

**TN# - RSS-801**

Rev 10 – May 2010

Vehicle Radiation Detection Systems – Installation Issues**CONFIDENTIAL****1. DETECTOR Orientation.**

In the "old days" it was common to use Horizontal detector locations and this was due to 2 main factors. The relatively slow 1/sec sampling time of the system made it preferable to get more data from the passing truck if the longer detector dimension was parallel to the truck direction so it was slightly less susceptible to vehicle speed. In addition, the technical assumptions based on testing at that time was that a worst-case deeply buried source scattered so much that a large "cloud" of low level radiation was created. In this case EITHER Horizontal or Vertical detector positioning gave the same result because the "cloud" was much bigger than the detectors, but for speed reasons a Horizontal mount was preferred.

However the new RSI technology has no timing limitations as it samples at 10/sec and new risk assessment shows that deeply buried sources that are significantly decayed due to half-life are substantially smaller targets than previously believed, so better **GEOMETRIC** coupling to the vehicle is a significant benefit. For these reasons a **VERTICAL** mount is a significantly better choice to optimize this detector to truck coupling.

2. 2 Vs 3 Vs 4 PMT /scintillator selection

In RSI systems we use 2 detector lengths 48" and 72". 3 detector sizes are used - the **1512 cu ins** (48" long scintillator) – the **3024 cu ins** (48" long scintillator) and the new RSI detector of **4698 cu ins** (72" long scintillator).

2PMT systems - RSI has made significant technical improvements over older systems in the 2PMT **RS-200** system with 48" scintillator, designed for the Scrap user. By using big slab detectors, large enhanced PMTs and fully digital electronics - the RS-200 systems are probably the technological equivalent of the Exploranium GR-526 or AT-900 detectors but of course the signal processing discussed below makes them significantly out perform these older units.

3PMT systems – the **RS-300** system uses the same detector VOLUME as most older systems = 3000 cu in, but use a single slab PVT detector using **3 PMTs**. This unique approach offers 10-20% improvement over older technology systems.

4PMT systems - RSI full system testing shows that there are substantial benefits regarding the use of 4 PMTs, certainly on the longer detectors where signal loss over the long detector length causes signal loss. Even on the smaller detectors we see substantial improvements in the spectral shape which makes our spectral analysis more accurate. In addition the better signal processing offers some significant improvements in absolute count rates. We are seeing typically a **10% improvement** on the 48" detectors and **25%+** over the longer detectors.

In principle it is possible to add 4PMT technology to smaller detectors for signal optimization. While this would be an advantage in system count rate and therefore overall performance, the PVT detector size would have to significantly reduce in order to maintain the same detector box size as older detectors, which removes much of the performance improvement. In addition most users would see a reduction in detector volume as a negative and, even if this loss was offset by count rate improvements, would be difficult to accept. For this reason 4PMT technology is only offered on the RS-400 systems used in new installations where box size limitations are not a limiting factor. Another factor in support of 4PMT technology is that in the event of a PMT hardware failure, since the electronics are fully duplicated a 1 PMT loss has a relatively minor effect so major components can fail but the system can still function at a high level of performance until repairs can be facilitated.

A final benefit is that all PVT detectors "age" with time, some faster than others. The net effect of this aging is that the detector "yellows" thus significantly attenuating the low level scattered radiation that is so important to high performance detection systems. With PMTs at BOTH ends, clearly this attenuation affect is significantly reduced thus effectively extending detector life, so once again the RS-400 technology has an advantage

3. **Truck SIZE**

In most scales a mix of LO and HI trucks are common.

- LO trucks are classified as a 4-5ft trailer deck height and 5-6ft of scrap loading
- HI trucks are classified as a 4-5ft trailer deck height and 8-9ft of scrap loading

Radiation analysis optimization is determined largely by scrap target size, so when in doubt the system should be scaled for HI trucks as the worst case scenario.

4. **Railcar SIZE**

Railcars normally come in 2 basic categories for detector sizing purposes:

- Standard = 3.5ft rail deck bottom height + 5-6 ft of scrap loading
- High Gondola = 3.5ft rail deck bottom height + 12-13ft of scrap loading

Radiation analysis optimization is determined by scrap target size, so if High Gondola cars are used the system must be scaled properly.

