STUDY TOUR FOR TEST TRACK

- TTCI AT PUEBLO
- SIEMENS TEST CENTER
- WEGBER-WILDERNARTH, GERMANY
- OLD DALBY
The work of construction of dedicated test track facilities for conducting various trials, tests and studies related to Railway technology has been included in the Works Programme 2002-2003 in the Plan head 'Railway Research' under DF-III at an estimated cost of Rs.87.3 crores.

For better appreciation and understanding of the project, so as to ascertain the suitability for the I.R conditions multidisciplinary team was formed to visit the various test tracks available with advance world railway system for understanding the various features of test tracks, various testing facilities available, type of test being conducted by them etc. is of great relevance.

It may be mentioned that test track facilities are available worldwide. TTCI at Pueblo in USA is one of the oldest & considered the leader amongst them. Test Track of SIEMENS in Germany & Old Dalby Test-track, U.K are also available. In order that the test track serves the total interest of Indian Railways for the years to come as a tool for research and development in railway technology, it is imperative and essential that planning and execution of the project is precise. This can be attained successfully by having in-depth knowledge and complete understanding of the subject. Great care and emphasis is required to be taken in assimilating technology, which would serve the purpose of the test track for Indian Railways.

The purpose of the visit of the team is to study the infrastructure provided for testing on various advanced railway systems, facilities available for testing and type of tests being conducted by them. This in turn helps in system improvement studies, performance and reliability studies, testing of new components and designs and improving existing track maintenance practices on Indian Railway.

The visit results in acquiring knowledge and understanding of technological aspects of various tests and trials on test track technology for measurement of various tests and trials data on test track, control techniques for creating defects and disturbances during tests and trials, mechanism to create the particular track perturbation etc. The proposed areas of field testing are tests on formation and ballast, track components, bridge components including fast accelerated service trials, on rolling stock & its components.

A team of officers namely S/Shri.R.K.Bhatnagar, ED/E&R, Railway Board, Ranjanesh Sahai, ED/Finance(S), Railway Board, B.S.Dohare, ED/Testing, RDSO & Vijay Sharma, ED/TM, RDSO were deputed to make study visit to TTCI/USA, SIEMENS/
GERMANY, Old Dalby, UK vide Rly. Bd’s letter no. 2007/E(O)II/14/172 dt.09.4.2009 (Copy is enclosed as Annexure-A)

The team also utilised this opportunity to assess the suitability/capability of the organisations visited for the implementation of Heavy Haul projects of IR.

This report is based on the discussions held by the group with Railway personalities of these Test track centres, visit of systems prevailing in their railways, review of best practices, field visit & on board run on Loco/Coach on test tracks.

2. Places Visited

Team of officers on deputation visited the test track facilities at TTCI, PUEBLO, USA, Old Dalby, UK & SIEMENS, GERMANY. The details of visit are as below.

3.0 TTCI, PUEBLO, USA

The team visited the TTCI for 03 working days. During this visit, the TTCI officials made presentation & arranged for field visit of test track & their facilities. Observations & points noted/observation are summarised below:

Originally U.S. Federal Railroad Administration’s (FRA) Transportation Technology Center (TTC) near Pueblo, Colorado was run by Association of American Railroads (AAR) with mission "to accelerate the rate at which beneficial new technologies are developed and used by the railroad industry." Subsequently on January 1, 1998, the Transportation Technology Center, Inc. (TTCI) was formed as a wholly owned, subsidiary of the Association of American Railroads (AAR).

About the Association of American Railroad (AAR)

- Master Car Builders Assoc. formed 1867
- The goal was to promote interchangeability among freight cars
- In 1933 the Rail Transportation Act was passed to deal with depression-era problems affecting railroads
- President Franklin D. Roosevelt recommended railroads unify into one organization.
- AAR formed on October 12, 1934
**AAR’s Mission & Vision**

- **Mission**
  - To add value to the North American railroad industry by fostering improved safety, security, service, efficiency and profitability through leadership and coordination on industry issues.

- **Vision**
  - To be recognized by industry leaders and valued by public policy decision makers as the definitive voice of the North American rail industry.

**AAR Structure**

**Six functional areas:**

- Safety, Security and Operations □ Government Affairs
- Policy and Economics □ Administration and Finance
- Communications □ Law
- Two subsidiaries and one affiliated organization:
- Research and development
- Information technology
- World-class **policy research organization**

**AAR Full Members**

**AAR Affiliate RR Members**

- Great Salt Lake and Southern Railroad LLC
- ISG - Cleveland Works Railway Company
- Lake Superior & Ishpeming Railroad Co.
- Metro-North Railroad
- MG Rail, Inc.
- Morristown & Erie Railway, Inc.
- New Orleans & Gulf Coast Railway
- New York City Transit
- Northern Plains Railway Republic N&T Railroad, Inc.
- Roberval and Saguenay Railway Company
- Sidney and Lowe Railroad, LLC
- Transtar Inc.

**AAR Associate (Gold) Members**

- Alstom Transport
- American Railcar Industries, Inc.
- Amsted Rail Group
- Chicago Freight Car Leasing Co.
- CIT Rail Resources
- Diamond Rail Lease Corporation
- First Union Rail Corporation
<table>
<thead>
<tr>
<th>Association Name</th>
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<tbody>
<tr>
<td>FreightCar America, Inc.</td>
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<td>GATX Rail</td>
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<td>General Electric Railcar Services Corp.</td>
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<td>GE Transportation</td>
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<td>The Greenbrier Companies</td>
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<td>HDR Engineering</td>
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<td>HNTB Corporation</td>
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<tr>
<td>Lockheed Martin Maritime Systems &amp; Sensors</td>
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<td>MPL Technology</td>
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<td>New York Air Brake Corporation</td>
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**AAR Associate (Gold) Members (Cont.)**

- Pacer Stacktrain
- Parsons Brinckerhoff
- Progress Rail Services
- Rail CRC
- Reidler Decal Corporation
- RESCAR Companies
- Southern Company Generation
- Standard Car Truck Company
- Standard Steel, LLC
- The Timken Company
- TransEd, Inc.
- TranSystems Corporation
- TrinityRail
- TTX Corporation
- Union Switch & Signal
- Union Tank Car Company
- Wabtec Corporation

**AAR Associate (Silver) Members**

- AIG Rail Services, Inc.
- All Capital (US), LLC
- American Railcar Leasing CSR Zhuzhou Rolling Stock Works
- GLNX Corporation
- Global Welding Technologia Ltd.
- Herzog Contracting Corp.
- Holland Company
- JK-CO LLC Specialty CarRepair
- Kennedy / Jenks Consultants
- Kim Hotstart
- MHF Logistical Solutions
- Mid-America Car Inc.
- Plasser American / Franz Plasser
- Procor Limited

**AAR Associate (Silver) Members (Cont.)**

- RailPower Hybrid Technologies Corp.
- Road & Rail Services, Inc.
- Salco Products, Inc.
- Saskatchewan Grain Car Corporation
- Savage Transportation Management (Formerly CANAC)
3.1 STATUS OF TTCI

TTCI operates and maintains the site under a contract with the US Government, Federal Railroad Administration.

