Ministry of Railways, RDSO, Lucknow is interested for developing specification of Automated Test System for Rolling Stock Axles in Service by Phased Array Ultrasonic Technique (PAUT) based on functional requirement. Firms, who have enough experience & capability in the above fields and ISO certificate, are requested to see the details on the RDSO website www.rdso.indianrailways.gov.in at home page → Expression of Interest (EOI). In case of any clarifications /details may be contacted on any working day on address given below:

Contact address:
Shri G.C. Verma, Dy. Director/M&C-V
Research Designs & Standards Organisation (RDSO)
Ministry of Railways,
Manak Nagar,
Lucknow-226011,
Utter Pradesh (India)
Contact No. 09794863212
### Technical Specification of functional requirement of Automated Test system for Rolling Stock Axles in Service by Phased Array Ultrasonic Technique (PAUT)

#### Amendment history:

<table>
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<th>S. No.</th>
<th>Amendment date</th>
<th>Version</th>
<th>Reasons for Amendment</th>
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Technical Specification of functional requirement of Automated Test system for Rolling Stock Axles in Service by Phased Array Ultrasonic Technique (PAUT)

1. Introduction

i. This technical specification outlines the functional requirements of Indian Railways for the provision of automated ultrasonic test systems for the inspection of rolling stock axles in service by Phased Array Ultrasonic Testing technique. The whole Test System shall be offered by the supplier.

ii. Test System shall be used to detect any defects on overhauled rolling stock axle in service during POH/ROH operated by IR, in accordance with code of procedures issued by RDSO.

iii. The test system will have to be installed at dedicated locations in Mechanical Workshops, Loco sheds & ROH depots of Indian Railways.

2. General information

1. Following information and Table 1 describe the rolling stock of Loco, Carriage & Wagon axle currently in operation. These axles shall be inspected using the ultrasonic test system.

Table 1: Characteristics of solid axle-wheel set

<table>
<thead>
<tr>
<th>Rolling stock</th>
<th>Axle diameter [mm]</th>
<th>Axle length [mm]</th>
<th>Axle Weight Kg</th>
<th>Weight (Wheel set) Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotive</td>
<td>Max. ~ 260 Min. ~ 150</td>
<td>Max. ~ 2600 Min. ~ 2000</td>
<td>Max ~ 1000</td>
<td>Max ~ 2000</td>
</tr>
<tr>
<td>Passenger</td>
<td>Max. ~ 200 Min. ~ 130</td>
<td>Max ~ 2500 Min. ~ 2000</td>
<td>Max ~ 500</td>
<td>Max ~ 1500</td>
</tr>
<tr>
<td>Freight</td>
<td>Max. ~ 225 Min. ~ 120</td>
<td>Max. ~ 2550 Min. ~ 2000</td>
<td>Max ~ 800</td>
<td>Max ~ 2000</td>
</tr>
</tbody>
</table>
2. In addition, the test system shall be suitable for the inspection of solid axle wheel sets of electrical locomotives and EMUs.

3. It is to be noted that details mentioned in Tables 1 the test system shall also be used for inspection of future rolling stock to be operated by IR, including electric locomotives and EMUs. Therefore, the test system shall be easily adaptable to different rolling stock, wheel set structures, axle outside diameters, axle lengths, distances between axle centre line. The machine shall be capable to detect internal defects for all type of rolling stock axles. The drawings of the same shall be provided by the purchaser.

3 Requirements of the Automated Phased Array Ultrasonic Test System

Following sections explain the different requirements of the ultrasonic test system and additional information.

3.1 General requirements and information

(1) The test system shall be stationary, with a permanent location at Mechanical Workshops of IR at ground level.

(2) The test system shall be used to inspect the axle of wheel sets which are dismantled from the bogie/locomotives. (i.e. standalone wheel set).

(3) The test system design shall be according to state of the art proven technology, which is demonstrably used in other similar applications. The supplier should have installed such unit successfully in any major Rail Road system and shall submit performance of such unit.

(4) The occupational Health and Safety assessment shall be as per OHSAS 18001. The quality management system shall be in accordance to norms of ISO-9001.

