

INSTRUCTION MANUAL

RAD CHECK METER (EXTERNAL PROBE / INTERNAL)



TYPE : RC 705E (External)



TYPE : RC 705I (Internal)

NUCLEONIX SYSTEMS PRIVATE LIMITED

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File Name : RC705(E&I)_MAN

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IMPORTANT NOTE :

1. Nucleonix will in no way be liable for any damages or losses or consignment rejections either due to improper usage of this equipment or any other reason.
2. Only Sr. Technicians who are fully trained by Nucleonix Systems or otherwise & have complete understanding of measurements of RaC using this meter only need to operate and make measurements on regular basis.
3. Users are advised to keep updating their measurement methods, whenever Nucleonix sends updates. They can periodically check Nucleonix website for new methods & products.
4. Also it good practice to get the Rad Check Meter calibrated once in a year.
5. Equipment electronics, has 1 year warranty Scintillation detector probe is fragile & has glass ware (PMT). This doesn't have 1 year warranty, only inspection warranty is offered. Also this detector warranty doesn't cover physical damage, breakage internal cracks which may develop due to dropping or shock to the instrument. Users are advised strickly to train & inform their technicians who operate this product about this.
6. Always use protective belt & having the detector probe to the shoulder, in case of Rad Check with external detector probe.

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PERSON CHECKING FOR RADIOACTIVE CONTAMINATION USING RADCHECK METER & 2"X2" NaI EXTERNAL DETECTOR PROBE



PERSON CHECKING FOR RADIOACTIVE CONTAMINATION USING RADCHECK METER & 1"X1" NaI INTERNAL DETECTOR PROBE



CHAPTER- I

INTRODUCTION

Rad Check Meter Type : **RC 705B** manufactured by NUCLEONIX SYSTEMS is primarily designed to inspect & measure **Radioactive Contamination (RaC)** in steel samples such as billets, rods, rounds, flates, castings, Automotive / Engineering components etc. Components in different sizes & shapes can be inspected by this meter. This Rad Check Meter is widely used **globally** by many steel industries. This is a Portable Hand Held Meter, designed around integrally coupled 1" x 1" or 2" x 2" NaI(Tl) Scintillator to a 1" x 1.5" or 2" x 2" PMT, will offer an optimum performance in counting Low-Level Gamma contamination.

This unit has Two modes of measurement namely Doserate mode & countrate mode. In **doserate mode** it measures in two 'Unit' i.e., nSv/hr and also in mR/hr and in **countrate mode** it can measure in CPS & also in CPM modes. Dose rates close to natural background levels can be measured accurately.

This Rad Check Meter is an ideal choice for the Recycled steel /casting industry & Engineering component industry & serves as a good quality assurance (QA) tool to check for Radioactive Contamination (RaC).

This unit employs microcontroller based design and has number of unique features. User can store upto 1000 readings at the press of a button and can recall back, for visual indication on a dot matrix LCD display. This unit is provided with a built-in RS232 port (optionally) through which the stored data can be down loaded into PC.

Some important features of this unit are :

- Microcontroller based design
- Compact, elegant and light weight
- User can store upto 1000 readings
- Detects Gamma and X radiation
- Measures **dose rate** from (1mR/hr - 10000 mR/hr) (or) (10nSv/hr - 100k nSv/hr)
- Countrate mode : CPS (0 - 50000) CPM (0 - 5000)
- Detector : 1" x 1" or 2" x 2" NaI (TI) Detector probe assembly is built into the instrument enclosure box
- RS 232 serial port (Optional)
- Built in audio
- Works on 7.5V DC dry cells

APPLICATIONS

This is a handheld portable instrument used to check for **Radioactive contamination (RaC)** in both finished products and raw materials made of stainless steel, castings, iron products, engineering precision components, buckles, metal rings, zips, ornamental metal rings in leather jackets / textile garments etc. Input raw materials of iron/steel scrap, including melting scrap, engine block scrap, counter weight scrap etc also can be inspected by this unit.

All steel/Iron/alloy structural products/ fittings/parts/accessories including Road fencing/Road barriers, vehicle chassis fittings etc can also be inspected for radioactive contamination. Additionally it can be used as a general purpose **Rad check Meter**.

CHAPTER - II

INTRODUCTION TO RADIOACTIVE CONTAMINATION (RaC) IN STEEL INDUSTRY

Nucleonix Systems has Products, developed for the inspection of Radioactive contamination in **steel industry** to meet the requirements at different stages of production cycle. These are useful for inspection of inputs such as scrap metal, semi-finished raw materials & finished products in different forms, such as billets, rods, machined parts, castings, forgings etc.

Radioactive Contamination (RaC) can be defined as uncontrolled distribution of radioactive material in a given environment / material. Radioactive contamination in steel / foundry is due to the accidental incorporation of radioactive material into the scrap metal chain supply system. There are a lot of radioactive sources (industrial and medical), used for industrial gauging applications and in medical systems in cancer hospitals. When these sources are disposed illegally (not following the Atomic Energy Regulatory Board guidelines) it is likely that they come into scrap metal supply chain system, Steel / foundry mills who own smelting furnaces get the scrap metal from this scrap supply chain system, leading to radioactive contamination of the end products made from the ingots processed through these smelting furnaces.

Exports of engineering products and other steel construction materials made of steel, iron, alloy and castings, to countries such as the UK, US and EU are growing from India. Radioactive contamination in steel, iron, alloy, castings and allied products meant for exports has become a serious issue these days. Lot of radioactive contamination cases have been reported by steel / foundry industry.

It is now essential for the Indian / Steel and foundry industry to wake up and take corrective steps to address these issues of Radioactive Contamination (RaC). Incoming scrap metals as well as outgoing finished products are to be thoroughly inspected for Radioactive Contamination (RaC), before exporting them to foreign countries to avoid embarrassment, heavy losses and damage to reputation. Developed countries are rejecting even very low-level radioactive contaminated products from India.

To address these above issues and find solutions to the above problems faced by the steel industry, **Nucleonix Systems** with vast design experience in Nuclear Instrumentation, has developed four products to meet the steel industry's demand to check / inspect their incoming scrap metal and also their end products for Radioactive Contamination (RaC) in different situations. Nucleonix Systems has studied some of the export-rejected contaminated samples as part of this exercise to offer best possible product design for Radioactive Contamination (RaC) measurement to the steel industry. These four products developed include:

1. Rad Check Meter RC705B
 - a. With Internal detector
 - b. With External detector probe
2. Truck / Container Monitoring System for Radioactive Contamination (Type: TR1020)
3. Gamma Ray Spectroscopy System for Radioactive Contamination Measurement by Nuclide Identification & its quantification. (To measure contamination in Bq/gram)
4. Package Monitoring System (Type :PMS 1009)

CHAPTER - III

FRONT PANEL & SIDE PANEL CONTROLS

3.1 FRONT PANEL CONTROLS AND INDICATIONS

3.1.1. LCD DOTMATRIX DISPLAY

This is a 16 X 2 alpha numeric LCD dotmatrix display and responds to all the commands from the keypad and displays programme parameters like Acquisition modes (BG, CPS, CPM, DOSE RATE, PRESET TIME), TC, Recall, Save etc.

3.1.2. INTELLIGENT KEYPAD

- (a) PROG key button : This key is an important one which facilitates the user to programme the operation of the instrument for different modes / conditions.
- (b) START key button : This is used for starting of acquisition once all the programme parameters have been set.
- (c) STOP key button : This key can be used to stop acquisition.
- (d) INC/DEC key button : These keys are used while setting the programme parameters to increment/ decrement a value or to change the option selected to another value available.
- (e) STORE key button : This key is used for storing the readings or data values in the following way.

If you want to store the data, then press STOP button to stop acquisition and then press STORE button.

Note : Keypad commands have been explained in detail under chapter V - 5.1.

3.1.3. POWER ON (ROCKER SWITCH)

This is a rocker switch to put on the power to the unit. The power to this unit is provided through 7.5V, DC 5 x 1.5 Volts cells which is housed inside the unit.

3.1.4. RS232 (OPTIONAL AT EXTRA COST)

This connector is having RS232 compatible signals for serial data communication to a P.C. Under software control from a P.C, the stored data reading from this unit can be down loaded on to P.C.



