

ANNEXURE-III A

**COMMON LIST OF MACHINE TOOLS, INSTRUMENTS, LIFTING, HANDLING,
COMMUNICATION, TEST EQUIPMENT, TRANSPORT
FACILITIES,AUTOMATED/REMOTE DIAGNOSTIC & MONITORING
EQUIPMENT FOR SHED WITH 200 CONVENTIONAL/THREE PHASE
LOCOMOTIVES**

LIST 1 - MACHINE TOOLS (GENERAL PURPOSE MACHINES)		Shed Holding
		For 200 locos
A- Machine Shop		
1	Lathe 250 mm swing x 1500 mm between centers	1
2	Lathe 150 mm swing x 1000 mm between centers	1
3	Radial drilling machine	1
4	Universal milling machine 900 mm x 300 mm table With indexing attachment	1
5	Shaping machine, 600 mm stroke	1
6	Power drill (40 mm hole in M.S.)	1
7	Power Hacksaw to cut 150 mm dia M.S.	1
8	Pipe Threading machine	1
9	Pipe Threading die sets	2
10	Pipe bending machine	2
11	Marking table	1
12	1.5 KVA portable generating sets	4
13	Shearing machine sheet cutting M/c table type/ Power press.	1
14	Heavy duty shaping machine	1
15	Winch machine 03 Ton. Cap.	5
16	Pipe Swaging machine for SS pipes	2
1	Sensitive drill (20 mm hole in M.S.)	2
2	Watchmaker`s lathe	2
1	Portable welding set 600 A dc	6
2	Portable transformer welding plant 350 A	6

3	Oxyacetylene welding and cutting set with 25 sets of cylinders for oxygen and acetylene.	5
4	Eutectic weld deposit torch set	2
5	Inverter based multipoint welding m/c	4
6	Smith Hearth	1
7	Gauging facility for cutting and making grooves	3
1	Spray guns portable Compression unit and reservoir with 2 spray guns.	3
1	Portable electric tools (grinder, drills, wrenches) set	12
2	Torque wrenches (Pneumatic/electrically operated)	12
3	½” Sq. Drive industrial socket set (Taparia)	60
4	¾” Sq. Drive industrial socket set (Taparia)	60
5	Pneumatic impact wrenches ½”	10
6	Pneumatic impact wrenches ¾”	6
7	Pneumatic impact wrenches 1”	4
1	Air compressor-complete with air drier filter after cooler, reservoir, outlet valves 250 cfm.-9 kg/cm sq.	3
2	Distributed compressor sets to be provided with pipelines at far away locations for better energy efficiency	6
1	Portable vacuum plant	4
2	Filter cleaning plant	2
3	Pit dewatering portable electric pump	5
4	Booster pump for washing lines	3
5	Sand drying and sieving plant	2
6	Submersible pump fitted in each pit	As per No. of pits
1	Battery charger	3
2	Portable battery charger	4
3	Loading resistor for battery	3
4	Distilled water plant (Electrical)	3
5	Oil centrifuging and filtering plant 3000 LPH capacity(VPI)	4
6	Pneumatic crimping tool for power cable	3

7	Hand crimping tool for control cables	10
8	Panto assembly fixture	2
9	Special crimping tool for sub 'D' connector	5
10	Special crimping bayonet connector	4
11	Anti static soldering & De-soldering plan	1
12	Anti static vacuum cleaner	2
13	Ionizing blowers	2
14	Set of anti static tools	2
15	Anti static storage transportation box facility	1 set
16	Contactless thermometer	10
17	Thermo vision camera	1
18	Q meter	2
19	Panto TF measuring fixture	1
20	Spring scale (cap. Above 30 kg) for measuring housing force of pantograph	4
21	AM12 Servometer overhauling fixture	3
22	AM92 Servometer (old version) overhauling fixture	2
23	Magnifying scale	2
24	Portable grease gun & lubricating equipment	3

LIST 2 - SPECIAL PURPOSE MACHINE TOOLS

A- Bogie and Wheel Sets(Including Repairing, Rediscing & MSU repairing)

