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No. EL/3.2.15/3-Phase

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SPECIAL MAINTENANCE INSTRUCTION NO. RDSO/2016/EL/SMI/299, Rev. '0'

1.0 Title:

Technical Scope of work for Annual Maintenance Contract (AMC) for 1750 LPM capacity lubricated reciprocating compressors of Electric Locomotives.

2.0 Brief History :

2.1 Compressed air is supplied by the lubricating reciprocating compressors for electric locomotives. On the basis of failures analysis, it is observed that the maintenance practices are not uniform and conforming to the recommendations of OEM.

There are generally two makes of 1750 LPM compressors working in Electric Locomotives i.e. ELGI and FTRTIL. These compressors are generally working in three phase locomotives but some quantities are also working in WAP-4 conventional locomotives.

2.2 During the discussion in Railway Board on 14.06.2016, RDSO was directed to prepare technical scope of work for AMC for 1750 LPM compressor to ensure its proper maintenance. Moreover as per Minutes of CEE's conference held on 4th June 2016 in Railway Board issued vide Letter No. 2016/Elect. (TRS)/138/3 dated 15.06.2016, Board had advised Zonal Railways to process AMC of items requiring specialised maintenance with OEM's. Moreover, Member Traction also directed RDSO to issue technical scope of work for AMC of reciprocating compressor capacity 1750LPM provided in three phase locomotives during Governing Council Meeting held at RDSO on 06.09.2016. In view of above, a technical scope of work for AMC for compressors is prepared to facilitate Zonal Railways for proper maintenance.

3.0 DEFINITIONS:

Throughout this document, the terms:

- a) **'Compressor'** means 1750 LPM capacity oil lubricated reciprocating compressor.
- b) **'IR'** means Government of India, Ministry of Railways, Railway Board, New Delhi or its nominees.
- c) **'Tenderer'** means the firm/company submitting the offer for annual maintenance of compressor commissioned on Conventional tap changer Electric locomotives.
- d) **'Contract'** means the contract for annual maintenance of compressor fitted on Conventional tap changer and 3- phase Electric locomotives between IR and the firm, against the tender.

- d) **‘Contractor’** means the firm / company or its wholly owned subsidiary in India on whom the order for annual maintenance of compressor fitted on Conventional tap changer and 3- phase Electric locomotives is to be placed.
- f) **‘Sub-contractor’** means any person, firm or company from whom the contractor may obtain any services for maintenance of compressor
- g) **‘User Railway’** means the Zonal Railway or Divisional Railway which has placed the contract on firm in terms of this agreement.
- h) **‘Designated Shed’** shall be the shed so designated by the user Railway, within the zone of that user Railway, where the locomotives shall be brought for maintenance including the maintenance of compressor.
- i) **‘Nominated Officer’** means the person nominated by user Railway for the purpose of execution of contract.
- j) **‘RDSO’** shall mean Research, Design and Standards Organization / Lucknow for the purpose of consultation regarding up gradation.
- k) **‘GCC’** shall mean General Conditions of Contract (Works) contract, of the concerned Zonal railway.
- l) **‘Minor Schedule’** The inspection schedule IA, IB IC and ICo
- m) **‘Major Schedule’** The overhauling schedule AOH/MOH, IOH & POH
- o) **‘OEM’** means Original Equipment Manufacturer

4.0 Object:

To provide technical scope of work for Annual Maintenance Contract (AMC) for 1750 LPM capacity lubricated reciprocating compressors of Electric Locomotives.

5.0 Scope of work of AMC:

- 5.1 This is a comprehensive Annual Maintenance Contract for air compressors, where Original Equipment Manufacturer (OEM)/contractor shall at its own cost and expense attend, replace and install materials which get consumed, wear out due to ageing /use in the normal course of operation as well as attend failures/breakdowns /out of course repairs of compressor including components, assembly and sub-assembly for efficient and reliable operation of equipment under AMC. During the maintenance period OEM/contractor shall arrange transport of man and material at its own cost as and when required for maintenance of the equipment.
- 5.2 Railways will enter into AMC for compressor with manufacturers of compressor for their own make of compressor units or with sources approved for repair of compressor of a particular make.
- 5.3 Compressor units under warranty shall not be included in scope of AMC. Compressor units beyond manufacturer’s warranty shall only be included in scope of AMC. However, Railways may enter in to AMC contract for compressor units covered under warranty, but in such cases, AMC for units still covered