5. **OVERHEAD Detectors**

In almost ALL vehicle or railcar applications, an OVERHEAD detector is **highly recommended**. Even if the upper detector is relatively high up from the scrap there are usually significant benefits, as the source radiation signal is NOT shielded by vehicle walls so an "easier" target. In most truck applications a 14-15ft high overhead detector is practical and at this height there are very substantial benefits. A 17ft high detector is usually only practical for all Rail applications including Hi-Gondola for clearance reasons. The overhead detector installation does not need the same amount of shielding so usually 1" is fine.

6. **SPEED Restrictions**

All radiation detection systems are speed limited. If a vehicle passes above a certain speed limit then system sensitivity and detection capability are seriously limited. Most RSI systems should be operated at a recommended transit speed of **3mph** with a **MAX of 5mph** for best performance. However many users find these speeds restrictive, the solution is more detector because Speed and Sensitivity are essentially directly related. Double the speed = Double the detectors. RSI can offer **a dual width detector system** that can then tolerate transit speeds of **6mph** with a **MAX of 10mph** for best performance. An alternative is to stack the detectors horizontally

7. **TYPICAL Installations**

Since all scales handle a wide variety of vehicle sizes, detector sizing to handle the large trucks is recommended as if the system works well for LARGE trucks it is also optimized for SMALL trucks

There are a variety of options as shown depending on local logistics, the following sketches shows some options

Many users prefer the RS-300 systems as they fit older detector mounts but the higher performance RS-400 are usually recommended for difficult logistics

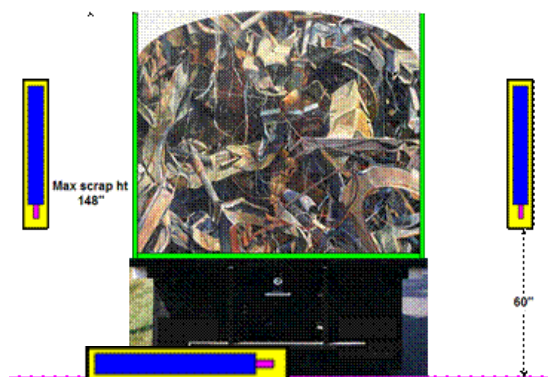
TRUCKS

a) RS-300/6000 – 2 detectors

Suitable for :

- Mix of HI and LO truck heights
- max scrap height off the road base of 148"
- Typically the side detectors are 60" off the ground
- 3-5mph operation

This installation uses the **SHORT RSI** detector systems with **3PMT technology**.



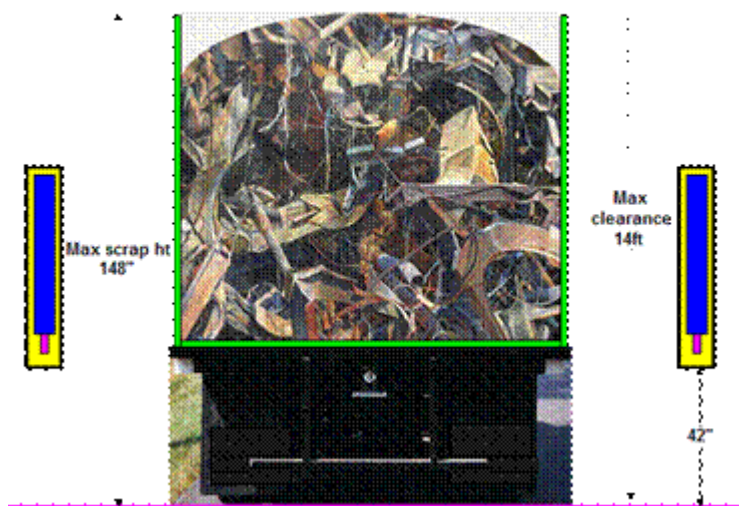
b) IF OVERHEAD is permitted

RS-300/9000 – 3 detectors

Suitable for :

- Mix of HI and LO truck heights
- max scrap height off the road base of 148"
- Typically the side detectors are 42" off the ground and overhead is 14ft clearance
- 3-5mph operation

This installation uses the **SHORT RSI** detector systems with **3PMT technology**.



