

Reference __

Specification: _____ **S-5174**
Fleet: _____ **RRD - Silverliner IV**
System: _____ **Real Time Monitoring**
Latest Revision Date: _____

AGENDA and REVISIONS
SEPTA
TECHNICAL SPECIFICATION

<u>Change No</u>	<u>Release Date</u>	<u>Reason for Issue</u>	<u>Release Approval</u>
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1.0 PURPOSE AND SCOPE OF SPECIFICATION

This Specification provides the general description and performance criteria for a real time condition based remote monitoring system. The service performed by the bidder and the resulting end item, shall comply with all specifications, standards, codes, regulations, and procedures for the type of equipment and its application specified.

There are 225 cars in the SLIV Fleet. Each car has systems that need to be condition based monitored and displayed in real time via a web page view that is available to view from the internet. The contractor shall supply 10 percent spare hardware as part of this contract.

The mechanical desk in SEPTA's control center shall be able to use the system to see Active Faults across the entire fleet or look at a single vehicle. They shall be able to determine if a vehicle needs to be removed from service by looking at active faults, real time data and historical data. An employee working at an outlying point such as Doylestown Yard shall be able to use the system on a smart device and see the trains in the yard and determine if there are faults or conditions that need to be checked before leaving their office. The system shall report important faults and conditions via email and text message.

The qualified Contractor shall supply hardware within 90 days of SEPTA approval to test the real time condition based monitoring system on 3 prototype cars. The real time condition based monitoring system shall be tested for up to 6 months. If there is a failure, a failure analysis report and corrective action shall be submitted to SEPTA. Upon successful completion of the tests, the Contractor shall deliver the hardware for the remaining systems for the SLIV fleet within 12 months after the issue of Notice to Proceed(NTP).

2.0 QUALIFICATIONS

In order to qualify for this project, a Contractor must be able to furnish proof of prior Railroad experience performing work of a similar nature within 14 days of written notification to do so by the Southeastern Pennsylvania Transportation Authority.

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3.0 DESIGN REQUIREMENTS

The real time condition based remote monitoring system shall have the capability to monitor a minimum of 32 Digital Inputs and 32 Analog Inputs. Each digital input shall be able to monitor signals that utilize voltages 0-48VDC. A digital Input shall record and display a 1 to show that the input is on when the voltage is 24-48VDC. A digital input shall not display a 1 when voltage is lower than 24VDC. Each analog Input shall record and display the analog value. These signals are raw signals and will need conditioning by the Contractor. The system shall either be able to handle the raw signal or condition the signal externally.

The system shall display all vehicle locations using google maps in real-time and in historical view. Any vehicle shall be able to be selected and show real time operational information, indications and active faults. Any vehicle shall be able to be selected and show historical operational information, indications and faults. The data shall be able to be reviewed for any vehicle in table form and graphical view in the form of a chart in real time or historical data for a minimum time period of 1 month. The data shall be able to be filtered and sorted to show results in different order in table and graphical chart form. The configuration of the parameters shall be user specific and shall be able to be setup by each users preferences.

3.1 CELLULAR CONNECTION

The system shall utilize the SEPTA Digi Router that already exists on the train for cellular connection. The system shall connect to the DIGI Router with 50ft ethernet cables with M12 X Code connectors provided by the Contractor. The system shall be capable of using port forwarding and NAT configuration.

The system shall be able to be viewed remotely through cellular or locally by plugging into the system on the train using a Mozilla Firefox, Google Chrome, or Microsoft Edge web page. The system shall be able to be viewed using any smart device such as a laptop computer, tablet and smart phone.

The web view and recording sample/refresh rate shall be ≤ 1 second, however, the sample/refresh rate shall be determined during review of the design and agreed upon by SEPTA during testing.

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3.2 System Inputs

Digital Inputs Signals (24-48VDC-Nominal 37.5V Battery System)

- | | |
|---------------------|--|
| 1. FWD TL | Forward Direction |
| 2. REV TL | Reverse Direction |
| 3. Switch | Power Position 1 |
| 4. P1 | Power Position 2 |
| 5. P2 | Power Position 3 |
| 6. P3 | Power Position 4 |
| 7. A1 | A Winding (A1) |
| 8. A2 | C Winding (A2) |
| 9. A3 | B Winding (A3) |
| 10. AM1,2 | AM1, AM2 Contactor |
| 11. AM3,4 | AM3, AM4 Contactor |
| 12. PC Relay | Motor Amps – PC Relay |
| 13. EM BRK | Emergency Brake |
| 14. DYN. BRK | Dynamic Brake |
| 15. CAM POS 20 | CAM is in Position 20 |
| 16. CAM POS 17 | CAM is in Position 17 |
| 17. CAM POS 1-17 | CAM is in Position 1-17 |
| 18. CAM POS 1 | CAM is in Position 1 |
| 19. B1, B2 | Brake Control – BCR |
| 20. P1, P2 | P1 and P2 Relays are Picked Up |
| 21. WSR1 | Wheel Slip Relay 1 |
| 22. WSR2 | Wheel Slip Relay 2 |
| 23. DBOR | Dynamic Brake Out Indicator on local Car |
| 24. Failed Blowers | Fault for Failed Blowers |
| 25. XFMR OL | Fault for Transformer Overload |
| 26. XFMR COOLING | Fault for Transformer Cooling |
| 27. IG/SCR Overheat | Fault for Ignitron/SCR Overheat |
| 28. IG/SCR Overheat | Fault for Ignitron SCR Overheat |
| 29. Motor OL | Fault for Motor Overload |
| 30. A1,2,3 OL | Fault for A1,A2,A3 AC Overload |
| 31. GND | Fault for GND – GR Relay Picked Up |
| 32. NO Power | Fault for No Power |