In early 80's US, Canadian Railroads wanted to adopt the Heavy axle load technology and there was no room for making errors as they would be costly as well as disastrous for these commercially run railroads. To prevent this situation, AAR was asked to develop this technology by undertaking High axle load trials in a closed circuit Heavy axle load (HAL loop) test track at TTCI. TTCI tested all types of combinations of track structures, bridges, rolling stock etc and develop the requirements for railway infrastructure and rolling stock design based on these experimental observation obtained by running a dedicated heavy axle load train continuously on a dedicated test track at a enormous cost for a period extending many years. As a result entire technology of
Heavy axle load covering track, bridges, rolling stock based on methodology of controlled monitored experimentation was successfully developed by TTCI. Subsequently the technology of Heavy Axle load developed by TTCI was successfully implemented on US railroads resulting in millions of dollars of additional earning and saving enormous amount of expenditure which would otherwise be spent in trial and error. Subsequently TTCI has entered into contracts with other countries e.g. Brazil for transfer of technology.

As per US railroad fact book of 2006, US railways have 140490 miles of track. The US railways have revenue ton miles 1,771,897 million, revenue of $ 54 billion providing a return on equity in excess of 10% in recent years. The huge volume of HAL operation in USA is based on technical inputs of TTCI is also reflected in the complete range of technical publications of TTCI.

TTCI has the unique distinction of having diverse array of capabilities, which include all the technical aspects of railroad, all at one place, along with an extensive experience in development of high axle load freight cars for heavy haul operations. specialized research for railroads, inspection services to ensure that safety regulations and interchange, design & maintenance rules are followed, development of all technical specifications / standards for all aspects (like wagon body, bearings, wheels, Draft gear & couplers & others), specialized testing facilities and track. It has rendered its services for higher axle loads in other countries like Brazil, China, South Africa, and UK, apart from USA & CANADA.

It is unique in its experience with heavy haul operations, which include axle loads of 25t & 32.5t and above. Heavy haul Standards of Australia uses Standards of AAR developed by TTCI as the fundamental Reference.

TTC is an isolated and secure 52 square mile facility with a vast array of specialized testing facilities and tracks. Layout is placed at Annexure-1. All types of freight and passenger rolling stock, vehicle and track components can be tested at TTCI. There are 48 miles of test track which are used for track structure and vehicle performance testing, life cycle prediction and component reliability, freight ride quality and passenger comfort.

Research through tests conducted on test track in TTCI is the basis of all knowledge, standards and software of AAR (A Large nos being used by Indian Railways for Goods stock and bogie development using NUCARS model of AAR) and AREMA which are used by many countries.

TTCI is having lot of openmess in sharing information and knowledge, intellectual property and therefore any collaboration
with them would be very fruitful.

In the past, TTCI has invested enormous amount in generating research data through tests conducted on test-track.

Vast array of capabilities as is available with the M/s TTCI at one place include maintaining technical standards used by the railroad industry, specialized research for railroads, inspection services to ensure that safety regulations and interchange, design & maintenance rules are followed, development of all technical specifications / standards for all aspects (like wagon body, bearings, wheels, Draft gear & couplers & others), specialized testing facilities and track. The 32.5 t and higher loading test track of TTCI permits simultaneous tests spanning the entire range of data collection for formation, track, bridges, and wagons. This facility also includes 3 research bridges developed exclusively to gather data on load environment. The test train and all the track components gather GMT by running the loads equal to those in revenue service thus replicating load environment conditions for all items being tested under repeatable conditions.

### 3.2 TTCI Strategic Research Initiatives

Strategic Research Initiatives (SRI) included in the Association of American Railroads research plan focuses attention on high priority research programs concentrated in 12 areas in which research promises significant economic return to the industry and addresses industry business objectives.

SRI future plans are based on such considerations as prospective economic return, technical merit, and feasibility. It is designed to focus on the long-term strategic objectives of the industry established by the AAR Board, which includes Safety, Reliability, Cost, Containment, and Reducing Stress State for the railroads. The list below outlines the focus of SRI's over the next several years.

- Wheel / Rail Asset Life Extension
- Vehicle / Track Performance
- Train Condition Monitoring
- Heavy Axle Load Implementation
- Track Integrity Monitoring
- Special Track Work
- Bridges
- Track Components
- Improved Performance Track
- Signal, Communication and Train Control
- Improved Car Performance
- Improved Car Components
- Advanced Train Equipment
- Technical Support
- Technology Scanning

TTCI is responsible for the majority of the standards function previously performed by the AAR Technical Services Division. The purpose of this new program is to consolidate technical functions at TTCI, to expand the technical standards capability, and to make this technical standard expertise available to others.

Any collaboration with TTCI would not only give access to their past research but also to the current day SRI (Strategic research programmes).

### 3.3 Certification Testing Services

TTCI provides certification test services for most AAR Technical Standards including:

- Wheels
- Wheel Bearings
- Brake Shoes
- ECP Brake Components
- Brake Beam Slack Adjusters
- Hand Brakes
- Center Plate Liners
- Bolsters
3.4 Technical Standards and Quality Assurance

Internationally for Heavy Haul above 30t, the operation is only on standard gauge and AAR standards are followed. These standards have been formulated on basis of research and tests conducted on test track at TTCI and are maintained on behalf of AAR by Chief, Technical Standards at TTCI. Therefore all major technical standards of AAR used by US railroads regarding Freight cars, Track, formation, bridges etc, are based on research work done on the TTCI test track. TTCI assumed responsibility for the majority of the technical and administrative functions related to the standards function previously performed by the AAR Technical Services Division. Maintenance of AAR’s technical standards is critical to the efficient functioning of the North American rail car fleet. The AAR maintains oversight, with all technical standards development carried out by TTCI.

The standards are issued and enforced to ensure safety, compatibility, reliability, and efficiency of equipment used in interchange service. Maintenance of AAR’s technical standards is critical to the safe and efficient functioning of the North American railcar fleet.

TTCI provides technical and administrative support to AAR’s committee structure. These committees of industry technical experts are responsible for the development and maintenance of industry standards. Committees include railroad and non-railroad experts in the area of quality assurance, locomotives, intermodal equipment, open top loading, freight car design, freight car truck systems, railway electronics and freight and locomotive braking systems.

Research in TTCI is the basis of all standards of AAR (A Large nos being used by Indian Railways for Goods stock and bogie development using NUCARS model of AAR) and AREMA which are used by many countries.

It may be noted that all wagon design in US railroads is built around AAR standards. AAR standards are available for all components of Wagons. Infact IR is also following AAR standards at present for all its wagon design.

AAR has implemented Heavy Axle Load (HAL) on large part of its network with the help of TTCI. In its efforts to increase axle loads, Indian Railways should follow the model of AAR. Heavy haul Standards of Australia & Sweden uses Standards of AAR developed by TTCI as the fundamental
Reference. No fundamental research has been carried out on test track of Australian, Swedish railroad which could have given codes, manuals, standards etc. DUE TO THIS AUSTRALIA, SWEDEN etc ARE ADOPTING AAR, AREMA STANDARDS WHICH IN TURN ARE BASED ON RESEARCH DONE ON TEST TRACK BY TTCI. IT HAS ALSO DONE THE SAME IN PAST