- under warranty shall commence from the next day of completion of warranty period.
- 5.4 AMC will be carried out for compressor units in working condition.
- 5.5 The contract shall be comprehensive in nature wherein preventive as well as Breakdown Maintenance of compressor shall be carried out by the contractor including the arrangement of spares, tools, consumables, technical expertise and man power. The released components, consumables, tools, items etc. will be contractor's property. Contractor shall remove the same from the shed's premises with due authority/procedures.
- 5.6 The maintenance and support by the contractor shall consist of periodical preventive checks as per the maintenance schedule of compressor for trouble free operation of the equipment.
- 5.7 Contractor shall ensure that AMC maintenance schedule should match with the loco inspection schedules. i.e. IA, IB, IC, AOH/MOH, IOH, etc. The scope of maintenance by the contractor shall be largely as per preventive maintenance schedule of the equipment, but shall include out of course attentions including breakdown, if any required, to ensure trouble free operation of the locomotive.
- 5.8 AMC shall not cover the compressor failures due to circumstances such as fire in locomotives, accident, earth quake, floods etc. However, in such circumstances payment for spares to be replaced by the tenderer will be made extra as per the price list of OEM submitted along with their offer.
- 5.9 All maintenance activities shall be carried out as per the schedule given in this SMI by RDSO. In case of any abnormalities found during minor/major schedules, associated component/subassemblies shall be replaced/repared by the contractor. The activities to be covered under scope of work of AMC of compressors are given below:
- 5.10 **Activities and scope of work:**
- 5.10.1 **Schedule of works during IA Inspection**
- i) Check the abnormal sound and abnormal working during operation.
 - ii) Clean the compressor thoroughly.
 - iii) Check the oil levels in crank case and contamination levels, change if found contaminated or otherwise replenish with correct grade of oil if required.
 - iv) Drain the condensate from the intercooler, after cooler and the air receiver.
 - v) Check the tightness of mounting bolts and other fasteners.
 - vi) Breather should be dismantled and cleaned.
 - vii) Remove the oil filter assembly from crank case and clean the oil filter strainer as applicable.
 - viii) Clean the suction filters thoroughly.

5.10.2 **Schedule of works during IB Inspection**

The work carried out in IA inspection should be repeated in IB schedule. In addition, the following works are to be carried out:

- i) Open the crankcase side cover and check all the connecting rod nuts and the split pins as applicable.
- ii) All the pipe lines should be checked for leaks at the joints.

- iii) Check for the pressure building time as per RDSO Technical Circular No. RDSO/2012/EL/TC/0113, Rev.'0' dated 29.03.12 and if CP is taking more time to build up pressure, remove the valves from the cylinder head, dismantle and clean them thoroughly. Examine all the parts. Service and check all the valves according to procedure prescribed by the OEM and de-carbonize the inter-cooler and after-cooler as applicable.
- iv) Check the condition and setting of safety valve, if found disturbed or blown off, test & set them for correct operation and attend, service the safety valves. Test and set them for correct operation.
- v) Replace the oil filter and air filter element on condition basis during minor schedules as applicable.

5.10.3 **Schedule of works during IC Inspection**

The work carried out in IB inspection should be repeated in IC schedule. In addition, the following works are to be carried out:

- i) Drain the oil from the crankcase.
- ii) Run the compressor for 2-3 minutes and drain the oil while the compressor is in hot condition.
- ii) Remove the oil pump and the oil filter from the crankcase and remove fan and coupling and check for defects if any and replace the defective parts. Oil pump in case of compressor model 2A 320D of M/s. FTRTIL. The kit to be changed on condition basis. The pump kit is must change in IOH schedule (Only applicable to M/s FTRTIL make compressor).

5.10.4 **Schedule of works during TOH/MOH/IOH/POH schedule**

Following works are to be carried out in TOH/MOH/IOH/POH schedule:

- i) The compressor should be completely dismantled. All parts should be thoroughly cleaned by kerosene/ petrol, examined and attended in a clean surrounding.
- ii) Replace all the packings and rubber items.
- iii) Remove the valves from the cylinder head, dismantle and clean by kerosene/ petrol them thoroughly. Examine all the parts. Service and check all the valves according to procedure prescribed by the OEM.
- iv) De-carbonize the inter-cooler and after-cooler.
- v) Remove the motor portion from the compressor. Remove the rotor and the fan from the motor shaft. Drain the oil from the crankcase. Remove the oil pump and the oil filter from the crankcase. Remove the crankcase vent and the dipstick from the crankcase. Remove the pipe connectors at the suction and delivery ports of the cylinder heads. Now remove the shroud. (Only in case of Compressor Model 2A 320D of M/s. FTRTIL).
- vi) Inspect suction and delivery valves for pitting, wear and distortion. Spring plates should be checked for any sign of fatigue. Ensure that the locating pin is not worn out or bent or loose in valve seat. It is recommended to replace the valve plates and spring plates to avoid fracture due to fatigue. It is not recommended to recondition the valves, disc valve and concentric valves should be replaced.

