO-MGS	397	489/20-22	1	0.91
68	MPO-MGS	398	490/01-03	1	0.91
69	MPO-MGS	399	490/18-20	1	1.83
70	MPO-MGS	400	490/30-32	1	0.61
71	MPO-MGS	401	491/05-07	1	0.61
72	MPO-MGS	402	491/19-21	1	x0.61
73	MPO-MGS	402/A	491/19-21	1	1.83
74	MPO-MGS	403	491/27-29	1	1.83
75	MPO-MGS	404	492/11-13	1	3.66
76	MPO-MGS	405	492/13-15	1	1.83
77	MPO-MGS	406	492/27-	2	9.14



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
78	MPO-MGS	407	493/11-13	1	1.83
79	MPO-MGS	408	493/17-19	1	0.91
80	MPO-MGS	409	494/09-11	1	0.91
81	MPO-MGS	410	494/09-11	1	3.66
82	MPO-MGS	411	494/09-11	1	0.91
83	MPO-MGS	412	494/17-19	1	0.61
84	MPO-MGS	413	494/23-27	1	0.61
85	MPO-MGS	414	495/09-11	1	0.61
86	MPO-MGS	415	495/25-27	1	0.91
87	MPO-MGS	416	495/27-	1	0.61
88	MPO-MGS	417	497/01-03	1	0.91
89	MPO-MGS	418	497/7-9	1	0.61
90	MPO-MGS	419	497/17-19	1	0.61
91	MPO-MGS	420	498/27-29	1	1.83
92	MPO-MGS	421	499/11-13	2	1.83
93	MPO-MGS	422	499/17-19	1	0.61
94	MPO-MGS	423	500/01-03	1	0.61
95	MPO-MGS	424	500/09-11	1	0.61
96	MPO-MGS	425	501/03-05	1	0.91
97	MPO-MGS	426	501/13-15	1	0.91
98	MPO-MGS	427	502/05-07	1	0.91
99	MPO-MGS	428	502/11-13	1	0.91
100	MPO-MGS	429	509/19-21	1	0.91



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
101	MPO-MGS	430	503/01-03	1	1.83
102	MPO-MGS	431	503/21-23	1	0.61
103	MPO-MGS	432	504/03-05	1	0.61
104	MPO-MGS	433	504/05-07	1	0.61
105	MPO-MGS	434	504/17-19	1	0.61
106	MPO-MGS	435	504/27-	1	0.61
107	MPO-MGS	436	505/08-10	1	0.91
108	MPO-MGS	437	505/15-17	1	0.61
109	MPO-MGS	437/A	505/29-	2	3.048
110	MPO-MGS	438	506/03-05	2	0.61
111	MPO-MGS	439	506/09-11	1	0.61
112	MPO-MGS	440	506/21-23	2	0.61
113	MPO-MGS	441	506/23-25	2	0.61
114	MPO-MGS	442	507/17-19	1	1.83
115	MPO-MGS	443	508/02-04	1	3.66
116	MPO-MGS	444	508/07-09	1	3.66
117	MPO-MGS	446	510/13-15	1	0.61
118	MPO-MGS	447	510/25-27	1	0.61
119	MPO-MGS	448	511/09-11	1	3.66
120	MPO-MGS	449	511/19-21	1	1.83
121	MPO-MGS	450	511/25-27	1	0.91
122	MPO-MGS	451	512/17-19	2	0.61
123	MPO-MGS	452	513/07-09	2	0.91



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
124	MPO-MGS	453	513/23-25	1	3.66
125	MPO-MGS	454	515/21-23	1	1.83
126	MPO-MGS	455	516/05-07	1	1.83
127	MPO-MGS	456	516/07-09	1	1.83
128	MPO-MGS	457	516/17-19	2	3.66
129	MPO-MGS	461	518/30-32	1	0.61
130	MPO-MGS	463	520/10-12	1	1.83
131	MPO-MGS	464	520/16-18	1	3.66
132	MPO-MGS	465	520/23-25	1	1.83
133	MPO-MGS	466	521/07-09	1	0.61
134	MPO-MGS	467	521/11-13	1	1.83
135	MPO-MGS	468	521/22-24	1	1.83
136	MPO-MGS	470	522/10-12	1	1.83
137	MPO-MGS	471	522/26-	1	1.83
138	MPO-MGS	472	523/18-20	1	0.91
139	MPO-MGS	473	532/26-28	1	0.61
140	MPO-MGS	474	524/04-06	1	0.61
141	MPO-MGS	475	524/07-09	1	6.1
142	MPO-MGS	476	524/15-17	1	0.91
143	MPO-MGS	477	525/03-05	1	0.61
144	MPO-MGS	478	525/07-09	1	3.66
145	MPO-MGS	479	525/17-19	1	0.61
146	MPO-MGS	480	525/23-25	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
147	MPO-MGS	481	526/09-11	1	1.83
148	MPO-MGS	482	526/21-23	1	3.66
149	MPO-MGS	483	527/03-05	1	0.91
150	MPO-MGS	483/A	527/17-19	1	3.66
151	MPO-MGS	484	528/01-03	1	1.83
152	MPO-MGS	485	528/27-29	1	0.91
153	MPO-MGS	486	529/21-23	1	0.305
154	MPO-MGS	486/A	529/24-26	1	0.91
155	MPO-MGS	488	531/02-04	1	0.91
156	MPO-MGS	490	532/20-22	1	1.83
157	MPO-MGS	491	533/08-10	1	3.66
158	MPO-MGS	492	533/22-24	1	1.83
159	MPO-MGS	494	534/12-14	1	3.66
160	MPO-MGS	495	534/14-16	1	1.83
161	MPO-MGS	496	534/24-26	1	1.83
162	MPO-MGS	497	535/08-10	1	0.61
163	MPO-MGS	498	535/18-20	1	x0.91
164	MPO-MGS	499	536/08-10	1	0.61
165	MPO-MGS	500	536/12-14	1	0.61
166	MPO-MGS	501	536/22-24	1	1.83
167	MPO-MGS	502	537/10-12	1	3.66
168	MPO-MGS	503	537/26-28	1	0.91
169	MPO-MGS	504	538/05-07	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
170	MPO-MGS	506	539/02-04	1	0.61
171	MPO-MGS	507	539/10-12	1	0.61
172	MPO-MGS	508	539/20-22	1	1.83
173	MPO-MGS	510	540/16-18	1	9.14
174	MPO-MGS	511	541/06-08	1	6.1
175	MPO-MGS	512	541/16-18	1	3.66
176	MPO-MGS	513	541/28-	1	6.1
177	MPO-MGS	514	542/08-10	1	0.61
178	MPO-MGS	515	542/14-16	1	0.61
179	MPO-MGS	516	542/24-26	1	0.61
180	MPO-MGS	517	543/01-03	1	0.61
181	MPO-MGS	518	543/18-20	1	1.83
182	MPO-MGS	519	544/14-16	1	3.66
183	MPO-MGS	520	544/24-26	1	8.74
184	MPO-MGS	521	545/05-07	1	1.83
185	MPO-MGS	522	546/06-08	1	3.66
186	MPO-MGS	523	546/27-29	1	4.5
187	MPO-MGS	525	547/05-07	1	3.66
188	MPO-MGS	526	547/11-13	1	1.83
189	MPO-MGS	527	547/19-21	1	1.83
190	MPO-MGS	528	547/28-	1	1.83
191	MPO-MGS	529	548/21-23	1	3.66
192	MPO-MGS	530	549/27-28	1	3.66



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
193	MPO-MGS	531/A	555/07-09	3	4.57
194	MPO-MGS	534	556/01-03	1	3.66
195	MPO-MGS	535	556/07-09	3	0.91
196	MPO-MGS	536	557/01-03	3	0.61
197	MPO-MGS	536/A	557/03-04	4	3.048
198	MPO-MGS	537	557/11-13	1	0.61
199	MPO-MGS	538	557/15-17	1	0.61
200	MPO-MGS	539	557/23-25	2	0.91
201	MPO-MGS	540	558/03-05	1	0.61
202	MPO-MGS	541	558/25-27	1	0.61
203	MPO-MGS	542	559/21-23	1	1.83
204	MPO-MGS	543	560/05-07	1	1.83
205	MPO-MGS	544	560/23-25	1	3.66
206	MPO-MGS	545	561/03-05	1	1.83
207	MPO-MGS	546	561/23-25	1	0.61
208	MPO-MGS	548	564/03-05	1	9.05
209	MPO-MGS	549	564/17-19	2	0.91
210	MPO-MGS	550	564/21-23	1	1.83
211	MPO-MGS	551	564/23-25	1	1.83
212	MPO-MGS	552	565/23-25	1	0.61
213	MPO-MGS	553	566/01-03	1	0.61
214	MPO-MGS	554	566/05-07	1	0.61
215	MPO-MGS	555	566/15-17	1	0.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
216	MPO-MGS	556	566/19-21	1	0.61
217	MPO-MGS	557	566/25-27	1	3.66
218	MPO-MGS	558	567/23-25	1	0.61
219	MPO-MGS	559	568/01-03	1	0.61
220	MPO-MGS	560	569/17-19	1	0.61
221	MPO-MGS	561	571/01-03	5	1.83
222	MPO-MGS	562	571/18-20	1	1.83
223	MPO-MGS	563	571/26-28	1	1.83
224	MPO-MGS	564	571/31-33	1	0.91
225	MPO-MGS	565	572/13-15	1	0.91
226	MPO-MGS	566	572/27-	1	3.66
227	MPO-MGS	567	574/17-19	1	0.91
228	MPO-MGS	568	575/05-07	1	0.91
229	MPO-MGS	568/A	575/10-12	1	3.05
230	MPO-MGS	569	575/15-17	1	0.91
231	MPO-MGS	570	575/21-23	1	0.91
232	MPO-MGS	571	576/05-06	1	3.66
233	MPO-MGS	572	576/11-13	1	1.83
234	MPO-MGS	573	576/15-17	1	1.83
235	MPO-MGS	574	576/21-23	1	3.66
236	MPO-MGS	575	577/01-03	1	3.66
237	MPO-MGS	576	577/13-15	1	0.61
238	MPO-MGS	577	577/25-27	1	0.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
239	MPO-MGS	578	578/09-11	1	0.91
240	MPO-MGS	579	578/17-19	1	0.61
241	MPO-MGS	580	578/27-	1	1.83
242	MPO-MGS	581	579/09-11	1	0.61
243	MPO-MGS	582	579/17-19	1	0.61
244	MPO-MGS	583	581/01-03	1	3.66
245	MPO-MGS	584	581/05-07	1	0.91
246	MPO-MGS	585	581/11-13	1	0.61
247	MPO-MGS	586	582/07-09	1	0.61
248	MPO-MGS	587	582/25-27	1	0.61
249	MPO-MGS	588	583/05-07	1	0.91
250	MPO-MGS	589	583/21-23	1	3.66
251	MPO-MGS	590	584/13-15	1	0.61
252	MPO-MGS	591	585/03-05	1	1.83
253	MPO-MGS	592	586/00-01	1	0.91
254	MPO-MGS	593	586/21-23	1	1.83
255	MPO-MGS	594	587/09-11	1	0.91
256	MPO-MGS	595	587/15-17	1	0.91
257	MPO-MGS	596	587/29-	1	1.83
258	MPO-MGS	597	588/15-17	1	0.61
259	MPO-MGS	598	588/25-27	1	0.61
260	MPO-MGS	599	589/05-07	1	0.61
261	MPO-MGS	600	589/09-11	1	0.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
262	MPO-MGS	601	589/15-17	1	1.73
263	MPO-MGS	602	589/21-23	1	0.61
264	MPO-MGS	603	589/25-27	1	1.71
265	MPO-MGS	604	591/03-05	1	0.91
266	MPO-MGS	605	591/21-23	1	0.91
267	MPO-MGS	606	592/05-07	1	3.66
268	MPO-MGS	607	592/13-15	1	0.91
269	MPO-MGS	608	592/21-23	1	1.83
270	MPO-MGS	609	593/01-03	1	1.83
271	MPO-MGS	610	593/07-09	1	3.66
272	MPO-MGS	612	594/05-07	1	1.83
273	MPO-MGS	613	595/15-17	1	0.91
274	MPO-MGS	614	596/03-05	1	3.66
275	MPO-MGS	615	596/21-23	1	0.61
276	MPO-MGS	615/A	596/23-25	2	6.09
277	MPO-MGS	616	597/11-13	1	1.83
278	MPO-MGS	617	598/07-09	1	1.83
279	MPO-MGS	618	598/17-19	1	0.91
280	MPO-MGS	619	599/05-07	1	0.91
281	MPO-MGS	620	599/15-17	1	1.83
282	MPO-MGS	621	599/27-29	1	0.91
283	MPO-MGS	622	601/09-11	1	0.91
284	MPO-MGS	623	602/21-23	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
285	MPO-MGS	624	603/11-13	1	0.61
286	MPO-MGS	625	603/15-17	1	0.61
287	MPO-MGS	626	603/25-27	1	0.61
288	MPO-MGS	627	604/07-09	1	0.91
289	MPO-MGS	628	604/15-17	1	3.66
290	MPO-MGS	629	605/09-11	1	6.09
291	MPO-MGS	630	606/13-15	2	0.91
292	MPO-MGS	631	607/13-15	1	3.42
293	MPO-MGS	632	607/26-28	1	0.61
294	MPO-MGS	633	608/01-03	1	x3.66
295	MPO-MGS	634	608/19-21	1	1.83
296	MPO-MGS	635	609/01-03	1	1.83
297	MPO-MGS	636	609/09-11	1	1.83
298	MPO-MGS	637	610/03-05	1	3.53
299	MPO-MGS	638	610/20-22	1	x0.91
300	MPO-MGS	639	610/27-	1	3.52
301	MPO-MGS	640	611/15-17	1	1.72
302	MPO-MGS	641	612/03-05	1	3.57
303	MPO-MGS	642	612/11-13	1	1.83
304	MPO-MGS	643	613/05-07	2	6.09
305	MPO-MGS	643/A	613/23-25	2	6.09
306	MPO-MGS	644	614/09-11	1	6.09
307	MPO-MGS	645	614/17-19	1	0.91



