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2152



Government of India
Indian Railways

TECHNICAL SPECIFICATION
FOR
UNATTENDED AXLE BOX LEVEL ACCELERATION MEASUREMENT SYSTEM (UABAMS)
(Specification no. TM/IM/434)

S. No.	Month & Year of approval	Revision/ Amendment	Reason for Amendment
1.	Nov. – 2018	Nil	First Issue
2.	May – 2021	Rev. – 1	Inclusion of SMS alert and other requirements.
3.	April. - 2024	Rev. – 2	Incorporating the amendments.
4.	Oct. – 2024	Rev. – 3	Inclusion of data safety clauses and other amendments.
5.	Nov. - 2025	Rev. - 4	Inclusion of Signal dte. recommendations

Issued By:

Track Machine & Monitoring Directorate, Research Designs and Standards Organization Lucknow - 226011	Railway Board, New Delhi – 110 001	Center for Railway Information Systems, New Delhi – 100 021

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Technical Specifications of Unattended Axle Box Level Acceleration Measurement System (UABAMS)

1. Definitions and Abbreviations:

IR	: Indian Railway
ICF	: Integral Coach Factory
RDSO	: Research Designs and Standards Organisation
Purchaser	: Indian Railways, Ministry of railways
MMD	: Maximum Moving Dimension
TMS	: Track Management System (IT application developed by CRIS)
GPS	: Global Positioning System
CRIS	: Centre for Railway Information Systems (CRIS is an Organisation under Ministry of Railways, engaged in development software/IT systems for different departments of the Railways)

2. General:

- 2.1. The Unattended Axle Box Acceleration Measurement System (UABAMS) is a system having capability to measure acceleration at Axle Box level and Bogie level in the first and the last vehicle of a revenue train without human interference. It will be referred as system in subsequent clauses of this document.
- 2.2. The First and the last vehicle of the revenue train where the system is proposed to be mounted will have standard FIAT Bogie and LHB coach/Vande Bharat Bogie and coach. The drawing of the LHB coach and Bogie/Vande Bharat coach and Bogie where system is proposed to be mounted is attached as Annexure-I.
- 2.3. Accelerometers, all system hardware and their mounting arrangements shall be installed within the Maximum Moving Dimension (MMD) envelope of IR as per Schedule of Dimension (SOD) - 2022 and latest correction slips. The same is available at <http://www.indianrailways.gov.in>.
- 2.4. The scope of specifications includes supply and installation of system, capturing of discrete data in time domain, storage, transfer of data continuously, processing of data in intermediate processing station at the CRIS premises at specified location to generate alert reports and transfer of data to CRIS server (TMS). The Scope also includes online generation of safety alerts (containing value and GPS location) in the form of text messages (sms/notifications) to concerned railway officials, whenever recorded accelerations exceed the pre-defined limits. The purchaser shall be able to edit these pre-defined limits route wise as and when required.
- 2.5. All data and reports in processing station shall be stored in a database or ASCII file which shall be compatible for uploading in TMS. Two types of data files are to be transferred in TMS. i) Spatial acceleration data, ii) Processed data having peaks. Data

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file transfer protocol mechanism (including details in data file) from Intermediate server to CRIS server will be decided by vendor/firm in consultation with CRIS. Data file to be transferred in TMS would preferably be in MDB format. In case of any change in format, the same will be decided by vendor/firm in consultation with CRIS after award of Contract.

- 2.6. All file formats shall be open and documented.
- 2.7. The following norms are to be referred along with this draft specification for compliance;
 - EN 13848: 2020 – part I – Railway applications – Track – Track geometry quality. Part I – Characterization of Track Geometry.
 - EN 50155: 2021 - Railway applications – Rolling stock – Electronic equipment.
 - IEC 60571: 2012 - Railway applications - Electronic equipment used on rolling stock
 - IEC 61373: 2010 - Railway applications - Rolling stock equipment - Shock and vibration tests
 - Any relevant code mentioned in above documents/codes

3. Environmental Conditions:

- 3.1. The System shall be capable of functioning in the climatic conditions prevalent on Indian Railway. The machine shall be in continuous operation under the following general service conditions:

I. Ambient temperature	-	0°C to 55°C
II. Humidity	-	Upto 100%
III. Rainfall	-	Fairly heavy
IV. Atmospheric condition	-	Very dusty, Heavy fog
- 3.2. On IR network the electrified traction consists of overhead electric system of 25000 V AC or 2*25000 V AC with residual return current passing through one of the rails in the track and systems and accessories which are part of electronic train running safety system such as Train protection warning system (TPWS), Audio frequency track circuit (AFTC), Digital axle counter, DC track circuiting, Mobile Phones and wireless sets in very close proximity. These shall not affect the accuracy of acceleration and location measurements in any manner due to the induction effect.

4. Salient Features:

- 4.1. The system shall be capable to measure acceleration in the speed band of 20-160 Kmph. The space interval for spatial data acceleration file shall be 25 cm.
- 4.2. The system shall be capable to start automatic acquisition of acceleration at speed above 20 Kmph and online transfer of data to processing station through GSM network and subsequently to CRIS server after processing, on encounter with upcoming track feature with GPS coordinates. System should have enough storage

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space to store the acquired acceleration data for the period of non-availability of GSM signal for data transfer.

- 4.3. On availability of GSM signal, the stored acceleration data shall be transferred to intermediate server (processing station) and subsequently to CRIS server after processing. The storage space shall be cleared automatically after transmission of data to processing station and receipt of confirmation. No data shall be lost during period of non-availability of GSM signal for a distance of 100 Kilometers. The online alerts whenever the recorded accelerations exceed pre-defined limits above the speed of 80 kmph in form of text messages (SMS)/ notifications shall be sent through GSM network to concerned p-way officials of Zonal Railways.

In case of multiple peaks exceeding the pre-defined limits in close vicinity, only one sms/ notification for highest peak recorded (vertical and lateral accelerations separately) in distance of 50m shall have to be sent.

