

Expression of Interest (EoI)
for
**Implementation of Vision Enhancement
System for Foggy Weather**

(at Bacheli Complex of Bailadila Iron Ore Mines in
Dantewada District of Chhattisgarh State
and Other Mines in India)



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TERMINOLOGY/ ABBREVIATIONS

- **ADS** Advanced Development System.
- **CSIR** Council of Scientific and Industrial Research.
- **CIMFR** Central Institute of Mining and Fuel Research
- **IEC** International Electro-Technical Commission.
- **LED** Light Emitting Diode.
- **IS** Indian Standard.
- **IR** Infrared.
- **AAR** Association of American Rail-roads.
- **SWIR** Short-wave infrared ($\lambda = 1.0$ to $3 \mu\text{m}$).
- **MWIR** Mid-wave infrared ($\lambda = 3$ to $5 \mu\text{m}$).
- **LWIR** Long-wave infrared ($\lambda = 8$ to 12 , or 7 to $14 \mu\text{m}$).
- **HMI** Human Machine Interface.
- **GPS** Global Positioning System.
- **GNSS** Global Navigation Satellite System.
- **RCS** Radar Cross Section.
- **AMOC** Annual Maintenance and Operations Contract.
- **RADAR** Radio Detection and Ranging.
- **LASER** Light Amplification by Stimulated Emission of Radiation.
- **V2V/V2X** Vehicle to Vehicle communication.
- **GPU** Graphics Processing unit.
- **CPU** Central Processing unit.
- **CNN** Convolution Neural Network.
- **DNN** Deep Neural Network.
- **VIS** Vision Improvement System.
- **VES** Vision Enhancement System.



1. INTRODUCTION

One of the major causes of vehicle accidents in opencast mine is reduced visibility due to bad weather conditions such as fog, haze, rain and low light conditions. Generally, the production rate is very low due to the reduced visibility during winter and rainy seasons in opencast mines. Fog can reduce visibility to near zero by fading the contrast and colour of the scene, making driving extremely difficult. While operating heavy earth moving machinery, the operator shall be aware of surrounding areas to avoid accidents and damage. Therefore, it is paramount importance for the mining industry to improve visibility of dumpers/shovel operators using the latest technologies so that mining operation can be continued during foggy weather to meet the growing demand for minerals.

Therefore, it is necessary to develop an Integrated Vision Enhancement System. The driver assistance system is required for effective visualization of transportation path as well as loading/unloading areas with the help of thermal imaging cameras, high definition cameras, proximity RADARs, Rover/Global Navigation Satellite System (GNSS), proximity RADAR, roadside edge detection arrangements (using flash light and self-regulating heating cable), retro-reflecting material, LED fitted vest, thermal binocular, etc.

2. SYSTEM REQUIREMENT

The required system for dumper is shown in Figures 1 and 2, for dozer is shown in Figure 3, for shovel is shown in Figure 4, for Jeep (shift in-charge vehicle) is shown in Figure 5, for drill machines is shown in Figure 6, for loader is shown in Figure 7, and for mine lease area is shown in Figure 8. The system shall use advanced thermal imaging cameras, proximity RADAR to identify and distinguish potential obstacle in front of the vehicle. The driver can toggle between front and rear-view thermal image footage while driving forward or while reversing. The system shall incorporate navigation with Rover/GNSS receiver for accurate positioning of itself and other surrounding vehicles while driving. Vehicle transceivers shall be used to transfer vehicle information such as its geolocation and simultaneously shall display the geolocations of other mining vehicles on the dashboard screen. The system shall detect any obstacle by proximity RADAR and warn the driver regarding potential obstacles in his path by audio-visual methods. The system shall incorporate road edge lights for better visibility during adverse weather condition. The system shall allow vehicle driver to communicate with the control room operator.

Anti-collision laser light shall be installed in the top of the rear end of the vehicle in both corners to provide horizontal virtual lines on road surface for a more eye-catching warning to the vehicle coming behind the dumper which will avoid traffic accidents while driving in rain,



fog, and low light conditions. The system includes a retroreflective LED vest for field supervisors which shall be visible from over a certain distance to reduce unfortunate accidents. The system shall also incorporate a self-regulating heating cable which shall be laid down along the haul road edge for better visibility of road edge through thermal imaging camera. Thermal binocular shall be provided to the field supervisor to monitoring mining activities at working face during foggy weather.

Initially, the vision enhancement system shall be installed in 8 dumpers, 4 shovels, 4 dozers, 3 drill machine, 1 loader and 9 jeeps (for shift in-charge) of Bailadila Iron Ore Mines (Bacheli Complex) of NMDC, in Dantewada District of Chhattisgarh State. After successful installation of the system at Bacheli Complex, it will be installed in other mines of the country where problem of fog persist as per the requirement and financial support of mining industry.