<table>
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<tr>
<th>3.5</th>
<th>TTCI Revenues &amp; activities</th>
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<tr>
<td>Revenues:</td>
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<tr>
<td>o Domestic and international commercial work (59%)</td>
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<td>o AAR for SRI and Task Orders (29%)</td>
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<tr>
<td>o U.S.Government (12%)</td>
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<tr>
<td>Activities:</td>
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<tr>
<td>o Strategic Research Initiatives</td>
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<tr>
<td>o Research initiatives, including vehicle track systems, engineering research, heavy axle load research, mechanical research, technology scanning</td>
<td></td>
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<tr>
<td>o Task Orders for Safety and Operations</td>
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<tr>
<td>o Assists AAR with technical standards, mechanical inspections, hazardous materials, tank car development, spent nuclear fuel casks, communications, railway electronics, car repair billing, AAR scales, locomotive emissions, bolsters, security, damage prevention/freight claims.</td>
<td></td>
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<tr>
<td>o TTCI serves member railroads through the AAR's Strategic Research Initiative Program. Focused on enhancing railroad safety, reliability, and productivity, TTCI also plays a major role in the development and application of new technology for railways, suppliers, governments, and others involved in rail transportation. TTCI helps railways implement new technology and solve technical problems. TTCI also provides services to the railway supply industry for testing, evaluation, and training.</td>
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<tr>
<td>o TTCI has some very unique characteristics and capabilities that are unmatched by any other railroad research organization in the world:</td>
<td></td>
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<tr>
<td>• It is an integral part of the North American Railroad System</td>
<td></td>
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<tr>
<td>• The North American System is recognized as the most cost effective general use system in the world</td>
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<tr>
<td>• North American heavy haul operating standards and technology are the technology of choice for heavy haul railways worldwide.</td>
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- TTCI has demonstrated that it can develop cost effective research programs that fit the needs of a variety of stakeholders
- TTCI has the experience and has demonstrated its ability to work with a variety of railways world wide
- TTCI has experience in operating and managing a large test facility

As already indicated the US railways have a return on equity in excess of 10% in recent years. The huge volumes of HAL operation in USA is based on technical inputs of TTCI. Since return on equity is in excess of 10%, it is established beyond doubt that the inputs given by TTCI have yielded the desired profitable results for US railroads.

### 3.6 Test Track Facilities

The various test track facilities available at TTCI are as under:

### 3.6.1 Railroad test track (RTT)

The RTT is a 21.7 km. (13.5 miles) long loop capable of accommodating speeds up to 265 km/h (165 mph)( As shown in Annexure-I The oval track has one 1 degree, 15 minute reverse curve and the remaining 50 minutes curves. All curves have 6-inches of super elevation. Track structure includes welded 136-pound per yard rail, concrete ties and treated hardwood ties with elastic fasteners. The track loop is also being equipped with a rail break detection and switch indication system. The track is maintained to FRA class 8 standards.

The RTT has also been provided with OHE capable of operating at different nominal voltages of 12.5 KV, 25 KV and 50 KV so that vehicles of different designs and capabilities could be tested. The contact wire height can be adjusted to simulate tunnel or bridge conditions.

The RTT is the site of frequent high-speed stability and endurance tests for diesel and electric locomotives. This facility has recently been used very extensively for testing of Acela train of AMTRAK which is the first high speed being introduced on the North eastern corridor of USA. Japanese Railways have used this facility for testing of their high speed "Gauge Change Train". This train can switch over from standard gauge (1067 mm gauge width) to MG at a slow speed of 15-20 km/h during run test.
Since this facility provides for daily-uninterrupted running for several hours, it enables life cycle studies to be carried out conveniently. The Japanese have used the facility to earn up to 1,00,000 miles on this train. The entire assembly is thereafter being checked for wear and tear etc. to optimize the design.

3.6.2 Transit Test Track (TTT)

The transit test track is located in the south central portion of the Test Centre. It is a 9.1 mile (14.6 Km) closed track loop maintained as a FRA Class 5 track. As shown in Annexure 1 & 2, the north and south curves have a super elevation of 41/2" on the 1" 30' degree curves. This allows the track to be used at the maximum speeds for Class 5 track (80 mph freight, 90 mph passenger). Its primary design purpose was to serve as a reference track for testing and evaluating urban rail vehicles, including light, rapid and commuter rail cars. Secondary purposes are the development, test and evaluation of vehicle subsystem, alternative types of track structures and appropriate instrumentation. Over six segments of different track material construction; e.g. continuous welded rail versus jointed rail, wood versus concrete ties. The third rail DC electrified power system provides transit and commuter vehicles with a voltage variable from zero to 1,000 volts DC with a 3,500 amp continuous rating. The track includes a 10,000 foot long overhead DC catenary, suitable for low-speed operation and evaluation of light rail urban vehicles.

3.6.3 Tight Turn Loop

The Tight Turn Loop (TTL) is located at the lower end of the south east tangent section of the TTT. TTL layout is as shown in Annexure 1 & 2. It consists of a 150 foot radius loop (38.9 degree curve) constructed as a ballasted track with continuous welded rail on wood ties. Third rail power has been extended into the TTL. The loop is connected with a short spur track having a 17-2/3 degree curve. The main purpose of the TTL is to provide a facility for the detailed investigation of wheel noise, truck curving behaviour, and rail vehicle stability under extreme curvature conditions.

3.6.4 FAST Facility

The best known, most utilized, and the most versatile track at TTC was the 4.8 mile FAST loop, the Facility for Accelerated Service Testing as shown in Annexure 1 & 2. Even though the original FAST programs (1976 thorough 1988) ended under 33 ton axle loads, FAST was a million- gross-ton-per day durability test of many types of rails, fasteners, cross-ties, ballasts, sub-grade materials, wheels and freight car trucks. This loop was split in two
The High Tonnage Loop, 2.7 miles long, is currently used for heavy axle loads of 39 tons (U.S.).

**3.6.5 High Tonnage Loop**

The HTL, 2.7 miles long (as shown in Annexure 1, 2 & 3), is used for track component reliability, wear and fatigue research under heavy axle loads of 39 tons (U.S.). Operations are restricted to a maximum speed of 40 miles per hour.

The HTL is divided into test sections which generally correspond to tangents, spirals, curves (three 5 degree curves and one 6 degree curve) and turnouts. This track is used for conducting test i.e. rail performance, evaluation of ties and fasteners, turnouts, ballast and sub grade. Test train operations are designed to accumulate 1.0 million gross ton (MGT) a day traffic density at a maximum 40 miles per hour operating speed. During the visit, heavy haul train testing (39 T Axle Load with 80 Cars) was in progress with max. speed of 40mphr.

**3.6.6 HTL Bridges**

There are 3 bridges located in the High Tonnage Loop; one is within the tangent section of Section 5, and two are in the 5° curve in Section 3. (Annex.III). The bridge in the tangent section is a welded steel plate girder open deck bridge, open spans of 55 feet and 65 feet. See fig. 1, 2 & 3. The all welded girders are supported on concrete caps with steel piling. The girders are used members salvaged from 30 to 50 year old bridges.

The other two bridges are new concrete structures installed in 2003. (Fig. 4) One bridge has 24’ and 30’ double cell box spans and is usually called a “conventional bridge”. The other bridge is known as a “state of the art” bridge. The intermediate span is 42’ and has double cell box type girders made from high performance concrete. The flanking spans are a 30’ double cell box and a 15’ slab span. Both of the bridges have standard concrete ties in a ballast section, with the ballast depth of 12” under the low rail, and 16” under the high rail.

The concrete bridge span design of all but the 42’ spans are based on Cooper E-80 loadings and follow AREMA Chapter 8 design guidelines and BNSF/UP design practices. The 42’ span was designed by CN based on E-90 design. The girders are supported on precast pile caps laid over H-piles.

**3.6.6 Wheel Rail Mechanism Loop (WRM)**

This is a special loop of 3.5 miles length which has sharp curves...
from 3 deg. to 12 deg. (See Annexure 1 & 2) to monitor the curving performance of a vehicle. Track is configured to determine vehicle performance on normally smooth track and on track with perturbation designed to indicate known poor performance modes. Facilities are available to instrument the track to measure the lateral forces on the track during this movement.

The WRM is rated as FRA class 3 track due to geometry conditions. WRM is a key facility for slow speed AAR freight vehicle interchange performance testing and certification.