- 4.4. The accelerometers/sensors shall be mounted on both left and right side of one axle of FIAT bogie/Vande Bharat bogie and on bogie level. These shall be capable for measurement of acceleration in vertical and lateral direction. The speed shall be accurately recorded using optical or any suitable encoder. The encoder shall be connected to one of the axles of the bogie. System shall have the facility for wheel wear compensation to enable accurate measurement and recording of speed and distance and also ensure constant sampling distance with new as well as worn wheel.
- 4.5. The data logger unit shall be mounted on under frame of the coach or inside the coach at a convenient location and communication & data transfer from accelerometer to data logger unit shall be wired/wireless.
- 4.6. The Junction box consisting of microcontroller can be mounted either on underframe or inside the coach at a convenient location. The communication between data logger and junction box shall be wired/ wireless. Firms are free to design the integrated system consisting of Junction Box and Data Logger.
- 4.7. The GPS and GSM antenna shall be mounted on roof of coach or on other suitable location within MMD and should be safe from tampering by outsiders
- 4.8. All transducers and system hardware shall be securely installed on the Bogie and Coach with proper protective shields to ensure that these are not damaged during running and are pilferage proof. The design of mounting arrangement of transducers and system hardware shall be got approved from purchaser i.e. Indian Railways before actual adoption.
- 4.9 The system shall have its own power backup battery pack for uninterrupted working of the system up to a minimum period of 24hrs. Power backup battery pack shall be charged from the available DC/ AC power supply of 24/ 110 volt from coach. Power supply status should be monitored on the intermediate server so that necessary action can be taken.

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- 4.10 The system shall be capable to identify the track/ route using pre prepared route data file having latitude and longitude to be provided by the RDSO and synchronization with proven navigation system, which shall include GPS and encoder. Route data file having latitude and longitude along with track features would be provided by RDSO.
- 4.11 Adequate redundancy of the communication media between Accelerometers/Sensors to Junction box/Data logger should be kept.

5. Requirements for Measurement of acceleration:

- 5.1. The accelerometers mounted on axle box level shall be capable to measure accelerations up to +/- 100g in the frequency range of 0 - 500 Hz and accelerometer mounted on bogie level shall be capable to measure acceleration up to +/- 5g in the frequency range of 0-100 Hz or latest provision of EN 13848: part- I.
- 5.2. As the expected range of frequency of acceleration at axle level is up to 500 Hz and at bogie level is 100 Hz., The sampling frequency of acceleration shall not be less than the 5 times of the expected maximum frequency. Thus the sampling frequency at axle level shall not be less than 2500 Hz and at bogie level shall not be less than 500 Hz or latest provision of EN 13848: part- I.
- 5.3. The location of acceleration peaks shall be acquired accurately using some proven navigation system, which may consisting of a GPS and encoder.
- 5.4. The accuracy for reporting location of acceleration peaks shall be better than 5.0 metre.
- 5.5. a. "The least count of the accelerations to be measured shall be better than +/-0.1g".
b. "The accuracy of speed measurement shall be +/- 2% of actual speed".

6. Processing of data and Reports Generation in Intermediate Processing (Intermediate Server) Station at CRIS premises:

- 6.1. The system should be capable of processing data for online generation of safety alerts in the form of text messages (sms/ notifications) and transfer of same through processing station to concerned railway officials, whenever recorded accelerations exceed the pre-defined limits. (This clause to be read along with clause 4.3). The report of safety alerts shall be stored in intermediate server along with nearest track feature and instantaneous speed for a duration of one month and shall be transferred to CRIS server.
- 6.2. The processing station is to be established or acquired by the firm to get data transferred from various systems (which may be up to 100) installed in various revenue trains and plying on different routes. To create storage on processing system number of kilometer recorded per month by a single train system may be taken as 30,000-40,000 Kms.
- 6.3. The processing station shall be capable to receive the data from various (which may be

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- up to 100) systems and it shall receive the data unsolicited *i.e.* the system will send the data as and when the GSM signal is available. The discrete data in time domain shall be retained for seven days from date of recording and afterwards deleted from the processing station. The firm shall give non-disclosure certificate for data.
- 6.4. The acceleration data in space domain at the sampling interval of 25 cm and generated alert reports are to be stored in intermediate server for every run for latest 30 days from date of recording. The intermediate processing station shall be designed to have facility for extending the storage capacity in future.
- 6.5. The format of route file is attached as Annexure-II.
- 6.6. The acceleration data transferred from various systems plying on IR to processing station shall be stored and processed and subsequently transferred to CRIS server.
- 6.7. The details of specified sections associated to each system will be provided by the RDSO and shall be stored in the processing station for generation of section wise report. The details of section will include Railway, Division, Section, From KM and To KM.
- 6.8. The route wise limiting values above which the SMS alerts/ notification are to be generated will also be provided by the purchaser and shall be stored in intermediate processing station. The purchaser shall be able to edit these pre-defined limits route wise as and when required.
- 6.9. The data from the systems shall be transferred with suitable encryption for data security.
- i. GSM module should support 5G with auto fall back to 4G/3G.
 - ii. M2M SIMs to be used with private APN configured on them.
 - iii. Backhaul link from MSP (Mobile Service Provider) of SIMs to intermediate processing station to be provided by the firm along with relevant termination devices for secure communication between data logger unit & intermediate processing station and for reduced latency.
- 6.10. System shall be designed to ensure 0% data loss in transfer between systems and processing station.
- 6.11. The facility to add, delete and edit details of train in processing station shall be available. In addition to this, facility shall be provided for detailed analysis of the status of the software and hardware of any system plying on IR network from processing station.

7. Maintenance and Calibration of System:

- 7.1. The Firm shall specify the frequency/ periodicity in their technical bid, considering reliability of the system and type of calibration and maintenance required for accelerometers and other equipment/ sensors.
- 7.2. The periodic maintenance of all equipment, sensors and processing station is to be

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done by the supplier during warranty period and for 05 years CAMC period after warranty period at major cities of India i.e. New Delhi, Kolkata, Chennai, Mumbai, Secunderabad, Bangalore and Guwahati/Dibrugarh. The car will be available for generally 3-4 consecutive hours in washing line under open sky for maintenance.

- 7.3. The dynamic calibration of accelerometers is required to be done by at any govt./ ISO accredited/ certified lab or NABL accredited lab or any Internationally accredited lab/ institution, thus the accelerometers shall be replaced with the pre calibrated sensors. No additional payment will be made for replaced sensors.

The car will be available for 3-4 consecutive hours in washing line under open sky for maintenance. The maintenance work should be carried out along with other routine maintenance of coach.