RC705B (External)



RC705B (Internal)

CHAPTER - IV

SPECIFICATIONS

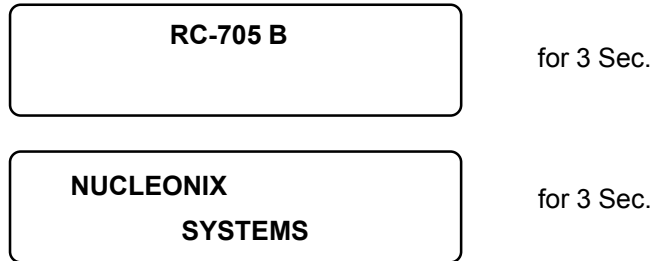
Detector (options)	:	(a) NaI (TI) Scintillator, 1"d x1"h or 2" x 2" coupled to a Photomultiplier Tube. Detector assembly is inside the survey meter enclosure. (b) External unit through 1mtr cable
Calibration Accuracy	:	(a) Better than +/-10% (specified with a Cs-137 standard source) from 100 mR/hr onwards (b) within +/-20% upto 200 μ R/hr
Acquisition mode	:	CPS : 0-50000 CPM : 0-5000
Dose Rate (mode)	:	1-10000 μ R/hr 10nSv/hr - 100k nSv/hr
Over Range	:	This instrument will show over range above the 10,000 μ R/hr
Alarms	:	Provision for audio/visual alarms of doserate exceeds preset level
Preset level	:	User selectable in modes
Data Storage	:	Can store upto 1000 data readings. Stored data can be recalled back on to display.
Display Indication	:	Dot Matrix LCD display for dose rate / cum dose.
Sensitivity	:	1 micro-R/hr or 0.01 μ Sv/hr
Serial Port (optional)	:	Built-in serial port facilitates data down loading into PC. Data Communication Software with connecting cable can be provided at extra cost as an additional option.
User Interface	:	i) Power ON/OFF switch. ii) START, STOP, PROG, REC, INC, DEC command buttons for setting of parameters & operation of the instrument.
Power	:	7.5 volts DC, BPL Excell or DURACELL ULTRA, Size AA, MN1500 LR6 (5 X 1.5 Volts), Alkaline cells.
Dimensions	:	106W x 196L x 105Ht in mm (Approx.)
Weight	:	1. External unit (without probe) : 1.5kg 2. External probe (2"x2" NaI) : 2.1kg 3. External unit with probe : 3.6kg 4. Internal unit with probe (1"x1.5" NaI) : 2kg

CHAPTER - V

OPERATING INSTRUCTIONS

5.0 INSTRUCTIONS ON INTELLIGENT KEYPAD COMMANDS

On switching the unit ON, the display will show up below initialization screens.



After this, unit acquires BG automatically

This unit has been specially modified to suit the needs of the steel industry. it additionally generates audio/visual alarms in case preset levels are exceeded.

Now user can proceed to acquisition of samples / materials.

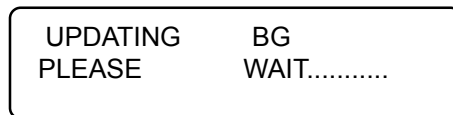
5.1 Step wise sequence for configuration and use of the survey meter

- i. Update BG (background radiation level)
- ii. ACQ mode selection
Select either CPS, CPM, DOSERATE, PRESET TIME, mSv/hr modes
- iii. Select time constant for doserate mode or select preset time for PRESET TIME mode
- iv. Enable/Disable the alarm level
- v. Acquire in the selected mode
- vi. Store acquired readings in the memory (optional)
- vii. Download stored readings to PC through RS232 port (optional)

5.1.1 TO UPDATE BACKGROUND

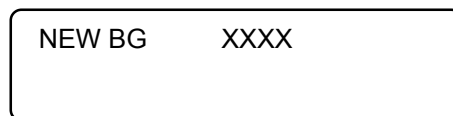
Switch ON the unit, BG gets updated automatically.

Ensure to keep the surveymeter & probe about 1mtr above ground and atleast 4-5 mtrs away from any scrap & sources.



This screen appears after switching ON the unit

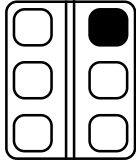
At the end of 20 seconds, below screen appears indicating completion of acquisition for background



Now user can proceed to acquisition of samples / materials.

5.1.2 TO SELECT ACQ MODE

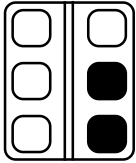
Press PROG key to select below menu option



ACQ MODE
XXXXXX

Now using ▼ or ▲ buttons, select suitable menu option - CPS, CPM, DOSERATE, PRESET TIME

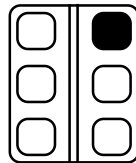
5.1.3. To select time constant for doserate mode after selecting 'DOSERATE' mode in the 'ACQ MODE' menu, press PROG to select below menu option



RANGE SELECTION
XXXXX

Now using ▼ or ▲ buttons, select suitable TC - LOW, MED or HIGH TC

5.1.4 TO SELECT PRESET TIME FOR PRESET TIME MODE



After selecting 'PRESET TIME' mode in the ACQ MODE menu, press PROG to select below menu option

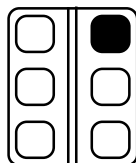
PRESET TIME ^
 XXXX

Now using ▼ or ▲ buttons adjust preset level

5.1.5 SET ALARM LEVEL FOR CPS/CPM MODES

When the user intends to use the meter to make contamination measurements in steel raw material, scrap or finished steel goods, alarm level can be set to detect contamination by means of audio/visual alarms

Preset level can be chosen by going to below menu option by pressing PROG button



ALARM LEVEL
ENABLED

Now using ▼ or ▲ buttons enable/disable the alarm level

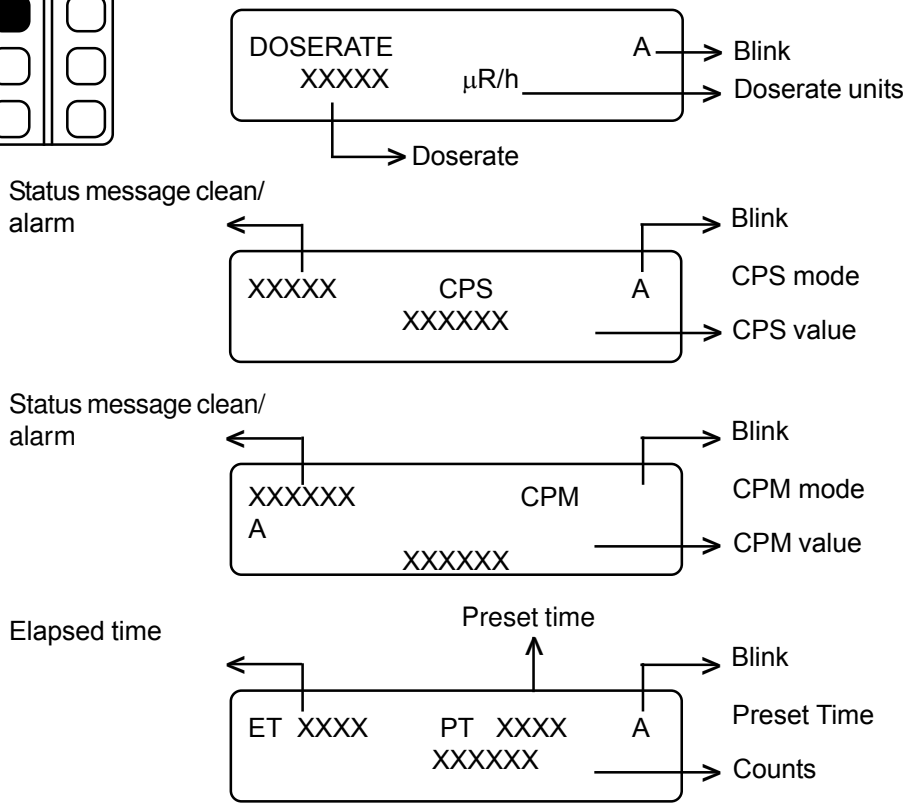
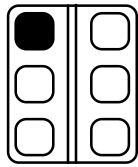
Alarm level is chosen as a factor of background radiation level.

When acquiring in CPS mode, choose alarm level in the range of 1.1 to 1.5 of BG keep alarm level as low as possible at a level where there is no occurrence of false alarms when acquiring for natural radiation levels (without scrap/material)

For CPM mode, choose a factor in the range of 1.5 to 1.3 of BG. Select criteria for alarm level is same as that for CPS mode of acquisition.

5.1.5 ACQUIRING IN SELECTED MODE

Once the acquisition mode is selected and other configuration parameters are selected, user may proceed to acquisition mode by pressing START button below screens will appear depending upon the mode selected.



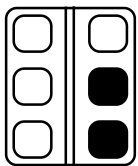
Depending upon the minimum detectable level or on occurrence of alarms user may decide on accepting / rejecting the material (scrap/finished goods).

5.1.6 STORING OF ACQUIRED READINGS

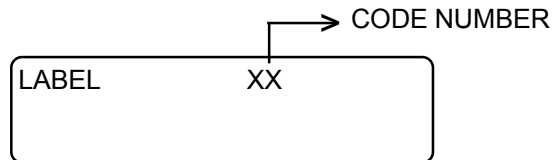
To store last acquired readings into the memory press STORE button while acquisition is going ON for DOSE RATE, CPS & CPM modes
 For PRESET TIME mode at the end of counting for preset time press STORE button.

5.1.7 TO SET THE LABEL FOR A CORRESPONDING READING

By using this feature user can give code numbers to different locations when making measurements on field.



By using ▼ or ▲ keys code number can be changed to 00 to 99.

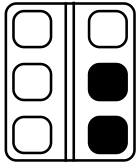


5.1.8 CALIBRATION

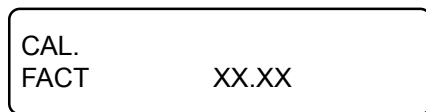
This is a very useful & important feature, it allows one to calibrate the unit to obtain expected dose rate for the type of the scintillator used. This is to be changed only if user intends to recalibrate the unit.



To recalibrate press ▲ or ▼ keys to get the following display.