### 3.6.7 Precision Test Track (PTT)

This is a 6.2 mile long test track specially laid with perturbations designed into the track to enable study of vehicle dynamics behaviour and safety compliance. (See Annexure 1 & 2)

The dynamic pitch and bounce response of the test vehicle, excited by vertical inputs from the track is evaluated on PTT's 400-foot test section with 0.75 inch vertical perturbations in phase at 39 foot intervals on both rails. The dynamic twist and roll response of the test vehicle is excited by cross-level perturbations in the track which is evaluated on PTT's 800 foot section with 0.75 inch out of phase vertical profile variations at 39 foot intervals. The dynamic yaw and sway response of the test vehicle, excited by the laterally misaligned track, is evaluated on the PTT's 250 foot test section. On this test section, there are sinusoidal track alignment deviations of 39 foot wave length and amplitude of 1.25 inches peak to peak on both rails. Maximum speed tested is 257 mph (411 kmph).

### 3.6.8 Train Dynamics Track /Impact Track

The Train Dynamics Track is currently an access track to the FAST Facility, Impact Track, and Ballast handling Facility. The TDT is maintained as an FRA Class 4 track, with maximum operating speeds of 60 mph freight, 80 mph passenger trains. The curve on the TDT is a 1°30" curve with 4-1/2" super elevation, approximately 1.7 miles long. There is a small section of the track specially dedicated to test required to be carried out like adhesion testing with sand for dry testing and vegetable oil to be used on the rail for lower adhesion levels.

The impact Track is used for impact and derailment testing. The Impact Track is straight (tangent), 4, 400 feet (1341 m) long, with moderate (less than 1-percent) grades. The purpose of this track is to simulate and analyse carefully controlled "accidents" and various emergency situations. Impact tests at up to 60 mph have been performed on the track. A section of the track near the FAST Wye Track has been set up with an at grade road crossing and wayside power outlets to run instrumentation and photographic
### 3.6.9 Rail Defect Test Facility (RDTF)

The AAR and FRA have co-sponsored a test program to assist in the development of rail flaw technology. Through the test program, TTCI has installed the Rail Defect Test Facility (RDTF), using rail containing flaws found during in service rail flaw inspection performed by AAR member inspection crews.

Rail received at TTCI has been evaluated for internal and external flaws using visual, ultrasonic, radiographic and other non-destructive evaluation (NDE) methods. The flaws found during evaluation have been categorized by type and location and entered into a rail flaw database. Selected rail samples containing flaws have been installed into the RDTF for research and test purposes.

RDTF installation has been a joint effort between the AAR member railroads, the FRA, and TTCI. This track was specifically developed for research and test purposes to enhance technology and verify rail flaw detection system capability.

The RDTF track consists of two sections one for System Evaluations and one for Technology Development and consists of over 5440 feet (1658 meters) of track. Track classification is class 3 with allowable speed of up to 40 mph (64 kmph).

### 3.6.10 Balloon Loop Track

The Balloon Loop was constructed as a phased portion of the RTT under Federal Highways Project, with similar construction as the RTT. The track loop was designed to allow the turning of consists on the RTT to reverse direction. It was also used to turn vehicles for logistics in the core area. The track is maintained under FRA Class 3 safety standards, with maximum speeds of 40 mph freight, and 60 mph passenger trains.

Overhead catenary for the Balloon Loop transitions from compound style on the RTT, to a simple style catenary. The catenary around the loop can be isolated from the RTT to remove clearance restrictions when working on the track.

### 3.7 Rail Dynamics Laboratory

The Rail Dynamics Laboratory is a unique facility for researching vehicle and component dynamics for safety, ride quality, stability and durability. The 55,000 square foot high bay building houses highly sophisticated testing rigs, including the Simuloader, the Vibration Test Unit, and the Mini-shaker Unit. Their functions are monitored, controlled and recorded from the RDL control room. The data developed is collected by a computer in the control room. Both the VTU and SMU can transmit 64 channels of data from...
different types of transducers to the control room where data reduction system provide both “quick look” and in-depth analysis.

(a) Simuloader

The SMU is a hydraulic shaker system that inputs vibrations into a test vehicle’s car body directly through the body bolsters. The inputs used for this system are truck bolster responses which can be acquired while traversing railroad track or during testing on the VTU. The SMU is designed to run efficiently for long periods of time which makes it particularly well suited for fatigue tests. The fatigue life of a railcar (average of 30 years) can be determined from the fatigue data obtained within just a few weeks of Simuloader testing. The resulting fatigue analysis serves as a source of design information and safety data. Typical tests on the Simuloader consist of the evaluation of structural integrity of stub sill tank cars and prototype aluminium coal cars of different U.S. manufacturers. Other structures including highway buses have been tested on this machine.

(b) Vibration Test Unit

It subjects a railcar of size up to 90 feet long and weighing up to 130 tons to both vertical and lateral force displacements ranging from 0.2 to 30 Hz over simulated on-track conditions.

(c) Mini Shaker

Measures rail vehicle truck suspension system characteristics and rigid body modes on one end of a railcar up to 210 thousand pounds.

3.8 Instrumentation and Data Collection, Analysis and Reporting

TTCI has extensive test instrumentation, data collection and communication, and analysis capabilities that support laboratory and field testing activities including

- Integrated Remote Railway Information System: wayside data collection system for dynamic response measurement of vehicles, track, components, and structures.
- Static measurements of rail, track modulus and soil density, track geometry, rail flaws, lubrication, and tie stiffness.
- Dynamic wayside measurements of wheel and rail forces, wheel set angle of attack.
- Dynamic onboard measurements of ride quality, acceleration and vibration levels, coupler forces and
wheel/rail contact forces.

- Load measuring instrumented wheel sets.
- Longitudinal rail profile measurement system.

### 3.9 Modelling Services

TTCI has developed several unique analytical models which can predict performance and be used to make comparisons between alternative scenarios. TTCI continually updates the models so customers using these services can be assured of having the most up-to-date program results. These greatly reduce the cost of field testing:

- **NUCARS ®**
- **TOES™ /STARCO™ -Train Operations and Energy Simulator and Simulation of Train Action to Reduce Cost Operations.**
- **RTLMTM - Railway Track Life-cycle Model.**
- **WRTOL™ - Wheel /Rail Tolerance**

### 3.10 Vehicle Monitoring Systems

TTCI gathers information from the following systems to create valuable information that directly helps the railroad industry. They are:

- **Performance- Based Track Geometry Technology-**
  **PBTG™.** This system allows railroads to reduce track geometry- caused derailments and optimize track maintenance. Individual geometry defects do not always produce undesirable vehicle responses. Conversely, track locations that produce undesirable vehicle responses do not always relate to individual geometry defects. Experience shows that frequently the combined effect of geometry deviations, track features, operating speed, and vehicle characteristics causes poor vehicle performance. Our **PBTG™ system identifies track sections that are likely to produce undesirable vehicle performance.**

- **Truck Performance Detector -TPD -** This wayside defect detection system is capable of detecting and identifying railroad trucks that exhibit poor performance in curves. This system monitors safety performance in several regimes such as: potential of flange climb derailment, gage spreading, and rail over. This state-of-the-art system has the
• **Trackside Acoustic Detection System – TADS ®** - This system is used to detect bearing flaws in freight cars as they pass the detector at track speeds. TADS ® detects and reports cup, cone and roller defects in numerical severity levels from 1-5. This system can also be modified to include additional wheel diameters and bearing sizes. Other types of acoustic data like flat wheels and multiple defect bearings are detectable and can be refined to meet client objectives. By using TADS ® you can reduce the potential for bearing related derailments, lading damage, and damage to infrastructure. Customers can experience cost savings while optimizing operations and enhancing safety.