1.	Bogie washing and jet cleaning plant	2
2.	Pit type wheel lathe (with mechanical scrap removal and disposal)	2
3.	Horizontal boring machine 1000 mm x 1000 mm table.	1
4.	Hack's burners	2
5.	Bogie squaring Jig	1

6.	Wheel profiling set (tool room)	2
7.	Grease guns and lubricating equipment (One set for each type of oil or grease)	8
8.	Lifting beam for locomotive body with stand	4
9.	Lifting tackle for bogie	8
10.	Spring testing equipment	2
11.	Shock absorbers snubbers testing jig	2
12.	Hydraulic Dampers testing and Calibration Machine	2
13.	Motorized drop pit with wheel dropping arrangement for removing of axle without lifting loco.	1
14.	AJTB Machine	1
15.	VTL Machine	1
16.	Axle turning machine	1
17.	Press machine 400 t	1
18.	Bogie manipulator for welding of bogie frames	1
19.	CNC Surface wheel lathe	1
20.	Axle turning lathe, CNC(indigeneous)	1
21.	Vertical turret lathe, CNC	1
22.	Axle grinding machine, CNC	1
23.	AJTB lathe	1
24.	Wheel press, 500 Ton	1
25.	EOT crane 15 t	1
26.	Ultrasonic flaw detector	1
27.	Induction heaters	3
28.	Bearing extractor, motorized	2
29.	Drilling & tapping machine	2
30.	5T fork lift	1

31.	Welding for axle box (inverter based)	1
B- Traction Motor Shop		
1	Pinion extractor	2
2	Pinion heating oil bath or induction heater	3
3	Autotransformer-rectifier unit 100 V x150 A dc	2
4	Commutator turning, Mica undercutting and chamfering and armature banding lathe	2
5A	Dynamic balancing machine for Aramature (1 tonne)	1
5B	Dynamic balancing machine for impellers (200 kg)	1
5C	Portable balancer for balancing of rotors and impellers of auxiliary machine in position (500-6000 r.p.m. range)	2
6	Vacuum impregnating plant	1
7	Baking oven 200° C with trolley	3
8	Brazing tongs with transformer	2
9	Bearing extractor set	3
10	Hand 5operated shearing machine for insulation	2
11	Traction Motor assembly fixture set (shop made), One set for each type of motor.	2
12	Electric motor Checker 5type EMC-22 (SMI/163) for checking rotor bar cracks in the rotors of auxiliary machine & Arno	3
13	TM stator cleaning plant	1
14	Axle racer puller	2
15	Run test machine for TM	2
16	Run test machine for assembled wheel sets	2

LIST 3 – TESTING, MEASURING INSTRUMENTS AND PANELS

A - Testing Panels		
1.	Test and calibration panel with meters for each type of relay	2
2.	Test and calibration panel with meter for speedometer	2

3.	Test panel with meters for auxiliary machines	2
4.	Loading dynamometer with test bed for auxiliaries	2
5.	Test panel with meters for contactors circuit breakers	2
6.	Brake and pneumatic equipment test panel including air compressor 500 liters per min 15 kg/cm sq	2
7.	Air brake pneumatic testing rig	2
8.	Test panel for testing of SMGR	1
9.	Variable Auto Transformer Rectifier Unit Out Put 0-135V,100A.	2
10.	3 Phase 415V, 50Hz variable Auto transformer rectifier unit for high cap. DC Motor testing.	2
11.	Relay test bench for Air flow relay testing.	1
12.	Test bench for Pressure switch relay testing.	1
13.	Test bench for Electro Pneumatic valve.	2
14.	Test bench for Reverser/ CTF.	2
15.	Three tank portable work station for cleaning Sinter Bronze capsule of Pneumatic circuit of AC Locomotive.	2
16.	Angle Indicator test kit for Digital notch Indicator.	1
17.	Set of Test Unit for SMGR/GR & CGR.	1
18.	Constant current/ Constant voltage Battery Charge/ Discharge Panel.	2
19.	Battery impedance test equipment bite 3, 230 V AC, 50 Hz, CE Marked including Accessories & operating manual & printer battery operated 220 V AC.	1
20.	LCD Multimedia projector.	1
21.	Static converter(SIV) analyzer with printer & memory reader unit.	1
22.	Hydraulic puller of capacity – 15 ton with spread – 280mm, reach – 229mm stroke – 82mm.	2
23.	TFP oil circulation pump MPH test Bench.	1
24.	TFP oil circulation pump Radiator test Bench.	1
25.	Testing panel for Air Dryers.	1
26.	Testing panel for circuit breaker.	1
27.	Testing panel for ARNO Converter.	1

