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Document Type	**SPECIFICATION OF DIESEL ELECTRIC SHUNT LOCOMOTIVE**		
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1. INTRODUCTION

The purpose of this document is to outline Rolling Stock requirements for the procurement of Diesel electric shunt locomotives that will be able to operate on the existing infrastructure within the Prasa network, from the available market in line with the existing train schedule to sustain services Shosholoza Meyl locomotive operations. The locomotive should be designed to be able to draw all types of trains (heavy shunting) according to UIC specification. It should be suitable for heavy shunting as well as for variable distances.

2. LOCOMOTIVE OPERATING ENVELOPE

WHEEL-RAIL

2.1 the track gauge and tolerances are as follows:

GAUGE (mm)	STANDARD (mm)	Upper limit (mm)	Lower limit (mm)
1065	A	5	3
1065	B	12	7
1065	c	25	10

2.2 CATENARY

Not applicable

2.3 TRAIN INTERACTION

2.3.1 Standard MR-approved coupling system in accordance with (or, where relevant, exceeding) all requirements of the following AAR standards and specifications:

- AAR M-201
- AAR M-205
- AAR M-211
- AAR M-215
- AAR M-269 (if applicable to design)
- AAR S-106 (AAR No. 10-A contour)
- AAR S-117 (F-type coupler contour)

2.3.2 The draft gear and yoke arrangement shall be dimensioned to reliably withstand any loads due to all service types. The draft gear and yoke unit must offer maintenance-free operation between major overhauls - i.e. the coupling system shall be dimensioned to completely avoid the need for maintenance to the internal components of the draft gear pocket, other than at major overhauls of the locomotive.

2.3.3 The locomotive coupling system shall be designed to safely negotiate all routes in South-Africa, coupled to any existing vehicle used on PRASA routes. Coupler height above rail top: Nominal PRASA locomotive coupler height = 889mm (Range: 880-895 mm}.

2.3.4 Locomotive coupler height must allow trouble-free coupling to and safe operation with all PRASA vehicles with the following coupler height ranges:

- Electrical locomotive : 865- 915mm
- Mainline Coaches (MLPS): 865 - 910 mm
- Diesel Electrical Locomotive:

2.3.5 The manufacturer shall provide details of means to adjust the coupler height to the required height to compensate for wheel diameter changes due to wear and re-profiling.

2.3.6 Knuckle strength to a rated value of 2890 kN and an ultimate strength of 3780 kN

2.3.7 The coupling system shall be compatible with and safe for use with the following coupling systems in use with PRASA:

- AAR E-type coupler (electric locomotives)
- SASKOP DS – type coupling system as used on certain diesel locomotives
- SASKOP MS-type coupling systems as used with vestibule buffers on mainline passenger and Metro Rail vehicles

2.3.8 The uncoupling mechanism shall be configured such that a shunter does not need to enter the area between the locomotive and any other vehicle coupled to or to be coupled to the locomotive for any of the following processes:

2.3.8.1 Coupling

2.3.8.2 Uncoupling

2.3.8.3 Preparation of coupler for coupling.

2.3.9 The position of the uncoupling lever shall be ergonomically determined to allow easy and safe operation under all marshalling yard conditions.

2.3.10 Optional: the position of the locomotive uncoupling lever shall be such that malevolent operation by passengers will not be possible

2.3.10.1 The Standard AAR air brake connections

2.3.10.2 Provision for EP (electro pneumatic} braking

2.3.10.3 Provision for train status data line information

2.3.11 Provision to accept remote telemetry signals regarding:

2.3.11.1 brake pipe pressure

2.3.11.2 hot axle boxes

2.3.11.3 dragging equipment

2.3.11.4 axle loads

2.3.12 Provision to reset and/or restart remote locomotives

2.3.13 Provision to accept loco condition and status from remote locomotives

3. ENVIRONMENTAL COMPATIBILITY

3.1 ENVIRONMENTAL COMPATIBILITY A

Electricity Supply - Quality of Supply

Harmonics induced by the locomotives in the three phase power supply system must not exceed the values given in specification NRS 048 part 2 of 1996. Tenderers must note that Total Harmonic Distortion (THD) limits of specification NRS 048 part 2, as given below must not be exceeded:

- Medium and Low voltage networks - THD cs: 8% {Refer to clause 4.1.1 Table 1)
- High Voltage networks - THD s; 3% (Refer to Annexure A Table A.1).