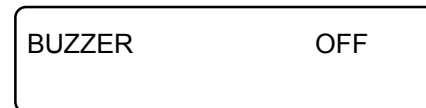


Now on pressing PROG key, the existing calibration factor is displayed and user can change it with ▲ or ▼ keys to get new calibration factor

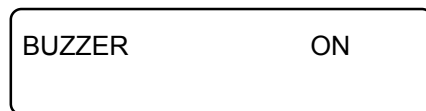


5.1.9 BUZZER

On pressing PROG key the following display appears,



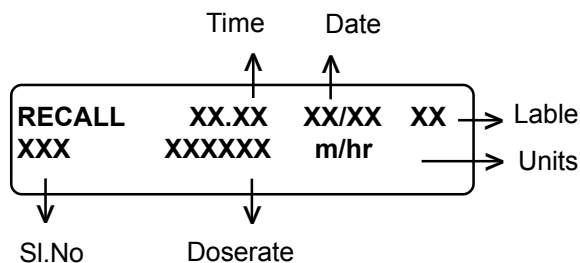
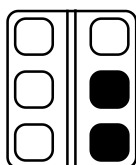
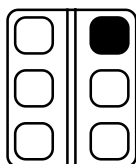
The default buzzer condition is OFF. User can change this by pressing ▲ or ▼ keys.



5.1.10 RECALL DATA READINGS

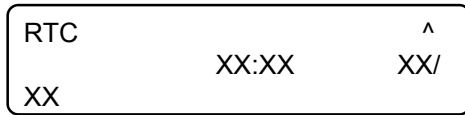
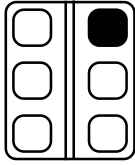
This is a very useful feature that has been provided in this unit. At the end of storing/saving of a set of readings, this feature will enable the users to recall the readings on to the display, from the SI.No. set in the "RECALL" mode. Changing of the SI.No. is similar to that explained under "SL. NO." selection.

By pressing PROG key, display changes to,



5.1.11 TO SET RTC OF THE INSTRUMENT

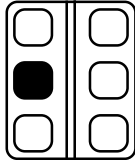
Press PROG button to select below menu option



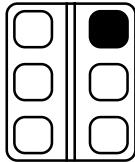
Here the RTC is displayed in HH : MM dd/mm format and the time is in 24hr mode (i.e. 1:00 PM will be 13:00)

Now to set the RTC, using ▲ or ▼ buttons and set it to a desired value.

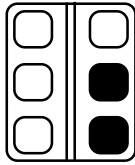
5.1.12 SAVE?



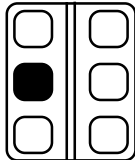
- After changing all program parameter you can save those parameters.
- Press STOP key
- Press PROG key unit you get SAVE? option
- Press ▲ or ▼ key
- You will observe on display as shown below



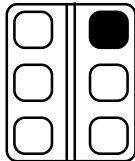
- Then press START key to start aquisition in selected mode



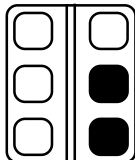
5.1.13 ERASE ?



If user wants to erase the stored memory press stop key & then PROG to get ERASE parameter then press ▲ or ▼ key you will see as



Then again go for START to acquire in selected mode.



MENU	-	OPTIONS
ACQ MODE	-	DOSERATE (mR/hr & mR/hr) CPS CPM PRESET TIME mSv/hr
UPDATE	-	BG?
SL.NO (A/O)	-	-
RECALIB?	-	NO/YES
BUZZER	-	OFF/ON
RECALL	-	-
SAVE ? (PROG)	-	OK/SKIP

5.2 OPERATING PROCEDURE (General)

This unit is packed and dispatched in ready to use condition. On unpacking, user is advised to go through Instruction Manual including instructions under Chapter V (5.1) completely.

Now switch ON the power to the unit by pressing the Rocker switch to the ON position.

User can now operate the equipment to make measurements in CPS/CPM or DOSERATE (mR/hr & mR/hr) modes as per the requirement. User can store and recall the readings if required also.

Optional feature (offered against specific order only) :

Stored readings can be downloaded into a PC if required under the control of data communication software which is supplied at extra cost as an optional accessor

Note : Once the meter is switched on it enters into BG measurement mode & at the end of measurement (typically 20 sec) it display,

BG = 00222 nSV/hr (typical value in hyderabad) value depends on place & location.

Unit of BG, indicated will be the unit selected earlier. However user can change the unit by going to PROG mode selecting the desired unit.

Once BG is recorded, user is now ready to make measurement on a 'sample for RaC inspection'.

5.3 HOW TO MAKE MEASUREMENTS ON A SAMPLE FOR RaC INSPECTION (STEP BY STEP PROCEDURE)

The following are the prerequisite steps that we suggest before making the actual measurements:

Employ a qualified science graduate with a responsible and meticulous attitude to make the measurements.

Training – Understand the user manual and documentation.

Making sure the instrument is in working condition and within calibration period.

The following are the steps to follow in making measurements to check for radioactive contamination:

Measure the natural background

Measure the sample near the same spot where natural background is measured

Identify whether it is clean sample or suspected contamination or sure contamination case

Take appropriate action

Repeat steps 1 to 4 for next measurement

5.3.1 MEASURING THE NATURAL BACKGROUND RADIATION

Natural Background radiation is the ionizing radiation constantly present in the environment, emitted from a variety of natural and artificial sources.

It comes from 2 primary sources – Cosmic radiation (space) and terrestrial sources (soil, rock, vegetation, air).

Natural background varies from location to location. For Eg. it is different in Mumbai and Hyderabad. It also varies from one spot to another in the same location. For eg. it will be different inside your office building when compared to the outdoor area. There is also a small variation even at the same spot.

For measuring natural background levels, take the unit to the area where actual sample measurements are to be done. Make sure there are no samples close by. (at least a few meters away). Hold at least 1 meter above the ground level and 1 metre away from side walls observe the natural background (BG) reading. Make about three measurements & take average of the three readings & that should be treated as the natural B.G. (Base value)

We recommend that measurement is done in nSv/hr which is internationally accepted unit. Other units available in the instrument are μ R/hr, CPS or CPM.

5.3.2 MEASUREMENT ON A SAMPLE

Samples are available in different stages of processing like raw material entry stage, intermediate processing state, finished product stage, etc. To detect contamination without missing, maximum number of measurements that are practically possible, are to be made at various stages of production. The input stage must be given the utmost attention so that you do not waste time, money and effort in processing contaminated raw material.

Samples can be in various shapes and sizes.

To get authentic measurements, Samples must be chosen such that they are:

To get authentic measurements, Samples must be chosen such that they are:

Sample weight : Total weight is not less than 2 kg

Sample size : Area of sample must exceed front face of the detector probe (in case of external probe) and front face of the unit in case of internal detector probe.

If samples/components are small in size, they must be bunched together to meet weight & size criteria as said above.

To measure for RaC on the sample, press 'START' button to enter into D.RATE mode assuring that D.RATE mode is default setting, and bring the detector probe close to sample until it touches and covers the probe face completely.

Once a measurement is completed at the end of TC (=4sec typical) user can 'STORE' the reading if required & start again for another measurement.

5.3.3 IDENTIFYING WHETHER SAMPLE IS CLEAN / SUSPECTED CONTAMINATION / SURE CONTAMINATION CASE

Make sure that sample size & shape criteria are met as given above.

Case 'a' – Clean sample

When you touch the sample with the meter, if the reading goes lower than BG by more than 10%, then the sample is clean.

Case 'b' – Suspected contamination

When you touch the sample with the meter, if the reading slightly falls below BG, but not more than 8%, then it is a case of suspected contamination. This sample must be examined more carefully by repeating the measurements with larger masses. Sample can be sent to Nucleonix for ascertaining the contamination.

Case 'c' – Sure contamination

When you touch the sample with the meter, if the reading remains same or increases, then it is a case of sure contamination.

5.3.4 APPROPRIATE ACTION

In case of suspected contamination, samples can be sent to Nucleonix for further analysis by “**Gamma Ray Spectroscopy System for Radioactive Contamination Measurement by Nuclide Identification & its quantification**”. A report will be given in Bq/gm. Nucleonix Systems is offering sample analysis services. Please refer to our website & click on Radioactive contamination Inspection Systems / Products for Steel Industry” on home page (last para) & then to choose ‘Sample analysis services”.

Contact on mobile 9346645906 (Mr.Vinay / Mrs.Narmada) for further details on this.

If you find that your sample is contaminated, then contact AERB for further help & guidelines on how to dispose it.

Shri. S.P Agarwal (Head),
Radiological Safety Division,
Atomic Energy Regulatory Board,
Niyamak Bhavan, Anushaktinagar,
Mumbai – 400 094.

Ph : 022-25574287 Fax : 022-25565717, 25562344, 25583230 Mobile : 9820864880

CHAPTER -VI

BLOCK DIAGRAM DESCRIPTION

A. +5V REGULATOR OUTPUT

Unit draws power from +7.5V (1.5V x 5) dry cells. A low dropout regulator provided, regulates & gives out +5V. This also provides signal for low battery indication.

B. HV CIRCUIT

This is a blocking oscillator based on DC to DC converter circuit which generates required HV to the Plastic Scintillator assembly, gamma probe.