• **Instrumented Wheel sets** – Dynamic vertical, lateral, longitudinal wheel/rail loads are key to understanding vehicle performance. TTCI's load measuring wheel sets are documented and traceable to provide the confidence required for lightweight transit cars up to 125-ton freight cars and 210-ton locomotives. TTCI's patented, multifaceted instrumented wheel sets respond to the need for accurate and proven measurement equipment. These high accuracy wheel sets provide information to improve design and management decisions, promoting safety and efficiency.

### 3.11 Research Publication

Large no. of research publications have been published by TTCI based on their research/data based. List is enclosed as Annexure IV.

### 3.12 What TTCI has achieved by Test track

- Heavy haul technology was adopted in US railroads after detailed experiments on test track at TTCI by undertaking dedicated heavy axle load train continuously on a dedicated test track. This enabled TTCI to test all types of combinations of track structures, bridges, rolling stock etc and develop the requirements for railway infrastructure and rolling stock design based on this experimental observation which are essential features for the research.

- Due to large experiments done on test track with different types of bearing defects, weld defects, different formations, different type of Bridge approaches, wagon instrumentations, the technology of Heavy Axle load developed by TTCI was successfully implemented on US railroads resulting in millions of dollars of additional earning and saving enormous amount of expenditure which would otherwise be spent in trial and error.
The Facility for Accelerated Service Testing (FAST) research program began in 1976 at the FRA's Transportation Technology Center near Pueblo, Colorado. FAST was built to test the effects of increased axle loads on track structure and rolling stock. Early tests up to 1985 were aimed at quantifying the rate of track degradation caused by 33-ton axle loads, the current AAR standard for unrestricted interchange between railroads of four-axle freight cars.

Building on the knowledge gained in those experiments, the Heavy Axle Load (HAL) Research Program was initiated in 1988. Researchers increased the weight to 35.5 tons — considered to be a potential future axle loading. Since then, the HAL program has reliably produced improvements in track structure, component design, construction practices, inspection technologies, training, and maintenance procedures.

Armed with HAL results, the rail industry has safely and profitably introduced 32.5 ton axle loads as the new interchange standard in North America.

FAST has been at the forefront of research and development related to HAL operations by providing a unique test environment where variables can be controlled, and experimental components can be evaluated for their use in revenue service. Recent findings from the program include:

- Rail and rail welding tests at FAST include the evaluation of state-of-the-practice steels and termite welds. Service lives of these components have improved significantly (by 50 percent or more) under 39-ton axle loads.

- FAST rail maintenance tests have shown the benefits of optimal profile grinding and lubrication policies. Longer service lives and less maintenance were attained.

- Tests at FAST have shown that improved materials and designs have improved the capability of special track work (frogs and turnouts) to withstand HAL, and better designs have reduced dynamic loads. As a result, component lives have increased even as axle loads increase.

- **Flange bearing crossing frogs** have been proof-tested for 39-ton axle loads at FAST. They can improve safety and railroad productivity by minimizing wheel impacts.

- **Ultrasonic impact treatment** can change residual stresses in bridge weld areas, with the goal of preventing or delaying...
formation of fatigue cracks. Following a successful preliminary demonstration at FAST, one Class I railroad is using this method to improve safety and extend life on selected steel spans. Others are considering it.

- Field reports from railroads using concrete ties indicated a potential safety and economic issue with rail seat abrasion. Most railroad using concrete ties today follow one or more of the mitigation and repair practices developed at FAST.

- Poorly performing cars can increase track degradation and energy consumption, which may lead to derailments. TTCI developed a wayside truck performance detector, which was installed and tested at FAST. The facility's unique testing environment provided the experience that allowed TTCI to improve the system before its introduction into revenue service in North America.

- FAST provides a test bed where the railroad supply industry in North America continued to evaluate track components under the FAST program. Components recently tested include: experimental rail steels, sub grade strengthening materials, ladder sleepers, wood composite ties, plastic composite ties, dual-block concrete ties, concrete ties to be interspersed with wood ties, and a ballast movement detector.

- The test train at FAST was equipped with improved suspension trucks in 1995. Testing conducted over a three-year period showed that the trucks reduced lateral forces, wheel wear, rail wear, tie degradation, joint and weld batter, and fuel consumption, showing the importance of track friendly bogie for successful HAL implementation.

- The test train at FAST was used to demonstrate and test early versions of cable based Electronically Controlled Pneumatic (ECP) brake systems. This helped to quantify the operational benefits that these systems offer. Information gained during ECP operations at FAST was used to develop the industry specifications for ECP brakes.

- Research in TTCI is the basis of all standards of AAR (A Large nos being used by Indian Railways for Goods stock and bogie development using NUCARS model of AAR) and AREMA which are used by many countries. Currently the test train operates with 35.4t axle loads on this test track. Wide spread use of 32.5t and above axle load on US railroads is based on TTCI Research.
HOW HEAVY HAUL TECHNOLOGY IS DEVELOPED ON TEST TRACK BY TTCI

FLOW DIAGRAM

Chose different parameters and implement them in test track, rolling stock

↓

Trial - Run dedicated heavy axle load train continuously on a test track

↓

Publish test data in form of Reports - available in Public Domain as proof of research done

↓

Choose the best alternative

↓

Decision

↓

Formation of standards in form of Code, rules, manuals

↓

Generate Manufacture and maintenance standards

↓

Experience on Railroads

↓

Problems and feedback with corrective action

↓

Wide spread adoption of Standards
3.13 Remarks regarding TTCI test track and facilities.

Presently TTCI is the only organisation in the world having test track capable of testing upto 32.5 t and beyond freight stock and has successfully implemented HAL technology in North America. Research done on test track in TTCI is the basis of all standards of AAR (A Large numbers being used by Indian Railways and Foreign Railways) and AREMA which are used by many countries. Development of maintenance and other standards on basis of R&D on test track is done by TTCI. Currently the test train operates with 35.4 mt axle loads on this test track. Wide spread use of 32.5t and above axle load on US railroads is based on TTCI Research.

Thus this test track model is fully suitable for IR test track adoption.

It would not be out of place to mention that TCCI is capable of giving consultancy for Test track project for implementation of Heavy Haul on Indian Railways for rolling stock as well as infrastructure as World over heavy haul above 30 t is running in US and the same has been implemented by the controlled experimentation done on test track at TTCI.

4.0 Siemens Test Center Wegber-Wildenrath, Germany

4.1 Wegberg-Wildernrath, Test Centre in Germany was inaugurated in January 1997. it is accredited in accordance with ISO17025, officially approved for railway tests by the German Federal Railway Authority (EBA) and associated partner of the Notified Body Interoperability in Germany (EBCert).

This Test Center is in an area of 35 Hectare out of which 21,300 sqm is built up. The test centre has been designed and utilised for non freight applications mostly for testing locomotives and passenger service car. Therefore this test centre as such has got no experience to offer as far as freight operation is concerned.

This Test Track is approximately 28 km in standard gauge; some of which is in meter gauge. Where mass transit regional and main-line trains are tested and testing under field condition.

The Test Track is divided in two large oval section wherein they can also simulate system changes with ease and a short notice. Voltage
gaps, sudden voltage jumps and transitions between power systems are just some of the aspects that play an important role.

The number of employees (average) is 250 of Siemens and 100 of non-Siemens (consortium/supplier). Siemens have an investment of 105 million EUR.