(5) The supplier shall be committed to provide full-service and total customer support in concerned workshop, in order to meet inspection needs in an effective, prompt, and supportive manner. IR may accept an arrangement that full-service and customer support can be provided via a secure remote link or by a local representative designated by the supplier without derogating suppliers’ obligations and warranties as specified in the agreement. IR operators who conduct the testing and analysis of the axle wheel sets with the ultrasonic test system shall be approved as Level II in accordance with the requirements set out by BS EN ISO 9712-2012 or SNTC-1A of ASNT or ISNT as per IS 13805 or authorized by Indian Railways.
3.2 Inspection requirements

3.2.1 Inspection area and inspection targets

(1) The axles shall be inspected along the entire length. The cross sectional areas are regarded as particularly susceptible to cracking, especially at the brake disc seat, axle journal, wheel seat & gear seat. Inspection shall be fully executable from above the axle wheel set.

(2) The device shall be capable of detecting transverse defects at the surface of the axle. The ultrasonic inspection of axles shall permit detection of critical defect formation below press fit locations such as wheels, brake discs, journal bearings, traction motor bearings etc. are mounted on the axle at the time of inspection.

(3) A fast changeable setting to different axle-wheel sets (with different diameters and lengths) shall be achievable.

(4) Each inspection process shall be practicable by one operator.

(5) Optional: The inspection of axle-wheel sets with mounted gear units might be difficult because of space requirements. Therefore the supplier shall make proposals on how to inspect a solid axle wheel set with mounted gear unit. Drawings of axle wheel set with mounted gear unit shall be provided on request by concerned railway /purchaser

3.2.2 Inspection sensitivity

(1) The test system must be capable of detecting at least 3 mm deep and 5 mm long transverse defect generated from surface of axle in any location of entire axle length.

(2) The supplier shall provide drawings of a suitable reference solid axle with simulated defects, to be approved by any NABL/NABC accredited lab. Proposals shall be based on the supplier’s knowledge and experiences with calibrating their device. Given that various types of solid axles will have to be inspected, for which more than one (1) reference axle is required to calibrate the test system. and will be provided by the purchaser

3.2.3 Inspection time

(1) The test system shall be designed to complete inspection of each axle in within 10 minutes. The inspection time is applicable for any standalone axle wheel set, even if disc brakes, gears, wheels etc. are mounted.

The inspection time excludes the following:

- Positioning and securing of the wheel set onto the test system.
- Cleaning from dirt and rust.
- Wetting surfaces of the axle with couplant.
- Positioning of inspection equipment and mechanics.
3.2.4 Inspection results

(1) Results of axle inspection shall be displayed in Test System control cabinet with state of the art proven methods (see section 3.3.4).

(2) Presentation of the results shall enable the operator to identify a defect easily.

3.3 Structure requirements

The following sections describe the structure requirements and components that shall be used for the Test System and are part of the scope of delivery.

3.3.1 Test System layout

(1) The Test System shall be designed as a stationary automatic inspection unit to inspect standalone axle-wheel sets.

(2) The Test System consists of a steel frame, designed to support the inspection process for its entire operating life without any major maintenance.

(3) The Test System shall be equipped with an integrated cost effective couplant with recycling system. It is envisaged that this system consists of an appropriate storage tank, filters, pumps, flexible hoses and all other necessary equipment to ensure coupling of the probes. Couplant shall be supplied to the probe heads throughout the ultrasonic inspection. The couplant in nature shall not be a proprietary

(4) Automatic positioning of the wheel set shall be possible using an adjustable lifting and rotating device. It shall be integrated below the steel frame in the track bed and shall include catching and ejection devices for the wheel set, as well as intake and discharge barricades for protection of the wheel sets.

(5) A safe guiding of axle-wheel sets is practicable with installed feeding track.

(6) All parts of the Test System that require maintenance or cleaning shall be easily accessible.

(7) The Test System shall be connected to the mains power supply.

(8) The purchaser or user has to remove paint /corrosion protection (if any) from the surface of axle before the inspection begins at the test surface for proper coupling and penetration of ultrasonic wave.
3.3.2 Probe head

1. Inspection of the required areas of axle shall be possible from the outside of the axle for different configurations i.e. from body as well as ends of axles.