28.	3 Phase testing panel with Amp. Meter for testing 3 CPs.	1
29.	Air dryer test ring with stand & Dew-point meter	1
30.	Thermal imaging equipment	2
31.	Provision of testing facilities for testing of MPCS & SIVs of conventional locomotive on the line of test jig of electronic cards developed by M/s MEL system Chennai.	As per requirement

B- Testing and Measuring Instruments

1A	Megger 2500 V	8
1B	Megger 1000 V	10
2	Megger 500 V	8
3	Universal multimeter	10
4	Portable voltmeter dc	5
5	Portable voltmeter ac	5
6	Portable ammeter dc	5
7	Portable ammeter ac	5
8	Current transformer set 20 to 2000 A	3
9	Ammeter shunts 75 m V 2000 A	2
10	Millivoltmeter 0-75 mV	3
11	Storage type Oscilloscope with current & voltage probes	4
12	High voltage tester 0-15 kV	2
13	High voltage tester 0-75 kV	2
14	Oil tester 0-50 kV	3
15	Current injection set 2000 A 3 V dc	1
16	Silicon diode tester	3
17	Electro- plating thickness measuring equipment	2
18	Contact pyrometer (0 – 200 °C)	5
19 A	Ultrasonic crack detector for testing white metal bonding in suspension bearing	1
19 B	Ultrasonic crack detector for Axles and traction motor shafts	4
20	Zyglo ultraviolet light crack detector	2

21	Brinell hardness tester	2
22	Shore hardness tester	2
23	Spring balance (0-1 kg)	3
24	Spring balance (0-3 kg)	3
25	Spring balance (0-5 kg)	3
26	Spring tester	2
27	Recording ammeter	2
28	Recording voltmeter	2
29	Aneomometer	6
30	Manometer	2
31	Vibration meter	3
32	Capacitance and induction bridge	2
33	Clip on ammeter 0-5-10-25-50-100-250 A	8
34	Dial gauge, Cernier valiper, micrometer and feeler gauge (1 set each)	7
35	Revolution counters	5
36	KWHr meter with accessories for mounting on loco	3
37	Electric coil tester	2
38	Electric timer	2
39	Portable relay testing kit	1
40	Commutator profile recorder	2
41	Stop watch	3
42	Illumination meter	2
43	Wheat stone bridge	2
44	Distilled water tester	2
45	Stroboscope/8Tachometer	2
46	Gear teeth micrometer	2
47	Capacitance & Tan-delta measuring instrument	1
48	Ultrasonic hardness tester	2
49	Dissolved gas analysis apparatus	2
50	Universal tensile testing machine (40 tonne)	2
51	VCB overhauling & testing tool	2
52	Surge comparison tester	3

53	Shock pulse meter for bearing	4
54	Bearing room with ultrasonic cleaning facility	2
55	Induction heater for mounting/ dismounting of bearing	2
56	Micro ohm resistance meter for bar to test of armature.	2
57	Resistivity meter (Model-I.R.T.).	1
58	Microprocessor based Moisture tester (Vigio matic-III).	1
59	Surface & interfacial tension meter.	1
60	Pensky-Marten (closed) Flash point apparatus.	1
61	Electric & Battery operated single pan balance.	1
62	Reference block type – VI (IIW).	1
63	Flexible oven illuminated magnifier.	1
64	Welding resistance meter	2
65	Electrode heating oven 350 ^o C	6
66	Testing kit for Furan analysis	1
67	Transformer ratio tester	1
68	Vacuum drying plant	1
69	Dew point meter	1
70	Micro ohm meter for measuring of RF/RPS & RS resistance	1
71	Delay time for EMC	2
72	Air flow meter	4
73	Thermovision camera	1
74	High speed camera (for taking photo of equipment failures)	1
75	Ultrasonic air leakage detector	1
76	Wheel profile recorder	1
77	Lubricating grease metal particle analyzer	1

- Note:** 1. All electronic equipment maintenance sections, Relay maintenance, SMGR overhauling section and bearing overhauling section to be air conditioned.
2. All electronic equipment maintenance sections should have anti-static flooring.