- vii) De-carbonize and thoroughly clean the cylinder heads. Use new gasket and new spring washers below the nuts.
- viii) Remove the nuts fixing the cylinders to the crankcase. Examine the cylinder bores for any damage. Measure the bore diameter at the top, middle and bottom at two places 90° apart, as recommended by OEM. If the cylinder or piston is damaged replace the same.
- ix) Check the dimensions of the cylinders and pistons. If it is damaged or worn out beyond limits as recommended by OEM replace the same by a new one.
- x) Check connecting rods and mark the bearings for their condition and ensure that the oil holes are properly located and fully opened. Change the bearings if required as applicable.
- xi) Check for the play (shake) of piston on the connecting rod. If there is a small play, the small end bearing bush has to be replaced. Examine the gudgeon pin for damages or play, replace the same if required.
- xii) Measure the side clearance and gap. If the limits as recommended by OEM are reached the rings should be replaced.
- xiii) Check the bore size of the bearings and if it is worn out or exceeds the condemning limit as recommended by OEM, change the bearing as applicable.
- xiv) Check the oil pump for all worn out parts. All worn out or damaged parts should be replaced. Applicable to M/s FTRTIL make compressor.

5.11 **Running the compressor unit after major schedule (TOH/MOH/IOH/POH):**

(a) Without Cylinder Head:

- i) Remove top plug of the oil filter and fit oil pressure gauge as applicable.
- ii) Fill the crankcase with recommended oil.
- iii) Check that the unit is free to run by rotating the crank shaft for few times as applicable.
- iv) Run the compressor for few hours and ensure there is no any leakage of oil.

(b) With Cylinder Head:

- i) Assemble cylinder heads, shroud, shroud cover and connect manifolds, intercooler, after cooler air reservoir etc.
- ii) Initially run the unit without load for 15 minutes and then at rated pressure for 2 hours.
- iii) Check the oil pressure is steady and within recommended limits, in case of oil pump provided with the compressor.
- iv) Check for any air leakages in the pipe lines.
- v) Check that the current drawn by the motor is steady and within limits.
- vi) Ensure there is no over-heating, abnormal noise or vibration.

5.12 In addition to above, modifications/reliability improvement measures / instructions related to compressor issued by Railway Board/RDSO from time to time shall be considered as part of scope of AMC. The cost of such modification (material portion) will be borne by Railways. However, labour portion including provision & testing is to be done at free of cost by the

Contractor. Contractor will carry out the required modifications and inform Railways and RDSO.

- 5.13 Above schedule of works is for guideline. Railways may include any additional action/works deemed necessary to ensure proper maintenance.

5.14 Responsibilities of Railways:

- 5.14.1 The Railway authority shall permit the contractor to work on compressor fitted on conventional tap changer and 3-phase electric locomotives under preventive maintenance or break down.
- 5.14.2 Railways shall nominate the Officer/ Supervisor for supervision of the work done by the contractor under the contract.
- 5.14.3 The necessary space, electricity, and water connection shall be provided by Railway free of cost as required for at the nearest possible point of the site. In addition, a suitable covered lockable space to store the tools and tackles shall be provided free of cost by the IR to the contractor. However, there shall be no separate exclusive security systems for the space/facility provided to the contractor by Railway.
- 5.14.4 Railway shall mention the details of the locomotives including the locomotive nos. covered under AMC for the reference of both the parties. In case the base maintenance designated shed of the locomotive is shifted to any other location, than those specified in the scope, the scope of AMC shall accordingly shifted to new site/base.
- 5.14.5 Railways shall inform in advance the contractor regarding locomotives planned for scheduled repairs (i.e. IA/IB/IC/IC0/AOH/MOH/TOH/IOH/POH) so that contractor can also plan and carry out the activities as per scope of work of AMC.
- 5.14.6 Railways shall also inform the contractor regarding any line failures/breakdown of the locomotive and likely place (trip shed/ loco shed) and date where locomotive needs to be attended by the contractor.
- 5.14.7 The owning shed and the firm shall jointly arrive at the no. of locos that are under AMC at the start of every month and a record shall be kept for this purpose.

