TRANSNET ENGINEERING

TECHNICAL SPECIFICATION

For

Fuel Pump Inverter for Class D43 Diesel Locomotive

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Revision 01

Summary of Revision

First Issue: December 2023

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The following changes have been made in these revisions:

Rev	Description	Author	Date
0	Initial Release	Wing Lau	Dec 2023
1	Removed Class 44D information and made specification solely for class 43D inverter	Wing Lau	Feb 2024

Symbols and Abbreviations

TE	Transnet Engineering
TFR	Transnet Freight Rail
GPM	Gallons per Minute
COTS	Commercial Off the Shelf

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1. BACKGROUND AND INTRODUCTION

The fuel pump on the class 43D delivers fuel from the fuel tank to the engine on the locomotive. The fuel pumps deliver fuel at a rate of 7 gallons per minute (GPM) for the class 43D locomotive at a pressure of 120 psi. The existing fuel pump uses a three-phase motor supplied with a three-phase inverter.

The purpose of this document is to provide the scope of work to the successful bidder which will provide an end-to-end solution of an alternative inverter for the fuel pump for the class 43D locomotive.

Due to time pressure a COTS solution that allows for the waiver, or shortening, of type testing and/or in-service tests (see section 10) is likely to be scored higher due to shorter project completion times.

2. DOCUMENT SCOPE

2.1. This Technical Specification is for the supply of an inverter for the fuel pumps of the class 43D locomotive.

2.2. The specification states the minimum requirements relating to the required service of supplying an inverter for the fuel pump(s) for the class 43D locomotive, and in no way absolves the supplier from additional duties of ensuring the inverter is suitable for the fuel pump.

2.3. For clarity, when used in the context of this document the entities listed below shall have the following meanings:

2.3.1. Fuel Pump – Refers to the fuel pump for the class 43D locomotive.

2.3.2. Inverter – Refers to the inverter for the fuel pump for the class 43D locomotive.

2.3.3. Respondent – the person/organisation tendering along with others for the supply of the Goods/Services required under this tender or procurement process.

2.3.4. Successful Bidder – the person/organisation who after submitting the tender response, has successfully passed evaluation and has been awarded the business, thereafter, referred to as the Supplier.

3. RESPONSE TO TECHINICAL SPECIFICATION

3.1. General

The Respondent must adhere to all the requirements included in this document. Failure to adhere to these requirements may, subject to the decision of the adjudication panel, result in the disqualification of the Respondent's submission.

Transnet reserves the right to disqualify any Respondent should its submission not adhere to all the requirements specified in this document.

3.2. Bidder's Technical Response

3.2.1. Respondents shall provide a clause-by-clause response to this Technical Specification. Failure to comply with this requirement may result in the disqualification of a Respondent.

3.2.2. The responses should therefore contain a clause-by-clause response for each clause in this document, containing at least one of the following answers:

- FULLY COMPLIANT: When the bidder complies completely with the clause.
- PARTIAL COMPLIANT: In case of partial compliance of the clause by the bidder.

- NOT COMPLIANT: To state that the clause is not met currently and not an option at all.

3.2.3. The Respondents must supply an outline proposal of the design, and/or datasheets along with corresponding test results if an existing unit is quoted. This includes comprehensive information on performance and efficiency.

3.2.4. Respondents shall provide drawings, diagrams, and additional literature to clearly describe the operation of the proposed system and highlight any noteworthy features.

3.2.5. Commercial Off-The-Shelf (COTS) unit that is already in use for railway locomotive system application shall be preferred. In all instances the following information shall be furnished:

- Type test report
- All relevant technical information (datasheet, previous application used, etc.)
- Provide sample(s) for viewing, static testing, and test fitting.

3.2.6. The respondent shall attend a compulsory tender briefing, prior to tender submission, to outline the scope of work, solution, and product that the successful bidder will provide. This tender briefing will provide a platform for bidders to request or ask any questions with regards to this specification.

Table 1: Technical Documentation Checklist

Information Description	Content	Bidder Checklist
Cover letter	Contains information on: - Warranty	
Detailed Technical Offering	Evidence for the responses given in **Section 4 - 15**. (Please be very detailed in the information provided)	
List of Documents Supplied for tender	List of technical documents, data sheets and other documents supplied as part of the offering.	
Previous Experience information	- Contact information of relevant reference where a similar type product was supplied, - List of relevant projects and detail, - Company brochure, - OEM authorization letters.	
Technical Documentation	Filled in, signed and stamped Technical Specification Document.	