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
308	MPO-MGS	646	614/29-	1	0.91
309	MPO-MGS	647	615/15-17	2	6.09
310	MPO-MGS	648	615/29-	1	1.83
311	MPO-MGS	649	616/13-15	1	1.83
312	MPO-MGS	650	616/25-	1	1.83
313	MPO-MGS	651	617/05-07	2	0.91
314	MPO-MGS	652	617/13-15	1	3.66
315	MPO-MGS	653	618/05-07	1	1.83
316	MPO-MGS	654	619/01-03	1	0.91
317	MPO-MGS	655	620/04-06	1	0.91
318	MPO-MGS	656	620/13-15	1	0.61
319	MPO-MGS	657	620/23-25	1	0.91
320	MPO-MGS	658	621/03-05	1	0.91
321	MPO-MGS	659	621/11-13	1	0.91
322	MPO-MGS	660	621/27-29	1	0.61
323	MPO-MGS	661	622/11-13	1	0.91
324	MPO-MGS	662	623/05-07	1	x0.61
325	MPO-MGS	663	623/21-23	1	0.91
326	MPO-MGS	664	624/09-11	1	0.61
327	MPO-MGS	665	625/01-03	1	1.83
328	MPO-MGS	666	625/13-15	5	2.1
329	MPO-MGS	667	625/21-23	1	1.83
330	MPO-MGS	668	626/07-09	5	5x2.1



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
331	MPO-MGS	669	627/07-09	1	1.83
332	MPO-MGS	670	627/25-27	1	0.91
333	MPO-MGS	671	628/19-21	1	0.61
334	MPO-MGS	672	629/17-19	1	0.61
335	MPO-MGS	672/A	629/27-29	3	x6.09
336	MPO-MGS	673	630/07-09	1	1.52
337	MPO-MGS	674	630/17-19	1	6.09
338	MPO-MGS	679	633/25-27	2	6.09
339	MPO-MGS	680	634/17-19	2	6.09
340	MPO-MGS	681	634/27-	1	1.83
341	MPO-MGS	682	635/07-09	1	6.09
342	MPO-MGS	683	635/13-15	1	3.51
343	MPO-MGS	684	636/01-03	1	0.91
344	MPO-MGS	685	636/07-09	1	3.51
345	MPO-MGS	686	636/19-21	1	0.91
346	MPO-MGS	687	637/05-07	1	0.61
347	MPO-MGS	688	638/01-03	1	0.61
348	MPO-MGS	689	638/07-09	1	0.91
349	MPO-MGS	690	638/21-23	1	0.61
350	MPO-MGS	691	638/21-23	1	3
351	MPO-MGS	692	639/25-27	1	3.55
352	MPO-MGS	692/A	641/11-13	1	3.66
353	MPO-MGS	694	642/13-15	2	8.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
354	MPO-MGS	696	643/03-05	1	3.53
355	MPO-MGS	699	645/19-21	1	3.5
356	MPO-MGS	700	646/09-11	1	6.01
357	MPO-MGS	701	646/19-21	1	3.58
358	MPO-MGS	702	647/03-05	1	1.77
359	MPO-MGS	703	647/21-23	1	0.61
360	MPO-MGS	704	647/25-27	1	0.91
361	MPO-MGS	705	647/29-	1	0.61
362	MPO-MGS	706	648/11-13	1	0.91
363	MPO-MGS	707	649/13-15	1	0.61
364	MPO-MGS	708	649/25-27	1	3.66
365	MPO-MGS	709	651/25-27	1	1.83
366	MPO-MGS	709/A	652/07-09	1	1.83
367	MPO-MGS	710	652/25-27	1	1.83
368	MPO-MGS	711	655/03-05	1	3.66
369	MPO-MGS	712	655/23-25	3	3.66
370	MPO-MGS	712/A	656/03-05	4	3.66
371	MPO-MGS	712/B	656/07-09	4	3.66
372	MPO-MGS	714	656/25-27	1	1.83
373	MPO-MGS	715	657/21-23	1	0.61
374	MPO-MGS	716	659/13-15	1	x0.61
375	MPO-MGS	718	660/07-09	4	3.66
376	MPO-MGS	719	660/21-23	1	0.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
377	MPO-MGS	720	661/05-07	1	1.98
378	MPO-MGS	720/A	661/19-21	1	1.98
379	MPO-MGS	721	662/13-15	1	0.61
380	MPO-MGS	722	662/23-25	1	1.86
381	MPO-MGS	723	663/07-09	1	0.91
382	MPO-MGS	724	663/11-13	1	0.61
383	MPO-MGS	725	664/09-11	1	0.61
384	MPO-MGS	726	664/19-21	1	1.85
385	MPO-MGS	727	665/17-19	1	1.87
386	MPO-MGS	728	666/11-13	1	1.84
387	MPO-MGS	729	666/27-29	1	1.83
388	MPO-MGS	730	667/15-17	1	0.61
389	MPO-MGS	731	667/23-25	1	1.83
390	MPO-MGS	732	667/31-33	1	1.2
391	MPO-MGS	733	667/33-35	1	1.83
392	MPO-MGS	734	668/16-18	1	0.61
393	MPO-MGS	735	668/26-28	1	0.61
394	MPO-MGS	736	669/00-01	1	0.61
395	MPO-MGS	737	669/03-05	1	1.83
396	MPO-MGS	738	669/10-12	1	0.61
397	MPO-MGS	738/A	669/17-19	2	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
398	MPO-MGS	739	669/30-32	1	0.23
399	MPO-MGS	740	670/06-08	1	1.22
400	MPO-MGS	EF/1	668/20-22	1	0.45
401	MPO-MGS	EF/2	668/28-30	1	1.2
402	MPO-MGS	EF/3	668/34-36	1	0.4
403	MPO-MGS	EF/4	669/14-16	1	4.49
404	MPO-MGS	EF/5	669/30-32	1	4.53
405	MPO-MGS	EF/6	670/06-08	1	7.58
406	MPO-MGS	EF/9	670/24-26	1	x3.55
407	MPO-MGS	EF/10	671/16-18	1	3.55
408	MPO-MGS	EF/11	671/3234	1	x3.52
409	MPO-MGS	EF/12	672/18-20	1	3.58
410	MPO-MGS	EF/13	672/40-42	1	1.83
411	MPO-MGS	1/A	757/03-04	1	0.61
412	MPO-MGS	1/B	759/08-09	1	0.61
413	MPO-MGS	1/C	758/04-05	1	0.61
414	MPO-MGS	MD/1	749/66	1	1.22
415	MPO-MGS	MD/2	749/97	1	1.22
416	MPO-MGS	1/AL	674/35	1	0.53
417	MPO-MGS	2/AL	674/46	1	0.53
418	MPO-MGS	3/AL	674/51	1	0.61
419	MPO-MGS	4/AL	675/14	1	0.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
420	MPO-MGS	5/AL	675/73	1	0.61
421	MPO-MGS	6/AL	675/80	1	0.53
422	MPO-MGS	7/AL	675/85	1	0.61
423	MPO-MGS	2	758/08-09	1	0.91
424	MPO-MGS	3	759/02-03	1	2.47
425	MPO-MGS	4	759/12-13	1	1.83
426	MPO-MGS	2/AF	675/33	1	x4.57
427	MPO-MGS	3/AF	675/66	1	4.57
428	MPO-MGS	4/AF	676/33	1	1.22
429	MPO-MGS	1/LD	756/11-12	1	1.83
430	MPO-MGS	2/LD	757/02-03	1	1.22
431	MPO-MGS	3/LD	757/18	1	1.22
432	MPO-MGS	4/LD	757/31	1	0.61
433	MPO-MGS	5/LD	757/65	1	3
434	MPO-MGS	6/LD	758/28	4	3
435	MPO-MGS	7/LD	758/70	1	2.43
436	MPO-MGS	8/LD	759/15	1	2.43
437	MPO-MGS	533	555.77	1,2	25.416, 24.166
438	MPO-MGS	535A	556.536	2,13	5.435, 5.44
439	MPO-MGS	611	593.425	6	18.30
440	MPO-MGS	693	641.608	6	8.60



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
441	MPO-MGS	694	642.58	1	18.30
442	MPO-MGS	695	642.989	5	30.50
443	MPO-MGS	697	643.487	4	8.60
444	MPO-MGS	698	643.778	7	8.60
445	MPO-MGS	709A	652.36	2,2	4.936, 5.226
446	MPO-MGS	711A	655.3	14, 2	4.385, 4.02
447	MPO-MGS	713	656.44	2,10	3.50, 4.26
448	MPO-MGS	717	660.02	2,6	3.645, 4.36
449	MPO-MGS	531A	555.625	1,1,1	x3.785, 4.648, 3.720
450	MPO-MGS	534	556.06	1	3.52
451	MPO-MGS	535	556.299	1	4.3
452	MPO-MGS	536	557.059	1	1.77
453	MPO-MGS	536A	557.145	4,2	3.05, 5.95
454	MPO-MGS	537	557.41	1	1.00
455	MPO-MGS	538	557.533	1	1.00
456	MPO-MGS	539	557.828	1	2.60
457	MPO-MGS	540	558.142	1	1.00
458	MPO-MGS	541	558.876	1	1.00
459	MPO-MGS	552	565.71	2	0.610
460	MPO-MGS	553	566.05	1	1.00
461	MPO-MGS	554	566.19	1	1.830
462	MPO-MGS	555	566.59	1	1.00



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
463	MPO-MGS	556	566.7	1	1.00
464	MPO-MGS	557	566.91	1	3.66
465	MPO-MGS	558	567.84	1	1.87
466	MPO-MGS	559	568.08	1	1.00
467	MPO-MGS	560	569.65	1	1.00
468	MPO-MGS	561	570.98	1,1	7.005, 4.485
469	MPO-MGS	562	571.57	1	1.730
470	MPO-MGS	563	571.87	1	1.760
471	MPO-MGS	583	581.0309	1	3.64
472	MPO-MGS	584	581.242	1	1.00
473	MPO-MGS	585	581.3837	1	1.00
474	MPO-MGS	586	582.278	1	1.00
475	MPO-MGS	587	582.9257	1	1.00
476	MPO-MGS	588	583.2125	1	2.590
477	MPO-MGS	589	583.797	1	3.500
478	MPO-MGS	590	584.4886	1	1.00
479	MPO-MGS	591	585.0806	1	1.760
480	MPO-MGS	592	586.0085	1	2.62
481	MPO-MGS	593	586.644	1	1.830
482	MPO-MGS	594	587.288	1	2.60
483	MPO-MGS	595	587.517	1	1.00
484	MPO-MGS	596	587.98	1	1.80



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
485	MPO-MGS	597	588.548	1	1.00
486	MPO-MGS	598	588.948	1	x1.00
487	MPO-MGS	599	589.22	1	1.00
488	MPO-MGS	600	589.385	1	1.00
489	MPO-MGS	601	589.588	1	1.70
490	MPO-MGS	602	589.783	1	1.00
491	MPO-MGS	603	589.956	1	1.74
492	MPO-MGS	604	591.149	1	1.00
493	MPO-MGS	605	591.819	1	1.00
494	MPO-MGS	606	592.193	1	3.43
495	MPO-MGS	607	592.466	1	1.00
496	MPO-MGS	608	592.769	1	1.84
497	MPO-MGS	609	593.05	1	1.88
498	MPO-MGS	610	593.26	1	3.46
499	MPO-MGS	612	594.157	1	1.830
500	MPO-MGS	613	595.509	1	2.62
501	MPO-MGS	613 A	595.905	1,1	3.05, 3.74
502	MPO-MGS	614	596.119	1	3.54
503	MPO-MGS	615	596.731	1	1.00
504	MPO-MGS	615 A	596.802	2	6.10
505	MPO-MGS	616	597.392	1	1.830
506	MPO-MGS	617	595.158	1	1.810
507	MPO-MGS	618	598.466	1,1	1.00, 0.915