LIST 4 – LIFTING, HANDLING AND TRANSPORT EQUIPMENT**A - Lifting and Handling Equipment**

1	65 tonne Electric overhead travelling crane with 10 ton Auxiliary hoist for heavy lifting bay.	4
2	35 tonne crane for medium, TM & Aux lifting bay.	4
3	25 tonne EOT crane with 6 t auxiliary hoist	2
4	15 tonne EOT crane	4
5	Lifting tackles for transformer, traction motor, armature loco underframe, roof sections, bogie, wheel set, loco body etc.	4
6	2 tonne chain pulley hoist	6
7	Capstan units 3 tonnes	6
8	Tirfors 3 tonnes	5
9	35 tonne screw jack electrically operated with traversing bases (4 numbers a set)	2
10	20 tonne high lift hydraulic jack (4 numbers a set)	4
11	Accommodation bogies for each type of loco (loco set)	4
B. Transport Facilities		
1	2 tonne fork lift battery truck	4
1A	5 tonne fork lifter	4
2	1 tonne pallet battery truck	2
3	1 tonne material hand trolley platform type (rubber tyres)	5
4	1 tonne hand pallet trolley	5
4A	2.5 tonne hydraulic pallet trolley	6
5	7.5 tonne trolley on rail (for traction motors)	3
6	10 tonne truck	2
7	Jeep with trailer	2
8	Departmental wagon	1
9	Material handling van fitted with crane	2
10	Breakdown vehicle	2
10A	Rail cum Road Vehicle	1
11	Battery driven trolley with rubberized wheel of 3 ton cap.	2

12	Fork lifter having multi stacking features.	3
C. Weighing Machine/Scales		
1	Weighing machine 1 tonne (Stores Depot)	2
2	Weighing machine 50 kg (Stores Depot)	2
3	Weighing machine (Electronic 0-300kg)	2

LIST 5 – COMMUNICATION FACILITIES

1	Fax machine	2
2A	Telecom facility (with electronic exchange of 100 lines)	1
2B	Linkage of shed Computer network with Zonal head Quarter and Divisional HQs	As per requirement
2C	V.H.F. sets (Walkie- Talkie)	40
3	Laptop & P.C.s with associated hard ware.	Adequate nos
4	PC based computer system with tape drive printer etc and linked with stores computer	2
5	LAN connection with server unit having PC in each section/Sr. Supervisor and 4 PCs in SrDEE's Technical section with railnet/internet facility.	1
6	FOIS/COIS -terminal	2
7	Software Tools for maintenance magnet, failure analysis, inventory magnet and establishment.	As per requirement
8	Railnet & Intranet	10
9	CUG connections	100

LIST 6 – GENERAL PURPOSE MACHINES

1	Rain water leakage testing shed	1
2	Facility for mechanised washing of loco body for coaching locos	2
3	Floor scrubber	6
4	Portable compressed Air system for blowing out the pipelines in IOH/POH in situ	2

5	Industrial vacuum cleaner for cleaning inside the loco	8
6	500 KVA DG Set.	2
7	Water cooler with water purifier (R/O)	10
8	Deep freezer (675lt. capacity).	2
9	Multi split air conditioner for lab upto 3 ton. Capacity.	4
10	33/0.44 kV sub station TFP of 500 KVA.	2

LIST 7 – WORK BENCHES , LOCKERS Etc.