C. GAMMA DETECTOR PROBE

This is a 1"x1" NaI or 2" x 2" NaI optically coupled to 1" or 2" PMT. Also it contains HV bleeder circuit required for the probe assembly.

D. PULSE AMPLIFIER / DISCRIMINATOR CIRCUIT

This receives negative tail pulses from the gamma probe & amplifies these signals considerably before they are passed into discriminator followed by which to monostable, to generate TTL signals. Input stage of amplifier is a charge sensitive stage.

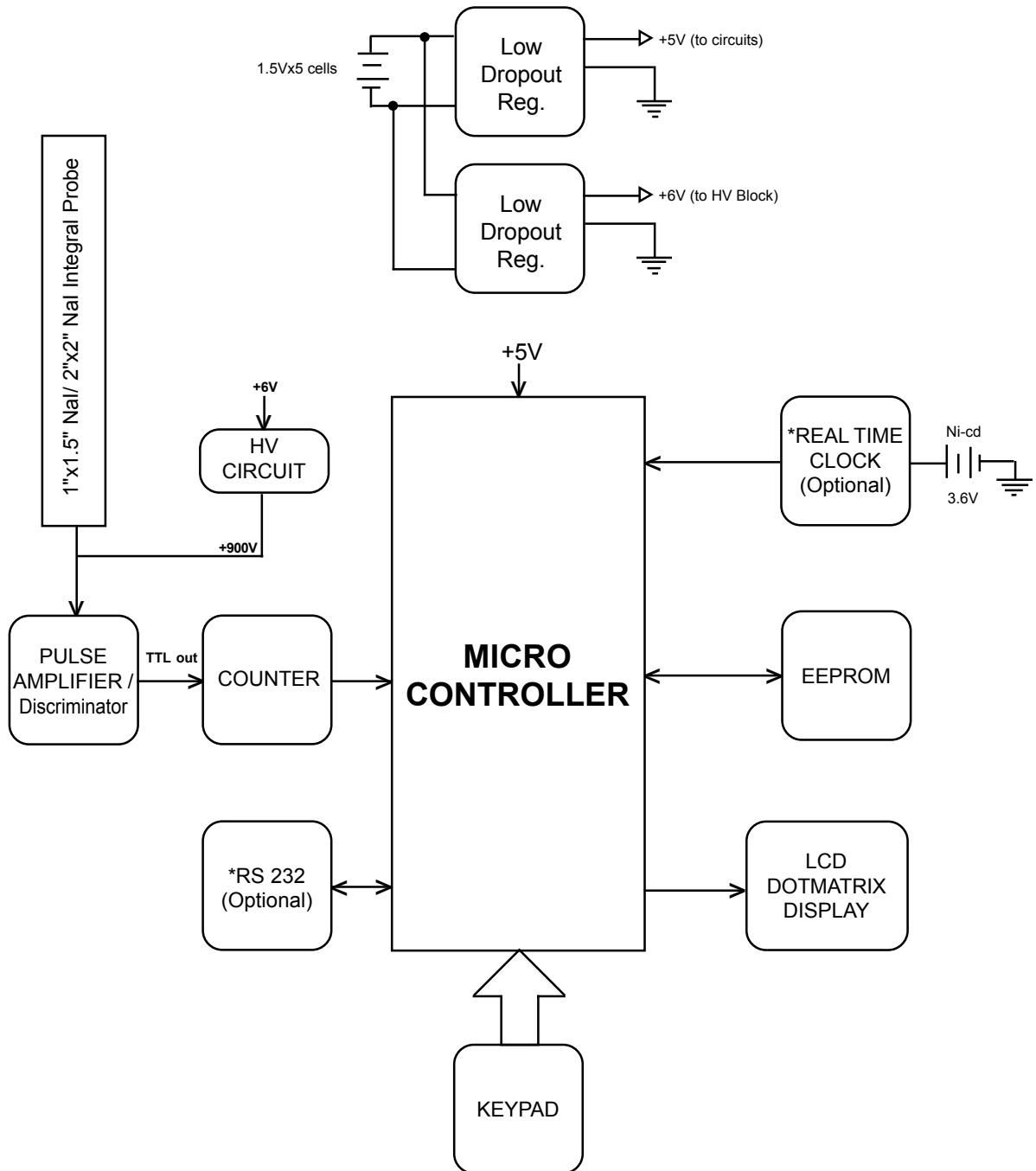
E. REAL TIME CLOCK (OPTIONAL)

This is a single RTC chip with battery backup. It is provided only in case the user specifically orders the unit with RTC. This facilitates the user to log and store dose rate & RTC information simultaneously. Note : In normal Micro-R Survey Meter RTC is not provided.

F. MICROCONTROLLER & ASSOCIATED CIRCUIT BLOCKS

TTL pulses from the detectors are counted in a digit BCD counter, which is interfaced to microcontroller. These counts are read by microcontroller, counted for a Time Constant (TC) & shown on a LCD dot-matrix display in terms of dose rate, CPS or CPM. There is a choice of three TCs, for the user. The user interface to the unit is through keypad consisting of SIX command buttons. Unit has additionally EEPROM chip which allows the user to store readings upto 1000. Further the stored data readings can be down loaded into PC under the control of data communication software. There is an RS232 port provided (optionally) for connecting to PC for data transfer. This unit works on dry cells 5x1.5V (=7.5V).

BLOCK DIAGRAM OF RAD CHECK METER TYPE : RC705B



CHAPTER – VII

RS 232 DATA COMMUNICATION & REPORT GENERATION SOFTWARE

1. Put the CD in **CD Drive** and open the CD by clicking **mouse button**.
2. Automatically, it will go through **set-up** procedure for the mR Link.
3. By selecting mR link, **PC down load software for NX-Instruments** will appear on the monitor. In that screen one would see **Port setting & Data setting** options.
4. Select appropriate **Port setting** and give the port number
5. Select **Data setting** to give start SI.No. and **Number of readings**, to be down loaded from the instrument into PC.
6. Now **log the data**, by clicking on the **Log data** button the monitor will show up **Serial Number, Label** and **Doserate** information on the display which is in mR/hr as given below.

SI.No.	Label	Dose Rate in uR/hr
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CHAPTER - VIII