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
508	MPO-MGS	619	599.096	1	1.00
509	MPO-MGS	620	599.5695	1	1.83
510	MPO-MGS	621	599.968	1	1.00
511	MPO-MGS	622	601.357	1	1.00
512	MPO-MGS	623	602.795	1	1.80
513	MPO-MGS	624	603.363	1	1.00
514	MPO-MGS	625	603.5416	1	1.00
515	MPO-MGS	626	603.3715	1	1.00
516	MPO-MGS	627	604.2692	1	2.660
517	MPO-MGS	628	604.535	1	3.570
518	MPO-MGS	629	605.313	1	6.10
519	MPO-MGS	630	606.4465	1	3.05
520	MPO-MGS	631	607.457	1, 1	3.62, 3.62
521	MPO-MGS	632	607.807	1	1.00
522	MPO-MGS	644	608.057	1	3.53
523	MPO-MGS	634	608.75	1	1.77
524	MPO-MGS	635	609.108	1	1.80
525	MPO-MGS	636	609.343	1	1.730
526	MPO-MGS	637	610.157	1	3.57
527	MPO-MGS	638	610.738	1	1.00
528	MPO-MGS	639	610.989	1	3.52
529	MPO-MGS	640	611.592	1	1.70
530	MPO-MGS	641	612.129	1	3.56



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
531	MPO-MGS	642	612.472	1	4.473
532	MPO-MGS	643	613.243	5	2.129
533	MPO-MGS	643 A	613.857	5	2.129
534	MPO-MGS	644	614.301	1	5.73
535	MPO-MGS	645	614.608	1	0.900
536	MPO-MGS	646	614.994	1, 1	0.90, 1.00
537	MPO-MGS	647	615.57	2	6.035
538	MPO-MGS	648	616.071	1	1.730
539	MPO-MGS	649	616.584	1	1.750
540	MPO-MGS	650	617.009	1	1.750
541	MPO-MGS	651	617.202	1	2.650
542	MPO-MGS	652	618.476	1	3.585
543	MPO-MGS	653	618.238	1	1.830
544	MPO-MGS	654	619.109	1	2.660
545	MPO-MGS	655	620.157	1	0.915
546	MPO-MGS	656	620.426	1	1.00
547	MPO-MGS	657	620.717	1	0.915
548	MPO-MGS	658	621.157	1	1.00
549	MPO-MGS	659	621.443	1	1.00
550	MPO-MGS	660	621.924	5	2.192
551	MPO-MGS	661	622.483	1	1.00
552	MPO-MGS	662	623.235	4,1	2.15, 2.40



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
553	MPO-MGS	663	623.855	1	1.00
554	MPO-MGS	664	624.421	4, 1	2.145, 2.29
555	MPO-MGS	665	625.097	1	1.75
556	MPO-MGS	666	625.55	2, 1,2	2.25, 2.40, 2.05
557	MPO-MGS	667	625.862	1	1.80
558	MPO-MGS	668	626.358	4,1	2.135, 2.0
559	MPO-MGS	669	627.38	1	1.820
560	MPO-MGS	670	628.019	1	1.00
561	MPO-MGS	671	628.699	4, 1	2.18, 2.26
562	MPO-MGS	692A	641.333	1,1	3.62, 4.59
563	MPO-MGS	696	643.231	40	6.10
564	MPO-MGS	699	645.863	1	3.60
565	MPO-MGS	700	646.451	1	6.00
566	MPO-MGS	701	646.802	1	3.61
567	MPO-MGS	702	647.228	1	2.10
568	MPO-MGS	703	647.834	1	1.00
569	MPO-MGS	704	647.976	1	2.60
570	MPO-MGS	705	648.158	1	1.00
571	MPO-MGS	706	648.986	1	1.00
572	MPO-MGS	707	649.47	1	1.00
573	MPO-MGS	708	649.89	1	3.660



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
574	MPO-MGS	709	651.94	1	1.830
575	MPO-MGS	710	653.02	1	1.84
576	MPO-MGS	711	655.17	1	3.66
577	MPO-MGS	712	655.83	2,1	3.82, 3.99
578	MPO-MGS	712A	656.09	2,2	3.604, 3.598
579	MPO-MGS	712B	656.36	4	3.74
580	MPO-MGS	714	656.84	1	1.85
581	MPO-MGS	716	659.53	1	1.00
582	MPO-MGS	718	660.28	1	3.66
583	MPO-MGS	719	660.77	1	1.00
584	MPO-MGS	720	661.2	1	1.83
585	MPO-MGS	720A	661.69	1	1.91
586	MPO-MGS	721	662.59	1	1.00
587	MPO-MGS	722	662.95	1	1.83
588	MPO-MGS	723	663.35	1	1.00
589	MPO-MGS	724	663.5	1	1.00
590	MPO-MGS	725	664.39	1	1.00
591	MPO-MGS	726	664.69	1	1.85
592	MPO-MGS	727	665.64	1	1.80
593	MPO-MGS	728	666.37	1	1.83
594	MPO-MGS	729	666.8	1	1.83
595	MPO-MGS	730	667.38	1	1.00



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
596	MPO-MGS	731	667.56	1	4.44
597	MPO-MGS	732	667.72	1	1.22
598	MPO-MGS	733	667.93	1	4.64
599	MPO-MGS	734	668.56	1	.00
600	MPO-MGS	735	668.68	1	1.00
601	MPO-MGS	736	668.98	1	1.00
602	MPO-MGS	737	669.18	1	1.82
603	MPO-MGS	738	669.23	1	1.00
604	MPO-MGS	738A	669.48	3	1.925
605	KQR-MPO	235	394	1	x1.83
606	KQR-MPO	236	394	2	1.2
607	KQR-MPO	237	395	1	0.6
608	KQR-MPO	238	395	1	0.9
609	KQR-MPO	239	395	1	1.2
610	KQR-MPO	240	396	1	1.83
611	KQR-MPO	241	396	1	0.9
612	KQR-MPO	242	396	1	1.83
613	KQR-MPO	243	396	1	1.8
614	KQR-MPO	244	396	2	0.60
615	KQR-MPO	245	397	1	0.9
616	KQR-MPO	246	397	1	6.1



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
617	KQR-MPO	247	397	1	0.76
618	KQR-MPO	248	398	1	1.83
619	KQR-MPO	249	398	2	5.49
620	KQR-MPO	250	398	1	0.9
621	KQR-MPO	251	399	1	0.9
622	KQR-MPO	252	399	1	1.813
623	KQR-MPO	253	399	1	3.05
624	KQR-MPO	254	400	1	0.6
625	KQR-MPO	255	400	1	0.9
626	KQR-MPO	256	400	1	1.83
627	KQR-MPO	257	401	1	1.83
628	KQR-MPO	258	401	1	1.83
629	KQR-MPO	259	401	1	1.5
630	KQR-MPO	260	402	1	3.05
631	KQR-MPO	261	403	1	3.05
632	KQR-MPO	262	404	1	1.83
633	KQR-MPO	263	404	1	0.9
634	KQR-MPO	264	404	1	0.6
635	KQR-MPO	265	404	1	3.66
636	KQR-MPO	266	405	1	0.9
637	KQR-MPO	267	405	1	0.6



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
638	KQR-MPO	268	405	1	0.6
639	KQR-MPO	269	406	1	1.2
640	KQR-MPO	270	406	1	1.2
641	KQR-MPO	271	406	1	0.600
642	KQR-MPO	272	406	1	0.60
643	KQR-MPO	273	406	1	0.60
644	KQR-MPO	274	407	1	0.60
645	KQR-MPO	275	407	1	0.90
646	KQR-MPO	276	407	1	1.80
647	KQR-MPO	277	408	1	1.20
648	KQR-MPO	278/A	409	1	1.20
649	KQR-MPO	279	410	1	2.50
650	KQR-MPO	280	410	1	1.50
651	KQR-MPO	281	410	1	0.90
652	KQR-MPO	282	410	1	1.83
653	KQR-MPO	283	411	1	3.66
654	KQR-MPO	284	411	2	0.60
655	KQR-MPO	285	411	1	0.90
656	KQR-MPO	286	411	2	0.60
657	KQR-MPO	288	413	1	1.83
658	KQR-MPO	289	413	1	2.45



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
659	KQR-MPO	290	413	1	0.60
660	KQR-MPO	292	414	1	1.2
661	KQR-MPO	293	414	1	3.66
662	KQR-MPO	294	414	1	3.05
663	KQR-MPO	295	414	1	1.83
664	KQR-MPO	296	415	1	3.66
665	KQR-MPO	297	415	1	3.05
666	KQR-MPO	298	416	1	3.66
667	KQR-MPO	299	416	1	1.83
668	KQR-MPO	300	416	1	0.9
669	KQR-MPO	301	416	1	0.9
670	KQR-MPO	302	417	1	3.66
671	KQR-MPO	303	417	1	1.83
672	KQR-MPO	304	417	1	1.2
673	KQR-MPO	305	417	1	1.2
674	KQR-MPO	306	418	1	3.05
675	KQR-MPO	307	418	1	1.2
676	KQR-MPO	308	418	1	1.83
677	KQR-MPO	309	419	1	1.2
678	KQR-MPO	310	419	1	1.83
679	KQR-MPO	311	419	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
680	KQR-MPO	312	419	2	1.2
681	KQR-MPO	313	420	1	3.05
682	KQR-MPO	314	420	1	0.76
683	KQR-MPO	316	421	1	0.9
684	KQR-MPO	317	421	1	1.2
685	KQR-MPO	318	422	1	3.05
686	KQR-MPO	319	422	1	1.83
687	KQR-MPO	320	423	3	0.6
688	KQR-MPO	321	423	1	1.83
689	KQR-MPO	322	423	1	1.83
690	KQR-MPO	323	423	1	1.83
691	KQR-MPO	324	424	1	3.66
692	KQR-MPO	325	424	2	5.180
693	KQR-MPO	326	424	1	1.83
694	KQR-MPO	327	425	1	1.5
695	KQR-MPO	328	425	1	0.9
696	KQR-MPO	329	425	1	1.5
697	KQR-MPO	330	425	2	0.6
698	KQR-MPO	331	426	1	0.53
699	KQR-MPO	333	428	1	0.9
700	KQR-MPO	334	429	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
701	KQR-MPO	339	431	1	1.5
702	KQR-MPO	340	431	1	0.9
703	KQR-MPO	341	432	1	0.9
704	KQR-MPO	342	433	1	0.9
705	KQR-MPO	343	433	1	0.90
706	KQR-MPO	344	434	1	0.6
707	KQR-MPO	346	434	1	3.66
708	KQR-MPO	347	435	1	1.83
709	KQR-MPO	348	435	1	1.83
710	KQR-MPO	349	435	4	0.6
711	KQR-MPO	350	435	3	0.60
712	KQR-MPO	351	436	4	0.530
713	KQR-MPO	352	436	1	0.53
714	KQR-MPO	353	436	1	1.83
715	KQR-MPO	354	436	1	0.91
716	KQR-MPO	356	437	1	3.66
717	KQR-MPO	357	438	1	1.81
718	KQR-MPO	358	438	1	0.60
719	KQR-MPO	359	439	1	0.53
720	KQR-MPO	360	439	1	1.5
721	KQR-MPO	361	439	1	0.6



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
722	KQR-MPO	362	440	1	0.9
723	KQR-MPO	364	441	1	3.0
724	KQR-MPO	365	441	1	0.9
725	KQR-MPO	366	441	1	0.6
726	KQR-MPO	367	442	1	0.6
727	KQR-MPO	368	442	2	0.60
728	KQR-MPO	369	442	2	0.530
729	KQR-MPO	370	443	1	0.9
730	KQR-MPO	371	443	1	9.15
731	KQR-MPO	372	443	1	0.9
732	KQR-MPO	373	443	1	1.83
733	KQR-MPO	374	443	1	1.83
734	KQR-MPO	375	443	1	0.53
735	KQR-MPO	376	444	1	2.0
736	KQR-MPO	377	444	1	0.9
737	KQR-MPO	378	445	1	0.6
738	KQR-MPO	379	445	1	0.6
739	KQR-MPO	380	445	1	2.0
740	KQR-MPO	381	445	1	0.6
741	KQR-MPO	382	445	1	0.6
742	KQR-MPO	383	446	1	0.9



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
743	KQR-MPO	384	446	1	1.83
744	KQR-MPO	385	446	1	0.9
745	KQR-MPO	386	447	1	0.6
746	KQR-MPO	387	447	1	1.83
747	KQR-MPO	388	447	1	0.53
748	KQR-MPO	389	447	1	0.6
749	KQR-MPO	390	448	1	1.83
750	KQR-MPO	391	448	1	0.91
751	KQR-MPO	392	448	1	1.83
752	KQR-MPO	393	448	1	0.60
753	KQR-MPO	394	448	1	1.83
754	KQR-MPO	395	449	1	1.83
755	KQR-MPO	396	450	2	0.600
756	KQR-MPO	397	450	1	0.90
757	KQR-MPO	398	450	1	0.60
758	KQR-MPO	399	450	1	0.53
759	KQR-MPO	400	451	1	0.53
760	KQR-MPO	401	451	1	0.53
761	KQR-MPO	402	451	2	1.500
762	KQR-MPO	403	451	1	0.90