1	Stores	Adequate quantity to be provided as per requirement
1A	Workmen's tables, Battery charging Benches, Armature Trestles	
2	Bench vices	
3	Individual fitters tools	
4	Steel lockers for workmen	
5	Steel almirahs and stores racks	
6	Steel tables and chairs, cardex boards, filing cabinets, index cards cabinets, Printers, PC for PPO's office.	
7	Tables, chairs for officers and supervisors, almirahs, filing racks, cabinets, Printers, duplicator, drawing office and ferro printing equipment.	
8	Time office equipment, Time clock, ticket filing racks, tables and chairs.	
9	Optimiser/File keeping racks	
10	Multi level stacking facility for storage of material on shop floor	
11	Stool with 8" back support for micro-processor/ electronic equipments repair for staff	

LIST 8 – Training & staff welfare facilities		
S.No.	Items	
1	Basic Training school(BTC) with Hostel/rest room having 2 class rooms with LCD projector, one small meeting room and one model room	1
2	Well furnished Library having all the facilities viz. adequate technical books, PC with internet connection, printer, photo copier	1
3	Lunch / Tiffin room	1
4	Staff Canteen	1
5	Cycle/motor cycle stand	1
6	Digital Camera	2
7	Micro processor based training module for conventional / 3 phase loco	1

LIST 9 – Other facilities		
S.No.	Items	
1	Water Harvesting arrangement	1
2	Fire fighting arrangement	1
3	General electrification with provision of all electrical fitting light & power socket point.	1
4	Heavy Duty Digital copier machine	1
5	Audio conferencing system for meeting room.	1
6	Provision of CCTV	As per requirement
7	Borewell with pump	As per requirement
8	Provision of motorized points to expedite shunting and avoid the need for points men	
9	Provision of ESD free lab	
10	Provision of effluent treatment plant	
11	Provision of security chowkie at main gate	

LIST 10 – Testing Facilities to be made available at Chemical & Metallurgical Lab

- 1) Facilities available for Insulating oil Testing
 - a) Dissolved Gas Analyser/Chromatograph – 2 Nos.
 - b) Tan Delta and Specific Resistance tester – 1 No.
 - c) Moisture tester – 1 No.
 - d) Flash Point Apparatus – 1 No.
 - e) Vis gauge for Viscosity Testing – 2 No.
 - f) Interfacial Tensiometer – 1 No.
 - g) Acidity test kit – 1 No.
 - h) Testing kit for testing carbonization of battery electrolyte in Ni-Cd batteries
- 2) Ultrasonic Flaw Detector to check internal crack of Loco Axle, Armature Shaft, Wheel disc, Looseness of racer etc. – 02 Nos.
- 3) Universal Tensile Tester for Rubber, Cork etc. – 01 No.
- 4) Spectrometer to check metallurgical composition of various loco components – 01 No.
- 5) Rockwell cum Brinnell Hardness Tester to test metallic component hardness – 1 No.
- 6) Poldi Hardness tester to test metallic component hardness – 1 No.
- 7) Shore Hardness tester to test rubber, cork hardness – 01 No.
- 8) Grease Penetrometer to check consistency of grease – 1 No.
- 9) Magnetic crack detector AC/DC 230 V to check surface crack of Ferrous components – 1 No.
- 10) Permanent pole Magnet to check surface and sub surface crack of ferrous component – 1 No.
- 11) Other Mandatory Lab equipments
 - a) Magnetic stirrer cum heater – 02 Nos.
 - b) Mono Pan Balance – 01 No.
 - c) Muffle Furnace – 1 No.
 - d) Hot air oven – 01 No.
 - e) Dial Thickness gauge – 1 No.
 - f) Integrated Portable Hardness tester – 1 No.
 - g) Conductivity meter of Battery water – 1 No.
 - h) Refrigerator – 1 No.
 - i) Gas cylinders for DGA – 02 each of Hydrogen, Oxygen and Nitrogen
 - j) Distillation plant – 1 No.
 - k) Metallurgical Microscope – 01 No.
 - l) Voltage Stabiliser – 01 No.
 - m) Set of Laboratory Glass wares
 - n) Argon gas Cylinder – 2 Nos.
 - o) Set of Laboratory chemicals
 - p) DPT test kit
 - q) Magnetic powder for MPT
 - r) Contactless Thermometer
 - s) Gas generator for DGA
 - t)

Other Facilities:

- 1) Fuming Gas Chamber
- 2) 02 Desktop computers with UPS and Laser Printer

LIST 11 - Computerized Network data base system of maintenance of locomotives and equipment in electric loco sheds