4.2 **Key Data at a glance**

- Approx 28 km of standard gauge track; some of which in meter gauge as well
- Two test ovals, 3 test tracks for the most varied test requirements
- 150 m track curve for derailment tests
- Power supply for all system, including third rail for metros, with possibility of regenerative braking
- Signalling and safety systems (electronic interlocking for ETCS, GSM-R, Indusi, audio-frequency track circuit, continuous ATC system)
- Train formation buildings and workshops
  Pressurized water-jet equipment, bogie drop and lifting devices, rotation torque station for bogies, scales, equipment for measuring electric parameters, noise, EMC, etc.

4.3 **Test Track facilities**

There are number of interconnected test tracks at Wegberg-Wildernrath. Sketch showing various details of test track is at annexure IV.

**Test oval T1**

Test oval T1 is of 6 kilometres standard gauge with a curve of minimum 700m. Test over 1 is equipped with various automatic train control system, including ATB-EG, ETCS Levels 1 and 2 as well as PZB (intermittent ATC) and is built for test speeds of up to 160 km/h.

**Test oval T2**

Test oval 2 with a curve radius of 300 m is to test vehicles at maximum speeds of 100 km/h on standard-gauge and meter-gauge sections. Therefore, this oval is also used for trams.

**Test track T3**

This track is especially suitable for braking distance measurements. On straight and level sections of track totalling 1,500 m in length, standard-gauge and meter gauge vehicles can reach speeds of up to 80 km/h.
### Test track T4

Over a distance of 600 m. It can test the curving performance of vehicles in different curve radii. This applies to standard-gauge and meter-gauge vehicles.

### Test track T5

The shortest track, with 400 m, is the gradient track. It has a rising gradient of 40% and a falling gradient of 70%.

#### 4.4 Guarded and illuminated core area of the facility

**Train formation hall 1 (with overhead contact line)**

- Group-level standard-gauge tracks, some with work pits each: 220 m
- Elevated standard-gauge tracks, with work pits each: 220 m
- Elevated standard-gauge track; some with work pits each: 75 m
- Elevated standard-gauge and meter-gauge track; with work pit: 75 m
- Roof-height working platforms: 62 m

**Train formation hall 2 (with overhead contact line)**

- Elevated standard-gauge tracks; with work pits each: 220 m
- Bogies changing device with 30 ton lifting capacity: 7 m
- And 80 ton load-bearing capacity
- Crane with a load-carrying capacity of 20 tons
- Diesel exhaust-gas extraction system over a distance of: 100 m

**Workshop (not electrified)**

- Standard-gauge and meter-gauge track; with work pits: 49 m
- Bogie changing device with 30 ton lifting capacity and 80 ton load-bearing capacity
- Crane with a load-carrying capacity of 20 tons
- Jack with 4 x 32 ton as well as 4 x 16 ton

**Holding tracks (not electrified)**

- Tracks with external power supply: total length 1,732 m
### 4.4 Technical Details of Test Center

<table>
<thead>
<tr>
<th>Test area characteristics</th>
<th>Test track T1</th>
<th>Test track T2</th>
<th>Test track T3</th>
<th>Test track T4</th>
<th>Test track T5</th>
<th>Train formation buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test area T4</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
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<tr>
<td>Test area T5</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
<td>1435</td>
</tr>
</tbody>
</table>

| Track gauge (mm)          | 1000          | 1000          | 1000          | 1000          | 1000          |
| Axle load (t)             | 22.5          | 22.5          | 22.5          | 22.5          |
| Axle load (t)             | 26            | 26            | 26            |
| Max speed (km/h)          | 160           | 100           | 80            | 25            | 25            | 5                        | 5                        |
| Length (m)                | 6083          | 2485          | 1400          | 553           | 410           | 9x22°                    | 3x75                     |
| Min radius (m)            | 700           | 300           | -             | 50/25         | -             | -                        | -                        |
| Max gradient (%.sub.0)    | 3.8°          | 6°            | 0             | 0             | 40°/70°       | 0                        | 0                        |
### 4.5 Experience of M/s Siemens

M/s Siemens has mainly done High Speed Railway Projects of Germany, China and Malaysia and metro rail projects, tram way projects of European countries. No testing on freight stock has been undertaken at this test track. Some of the rolling stocks tested at its center are as below.

1. DJ1 double locomotive (China) Type and 100% test
2. BR152 (German Rail) Type test, 100% test
3. OBB Rh1016/1116 Type test
4. HeathrowExpress (UK) Type and 100% test, continuous test
5. OSE H560 locomotive (Greece)
6. First article inspection Metro BTS (Bangkok) Type and 100% test, continuous test
7. Metro PMT (Taipeh) Type and 100% test, continuous test
8. Combino (various customers in Germany and elsewhere) Type and 100% test
9. Desiro (various customers in Germany and elsewhere) Type and 100% test
10. Bursa (Turkey) Type and 100% tests
11. HV-IGBT 3.3kv @ Test track on 1500V DC
12. VT610 (R) Trial of Siemens tilt trucks

### 4.6 Testing facilities

#### Static and Dynamic test

Various static and dynamic tests done at the test center are as below

**Stationary tests**

Mechanical part of vehicle

- Geometrical vehicle test
- Stationary bogie tests (ease of movement, rotation torques)
- Discharge tests
- Tilting coefficient and axis of rolling (Fig.5)
- Air brake, stationary test
- Loading and load-status tests
- Reciprocal sound radiation (attenuation of air-borne noise)
- Measuring of air-borne and structure-borne noise
- Stationary thermal measurements.
- Measuring of air and lighting systems
- Leakage test, exposure to rain
**Stationary test**

Electrical part of vehicle

- Insulation test
- EMC measurement
- Measurements of on-board power systems
- Testing of safety and information systems
- Testing of diagnostic systems
- Measurement of heating, ventilation and air-conditioning systems
- Testing of grounding and protective measures
- Tests of auxiliaries (direction of rotation, starting)

**Dynamic tests**

Mechanical part of vehicle

- Breaking effort tests, e.g. to UIC 544
- Determination of natural frequencies, vibration tests
- Testing of rolling resistance characteristics and safety
- Measurements of mechanical stress
- Continuous thermal tests of electrical and mechanical components
- Dynamic traction trials
- Noise levels for vehicle interior and passage
- Reference track in accordance with technical specifications for interoperability (TSI)

Electrical part of vehicle (Fig.6)

- Testing of performance and vehicle dynamics, traction and electric brake
- Measurement of interference (system perturbations, track circuit, psophometry, measurement of radio interference)
- Processes involved in transitions and system changes (voltage gaps and jumps)
- System trails with on-board/traction supply or on-board/control and safety systems
- Continuous thermal tests

**4.7 Remarks regarding Siemens test track**

It is noted that at Siemens Test Centre Wegber-Wildenrath, Germany, maximum axle load is restricted to 26 t and no project on freight service evaluation has been undertaken so far. Thus this test track model is not suitable for IR test track adoption.
5.0 OLD DALBY TEST TRACK

5.1 Introduction

The Old Dalby Test Track is a 21Km test track located between Asfordby, near Melton Mowbray in Leicestershire, and Edwalton, on the outskirts of Nottingham. It once formed part of the Midland Railway from London St Pancras to Nottingham via Corby, Melton Mowbray & Edwalton but was included in the closures implemented by Dr Beeching in the late 1960s.

With a small Control Centre at Old Dalby it was later used for a wide variety of purposes, including the famous Nuclear Flask Test in 1984, and several other tests that would have been either impossible or impractical on an operational railway. Railtest, formed under British Railways, was the operator of the Old Dalby Test Track at the time of privatisation of the railways. Serco Group purchased Railtest in February 1997.

