Radiation Detection for a Safer World

The Ludlum 4525-4400

Gate Monitor Test Report **January 2009**

Comparison Testing Between Exploranium & Ludlum Gate Monitoring Systems

1.0 Introduction

Ludlum engineers were allowed to perform comparison testing between Exploranium and Ludlum gate monitoring systems in Illinois, Texas and Mexico. All tests revealed similar results. This report presents the results of one of these tests between an Exploranium GR-526 dual panel system at what is called Site A and a similar dual panel Ludlum Model 4525-4400 system at Site B. This test was performed in a strictly professional and scientific manner using radiation sources, a Ludlum Model 19 uR meter, metal scrap, a truck and gate monitoring systems all owned by one undisclosed US-based company. Ludlum certifies that this report accurately presents the conditions under which the test was performed and the results.

2.0 Test Conditions

Two radioactive sources were used to conduct these tests. The first was a 3'foot piece of NORM pipe with a hot spot, reading 140 μR/hr at contact and 1 μR/hr at 3'. One of the yard managers stated that catching this type of NORM pipe was the reason that they had purchased a gate monitoring system. The second was a 10 μCi Cs-137 check source, reading about 1500 μR/hr at contact, and 5 μR/hr at 3'.

All tests were performed using a 25 yard roll-off truck, loaded about half-full with scrap pieces of guardrail. Speed was kept down to approximately 3 mph. Pieces of duct tape were used to mark exactly where the radiation source was placed, so that the test could be consistent.

Ludlum System at Site B

Testing was first performed at Site A with the previously installed Exploranium GR-526 system. The customer at Site A reported they were very happy with this system. No details of the system were available. Close inspection did reveal three advantages at Site A over Site B for background level, detector distance, and detector height as noted separately below:

1. Background radiation measurements taken around the Site A system revealed a lower background of 5 μR/hr than at the Site B where it was 8 μR/hr. This reduced background, which may not seem like much, gives an approximate 25% advantage to the Exploranium system operating with the lower background. If you use the analogy of "listening" for radiation, then it's like listening in a noisy room versus listening in a

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quiet room. The radiation background level does vary in the United States from about 5 to 15 μR/hr, and its advantage should not be discounted.

2. Detector Distance between the two detectors for the Exploranium system was only 13.5', whereas the Ludlum system was set to 14.5'. This results in a clearance of 2.5' between detector and trailer, instead of 3'. Reduced clearance means more broken mirrors and greater chances of damage, but it does increase sensitivity. The difference in sensitivity is not much with sources hidden deep in the load, but if the source is at the edge of the trailer, the sensitivity increase is 44%.

3. Detector Height. The Exploranium system has detectors placed horizontally, covering from about 6' to 9' above the ground. This arrangement provides increased sensitivity for big trucks, but would obviously be a disadvantage for smaller vehicles and flatbed trailers. The Ludlum system had its detector placed vertically, in order to have more coverage of short and tall loads. Had this test used a shorter trailer, the Ludlum system would have had a great advantage.

Picture of scrap inside rolloff trailer with duct-taped source in position 5 (Check Srce #3)

Table 1 Comparative Sensitivity Testing

	Pipe #1	Pipe #2	Check Src #1	Check Src #2	Check Src #3	Check Src #4	Check Srce #5	Check Src #6	TOTAL
Ludlum System	Miss	Hit	Hit	Hit	Miss	Hit	Miss	Hit	5 of 8
Exploranium System	Miss	Miss	Miss	Hit	Miss	Hit	Hit	Miss	3 of 8

Description of Passes:

Pipe #1- 140 μR/hr pipe placed 1'from the inside wall of the trailer
Pipe #2- 140 μR/hr pipe placed against the inside wall of the trailer
CheckSrc #1- 10 μCi source placed 2.25' from the inside wall-down within the scrap
CheckSrc #2- 10 μCi source placed 1' from the inside wall-on top of scrap
CheckSrc #3- 10 μCi source placed 3.5' from the inside wall-on top of scrap
CheckSrc #4- 10 μCi source placed 2.5' from the inside wall-on top of scrap
CheckSrc #5- 10 μCi source placed 3.2' from the inside wall-on top of scrap
CheckSrc #6- 10 μCi source placed 3.5' from the inside wall-covered with 1/8" plate