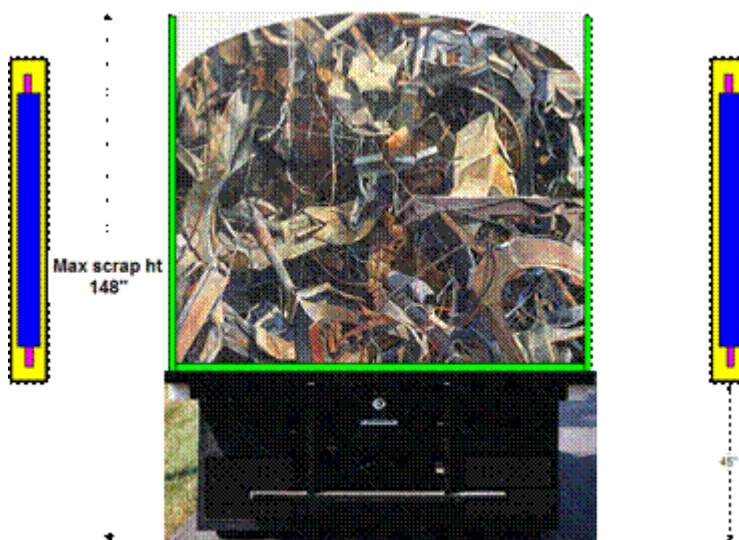
c) IF OVERHEAD is NOT permitted

RS-400/10000 – 2 detectors

Suitable for :

- Mix of HI and LO truck heights
- max scrap height off the road base of 148"
- Typically the side detectors are mounted 45" above ground level
- 3-5mph operation

This installation uses the **LONG RSI** detector systems with full **4PMT technology**.

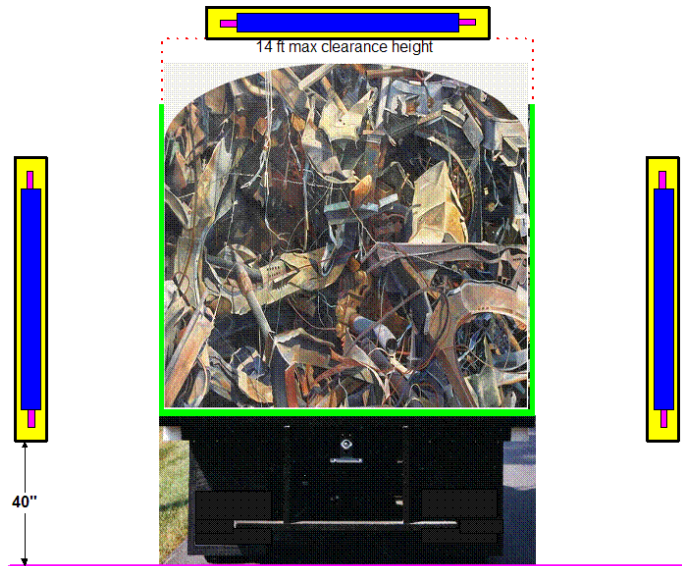


d) RS-400/15000 – 3 detectors including 1 overhead

Suitable for :

- Mix of HI and LO truck heights
- max scrap height off the road base of 148"
- Typically the side detectors are 40" off the ground and overhead is 14ft clearance
- 3-5mph operation

This installation uses the **LONG RSI** detector systems with full **4PMT technology**.



NORMAL - RAIL

e) RS-300/6000 – 2 detectors

Suitable for :

- LO rail cars
- max scrap height off the road base of 135"
- Typically the side detectors are 48" off the ground
- 3-5mph operation

This installation uses the **SHORT RSI** detector systems with **3PMT technology**.

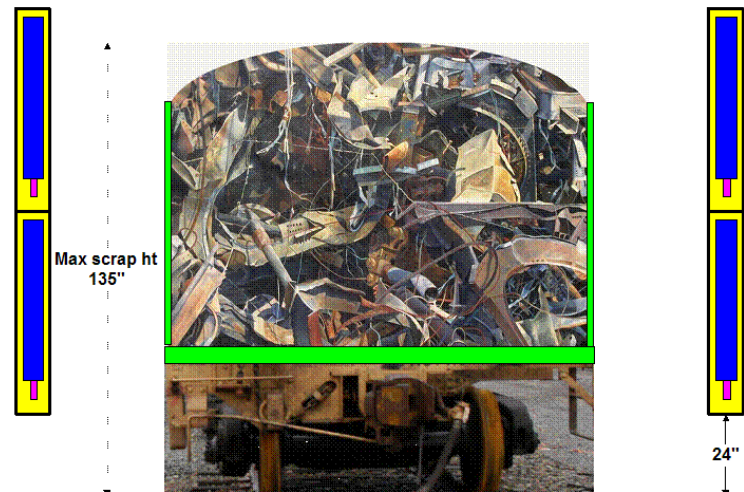


**i) IF OVERHEAD is NOT permitted
RS-300/12000 – 4 detectors**

Suitable for :

- LO rail cars
- max scrap height off the road base of 135"
- Typically the side detectors are 24" off the ground
- 3-5mph operation

This installation uses the **LONG RSI** detector systems with full **4PMT technology**.