In 1999 the lease was sold to Alstom Transport who, in conjunction with Network Rail, invested a total of £23M in upgrading and fitting most of the route with 25kV AC Overhead Line Electrification (OHLE) to enable Alstom to test and commission their new tilting “Pendolino” fleet for Virgin Trains. An additional track was also installed, between Old Dalby and Widmerpool, primarily for use by Network Rail in developing ERTMS signalling & train control systems.

Alstom took over a former coal storage building at the closed Asfordby Colliery. This building was converted and extended into a 3 road workshop to house the trains. In December 2006 the facility was taken over by Metronet SSL with the prime objective of testing sub surface trains.

The test track is operated and maintained by the Serco as per the contract. The test centre has been designed and utilised for non freight applications mostly for testing locomotives, and passenger service cars. Therefore this test centre as such has got no experience to offer as far as freight operation is concerned.

5.2 TEST TRACK FACILITIES

The various test track facilities at Old Dalby is as attached at annexure –V. The photos showing various activities conducted in their premises since early tests are shown as fig 7 to 18.
5.2.1 Track Infrastructure

- Existing track
  - Down Reversible Line
    - 10.75 miles Down Reversible Line electrified with maximum speed of 200 Km/h for tilting trains
    - Predominantly continuous welded rail (84%)
    - Sections of jointed track at remote ends
  - Rail sections
    - FB 109lb/FB110A/FB113A/UIC60
  - Sleepers
    - Concrete (69%) /Wood (31%)
  - Up Reversible Line
    - 4.25 miles Up Reversible Line electrified with 60 mph
    - Predominantly jointed track (92%)
    - Rail section FB113A
    - Sleepers
      - Concrete (49%)/Wood (51%)

5.2.2 Existing Infrastructure

- Designed to accommodate rail vehicles built to UK loading gauge
  - 25 tonne maximum axle loads
- Existing maximum line speed
  - 90mph (144kph) for conventional (non-tilting trains)
  - 125mph(200kph) for tilting trains
- Electrified – 25kV 50 Hz overhead line, to UK standards
  - 10.75 miles Down Reversible Line electrified
4.25 miles Up Reversible Line electrified
- 4.3 km of fourth rail DC electrified line
- Structures
  - 4 tunnels
  - 12 over bridges

5.2.3 Overhead Line Infrastructure

Existing infrastructure installed for Class 390 Testing Programme during 2000/01
- 25kV OLE
- 4 No configurations (based on WCML electrification types)
  - 107m 15c – 110m 10c MkIII
    110mph (176 kph)
  - 110m 10c – 112m 64c MkIII (Modified)
    >110mph (176kph)
  - 112m 64c – 115m 65c MkI (Modified)
    >110mph (176 kph)
  - 115m 65c – 118mp MkI Simple (Catenary + les)
    110mph (176 kph)

Possible to extend OLE at North end of existing line

Provide an acceleration/deceleration section

5.2.4 Conductor Rail Line Infrastructure

- 4.3 km of fourth rail DC conductor rail currently installed capable of 630 and 750 end feeding:
  - Steel
  - Low Loss
  - Extra low loss
5.3 LIMITATIONS OF OLD DALBY TEST TRACK

Limitations

- Planning restrictions on operating hours of the test track.
- Environmental restriction due to badger sets.
- No Restrictions apply to the workshop which can be a 24/7 operation.
- Limited space available in the workshop.
- Stability of Embankments.

Old Dalby Test Track is capable only of testing high speed primarily passenger train in Europe. No testing on freight service has been undertaken on this test track. Maximum axle load is also restricted to 25 t. No testing on freight stock has been undertaken at this test track.

5.4 Notable events were

- Testing of the high speed tilting advanced Passenger Train (APT) in the 1970s.
- The dramatic nuclear flask collision, staged in 1984 to demonstrate the safety of transporting nuclear waste by rail.
- Virgin’s Pendolino fleet was tested intensively on the track in the early 2000s, after major upgrade work.

During the visit, passenger tram manufactured by Bombardier for Metro net Railway for London underground was under testing.

Photographs of Old Dalby Test Track, Asfordby workshop, earlier testing vehicle tested on test track is attached as Annexure.

5.5 Remarks regarding Old Dalby Test track

It is noted that at Old Dalby Test Track, maximum axle load is restricted to 25 t and no project on freight service evaluation has been undertaken so far. Thus this test track model is not suitable for IR test track adoption.
### 6.0 SUMMARY:

<table>
<thead>
<tr>
<th></th>
<th>TTCI</th>
<th>SIEMENS</th>
<th>DALBY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td>134.67 Sq Km</td>
<td>0.35 Sq Km</td>
<td>No loop available, only straight tracks Up &amp; DN reversible lines.</td>
</tr>
<tr>
<td><strong>Length of Test Track</strong></td>
<td>77.25 Km</td>
<td>28 Km</td>
<td>21 Km</td>
</tr>
<tr>
<td><strong>Test centre established in year</strong></td>
<td>Mid 70’s to 1981</td>
<td>Jan, 1997</td>
<td>1984</td>
</tr>
<tr>
<td><strong>Various loop length &amp; testing speed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Rail road Test Track (RTT)</td>
<td>Length- 21.7 Km Speed- 265 kmph</td>
<td>T1 Length- 6 Km Speed- 160 Kmph</td>
<td>DN reversible line 17.2 Kms long with speed upto 200 KMPH</td>
</tr>
<tr>
<td>2. Transit Test Track (TTT)</td>
<td>Length- 14.6 Km Speed- 144.84 Kmph</td>
<td>T2 Length- 2.485 Km Speed- 100 Kmph</td>
<td>UP reversible line 6.2 Kms long with speed upto 96 KMPH</td>
</tr>
<tr>
<td>3. Tight Turn loop (TTL)</td>
<td>This track is of 38°12' curve located within Transit Test Track</td>
<td>T3 Length- 1.40 Km Speed- 100 Kmph</td>
<td></td>
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<tr>
<td>4. Facility for accelerated service testing (FAST)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) HTL</td>
<td>Length- 7.724 Km Speed- 64.36 Kmph</td>
<td>T4 Length- .553 Km Speed- 25 Kmph</td>
<td></td>
</tr>
<tr>
<td>(ii) Wheel Rail Mechanism (WRM)</td>
<td>Length- 2.57 Km</td>
<td>T5 Length- .410 Km Speed- 25 Kmph</td>
<td></td>
</tr>
<tr>
<td>Test Scope</td>
<td>Type of various stock tested with axle load &amp; speed</td>
<td>Type of catenary for testing different locomotives</td>
<td></td>
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<tr>
<td>------------</td>
<td>---------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Length- 1.20 Km</td>
<td>Heavy axle loads upto 35.4 metric ton axle load. Wide spread use of 32.5 ton and above axle load on US rail roads is based on TTCI research. New generation locomotives and train sets are also being tested.</td>
<td>OHE capable of operating at different nominal voltages of 12.5 KV, 25 KV and 50 KV. The contact wire height can be adjusted to simulate tunnel or bridge conditions. The third rail DC electrified power system provides transit and commuter vehicles with a voltage variable from zero to 1,000 volts DC with a 3,500 amp continuous rating. The track includes a 10,000 foot long overhead DC catenary, suitable for low-speed</td>
<td></td>
</tr>
<tr>
<td>(iv) Precision Test Track (PTT)</td>
<td>Mostly locomotives, high speed train sets and tram ways are being tested. Heavy axle load wagons etc are not being tested here.</td>
<td>Overhead line Conductor rail Traction power supply 15kV 16 2/3 Hz 25kV 50 Hz [+ or -] 750V dc [+ or -] 400 - 2000V dc [+ or -] 2000 - 4000V dc</td>
<td></td>
</tr>
<tr>
<td>Length-9.97 Km</td>
<td>Mostly locomotives, high speed train sets and tram ways are being tested. Heavy axle load wagons etc are not being tested here.</td>
<td>25kV 50 Hz overhead line, to UK standards &amp; 4.3 km of fourth rail DC electrified line</td>
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<tr>
<td>5. Train Dynamics Track</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Length- 2.73 Km</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Speed- 128 Kmph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight cars, locomotive, passenger service car, track, bridges and formation etc.</td>
<td>Locomotive and passenger service car</td>
<td>Locomotive and passenger service car</td>
<td></td>
</tr>
<tr>
<td>Remarks</td>
<td>Presently TTCI is the only organisation in the world having test track capable of testing upto 32.5 t and beyond freight stock and has successfully implemented HAL technology in North America. Research done on test track in TTCI is the basis of all standards of AAR (A Large numbers being used by Indian Railways and Foreign Railways) and AREMA which are used by many countries. Development of maintenance and other standards on basis of R&amp;D on test track is done by TTCI. Currently the test train operates with 35.4 mt axle loads on this test track. Wide spread use of 32.5t and above axle load on US railroads is based on TTCI Research. Thus this test track model is fully suitable for IR test track adoption.</td>
<td>Seimens Test Centre Wegber-Wildenrath, Germany, maximum axle load is restricted to 26 t and no project on freight service evaluation has been undertaken so far. Thus this test track model is not suitable for IR test track adoption.</td>
<td>Old Dalby Test Track, maximum axle load is restricted to 25 t and no project on freight service evaluation has been undertaken so far. Thus this test track model is not suitable for IR test track adoption.</td>
</tr>
</tbody>
</table>
The facilities available and their experience in testing of different stock are tabulated above. From above it is clear that TTCI is the only organization having test track capable of testing upto 32.5 t and beyond which doesn't exist anywhere in the world. Test track is a unique field lab where different parameters, equipments, design & manufacturing process can be tested under repeatable conditions with loading environment identical to that encountered in service. This has permitted to use unified test methodologies which cover the effect of different parameters on rolling stock, track and bridges in an integrated simultaneous fashion. Based on these standards, maintenance practices have been developed which gained wide adoption on US & many international rail roads. The technology developed has permitted American Rail Roads to be amongst the extremely cost effective rail roads in the world, recently developing a return on equity in excess of 10%. Thus TTCI test track model is the model which is suitable for IR test track adoption.

