Reason Document for Technical Specification No. TS/ED/2016/80 0f February'2016					
S. No.	Clause No.	RDSO specification	Comments as received from M/s Medha vide email dt. 2 April'16	RDSO Remarks	Revised clause
1.	2.2	Refinement of an existing radial turbocharger to suit the upgraded ALCO 6 cylinder engine with a turbocharger OEM.	Scope of Work & Supply of Radial Turbocharger, Higher effectiveness after-cooler, Optimization of the combustion chamber and Optimized pistons to be considered as a separate Project/ Specification as these and CReDI suppliers are independent. In this CReDI specification, requesting to include the scope of Work and Supply related to CreDI project only.	Accepted, clause deleted	Clause deleted
2.	2.3	Optimization of the combustion chamber, injector nozzle hole geometry, spray angle and split Injection.		Accepted, clause deleted	Clause deleted
3.	2.4	Selection and development of a higher effectiveness after-cooler		Accepted, clause deleted	Clause deleted
4.	3.4	High pressure connectors from common rail to the injectors	High Pressure pipes are connected between common rail to injectors	Accepted, clause revised	High pressure pipes from common rail to the injectors
5.	3.7.2	Engine speed sensor	These items are already in Specification of Microprocessor Control System scope of supply. Hence these sensors can be made optional and vendor may decide to provide them if needed for their system functionality. However desired protection for Diesel Engine should be available in Locomotive either through Microprocessor system or CReDI.	Not accepted	No change
6.	3.7.4	Engine cooling water temperature sensor		Not accepted	No change
7.	3.7.5	Engine oil temperature sensor		Not accepted	No change
8.	3.11	Radial turbine state-of-the-art	Pls refer the Reason of Clause	Accepted, clause	Clause deleted

		turbocharger	No: 2.2 to 2.4	deleted	
9.	3.12	Optimized pistons — 8 nos.			
10.	3.13	Higher effectiveness after-cooler			
11.	3.14	All adaptation parts for fitment of the high pressure injectors, pumps, common rails, **turbocharger**, fuel headers, sensors etc.	Pls refer the Reason of Clause No: 2.2 to 2.4 for Turbocharger removal,	Accepted, clause revised	All adaptation parts for fitment of the high pressure injectors, pumps, common rails, fuel headers, sensors etc.
12.	4.4	**Mounting Arrangement:** The complete system including the Engine Management and high pressure fuel injection components, sensors and **set point generators,** interfaces, fuel supply system (low pressure stage), electronic components and transducers, turbocharger adaptation kit, higher effectiveness after-cooler shall be mounted on the engine or in the locomotive cab.	Pls specify in detail the meaning/requirement of **set point generators** in CReDI application.	Accepted, clause revised	**Mounting Arrangement:** The complete system including the Engine Control Unit, High Pressure Pump, Common Rail, Injectors etc. shall be mounted on the engine or in the locomotive cab.
13.	4.5.4	Vendor should provide design support for any design changes needed on the engine parts to use the CReDI fuel system. Fitting of camshaft/crankshaft speed and position sensors etc. shall not require any major design modifications. Sensors for pressure and **temperature measurements** shall be mounted on the existing **lube oil/ water/ air circuits** at suitable locations.	Pls refer the Reason of Clause No: 3.7.2 to 3.7.5 about Temperature Sensors.	Not Accepted	No change
14.	4.7	Redundancy. 100% redundancy is	Redundancy provided in CReDI	Not accepted	No change