3.3. Alternatives Offered

3.3.1. In addition to offers which, in the first instance, comply with the requirements set forth in this Specification, Respondents may also offer, as alternatives, variations of detail that they consider might be advantageous and acceptable to TE.

3.3.2. The respondent may also offer additions to the scope, either being requested or of their own accord. The final decision on the additions rests with TE.

3.4. Quotation Requirements

3.4.1. TE requires that the price breakdown be made available in at least the following detail:

- COTS inverter for fuel pump (if applicable).
- Prototyping or development cost (if applicable).
- Prototype inverter for fuel pump (if applicable).
- Pre-production inverter for fuel pump (if applicable).

3.4.2. The quantities for the prototype and pre-production unit are as follow:

	Capacitor Type	Qty
Prototype	Class 43D inverter for fuel pump	1
Pre-production	Class 43D inverter for fuel pump	3

4. SCOPE OF GOODS AND SERVICES

4.1. General

4.1.1. The successful bidder shall supply the fuel pump inverter for the class 43D locomotive.

4.1.2. This Technical Specification is for the development, or supply of a COTS solutions, of a fuel pump inverter, as per section 5, for the existing diesel fuel pump for the class 43D locomotive.

4.1.3. The successful bidder will be given an opportunity to develop, or supply, initial fuel pump inverters (prototype units) for the class 43D locomotive. The supplied initial inverters will undergo comprehensive testing. After testing, the Supplier will be given the opportunity to rectify any identified deficiencies in the supplied inverter. Additional inverters, with the identified deficiencies corrected (pre-production units), will then be used for further in-service evaluation. Failure to meet the expectation of this technical specification, as well as fit for purpose use, will result in discontinuation of business with the successful bidder regarding the supply of such goods and services.

4.1.4. The prototype units will undergo a dummy test fit, and type testing (as per section 8)

4.1.5. Only upon acceptance of the prototype units shall further approval be given to continue to the development, or supply, of pre-production units.

4.1.6. The fuel pump inverters will undergo an in-service evaluation, as per section 9, for each phase of development – prototyping, and pre-production unit.

4.1.7. The successful bidder shall provide the type test, or service proven, report(s) for the supplied fuel pump inverters as per section 8. Only once the type test report(s) or service proven report(s) are satisfactory shall the protype fuel pump inverter units be approved to be fitted in the locomotive for in-service evaluation.

4.1.8. The successful bidder shall collaborate with Transnet for the development, installation, integration, and in-service evaluation on the locomotive.

4.1.9. The fuel pump inverters supplied by the successful bidder shall undergo in-service evaluation (as per section 10) before further approval will be made for further purchasing.

4.1.10. The respondent shall respond to the following table in the right hand most column, with **FULLY COMPLIANT**, **PARTIALLY COMPLIANT**, or **NOT COMPLIANT**, with respect to compliance with the requirement.

Note: Scope of Goods and Service is mandatory. A respondent will be disqualified if the answer "Not Compliant" (i.e. response No/blank) to any point in the table below.

#	Scope of Goods and Service Required		Response (FULLY COMPLIANT/ PARTIALLY COMPLIANT/ NOT COMPLIANT)
D.1	Supply	Protype and provide fuel pump inverter solution for class 43D locomotive as per section 5.	
D.2	Delivery	Delivery of fuel pump inverters as mentioned to site (including all freight forwarding and custom cost): - Koedoespoort Depot, - Cnr. Lynette Street and Koedoespoort Rd, - Koedoespoort, - Pretoria - Gauteng - 0186	
D.3	Documentation of Supplied Equipment	Technical Data Sheet	
D.4		Type Test report or service proven report	
D.5		Maintenance Manuals, and Installation Manuals	
D.6	Training	Training to be provided for installation and maintenance and service.	
D.7	Installation, Testing and Commissioning	Support during the in-service evaluation, testing, and commission of the fuel pumps inverters for the locomotive.	

5. TECHNICAL SPECIFICATION

The following technical specification shows the technical information to the item mentioned.

5.1. General

5.1.1. The respondent shall supply supporting document that can demonstrate the ability to supply according to these requirements.

5.1.2. The successful bidder shall be responsible for the installation of the protype and preproduction units on to the locomotive.

