CONTAINER / TRUCK MONITORING SYSTEM

For inspection of Radioactive contamination (RaC)

TYPE: TR1030 / TR1039

Technical Data

FEATURES :

- ❑ Uses 2 / 4 no. of large volume plastic scintillation detectors.

- ❑ Uses State-of-Art SBC and FPGA Technology in the data acquisition unit.

- ❑ Ethernet port has been provided for connectivity to plant wide LAN / PC.

- ❑ Automatic / manual mode of vehicle scan supported.

- ❑ Designed to meet ANSI N42.35 specification.

CONTAINER/TRUCK MONITORING SYSTEM Type: TR1030/TR1039 manufactured by NUCLEONIX has been primarily designed to detect Radioactive Contamination (RaC) – Gamma Radiation, present in a moving vehicle loaded with steel scrap metal finished goods. Hence, this system finds use in steel industry, forging units and in large foundries to monitor incoming scrap and also to monitor outgoing finished products at entry and exit gates for radioactive contamination.

This system could also be used to detect **clandestine** movement of Radioactive and special nuclear material across the borders, sea ports, airports, nuclear and other high security installations in trucks and containers.

Container/Truck Monitoring System is offered in 2 configurations for steel industry.

(i) Truck monitoring version - TR1030

(ii) Container/Truck/Small Vehicle monitoring version – TR1039

The gamma detection system essentially comprises of 2 large volume of plastic scintillation detectors housed inside each detector pillar. Each PVT detector has an active volume of 22400cc. Each gamma detector is provided with necessary lead shielding to minimize the background and to enhance the MDA of the system.

The gamma detection assembly is housed inside aluminized material based detector pillar. Two such detector pillars are placed along either side of the passage from where the vehicle is going to pass. This installed monitor automatically detects the presence of radioactive material being transported in vehicles if it exceeds preset levels. The monitoring system does this by measuring the radiation level taken while vehicle occupies detection area and comparing this level to the background radiation level that is measured and updated while detection area is unoccupied.

The background radiation levels are continuously measured and automatic adjustment of alarm thresholds enables a constant statistical false alarm rate to be maintained during the system use. Occupancy sensors are used to detect the presence and absence of vehicles as it passes through the monitor to know when to monitor the background and when to monitor the vehicle.

The sensitivity of detectors is dependent upon the closeness of the detector and source as well as the slowness with which they pass across the detectors. For large trucks and vehicles, large volume detector pillars are recommended and maximum distance between pillar is 3.5m. Additionally barriers are to be provided for the detectors to protect monitor from being damaged by vehicles.

The detector needs to be placed where speed of the vehicle is controlled and reduced. The speed of the vehicle should be less than 4 kmph and the vehicle should not stop while passing through the monitor.

The performance and effectiveness of the installed instrument is strongly dependent on its ability to measure radiation intensity over the search area of interest. As such based on this requirement detector volumes, geometry and dimensions have been adopted.

Alarm indications and displays are available locally and are clearly visible to the officers manning the inspection point and are also available remotely at the central monitoring PC.

This system could be installed at various entry/exit points of the vehicles and can be under the supervision of security officer.

SPECIFICATIONS

(A) GAMMA DETECTION SECTION
Detectors Type: High sensitivity PVT (Plastic Scintillation) detectors coupled to PMT detector
No. of detectors per pillar: 1 (TR1030) or 2 (TR1039)
No. of pillars : 2
Total No. of detectors : 2 (TR1030) or 4 (TR1039)
Volume of each detector : 22400cc
Dimensions of each detector: 2000 x 280 x 40mm
Energy range: 30 KeV to 3 MeV
Shielding: Suitable thickness lead shielding is provided on all sides of detector except the measuring face to suppress background radiation and to enhance MDA.
High voltage and front-end electronics: High voltage and front-end electronics are all housed together in each of the detector pillar.
Distance seperation between detector pillars: 3.5m
Height of detector pillar: 2.5mtrs.(TR1030) / 5 mtrs.(TR1039)

Radiation Detected : Gamma

Sensitivity : Better than the following –
1μCi for Co-60 or 2.5μCi for Cs-137 with a monitoring time of 2sec in the ambient background of 0.10μSv/hr in the radius of 0.5 meter around the monitor 4μCi Co-60 at 1.25 meter

(B) MEASUREMENT & ALARM UNIT:
This unit comprising of advanced electronic circuits with embedded code built-in to receive data from the gamma detector assembly and correct for background levels and generate audio/visual alarms in the event counts due to vehicle monitoring exceed the preset levels set.