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
763	KQR-MPO	404	451	2	0.53
764	KQR-MPO	405	452	1	0.9
765	KQR-MPO	406	452	1	0.9
766	KQR-MPO	407	452	1	0.60
767	KQR-MPO	408	452	1	0.6
768	KQR-MPO	409	453	1	1.83
769	KQR-MPO	410	453	1	0.9
770	KQR-MPO	411	454	1	1.83
771	KQR-MPO	412	454	1	6.1
772	KQR-MPO	413	454	1	0.9
773	KQR-MPO	414	455	1	1.5
774	KQR-MPO	415	455	2	3.0
775	KQR-MPO	417	456	3	5.490
776	KQR-MPO	418	456	1	0.9
777	KQR-MPO	419	456	1	1.5
778	KQR-MPO	420	458	1	0.9
779	KQR-MPO	421	458	1	0.9
780	KQR-MPO	422	458	1	0.6
781	KQR-MPO	423	459	1	0.9
782	KQR-MPO	424	459	3	3x1.2



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
783	KQR-MPO	425	459	1	1.5
784	KQR-MPO	426	459	1	0.9
785	KQR-MPO	427	460	1	0.9
786	KQR-MPO	428	460	1	0.9
787	KQR-MPO	429	460	1	0.9
788	KQR-MPO	430	460	1	0.9
789	KQR-MPO	431	461	1	0.9
790	KQR-MPO	432	461	1	0.9
791	KQR-MPO	433	461	1	0.9
792	KQR-MPO	434	462	1	0.53
793	KQR-MPO	335	462	2	0.61
794	KQR-MPO	336	462	2	0.61
795	GMO-KQR	69	300	1	0.91
796	GMO-KQR	70	301	1	0.90
797	GMO-KQR	72	302	1	1.800
798	GMO-KQR	73	303	1	0.91
799	GMO-KQR	74	303	1	0.61
800	GMO-KQR	75	303	1	0.91
801	GMO-KQR	76	304	1	1.2
802	GMO-KQR	78	304	1	1.2
803	GMO-KQR	79	305	1	0.91



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
804	GMO-KQR	80	305	1	0.61
805	GMO-KQR	81	305	1	0.61
806	GMO-KQR	82	305	2	6.1
807	GMO-KQR	83	306	1	0.61
808	GMO-KQR	84	307	1	0.91
809	GMO-KQR	85	307	1	1.83
810	GMO-KQR	86	308	1	0.91
811	GMO-KQR	87	308	1	1.83
812	GMO-KQR	88	309	1	0.91
813	GMO-KQR	89	309	1	0.61
814	GMO-KQR	90	309	1	2x6.10
815	GMO-KQR	92	310	1	0.91
816	GMO-KQR	93	310	1	1.2
817	GMO-KQR	94	310	1	0.61
818	GMO-KQR	95	310	1	6.10
819	GMO-KQR	96	311	1	0.91
820	GMO-KQR	97	311	1	1.83
821	GMO-KQR	98	311	1	0.91
822	GMO-KQR	99	311	1	0.610
823	GMO-KQR	100	312	1	1.83
824	GMO-KQR	101	312	1	6.10



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
825	GMO-KQR	102	313	1	1.83
826	GMO-KQR	104	314	1	0.91
827	GMO-KQR	106	315	1	0.91
828	GMO-KQR	107	316	1	1.2
829	GMO-KQR	108	317	1	3.66
830	GMO-KQR	109	317	1	4.572
831	GMO-KQR	110	318	1	1.83
832	GMO-KQR	111	318	1	1.83
833	GMO-KQR	112	319	1	1.2
834	GMO-KQR	113	319	2	4.57
835	GMO-KQR	114	320	1	0.610
836	GMO-KQR	115	320	1	0.610
837	GMO-KQR	117	321	1	3.05
838	GMO-KQR	118	322	1	3.05
839	GMO-KQR	119	322	3	5.49
840	GMO-KQR	120	323	1	0.91
841	GMO-KQR	121	323	2	0.61
842	GMO-KQR	122	324	1	1.83
843	GMO-KQR	123	325	1	0.610
844	GMO-KQR	124	325	1	1.22
845	GMO-KQR	125	325	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
846	GMO-KQR	126	326	1	6.10
847	GMO-KQR	127	327	1	1.83
848	GMO-KQR	128	328	1	0.91
849	GMO-KQR	129	328	1	0.91
850	GMO-KQR	130	328	12	4.57
851	GMO-KQR	131	329	1	1.83
852	GMO-KQR	132	330	1	0.91
853	GMO-KQR	133	330	2	4.57
854	GMO-KQR	135	331	2	0.914
855	GMO-KQR	136	332	1	1.22
856	GMO-KQR	137	332	1	1.22
857	GMO-KQR	138	333	2	x1.83
858	GMO-KQR	140	334	2	1.83
859	GMO-KQR	141	335	1	1.83
860	GMO-KQR	142	335	1	0.91
861	GMO-KQR	143	336	1	4.57
862	GMO-KQR	144	337	1	0.61
863	GMO-KQR	145	337	1	1.83
864	GMO-KQR	146	337	1	0.91
865	GMO-KQR	147	338	1	4.55
866	GMO-KQR	148	338	1	0.91



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
867	GMO-KQR	149	339	1	0.91
868	GMO-KQR	152	341	1	1.83
869	GMO-KQR	153	341	1	0.91
870	GMO-KQR	154	342	2	3.45
871	GMO-KQR	155	343	2	4.57
872	GMO-KQR	156	344	1	0.91
873	GMO-KQR	156A	345	1	0.91
874	GMO-KQR	157	345	1	1.2
875	GMO-KQR	158	346	1	3.05
876	GMO-KQR	159	347	1	3.05
877	GMO-KQR	161	349	1	3.05
878	GMO-KQR	162	350	1	4.572
879	GMO-KQR	163	350	1	1.2
880	GMO-KQR	164	350	1	0.9
881	GMO-KQR	165	351	1	1.8
882	GMO-KQR	166	351	1	3.0
883	GMO-KQR	168	353	1	0.91
884	GMO-KQR	169	354	1	.9
885	GMO-KQR	170	355	1	0.9
886	GMO-KQR	171	355	1	0.9
887	GMO-KQR	172	356	1	1.8



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
888	GMO-KQR	173	356	1	1.2
889	GMO-KQR	174	358	1	4.57
890	GMO-KQR	175	359	1	3.05
891	GMO-KQR	176	359	1	1.2
892	GMO-KQR	177	360	1	1.2
893	GMO-KQR	178	360	1	1.82
894	GMO-KQR	179	361	1	1.82
895	GMO-KQR	180	361	1	0.91
896	GMO-KQR	181	361	1	1.82
897	GMO-KQR	182	361	1	1.82
898	GMO-KQR	183	361	1	1.82
899	GMO-KQR	184	362	1	5.48
900	GMO-KQR	185	362	1	0.91
901	GMO-KQR	186	363	1	3.66
902	GMO-KQR	188	365	1	1.2
903	GMO-KQR	189	365	1	1.82
904	GMO-KQR	190	366	1	0.91
905	GMO-KQR	191	366	1	0.91
906	GMO-KQR	192	368	1	3.0
907	GMO-KQR	193	368	1	1.8
908	GMO-KQR	194	369	1	1.2



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
909	GMO-KQR	195	369	1	1.83
910	GMO-KQR	196	370	1	1.82
911	GMO-KQR	197	370	1	0.91
912	GMO-KQR	198	372	1	6.1
913	GMO-KQR	199	372	1	1.8
914	GMO-KQR	200	373	1	0.91
915	GMO-KQR	201	374	1	0.61
916	GMO-KQR	203	375	1	2.0
917	GMO-KQR	204	376	1	1.82
918	GMO-KQR	205	376	1	1.2
919	GMO-KQR	206	377	1	2.0
920	GMO-KQR	207	377	1	x3.0
921	GMO-KQR	208	378	1	3.0
922	GMO-KQR	209	378	2	1.2
923	GMO-KQR	210	378	1	0.9
924	GMO-KQR	211	378	1	0.91
925	GMO-KQR	212	379	1	0.61
926	GMO-KQR	213	379	1	1.82
927	GMO-KQR	214	380	1	0.91
928	GMO-KQR	215	380	1	3.0
929	GMO-KQR	216	381	1	1.82



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
930	GMO-KQR	217	381	1	1.22
931	GMO-KQR	218	381	1	0.91
932	GMO-KQR	219	382	1	1.8
933	GMO-KQR	220	383	1	0.91
934	GMO-KQR	221	384	1	1.2
935	GMO-KQR	222	387	1	1.2
936	GMO-KQR	223	388	1	0.91
937	GMO-KQR	224	388	2	0.9
938	GMO-KQR	225	388	1	1.25
939	GMO-KQR	226	389	1	0.9
940	GMO-KQR	227	390	1	3.05
941	GMO-KQR	228	390	1	1.83
942	GMO-KQR	229	391	1	1.83
943	GMO-KQR	230	391	1	0.9
944	GMO-KQR	231	391	1	0.9
945	GMO-KQR	232	392	1	0.9
946	GMO-KQR	233	392	1	0.6
947	GMO-KQR	234	392	1	0.6
948	DHN-GMO	3	272	1	1.83
949	DHN-GMO	4	272	1	0.914
950	DHN-GMO	5	273	1	1.83



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
951	DHN-GMO	6	273	1	1.83
952	DHN-GMO	7	273	1	1.83
953	DHN-GMO	8	274	2	0.61
954	DHN-GMO	9	274	2	0.61
955	DHN-GMO	10	274	2	0.61
956	DHN-GMO	11	274	2	0.61
957	DHN-GMO	12	275	3	3x3.05
958	DHN-GMO	13	275	1	0.91
959	DHN-GMO	14	275	1	0.61
960	DHN-GMO	15	275	3	1.22
961	DHN-GMO	17	276	1	0.91
962	DHN-GMO	18	276	1	0.91
963	DHN-GMO	20	276	1	1.83
964	DHN-GMO	21	276	1	0.61
965	DHN-GMO	22	277	1	1.22
966	DHN-GMO	23	277	2	4.88
967	DHN-GMO	25	277	1	0.91
968	DHN-GMO	27	278	1	0.61
969	DHN-GMO	28	278	1	0.91
970	DHN-GMO	29	278	2	3.05
971	DHN-GMO	30	279	1	0.61



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
972	DHN-GMO	31	279	2	0.61
973	DHN-GMO	32	279	1	1.83
974	DHN-GMO	33	280	1	1.83
975	DHN-GMO	34	280	1	4.5
976	DHN-GMO	35	280	1	6.20
977	DHN-GMO	36	281	1	0.61
978	DHN-GMO	37	282	1	6.10
979	DHN-GMO	38	282	1	.80
980	DHN-GMO	40	284	1	0.91
981	DHN-GMO	41	284	1	1.83
982	DHN-GMO	42	284	1	4.572
983	DHN-GMO	43	285	1	4.56
984	DHN-GMO	44	285	1	2.44
985	DHN-GMO	45	285	3	0.61
986	DHN-GMO	45B	286	3	0.61
987	DHN-GMO	46	286	1	1.83
988	DHN-GMO	47	287	1	3.05
989	DHN-GMO	48	287	1	0.61
990	DHN-GMO	49	287	1	0.91
991	DHN-GMO	50	287	1	1.83
992	DHN-GMO	51	288	1	6.71



MINOR BRIDGES				ANNEXURE - E	
S.No	Block section	Br. No	Location	No. of span with span length (m)	
				NS	SP
993	DHN-GMO	52	289	1	0.91
994	DHN-GMO	53	290	1	1.22
995	DHN-GMO	54	291	1	6.10
996	DHN-GMO	55	292	2	5.49
997	DHN-GMO	56	293	3	3.65
998	DHN-GMO	57	293	1	0.91
999	DHN-GMO	58	293	1	1.83
1000	DHN-GMO	59	294	1	3.05
1001	DHN-GMO	60	294	1	0.91
1002	DHN-GMO	61	295	1	0.91
1003	DHN-GMO	62	296	1	3.66
1004	DHN-GMO	63	296	2	3.66
1005	DHN-GMO	64	297	2	1.8
1006	DHN-GMO	67	299	2	x3.65
1007	MHQ GMO	65	354	1	1.83
1008	MHQ GMO	66	355	1	1.83



DETAILS OF ROBs				ANNEXURE - F							
S.No	Block section	BR./ LC. No	Location	No. of span with span length (m)							
				NS1	SP1	NS2	SP2	NS3	SP3	NS4	SP4
1	MPO - GYA	67	462/19-21								
2	MPO - GYA	71	468/15-17								
3	GYA-KSTA	4	473/01-03								
4	GRRU-IMGE	11	491/27-29								
5	IMGE-RFJ	19	506/05-07								
6	AUBR-SEB	32	542/21-23								
7	DOS-PHE	35	556/25-27								
8	PHE-KWD	36	559/15-17								
9	PHE-KWD	37	562/11-13								
10	PHE-KWD	38	564/19-21								
11	KWD-SSM	39	566/00-01								
12	KWD-SSM	41	569/17-19								
13	KWD-SSM	42	571/19-21								
14	SSM-KMGE	45	578/9-11								
15	KMGE-SSG	46	581/01-03								
16	KMGE-SSG	47	583/05-07								
17	KMGE-SSG	48	585/05-07								
18	SSG-KVD	49	586/21-23								
19	SSG-KVD	50	588/25-27								
20	KVD-KTQ	52	594/17-19								
21	KTQ-PSE	52 II	600/05-07								
22	KTQ-PSE	53	601/07-09								
23	KTQ-PSE	55	605/25-27								
24	PSE-MTGE	56	609/07-09								
25	PSE-MTGE	57	612/25-27								
26	BBU-DGO	61	624/11-13								