- | | |
|--------------------|---------|
| 1. Computer Room | 2 No. |
| 2. Split AC | 4 Nos. |
| 3. Computer Table | 50 Nos. |
| 4. Computer Chairs | 50 Nos. |
| 5. PCs | 50 Nos. |
| 6. Server | 05 Nos. |
| 7. Printer | 25 Nos. |
8. All hardware & software required for LAN
 9. Development of a uniform Shed management Software to monitor the position/status of overhauling/repair/inspection/failure of equipment and locomotives, status of availability of spares/equipment in stores, Status of implementation of modifications suggested by RDSO etc. to be connected through LAN and used by all the officers and staff of shed.
 10. Development of a comprehensive Loco Management Software like FOIS, through reputed organisations like CRIS connecting sheds, Zonal Railways, Railway Board, RDSO, CLW and other units for monitoring the position of locomotives and carrying out failure analysis for the same.

List 12 – Advanced automated maintenance & condition monitoring system for on line health monitoring of electric locomotive and Real-time preventive maintenance support system for Electric rolling stock:

A. Advanced automated maintenance & condition monitoring system for on line health monitoring of electric locomotive

Automatic maintenance system plays an important role as a solution to the problem of handling down maintenance techniques to younger generations, due to the ageing society and reduction of man power, because the system

always yields stable measurement/maintenance results without depending on personal skills. Industries have developed many automatically measuring & maintenance equipments which can provide maintenance solutions in conditions where dangerous, hard and dirty tasks are inevitable and for reducing the work load of maintenance operators. The following is an indicative & inexhaustive list where automated system could be considered for use by sheds:

SN	Description	Remarks
1	Pantograph contact measuring system	The thickness or abnormal wear of pantograph contacts are measured by the ultrasonic method and image processing method.
2	Monitoring system for loco roof tops	Still picture of the pantographs and AC devices and the moving images of the entire roof top condition are recorded.
3	Wheel profile measuring system	Dimensions of different sections of a wheel are measured by laser and camera.
4	Brake wear measurement unit	Dimensions of the brake shoe and brake lining are measured by a camera and their replacement periods are estimated.
5	Wheel flat detection device	Flats on the wheel treads are detected by acoustic sensors and camera images.
6	Axle flaw auto detector	Flaws in axles are automatically detected by ultrasonic echo analysis
7	Paint peeler	Higher pressure water jet shall be used to peel off the paint , instead of solvent which has higher environmental impact
8	Loco body dirt auto detector	The degree of dirt accumulated on the surface of loco body and inside loco is judged by image processing technique for improved efficiency of the following chemical cleaning process
9	Blower for under frame equipment	Air blowing of under frame devices is automatically performed.
10	Simulator for malfunction recovery training	Procedures for counter measures taken by Railway man in the event of problems during train operation are outlined on a PC.

11	Infrared Thermograph	An inexpensive way to embark on condition monitoring is through the use of infrared imaging. The temperature of conductors, bus, switches, transformer tanks, motors and bushings are a direct function of the level of loading of the components, infrared techniques provide value by reviewing temperature differences. The magnitude of difference in temperatures can assist in determining whether the repair should occur immediately or if the problem can be addressed during scheduled routine maintenance.
12	Ultrasonic and Vibration Detector	Ultrasonic detection techniques are based upon analysis of sounds that the ear can't normally detect. Electrical arcing and corona discharge and pressure or vacuum leaks can be pinpointed with the aid of detecting devices. Electrical discharges are heard as a frying or buzzing sound whereas a pressure or vacuum leak is heard as a rushing sound or noted on a ballistic meter. The device can be used to test switchgear, transformers, circuit breakers, relays, junction boxes, insulators, bushings, arresters and other electrical gear.
13	Oil Analysis equipments	<p>Beside gas chromatography; which requires drawing of oil routinely to assess & analyse the levels of various gases.</p> <p>The on-line system designs will improve upon the semi-annual or yearly DGA sampling cycle. The system detects four key gases through tiny semiconductor sensors immersed directly in the transformer oil at the end of a sensor</p>