TTCI has also ability to explain the 'why' part of the design due to its long experience in research conducted on test track especially in HAL and openness in sharing knowledge, will be very useful for R&D organisation like RDSO.

It would not be out of place to mention that TCCI is not only capable of giving consultancy for Test track project but it is the single agency available for giving a comprehensive consultancy for implementation of Heavy Haul on Indian Railways for rolling stock as well as infrastructure as World over heavy haul above 30 t is running in US and the same has been implemented by the controlled experimentation done on test track at TTCI. Collaboration with TTCI would not only give assess to there past research but also to the current day SRI (Strategic research programmes) which are additional to the scope of our existing projects and IR is surely going to be benefited by them. All the deliverables required by RDSO for the implementation of Heavy haul projects will be fully met by TTCI.

Since TTCI is the suitable model for adoption on IR test track and for implementation of Heavy haul projects, a Team of Directors may visit TTCI for further in depth study.
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

No.2007/E(O)/14/172

Pay & Accounts Officer, Ministry of Railways, Railway Board, New Delhi.

New Delhi, dated 09.04.2009.

Sub: Deputation of Indian Railway Officers to U.S.A., Germany & U.K.

Sanction of the President is hereby communicated to the deputation of the following officers to U.S.A., Germany and U.K. in connection with study dedicated track project -

1. Shri R.K. Bhatnagar, Executive Director (E&R)/Railway Board
   (in the pay scale of Rs.18400-22400/-PR)
2. Shri B.S. Dohare, Executive Director (Testing)/RDSO
   (in the pay scale of Rs.18400-22400/-PR)
3. Shri Vijay Sharma, Executive Director (TM)/RDSO
   (in the pay scale of Rs.18400-22400/-PR)
4. Shri Ranjanesh Sahai, Executive Director Finance (S)/Railway Board
   (in the pay scale of Rs.18400-22400/-PR)

2. The period of deputation will be three working days in USA, two working days in U.K. and two working days in Germany excluding transit time from 15th to 29th April, 2009

3. The deputation will be governed by the terms and conditions as contained in the Ministry of Finance (Department of Expenditure’s) O.M.No.19036/7/83-E-IV dated 7.11.1984 as amended from time to time.

4. The following expenditure may be incurred:-

   i) Passage : As per entitlements in the annexure.
   ii) Cash Allowance: As admissible under extant order of the Ministry External Affairs.
   iii) Contingency: Contingency expenditure of stationery, postage, telegrams, telephones, etc incurred in discharge of official duties may be allowed in accordance with the existing rules.
   iv) Hotel accommodation: Suitable accommodation appropriate to status may be booked for the officers on request and debit raised against P & AO/Rly. Board and Exec. Director (Finance)/RDSO, as the case may be.
v) Excess Baggage: Official: As considered necessary and as admissible.

vi) Airport tax/Visa fee: May be reimbursed as required.

vii) Internal Travel: Suitable transport may be arranged for the officers for official journeys on request and debit raised against P & AO/Railway Board and Exec. Director (Finance)/RDSO, as the case may be.

5. The expenditure on the deputation of the officers will be charged to the head to which their pay and allowances are charged. Posts held by the officers will not be filled up during the period of their deputation.

6. The release of foreign exchange on account of personal incidentals will be regulated in terms of the Ministry of Finance (Dept. of Economic Affairs)'s O.M. No. F.13/EC/94 dated 22.3.94 as amended from time to time.

7. Entitlements of the officers may be paid to them in US dollars in India and no part thereof shall be paid to them by the missions abroad.

8. This issues with the concurrence of the Finance Directorate of the Ministry of Railways.

(N. Soman)
Director (Depuation)/Railway Board.

Encl: Extracts of Min. of Finance.
(Dept. of Expenditure)'s OM

No. 2007/E(O)/II/14/172
New Delhi. dated 09.04.2009

Copy forwarded to:

(1) The Principal Directors of Audit, Central & Northern Railways.
(2) Dy. Comptroller & Auditor General of India (Railways), Room No. 224, Rail Bhavan, New Delhi.

for Financial Commissioner, Railways
Insulated Joints With Modified Support Ties
Length 3.0 mile (4.827 km)
Speed 40 mph (64.36 kmph)
Early Tests

Experimental Advanced Passenger Train

Fig. 7

Nuclear Flask Test

Nuclear flask collision demonstration test

Fig. 8
Test Tracks

Fig. 11

Activities - Rolling Stock Testing

Fig. 12
Activities - Type Testing

Fig. 13

Speeds to 110 mph or 125 mph for tilting stock

Activities - Endurance & Reliability

Fig. 14

Mix of carted & zero carted curves
Activities - Train Control Testing

Fig. 15

Activities - Calibrating UTU's

Fig. 16
Activities - Tamper Commissioning

Fig. 17

Activities - S Stock Testing

Capability to Test Tube Trains

Fig. 18