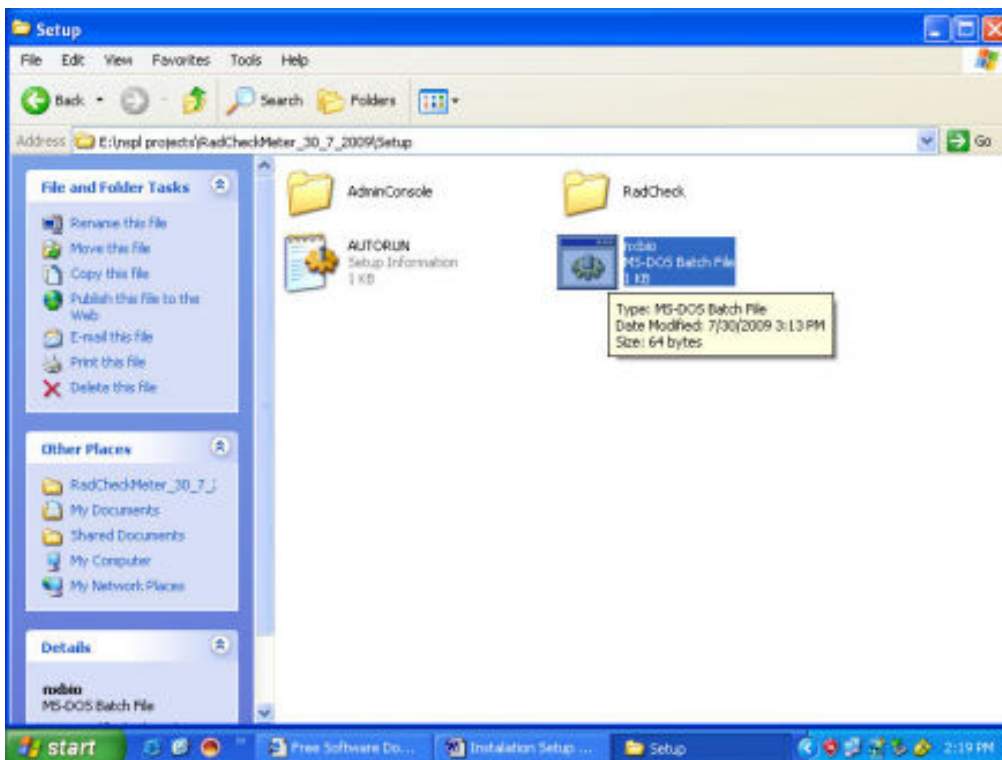
INSTALLATION MANUAL FOR RAD CHECK METER

INSTALLATION PROCEDURE

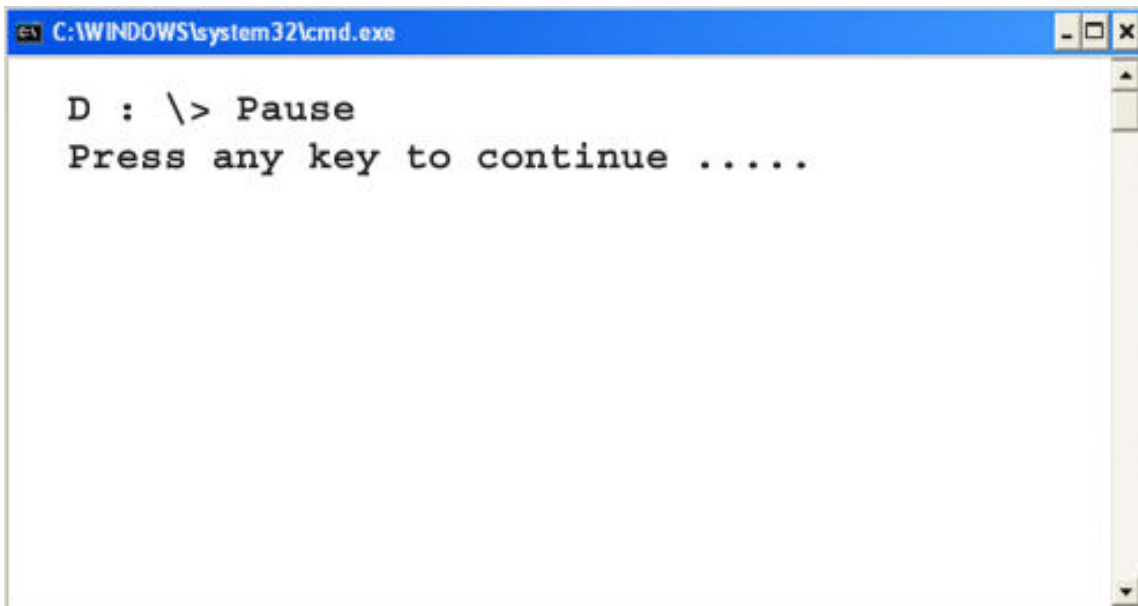
The following is the procedures to install Rad Check Meter. Please follow the steps

- Please insert the Rad Check Meter CD in the CD drive
- Installation starts automatically.

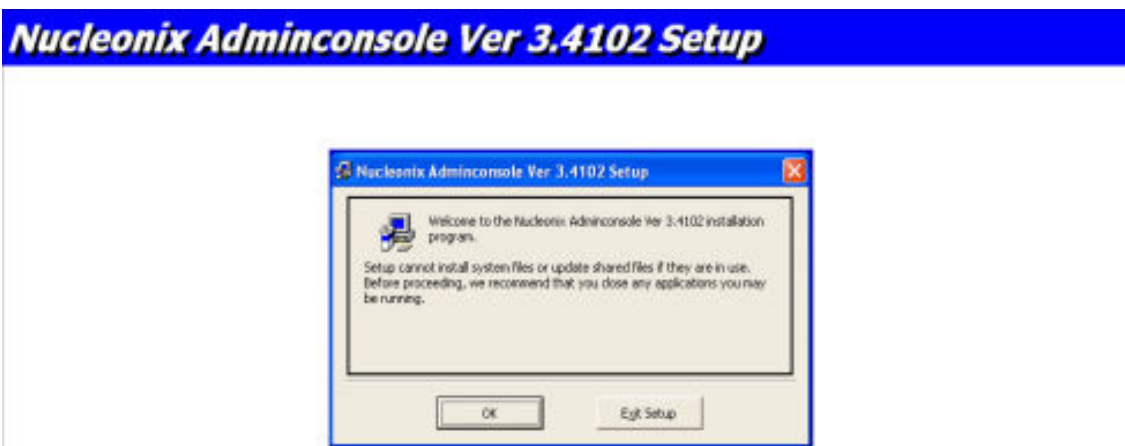
If not then explore the CD and double click on "nxbio"



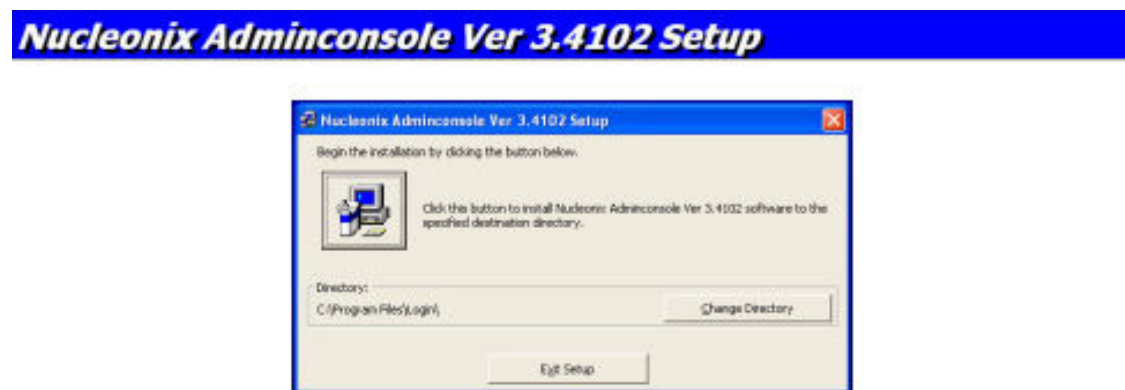
→ Following window appear



→ Press any key from keyboard the installation will start and the following win dow will appear



Click



Click on computer symbol

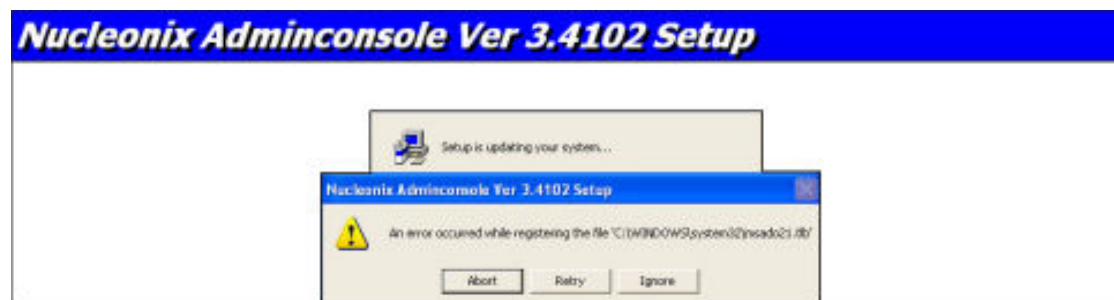
→ Follow the installation procedure. When following screen appear click continue



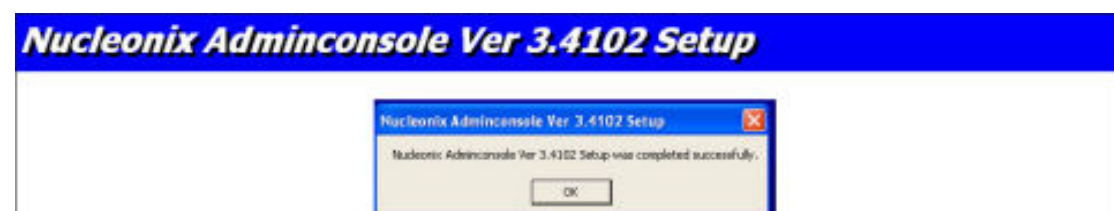
→ Follow screen will appear several times, each time click yes



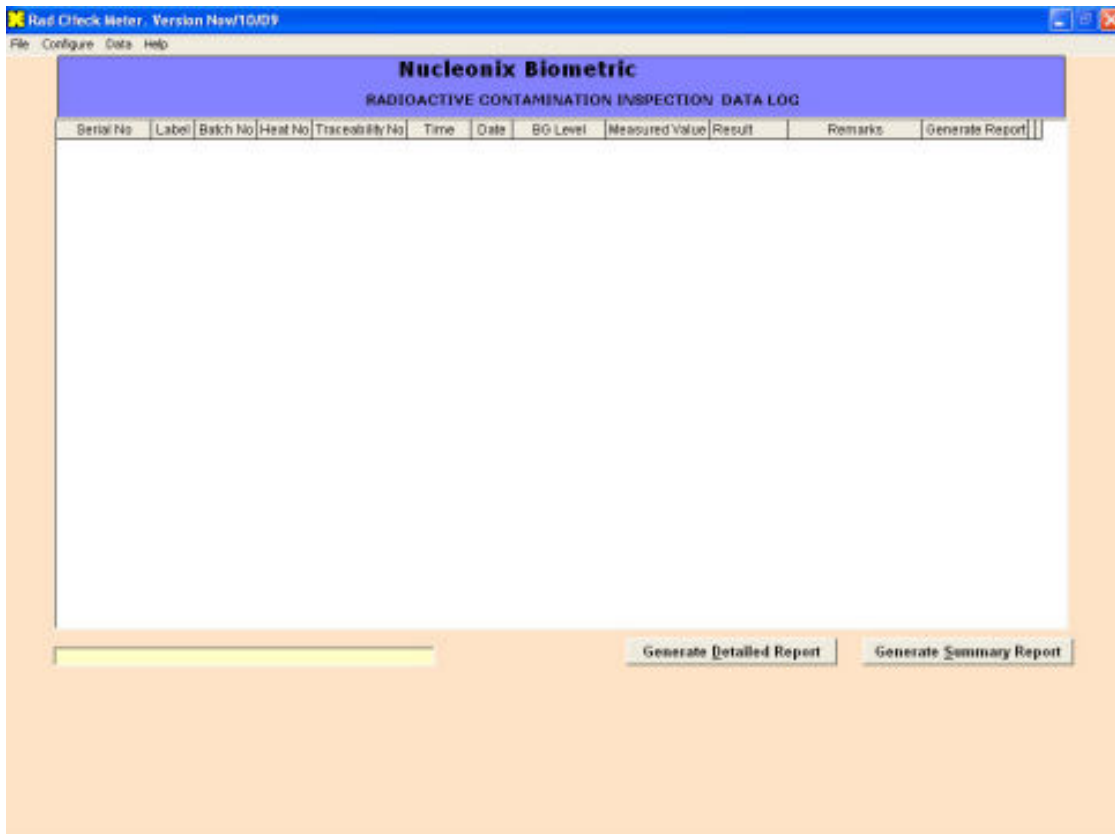
→ If following screen appear then click on "ignore" then click OK.