		probe. Hydrogen, carbon monoxide, ethylene and acetylene concentrations are continuously monitored for detection of corona or partial discharge, cellulose overheating, pyrolysis, oil overheating and arcing, respectively. Fault gas readings are displayed on-site via a microprocessor unit or are accessed via a computer, on-site or remotely. Transformer maintenance can be better managed based on information obtained through the monitoring system. <i>One such system, developed by Micromonitors, Inc., Bend, Oregon, U.S</i>
14	On-line monitoring system for transformers	On-line monitoring system that can be retrofit to existing transformers or supplied with new transformers. The system is based on a condition monitoring package that performs gas-in-oil and partial discharge analysis. It also uses an acoustic method to monitor vibrations of transformers with load tap changers. Load current and oil temperature are also monitored.
15	Breaker Maintenance & Diagnostics tools	On line Breaker condition monitoring system captures information on the condition of the breaker every time it operates. Trip and close coil currents, open and close of contacts, fault current values and station battery voltage dips. The device provides output alarms for operate times, coil currents and contact duty. The system can also accept inputs from various types of transducers.
16	Automatic locomotive Washing Plant	Required for fast and automatic cleaning and washing of locomotive body
17	CNC M/Cs	For Machine shop activities
18	TPWS/ACD/TCAS/DPWCS Test stand of associated equipment	Required to check the functionality of each equipment

19	E-70/CCB Brake equipment (full simulation) test and diagnostic console	Required to check the functionality of brake system on 3 phase locomotives
20	Automated Storage and Retrieval System(AVSRS) Vertical Retrieval	Provides easy storage and retrieval of equipment/components with multilevel stacking facility within available space

Note: The above list is indicative & inexhaustive and the same can be expanded depending on the development and availability of more automated tools to assist maintenance of locomotives and its equipment.

B. Real-time preventive maintenance support system for Electric rolling stock:

1. Introduction

With hundreds of components onboard, it is not possible to know the extent of utilization of each component within a rolling stock by any off line methods or analysis. However, by providing suitable onboard monitoring systems, the utilization of many vital components can be precisely monitored and reported to base station on a real time basis. At the base station, a large repository of such data for all the assets can be created, which will provide timely alerts when an asset is due for a preventive check. Such a repository can be connected to all the custodians of assets simultaneously using internet technology. Using this method, centralized expert advice can also be sought. Upon receiving such alerts of an expected failure or component replacement request from the system, the depot can mobilize a quick response team to the site with necessary materials which would avoid a line failure and major catastrophe. This is the trend now in developed Railway Systems and comes under the umbrella of **Remote Diagnostics & Remote Monitoring**.

2. Infrastructure Requirement

2.1 Onboard Hardware

To start with, this system can be targeted in 3-phase locomotives, tap-changer locomotives, EMUs and MEMUs. Three phase locomotive has already microprocessor based system and hence the status of almost all items are available in realtime on board. This only has to be suitably brought to a base

station repository. In tap-changer locomotives provided with microprocessor based systems, some level of augmentation can provide additional hardware and sensors to capture the required details, so also the case with EMUs & MEMUs. Additional investment will go in for such hardware onboard the rolling stock.

2.2 Base Station

The base station will contain one or more large data servers, loaded with various application programs to analyse the raw data received from various rolling all over India. It will have access to registered users. The system itself will make alerts to the custodians about the failure trend, expected time for preventive check, replacement of a components etc.

2.3 Data Network

The most important aspect for success of this scheme is to have a seamless coverage of a wireless data network in the entire Indian Railways electrified section. Even though private operators like Reliance & Airtel as well as state owned BSNL provide wireless coverage in many parts of the country, these are mainly for voice applications and for public use. These networks will not provide facility for huge data transfer, and even if it is available in future with 3G spectrum, such operators would not be able to guarantee uninterrupted data transfer and foot print across the electrified track. Hence, as part of this project, it would be needed to set up a pan India (covering electrified tracks to begin with) broad band wireless network like WiMax. Alternatively, some network operators who would be getting the 3G spectrum and WiMax in future can be asked to provide this facility with an exclusive arrangement.