3.2 ENVIRONMENTAL COMPATIBILITY B

3.2.1 Clearance Restrictions & Moving gauge

3.2.2 The dimensions of the locomotive shall be within the vehicle gauge and care shall be taken to ensure that the maximum off-set does not exceed 285 mm on a curve of91 m radius.

3.2.3 The above dimensions shall apply with new wheels and maximum spring heights

3.2.4 The following 1s applicable to outdoor earth clearances:

ITEM	3KVDC	25KVAC	50KVAC
Normal outdoor clearance	150mm	320mm	550mm

3.2.4.1 Tenderers shall provide robust easily replaceable cowcatchers at each end of the locomotive to adequately protect the underframe equipment against damage from foreign objects on the track. The risk of damage to traction motors, gear cases and other equipment in event of a derailment must be assessed and suitable additional means of minimising damage must be provided. (Present Spoornet practice is derailment bars that are provided at the outer and inner end of each bogie)

4. Signalling and Telecommunications infrastructure

4.1 The following signal track circuit systems are in use on the PRASA lines

4.2 50 Hz double element vane relays, capacitor fed

4.3 83 113 Hz double element vane relays, capacitor fed

4.4 Low frequency Jointless Aster type from 1 620 Hz to 2 820 Hz (voltage detection).

4.5 Jeumont asymmetrical high voltage impulse.

4.6 Reed jointed from 363 Hz to 411 Hz voltage detector

4.7 For the above track circuit systems it is required that the wheel-to-wheel electrical resistance of a wheel set does not exceed 0,5 ohm.

4.8 The following track side communication system is presently employed:

4.9 Frequency multiplex and time transfer methods either in buried co-axial cable or surface twin twisted cable routes within the railway reserve, as well as coiled pulse transmission on such cables

5. CIVIL INFRASTRUCTURE

5.1 Track Characteristics

The following is a general description of the track on which the locomotives will run:

5.1.1 The track gauge limits are as specified in clause 3.1

5.1.2 Nominal radius of the sharpest curve over which the locomotives will be required to be hauled "dead" when in transit, is 91 m and such a curve is check-railed.

5.1.3 The locomotive shall, however, be capable of negotiating a test curve of 85 m radius

5.1.4 The sharpest turnout is I in 8.

5.1.5 On the sharpest parabolic vertical curve, the grade changes at a rate of 240 mm per 20 m per 20 m

5.1.6 The super-elevation of the outer rail on a curve of 91m in radius is 100 mm.

5.1.7 The maximum rate of change of super-elevation entering and leaving such a curve is I in 300.

5.1.8 The gauge widening on a curve of 91 m radius is 20 mm.

5.1.9 The check rail clearance is 63 mm

5.1.9.1 The track is constructed of the following types of rails : 48kg/m UIC A. 57kg/m UIC A, 60kglm UIC CrMn and SAR 60kglm CrMn rolled by ISCOR

5.1.9.2 The-locomotives must negotiate both a 1 in 8 reverse turnout with 4064 mm (13 feet 4 inches) switches and a 1 in 8 cross-over road with 4064 mm (13 feet 4 inches) switches.

5.1.9.3 The locomotives shall be so designed and constructed that they will easily and safely traverse and negotiate the curves, etc., mentioned above, whether running alone or when coupled with other similar locomotives and to a train consisting of any vehicles used on the PRASA/TRANSNET rail network.