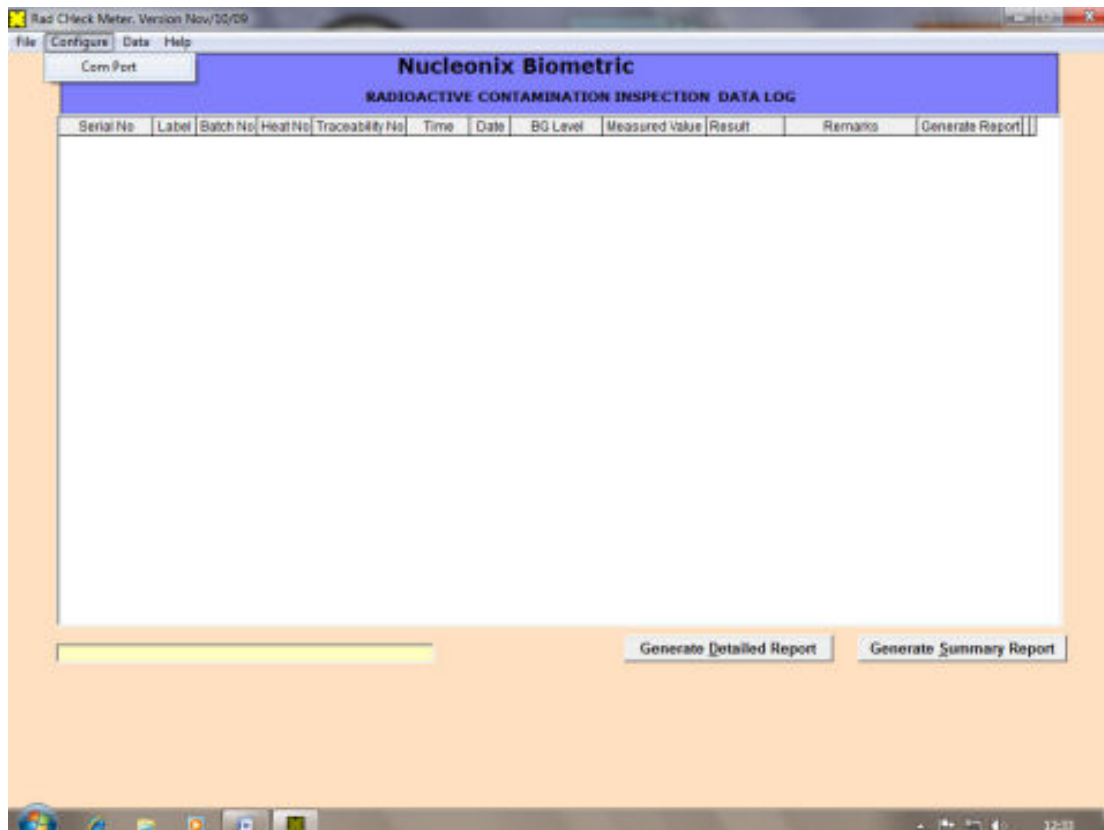
→ Click OK on following screen. Installation complete successfully



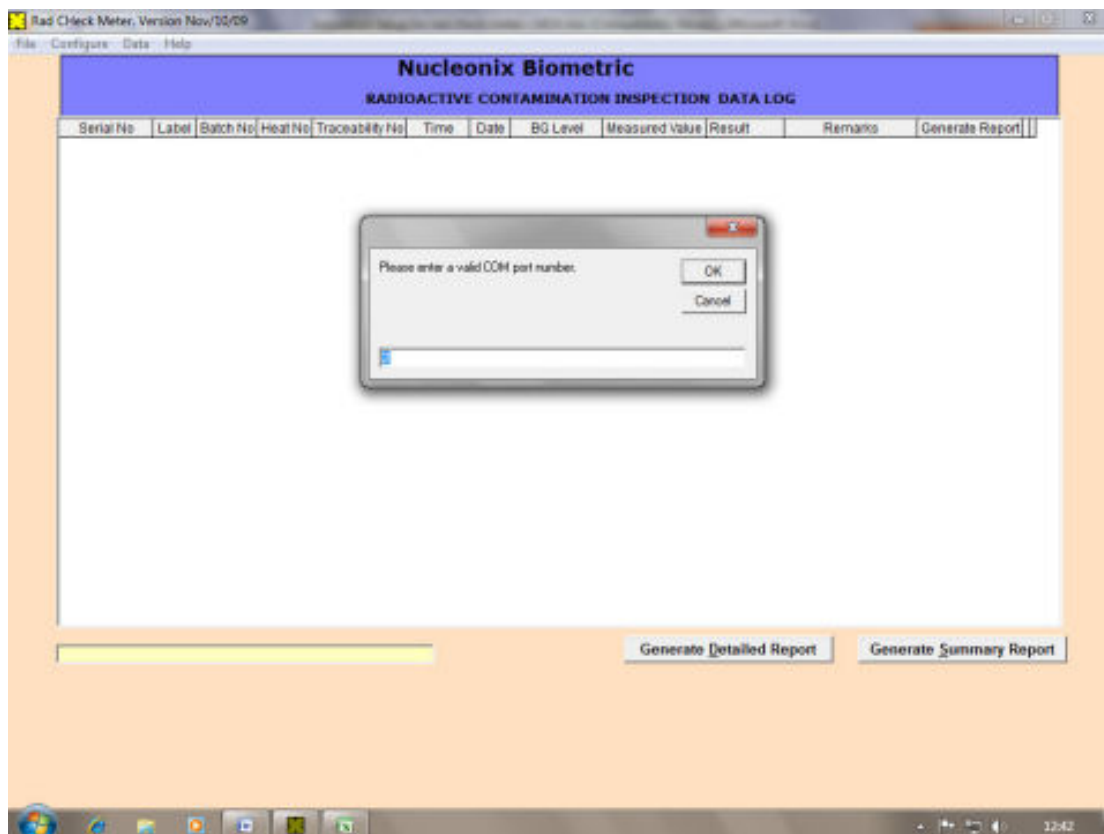
→ Installation complete successfully. You can check by going to My Computer "C" Drive and in that you can see NSPL folder open it and create a short of RAD CHECK.exe on desktop. Double click on Rad check.exe file then you can see the following screen.



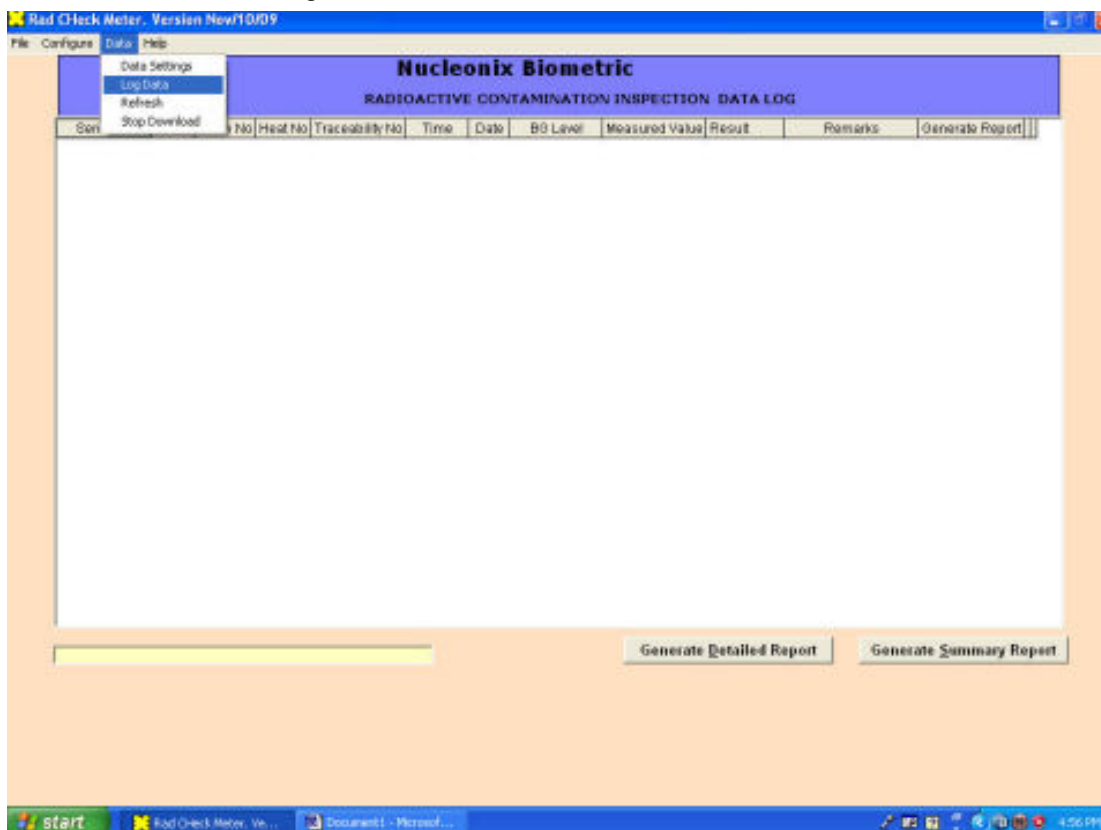
→ Now click on the configure button and select the com port