Note: All of these signals currently exist on the train and no sensors or wiring are needed to connect. SEPTA will connect these signals.

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Analog Input Signals (These are Raw Signals and will need conditioning)

1. Primary Current
2. Motor Current 1,2 CMRX1-Traction Motor 1,2 Current
3. Motor Current 3,4 CMRX2-Traction Motor 3,4 Current
4. MA Volts Motor Alternator Voltage(230VAC)
5. MA Frequency Motor Alternator Frequency(60Hz)
6. SS1 Speed Sensor Axle 1
7. SS2 Speed Sensor Axle 2
8. SS3 Speed Sensor Axle 3
9. SS4 Speed Sensor Axle 4

10. MSX Temperature Main Smoothing Reactor Temperature-K Type Thermocouple
 The contractor shall supply a K type Thermocouple that will connect to the system 100ft wire and a welded end.

11. Thermal Wire Thermal Wire Voltage(Existing on Train 0-48VDC)
12. Brake Cylinder Pressure (0-10V Existing Transducer)
13. F Cab Active 0-48VDC Signal – F Cab Active if Voltage >24VDC
14. R Cab Active 0-48VDC Signal – R Cab Active if Voltage >24VDC

The Contractor shall supply an Accelerometer and wiring to connect to the system.

15. Accelerometer X-Axis
16. Accelerometer Y-Axis
17. Accelerometer Z-Axis

The system shall be able to receive GPS system data from the existing DIGI Router ethernet connection.

GPS shall be utilized to determine wheel size correction for SS1, SS2, SS3, SS4. When GPS location and speed is not available, the system shall use speed sensor inputs to determine actual speed and location.

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3.3 Graphical Display

A graphical display screen resembling the Performance Fault & Indication(PF&I) Panel on the train shall be displayed by the real time condition based remote monitoring system. The screen shall be able to be selected and monitored in real time or to play back recorded events.



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3.4 Conditions for Monitoring and Alerts

Conditions		Action
[DBOR Indication Active + Speed ≥ 30 mph + Brake Cylinder ≥ 10 PSI + B1, B2 Active + No other Active Faults] for ≥ 10 seconds = Dynamic Brake Failure Fault	Dynamic Brake Failure Fault	Log Fault/Send Alert
Monitor Smoothing Reactor Temperature with thermocouple input. If the thermocouple exceeds a 165 degrees it is a fault.	Smoothing Reactor Temp	Log Fault/Send Alert
Monitor Thermal Wire Circuit for voltage above 24VDC	"Over Temperature Light" Fault	Log Fault/Send Alert
Count Wheel Slips for WSR1 and WSR2	Counter	N/A
Use Speed sensor inputs to Monitor Wheel Slip/slide for excessive wheel slip/slide	Wheel Slip Fault	Log Fault
Use SS1, SS2, SS3, SS4 to determine locked axle	Locked Axle Fault	Log Fault/Send Alert
Use speed sensor inputs to identify hot spots on the track for slip/slide. Use location to pinpoint where slip/slide hotspots are by comparing all trains slip/slide locations. If set amount slip and/or slides occur in the same general location it is slipper rail	Slippery Rail Fault	Log Fault/Send Alert
Monitor Motor Current and compare Motor Current 1, 2 & 3, 4. If they differ by more than 20% while above 100amps current it is a fault.	Motor Current Comparative Fault	Log Fault
MA Frequency ≤ 59.5 Hz or ≥ 60.5 Hz – Monitor 230VAC and wait 2 minutes after startup to check frequency. Recheck 230VAC to verify MA is not shutting down before declaring fault.	MA Frequency Fault	Log Fault
XFMR OL	Transformer OL Fault	Log Fault/Send Alert
Use Accelerometer to determine Emergency Brake Rate	Emergency Brake Rate	Log Information
Use Accelerometer to determine Hard coupling	Hard Coupling Fault	Log Fault
Use Accelerometer to determine Ride quality issues such as underinflated bellows.	Rough Ride Fault	Log Fault
All Faults shall be Logged	Log Fault	Log Fault
Customizable number of faults over time period alerts for all faults	Log Fault	Log Fault
Resettable Counter for DBOL, Failed Blower, No Power -Record Time when Fault Occurs and time when fault clears	Report Information	Log Information

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3.5 Mechanical

The design is preferred to fit in Length=8" X Width=8" Height=8" Footprint. The design can have multiple modules that make up the system. The enclosure or enclosures shall have a minimum Ingress Protection of IP62 rating. The module(s) and hardware shall have protection against corrosion that shall protect for minimum of 30 years.