DETAILS OF ROBs				ANNEXURE - F							
S.No	Block section	BR./ LC. No	Location	No. of span with span length (m)							
				NS1	SP1	NS2	SP2	NS3	SP3	NS4	SP4
27	BBU-DGO	63	628/03-05								
28	DGO-DCX	64	630/09-11								
29	DGO-DCX	65	633/07-09								
30	DCX-KMS	66	637/05-07								
31	KMS-SYJ	67	638/07-09								
32	KMS-SYJ	69	642/05-07								
33	KMS-SYJ	70	644/05-07								
34	KMS-SYJ	71	645/09-11								
35	SYJ S/L	72A	647/25-27								
36	SYJ S/L	72B	649/05-07								
37	SYJ S/L	73	649/15-17								
38	SYJ-CDMR	74	651/17-19								
39	SYJ-CDMR	75	653/19-21								
40	CDMR S/L	76A	657/21-23								
41	CDMR-GAQ	78	661/19-21								
42	GAQ-DDU	81	667/35-37								
43	GAQ-DDU	83	669/21-23								
44	KQR-MPO	236A	394	1,1,1	7.05, 21.4, 12.7						
45	DHN-GMO	18A	276	1	22.35						
46	DHN-GMO	45A	286	1	15						
47	DHN-GMO	52A	289	1	10.36						



DETAILS OF RUBs & LHS				ANNEXURE - G					
S.No	Block section	Br./LC No	Location	No. of span with span length (m)					
				NS1	SP1	NS2	SP2	NS3	SP3
1	KSTA - PRY	6	479/17-19						
2	PRY-GRRU	7	486/03-05						
3	PRY-GRRU	8	488/07-09						
4	PRY-GRRU	9	489/15-17						
5	GRRU-IMGE	12	493/11-13						
6	GRRU-IMGE	13	495/13-15						
7	GRRU-IMGE	14	497/01-03						
8	IMGE-RFJ	15	500/00-01						
9	IMGE-RFJ	16	502/00-01						
10	IMGE-RFJ	17	504/03-05						
11	IMGE-RFJ	18	505/15-17						
12	RFJ-JHN	20	510/13-15						
13	RFJ-JHN	21	513/05-07						
14	RFJ-JHN	22	514/11-13						
15	JHN-BHKH	23	519/07-09						
16	JHN-BHKH	24	522/23-25						
17	BHKH-PES	26	524/21-23						
18	BHKH-PES	27	525/23-25						
19	BHKH-PES	27A	527/17-19						
20	BHKH-PES	28	528/25-27						
21	PES-AUBR	29	531/15-17						
22	PES-AUBR	31	538/29-31						
23	MTGE-BBU	58	615/03-05						
24	GAQ S/L	80	665/01-03						
25	DDU-JEP	112	675/15-17						
26	DHN-GMO	34A	276	1	19.4				
27	DHN-GMO	42	280	1	4.572				
28	DHN-GMO	59	294	1	3.05				



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
1	PKA-DHN	262/35-37	132/33		
2	PKA-DHN	266/13-15	33		
3	DOKRA-DHN	268/15-19	11		
4	DHN-BLI	272/9-11	11		
5	DHN-BLI	273/13-15	11		
6	IBH-MRQ	293/11-13	132		
7	IBH-GMO (HWH END)	298/27-29	11		
8	IBH-GMO (KLK END)	298/27-29	11		
9	GMO-BLME	307/9-11	132		
10	PNME-NMG	316/5-7	33		
11	PNME-NMG	316/15-17	11		
12	SMND-YDD	372/23-27	220		
13	HZD-KSHR	347/1-3	132		
14	HZD-KSHR	346/3-5	11		
15	LRB-KQR	391/15-17	11		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
16	LRB-KQR	391/15-17	11		
17	LRB-KQR	392/17-19	11		
18	LRB-KQR	393/5-7	11		
19	KQR-GJD	395/25-27	33		
20	KQR-GJD	402/25-27	11		
21	GAP-PRP	436/7-9	11		
22	TKN-BNF	455/7-9	132		
23	BNF-MPO	461/9-11	132		
24	RKJE-SDBH	8/P12-P13	33		
25	RKJE-SDBH	14/P9-P10	33		
26	RKJE-SDBH	6/P11-P12	11		
27	RKJE-SDBH	10/P10-P11	33		
28	RKJE-SDBH	11/P8-P9	11		
29	SDBH-SNDT	16S/3-4	33		
30	SDBH-SNDT	16S/11-12	132/33		
31	SDBH-SNDT	17S/8-9	33		
32	SDBH-SNDT	17S/9-10	440V		
33	SDBH-SNDT	19S/7-8	11		
34	PEH-Sudamdih	316/P12-P13	11		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
35	PEH-Sudamdih	316/P12-P13	33		
36	PEH-Sudamdih	316/P13-P14	11		
37	PEH-SNMY	PS1/13-14	33		
38	DHN-KDS	DK3/K1-K3	33		
39	DHN-KDS	DK3/K1-K3	11		
40	KDS-KTH	DK3/K31L-DK4/K1L	220V		
41	KDS-TET	KT4/K2-K3	11		
42	KDS-TET	KT3/K14-K15	11		
43	KDS-TET	KT2/K13-K14	11		
44	SJA-KTH	DK10/27-29	11		
45	KTH-CRP	DK13/33-14/1	440V		
46	KTH-CRP	DK13/27-33	220V		
47	NPJE-KTH	NK2/2-3	11		
48	KTH-SZE	14/29-31	33		
49	KTH-PLJE	14/39-15/1	33		
50	PLJE-JNN	21/35-37	132		
51	PLJE-JNN	25/9-11	132		
52	PLJE-JNN	25/3-5	132		
53	CRP-JNN Link	349/MC13-14	132		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
54	PLJE Stn Limit	21/17-19	33		
55	GMO-TELO	C-6/11-13	132		
56	BHME-RJBE (CTPS-BRL)	RB-0/3-4	33		
57	CRP-BHME (CTPS-BRL)	C20/33-C21/1	33		
58	NSD SIDING	NSD/2007-08	33		
59	AMLO-PUS	31/11-13	33		
60	BKRO-JAN	37/27-28	11		
61	BKRO-JAN	38/11-12	11		
62	BKRO-JAN	41/18-19	132		
63	GMIA STN.	48/17-18	33		
64	GMIA-DMBR	53/11-12	220		
65	CNPR-KMHT	84/10-11	220		
66	KMHT-RRME	89/16-17	33		
67	KMHT-RRME	90/13-14	33		
68	RRME-BRKA	94/14-15	33		
69	RRME-BRKA	95/11-12	11		
70	RRME-BRKA	98/16-17	132		
71	ARIGADA- BRKA	0/16-17	132		
72	ARIGADA- BRKA	104/12-13	132		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
73	BHKD-PTRU	118/13-14	132		
74	BHKD-PTRU	119/9-10	33		
75	TKS-HNDR	132/23-25	33		
76	HNDR-KOLE	140/41-141/1	132		
77	KOLE-RAY	147/13-15	11		
78	KOLE-RAY	149/19-21	11		
79	KOLE-RAY	149/19-23	132		
80	KOLE-RAY	149/23-25	33		
81	KLRE-MGME	162/5-7	11		
82	KDH Siding Yd.	KDH/1055-1056	11		
83	KDH Siding Yd.	KDH/1029-1031	33		
84	DMX-LTHR	216/13-15	132		
85	LTHR-BFQ	218/33-35	132		
86	DTO-KFT	287/1-3	11		
87	DTO-KFT	293/25-27	132		
88	KFT-RHR	297/23-25	11		
89	KFT-RHR	299/7-9	132		
90	KFT-RHR	302/11-13	11		
91	TRZ-GHD	317/17-19	33		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
92	TRZ-GHD	317/17-19	33		
93	TRZ-GHD	317/17-19	33		
94	GHD STN.	319/3-5	11		
95	MGS	323/27-29,28-30	33		
96	MGS	344/37-39,38-40	33		
97	MGS	358/1-3,2-4	33		
98	MGS	363/31-364/1,363/32-364/2	33		
99	MGS	380/11-33,12-14	33		
100	MGS	462/25-27,26-28	33 & 11		
101	MGS	474/2-4,1-3	11		
102	MGS	490/9-11,10-12	11		
103	MGS	492/9-11,10-12	11		
104	MGS	408/1-3,2-4	33		
105	MGS	556/13-15	33		
106	MGS	556/15-17	132		
107	MGS	575/5-7,6-8	11		
108	MGS	618/4-4/1	33		
109	MGS	536/19-21,20-22	11		
110	MGS	651/1A1-1A2, 651/1-3	33		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
111	MGS	675/21-23	33		
112	MGS	676/5-7	33		
113	MGS	463/31-33,32-34	220		
114	MGS	463/25-27,32-34	132		
115	MGS	474/7-9,8-10	132		
116	MGS	509/9-11,10-12	132		
117	MGS	510/7-9,8-10	132		
118	MGS	410/27-29,28-30	132		
119	MGS	548/5-7,548/6-8	132		
120	MGS	SEB F3/10-8	132		
121	MGS	556/18-20,17-19	132		
122	MGS	575/6-8	132		
123	MGS	610/17A-19A,610/16-18	220		
124	MGS	615/12-14,615/11-13	132		
125	MGS	548/9-11	132		
126	MGS	675/9-11,14-16	132		
127	MGS	375/7-9	132		
128	MGS	375/13-15	132		
129	MGS	408/17-19,18-20	132		



ANNEXURE - H					
Transmission Lines Crossing The Right of Way					
S. No.	Station Between	Between Location	kV	OH/UG	Height
130	MGS	548/9-11,10-12	132		
131	MGS	410/31-33	132		
132	MGS	SEB/F/O/1/33-34	132		
133	MGS	548/10-12,9-11	132		
134	MGS	410/31-33,S-2/4-6	132		
135	MGS	556/13-15,14-16, 13A-15A	33		



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
1	Pt. Deen Dayal Station (DDU) to DDU Flyover Cabin (FOC)	DDU to DDU Fly over	40		6.60	3.00	-53.12	New tower to be erected at LC gate No- 83 B
		LC-83B		40	3.12			
		DDU Fly over to DDU	40		6.60	3.12	-54.48	
2	DDU Flyover Cabin (FOC) to Ganj Khawaja (GAQ)	DDU FOC to GAQ	40		2.15	2.15	-53.31	60% Fresnel is clear in full section, No extra Tower needed.
		GAQ to DDU FOC	40		2.15	2.15	-53.43	
3	Ganj Khawaja (GAQ) to Chandauli Majhwar Station (CDMR)	GAQ to CDMR	40		8.36	3.18	-54.35	New Tower to be erected at IBH location.
		IBH		40	5.00			
		CDMR to GAQ	40		8.36	3.10	-54.14	
4	Chandauli Majhwar (CDMR) to Saidraja (SYJ)	CDMR to SYJ	40		8.34	2.90	-54.89	New Tower to be erected at LC-75A
		LC-75A		40	4.17			
		SYJ to CDMR	40		8.34	2.40	-53.03	
5	Saidraja (SYJ) to Karamnasa (KMS)	SYJ to KMS	40		8.29	3.80	-53.93	New Tower to be erected at LC-70A
		LC-70A		40	4.17			
		KMS to SYJ	40		8.29	3.20	-53.80	
6	Karamnasa (KMS) to Dhanaicha (DCX)	KMS to DCX	40		6.27	4.00	-54.51	60% Fresnel is clear in full section, No extra Tower needed.
		DCX to KMS	40		6.27	3.50	-53.89	
7	Dhanaicha Station (DCX) – Durgawati (DGO)	DCX to DGO	40		5.20	4.50	-54.00	60% Fresnel is clear in full section, No extra Tower needed.
		DGO to DCX	40		5.20	3.25	-54.48	
8	Durgawati	DGO to BBU	40		9.00	3.50	-53.62	New tower to