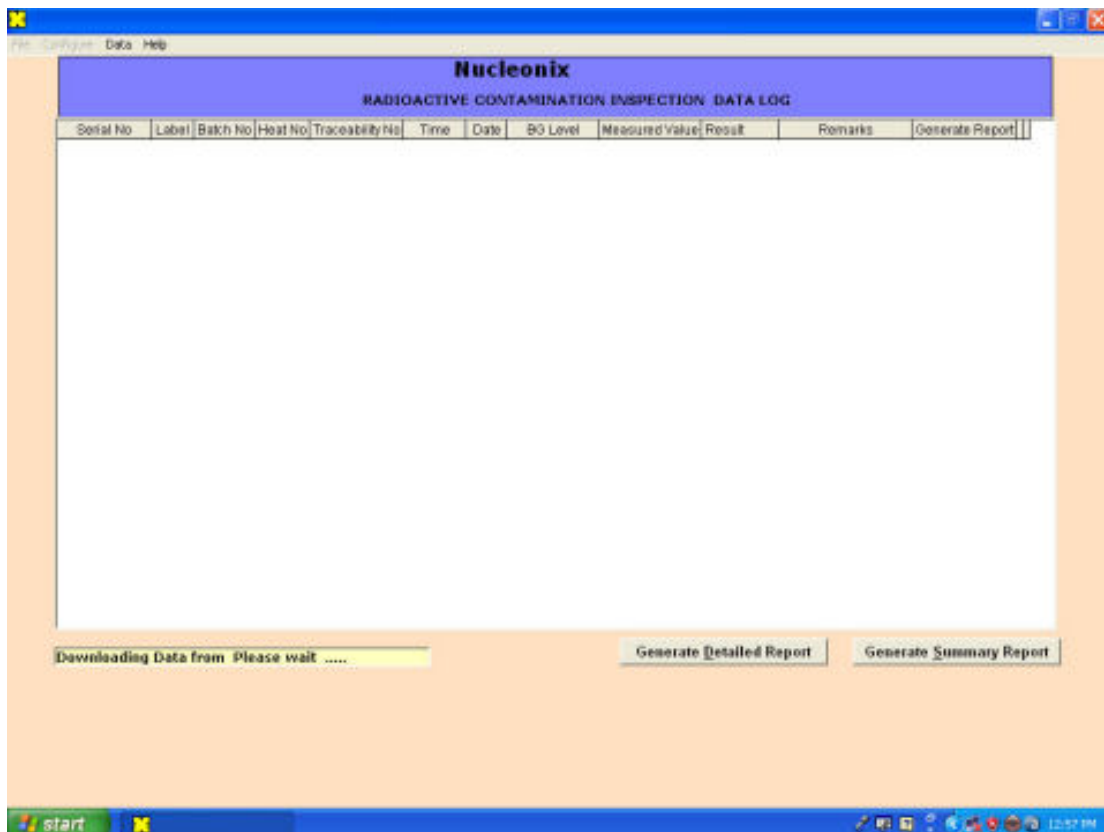
→ Now you can see the following screen. Now you can enter the com port number in the given slot as "1" and press OK.



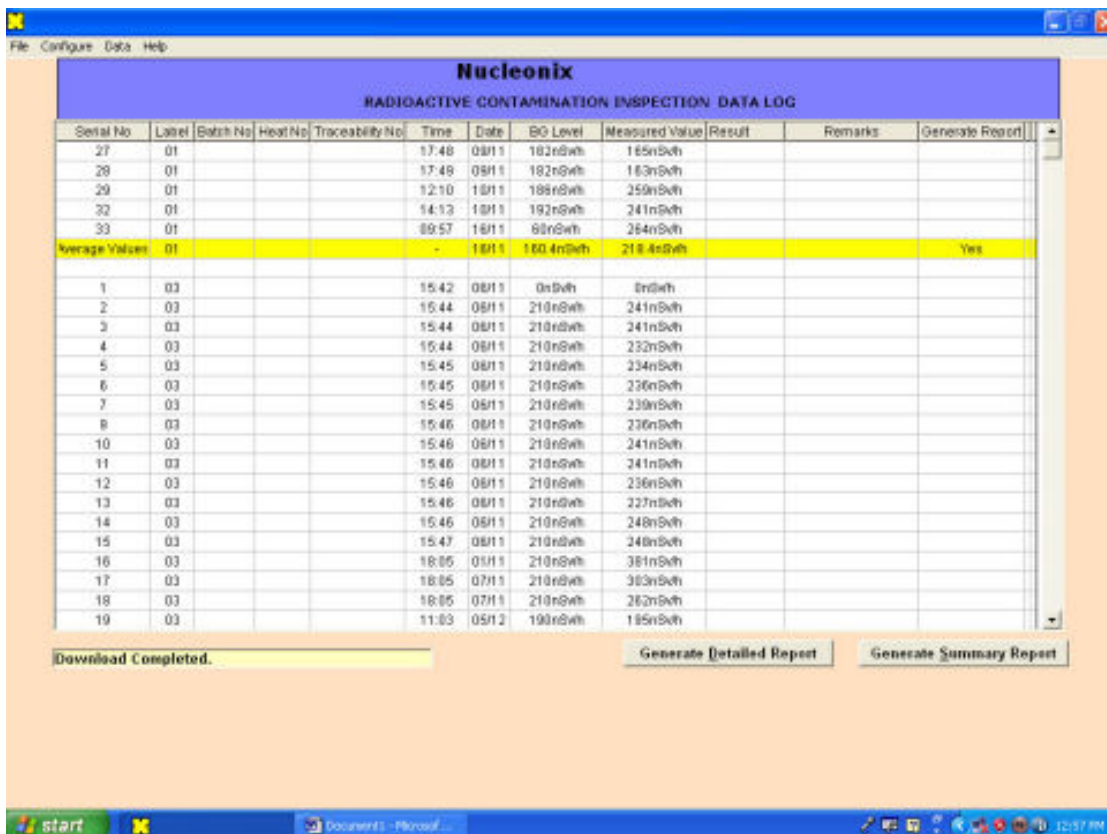
→ Go to data button and select "Log data"



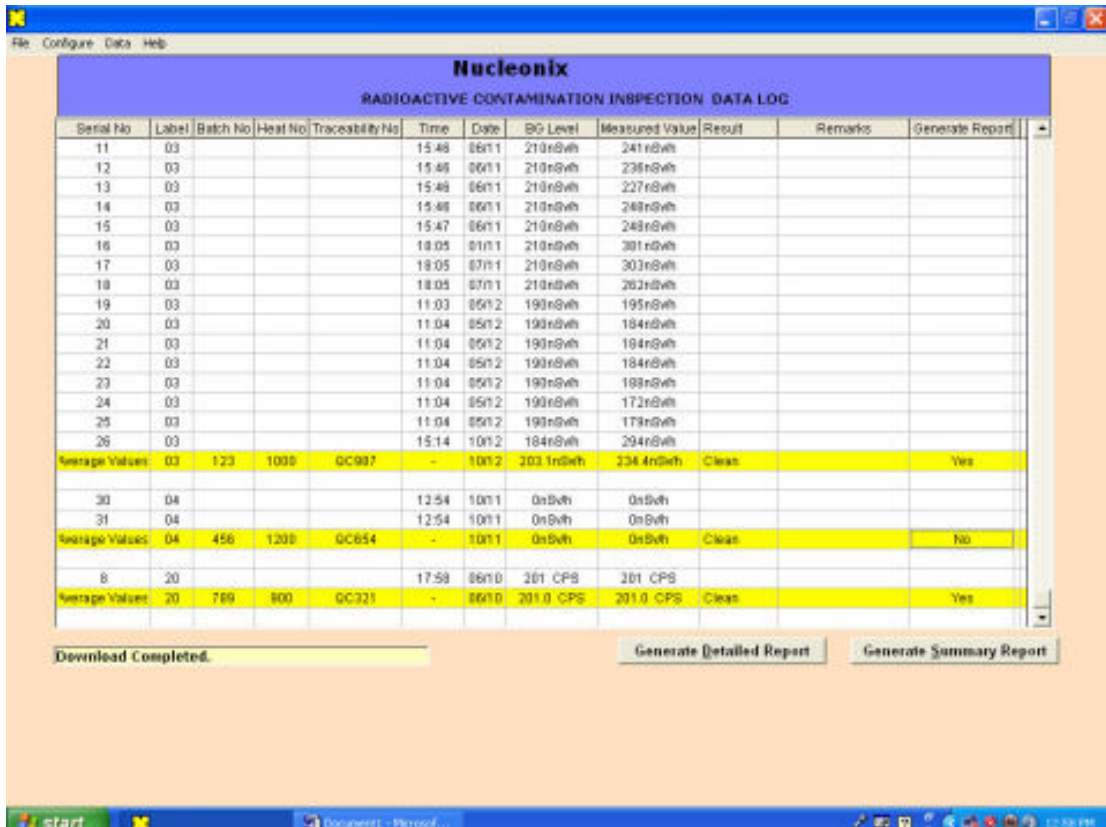
→ After pressing the Log data it show that is downloading data.