5.2. Environment Requirement

The equipment shall have the following environmental operating requirement:

5.2.1. Shock and Vibration resistance: IEC61373:2010
5.2.2. Operating Altitude: 2200m
5.2.3. Ambient Temperature: -40°C to +85°C
5.2.4. Humidity: Yearly average humidity: ≤ 75 %, Relative humidity: ≤ 95 %

5.2.5. IP protection: at least IP66
5.2.6. Oil and Diesel Fuel Resistance

5.3. Operating Requirement

5.3.1 The inverter shall be able to drive and power the class 43D fuel pump.

5.3.2 The supplied inverter shall have similar or better performance than the existing fuel pump inverters of the 43D class locomotive.

5.3.3 It is the successful bidder's responsibility to characterise the fuel pumps, for the class 43D, to drive them correctly to obtain the necessary performance from the fuel pumps.

5.3.4 Nominal input voltage of 74VDC shall be used to power the inverter.

5.3.5 The inverter shall be able to operate with an input voltage range between 40 VDC to 104 VDC. Bidder to provide input capability voltage range for the inverter.

5.3.6 The inverter shall be capable of driving the fuel pump of the class 43D locomotive to be able to provide a flow rate of 7 GPM at a pressure of 120 psi.

5.3.7 The inverter shall have the following protection: overtemperature, over current, over voltage and stall protection.

5.3.8 The inverter shall have soft starting capability.

5.3.9 The inverter shall be able to provide sufficient power, without damaging the fuel pump, to drive the fuel pump with a back pressure of 120 psi.

5.3.10 The inverter shall be able to withstand a voltage drop of up to 35 VDC of at least 15s during cranking of the engine at start-up.

5.3.11 The inverter shall have EMI protection and within EMI levels as according to standards mentioned in section 16.

5.3.12 Sine-wave inverters may be given preference.

5.3.13 Inverters with vector control (e.g. Field oriented control) will be preferred.

6. CONSTRAINTS

6.1. The fuel pump inverters shall interface with the original fuel pumps on the class 43D.

6.2. If the inverters must be relocated, the inverter must be capable of providing sufficient voltage to compensate for the voltage drop.

6.3. It is preferred to install the inverter in the same position as the original inverter for the fuel pump, utilizing the original mounting holes and space as the original.

6.4. Should reuse of the original mounting holes and placement of the inverter is not possible, the successful bidder will work with Transnet engineers to identify the alternative placement.

6.5. Additional mounting brackets and interfaces required for the inverter to drive the fuel pump will be part of the inverter solution for the fuel pump along with any accessories accompanying the inverter.

7. CLARIFICATION

7.1. The respondent may contact TE at any time through the relevant procurement personnel should any void exist in this specification or there be any uncertainty as a result any contradictory statement(s) within this specification.

7.2. All clarification questions directed to TE shall be made in writing through the official channels as detailed in the supporting documents of this procurement event.

8. TYPE TEST (FAI – FIRST ARTICLE INSPECTION)

8.1. The respondent must provide a list of standards and applicable clauses that they adhere to other than those mentioned in this specification.

8.2. The successful bidder will make available the type test procedure for review and approval, as well as the witnessing of the type tests.

8.3. The successful bidder shall conduct and provide a type test report for the supplied fuel pump inverters for review and approval.

8.4. The respondent may provide an existing type test report for the fuel pump inverters if an existing product is available.

8.5. Only upon approval of the type test report shall the fuel pump inverters be approved to undergo further testing in the locomotive for static and dynamic tests.

9. STATIC AND DYNAMIC TESTING

9.1. Static and dynamic testing shall be conducted to determine the inverters capability of driving the fuel pump to deliver the necessary fuel flow rate and pressure to the engine.

9.2. Static and dynamic testing procedure and results shall be discussed, reviewed, and approved with the successful bidder during the prototyping stage.

9.3. Only upon approval of the static and dynamic tests shall the fuel pump inverters be approved to undergo further in-service evaluation testing.

10. IN-SERVICE EVALUATION

10.1. The successful bidder shall arrange with Transnet engineers for the installation of the mention fuel pump inverters, as per section 3.4.2, for in-service evaluation.

10.2. The in-service evaluation testing period, of the installed fuel pump inverters, shall be three (3) to six (6) months for the prototype units, and three (3) months for the pre-production units. TE will monitor its in-service performance and follow-up on any possible failures.

10.3. The in-service testing period may be shortened or negated if:

10.3.1 The part supplied by the supplier is the same as the original and is certified to be used on the locomotive.

10.3.2 When Transnet Engineering's Chief Maintenance Engineer or Fleet Maintenance Owner accepts the product at an earlier stage for operational or other reasons.