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
	Station (DGO) to Bhabhua Rd. (BBU)	LC-61		40	4.75			be erected at LC-61
		BBU to DGO	40		9.00	3.50	-53.87	
9	Bhabhua Rd. Station (BBU) to Muthani(MTGE)	BBU to MTGE	40		5.44	3.50	-52.89	60% Fresnel is clear in full section, No extra Tower needed.
		MTGE to BBU	40		5.44	3.50	-54.25	
10	Muthani Station (MTGE) to Pusauli (PSE)	MTGE to PSE	40		7.94	3.75	-54.34	New tower to be erected at LC-56
		LC-56		40	4.75			
		PSE to MTGE	40		7.94	3.00	-53.87	
11	Pusauli (PSE) to Kudra (KTQ)	PSE to KTQ	40		8.86	3.25	-53.96	New tower to be erected at LC-53
		LC-53		40	5.40			
		KTQ to PSE	40		8.86	3.25	-54.20	
12	Kudra (KTQ) to Khurmabad Rd. (KVD)	KTQ to KVD	40		6.40	2.75	-53.86	As non availability of LC gate between KTQ and KVD, 20 Meter new tower to be erected at middle of the section for 60% Fresnel clearance from both side.
		50% of section		20	3.20			
		KVD to KTQ	40		6.40	2.75	-52.56	
13	Khurmabad Rd. (KVD) to Shiusagar Rd. (SSG)	KVD to SSG	40		5.20	3.75	-53.37	60% Fresnel is clear in full section, No extra Tower needed.
		SSG to KVD	40		5.20	4.50	-54.23	
14	Shiusagar Rd. (SSG) to Kumahu (KMGE)	SSG to KMGE	40		5.68	3.50	-54.41	60% Fresnel is clear in full section, No extra Tower needed.
		KMGE to SSG	40		5.68	3.00	-54.15	
15	Kumahu (KMGE) to Sasaram (SSM)	KMGE to SSM	40		7.90	4.00	-52.95	As non availability of LC gate between KMGE and SSM, 20 Meter new tower to be
		50% of section		20	3.95			
		SSM to KMGE	40		7.90	3.60	-53.45	



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
								erected at middle of the section for 60% Fresnel clearance from both side.
16	Sasaram (SSM) to Karwandia (KWD)	SMM to KWD	40		7.40	3.50	-53.67	New tower to be erected at LC-39
		LC-39		40	6.60			
		KWD to SSM	40		7.40	3.00	-51.44	
17	Karwandia (KWD) to Pahleza (PHE)	KWD to PHE	40		5.80	3.40	-53.31	60% Fresnel is clear in full section, No extra Tower needed.
		PHE to KWD	40		5.80	3.25	-53.18	
18	Pahleza (PHE) to Dehri on Sone (DOS)	PHE to DOS	40		4.50	4.50	-53.82	60% Fresnel is clear in full section, No extra Tower needed.
		DOS to PHE	40		4.50	4.50	-54.92	
19	Dehri on Sone (DOS) to Sonnagar (SEB)	DOS to SEB	40		5.67	3.40	-52.61	60% Fresnel is clear in full section, No extra Tower needed.
		SEB to DOS	40		5.67	4.50	-52.70	
20	Sonnagar (SEB) to Chiraila Pauthu (CPBH)	SEB to CPBH	40		5.70	3.75	-52.40	60% Fresnel is clear in full section, No extra Tower needed.
		CPBH to SEB	40		5.70	4.50	-54.26	
21	Chiraila Pauthu (CPBH) to Anugraha Narayan Rd. (AUBR)	CPBH to AUBR	40		5.00	3.20	-53.86	60% Fresnel is clear in full section, No extra Tower needed.
		AUBR to CPBH	40		5.00	4.50	-52.56	
22	Anugraha Narayan Rd. (AUBR) to Phesar (PES)	AUBR to PES	40		9.00	3.50	-53.13	New tower to be erected at LC-29
		LC-29		40	6.70			
		PES to AUBR	40		9.00	4.50	-53.31	
23	Phesar (PES) to Bagohi Kusa (BHKH)	PES to BHKH	40		4.50	3.50	-52.88	60% Fresnel is clear in full section, No
		BHKH to PES	40		4.50	3.50	-53.83	



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
								extra Tower needed.
24	Bagohi Kusa (BHKH) to Jakhim (JHN)	BHKH to JHN	40		6.50	4.50	-52.90	60% Fresnel is clear in full section, No extra Tower needed.
		JHN to BHKH	40		6.50	4.00	-53.73	
25	Jakhim (JHN) to Deo Rd. (DORD)	JHN to DORD	40		4.00	3.25	-53.86	60% Fresnel is clear in full section, No extra Tower needed.
		DORD to JHN	40		4.00	4.00	-50.95	
26	Deo Rd. (DORD) to Rafiganj (RFJ)	DORD to RFJ	40		7.20	3.25	-54.51	New tower to be erected at LC-20
		LC-20		30	4.50			
		RFJ to DORD	40		7.20	3.25	-53.53	
27	Rafiganj (RFJ) to Ismailpur (IMGE)	RFJ to IMGE	40		9.00	3.20	-51.04	New tower to be erected at LC-16
		Lc-16		30	4.60			
		IMGE to RFJ	40		9.00	3.10	-53.18	
28	Ismailpur (IMGE) to Guraru (GRRU)	IMGE to GRRU	40		6.80	3.50	-52.95	60% Fresnel is clear in full section, No extra Tower needed.
		GRRU to IMGE	40		6.80	3.40	-53.45	
29	Guraru (GRRU) to Paraiya (PRY)	GRRU to PRY	40		6.00	2.50	-54.86	New tower to be erected at LC-8B
		Lc-8B		30	2.50			
		PRY to GRRU	40		6.00	3.10	-51.23	
30	Paraiya (PRY) to Kastha (KSTA)	PRY to KSTA	40		7.20	2.50	-52.89	As non availability of LC gate between PRY and KSTA, 30 Meter new tower to be erected at middle of the section for 60% Fresnel clearance from both side.
		50% of the section		30	3.60			
		KSTA to PRY	40		7.20	4.25	-53.18	



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
31	Kastha (KSTA) to Gaya (GAYA)	KSTA to GAYA	40		8.00	3.40	-51.04	As non availability of LC gate between KSTA and GAYA, 20 Meter new tower to be erected at middle of the section for 60% Fresnel clearance from both side.
		50%of the section		20	4.00			
		GAYA to KSTA	40		8.00	3.60	-52.48	
32	Gaya (MOP) to Manpur (MOP)	GAYA to MOP	40		4.50	2.75	-52.88	60% Fresnel is clear in full section, No extra Tower needed.
		MOP to MOP	40		4.50	3.00	-53.83	
33	Manpur (MPO) to Bandhua (BNF)	MPO to BNF	40		7.20	3.25	-54.35	New tower to be erected at LC-67A
		LC—67A		30				
		BNF to MPO	30		7.20	3.75	-54.14	
33	Bandhua (BNF) to Tankuppa (TKN)	BNF to TKN	40		7.65	3.00	-54.89	New tower to be erected at IBH
		IBH		30				
		TKN to BNF	40		7.65	2.50	-53.03	
34	Tankuppa (TKN) to Bansinala BH (BNSL)	TKN to BNSL	40		5.90	3.60	-54.51	60% Fresnel is clear in full section, No extra Tower needed.
		BNSL to TKN	40		5.90	3.00	-53.89	
35	Bansinala BH (BNSL) to Paharpur (PPR)	BNSL to PPR	40		6.60	2.75	-54.51	Due to non availability of IBH or LC gate on this section, 50 Mtr towers at both locations are required.
		PPR to BNSL	40		6.60	2.50	-53.89	
36	Paharpur (PPR) to Gurpa (GAP)	PPR to GAP	40		11.70	3.90	-53.62	New tower to be erected at IBH IBP No-10
		IBH IBP NO-10		40	7.50			
		GAP to PPR	40		11.70	3.50	-53.87	
37	Gurpa (GAP)	GAP to YGM	30		3.30	3.30	-52.89	60% Fresnel is



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
	to Yadugram BH (YGM)	YGM to GAP	30		3.30	3.30	-54.25	clear in full section, No extra Tower needed.
38	Yadugram BH (YGM) to Banskatwa BH (BSCR)	YGM to BSCR	40			0.80	-54.34	New tower to be erected at 1.65 km
		BSCR to YGM	30	20	1.65		-53.87	
39	Banskatwa BH (BSCR) to Nathganj BH (NGY)	BSCR to NGY	30		1.50	0.25	-53.86	New tower to be erected at 1.10 km
		NGY to BSCR	30	30	1.10		-53.18	
40	Nathganj BH (NGY) to Dilwa (DLW)	NGY to DLW	30		4.50	0.75	-53.86	New tower to be erected at 1.25Km & 3.0 Km
				40	1.25			
				40	3.0		-53.18	
		DLW to NGY	90		4.50	1.50	-52.90	
41	Dilwa (DLW) to Lalbagh (LBZ)	DLW to LBZ	90		4.50	2.10	-52.90	60% Fresnel is clear in full section, No extra Tower needed.
		LBZ to DLW	40		4.50	3.40	-53.73	
42	Lalbagh (LBZ) to Gujhandi (GJD)	LBZ to GJD	30		2.00	1.90	-53.86	60% Fresnel is clear in full section, No extra Tower needed.
		GJD to LBZ	40		2.00	1.50	-52.56	
43	Gujhandi (GJD) to Koderma (KQR)	GJD to KQR	40		10.00	2.60	-53.96	New tower to be erected at IBH IBP-9
		IBH IBP NO.9		40	4.50			
		KQR to GJQ	40		10.00	1.70	-54.20	
44	Koderma (KQR) to Larabad (LRB)	KQR to LRB	40		4.50	3.50	-54.23	60% Fresnel is clear in full section, No extra Tower needed.
		LRB to KQR	40		4.50	3.00	-54.73	
45	Larabad (LRB) to Hirodih (HRE)	LRB to HRE	40		4.50	3.75	-53.37	60% Fresnel is clear in full section, No extra Tower needed.
		HRE to LRB	40		4.50	3.50	-54.23	



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
46	Hirodih (HRE) to Sharamatantr (SMND)	HRE to SMND	40		7.70	3.60	-53.67	New tower to be erected at IBH
		IBH		40	5.00			
		SMND to HRE	40		7.70	3.00	-51.44	
47	Sharamatantr (SMND) to Yadudih (YDD)	SMND to YDD	40		3.90	3.30	-53.31	60% Fresnel is clear in full section, No extra Tower needed.
		YDD to SMND	40		3.90	3.10	-53.18	
48	Yadudih (YDD) to Parsabad (PSB)	YDD to PSB	40		5.50	1.50	-53.82	60% Fresnel is clear in full section, No extra Tower needed.
		PSB to YDD	40		5.50	3.10	-54.92	
49	Parsabad (PSB) to Dasarah BH (DSME)	PSB to DSME	40		6.50	3.75	-52.61	60% Fresnel is clear in full section, No extra Tower needed.
		DSME to PSB	40		6.50	4.50	-52.70	
50	Dasarah BH (DSME) to Chaube (CBH)	DSME to CBH	40		4.90	2.00	-52.61	New tower to be erected at 2.45 Km
				30	2.45			
		CBH to DSME	40		4.90	1.50	-52.70	
51	Chaube (CBH) to Keshwari BH (KSHR)	CBH to KSHR	40		4.80	4.70	-52.40	60% Fresnel is clear in full section, No extra Tower needed.
		KSHR to CBH	40		4.80	3.00	-52.26	
52	Keshwari BH (KSHR) to Hazaribagh Rd. (HZD)	KSHR to HZD	40		5.60	3.60	-53.86	60% Fresnel is clear in full section, No extra Tower needed.
		HZD to KSHR	40		5.60	3.60	-52.56	
53	Hazaribagh Rd. (HZD) to Garea Bihar (GRBH)	HZD to GRBH	40		5.30	2.90	-53.13	60% Fresnel is clear in full section, No extra Tower needed.
		GRBH to HZD	40		5.30	4.20	-53.31	
54	Garea Bihar (GRBH) to Chichaki (CCK)	GRBH to CCK	40		4.50	4.50	-53.13	60% Fresnel is clear in full section, No extra Tower
		CCK to GRBH	40		4.50	4.50	-53.31	



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
								needed.
55	Chichaki (CCK) to Karmabad BH (KRMB)	CCK to KRMB	40		4.30	1.00	-52.88	New tower to be erected at LC-18A & 2.75 Km
		LC-18A		40	1.00			
				30	2.75	1.25		
		KRMB to CCK	40		4.30		-53.83	
56	Karmabad BH (KRMB) to Chaudharibandh (CBD)	KRMB to CBD	40		3.80	3.80	-52.88	60% Fresnel is clear in full section, No extra Tower needed.
		CBD to KRMB	40		3.80	3.80	-53.83	
57	Chaudharibandh (CBD) to Chegro BH (CEME)	CBD to CEME	40		5.10	1.60	-52.90	New tower to be erected at 2.55 Km
				30	2.55			
		CEME to CBD	40		5.10	2.40	-53.73	
58	Chegro (CEME) to Parasnath (PNME)	CEME to PNME	40		4.14	4.14	-53.86	60% Fresnel is clear in full section, No extra Tower needed.
		PNME to CEME	40		4.14	4.14	-50.95	
59	Parasnath (PNME) to Nimiaghat (NMG)	PNME to NMG	40		7.60	3.40	-54.51	Due to non – clearance of 60% Fresnel through LC gates, Tower of 40 Mtr is required on both sides for full section clearance
		NMG to PNME	40		7.60	2.75	-53.53	
60	Nimiaghat (NMG) to Bholidih (BLME)	NMG to BLME	40		5.50	1.75	-54.51	New tower to be erected at 2.75 Km
				30	2.75			
		BLME to NMG	40		5.50	2.75	-53.53	
61	Bholidih (BLME) to Netaji Subhash Chandra Bose Gomoh (GMO)	BLME to GMO	40		4.70	3.50	-51.04	60% Fresnel is clear in full section, No extra Tower needed.
		GMO to BLME	40		4.70	2.75	-53.18	