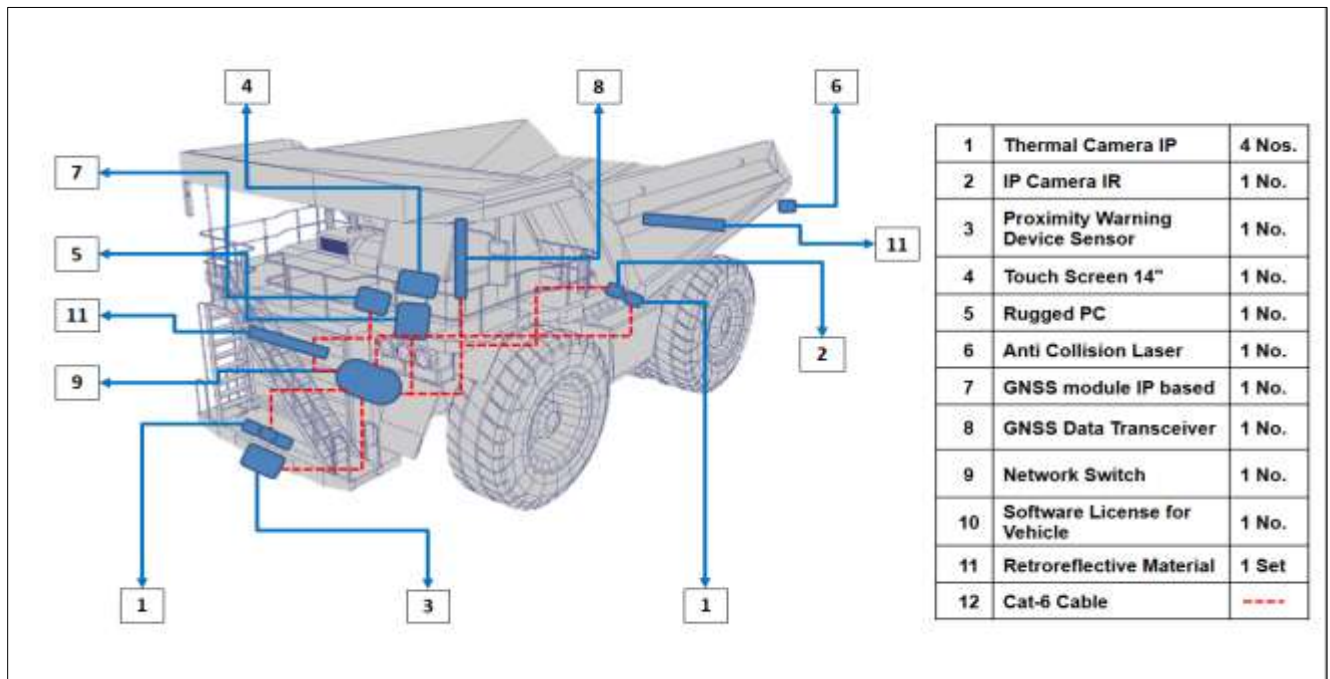


Figure 1: Layout of required system for dumpers



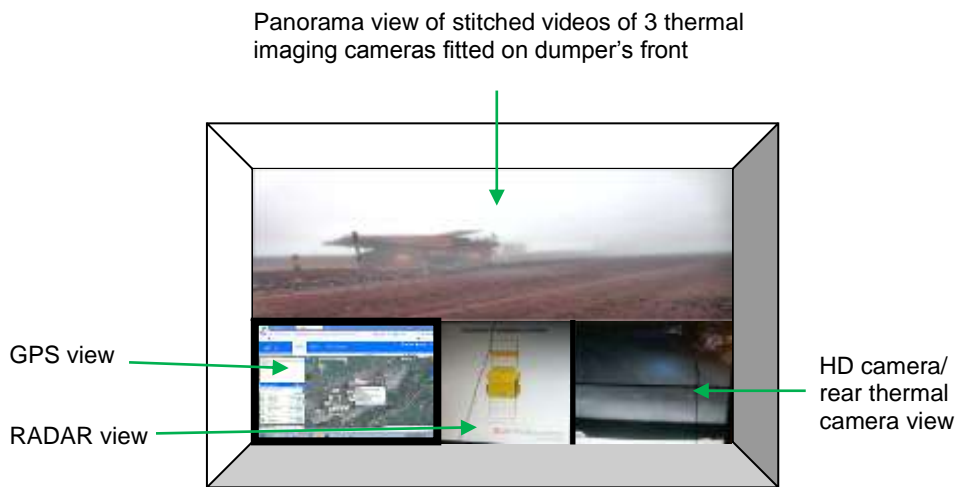


Figure 2: Display arrangement in front of driver's dashboard

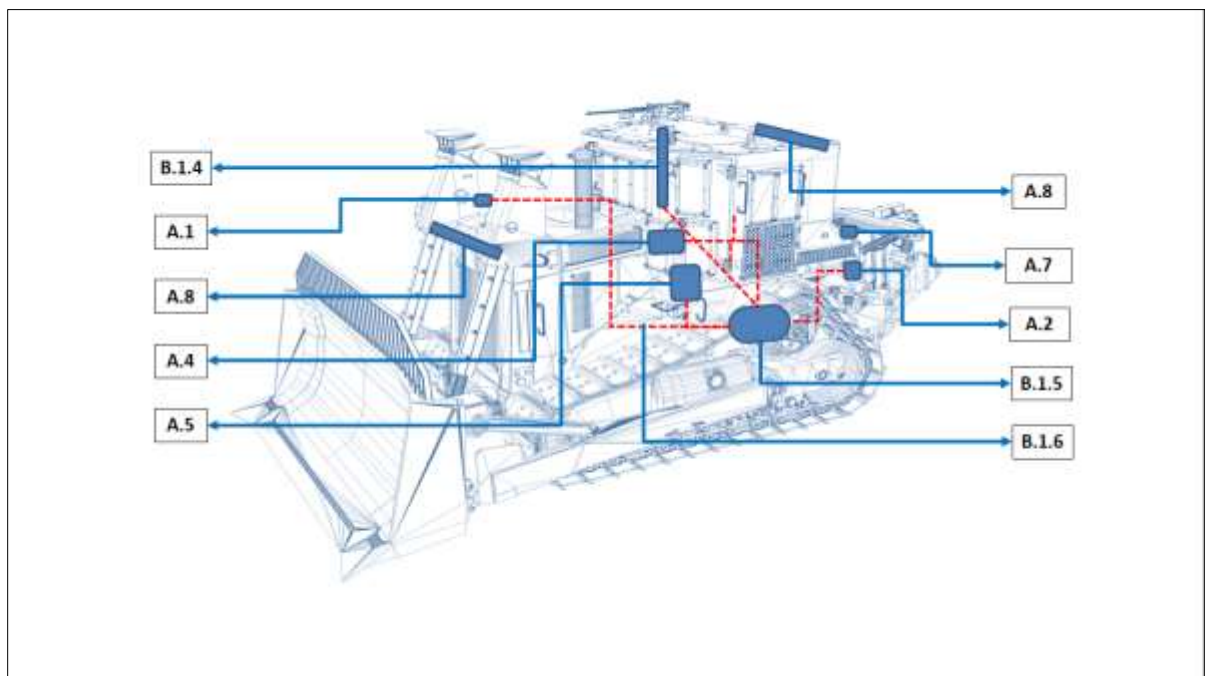


Figure 3: Layout of required system for Dozer



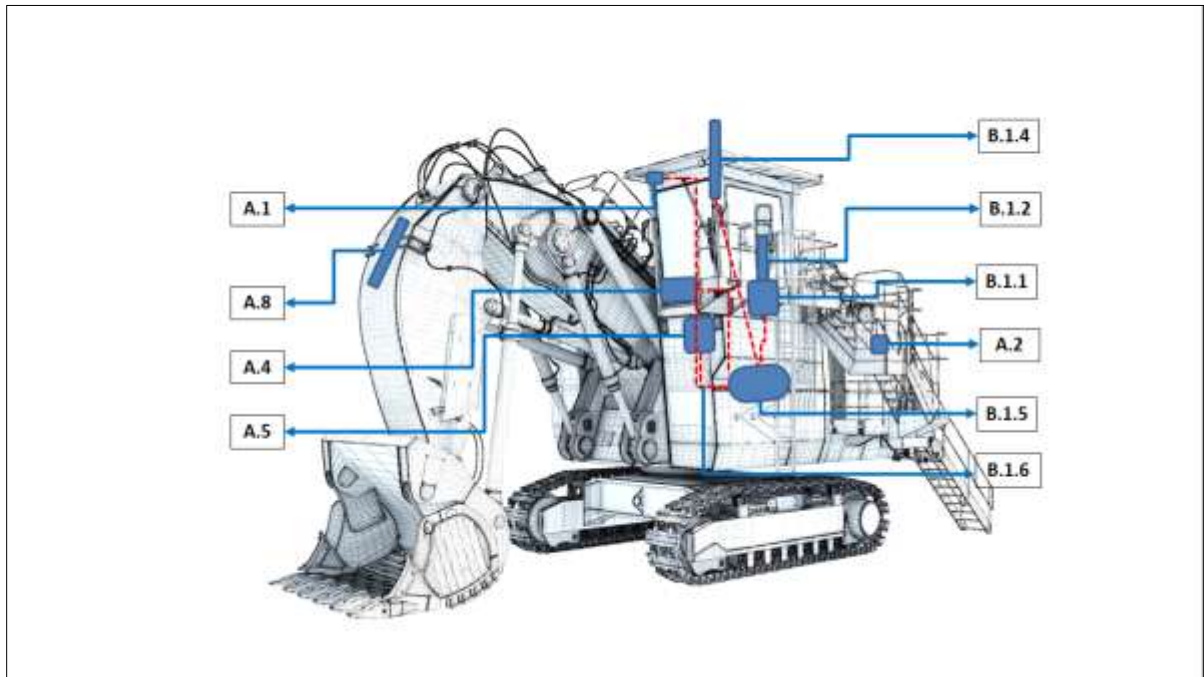


Figure 4: Layout of required system for Shovel

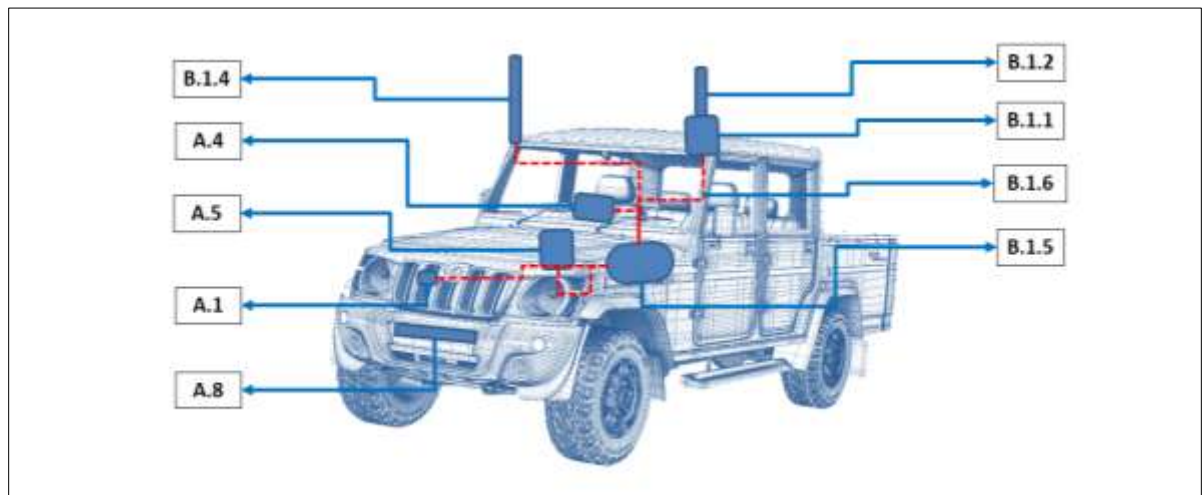


Figure 5: Layout of required system for Jeep (Mining Vehicle)