Background Updation: Automatic background measurement by sensing the detection area is unoccupied by using occupancy sensors.

Alarm Setting Adjustment: Automatically adjusted based on the current background level.

No. of monitoring channels: 2 (TR1030) / 4 (TR1039)

Display: 7 ½" colour LCD

User Interface: Front panel keypad (password protected) or through PC

Measurement Unit: CPS

Measurement Range: 0 to 99999 CPS

Alarm Range: 0 to 99999 CPS

Occupancy Sensing: Using IR/proximity sensors to detect vehicle presence.

Detection Area & Performance criteria:
Vertical :   2.5mtrs.(TR1030) or 5mtrs.(TR1039)
Horizontal : 0 to 550mm
Speed of Vehicle : 0-4 Km/h

Audio/ Visual Alarms: Hooter and sounder have been provided for the purpose of generation of audio/visual alarms.

Vehicle Identification (optional): This can be done by entering the vehicle number in the report generated by TMS Software.

PC connectivity : Through RS232 cable,data can be transfered from Control unit to PC

(C) COMPUTER SOFTWARE & PC CONFIGURATION:
The data acquisition and control application software running on the host PC with a Windows-7 OS will communicate with the processing electronics through RS232.

The software is extremely flexible allowing the user to easily configure the system general operations like adjustment of detector parameters and accessing of database of all the individual vehicle scans. T

PC Configuration: Present Standard configuration with Operating system

Performance specifications & detection capability : The truck monitoring system manufactured by Nucleonix will detect reliably very low levels of contamination which may be present in the vehicles carrying verity of scrap material. Detection capability will increase with decrease in speed. Details are provided in case studies.
The system is calibrated for empty Trucks of various makes, shapes & sizes. The loaded trucks data is compared with calibration data & results are generated. It is observed that system can detect radiation levels below Natural BG levels (without truck).

Minimum Detectable Activity : MDA is computed @1 sec counting time from when the following sources are kept @ 1 meter distance from the middle of detector assembly.

Source	MDA
Cs-137	90 k Bq
Co-60	60 k Bq
Ba-133	90 k Bq

System operating conditions :

Analog output : 0-5 volts for full range

Contact output : Potential free contact output provided for detected contamination for gate control