5.15 Responsibilities of Contractor

- 5.15.1 The contractor shall post adequate no. of qualified service engineers/backup engineers and arrange required materials exclusively for the execution of this contract at the designated shed/sheds with immediate effect.
- 5.15.2 Service Engineer shall carryout preventive maintenance on locos at all days and times including Sundays and Gazetted holidays depending upon availability of locomotive in the shed.
- 5.15.3 Normally Service engineer shall be available in the shed during normal working hours to attend breakdown calls/ preventive maintenance. A backup engineer shall be located at one of the contractor's office and shall be available at the designated shed if required to attend the complaints in case of absence of service engineer at the designated shed.
- 5.15.4 The service engineer nominated for the repair on the shed duty shall observe all safety and security rules prevailing at the place of work.
- 5.15.5 Firm shall make Joint Note along with shed staff for each and every line failure and shed detection cases duly indicating the root cause of failure and

corrective measures to be taken in the format as prescribed by RDSO. Investigation report in each case along with remedial action taken/to be taken shall be submitted to Railways & RDSO.

- 5.15.6 In case of any component of compressor found malfunctioning / behaving erratically showing fault intermittently or permanently, must be replaced by firm.
- 5.15.7 In some cases, the actual problem is not established and in these cases, loco is required to be escorted by the maintenance personnel. Hence, in such cases escorting of loco by the contractor's service engineer for finding the trouble to be included.
- 5.15.8 Firm service engineer should maintain compressor unit wise history of failure and other details and checks performed during the minor schedule in the form of check sheets which will be made as per RDSO guidelines and got approved from Railway Representative.
- 5.15.9 Scheduled work and testing if required should be carried out during the schedule and testing hours as specified by Railways.
- 5.15.10 After every attention to the compressor, contractor will give a report to the Railways giving details of activities carried out including details of components/sub-assemblies replaced.
- 5.15.11 The contractor shall quote the rates for comprehensive AMC (as specified in paragraph 5.1) considering both the break down & preventive maintenance (including spare materials, components, assemblies, labour, manpower, service, transportation etc.

5.16 PLACE OF WORK:

- 5.16.1 Minor schedule activities (IA/IB/IC/IC0) will be carried out at the home shed of the locomotive.
- 5.16.2 Major schedule activities (AOH/TOH/MOH/IOH) will be carried out at the home shed of the locomotive.
- 5.16.3 POH schedule activity will be carried out at the nominated workshop.
- 5.16.4 Breakdown maintenance will normally be carried out at the nearest trip shed/loco shed where loco is sent after failure. If the locomotive cannot be attended at out stations, locomotive may be called to home shed.

5.17 PENALTY CLAUSE FOR AMC:

- 5.17.1 As soon as failure of equipment under AMC takes place, the same shall be informed to Contractor by Shed/Railway authority. Contractor shall attend the defects as early as possible but not exceeding 24 hours after the placement of locomotive in shed/trip shed covered under contract mutually agreed among parties (Railways and contractors).
- 5.17.2 For smooth execution of AMC by contractor, Zonal Railways may include suitable penalty clause as special condition of contract for AMC. However sample penalty clauses are given as under for guidance of Zonal Railways.

5.17.3 **Downtime penalty for fleet of locomotives**

- a) Downtime on account of online failures of equipment under AMC shall be from the time the locomotive fails on line and reported to the contractor till the loco is given ready for service.
- b) The contractor shall ensure that during the billing period (three months), combined downtimes of all the locomotives covered under AMC, on account of out of course repair and online failures of equipment under AMC does not exceed 1.5% of total loco hours for the locomotives covered in the AMC. Penalty for Downtime for the fleet of the locomotive shall be as under:

Down time	Penalty
1.5 % or less	NIL
1.5% to 5%	2% of the total monthly proportional bill
5% to 10%	5% of the total monthly proportional bill
More than 10 %	10% of the total monthly proportional bill

5.17.4 **Downtime penalty for individual locomotive**

- a) Downtime on account of online failures of equipment under AMC shall be from the time the locomotive fails on line and reported to the contractor till the loco is given ready for service.
- b) The contractor shall ensure that during the billing period (three months), individual downtime of all the locomotives covered under AMC, on account of out of course repair and online failures of equipment under AMC does not exceed 5% of loco hours for the locomotive covered in the AMC. Penalty for Downtime of the individual locomotive shall be as under:

Individual Loco Down time	Penalty
5 % or less	NIL
> 5%	5% of the individual loco's monthly proportional bill

5.17.5 Overall liability in any case shall not exceed 10% of the contract value

6.0 Application to the Class of Locomotives:

In class of Electric locomotives fitted with 1750 LPM oil lubricated reciprocating compressors.

7.0 Agency of Implementation:

All Electric Loco Sheds & Electric Loco Workshops.

8.0 Periodicity of Implementation:

Minor schedule inspections (IA/IB/IC/ICO), MOH (AOH), IOH, POH overhauling schedules and any other unscheduled maintenance.

Encl: Nil

(Kishore Vaidya)
for Director General/Elect

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Encl: Nil

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