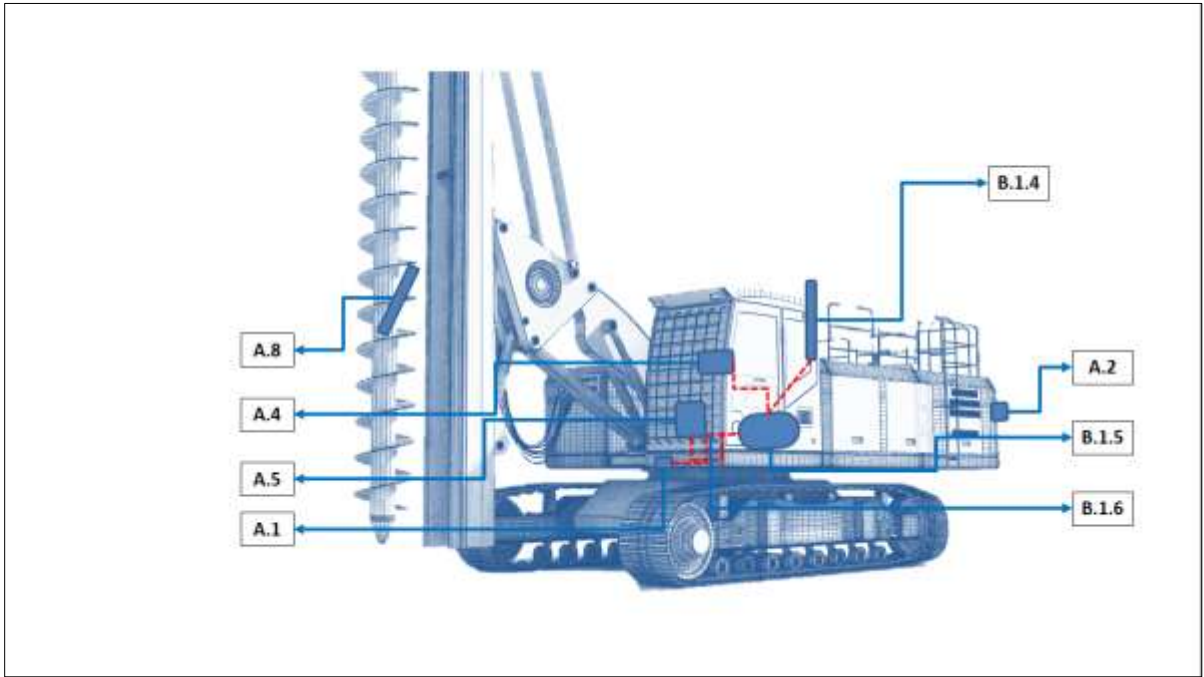


Figure 6: Layout of required system for Drill Machine

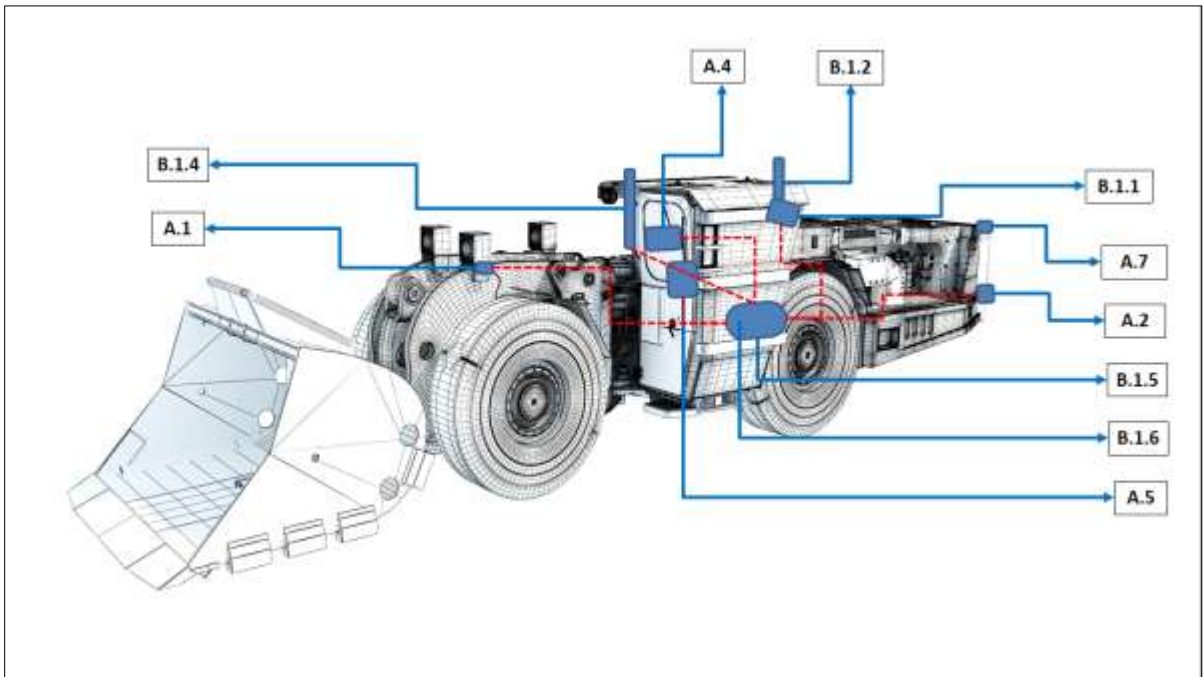


Figure 7: Layout of required system for Loader



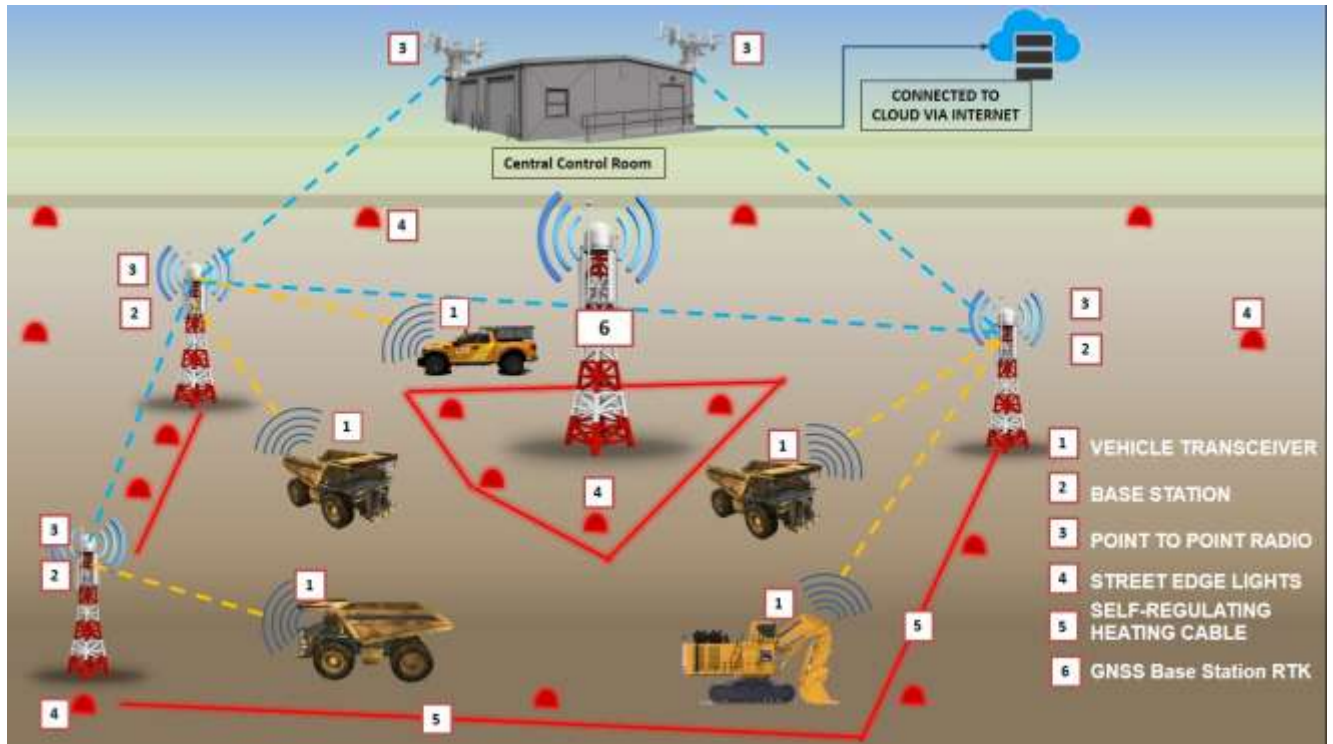


Figure 8: Layout of required system for Mine Communication

Major features of the system:

1. Driver shall be able to drive the dumper by seeing the display screen fitted in front of driver on the dashboard of vehicle.
2. Panorama view (stitched real-time videos) of all the 3 thermal imaging cameras installed in the front of driver shall be displayed on top of display screen as shown in Figure 2.
3. Artificial intelligence features and video analytics shall be incorporated in the thermal imaging processor and it shall be simultaneously integrated with real-time video footage display on screen for obstruction of objects, road edge detection, etc.
4. GPS/GNSS map view, RADAR detection view and HD camera/rear thermal camera view shall be displayed on the bottom of screen as shown in Figure 2.
5. Dumper operator shall be able to see the location of surrounding vehicles on the screen fitted in front of him in the Google map.