5.1.9.4 Specific attention shall be paid to the following cases with reference to the influence of coupling system configuration on track forces and wheel unloading due to high in-train forces during curving

- Passenger operation, requiring coupling on tight curves. The Tenderer shall show detailed calculations to substantiate the choice following dimensions:

  - Coupler length (distance from coupling line to coupler pivot point).
  - Bogie centre spacing.
  - Locomotive coupling length (total length over coupling lines of couplers).
  - Lateral bogie forces.
  - Individual lateral wheel forces.

The calculations must at least take the following factors into consideration.

- Coupling of the locomotive to all coaches relevant to each specific service type.
- Dynamic braking (Electric pneumatic brake) and traction forces, in combination with curve radii related to the specific service type
- Lateral vehicle displacement due to lateral wheel-rail, intra-bogie and bogie-body play, clearances and compliances.

The Tenderer shall take these calculations into account to make a recommendation on the most appropriate locomotive configuration i.e., Bo-Bo or Co-Co. (Please note requirements of 2.4.5 "The preferred configurations to include:-")

5.1.10 Tunnels

The applicable drawing is BE 83 - 237.

5.1.11 Bridges

The applicable drawing is BE 95-15

5.3.3 Moving gauge

The following is applicable:

ITEM	ANNEXURE	APPENDIX
Vehicle Gauge	3	1
Horizontal Clearances	3	2
Vertical Clearances	3	3

6. ENVIRONMENT

6.1 Snow, ice, severe dust and iron particle laden wind conditions and frequent severe lightning storms occur in the areas in which the locomotives will operate. The areas with the severest lightning intensity experience are up to 12 ground flashes per square kilometre per annum.

6.2 The maximum altitude at which the locomotives will operate is 1980m above sea level.

6.3 The locomotives will operate continuously; a saline atmosphere with a relative humidity as high as 86%.

6.4 The maximum air temperature is 40 ° C (in the shade) and the minimum air temperature is minus 10° C in the areas 1n which the locomotives will operate.

7. OPERATIONS CONDITIONS

7.1 At present PRASA uses trunked and open channel in 450 / 470 MHz bandwidth. Preferred radio is digital in nature with data and voice capability.

7.2 Cab Signalling/Authorisation System Requirements for Locomotive interface

7.3 The requirements for physical space on board locomotives is as follows (dimensions in millimetres):

- Processor equipment space (control system)
- Space for cubicle 2000 (h) x 600 x 600
- Driver Machine Interface (DMI):
- Max. cut-out 300(w) x 212
- Max cut-out depth 141 plus 60 for airflow and connectors, etc.
- Max. outside frame 345(w) x 227

  Protrusion of DMI will not exceed 20mm above the panel sluice.

This space must be provided in such a position that the driver has full view of the display (to be provided separately) for the purpose of driving the locomotive.

- 50mm x 50mm ducting routes (separate from other power cable routes) must be available as follows:
- DMI to processor space.
- DMI to roof.
- Processor space to locomotive control system.
- From processor space to roof.
- From processor space to power
- From processor to below locomotive (transponder equipment, tachometer).

7.4 The power requirements are as follows:

7.5 110V DC (74V DC)± 20% unregulated power rated at 10 ampere shall be available at the processor equipment (control system) space.

7.6 The antenna requirements (insulated and within the relevant vehicle/structure gauge) for the Signalling/Authorisation System (over and above other communications requirements) will be for the following functions:

7.7 GPS

7.8 Train complete

7.9 Train to central data communications

7.10 Detailed brake interface requirements/information in order to interface the Signalling/Authorisation System to the locomotive for the purpose of the initiation of a braking application by the on-board Signalling/Authorisation

7.11 System must be provided.

7.12 Data Transfer

7.12.1 Locomotive, train condition and status information are required.

7.12.2 Provision must be made for transmission and reception of position, train information, service information, train and locomotive condition data, train operatio11 orders, signing on and off of crew at remote locations.

7.12.3 The data system shall be modular, pluggable, non-proprietary and discless, designed for industrial use.

7.13 Train Load

7.13.1 The Electric Diesel shunt locomotive must be able to haul 22 coaches at the speed of 90km/h (60Km/H).

7.13.2 Total tonnage of the hauled 22 coaches with passengers is approximately 880 tonnes. Not to be used on passenger train.