Temperature : 0-60° C

Humidity : upto 95% RH

Environment Protection : IP-67
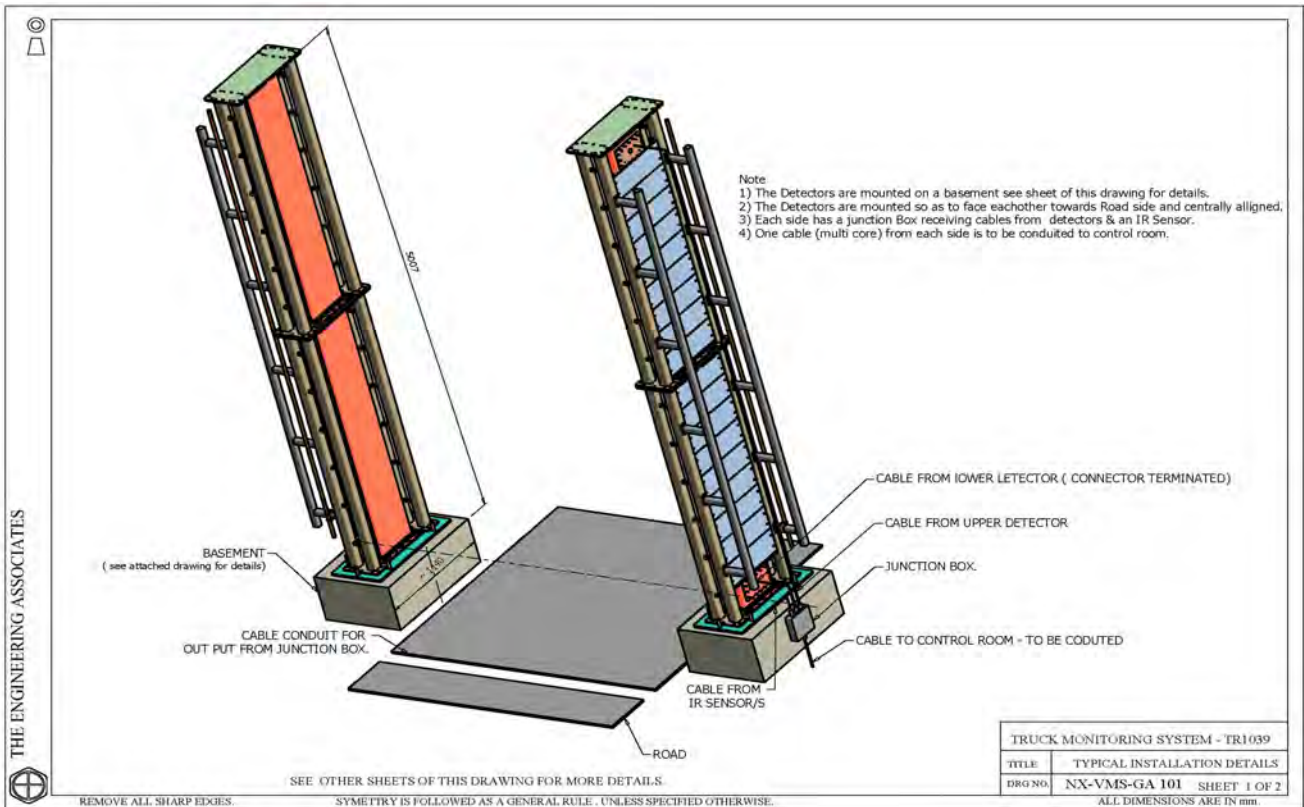
Power supply : 230 $\pm$10% Volt AC

TRUCK / CONTAINER MONITORING SYSTEM CONTROL UNIT

Data acquisition and alarm unit

Vehicle with scrap metal at the PVT detector pillars under inspection

Note:
1) The Detectors are mounted on a basement see sheet of this drawing for details.
2) The Detectors are mounted so as to face eachother towards Road side and centrally alligned.
3) Each side has a junction Box receiving cables from detectors & an IR Sensor.
4) One cable (multi core) from each side is to be conduited to control room.

CABLE FROM lower LETECTOR (CONNECTOR TERMINATED)
CABLE FROM UPPER DETECTOR
JUNCTION BOX.
CABLE TO CONTROL ROOM - TO BE CODUTED
CABLE FROM IR SENSOR/S

BASEMENT (see attached drawing for details)
CABLE CONDUIT FOR OUT PUT FROM JUNCTION BOX.
ROAD

SEE OTHER SHEETS OF THIS DRAWING FOR MORE DETAILS.

THE ENGINEERING ASSOCIATES

REMOVE ALL SHARP EDGES.
SYMETTRY IS FOLLOWED AS A GENERAL RULE, UNLESS SPECIFIED OTHERWISE.

TRUCK MONITORING SYSTEM - TR1039		
TITLE	TYPICAL INSTALLATION DETAILS	
DRG NO.	NX-VMS-GA 101	SHEET 1 OF 2
	ALL DIMENSIONS ARE IN mm.	

Note : Two such detector pillars are installed on both sides of the path way for the trucks carrying scrap metal or container with scrap metal.

SOFTWARE SPECIFICATIONS:

SYSTEM REQUIREMENTS:

PC (Minimum configuration): Intel i3 CPU or better, 2 GB RAM, 160 GB HDD.
OS: Windows 7 or higher version. (Windows Vista / XP is not supported)
Internet connectivity & Team viewer software: For remote trouble-shooting
COM port / USB to Serial convertor: For connecting Electronic Unit to PC.

INSTALLATION:

To install the software, execute TMS.bat in the installation CD. Click through the options, until you get the message that installation is completed successfully.
In case of any errors, please take a screen shot of the error message and email to Nucleonix Customer Support.