10.4 The part shall only be granted approval, for fit for use purpose, once the in-service evaluation testing is successful.

11. DATA PACK AND TRAINING

11.1. The successful bidder will provide the maintenance pack for the fuel pump inverters. The maintenance pack will include the following: datasheet of the fuel pump inverters, maintenance manuals, replacement parts, installation manuals, and maintenance schedule (if applicable)

11.2. The successful bidder will provide training on how to install and maintain the fuel pump inverters.

12. MAINTENANCE SUPPORT

12.1. The successful bidder will provide maintenance support and spare parts for at minimum period of 10 years.

12.2. In the event of repetitive similar failures, the successful supplier shall investigate and support with an updated solution.

13. PROJECT TIMELINES

13.1. The Respondent shall include the dates which the Respondent will be able to deliver (for both prototype and pre-production), together with the activities (and accommodating dates).

13.2. The following table shall be responded to in the right hand most column, with a YES or NO, with respect to compliance of the requirement.

Note: Scope of Delivery Period for the protype is mandatory. A respondent will be disqualified if the table is not completed (i.e., blank), indicating the possible delivery date of the prototype. The respondent with the shortest delivery period will receive a higher evaluation score.

#	Protype Delivery	Response [YES/NO]
D.1	1 Months	
D.2	<3 Months	
D.3	<6 Months	
D.4	Other: _____ (Supplier to stipulate the delivery period of the prototype, please provide reasons of not meeting <6 months delivery date)	

13.3. The Respondent is made aware that failure to reach the stated delivery date in 13.2 above may result in disqualification of this tender.

14. QUALITY ASSURANCE

The Supplier is to provide certificate of compliance for quality assurance.

15. Warranty

The following table shall be responded to in the right hand most column, with a YES or NO, with respect to compliance with the requirement.

Note: Scope of Warranty Period is mandatory. A respondent will be disqualified if the table is not completed (i.e., blank), indicating the warranty period to be provided. The respondent with a longer warranty period will receive a higher evaluation score.

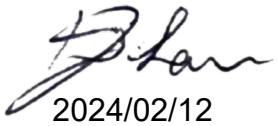
#	Warranty Period	Response [YES/NO]
W.1	3 Months	
W.2	6 Months	
W.3	12 Months	
W.4	Other: _____ (Supplier to stipulate the warranty period they will provide)	

16. STANDARDS ADHERENCE

The respondent shall adhere to the standards that are identified in this document, should the respondent be the successful bidder. The respondent must also provide a list of standards and applicable clauses that they have adhered to, other than those mentioned in this specification document, which address the requirements of the requested standards. The following tables a comprehensive list of SANS, IEC, EB and Transnet standards that the solution should adhere to. Bidders are to provide additional standards which the solution complies with, other than the list mentioned below.

S1	**SANS Standards**	**COMPLY [YES/NO]**
S1.1	SANS 10111 (Latest) Engineering Drawing	
S1.2	SANS 60529:2013 Degrees of protection provided by enclosures (IP Code)	
S2	**EN Standards**	**COMPLY [YES/NO]**
S2.1	EN 50121-3-2: Railway Applications - Electromagnetic compatibility, Rolling stock apparatus	
S2.2	EN 61373:2010 Railway applications – Rollingstock equipment – Shock and vibration tests.	
S3	**Transnet Standards/Drawings**	**COMPLY [YES/NO]**
S3.1	BBB2274 (Latest): Electromagnetic compatibility requirements for rolling stock operating on TFR railway lines	
S4	**IEC Standards**	**COMPLY [YES/NO]**
S4.1	IEC 60068-1:2013 Environmental testing – Part 1: General and guidance	
S4.2	IEC 60068-2-1:2007 Environmental testing – Part 2-1: Tests – Test A: Cold	
S4.3	IEC 60068-2-2:2007 Environmental testing – Part 2-2: Tests – Test B: Dry heat	
S4.4	IEC 61373:2010 Railway applications – Rolling stock equipment – Shock and vibration tests	
S4.5	IEC 50155 Railway applications - Electronic equipment used on rolling stock	
S5	**ISO Standards**	**COMPLY [YES/NO]**
S5.1	ISO 9001:2015 Quality management systems — Requirements	

DOCUMENT AUTHORITIES

COMPLIED BY	
Wing Lau	Signed: 
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