6. Front thermal imaging cameras frame shall be installed in such a way that viewing angle of the camera is always focused on road surface of dumper's front while dumper moves on plane or hilly road.
7. The system shall have recording facility of videos for atleast for 2 days record.
8. All the detection/warning signal shall be recorded in the system with date and time stamp logs.
9. Anti-collision laser light shall be installed in both corners of dumper's back with 2 nos. of light in each corner focusing in different angles so that atleast one bar line of laser line is displayed on road surface while the vehicle moves on hilly/plane roads.
10. While any moving object is detected by the RADAR, it shall display its position on display screen with audio alarm.
11. All thermal camera view can be enlarged with touch screen facility.
12. Rear thermal camera view and HD camera view shall be interchangeable in the same portion of display by touch screen facility.
13. Flashing LED light shall be displayed in the junction point or road crossing points.
14. Self-regulating heating cable shall be laid down on road edge wherever required for demarcating road edge detection using thermal imaging camera.
15. All the processing and display unit shall be installed in a single box with rack arrangement in the dumper's cabin.
16. Rover/GNSS/dumper's location view shall be displayed in the control room through wireless network.
17. Power for the total items fitted on dumper shall be safely taken from the respective dumper itself.
18. GNSS software report shall be generated from the central server and it shall be web-enabled so that it can be accessed from anywhere in the world.
19. The system shall allow vehicle driver to communicate with the control room operator.
20. A complete software shall be provided for vehicle tracking, geo-fenced area violation with alert through SMS, email and pop-up menu on the screen, daily production report, total run per day/shift/month, exception reports, down time reporting, viewing of path of each dumper, etc. as per the requirement of the respective mine management.



21. Dumper master data (health condition status parameters using various sensors) stored in the control unit of vehicle shall be interfaced using RS232 or TCP/IP port with the system for the purpose of wireless transmission of data to the central server in the control room for further data analysis as desired by the mine management. The data from the sensor and its protocol shall be shared by the owner of HEMM through its OEM.
22. The system shall be compatible with the future up-gradation of vehicle tracking/fleet management system, like introduction of rover and base station for accurate vehicle position system.
23. All the items proposed in shovels, dumpers, dozers, loaders, drill machines and shift incharge's jeeps with taping power from it.
24. LED fitted vest shall be used by mining persons working in the mine during foggy weather for better visibility of dumper's operator through thermal imaging camera.
25. Thermal imaging binocular shall be provided to the mining persons deputed at working face.
26. The GPS/GNSS software shall be used to monitor the position of mobile mining equipment online in mine and thereby providing enhanced vision in form of location of complete fleet and optimise the use and performance of the equipment.
27. In particular the system shall facilitate dispatch of dump trucks between the shovels, excavators and dumping points of the mine in foggy weather.
28. The system shall cater to all the aspects of production, performance and quality monitoring and reporting for mine in a single unified database. The user shall be allowed to view information at every level (i.e. equipment, section, mine) of the operation. The system shall be able to accept various performance indicators like trip count, working hour, idle hour, break down hours, maintenance hours, cycle time details, trips per hour and other forms of reporting, HEMM availability, HEMM utilization, HEMM overall equipment efficiency, operator performance, etc.
29. To achieve full functionalities and maximum advantage of this system, it shall have a provision to be integrated with ERP in future.
30. All reports (text, tabular and graphical) generated by the vision enhancement system and Truck Despatch System, shall have a provision to be published in web compliant format as and when required.



31. The system shall be able to improve the availability and utilization of all HEMM and allied equipment (Dumpers, Shovels, Dozers, Loaders, etc.) within the mine site and monitor and manage the fuel consumption in the mine (for future integration).
32. The system shall be able to interface with third party fuel management system, if required in future. In case fuel management system is not available, the system shall have a provision for manually entering fuel dispensed in the HEMMs.

Different components required for the total system are as follow:

1. **Thermal Imaging Camera:** Thermal imaging camera is a hermetically sealed system rated to IP-66 scanning at a rate 50 times per second and sensing temperature range from 0 °C to 100 °C.
2. **Street Edge Lights:** Street edge warning lights shall be used to outline the edges of a road during periods of darkness, fog, rain, haze or restricted visibility conditions and also in road edge detection using thermal camera.
3. **IR Camera:** High Definition camera shall help in reversing the vehicle. It shall be installed with rear proximity RADAR.
4. **Proximity radar:** Proximity radar for avoiding vehicle collision and having a detection range up to 25 m.
5. **Anti-Collision LASER:** This laser shall be implemented at the top of rear end of a vehicle, which shall provide more eye-catching position warning to the vehicle behind and to avoid traffic accidents while driving in rain, fog, and low light condition.
6. **Reflective LED Vest:** High visibility LED vests ensures miners to stay visible by heavy vehicles and stay safe.
7. **Self-Regulating Heating Cable:** Better visibility of road edge through thermal imaging camera.
8. **Rover/GNSS/GPS:** Rover/Global Navigation Satellite System (GNSS)/ Global Positioning System (GPS) over a vehicle for receiving locations of nearby vehicles in mine map and navigation instructions, with accurate and faster delivery of mapping data to the driver.
9. **Control Unit:** Control unit device shall be a separate module/ integral with other devices.



10. **Software:** It shall be used for vision enhancement in image processing, edge detection and object detection using machine learning algorithm like CNN, DNN, etc.
11. **Vehicle Transceiver:** Vehicle transceiver shall be used to transmit vehicle position to the nearest base station simultaneously receive the positions of other vehicles inside mine premise on to its dashboard.
12. **Base Station:** Base stations shall be used to collect and transmit all the information from and to the vehicle. All the vehicles shall be connected to at least one base station for data transmission through its transceiver and data receiving for both the moving and stationary vehicles.
13. **Point to Point Transceiver:** P2P modems shall be used to connect all the base stations together and to the control room.
14. **Touch Screen:** With screen size of more than 16”, it shall be used to display front paranoma view of front thermal cameras as single stitched image, along with proximity warning audio and visual alarms, rear camera and geo-locations of all the vehicles in the near vicinity of the vehicle.
15. **Rugged PC/ Control Unit:** Rugged PC / Control Unit shall be used to process all the information of the cameras, proximity warning RADARs and GNSS.
16. **Network Switch for Vehicles:** All the Ethernet based modules such as cameras, Radars, GNSS, Rovers, Control Unit shall be connected via network switch in vehicle.
17. **Thermal Binocular:** It will be provided to the site supervisor for monitoring mining operation at working face in foggy weather.



3. BILL OF MATERIAL

The required vision enhancement system shall contain the following major components in each vehicle which are within the scope of supply.

Module-A: Devices for Vision Enhancement															
S. No	Equipment -->	Dumper		Dozer		Shovel		Jeep		Drill machine		Loader		Lease	Total Qty.
	No of Equipment -->	8		4		4		9		3		1			
	Material	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total		
A.1	Thermal Camera IP	4	32	1	4	1	4	1	9	1	3	1	1	-	53
A.2	IR Camera IP 20 m	1	8	1	4	1	4	-	-	1	3	1	1	-	20
A.3	Proximity Warning Device Sensor	1	8	-	-	-	-	-	-	-	-	-	-	-	8
A.4	Touch Screen 16"	1	8	1	4	1	4	1	9	1	3	1	1	-	29
A.5	Rugged PC	1	8	1	4	1	4	1	9	1	3	1	1	-	29
A.6	Software License for Vehicle	1	8	1	4	1	4	1	9	1	3	1	1	-	29
A.7	Anti Collision Laser Light (each set with 2 laser lights)	2	16	1	4	-	-	-	-	-	-	1	1	-	20
A.8	Retroreflective Material	2	16	2	8	1	4	1	9	1	3	-	-	-	40
A.9	Street Edge Lights	-	-	-	-	-	-	-	-	-	-	-	-	50	50
A.10	Self-Regulating Heating Cable (500 m) with junction boxes (10 Nos.), temperature regulators (10 Nos.) and mounting kits	-	-	-	-	-	-	-	-	-	-	-	-	1	1
A.11	Reflective LED vest with battery and charging arrangement	-	-	-	-	-	-	-	-	-	-	-	-	50	50
A.12	Thermal binocular	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Module-B1: Truck Dispatch System for Fleet Management															
	Material	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total		Total Qty.
B1.1	GNSS Rover	1	8	-	-	1	4	1	9	-	-	1	1	-	22
B1.2	GNSS Reciever Antenna	2	16	-	-	1	4	1	9	-	-	1	1	1	31