2. Supplier shall make a proposal of state of the art proven probe heads to ensure an exact inspection (inspection technique, probe head configuration, angular adjustment, etc.) based on their knowledge and experiences.

3. Individual wear soles at probe if used, shall be replaceable (depending on axle geometry). It shall be supplied by supplier.

4. It shall be possible to make angular adjustments to probe heads.

5. The rotating speed (lifting and rotating device) shall ensure that all inspection requirements (as specified in Section 3) are met.

6. The ultrasonic frequency shall be within 01 MHz to 06 MHz. Consideration shall be given to ensure a high resolution and low weakening of the ultrasonic signal.

7. The same couplant, which is used as a couplant for calibration (with reference axle / wheel set), is also used for the examination of solid axles.

8. The couplant shall be automatically supplied to the probe head and evenly dispersed within the probe head contact area throughout the inspection.

9. Probe head position shall be identified by probe head holder.

10. Probe heads shall be easily replaceable in case of defects.

3.3.3 Probe head holder

1. Supplier shall propose the required number of probe heads for each holder.

2. It shall be possible to change-over probe head holder, depending on the selected axle-type.

3. Appropriate contact of probe heads to the solid axle surface shall be automatic based on the wheel set type. The device shall alert the operator in the event of probe head is not aligned correctly.

3.3.4 Test System control cabinet

1. The Test System shall be equipped with one control cabinet, which allows the operator to have a complete view of the inspection process.

2. The control cabinet shall include:
   I. Operator terminal and interface to display results.
   II. Hardware and software for data evaluation and acquisition.
   III. Two local hard disks with memory for storage of data minimum 2000 axles at the same time.
4. Data management and functionalities

The following sections describe the requirements for data management of the Test System:

4.1 Basic structure

All software functions shall be easily controlled and viewed via the main screen and it includes:

- Login and maintenance screens
- Systems setups and motion manipulations
- Inspection run (automatic & manual)
- Post process actions
- Reports

4.2 System setup

The System setup is defined to make sure that certain inspection parameters/functions/components can be modified to ensure exact results when inspection conditions are changing. The system setup shall be adaptable for:

- New geometries of axles.
- Changing inspection intervals (e.g. if a faster inspection is required).
- Setting of new inspection sensitivities.
- Different types of probe heads, for various types of applications.
- Different types of scans and result presentation.

4.3 Access security

1. The secure database shall provide permission for supervising at least three (3) levels of access privileges for unlimited users.

2. The three (3) security permission levels are as follows:

   - **Operator** – access to tests and reports. Operator is permitted to execute inspection without changing inspection parameters.
   - **Supervisor** – all operator access + system setup and inspection plan. Supervisor has access to setup mode and rights to change, delete and to save inspection parameters.
   - **Administrator** – all supervisor access + station setup and maintenance. The administrator has no restrictions.

4.4 Diagnostic functions

The Ultrasonic Test System shall offer the following diagnostic functions:

- Self-check of electronics after switch on.
- Plausibility check of inspection parameters.
4.5 Inspection software

1. The software shall offer a parameter setting mode.
2. The software shall offer an inspection mode, including:
   - Login by the operator
   - Selection of the relevant inspection plan based on Axle-wheel set number
3. The software shall display all parameter settings.
4. The software shall offer the ability for event logging (e.g. indication of defects, failure of the inspection system, etc.).

4.6 Main software functionalities

1. The software should run under Windows latest OS version available in the market when delivering the system.
2. Automatic and manual inspection mode shall be possible.
3. Inspection setup and results shall be saved on two (2) local hard disks with appropriate memory to store all data of minimum 2000 axles at the same time. This will allow a level of redundancy in the event that one of the hard disks fails.
4. In the future, transfer of data to a central electronic data processing system (Web Portal) is planned. The data will be stored on the central server through CD or removable storage device and data shall be in the readable form.
5. Previously stored data shall be used to compare current results with historical ones.
6. It shall be possible to display scans on the control console monitor.
7. Geometry echoes shall be clearly differentiated by the system as form echoes (not defects). Therefore, axle geometry shall be represented parallel to the test result.
8. "Back to defect" capability should be possible, in case further examinations of suspected areas are required.
9. Supplier shall be capable of online (remote) troubleshooting of Test System.