- 7.4. The System shall have the capability to update the software release, monitor the system status, communicate any malfunctioning of system to processing station and can be accessible from the processing station to update the software release, monitor the system status and also it can be remotely rebooted except in the case of malfunctioning of the GSM antenna.
- 7.5. Maintenance of intermediate processing station and data processing is to be done by the supplier during warranty period and for a period of 05 years after warranty. After 05 years post warranty period firm shall hand over intermediate processing station along with software to CRIS.
- 7.6. The supplier shall keep sufficient spares to keep the system in working order at all the time and minimize the down time. In case of any problem, the system shall be made operational within a specified period mentioned in contract at halting nominated metro cities after communication of problem by Railway official.

8. Warranty:

Warranty to be dealt as per relevant paras of Special Condition of Tender/ Contract.

9. Penalty for downtime of the system during warranty and Maintenance period:

Issues of payment during downtime to be dealt as per relevant paras of Special Condition of Tender/ Contract.

10. Acceptance Tests:

- 10.1. Firm shall provide a lab and field validation scheme, which will be approved by the purchaser. The scheme shall include the following;
- a) Verification of test and calibration certificates for all the third party items.
 - b) The testing of hardware of system as per approved procedure.
 - c) Verification of peak locations in field within specified accuracy of reporting location.

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- d) Repeatability of acquired acceleration data at same speed. The accuracy of acceleration measurement in repeatability at same speed and in identical conditions shall 1% of full scale offset (FSO) or better.

10.2. Following tests are to be conducted on UABAMS system being supplied and test report from any Govt. lab or NABL Accredited lab or Internationally accredited labs/ institutions must be submitted before Lab Validation Test. The UABAMS system should conform to the following.

- a) Vibration and Shock tests (As per IEC 61373)
- b) Electromagnetic compatibility (EMC) tests (As per EN 50121)
- c) Environmental tests (As per IEC 60571)

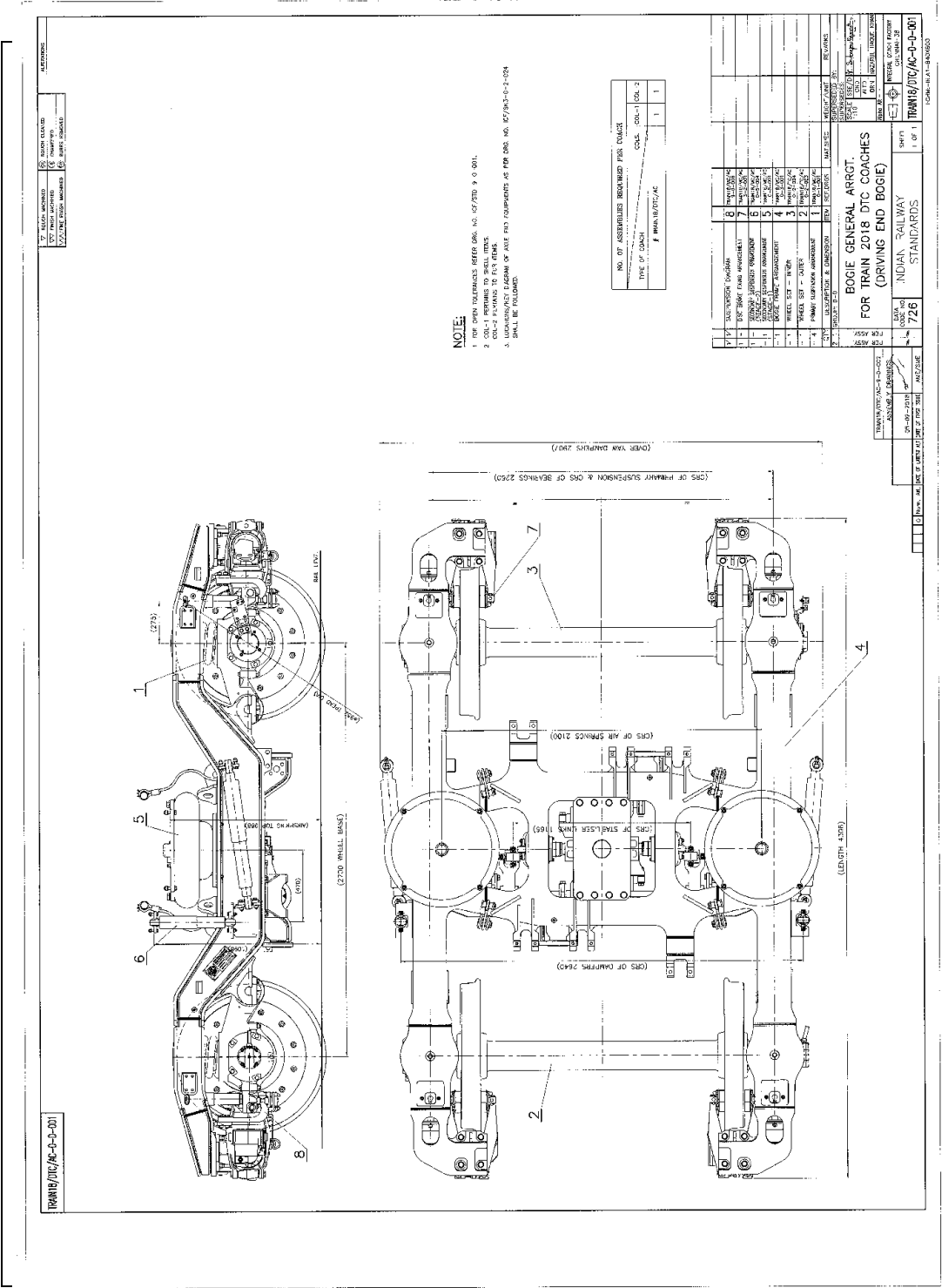
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Annexure - I