B1.3	GNSS Base Station RTK		-	-	-	-	-	-	-	-	-	-	-	1	1
B1.4	Vehicle Access Point / Base Station	1	8	1	4	1	4	1	9	1	3	1	1	1	30
B1.5	Network Switch for Vehicles / Base Station	1	8	1	4	1	4	1	9	1	3	1	1	1	30
B1.6	CAT6 Armoured (in Rolls) 1Roll=100Yards	0.2	2	0.2	1	0.2	1	0.2	2	0.2	1	0.2	0	4	10
Module-B2: Mesh Network for Truck Dispatch System															
	Material	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total		Total Qty.
B2.1	Base Station	-	-	-	-	-	-	-	-	-	-	-	-	15	15
B2.2	Point to Point Radio	-	-	-	-	-	-	-	-	-	-	-	-	10	10
B2.3	Network Switch	-	-	-	-	-	-	-	-	-	-	-	-	6	6
B2.4	Pole	-	-	-	-	-	-	-	-	-	-	-	-	5	5
B2.5	UPS 1 KVA with 27 Ah battery 3 Nos.	-	-	-	-	-	-	-	-	-	-	-	-	5	5
B2.6	Junction Box	-	-	-	-	-	-	-	-	-	-	-	-	5	5
Module-B3: Control Room															
	Material	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total		Total Qty.
B3.1	Server	-	-	-	-	-	-	-	-	-	-	-	-	1	1
B3.2	Software for Vision Enhancement	-	-	-	-	-	-	-	-	-	-	-	-	1	1
B3.3	Rack 9U for control Room	-	-	-	-	-	-	-	-	-	-	-	-	1	1
B3.4	Rack for Server	-	-	-	-	-	-	-	-	-	-	-	-	1	1
B3.5	Screen 43"	-	-	-	-	-	-	-	-	-	-	-	-	2	2
B3.6	UPS 3 KVA with 65 Ah battery 6 Nos.	-	-	-	-	-	-	-	-	-	-	-	-	1	1



4. SPECIFICATIONS

Sl. No.	MATERIAL	SPECIFICATION	CONFIRMATION BY SUPPLIER ABOUT THE SPECIFICATIONS	
			Confirmation by the firm (Yes/No)	Details available in catalog No. and page no.
Module-A: Devices for Vision Enhancement				
A.1	Thermal Camera IP	1. Resolution (minimum): 640 x 480 pixels		
		2. Frame Rate (minimum): 25 fps		
		3. IP Support: Yes (RJ45)		
		4. Recording support: Micro SD: 64 GB or higher		
		5. Video Compression: H.264		
		6. Onvif Support: Yes		
		7. Field of View: 60° (h) x 45° (v)		
		8. On Board Analytics: Yes		
		9. Ingress Protection: IP66 or better		
		10. Power Supply: 9-24 VDC		
A.2	IR Camera IP 20m	1. Resolution: 640 x 480 pixels	-	-
		2. Frame Rate: 25 fps	-	-
		3. Range: 20m	-	-
		4. IP Support: Yes (RJ45)	-	-
		5. Ingress Protection: IP66 or better	-	-
		6. Power Supply: 9-24 VDC	-	-
A.3	Proximity Warning Device	1. Sensor: Radar based		
		2. License: License Free Band as per WPC		
		3. The sensor(s) shall detect objects in a virtual target area as defined below		
		a. Detection Range: 25 m or better		
		b. Detection Width: Adjustable to the width of truck +1m on both sides		
		4. Ingress Protection: IP66 or better		
		5. Warning indication: Audio and Video		
6. Power supply: 9-24 V DC				
A.4	Touch Screen	1. Touch screen 16" size or more		
		2. To be mounted on truck/dumper dash board with folding arrangement		

		3. Interface: VGA / HDMI / Ethernet / RS232 / RS422		
A.5	Rugged PC	4. Windows PC, 2GB RAM, 32GB Storage or better		
		5. Fanless Design		
		6. External Interface: Serial / HDMI / VGA / Ethernet / USB		
		7. Operating voltage: 12-24 V DC		
		8. Operating temperature: -10°C to 70°C		
A.6	Software & License for Vehicle	1. The System software shall amplify the color, sets the brightness and contrast to the input video to make objects more visible by reducing the effect of Fog, Mist, Haze and Smog.		
		2. Ensures real-time operation, a faster CPU/GPU with the dedicated graphics processing unit to be well suited for intensive real-time processing.		
		3. The system is able to operate at a high frame rate and it is suitable for real-time driving assistance in adverse weather conditions.		
		4. The system shall provide a clear image to the driver's screen in day and night so that he can drive well and mining operation shall continue without any break and shall adopt in any weather condition.		
		5. The software will be interactive to the operator in a simple language as possible. The software shall provide at least the followings:		
		5.1. Image Stitching		
		5.2. Image Enhancement		
		5.3. Motion and object detection		
		6. Video enhancement		
		6.1. Edge detection and Object detection		
		6.2. Machine learning algorithm preferably (CNN, DNN)		
		6.3. Data Base Auto Backup Facility		
		6.4. Identify the vehicle navigation system		
		7. Display and detection from proximity warning device will be automatically given on the screen, without any real-time lag.		
		8. If any camera (IR/Thermal) is not working or damaged, it shall display an error message on the driver's screen displaying the particular camera identity.		
9. The software will save the date and time along with all other details for recording without any delay.				



		10.If the system is inconsistent or Rover/GNSS is not found or incorrect, a sound/message instruction will be issued. The main computer will get an alert of the error occurred.		
A.7	Anti Collision Laser Light	1. Operating range: 25 m or more. 2. Laser Beam: Modified for anti-collision applications 3. Power Source: 9-24 V DC 4. Operating Temperature: -30 °C to +70 °C 5. It shall be installed in both corners of dumper's back with 2 nos. of light in each corner fitted in a frame with different angles		
A.8	Retroreflective Material	1. High Intensity Reflective Multi Color Tape 48mmx2m 2. It reflects during night/dark from a distance of over 2 km 3. Self-adhesive, Durable, Longer Life and Reflect during Night		
A.9	Street Edge Lights	1. Power supply: 60W/100W/150W/200W/240W 2. Light efficiency: up to 140 lm/W 3. CCT: 4500~5500K (2500~5500K optional) 4. IP66 IK08 protection rating 5. LED lifespan > 100,000 hours(TM-21 L70) 6. Operating temp: -40 °C+55 °C		
A.10	Self-Regulating Heating Cable with junction boxes (IP65), temperature regulator and mounting kit	Maximum continuous exposure: 100 °C Minimum installation and operating temperature:-40 °C Power supply: 220 V Maximum resistance of protecting braiding: 18.2 Ohm/km Normal power consumption: 45 W/m		
A.11	Reflective LED Vest	Vest with reflecting strips and LED including battery and charging arrangement		
A.12	Thermal binocular	Visibility shall be minimum of 75 m during foggy weather and night		
Module-B1: Truck Dispatch System				
B1.1	GNSS Rover	1. To be mounted on truck 2. Accuracy < 10 cm 3. RTK Corrections 4. GPS Interface: Etherent / RS232 / RS422 5. The device shall fulfill the requirements mentioned in the scope of Work		
B1.2	GNSS	1. Frequency Range: GAGAN / GPS / GLONASS		



	Receiver Antenna	2. Impedance: 50 ohm		
		3. Polarization: RHCP		
		4. Azimuth Coverage : 360 degree		
		5. Phase Center Accuracy: 2 mm		
B1.3	GNSS Base Station RTK	1. Accuracy <10 cm		
		2. RTK correction		
		3. GPS interface Ethernet/RS232/RS422		
		4. The device shall fulfill the requirements mentioned in the scope of Work		
B1.4	Vehicle Access Point / Base Station	1. 802.11a/n radio		
		2. Speed up to 300 Mbps or better		
		3. Frequency Range: 5.725-5.875 GHz		
		4. Omni Antenna 360 degree		
		5. Enclosure: IP6		
		6. 10/100/1000 Base-T Ethernet		
B1.5	Network Switch for Vehicles	1. Managed / Unmanaged		
		2. Port 10/100/1000 GigE		
		3. Operating Temperature: -40 ⁰ C to +70 ⁰ C		
		4. Operating Voltage: 12VDC-24VDC		
B1.6	CAT6 Armoured	1. Applicable Standard : TIA/EIA and ISO Category6 / Class E Requirements.		
		2. Voltage : 300 V AC or DC		
		3. Cable shall have polyethylene Insulation and PVC Jacket		
Module-B2: Mesh Network for Truck Dispatch System				
B2.1	Base Station	1. 802.11a/n radio		
		2. Speed up to 300 Mbps or better		
		3. Frequency Range: 5.725-5.875 GHz		
		4. Enclosure: IP66		
		5. 10/100/1000 Base-T Ethernet		
B2.2	Point to Point Radio	1. 802.11a/n radio		
		2. Speed up to 300 Mbps or better		
		3. Frequency Range: 5.725-5.875 GHz		
		4. Enclosure: IP66		
		5. 1x 10/100/1000 Base-T Ethernet		
B2.3	Network Switch	5. Managed L2/L3.		
		6. Port 10/100/1000 GigE		
		7. Operating Temperature: -40 ⁰ C to +50 ⁰ C		
		8. Operating Voltage: 220-240 V AC		