4.7 Report structure

1. The inspection report shall include at least the following content:
   - Name of workshop, date.
   - Description, wheel set type, axle serial number.
   - Reference to inspection parameter settings.
   - Inspection equipment (if applicable adjustment values).
2. Reports shall be exportable in standard format, such as Excel, PDF, etc.

5. Materials and Protection
   1. The Test System shall be manufactured out of materials that ensure proper and long-term operability not less than 15 years in Indian environmental conditions.
   2. In the area of direct couplant and/or other water contact, corrosion shall be avoided.
   3. Aluminum components shall be anodized and steel components must have rust protection.

6. Electric equipment
   1. All measures to achieve a sufficient electromagnetic interference resistance and to limit disturbing electromagnetic emitted interferences must be taken.
   2. The control console shall be environmental hardened rack-mounted operator console with minimum 17" TFT monitor to display operator interface and to display inspection analysis and results.
   3. The control cabinet shall be designed and checked according to latest International standards.
   4. The housing of the Test System electronic equipment shall be protected against dust and humidity.

7. Tools
   All special tools to adjust or maintain Test System shall be part of the scope of delivery.

8. Calibration
   1. The Test System shall be verified separately in accordance with IS 12666 latest version. Each testing instrument shall be provided with "Name-Plate" mentioning the time of validity.
   2. Calibration and maintenance of Test System shall be carried out by the supplier once a year.
   3. It shall be possible to carry out calibration activities locally in railway workshop.
9. Foundation

1. Schematic drawings of the foundation requirements for the Test System shall be provided as part of the technical proposal. These should include a schematic foundation plan showing the arrangement of the systems and the required interfaces with equipment in the workshop building. The machine shall work on BG line of I.R

2. It is envisaged that the Supplier will visit IR Mechanical Workshop, in order to confirm the detailed design of the foundation.

3. The detailed design review for the Test System equipment shall be presented separately. Schematic drawings will show the arrangement of the Test System equipment in relation to the equipment in the workshop building. It shall also include information about detailed requirements with respect to interfaces with IR infrastructure and services, as well as an assessment of static loads.

4. The first detailed design review for the equipment shall be presented to IR within two (2) months following the signing of the agreement. This will be followed by a final design review, to be presented to IR within three (3) months following the signing of the agreement.

10. Safety

The Test System shall be supplied with the following safety features:

1. Main switch on the control panel.
2. Emergency switch for power-off.
3. Protecting covers to shield operator and others in the vicinity from injury in case of malfunctions.
4. Feature to protect wheel set in the event of any failure to the equipment.
5. Feature to avoid damage due to incorrect use (e.g. operator inserted an incorrect wheel set/wheel-type, etc.).
6. UPS-sufficient to ensure data savings and switching off the hardware units in case of power shut down.
7. Mechanical safety arrangement during lift/lower and rotating of axle/wheel set.
8. Unloading of rolling stock shall be facilitated manually in case of power failure.

11. Documentation

1. All documentation shall be in English.
2. Three (3) copies of printed documentation and three (3) copies in digital media such as WORD/PDF shall be delivered by the supplier for each inspection system.
3. Documentation shall comprise at least the following:

- Manuals of computer peripheral components and units.
- Technical description of the system components.
- Diagrams/schematics for electric / hydraulic / pneumatic systems.
- PLC ladder diagram.
- Layout diagram for equipment including interface details.
- Operating manual for Test System (including paint removing device).
- Instructions for equipment care and maintenance for Test System (including paint removing device).
- Instructions for trouble shooting Test System.
- Bill of materials.
- Training procedure and documents for new operator for Test System.
- CD/DVD for operating and inspection software recovery.
- Recommended list of spare parts for each unit including wearing parts and consumable; in a case of common parts please indicate it for Test System working safety regulations for Test System calibration certificate (as per IS 12666).

12. Environmental and IR workshop conditions

1. Temperature
   i. Room temperature is 0°C to 55°C.
   ii. Relative humidity: 10% to 90%.

2. Power and air supply

   (1) Supplied voltage with neutral conductor: 220 V single phase and 415 V supply.
   (2) Frequency: 50 Hz.
   (3) Permissible voltage tolerance: ± 10 %.
   (4) Permissible frequency tolerance: ± 2 %.
13. Pre Acceptance Tests Process at manufacturer site and training

1. The Pre Acceptance Tests Process ("Pre ATP") for the Test System shall take place at manufacturer site over two 04 days, in the presence of representatives from IR's rolling stock division (up to five 05 people).