3.6 Electrical

The monitoring system shall be powered from the vehicle battery system. The vehicle battery system voltage operates between 24 and 48VDC. The monitoring system is not required to operate when voltage goes below 24VDC, however, it shall not be damaged. The monitoring system shall be keyed for all connections and prevent damage from all reverse polarity connection. The monitoring system shall also have protection to prevent damage from overvoltage and transient voltages. The monitoring system inputs shall not be damaged by short circuit, reverse polarity and circuit loading. All real time condition based remote monitoring system connections shall not influence the vehicle by loading a circuit or otherwise adversely affecting the vehicle. All LED Indicators and lights shall meet or exceed 60,000 hours of operation unless approved by SEPTA.

3.7 Environmental

The system shall be designed to operate in the conditions for the climate in the Philadelphia Region. The system shall be able to operate in the vehicle from -10 degrees F ambient to 170 degrees F.

3.8 Software

The system shall be able to be viewed from the internet using a web browser. All licenses, cabling for all software shall be included and last the duration of the service contract. There shall be an unlimited number of licenses included in the service contract if the licenses are user specific. The cost escalation of the service contract shall only increase a maximum of 5% annually.

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3.9 Wiring

All wiring shall conform to SEPTA's Specification MS-0023 (latest revision). All wiring shall be permanently identified with its wire number and/or designation at the terminal ends.

- Each identification label shall be cross-linked, semi-rigid, fluid-resistant, shrinkable polyolefin material of a Military grade with a shrink ratio of 3 to 1, printed in bold print of high contrast for easy readability.
- All wiring must be of a length which will allow at least three additional terminations. This added length shall be stored in a service loop which must be done in a professional manner which reflects an organized, systematic approach.
- No wiring shall be under undue tension or load. Strain reliefs shall be used where applicable.
- Wire replacement shall be done from terminal board to terminal board. No splices shall be made or allowed.
- Multiconductor cable shall meet the above requirements for single conductors. Outer jacket material shall be crosslinked irradiated polyolefin.

3.10 Fire Safety

All materials used in the construction shall have the highest degree of fire resistance and lowest smoke emission. Engineer approved, independent laboratory certification is required for all materials including successful compliance with these requirements. The contractor will be responsible for complete conformance with these standards, including its subcontractors and suppliers.

As a minimum, all materials used in the construction shall meet the requirements of the CFR 238 and US Department of Transportation's "Recommended Fire safety Practices for Rail Passenger Car latest issue of that document.

Should a conflict exist between CFR 238, the USDOT document and the detailed requirements below, the more restrictive requirements shall govern. Independent laboratory certification is required for all materials to show successful compliance with these test requirements.

Materials not previously approved for use in passenger vehicles shall be tested to demonstrate compliance with the requirements.

Those materials and products generally recognized to have high toxic products of combustion shall not be used.

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4.0 Prototype Installation

On site support for the prototype installations shall be required upon delivery of the prototype units. The contractor shall write a work instruction to document how the real time condition based remote monitoring system interfaces with the vehicle.

5.0 Testing

The prototype real time condition based monitoring systems shall be tested for up to 6 months. The contractor shall provide on site support for the initial commissioning testing of the system. The contractor shall work with SEPTA during the testing phase to build and tune the system to a user friendly system that flags conditions that important. All nuisance faults and condition shall be eliminated prior to installation on the fleet. The graphical display of the PF&I panel shall be tested to update and show correct information as it is happening on the vehicle as well as historical information.

6.0 Training

Upon delivery of the first real time condition based remote monitoring system, the contractor shall provide on-site training for the operation and maintenance of the system. Pre-recorded training modules or training over Microsoft Teams may be acceptable if approved by SEPTA. Subjects covered shall include an overview and familiarization, operation, and PTU (laptop) training.

7.0 Manuals

The Contractor shall provide an operators manual that describes the details of how to use the system.

8.0 Shipping

All costs of shipping the parts that make up the system to SEPTA shall be the responsibility of the Contractor. All Warranty repairs from SEPTA to the Contractor and return to SEPTA shall be the responsibility of the Contractor.

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9.0 Warranty

All equipment supplied under this contract shall come with a 2 year warranty covering all parts and labor. If 10% of any module, or component fail during the warranty period, it will be considered a system defect. A System defect will need to be resolved by redesign and/or component replacement of all affected modules or components.