B2.4	Pole	1. Overall Length: 6 m		
		2. Effective Diameter: 4 Inches		
		3. Material: GI or Stainless Steel		
B2.5	UPS 1 KVA with 27 Ah battery 3 nos	1. Capacity: 1000 VA		
		2. Input Voltage Range: 160-280 V AC; 40-70 Hz		
		3. Output Voltage: 200/208/220/230/240VAC		
		4. Waveform: Pure Sine wave		
		5. Battery: 27 Ah, 3 nos.		
B2.6	Junction Box	1. Vandal Proof Junction box with proper gland as per site requirement Junction box is to accommodate all the equipment like UPS, Network switch, cable termination strip, and other components at the site. Hence, this shall be mounted firmly on the pole with GI iron clamps.		
		2. Ingress Protection rating of Junction Box is such that the equipment inside the box is protected from dust and water		
		3. The junction box shall be lockable and shall have all cable entries at the bottom.		
		4. All the equipment major components shall be accommodated in the junction box, which is to be mounted on same pole.		
Module-B3: Control Room				
B3.1	Server	1. Intel Core Xeon (latest generation)		
		2. Number of Processor: 2		
		3. CPU: 2.4 GHz or higher		
		4. RAM: Minimum 16 GB		
		5. Primary HDD: 3x300 GB (OS) + 4 TB (4x1 TB)		
		6. USB 2.0 Ports		
		7. 2 RJ45 Gigabit Ethernet ports		
B3.2	Software for Vehicle Tracking and Fleet Management	1. Different vehicle locations for tracking the vehicles on GIS Map.		
		2. Showing real time locations of the vehicle and route undertaken on the GIS Map.		
		3. Showing total distance travelled, Total time, time taken between stops, time taken during a trip, stoppage reports with round trips travelled by vehicle.		
		4. Facility to Monitor Route Deviations / Geofence deviations		
		5. To generate MIS reports on route, distance, number		



		of round trips travelled by vehicles on a daily/weekly/monthly/custom interval.		
		6. Geo-Fences: The facility to setup points along the route and area that the vehicle must travel to within a specific time frame and receive violation alerts when these are breached.		
		7. Alerts: To receive notification alerts when rover/GNSS unit was tampered or cut off from the vehicle battery, route violation, geo-fence violation, stoppage beyond specific period.		
		8. Different vehicle locations for tracking the vehicles on GIS Map.		
		9. Shall fulfill the requirements mentioned in the scope of Work		
		10. Fleet Management Software: The software shall provide fleet management facility for optimization of shovel-dumpers performance		
B3.3	Rack 9U for control Room	1. Rack with proper fitting as per site requirement		
		2. Rack is to accommodate all the equipment like Network switch, cable termination strip, and other components at the site.		
		3. This shall be mounted firmly on the wall.		
		4. Rack shall be lockable and shall have all cable entries at the bottom/top.		
		5. For terminating all cables, Rack shall have suitable terminating block or connections.		
B3.4	Rack for Server	6. Rack with proper fitting as per site requirement		
		7. Rack is to accommodate server		
		8. Rack shall be lockable and shall have all cable entries at the bottom/top/back.		
B3.5	Screen 43"	1. Diagonal Class: 43 inches		
		2. Resolution :1920 x 1080		
		3. Display Type: LED TVs		
		4. Display Format: Full HD 1080p		
		5. Other Input(s): HDMI, USB, Optional Ethernet		
		6. Speaker System: 2 Channel		
B3.6	UPS 3 KVA with 65 Ah battery 6 nos.	1. Capacity: 3000VA		
		2. Input Voltage Range: 160-280 V AC; 40-70 Hz		
		3. Output Voltage: 200/208/220/230/240 V AC		
		4. Waveform: Pure Sine wave		
		5. Battery: 65 Ah, 6 nos.		



5. SYSTEM REQUIREMENT

Sl. No.	TERMS AND CONDITIONS	Confirmation by the Supplier	
		Yes/ No	Remarks
A.	GENERAL REQUIREMENT		
1.	The supplier shall provide the system as per the indented specification and features.		
2.	The supplier shall handover the complete details of equipment to CSIR-CIMFR, Dhanbad along with user manual, technical specifications, and other necessary documents.		
3.	The supplier shall give comprehensive training to a group of CSIR-CIMFR staffs as well as dumper operators for 5 days at Bailadila explaining details of the equipment operation, technical aspects, working and other necessary information to run, operate and troubleshooting.		
B.	TECHNICAL REQUIREMENT		
1.	The system shall be user-friendly, providing hands-free and fully automatic features.		
2.	The system shall be highly rugged for the external environment.		
3.	Proper vibration isolation technology shall be provided for the system at the physical level.		
4.	Video stabilization algorithms shall be implemented to stabilize real-time videos.		
5.	Hermetic ceiling shall be provided for critical components.		
6.	Every component of the system shall be mounted on vehicle itself. The system shall be self-sufficient and there shall not be any installation on the trackside except street edge lights and electric heating cable.		
7.	The system shall be universally suitable for all types of vehicles /equipment in opencast mines.		
8.	The device must work in all types of weathers and terrains encountered in India, including high rainfall, dense fog conditions, etc.		
11.	The device must not distract the driver of vehicle/equipment with too many alarms/blinking Lights/flasher etc. during the course of his normal working and especially when no abnormal conditions		



	are existing on the road ahead.		
13.	The video so stored as above must be in a format that can be copied to a portable Hard Disk (USB) or a USB flash drive using software that shall be a part of the system installed on the vehicle and it shall be possible to simply copy it without the need for any other devices. Quality of video so transferred shall be as clear as the original video.		
14.	The display before the driver of the Vehicle shall support colour display. Visuals on the screen shall be uncluttered with only relevant information being displayed in different colors. The colour of an image which is likely to pose danger to the Vehicle shall preferably be in red colour to differentiate it from other images which do not pose any threat to the vehicle.		
15.	If the imaging processing device fails, then it shall give a positive indication to the driver/operator that the system has become inoperative. This shall be an act of positive alarm to the driver. Such alarm/warning shall be acknowledged by the driver through a positive act of acknowledgment.		
16.	The system video output shall be according to the following specification: (i) Video resolution shall be at least 1280 X 960 p. (ii) The video refresh rate shall be at least 50 Hz. (iii) Video latency of the system shall be less than 50 mSec		
17.	System control shall preferably be implemented by an HMI with a touch panel for display.		
18.	Vision improvement system (VIS) shall be powered from the Vehicle battery power supply of 24 volts or 24 volts DC and 110V DC for Vehicle Dumper, Jeep and shovels.		
19.	VIS shall have a logic that enables auto shut down when the vehicle is off.		
20.	For the camera, a common mounting platform shall be used. The mounting arrangement of the camera shall be such that clear view is available and it is robust to sustain and isolate jerk and vibration experienced while dumpers are running.		
21.	The processing unit of VIS shall be installed at a suitable location and total system shall be fitted in a box.		
C.	REQUIREMENT OF WIDE AREA NETWORK FOR DATA COMMUNICATION		
1.	The supplier shall be responsible for setting up Data network catering to Data communication of 115 Kbps or higher data rate from each Rover Stations to Base Station (i.e. FWS) and 11 Mbps or higher backbone using Spread Spectrum or higher generation		