2. During this process, the Test System functionality shall be tested and full inspection procedure on axles shall be demonstrated for each device three (3) times minimum, using wheel sets selected by IR.

3. If the Pre-ATP is not satisfactory, dependant on the severity, the supplier shall:
   - Fix all pending items.
   - Repeat tests.
   - Invite IR representatives to be present at the repeated Pre-ATP on a future date (at the supplier's expense).

4. After successful Pre-ATP, a test report shall be issued and signed by both parties.

5. Following the Pre-ATP, operational training of the IR representatives shall take place at the supplier's site over a period of four 04 days. This training shall include the following:
   - System instruments software operation.
   - Specific application training.
   - Maintenance / troubleshooting.
   - Practical sessions.

6. Following the successful Pre-ATP and operational training, a certificate of completion of Pre-ATP process shall be signed by both parties.

14. Acceptance tests Process (ATP) at IR site and training

1. The ATP of the Test System shall take place at IR Mechanical workshop after successful installation and commissioning.

2. During the ATP tests, the Test System functionality shall be tested and full inspection procedure on the relevant solid axle wheel sets shall be demonstrated (for each axle configuration) three (3) times minimum.

3. If the ATP is not satisfactory, dependant on the severity of the issues, the supplier shall:
   - Fix all pending items.
   - Repeat tests as required.

4. After successful ATP, a test report shall be issued and signed by both parties.

5. Following the successful ATP and operational training, a certificate of completion of ATP procedures shall be signed by both parties.
6. Operational and maintenance training shall be imparted for ten (10) working days on each inspection unit by the supplier or his authorized representative on successful commissioning of the machine at the premises of concerned workshop/shed of I.R.

15. Warranty

1. Initial warranty period starts following the completion of the ATP.
2. Initial warranty period is twenty-four (24) months from the date of commissioning.
3. Warranty support shall be provided at the site in railway workshops or by remote connection.
4. Initial warranty shall include any and all equipment, parts, hardware, software (including software updates and upgrades), and maintenance tools required for the maintenance and operation of the Test System.
5. Initial warranty includes updates to the documentation if required.
6. Supplier shall respond within twenty-four (24) hours following the receipt of IR’s query.
7. In case of fault in the system, following which the system, in whole or in part, cannot be operated by IR, the supplier shall repair such fault within three (3) working days following the receipt of such fault report from IR.

16. After-Sales-Service: The supplier shall have established the facility for prompt after sales service in India. Imported offers may not be considered technically acceptable without such facility.

17. Annual Maintenance Contract: The supplier shall enter into a comprehensive maintenance contract (CMC) for 5 years after expiry of warranty period. During CMC supply of the spare parts, software and hardware shall be a part of comprehensive maintenance contract.

If any/some parts required to be imported for comprehensive maintenance of the equipment, the payments towards custom duty, wharfage, demurrage etc and the botheration of getting the item released from the Air port shall lie with the sole responsibility of supplier/AMC contractor. Release of foreign exchange if any will also have to be managed by the supplier/AMC contractor and Railway will not be involved in these activities at all.

**************
4.5 Details to be submitted by the respondents

The respondents to the EOI shall be instructed to submit the following details:

1. Turn-over of the firm during the last three financial years with the copies of annual report.
2. Details of various items being manufactured/consultancy undertaken.
3. Details of customer(s) and supplies made in the field of item under EOI.
4. Experience and expertise for the items proposed in EOI.
5. Details of man-power with their qualification and experience.
6. Detailed proposal for items proposed in EOI including alternative proposal, if any.
7. Details of Intellectual Property Rights (IPR) held, patent filed/held and MoU/agreement signed.
8. Details of ISO certification

A starting template for response to the EOI is provided as an annexure to this document. This should be suitably amended to fit the conditions for the respective EOI.
FORMAT FOR LETTER OF RESPONSE
(MODIFY FOR USE WITH SPECIFIC EOI)

Respondents Ref No.: 
Date:

Designation of officer to whom the respondent replies
Room No.: 
Building: 
Research Designs & Standards Organization
Ministry of Railways
Manak Nagar
Lucknow,
INDIA 226011

Dear Sir,

Subject: RESPONSE TO - EOI FOR PARTICIPATION

1. We, the undersigned, offer the following information in response to the Expression of Interest sought by you vide your Notification No.______, dated______.