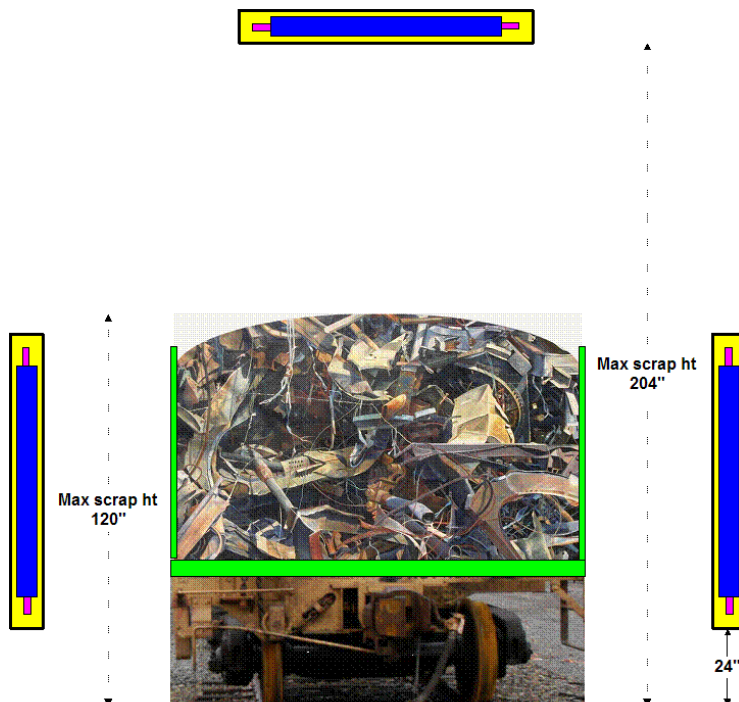


h) IF OVERHEAD is permitted
RS-400/15000 – 3 detectors including 1 overhead

Suitable for :

- LO rail cars
- max scrap height off the road base of 135"
- Typically the side detectors are 20" off the ground and overhead is 14ft clearance
- 3-5mph operation

This installation uses the **LONG RSI** detector systems with full **4PMT technology**.



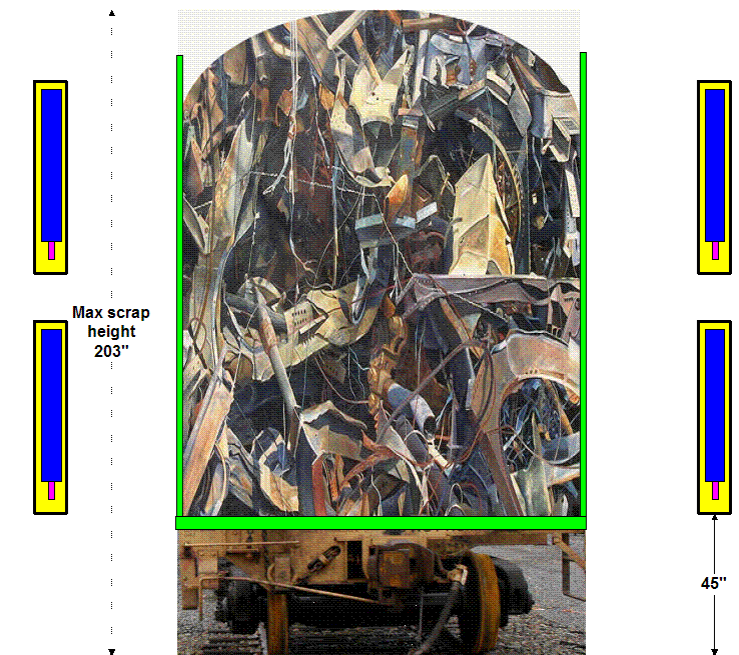
HI-RAIL (Gondola)

j) RS-300/12000 – 4 detectors

Suitable for :

- Hi-sided rail cars
- max scrap height off the road base of 203"
- Typically the side detectors are 45" off the ground
- 3-5mph operation

This installation uses the **SHORT RSI** detector systems with **3PMT technology**.