	System within the project comprising of Base Station, Section offices, Rover station, GM offices, workshops and other locations where all the clients will be located with all necessary accessories, equipments, towers, repeaters etc. They will also be responsible for supply and laying of all cables as required for connecting the servers with work stations, clients etc.		
2.	Bidder shall be required to provide all data communication hardware equipment, accessories, components, cables etc. and software required at control room and Base Station for data communication with Rover Stations,		
3.	Bidder shall be required to provide all communication hardware equipment, accessories, components, cables etc. and software required at Rover Stations for data communication with Base Station.		
4.	Bidder shall be required to provide all communication hardware equipment, accessories, components, cables etc. and software required at section offices for establishing data connectivity with base station, either as an extension of base station LAN or WAN.		
5.	Bidder shall be required to provide all communication hardware equipment, accessories, components, cables etc. and software required at Control room and field offices and other client locations for establishing data connectivity with base station with a speed of 11 mbps or higher.		
6.	Bidder shall ensure data communication between the Base Station and control room being vital to the performance of the system, provision of hot standby arrangement between the Base Station and Section Offices to ensure redundancy.		
7.	Bidder has to ensure network availability at all the working faces (Mineral / OB) through Radio connectivity using access point and if required, bidder shall use existing lighting towers and poles / towers for connectivity.		
D.	SYSTEM FEATURES REQUIREMENT		
1.	Driver shall be able to drive the dumper by seeing the display screen fitted in front of driver on the dashboard of vehicle.		
2.	Panorama view (stitched real-time videos) of all the 3 thermal imaging cameras installed in the front of driver shall be displayed on top of display screen.		
3.	Artificial intelligence features and video analytics shall be incorporated in the thermal imaging processor and it shall be simultaneously integrated with real-time video footage display on screen for obstruction of objects, road edge detection, etc.		
4.	GPS/GNSS map view, RADAR detection view and HD camera/rear		



	thermal camera view shall be displayed on the bottom of screen.		
5.	Dumper operator shall able to see the location of surrounding vehicles on the screen fitted in front of him in the Google map.		
6.	Front thermal imaging cameras frame shall be installed in such a way that viewing angle of the camera is always focused on road surface of dumper's front while dumper moves on plane or hilly road.		
7.	The system shall have recording facility of videos for atleast for 2 days record.		
8.	All the detection/warning signal shall be recorded in the system with date and time stamp logs.		
9.	Anti-collision laser light shall be installed in both corners of dumper's back with 2 nos. of light in each corner focusing in different angles so that atleast one bar line of laser line is displayed on road surface while the vehicle moves on hilly/plane roads.		
10.	While any moving object is detected by the RADAR, it shall display its position on display screen with audio alarm.		
11.	All thermal camera view can be enlarged with touch screen facility.		
12.	Rear thermal camera view and HD camera view shall be interchangeable in the same portion of display by touch screen facility.		
13.	Flashing LED light shall be displayed in the junction point or road crossing points.		
14.	Self-regulating heating cable shall be laid down on road edge wherever required for demarcating road edge detection using thermal imaging camera.		
15.	All the processing and display unit shall be installed in a single box with rack arrangement in the dumper's cabin.		
16.	GNSS/dumper's location view shall be displayed in the control room through wireless network.		
17.	Power for the total items fitted on dumper shall be safely taken from the respective dumper itself.		
18.	GNSS software report shall be generated from the central server and it shall be web-enabled so that it can be accessed from anywhere in the world.		
19.	The system shall allow vehicle driver to communicate with the control room operator.		
20.	A complete software shall be provided for vehicle tracking, ge-fenced area violation with alert through SMS, email and pop-up		



	menu on the screen, daily production report, total run per day/shift/month, exception reports, down time reporting, viewing of path of each dumper, etc. as per the requirement of the respective mine management.		
21.	Dumper master data (health condition status parameters using various sensors) stored in the control unit of vehicle shall be interfaced using RS232 or TCP/IP port with the system for the purpose of wireless transmission of data to the central server in the control room for further data analysis as desired by the mine management. The data from the sensor and its protocol shall be shared by the owner of HEMM through its OEM.		
22.	The system shall be compatible with the future up-gradation of vehicle tracking/fleet management system, like introduction of rover and base station for accurate vehicle position system.		
23.	All the items proposed in shovels, dumpers and shift incharge's jeeps as depicted in figures with taping power from it.		
24.	LED fitted vest shall be used by mining persons working in the mine during foggy weather for better visibility of dumper's operator through thermal imaging camera.		
25.	Thermal imaging binocular shall be provided to the mining persons deputed at working face.		
26.	The GPS/GNSS software shall be used to monitor the position of mobile mining equipment online in mine and thereby providing enhanced vision in form of location of complete fleet and optimise the use and performance of the equipment.		
27.	In particular the system shall facilitate dispatch of dump trucks between the shovels, excavators and dumping points of the mine in foggy weather.		
28.	The system shall cater to all the aspects of production, performance and quality monitoring and reporting for mine in a single unified database. The user shall be allowed to view information at every level (i.e. Equipment, Section, Mine) of the operation. The system shall be able to accept various Performance Indicators like trip count, working hour, idle hour, break down hours, maintenance Hours, cycle time details, trips per hour and other forms of reporting, HEMM availability, HEMM utilization, HEMM overall equipment efficiency, Operator performance, etc.		
29.	To achieve full functionalities and maximum advantage of this system, it shall have a provision to be integrated with ERP in future.		



30.	All reports (text, tabular and graphical) generated by the Vision enhancement system and Truck Despatch System, shall have a provision to be published in web compliant format as and when required.		
31.	The system shall be able to improve the availability and utilization of all HEMM and allied equipment (Dumpers, Shovels, Dozers, Loaders, etc.) within the mine site and monitor and manage the fuel consumption in the mine (for future integration).		
32.	The system shall be able to interface with third party fuel management system, if required in future. In case fuel management system is not available, the system shall have a provision for manually entering fuel dispensed in the HEMMs.		
E.	SOFTWARE REQUIREMENT		
1.	The software developer shall develop the complete software by integrating all the modules of Vision Improvement System (VIS) and controlling vehicle for better vision. Edge detection and object detection.		
3.	The software shall be professionally developed so that it becomes impressive, user-friendly and intelligent enough for importing and exporting of input/output results of one module to another module of software, proper interpretation and analysis, and accurate generation of results.		
4.	The software shall be developed in such a way that it is integrated with all the required features, running platforms, and database. It shall be capable enough to run independently in windows environment without any requirement of the additional software / database.		
5.	The overall software package shall work like an integrated product which can operate on any PC using Windows 2000, XP, Vista, Windows 7 or Windows 8 or Windows 10 or Linux.		
6.	The software developer shall hand over the complete software to CSIR-CIMFR, Dhanbad along with a user manual, flow chart, algorithm, source code, and other necessary documents.		
7.	The developer shall give comprehensive training for 5 days to a group of CIMFR staffs, dumper operators and the concerned mine management explaining details of the software operation, flow chart, algorithm, source code and other necessary information to run and update the software in the later stage.		
10.	The developed software and system shall be the property of CSIR-CIMFR. The first opening window of the software shall include the		



	name of CSIR-Central Institute of Mining and Fuel Research only with CSIR logo.		
11.	The software developer shall not disclose or share any information to the third party related to the system, work and software without prior permission from CSIR-CIMFR.		
19.	The software developer shall submit the followings <ul style="list-style-type: none"> • Source code with the narration of each function/module stating its functionality copied in two sets of pen drive. • Database structure design module in pen drive in two sets for uploading database and supply hard copy document of the data structure with Data in a soft copy and 3 hard copies. 		
F.	OTHERS REQUIREMENT		
1.	Annual Maintenance Cost after the expiry of first one-year warranty period shall be given separately.		
3.	All parts of the system shall be of reputed brand and weatherproof.		
5.	The quotation shall include all the necessary accessories for proper operation of the system in addition to indented items.		
6.	The bidder shall have previous experience in mine automation/communication/thermal imaging. The bidder shall enclose their experience related documents with the technical bid.		
7.	The warranty period of the software and hardware shall be 1 year. During the warranty period, any bugs/ issues/ hardware problem shall be resolved free of cost.		
8.	After the development of the software and system, the developer shall sign an collaborative/licensing agreement with CSIR-CIMFR for implementation of the software and system in different mines and vehicles as per the CSIR guidelines. The developer shall not sell the software and system without licensing/collaborative agreement with CSIR-CIMFR. The rate of the quoted items shall be same for 5 years. The similar system can be installed in other mines or vehicles by the selected firm only through CSIR-CIMFR with a payment of royalty of minimum 3% of total work order value to CSIR-CIMFR.		
G.	TRAINING REQUIREMENT		
1.	The equipment suppliers/manufacturers shall arrange training for operations and maintenance of the equipment for 5 days at site.		
2.	Adequate documentation shall be provided.		
H.	AGREEMENT REQUIREMENT		
1.	The selected firm shall sign an agreement with CSIR-CIMFR for supplying, installation and maintenance of Vision Improvement		