		desired for the sensors and devices whose failure can lead to unsafe operation of the engine. For those sensors, where 100% redundancy has not been provided, a fail-safe, fall-back strategy shall be adopted for all likely failures. Failure of any single component sensor/ sub-system shall not lead to an avoidable complete shut down of the engine. Limp home capability shall be built-in.	system in case failure of Sensor/Component/Signals which are specified below. * Position Sensor. * Boost Air Sensor. * Lube Oil Sensor. (Shall be able to take the Lube oil signal from Microprocessor Control system through RS485 communication in case of sensor failure in CReDI). * Notch Signals. (Shall be able to take the Notch signals from Microprocessor Control system through RS485 communication in case of Notch signals failure in CReDI).		
15.	6.0	MAIN DESIGN OBJECTIVES. * Increase in specific power output.	Will the specific power output of Loco increase with CReDI How ? If not remove this point	Accepted, Clause revised	CReDI system should work on increased power output of the engine
16.	7.0	FUNCTIONAL REQUIREMENT OF CReDI FUEL INJECTION SYSTEM Since the CReDl fuel system uses electrical signals to control the start and end of fuel injection, the existing fuel rack mechanism in the locomotive diesel engine **becomes redundant**. Consequently, the engine governor and the over-speed trip mechanism also **become redundant.** The CReDl	For more clarity replaced **removed** in-place of **redundant**. Also removed the below functions. * **Hot engine protection:** This function is in Microprocessor Control System.	Accepted, clause revised (Hot engine protection is already available in microprocessor control system and limp home capability is not	FUNCTIONAL REQUIREMENT OF CReDI FUEL INJECTION SYSTEM Since the CReDl fuel system uses electrical signals to control the start and end of fuel injection, the existing

		fuel system has to therefore, take over the following existing functions of the engine governor and the over-speed trip mechanism: *** Hot engine protection** *** Limp home capability**		required ion shunting locomotives, hence removed)	fuel rack mechanism in the locomotive diesel engine **shall be removed**. Consequently, the engine governor and the over-speed trip mechanism shall also be **removed.** The CReDI fuel system has to therefore, take over the following existing functions of the engine governor and the over-speed trip mechanism: • Isochronous governing of engine speed • Engine load shedding as and when required • Low lube oil protection • Engine over speed protection • Acceleration control to reduce exhaust smoke • Engine shutdown wherever necessary

					•Engine idling wherever necessary
17.	7.6	CReDI fuel system shall have the ability to provide Higher Injection Pressures, Faster Switching times and a variable-rate-of-discharge curve modified to the engine operating state, change the injection timing while the engine is running, and take feedback from the Manifold air temperatures. In case the inlet manifold air temperature rises due to either higher ambient temperature or due to cooling system degradation, the ECU should be able to retard the injection timing to control NOx emissions. This is also required for optimisation of fuel injection timings for each operating point of the engine.	This Clause is specifying to use the Temperature Sensor. Pls explain in detail how this feature to be execute. Also include the items in Scope of supply if needed.	Accepted, it is not possible to measure the onboard NOx emission to correct the injection timing, hence deleted	Clause deleted
18.	7.7	The CReDl fuel system shall be able to map injection timings with respect to load, speed, boost air pressure, **boost air temperature and engine jacket temperature** to achieve the lowest fuel consumption (both under static and dynamic conditions), and shall have improved cold start ability.	In the first phase design/testing we can try to map the injection timings based on the Boost Air Pressure and Notch-wise. Further RDSO to suggest how the injection mapping to be done based on the Boost Air Temperature & Engine Jacket Temperature in second phase of design i.e in next revise/version of RDSO Specification.	Accepted, clause revised	The CReDl fuel system shall be able to map injection timings with respect to load, speed, boost air pressure to achieve the lowest fuel consumption (both under static and dynamic conditions), and shall have improved cold start ability.