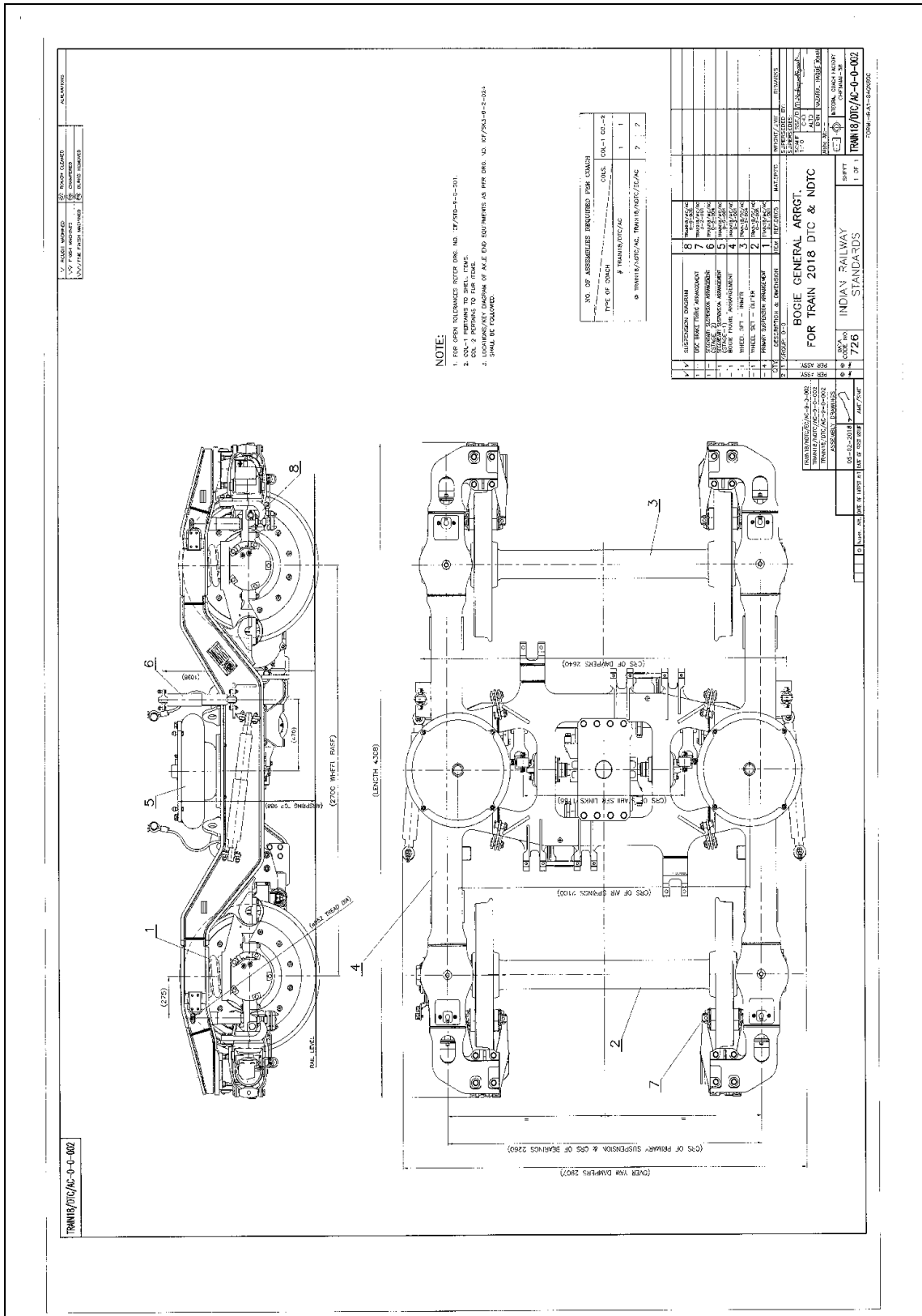
The list of drawings attached in Annexure-I is tabulated below:

SN	Drawing Name	Drawing No.
1.	Bogie General Arrgt. For Train 2018 DTC Coaches (Driving End Bogie).	TRAIN18/DTC/AC-0-0-001
2.	Bogie General Arrgt. For Train 2018 DTC & NDTC.	TRAIN18/DTC/AC-0-0-002
3.	Layout of Air Conditioned Driving Trailer Car for Semi High Speed Train Set.	TS/DTC-9-0-001
4.	Layout of Air Conditioned Motor Car for Semi High Speed Train Set.	TS/MC-9-0-001
5.	Layout of Air Conditioned Trailer Car for Semi High Speed Train Set.	TS/TC-9-0-001
6.	Layout of Air Conditioned Motor Car for Semi High Speed Train Set.	TS/MC2-9-0-001
7.	Layout of Non Driving Air Conditioned Trailer Car for Semi High Speed Train Set (Executive Class).	TS/NDTC/EC-9-0-001
8.	Layout of Non Driving Air Conditioned Trailer Car 2 for Semi High Speed Train Set (Executive Class).	TS/NDTC/EC2-9-0-001
9.	FIAT-SIG SCHIENENFAHRZEUGE AG.	1267400
10.	Generator Wagen Layout Cum Brake Van.	1 11012.0.01.000.001