RSSI SURVEY REPORT					ANNEXURE-I			
S/n	Station Name	Section	Existing Tower Height (M)	Proposed/New Tower (M)	RF link distance (Km)	Overlap (Km)	Radio Signal Strength (dBm)	Remark
62	Netaji Subhash Chandra Bose Gomoh (GMO) to Matari (MRQ)	GMO to MRQ	40		9.50	2.25	-53.37	New tower to be erected at 2.50 Km & IBP No-3
				40	2.50		-54.23	
		IBP No-3		40	5.00			
		MRQ to GMO	40		9.50	3.60	-53.37	
63	Matari (MRQ) to Nichitpur (NPJE)	MRQ to NPJE	40		5.25	4.50	-54.34	60% Fresnel is clear in full section, No extra Tower needed.
		NPJE to MRQ	40		5.25	4.50	-53.87	
64	Nichitpur (NPJE) to Tetulmari (TET)	NPJE to TET	40		5.90	4.50	-52.95	60% Fresnel is clear in full section, No extra Tower needed.
		TET to NPJE	40		5.90	2.75	-53.45	
65	Tetulmari (TET) to Bhuli BH (BLI)	TET to BLI	40		5.40	4.00	-54.86	60% Fresnel is clear in full section, No extra Tower needed.
		BLI to TET	40		5.40	3.00	-51.23	
66	Bhuli BH (BLI) to Dhanbad (DHN)	BLI to DHN	40		3.50	3.50	-53.18	60% Fresnel is clear in full section, No extra Tower needed.
		DHN to BLI	40		3.50	3.50	-53.18	
67	Dhanbad (DHN) to Dokra BH (DOKM)	DHN to DOKM	40		5.00	1.50	-51.04	New tower to be erected at 2.50 Km
				40	2.50			
		DOKM to DHN	40		5.00	2.75	-54.51	
68	Dokra BH (DOKM) to Pradhankhunta (PKA)	DOKM to PKA	40		4.50	3.60	-52.88	60% Fresnel is clear in full section, No extra Tower needed.
		PKA to DOKM	40		4.50	4.00	-53.83	



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
W3sTowards Manpur									
1	ULT-PKA	DN	260	200	260	300	100	RISE	200
2	ULT-PKA	DN	260	300	261	5	705	RISE	227
3	ULT-PKA	DN	261	5	261	310	305	LEVEL	0
4	PKA-DHN	DN	261	310	262	0	690	LEVEL	0
5	PKA-DHN	DN	262	0	262	50	50	RISE	250
6	PKA-DHN	DN	262	50	263	0	950	RISE	200
7	PKA-DHN	DN	263	0	264	0	1000	RISE	250
8	PKA-DHN	DN	264	0	264	75	75	RISE	200
9	PKA-DHN	DN	264	75	266	0	1925	RISE	217
10	PKA-DHN	DN	266	0	268	0	2000	RISE	200
11	PKA-DHN	DN	268	0	268	50	50	RISE	227
12	PKA-DHN	DN	268	50	269	25	975	RISE	200
13	PKA-DHN	DN	269	25	270	880	1855	LEVEL	0
14	DHN-GMO	DN	272	0	273	750	1750	FALL	215
15	DHN-GMO	DN	273	750	274	0	250	LEVEL	0



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
16	DHN-GMO	DN	274	0	274	500	500	RISE	200
17	DHN-GMO	DN	274	500	274	750	250	LEVEL	0
18	DHN-GMO	DN	274	750	276	0	1250	FALL	200
19	DHN-GMO	DN	276	0	277	0	1000	LEVEL	0
20	DHN-GMO	UP	277	0	277	750	750	RISE	200
21	DHN-GMO	UP	277	750	280	75	2325	LEVEL	0
22	DHN-GMO	UP	280	750	282	500	1750	FALL	200
23	DHN-GMO	UP	282	500	283	250	750	LEVEL	0
24	DHN-GMO	UP	283	250	283	750	500	FALL	200
25	DHN-GMO	UP	283	750	284	0	250	LEVEL	0
26	DHN-GMO	UP	284	0	284	500	500	RISE	227
27	DHN-GMO	UP	284	500	286	150	1650	RISE	200
28	DHN-GMO	UP	286	150	287	200	1050	RISE	227
29	DHN-GMO	UP	287	200	288	450	1250	RISE	200
30	DHN-GMO	UP	288	450	288	900	450	RISE	227
31	DHN-GMO	UP	288	900	290	0	1100	RISE	200



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
32	DHN-GMO	UP	290	0	290	200	200	LEVEL	0
33	DHN-GMO	UP	290	200	291	0	800	FALL	800
34	DHN-GMO	UP	291	0	292	0	1000	FALL	200
35	DHN-GMO	UP	292	0	292	100	100	LEVEL	0
36	DHN-GMO	UP	292	100	294	350	2250	RISE	200
37	DHN-GMO	UP	294	350	294	800	450	RISE	227
38	DHN-GMO	UP	294	800	295	500	700	RISE	200
39	DHN-GMO	DN	295	500	295	750	250	LEVEL	0
40	DHN-GMO	DN	295	750	296	0	250	FALL	200
41	DHN-GMO	DN	296	0	296	250	250	LEVEL	0
42	DHN-GMO	DN	296	250	296	750	500	RISE	200
43	DHN-GMO	DN	296	750	299	600	2850	FALL	200
44	DHN-GMO	DN	299	600	300	150	550	LEVEL	0
45	GMO-KQR	DN	300	150	300	900	750	LEVEL	0
46	GMO-KQR	DN	300	900	301	750	850	FALL	233
47	GMO-KQR	DN	301	750	302	0	250	LEVEL	0



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
48	GMO-KQR	DN	302	0	302	800	800	RISE	200
49	GMO-KQR	DN	302	800	302	900	100	LEVEL	0
50	GMO-KQR	DN	302	900	303	350	450	FALL	400
51	GMO-KQR	DN	303	350	304	400	1050	LEVEL	0
52	GMO-KQR	DN	304	400	307	800	3400	RISE	200
53	GMO-KQR	DN	307	800	308	450	650	RISE	233
54	GMO-KQR	DN	308	450	309	900	1450	RISE	200
55	GMO-KQR	DN	309	900	310	800	900	RISE	667
56	GMO-KQR	DN	310	800	312	300	1500	LEVEL	0
57	GMO-KQR	DN	312	300	313	750	1450	RISE	200
58	GMO-KQR	DN	313	750	314	0	250	RISE	500
59	GMO-KQR	DN	314	0	314	650	650	FALL	500
60	GMO-KQR	UP	314	650	315	0	350	LEVEL	0
61	GMO-KQR	UP	315	0	316	0	1000	RISE	357
62	GMO-KQR	UP	316	0	316	250	250	RISE	200
63	GMO-KQR	UP	316	250	317	750	1500	RISE	250



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
64	GMO-KQR	UP	317	750	318	500	750	RISE	500
65	GMO-KQR	UP	318	500	321	500	3000	RISE	200
66	GMO-KQR	UP	321	500	324	450	2950	RISE	233
67	GMO-KQR	UP	324	450	326	750	2300	RISE	200
68	GMO-KQR	UP	326	750	327	500	750	RISE	500
69	GMO-KQR	UP	327	500	327	750	250	FALL	250
70	GMO-KQR	UP	327	750	328	0	250	FALL	303
71	GMO-KQR	UP	328	0	328	500	500	LEVEL	0
72	GMO-KQR	UP	328	500	329	500	1000	RISE	200
73	GMO-KQR	UP	329	500	332	500	3000	RISE	250
74	GMO-KQR	UP	332	500	332	750	250	LEVEL	0
75	GMO-KQR	UP	332	750	333	400	650	FALL	602
76	GMO-KQR	UP	333	400	334	800	1400	FALL	250
77	GMO-KQR	UP	334	800	335	500	700	FALL	500
78	GMO-KQR	UP	335	500	336	500	1000	FALL	250
79	GMO-KQR	UP	336	500	339	250	2750	FALL	200



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
80	GMO-KQR	UP	339	250	339	750	500	LEVEL	0
81	GMO-KQR	DN	339	750	340	0	250	RISE	200
82	GMO-KQR	DN	340	0	341	500	1500	RISE	188
83	GMO-KQR	DN	341	500	342	250	750	RISE	201
84	GMO-KQR	DN	342	250	342	450	200	LEVEL	0
85	GMO-KQR	DN	342	450	343	100	650	FALL	200
86	GMO-KQR	DN	343	100	343	300	200	LEVEL	0
87	GMO-KQR	UP	343	300	344	200	900	RISE	200
88	GMO-KQR	UP	344	200	345	800	1600	LEVEL	0
89	GMO-KQR	UP	345	800	348	500	2700	FALL	200
90	GMO-KQR	UP	348	500	349	300	800	LEVEL	0
91	GMO-KQR	UP	349	300	349	550	250	RISE	200
92	GMO-KQR	UP	349	550	349	750	200	LEVEL	0
93	GMO-KQR	UP	349	750	350	750	1000	FALL	200
94	GMO-KQR	DN	350	750	352	450	1700	LEVEL	0
95	GMO-KQR	DN	352	450	353	550	1100	RISE	200



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
96	GMO-KQR	DN	353	550	355	500	1950	RISE	233
97	GMO-KQR	DN	355	500	356	0	500	LEVEL	0
98	GMO-KQR	DN	356	0	357	750	1750	RISE	200
99	GMO-KQR	DN	357	750	358	400	650	LEVEL	0
100	GMO-KQR	DN	358	400	360	0	1600	RISE	200
101	GMO-KQR	DN	360	0	360	200	200	LEVEL	0
102	GMO-KQR	DN	360	200	362	750	2550	FALL	500
103	GMO-KQR	DN	362	750	364	0	1250	FALL	303
104	GMO-KQR	UP	364	0	364	500	500	LEVEL	0
105	GMO-KQR	UP	364	500	365	500	1000	RISE	233
106	GMO-KQR	UP	365	500	366	700	1200	RISE	200
107	GMO-KQR	UP	366	700	367	500	800	RISE	500
108	GMO-KQR	UP	367	500	368	250	750	FALL	581
109	GMO-KQR	UP	368	250	369	100	850	RISE	200
110	GMO-KQR	UP	369	100	370	950	1850	RISE	345
111	GMO-KQR	UP	370	950	371	150	200	LEVEL	0



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
112	GMO-KQR	UP	371	150	372	250	1100	FALL	200
113	GMO-KQR	UP	372	250	372	350	100	LEVEL	0
114	GMO-KQR	DN	372	350	372	750	400	RISE	333
115	GMO-KQR	DN	372	750	373	0	250	LEVEL	0
116	GMO-KQR	DN	373	0	374	700	1700	FALL	200
117	GMO-KQR	DN	374	700	374	950	250	LEVEL	0
118	GMO-KQR	DN	374	950	376	0	1050	RISE	200
119	GMO-KQR	DN	376	0	377	0	1000	LEVEL	0
120	GMO-KQR	DN	377	0	377	750	750	RISE	200
121	GMO-KQR	DN	377	750	382	500	4750	RISE	310
122	GMO-KQR	DN	382	500	383	750	1250	RISE	250
123	GMO-KQR	DN	383	750	384	750	1000	RISE	500
124	GMO-KQR	DN	384	750	385	750	1000	RISE	310
125	GMO-KQR	DN	385	750	387	100	1350	RISE	200
126	GMO-KQR	DN	387	100	388	350	1250	RISE	233
127	GMO-KQR	DN	388	350	389	350	1000	RISE	200



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
128	GMO-KQR	DN	389	350	389	500	150	LEVEL	0
129	GMO-KQR	DN	389	500	391	100	1600	FALL	500
130	GMO-KQR	DN	391	100	391	400	300	LEVEL	0
131	GMO-KQR	DN	391	400	392	250	850	RISE	200
132	GMO-KQR	DN	392	250	393	550	1300	LEVEL	0
133	KQR-MPO	DN	393	550	394	0	450	LEVEL	0
134	KQR-MPO	DN	394	0	394	650	650	RISE	303
135	KQR-MPO	DN	394	650	396	0	1350	FALL	250
136	KQR-MPO	DN	396	0	397	750	1750	FALL	200
137	KQR-MPO	DN	397	750	398	750	1000	FALL	230
138	KQR-MPO	UP	398	750	399	0	250	LEVEL	0
139	KQR-MPO	UP	399	0	400	0	1000	RISE	303
140	KQR-MPO	UP	400	0	400	250	250	RISE	300
141	KQR-MPO	UP	400	250	401	400	1150	LEVEL	0
142	KQR-MPO	UP	401	400	403	0	1600	FALL	400
143	KQR-MPO	UP	403	0	404	100	1100	LEVEL	0