2. We are duly authorized to represent and act on behalf of ______________ (hereinafter the "respondent")

3. We have examined and have no reservations to the EOI Document including Addenda No(s) ____________.

4. We are attaching with this letter, the copies of original documents defining:
   a) the Respondent’s legal status;
   b) its principal place of business;
   c) its place of incorporation (if respondents are corporations); or its place of registration (if respondents are cooperative institutions, partnerships or individually owned firms);
   d) Self certified financial statements of Last three years, clearly indicating the financial turn over and net worth.
   e) Copies of any market research, business studies, feasibility reports and the like sponsored by the respondent, relevant to the project under consideration

5. We shall assist MoR and/or its authorized representatives to obtain further clarification from us, if needed.
   a) RDSO and/or its authorized representatives may contact the following nodal persons for further information on any aspects of the Response:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Contact Name</th>
<th>Address</th>
<th>Telephone</th>
<th>E Mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td></td>
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</tbody>
</table>

6. This application is made in the full understanding that:
   a) Information furnished in response to EOI shall be used confidentially by RDSO for the purpose of development of the project.
   b) RDSO reserves the right to reject or accept any or all applications, cancel the EOI and subsequent bidding process without any obligation to inform the respondent about the grounds of same
   c) We confirm that we are interested in participating in development of the project
7. We certify that our turnover and net worth in the last three years is as under:

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Turn over</th>
<th>Net worth</th>
</tr>
</thead>
</table>

8. In response to the EOI we hereby submit the following additional details annexed to this application.

8.1. Details of various items being manufactured/consultancy undertaken.
8.2. Details of customer(s) and supplies made in the field of item under EOI.
8.3. Experience and expertise for the items proposed in EOI.
8.4. Details of man-power with their qualification and experience.
8.5. Detailed proposal for items proposed in EOI including alternative proposal, if any.
8.6. Details of Intellectual Property Rights (IPR) held, patent filed/held and MoU/agreement signed.
8.7. Details of ISO certification
8.8 undertaking as per Annexure-A.

9. The undersigned declare that the statements made and the information provided in the duly completed application are complete, true, and correct in every detail. We also understand that in the event of any information furnished by us being found later on to be incorrect or any material information having been suppressed, RDSO may delete our name from the list of qualified Respondents. We further understand that RDSO will give first preference to the applicants considered relevant for the purpose. Our response is valid till (date in figures and words):

Yours sincerely,

(Sign)
NAME
In the Capacity of
Duly authorized to sign the
response for and on behalf
of
Date
Annexure-A

(To be taken on non-judicial stamp paper of appropriate value as applicable in the respective state and duly notarised & witnessed)

UNDERTAKING

1. I, son of .................. aged about ........ Years resident of ............... do hereby solemnly affirm as under

   1. That the deponent is the Authorised signatory of (Name of the Sole Proprietorship Concern/ Partnership Firm/ Registered Company/ Joint Venture).

   2. That the deponent declares on behalf of (Name of the Sole Proprietorship Concern/ Partnership Firm/ Registered Company/ Joint Venture) that:

   a) In regard to matters relating to the security and integrity of the country, no charge sheet has been filed by an agency of the Government / conviction by a Court of Law for an offence committed by the ----------------------(name of the entity) or by any sister concern of the ----------------------(name of the entity) would result in disqualification.

   b) In regard to matters other than the security and integrity of the country, ----------------------(name of the entity) has not been convicted by a Court of Law or indicted / passed any adverse order by a regulatory authority against it or it's any sister concern which relates to a grave offence, or would constitute disqualification. Grave offence is defined to be of such a nature that it outrages the moral sense of the community.

   DEponent

VERIFICATION

I declare that the contents of para 1 to 2 above are true as per my knowledge and nothing has been hidden.

DEponent