As the results indicate, the Ludlum system caught the source in 63% of the passes, and the Exploranium caught the source only 38% of the time. Since a total of only 8 passes were made with each system, the results are not totally reliable and conclusive. But they certainly point to the less costly Ludlum system being as sensitive or more sensitive than the Exploranium system. In addition, the NORM pipe, reading 140 μR/hr, was very difficult to see-and wasn't caught by the Exploranium unit at all. The 10 μCi source was easier to see, but was still missed when in the middle of the load, or when covered by scrap.

4.0 Improving Sensitivity

While the Ludlum system proved to be equal to or better than the Exploranium system, there are some measures that can be taken to improve the sensitivity.

1) More detectors-the easiest choice because it increases the signal to noise ratio. More detectors intercept more of the gamma photons escaping the truck/trailer, and cause an alarm. A scrap yard with a variety of flatbed and rolloff trailers would be better served by a system configured with at least 4 detectors, with 2 per side and with a 3' offset in height between them. This offset would maximize the sensitivity of the system in the middle (4' to 8' from the ground), and provide better coverage of tall trailers. This recommendation is not inexpensive, but might well pay for itself over time because of a reduced number of rejections.

2) Slower Speed-the least expensive choice. Speed does play a critical role in detection, and allowing vehicles thru at 5 mph instead of 3 mph really decreases sensitivity. While testing, Ludlum engineers observed that the newly installed system recorded 18 vehicle overspeed alarms with the speed alarm set to 5 mph. Based upon experience, if the scale operator is firm in having vehicles drive through again if they overspeed, the drivers will become trained to the speed limit. A great aid to help inform drivers is to post a large sign approximately 10' in front of the radiation detectors indicating "STOP HERE-then proceed through at less than 3 mph".

5.0 Setting Reasonable Expectations

All too often there is the expectation that a radiation detector independent of size, cost or other realities should be able to detect anything radioactive. The truth is that all radiation detection systems are subject to the same laws of physics and none are exempt. Anyone who states their system will catch any radiation 100% of the time is simply being untruthful.

The reasons for this are simply due to the fact that there are too many variables in:

- Radiation Source Isotopes - each with their own signature of alpha, beta and gamma emitters, decay schemes and energies. Gate monitoring systems are primarily sensitive to gamma/x-ray radiation which is common to most isotopes.
- Radiation Source Strength - commonly referred to as activity. The greater the radioactivity the more apt a detector is to detect it.
- Shielding - a radiation source surrounded by heavy steel or lead shielding will reduce the source activity which loses its energy or is stopped all together by the surrounding material
- Source Location - which sets the distance between it and the detectors. A universal law applies whereby all radiation activity drops off by the inverse square law. Thus a source activity is reduced to only ¼ its original value just two meters away.

Never-the-less, many scrap yards are faced with the problem of costly rejections from mills employing large and expensive gate monitoring systems like the GR-526 system. As these tests have demonstrated, these larger systems were, at best, able to reliably detect individual pieces with contact readings in the hundreds of μR/hr, and only when those pieces were near the outside of the trailer. Often times, users are fooled into believing that individual pieces pulled off of trucks and hand scanned showing a few uR/hr above background caused the alarm. This is typically a false assumption. If they had measured every piece on the load separately, they most likely would have discovered other pieces with similar or higher readings.

Summary

These tests, conducted under true field conditions, demonstrated that:

1) The lower priced Ludlum gate monitoring systems performed as well if not better than the more costly Exploranium systems

2) The most cost-effective way to improve sensitivity is to control truck speed as it passes by the detectors

3) Individual pieces of NORM must have contact readings with hundreds of uR/hr in order to be reliably caught

4) A particular geographical sites' background level, detector height, and spacing between detector panels are all critical