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
144	KQR-MPO	UP	404	100	405	500	1400	RISE	303
145	KQR-MPO	UP	405	500	405	850	350	LEVEL	0
146	KQR-MPO	UP	405	850	408	300	2450	FALL	85
147	KQR-MPO	UP	408	300	409	550	1250	FALL	80
148	KQR-MPO	UP	409	550	409	700	150	LEVEL	0
149	KQR-MPO	UP	409	700	410	800	1100	RISE	400
150	KQR-MPO	UP	410	800	411	0	200	LEVEL	0
151	KQR-MPO	UP	411	0	412	750	1750	FALL	85
152	KQR-MPO	UP	412	750	417	500	4750	FALL	90
153	KQR-MPO	UP	417	500	422	100	4600	FALL	85
154	KQR-MPO	UP	422	100	424	600	2500	FALL	120
155	KQR-MPO	UP	424	600	426	100	1500	LEVEL	0
156	KQR-MPO	UP	426	100	429	0	2900	FALL	200
157	KQR-MPO	UP	429	0	429	900	900	FALL	500
158	KQR-MPO	UP	429	900	434	0	4100	FALL	250
159	KQR-MPO	UP	434	0	434	600	600	LEVEL	0



GRADIENT DETAILS							ANNEXURE - J		
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
160	KQR-MPO	UP	434	600	436	300	1700	FALL	200
161	KQR-MPO	DN	436	300	439	850	3550	LEVEL	0
162	KQR-MPO	DN	439	850	443	0	3150	FALL	200
163	KQR-MPO	UP	443	0	444	600	1600	LEVEL	0
164	KQR-MPO	UP	444	600	446	100	1500	FALL	259
165	KQR-MPO	UP	446	100	447	100	1000	LEVEL	0
166	KQR-MPO	DN	447	100	449	100	2000	FALL	308
167	KQR-MPO	DN	449	100	450	600	1500	LEVEL	0
168	KQR-MPO	DN	450	600	451	400	800	RISE	200
169	KQR-MPO	DN	451	400	452	0	600	LEVEL	0
170	KQR-MPO	DN	452	0	452	300	300	FALL	303
171	KQR-MPO	DN	452	300	455	100	2800	FALL	200
172	KQR-MPO	DN	455	100	456	100	1000	LEVEL	0
173	KQR-MPO	DN	456	100	456	750	650	RISE	250
174	KQR-MPO	DN	456	750	457	750	1000	LEVEL	0
175	KQR-MPO	DN	457	750	458	300	550	FALL	200



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
176	KQR-MPO	DN	458	300	458	700	400	FALL	233
177	KQR-MPO	DN	458	700	462	0	3300	LEVEL	0
178	KQR-MPO	UP	462	0	462	617	617	FALL	400
179	KQR-MPO	DN	462	710	464	400	1690	LEVEL	0
180	MPO-GYA	UP	464	400	466	450	2050	RISE	666
181	MPO-GYA	DN	466	450	467	590	1140	LEVEL	0
182	MPO-GYA	UP	467	590	468	820	1230	FALL	400
183	MPO-GYA	DN	468	820	469	640	820	LEVEL	0
184	GYA-SEB	UP	469	640	470	720	1080	LEVEL	0
185	GYA-SEB	DN	470	720	471	560	840	FALL	400
186	GYA-SEB	UP	471	560	474	420	2860	LEVEL	0
187	GYA-SEB	DN	474	420	475	560	1140	FALL	400
188	GYA-SEB	UP	475	560	476	640	1080	LEVEL	0
189	GYA-SEB	DN	476	640	477	480	840	RISE	400
190	GYA-SEB	UP	477	480	479	0	1520	LEVEL	0
191	GYA-SEB	DN	479	0	481	800	2800	RISE	400
192	GYA-SEB	UP	481	800	482	560	760	FALL	625



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
193	GYA-SEB	DN	482	560	483	720	1160	FALL	400
194	GYA-SEB	UP	483	720	484	160	440	LEVEL	0
195	GYA-SEB	DN	484	160	484	640	480	FALL	900
196	GYA-SEB	UP	484	640	485	720	1080	LEVEL	0
197	GYA-SEB	DN	485	720	486	240	520	RISE	400
198	GYA-SEB	UP	486	240	486	800	560	LEVEL	0
199	GYA-SEB	DN	486	800	488	480	1680	RISE	400
200	GYA-SEB	UP	488	480	488	720	240	LEVEL	0
201	GYA-SEB	DN	488	720	492	240	3520	FALL	4100
202	GYA-SEB	UP	492	240	497	0	4760	LEVEL	0
203	GYA-SEB	DN	497	0	497	600	600	FALL	1000
204	GYA-SEB	UP	497	600	499	120	1520	LEVEL	0
205	GYA-SEB	DN	499	120	501	720	2600	FALL	2000
206	GYA-SEB	UP	501	720	503	680	1960	FALL	1000
207	GYA-SEB	DN	503	680	506	640	2960	FALL	500
208	GYA-SEB	UP	506	640	507	760	1120	LEVEL	0
209	GYA-SEB	DN	507	760	508	200	440	FALL	960



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
210	GYA-SEB	UP	508	200	509	80	880	LEVEL	0
211	GYA-SEB	DN	509	80	510	160	1080	RISE	400
212	GYA-SEB	UP	510	160	510	640	480	RISE	425
213	GYA-SEB	DN	510	640	512	720	2080	LEVEL	0
214	GYA-SEB	UP	512	720	514	0	1280	FALL	625
215	GYA-SEB	DN	514	0	517	480	3480	FALL	400
216	GYA-SEB	UP	517	480	518	760	1280	LEVEL	0
217	GYA-SEB	DN	518	760	519	520	760	RISE	400
218	GYA-SEB	UP	519	520	519	720	200	LEVEL	0
219	GYA-SEB	DN	519	720	520	680	960	FALL	400
220	GYA-SEB	UP	520	680	521	800	1120	LEVEL	0
221	GYA-SEB	DN	521	800	523	480	1680	RISE	1000
222	GYA-SEB	UP	523	480	524	160	680	RISE	500
223	GYA-SEB	DN	524	160	525	0	840	LEVEL	0
224	GYA-SEB	UP	525	0	528	720	3720	RISE	500
225	GYA-SEB	DN	528	720	531	880	3160	LEVEL	0
226	GYA-SEB	UP	531	880	532	640	760	FALL	500



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
227	GYA-SEB	DN	532	640	534	400	1760	LEVEL	0
228	GYA-SEB	UP	534	400	535	240	840	FALL	500
229	GYA-SEB	DN	535	240	536	400	1160	LEVEL	0
230	GYA-SEB	UP	536	400	536	800	400	RISE	500
231	GYA-SEB	DN	536	800	539	480	2680	LEVEL	0
232	GYA-SEB	UP	539	480	539	880	400	RISE	500
233	GYA-SEB	DN	539	880	542	240	2360	LEVEL	0
234	GYA-SEB	UP	542	240	542	720	480	RISE	333
235	GYA-SEB	DN	542	720	543	800	1080	RISE	400
236	GYA-SEB	UP	543	800	545	160	1360	RISE	400
237	GYA-SEB	DN	545	160	546	640	1480	RISE	500
238	GYA-SEB	UP	546	640	546	880	240	LEVEL	0
239	GYA-SEB	DN	546	880	547	720	840	FALL	666
240	GYA-SEB	UP	547	720	549	40	1320	LEVEL	0
241	SEB-SSM	DN	553	880	555	80	1200	LEVEL	0
242	SEB-SSM	UP	555	80	555	640	560	RISE	500
243	SEB-SSM	DN	555	640	555	880	240	LEVEL	0



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
244	SEB-SSM	UP	555	880	556	920	1040	FALL	625
245	SEB-SSM	DN	556	920	558	800	1880	LEVEL	0
246	SEB-SSM	UP	558	800	559	700	900	RISE	2000
247	SEB-SSM	DN	559	700	561	320	1620	LEVEL	0
248	SEB-SSM	UP	561	320	561	880	560	FALL	2000
249	SEB-SSM	DN	561	880	562	400	520	LEVEL	0
250	SEB-SSM	UP	562	400	563	720	1320	RISE	1000
251	SEB-SSM	DN	563	720	569	320	5600	LEVEL	0
252	SEB-SSM	UP	569	320	570	480	1160	FALL	500
253	SEB-SSM	DN	570	480	570	800	320	LEVEL	0
254	SEB-SSM	UP	570	800	571	640	840	FALL	666
255	SEB-SSM	DN	571	640	572	640	1000	LEVEL	0
256	SSM-DDU	UP	572	640	574	160	1520	LEVEL	0
257	SSM-DDU	DN	574	160	576	240	2080	FALL	625
258	SSM-DDU	UP	576	240	577	800	1560	FALL	500
259	SSM-DDU	DN	577	800	578	720	920	FALL	2000
260	SSM-DDU	UP	578	720	579	640	920	FALL	2000



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
261	SSM-DDU	DN	579	640	581	880	2240	FALL	1754
262	SSM-DDU	UP	581	880	582	800	920	LEVEL	0
263	SSM-DDU	DN	582	800	585	560	2760	FALL	1000
264	SSM-DDU	UP	585	560	587	0	1440	LEVEL	0
265	SSM-DDU	DN	587	0	591	300	4300	FALL	835
266	SSM-DDU	UP	591	300	594	400	3100	LEVEL	0
267	SSM-DDU	DN	594	400	596	480	2080	FALL	1000
268	SSM-DDU	UP	596	480	597	320	840	FALL	1100
269	SSM-DDU	DN	597	320	598	480	1160	LEVEL	0
270	SSM-DDU	UP	598	480	602	720	4240	FALL	1000
271	SSM-DDU	DN	602	720	604	240	1520	FALL	2000
272	SSM-DDU	UP	604	240	605	300	1060	LEVEL	0
273	SSM-DDU	DN	605	300	606	320	1020	FALL	1000
274	SSM-DDU	UP	606	320	607	400	1080	LEVEL	0
275	SSM-DDU	DN	607	400	612	300	4900	FALL	2000
276	SSM-DDU	UP	612	300	613	400	1100	LEVEL	0
277	SSM-DDU	DN	613	400	615	0	1600	FALL	2000



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
278	SSM-DDU	UP	615	0	615	560	560	LEVEL	0
279	SSM-DDU	DN	615	560	616	10	450	FALL	999
280	SSM-DDU	UP	616	10	618	800	2790	FALL	2000
281	SSM-DDU	DN	618	800	620	560	1760	LEVEL	0
282	SSM-DDU	UP	620	560	624	800	4240	FALL	2000
283	SSM-DDU	DN	624	800	628	240	3440	LEVEL	0
284	SSM-DDU	UP	628	240	629	560	1320	FALL	1666
285	SSM-DDU	DN	629	560	630	640	1080	LEVEL	0
286	SSM-DDU	UP	630	640	631	640	1000	RISE	500
287	SSM-DDU	DN	631	640	632	0	360	LEVEL	0
288	SSM-DDU	UP	632	0	633	240	1240	FALL	625
289	SSM-DDU	DN	633	240	633	600	360	LEVEL	0
290	SSM-DDU	UP	633	600	635	720	2120	RISE	2200
291	SSM-DDU	DN	635	720	641	400	5680	LEVEL	0
292	SSM-DDU	UP	641	400	642	800	1400	RISE	400
293	SSM-DDU	DN	642	800	643	160	360	LEVEL	0
294	SSM-DDU	UP	643	160	643	400	240	FALL	400



GRADIENT DETAILS								ANNEXURE - J	
S.No	Section	Line	Km From	MET From	Km To	MET To	Length	Direction	Gradient
295	SSM-DDU	DN	643	400	643	900	500	FALL	625
296	SSM-DDU	UP	643	900	644	300	400	FALL	1000
297	SSM-DDU	DN	644	300	646	400	2100	LEVEL	0
298	SSM-DDU	UP	646	400	647	800	1400	RISE	2000
299	SSM-DDU	DN	647	800	655	0	7200	LEVEL	0
300	SSM-DDU	UP	655	0	656	300	1300	FALL	2000
301	SSM-DDU	DN	656	300	657	800	1500	LEVEL	0
302	SSM-DDU	UP	657	800	658	500	700	RISE	500
303	SSM-DDU	DN	658	500	662	600	4100	LEVEL	0
304	SSM-DDU	UP	662	600	664	480	1880	RISE	2000
305	SSM-DDU	DN	664	480	669	800	5320	LEVEL	0
306	SSM-DDU	UP	669	800	670	210	410	RISE	1000
307	SSM-DDU	DN	670	210	670	500	490	RISE	1000
308	SSM-DDU	UP	670	500	670	690	190	RISE	800
309	SSM-DDU	DN	670	690	671	940	1250	RISE	625
310	SSM-DDU	UP	671	940	673	1792	2852	LEVEL	0
311	DDU - CAR	DN	673	1792	673	1992	200	LEVEL	0



-----END of Feasibility Report-----