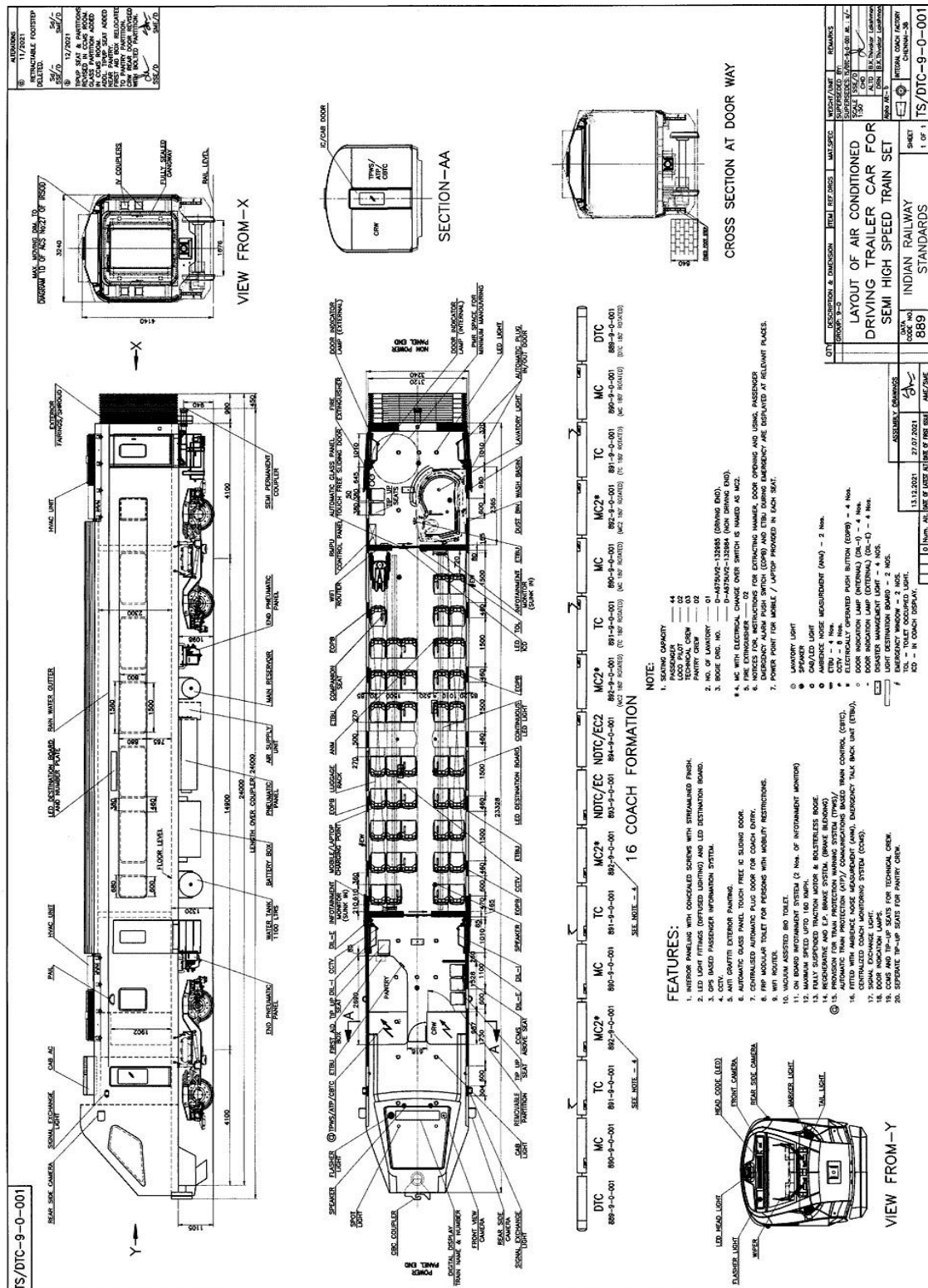
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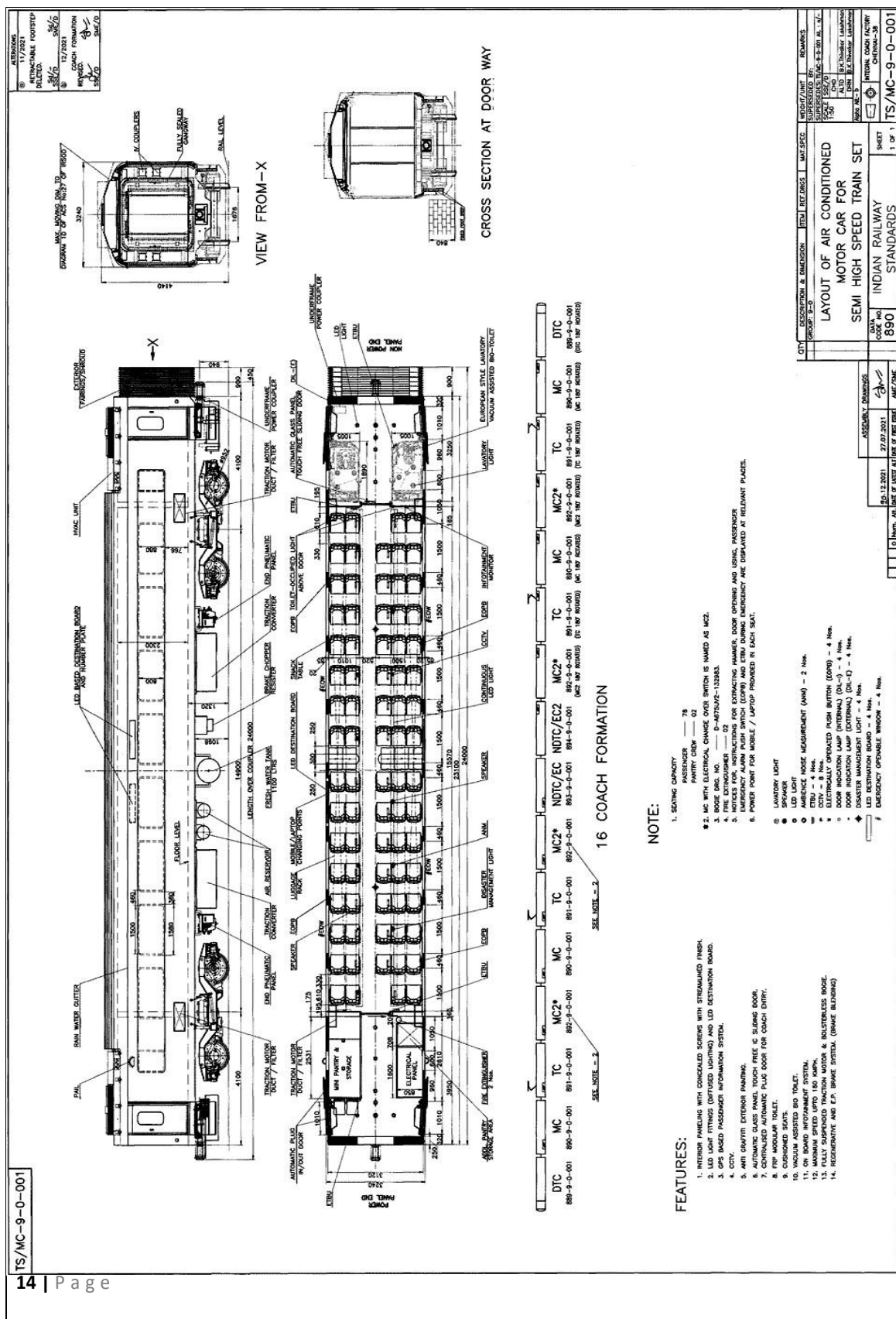
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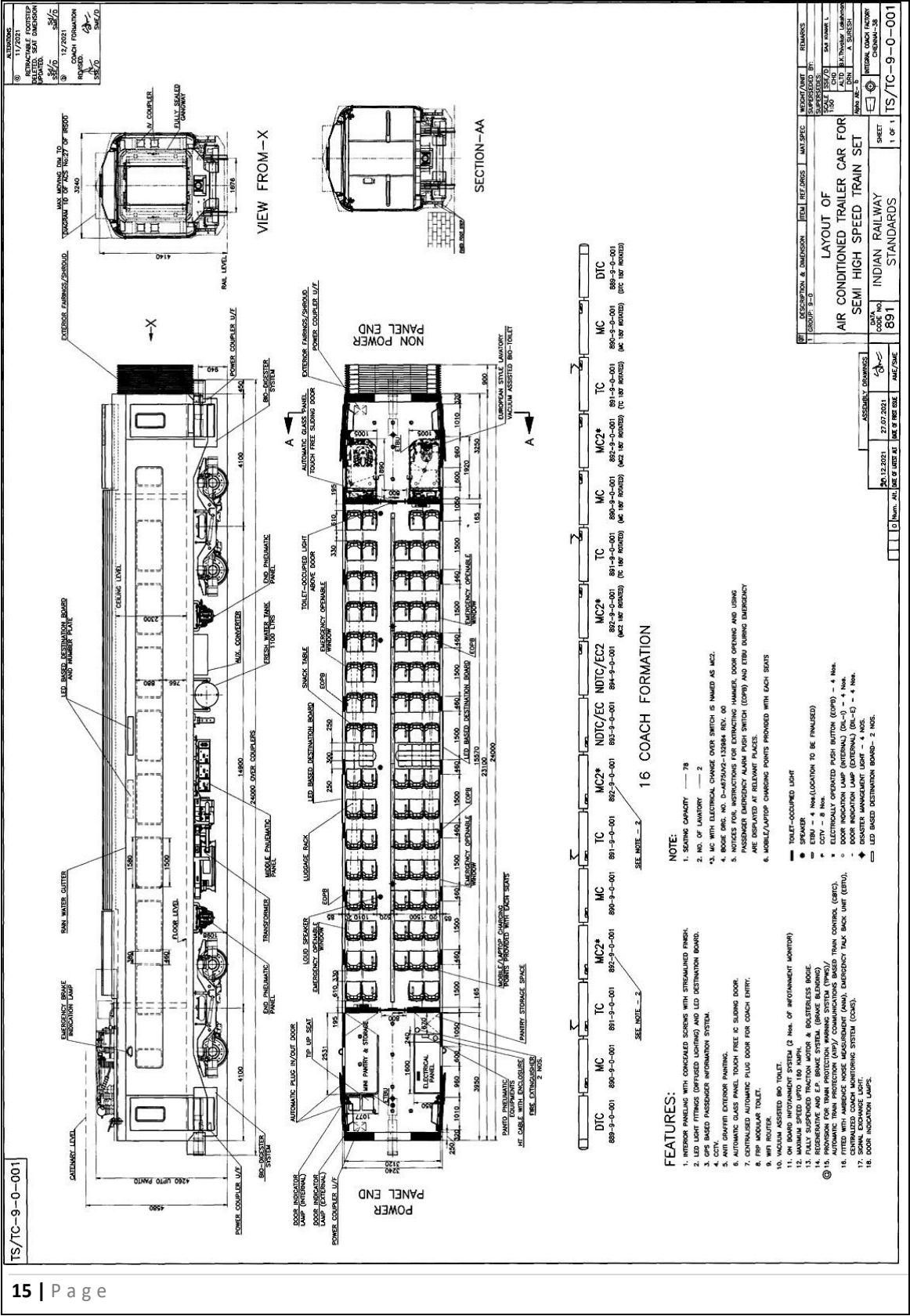