8. LOCOMOTIVE CHARACTERISTIC

8.1 Locomotive Profile Annexure A provides drawings with dimensions for the vehicle profile and horizontal and vertical clearances.

8.2 Axle loading (inclusive of dynamic effect)

8.3 Axle loading to be 22 - 25 tons per axle (too heavy for shunting locomotive)

8.4 Bogie Configuration and Dynamic Running Performance

8.5 Bo-Bo, Co-Co or 2x(Bo-Bo} will be considered

8.6

8.6.1 The following information must be supplied irrespective of the type of bogieoffered including alternative configurations: -

8.6.2 Longitudinal and lateral rail forces during curving for starting a load and at full

8.5.3 dynamic brake appl1cat1on: Electric pneumatic brake Wheel wear indication.

8.6.3 The dynamic running performance of the locomotive must comply with Spoornet standard "Dynamic running performance requirements for Spoornet rolling stock" revision 2.0 dated 1 February 2001. Verification for compliance with the dynamic running performance requirements will be based on UIC 518.

8.7 Type of Traction

8.7.1 AC traction motors are preferred however DC traction motors are also applicable.

8.8 Tractive and Brake effort characteristics

8.8.1 The Figure below illustrates a generic envelope of the tractive effort and dynamic brake curve characteristics expected by PRASA 22-25ton diesel- electric configurations

8.8.2 The OEM must indicate how the adhesion would be reliably sustained on normal specified track under all weather conditions.

8.8.3 Minimum starting tractive effort 1s 272 kN at 25% adhesion

8.8.4 Continuous tractive effort is minimum 218 kN at 26 km/h, at 20% adhesion.

8.8.5 Dynamic Brake peak effort is minimum 188kN at 26km/h.

9. Power of engine and traction motors

9.1 Diesel engine to be minimum 1500 hp (1200 kW).

9.2 Continuous speed rating 30 km/h range for the electrical configuration

9.3 Maximum speed 130 km/h (although characteristics are only to 120 km/h) speed to high for a shunting locomotive.

10. Fuel Capacity

Achieve a range of at least 1500 km with a 20% reserve or 3500 liters

11. Multiple Unit (MU) ability

- The combined fleet irrespective of configuration must Multiple Unit (MU) together.
- When utilizing diesel-electric locomotive in conjunction with new/combined fleet locomotive is required that the diesel-electric locomotive be reset, started, shut down and diagnosed from the new/combined fleet locomotive.
- Locomotives must be capable of being reset or restarted remotely

12. Sand

- The volume of sand must match the re-fueling cycle or sufficient for a locomotive distance of 1800 km.
- Sand box to be such that sand could be replenished using automated systems and/or manually.
- The design of the sand box and discharge pipe must prevent clogging

13. Brakes

- Standard AAR brake system is required with an option of vacuum.
- locomotive must have EP brake ability via plug in modules
- An option of a magnetic rail head brake in lieu of a tread brake to act as a parking brake is to be offered.
- Must utilize composition brake blocks with brake products not harmful to human and environment.
- A locomotive must be able to stop itself on a level track from its max speed
- in 85% of 1200m.

- Must not skid wheels in wet condition when brakes are fully applied.
- Stopping distance must not differ more than 15% between wet and dry conditions.
- Static holding of locomotive must be at least equal to continuous tractive effort of locomotive.
- The handbrake must hold the locomotive on a 1 in 40 down gradient.

14. Drivers Cab

14.1A single cab per module is required giving a dual module a cab on either end. Should a locomotive be offered comprising a single module only then a dual cab is required, unless alternatives are proposed to satisfy vision requirements, such as a narrow body design.

14.2 Vision - sufficient to observe signals, train movements and load movements, a single large window is preferred.

14.3 Crashworthiness - The OEM to specify technology and development to date including characteristics, energy absorption, speed, masses, force rating

14.4 The cab noise level must not exceed 75 dBA with the locomotive running at continuous power, all auxiliary machinery running and with the cab windows closed.