	System as an Implementation Partner of CSIR-CIMFR. The licensing agreement shall be valid for 5 years agreement period on non-exclusive basis and which may be renewed based on mutual consent.		
2.	The selected firm has to pay a lump sum license fee of minimum Rs. 5.00 lakh (excluding 18% GST) and royalty of minimum 3% of selling price of Vision Improvement System (excluding 18% GST) to CSIR-CIMFR. The agreed lump sum license fee shall be paid before placing work order to the selected firm as well as signing licensing agreement. The royalty amount has to be paid twice in a year as applicable.		
3.	The licensing agreement shall be signed as per the guidelines of CSIR.		
4.	During the tenure of the agreement [Five years] and thereafter the selected firm shall undertake on their behalf and on behalf of their subcontractors/ employees/ representatives/ associates to maintain strict confidentiality and prevent disclosure thereof, of all the information and data exchanged/generated pertaining to work under the agreement for any purposes other than in accordance with the agreement.		
5.	During the agreement period if any new technology is developed, it shall be owned by CSIR-CIMFR. CSIR-CIMFR will have right to publish research paper on the subject matter.		
6.	Arbitration: In the Event of any disputes relating to or arising out of this agreement, such disputes shall be resolved amicably by mutual discussions and negotiations in good faith. Failing the above, the disputes shall be referred to and finally resolved by Delhi International Arbitration Centre (DIAC) under Arbitration and Conciliation Act. 1996 and the rules framed there under for the time being in force. a) The seat of Arbitration shall be New Delhi. b) The language of arbitration proceedings shall be English only. c) Each party shall bear and pay its own cost of the arbitration proceedings unless the Arbitrator otherwise decides in the Award. d) The provisions of this clause shall not be frustrated, abrogated or become inoperative, notwithstanding this agreement expires or ceases to exist or is terminated or revoked or declared unlawful.		
7.	Jurisdiction and applicable laws: The agreement including all matters shall be governed by Indian Laws both substantive and procedural for the time being in force and subject to the exclusive jurisdiction of Courts at New Delhi		



6. A LAYOUT OF BAILADILA IRON ORE MINE WHERE THE FIRST SYSTEM SHALL BE INSTALLED

The system shall be supplied and installed at Bacheli Complex of Bailadila Iron Ore Mines. The material shall be supplied to the central store of NMDC at Bailadila and a store inventory certificate has to be taken from NMDC. Bailadila is a mountain range rising in the Deccan Plateau about 200 km west of the Eastern Ghats. It is located near Kirandul town in the Dantewada district of southern Chhattisgarh, India. The hills are located at a distance of about 40 km southwest of Dantewada district and around 450 km from Raipur.



Figure 5: Map View of Bailadila Iron Ore Mines

Location:Bailadila Iron Ore Mines, Chhattisgarh, Dantewada district Latitude: 18.6993919° N and Longitude: 81.2442478° E (Figure 9) with an Elevation of 1,276 m. It has dimensions of length 70 km SW-NE and width 25 km NW-SE.

7. ELIGIBILITY CRITERIA FOR SELECTION OF FIRM

- (i) The firm must have experience of system integration/ wireless networking/ thermal imaging. Firm has to submit supply/purchase order/contract copy in the name of bidder for system integration/ wireless networking/ thermal imaging and installation report in respect of having successfully supplied, installed and commissioned against the same contract issued by the firm/organization/industry where the system has been installed.



- (ii) Average annual turn-over of the firm shall be minimum Rs. 1.00 crore during last 3 financial years. The firm must submit the audited annual financial statement of the firm during last 3 financial years.
- (iii) The firm shall comply with the specification of Vision Improvement System components to be supplied as an Implementation Partner as mentioned in point no. 4 (table) of EoI.
- (iv) The firm shall accept the role of Implementation Partner with the required system as mentioned in the point no. 5 of EoI.
- (v) The firm shall give an undertaking for implementation of Vision Improvement System in any mine or industry throughout the country on PAN India basis.
- (vi) The selected firm shall sign an agreement with CSIR-CIMFR for supplying, installation and maintenance of Vision Improvement System as an Implementation Partner of CSIR-CIMFR. The agreement shall be valid for 5 years agreement period and which may be renewed based on mutual consent.
- (vii) The selected firm has to pay a lump sum license fee of minimum Rs. 5.00 lakh (excluding 18% GST) and royalty of minimum 3% of selling price of Vision Improvement System (excluding 18% GST) to CSIR-CIMFR. The technically qualified and eligible firm accepting for higher lump sum license fee and royalty rate will be given preference.
- (viii) The firm will be selected based on the quoted minimum rate of Vision Improvement System components including accessories, delivery, installation and maintenance costs at the site.

8. BID SUBMISSION REQUIREMENT

The interested firms shall submit their EoI with following information and documents in 2 bids system:

(i) Technical Bid:

- a) Company profile and Registration details of the company covering: Company registration certificate copy, PAN copy, and GST certificate copy.
- b) Necessary document/certificates/approvals in support of the said eligibility criterion for selection of the firm as per the point no. 7(i) of this EoI.
- c) Return of the company certified by a Chartered Accountant showing minimum Rs. 1.00 crore average annual turnover during last 3 financial years.
- d) Point-wise comply statement of specification of different components of Vision Improvement System to be supplied as an Implementation Partner as mentioned in point no. 4 (table) along with mentioning the respective page number of the enclosed leaflet of different items of Vision Improvement System where this specification is complied.



- e) Letter of the firm accepting the role of Implementation Partner with the required system and compliance statement of point no. 5 of EoI as well as different requirement of mining industry based on site specific requirement.
- f) Undertaking by the firm for implementation of Vision Improvement System in any mine or industry throughout the country on PAN India basis.
- g) Acceptance letter of the firm to sign licensing agreement with CSIR-CIMFR as per CSIR guideline for supply, installation, commissioning and maintenance of Vision Improvement System in the field as an Implementation Partner of CSIR-CIMFR for 5 years period.

(ii) Financial Bid:

- a) Lump sum license fee agreed to pay by the firm to CSIR-CIMFR. It shall be minimum of Rs. 5.00 lakh (excluding 18% GST).
- b) Royalty rate agreed to pay by the firm based on percentage of selling price (excluding taxes) of Vision Improvement System and its implementation cost. It shall be minimum of 3% of total material and its delivery, installation and maintenance costs, i.e. project cost of the Implementation Partner.
- c) The firm shall submit the minimum unit rate for different in different fields during next 5 years agreement period as per bill of materials listed in point No. 3 (table) considering mass scale requirement in the field. Rate justification document such as recent past PO of Government or Autonomous Body or PSU organization or Price List of OEM shall be submitted for each item of Vision Improvement System to be supplied by the firm.
- d) Cost of accessories, cables, enclosures, fittings, stands, clamps, installation kits, earth pit, surge protector, etc. [indicating its cost for Bachel Complex as well as conversion of the amount interms of percentage of total material cost, 7(ii)(c)].
- e) Cost of packaging, delivery, transport, insurance, handling etc. [indicating its cost for Bachel Complex as well as conversion of the amount interms of percentage of total material cost, 7(ii)(c)].
- f) Cost of installation and commissioning in mine by deploying manpower, vehicle, tools and kits, test and measurement devices, etc. including field expenditure [indicating its cost for Bachel Complex as well as conversion of the amount interms of percentage of total material cost, 7(ii)(c)].
- g) System operation cost by keeping 2 trained manpower, accessories and vehicle at the site during 1 year warranty period [indicating its cost for Bachel Complex as well as conversion of the amount interms of percentage of total cost, 7(ii)(c) to (f)].
- h) Comprehensive annual maintenance contract (CAMC) cost by supplying accessories keeping 3 trained manpower at the site after 1 year warranty period (work order for CAMC shall be issued separately at the end of warranty period by the mining industry/CSIR-CIMFR for Bachel Complex). This cost shall not be



- included in the initial work order. [indicating its cost for Bacheli Complex as well as conversion of the amount in terms of percentage of total cost, 7(ii)(c) to (f)].
- i) Training of dumper operators and concerned persons at mine site for 5 days [indicating its cost for Bacheli Complex as well as conversion of the amount in terms of percentage of total cost, 7(ii)(c) to (f)].
 - j) The minimum rate quoted by the technically qualified firm will be selected as an Implementation Partner. The minimum rate will be calculated based on the overall cost of Vision Improvement System implementation, i.e. [{total cost as mentioned in point no. 7(ii)(c) to (g)} *minus* {lump sum license fee as per 7(ii)(a) and royalty amount as per point no. 7(ii)(b)}].

9. SUBMISSION OF EOI

The interested firms shall submit their Eoi in a sealed envelope mentioning on top “Eoi for Implementation of Vision Improvement System” and inserting sealed Technical Bid envelope and Financial Bid envelope in the said envelope. Eoi shall be submitted to the following address:

The Head, BDIL,
CSIR-Central Institute of Mining and Fuel Research,
Barwa Road, Dhanbad – 826001, Jharkhand, India