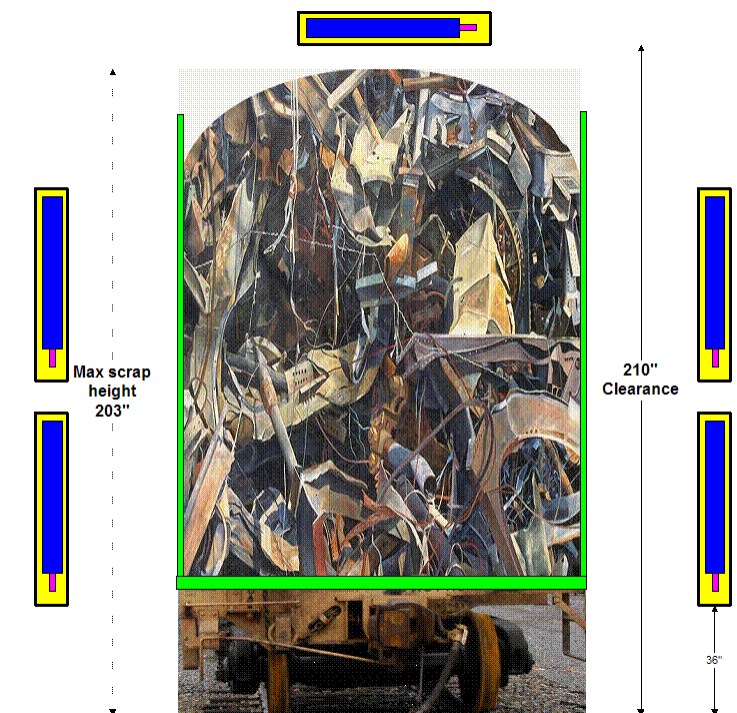
IF OVERHEAD is permitted

k) RS-300/15000 – 5 detectors

Suitable for :

- Hi-sided rail cars
- max scrap height off the road base of 203"
- Typically the side detectors are 36" off the ground and overhead is 17.5ft clearance
- 3-5mph operation

This installation uses the **SHORT RSI** detector systems with **3PMT technology**.



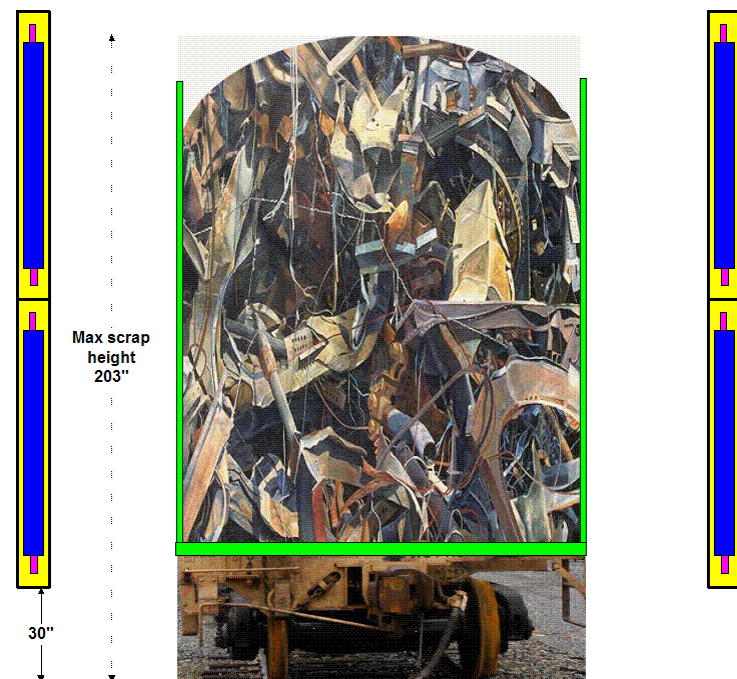
IF OVERHEAD is NOT permitted

l) RS-400/20000 – 4 detectors

Suitable for :

- Hi-sided rail cars
- max scrap height off the road base of 203"
- Typically the side detectors are 30" off the ground
- 3-5mph operation

This installation uses the **LONG RSI** detector systems with full **4PMT technology**.



SUMMARY

The above data is supplied to try to best explain many of the competing factors that affect system selection and deployment and is intended as a guide only. We strongly recommend that RSI be consulted prior to system selection to ensure that the correct system is selected for the application and the customer fully understands the trade-offs involved