19.	7.8	Automatic Low Idle: The CReDI fuel system shall be able to enter the low idle mode of the engine operation without the driver's intervention. When the driver brings the throttle handle to IDLE, the engine speed shall drop to the specified rpm. After a small time delay, CReDl fuel system shall reduce the engine speed at a predetermined rate. While it is reducing the engine speed, it will keep a watch on the engine lube oil pressure and the loco main reservoir pressure. When either of these two pressures reaches a predetermined minimum level, the CReDI fuel system will stop reducing the engine speed further. From this point on-wards it will keep adjusting the engine speed in a manner that will ensure that the above-mentioned two pressures never touch their minimum levels. Whenever the driver moves the throttle handle to first notch, the engine speed shall be raised to the first notch speed rapidly by the CReDl fuel System.	This function is taken care by Microprocessor Control System, but the execution of engine low idle RPM is done by CReDI by sensing the Notch input Signal combination of “A” & “D”.	Accepted, clause unchanged	No change
20.	7.9	Closed Loop Hot Engine Load Shedding: During the summer months the diesel locomotives are subjected to high ambient temperatures, which bring down the efficiency and heat dissipating capacity of the radiator	This function is taken care by Microprocessor Control System as it control the Excitation. Hence this point to be removed.	Accepted, Hot engine protection is already available with microprocessor	Clause deleted

		panels and a hot engine alarm results. The CReDl fuel system shall monitor the engine water temperature and whenever it starts approaching the upper limit it shall gradually reduce the power output of the engine without reducing the engine speed. This will result in decreased heat production by the engine. On the other hand the cooling capacity of the radiator shall remain at its maximum, as the radiator fan and the water pump (which are engine driven) shall continue to run at their maximal rated speed. The engine water temperature shall not be allowed to exceed its maximum limit. The power from the engine shall be restored back to its normal value gradually, as it cools down.		control system of the locomotive, hence clause deleted	
21.	7.11	Limp Home Capability: The system shall be designed in such a way that if there is failure of any component or subsystem of the CReDl fuel system, it shall be possible to run the locomotive at a reduced level of efficiency or power or functional capability.	This is already covered in Clause No: 4.7 & 7.0. Pls refer the Reason given the Clause.	No change	No change
22.	7.13	Diagnostics: The CReDl fuel system shall have built-in diagnostics. It shall run a full self- diagnostic on every power-on. In addition, it shall also run diagnostics at regular intervals, even	CReDI ECU is provided with Display for displaying of Engine parameters, Fault and Status messages. Hence the indication in the clause to be replaced with	Accepted, clause revised	Diagnostics: The CReDl fuel system shall have built-in diagnostics. It shall run a full self-

		while the engine is in operation. This operation shall be transparent, and should not affect the normal working of the system. All faults shall be logged for later downloading to a PC by the maintenance staff. **Major fault conditions shall be indicated by a suitable indicator mounted on the controller itself**. This is to help the driver in the field where a PC is not available. At a specified and alterable frequency, even in no fault condition, the data should be logged and recoverable for analysis or other use later.	displaying.		diagnostic on every power-on. In addition, it shall also run diagnostics at regular intervals, even while the engine is in operation. This operation shall be transparent, and should not affect the normal working of the system. All faults shall be logged for later downloading to a PC by the maintenance staff. **Major fault conditions shall displaying by a suitable indicator mounted on the controller itself**. This is to help the driver in the field where a PC is not available. At a speci¿ed and alterable frequency, even in no fault condition, the data should be logged and recoverable for analysis or other use later.

23.	7.16	Turbocharger	Pls refer the Reason of Clause No: 2.2 to 2.4	Accepted, clause deleted	Clause deleted
24.	7.17	Higher-effectiveness after-cooler			
25.	7.18	Optimised Piston			
26.	8.0	CReDI FUEL SYSTEM FOR ALCO DLW 6 inline configuration Layout and Performance data are as given below: Sensors and Pickups: One rail pressure sensor, **one engine rpm** and TDC pickup, lube oil and boost air pressure sensor	In CReDI, Position Sensor is used for TDC setting and for measuring the Engine RPM. Hence separate Engine rpm sensor is not required.	No change	No change
27.	10	Dimensional drawing for fitment of radial turbocharger on the 6 cylinder ALCO engine	Pls refer the Reason of Clause No: 2.2 to 2.4	Accepted, clause deleted	Deleted