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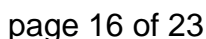
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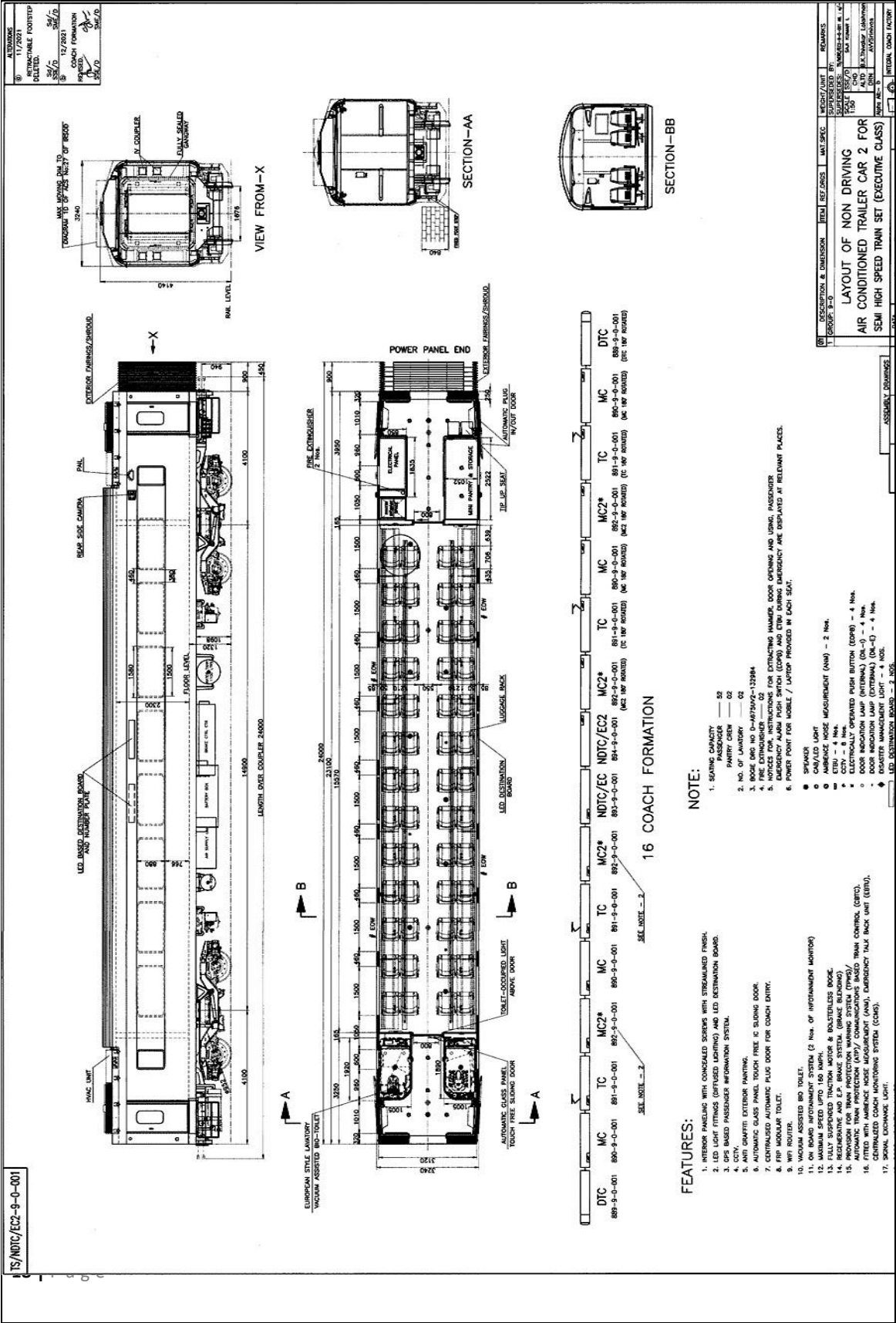
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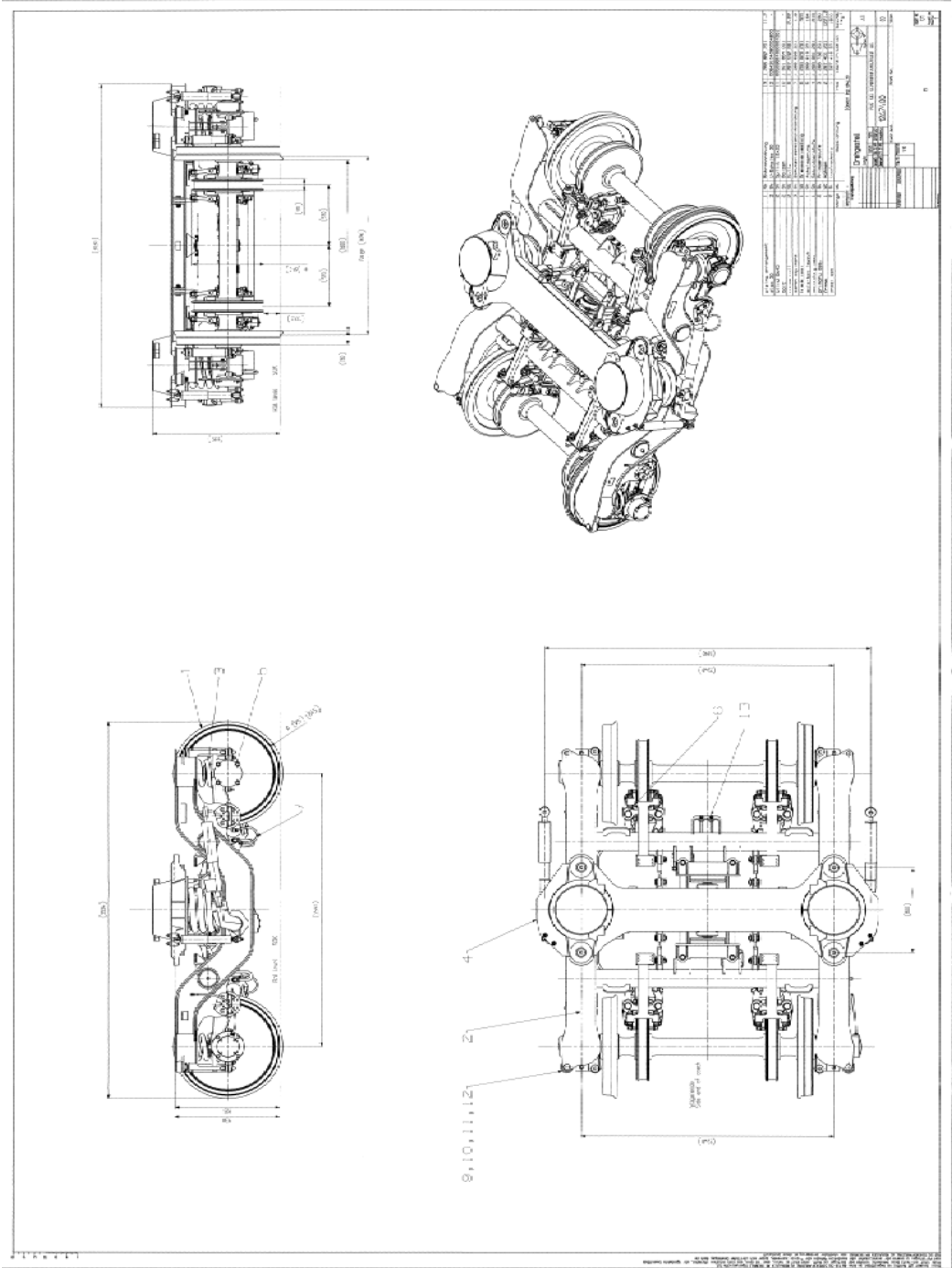