The machine compartment noise level must not exceed 85 dBA with thelocomotive running at continuous power and all auxiliary machinery running.

14.5. The risk of malfunction of systems/equipment must be assessed and the influence on the environment of the driver must be quantified by means of Failure Mode Effects Critically Analysis. Appropriate systems must be installed to protect against these risks.

14.5.1 Equipment

- provision for remote control as an option;
- intelligent vigilance;
- wheel slip and slide including indicators;
- consist total tractive effort indication;4.11,65
  consist line current indication;
- a kilowatt-hour indication;
- speed indication;
- acceleration indication;
- Line voltage indication
- Brake equalizing pressure

14.5.2 Brake pipe pressure indication

- Main air equalizing pressure indication
- Brake cylinder pressure indication
- Flow meter
- Holding brake pressure indication
- Comprehensive fault reporting system;
- Pantograph up and down control switch; not needed
- Carbon dioxide fire extinguisher of 7kg capacity;
- Sun visors;
- Adjustable rear-view mirrors,
- Window shall be tinted laminated safety glass to SABS 1191;
- Sound power level and audio frequency spectrum of horn;
- illumination of level of head lights;
- Electrically operated wind screen wipers;
- 2/3 power switch;
- environmentally clean and maintenance friendly;
- Climate control (HVAC system);

14.5.3 Seat with variable: -

- head rest, rotation and height;
- arm rest rotation vertically;
- lumber support;
- back rest rotation,
- seat height, tilt, rotation and longitudinal adjustment.
- doors to be supplied with lock mechanisms such that the driver can lock himself in the cab but release quickly in an emergency situation.
- provision for a multipurpose plug for radios, shavers, (16A) 220V AC 50Hz/12VDC/9VDC.

14.5.4 Accuracy and calibration of measurement indication equipment and transducers:

- All measuring transducers must be of the highest-grade suitable for a locomotive.
- The accuracy of the speed measurement indication must be such that the indicated speed will not be more than 2 km/h faster, and under no circumstances slower, than the actual speed travelled over the full operating range of the locomotive.
- Pneumatic pressure transducer accuracy must be O + 2%.
- Procedures and special test equipment must be provided for verification of calibration of measurement indication equipment in the driver's cab, e.g. measurement indication for line current, speed,acceleration, etc.
- The verification/ calibration intervals must be declared as well as the expected accuracy limits for each measurement indication equipment item in the driver's cab.

15. LOCOMOTIVE PERFORMANCE REQUIREMENTS

15.1. Reliability· Mean Distance Between Service Affecting Failures:

MDBSAF = Fleet kilometers for a relevant measurement period/ Number of technical failures = 30 000 km

15.2. Maintenance Effectiveness and Efficiency: Mean Days Between Failures(MDBF) per asset/components (time based 1.e. days/months) = 45 days

Availability: = 100%

16. RAILWAY SAFETY REGULATOR (RSR) REQUIREMENTS

16.1. The Railway Safety Regulator (RSR) is a key stakeholder in the process of acquisition/leasing and introduction of any new or old rolling stock in the South Africa.

16.2. While the process interface in the acquisition or leasing of the locomotives shall be with PRASA, the supplier is expected to be familiar as a minimum, with the requirements of the overarching National Railway Safety Regulator, Act 16 of 2002 (as amended) to which all design, construction (as applicable), commissioning and life cycle requirements shall adhere to and the associated RSR guidance notices/directives be adhered to

16.3. If the locomotives were not yet licensed/accepted for use on South African rail network, any costs associated with this approval will be for the suppliers account.These costs then need to be included in the contract price offer.

16.4. This might also be required when the RSR would need additional tests to be performed for approval processes, e.g. Toxicity of Diesels fumes in tunnels.

Test and commissioning activities should be conducted in accordance with IEC 61133 specification. Below are the minimum tests to be performed and will be submitted to RSR for a No Objection approval to operate the Electric Diesel shunt locomotives proposed.