CALIBRATION:

After installation of the system, it is calibrated by Nucleonix Engineer by generating Profiles for trucks of various Models, Makes, Lengths and Heights. The data related to trucks are stored in a Calibration file. For every acquisition, TMS Software shows the available calibrated Truck profiles & asks the User to select the Truck profile. This data is used in reports to arrive at a logical conclusion on Contamination. Details are given in Appendix A. Re-Calibration is required every 1 year.

EXECUTING THE APPLICATION:

A seperate TMS Software has been designed in such a way that it provides accurate results and this will be provided along with the Personal Computer

Report Generation Criteria

Interpretation of Reports

Given below is a sample report for a truck carrying steel scrap which is contaminated.

Notice the Alarm Status row, which shows that data from detectors D1, D2, D3, D4, 'Avg of all detectors', 'Sum of all detectors' - is contaminated.

Notice the % Fall row, which shows that there is an increase of 3.75% in average readings from all detectors for this truck. This again implies that there is contamination. Now notice the Spectrum data Section - 'Sum' column. There are several continuous readings which have crossed statistical limits of 3 Sigma (indicated in RED), which again suggests Contamination. Look at the Statistical Observations section. The Sum row shows that 'Total Events Score' and 'Events in Sequence Score' are both high, which indicates contamination. (Event is the case when current data value exceeded Sigma or 2 Sigma or 3 Sigma.
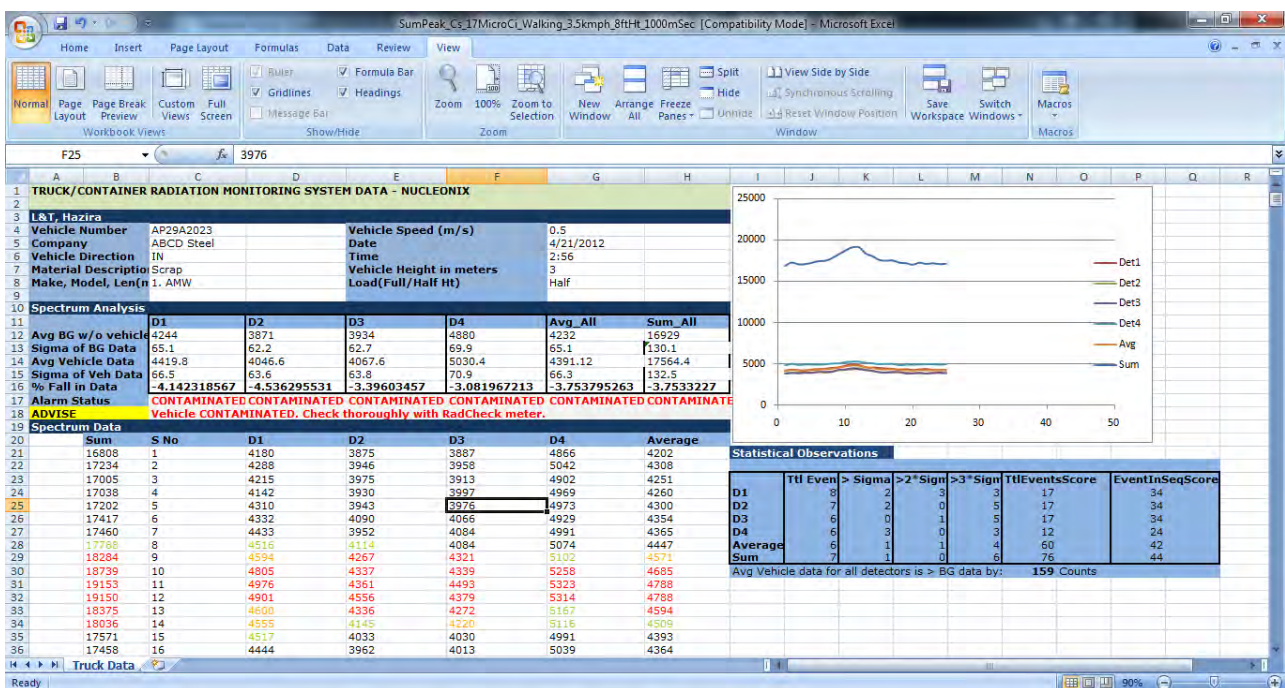
Let us now analyze another report shown below, which has much lower contamination:

Notice the Alarm Status row, which shows that data from detectors D1, D2, D3, D4, 'Avg of all detectors', 'Sum of all detectors' - is contaminated. Notice the % Fall row, which shows that there is an increase of 1.45% in average readings from all detectors for this truck. This again implies that there is contamination. Now notice the Spectrum data Section - 'Sum' column. There are 4 continuous readings which have crossed statistical limits of Sigma (indicated in GREEN) & 2 Sigma (ORANGE), which again suggests Contamination. Look at the Statistical Observations section. The Sum row shows that 'Total Events Score' and 'Events in Sequence Score' are both high, which indicates contamination. (Event is the case when current data value exceeded Sigma or 2 Sigma or 3 Sigma).
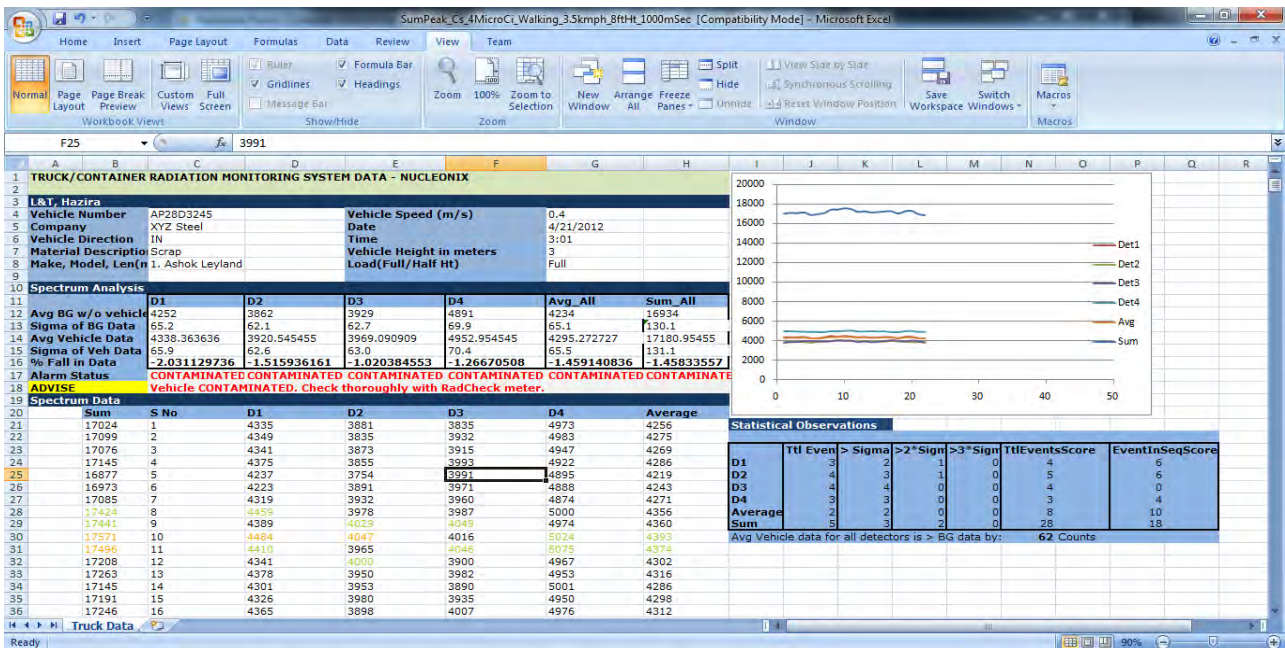
Help Menu

Clicking on this command this file is opened. In case there are any upgrades to the software, ask Nucleonix for the latest version of 'TMS Software User manual'. Copy it to the same folder as TMS application.

Maintenance and Customer Support

Periodic functional checks of system must be performed with Check source as frequently as possible, as per procedure given in Appendix B. This can be done by Customer's trained employees. Apart from this, PC must be kept free from Virus and backed up by UPS power.

Calibration must be performed every 1 year. You may contact us 1 month prior to completion of 1 year.

Customer must enter into Annual Maintenance Contract after Warranty. This will entitle them for preventive maintenance checks, software upgrades, Re-Calibration, etc.