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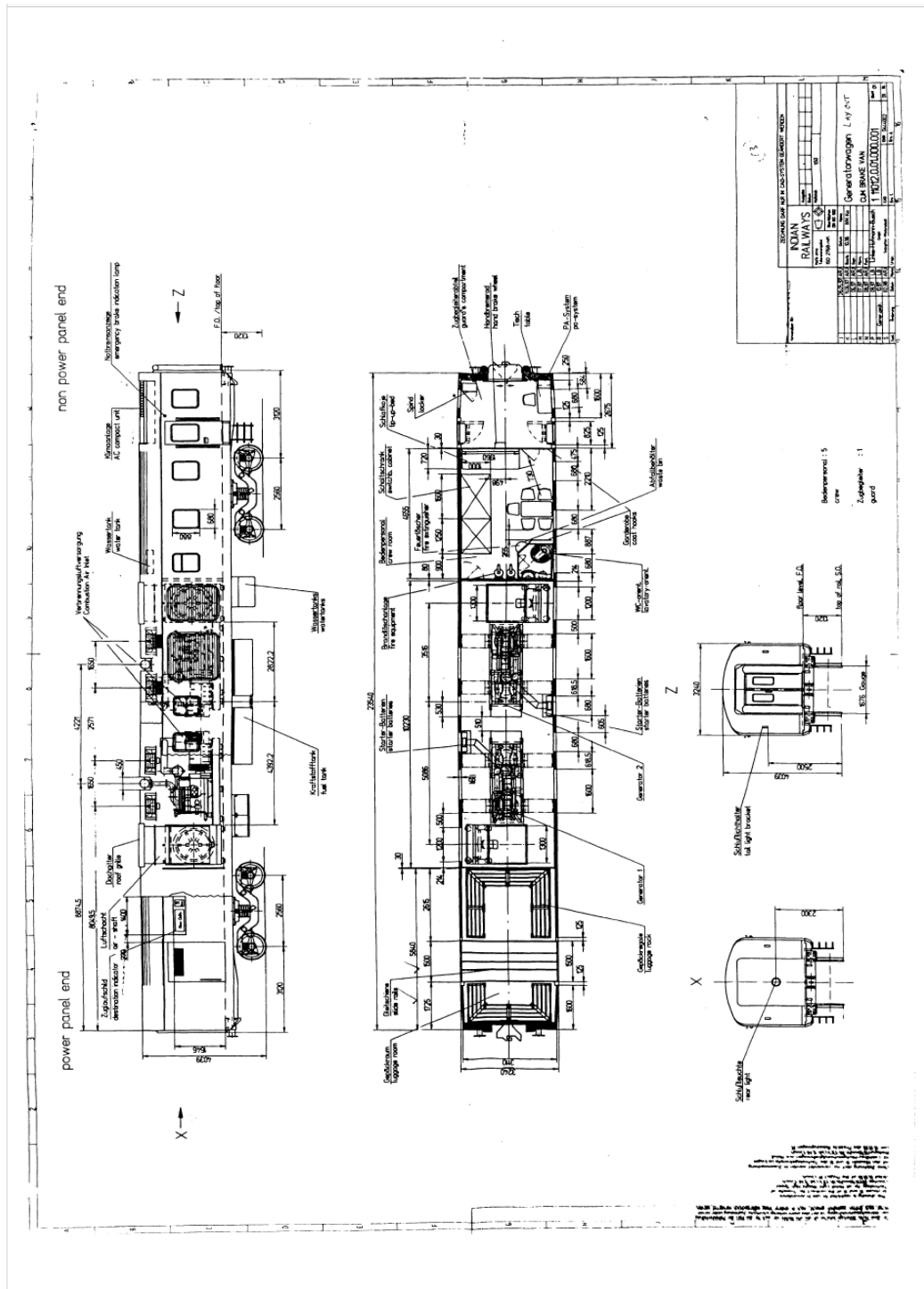


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Annexure –II/1-2

RT 1220501 DDU-BSB-PBH-LKO UP LINE KM FROM 756 TO 1080

756,1000,1,
757,344,10,
757,854,11,
757,1000,1,
758,836,10,
758,1010,1,
759,656,11,
759,1086,1,
760,1005,1,
761,998,1,
762,203,10,
762,403,11,
762,993,1,
763,25,10,
763,365,11,
763,998,1,
764,1006,1,
765,15,10,
765,455,11,
765,1001,1,
766,597,10,
766,697,11,
766,920,10,
766,1001,1,
767,760,11,
767,999,1,
768,100,10,
768,998,1,
769,1002,1,
770,580,11,
770,999,1,
771,1000,1,
772,943,10,
772,1080,1,
773,13,11,
773,129,10,
773,997,1,
774,209,11,
774,472,10,
774,972,11,
774,997,1,
775,998,1,
776,780,10,
776,1001,1,
777,409,11,
777,523,10,
777,1009,1,
778,244,11,

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Annexure –II/2

RT1240301 Lucknow - Kanpur UP Km 00 to 71 Data from TMS November 2017

0,1340,1,
1,1340,1,26°49'41.9184"N,80°54'1.7292"E,
2,990,1,26°48'45.4944"N,80°53'33.7176"E,
3,980,1,26°47'21.6348"N,80°51'42.7176"E,
4,1020,1,26°45'19.8048"N,80°48'55.3056"E,
5,1001,1,26°43'57.9270"N,80°47'2.9802"E,
6,986,1,26°43'17.0826"N,80°46'6.6552"E,
7,1002,1,26°42'56.6850"N,80°45'38.7858"E,
8,1000,1,26°42'15.7224"N,80°44'42.4818"E,
9,1000,1,26°41'55.4844"N,80°44'15.2232"E,
10,997,1,26°41'14.1468"N,80°43'18.1920"E,
11,1000,1,26°39'52.2984"N,80°41'25.8834"E,
12,939,1,26°38'53.9280"N,80°39'58.4310"E,
13,1002,1,26°38'32.8650"N,80°39'29.5524"E,
14,982,1,26°37'31.7658"N,80°38'6.5040"E,
15,627,77,
15,1001,1,26°36'42.5838"N,80°36'32.8704"E,
16,1012,1,26°35'4.3470"N,80°33'27.8226"E,
17,493,77,
17,1000,1,26°35'58.2870"N,80°34'57.2004"E,
18,1000,1,26°36'57.8790"N,80°37'5.6934"E,
19,997,1,26°36'13.0428"N,80°35'29.3514"E,
20,990,1,26°46'20.3166"N,80°50'17.8542"E,
21,1002,1,26°45'19.8048"N,80°48'55.3056"E,
22,998,1,26°46'20.3166"N,80°50'17.8542"E,
23,975,1,26°39'52.2984"N,80°41'25.8834"E,
24,1021,1,26°41'55.4844"N,80°44'15.2232"E,
25,1004,1,26°41'14.1468"N,80°43'18.1920"E,
26,983,1,26°41'33.9798"N,80°43'47.0394"E,
27,1009,1,26°39'31.9176"N,80°40'57.3006"E,
28,1000,1,26°39'52.0974"N,80°41'25.9350"E,
29,1000,1,26°38'53.9280"N,80°39'58.4310"E,
30,1010,1,26°37'12.7770"N,80°37'37.7958"E,
31,996,1,26°38'12.3294"N,80°39'1.5336"E,
32,1003,1,26°37'12.7770"N,80°37'37.7958"E,
33,1026,1,26°49'15.4362"N,80°53'44.1042"E,
34,1000,1,26°48'45.4998"N,80°53'33.6702"E,
35,1001,1,26°48'22.7610"N,80°53'7.0488"E,
36,964,1,26°47'21.6348"N,80°51'42.7176"E,
37,981,1,26°43'17.1234"N,80°46'6.6462"E,
38,1000,1,26°43'17.1234"N,80°46'6.6462"E,
39,1017,1,26°42'36.1332"N,80°45'10.5084"E,
40,1000,1,26°44'39.1872"N,80°47'59.4936"E,
41,1000,1,26°43'57.9270"N,80°47'2.9802"E,
42,998,1,26°43'17.0826"N,80°46'6.6552"E,
43,1000,1,26°44'39.1872"N,80°47'59.4936"E,

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Annexure III

SYSTEM ARCHITECHTURE OF UABAMS