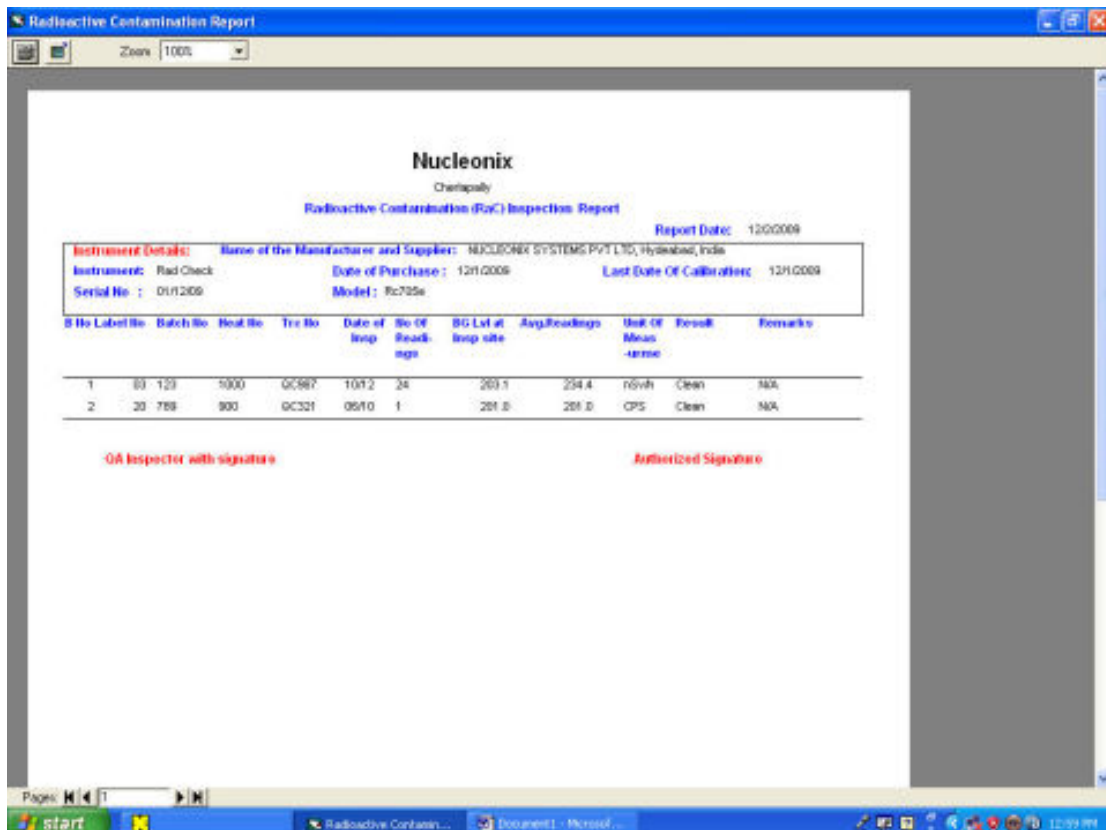
→ After that you can see the following screen.



→ For generating the report of the required data it should be "YES" on the getting report column. If it is "NO" you click once it will change. You should enter the data in respective columns like batch no, heat no, traceability no and result then click generate summary report.



→ You can the reports as follows. You can also take the print by clicking print option on the tool bar. By this the report generation is over.



CHAPTER - IX

FREQUENTLY ASKED QUESTIONS (FAQ)

Radioactive Contamination (RaC) issue is a new phenomenon for the recycled steel and foundry industry including automotive and engineering component industry. These RaC issues are important to all exporters to Europe, USA, UK & Japan. Low level contamination cases have been found to be more in the recent past. Nucleonix systems with vast design experience in the field of nuclear instrumentation have developed a package of products for the detection and measurement of RaC for this industry. Based on the questions encountered from the industry, we thought it may be appropriate to put these queries in the form of FAQ's and make an article so that majority of the industry personnel are benefitted.

1Q) What is Radioactive Contamination in Steel / Iron / Alloy / Casting Products?

A) Scrap metal, engine block scrap and other miscellaneous scrap (incoming) when purchased, may get mixed up with any of the Radionuclide substances (Sources), such as Co-60, Am-241, Cs-137 etc. (medical & industrial sources) can enter the factory accidentally leading to Radioactive contamination, when processed further in a steel industry. Also semi-finished inputs such as flats, bars, rounds, castings, other parts, received from vendors as inputs to automotive or Engineering component industry may have radioactive contamination already.

2Q) How it can happen?

A) There are lot of industrial & medical radioisotope products used in cancer hospitals & industries. When they are disposed, illegally, (not following AERB guidelines) it is likely that they come into steel plants & large foundries through input scrap metal or through semi-processed inputs purchased from other industrial unit, & can lead to radioactive contamination of the end product.

3Q) What is the remedy & how to detect & segregate contaminated parts?

A) There are sensitive low level radioactive contamination inspection systems, Truck/container monitoring systems (large) and smaller Portable instruments offered by companies' world over. In India, Nucleonix Systems a reputed company with its vast design, development & manufacturing experience into Nuclear Instrumentation has developed a package of products to meet requirements of steel industry in different situations to detect radioactive contamination.

4Q) Which are these products?

A) The following are the products, offered by Nucleonix Systems

1. Rad check meter (With Internal detector) RC 705I
2. Rad check meter (With external detector probe) RC 705E
3. Radioactive Contamination Analyzer (Bq / gm system) RA 1006
4. Package monitoring system PMS 1009
5. Truck / Container Monitoring System For Radioactive Contamination TR 1021

5Q) Apart from products being offered by Nucleonix Systems to measure RaC, whether Nucleonix also offers RaC measurement & analysis services? If yes what kind?

A) Yes. Nucleonix offers (a) Radioactive Contamination Analyzer inspection services for all exporters at site & issues certification and (b) we accept samples (Approx 1Kg) by courier for RaC analysis to give certification in Bq/gm which is required in some cases. (Few customers are availing our services.)

6Q) What is Rad Check Meter, in what situations we can use this product?

A) It is a sensitive, economy model which checks for radioactive contamination (Photons / Gamma Radiation) in steel/Alloys/ Iron samples / scrap metal, Automotive and Engineering components, when the meter front face is kept close to sample (almost touching). It is a hand held instrument suitable for scanning manually. There are more than Five Hundred meters supplied by us throughout the country, which are widely in use. Recently we exported these meters to few countries.

7Q) What is a G.M detector based Radiation monitor? Whether one can use it for checking of Radioactive Contamination in steel / iron/ alloy / castings products?

A) Low cost G.M. detector based meters are offered by some companies & they cannot detect low level radioactive contaminations. Higher contamination levels, only they can detect & hence are not recommended for this application.

Only sensitive meters which can measure Dose rates from 1µR/hr or 10 nSv/hr onwards are to be used. At Nucleonix System we have a product called Rad Check Meter in our range. This is a portable meter to be used either with internal or external probe.

8Q) When Truck/Container Monitoring System is to be used for Radioactive Contamination? How does this help?

A) This system comprises of two large volume plastic scintillator detector pillars, electronic measuring & alarms unit and software with PC. Highly recommended at the entry/exit gates to check for radioactive contamination in. In-coming trucks / containers carrying scrap metal, input raw material, iron, steel, alloy products etc. Also it can be used for checking outgoing finished goods in trucks / containers.

Inspection at the 1st entry level saves the industry from buying contaminated scrap metal & saves on electricity bills & other processing costs by melting the scrap metal in smelting furnaces

9Q) When Radioactive Contamination Analyzer (Bq/gm system) for Nuclide Identification & its quantification is to be used?

A) This is a powerful tool used for exact quantification of nuclide, present in a contaminated sample. This system identifies & quantifies the contamination in Bq/Kg or Bq/gm of the sample. This is an ideal choice in quality assurance departments of all steel. / iron / alloy/Foundry casting industries (medium & large). This facilitates loading of sample up to 1 to 2 kg on to the detector area, for measurement.

10Q) What is the 'unit' of measurement that is normally used in these above systems?

A) Normally the units used in these meters globally are Sv (sivert). In India we have been using R (Roentgen). But Nucleonix Systems has been providing both these units Sv & R. Additionally meters may have CPS , CPM , modes. All Nucleonix meters have FOUR modes of operation nSv/hr, µR/hr, CPS, CPM. In the Rad Check Meters you may find µ R/hr (micro roentgen / hour) & nSv/hr (nano sivert / hour)
 $\mu = \text{micro} = 10^{-6}$
 $n = \text{nano} = 10^{-9}$
 $m = \text{milli} = 10^{-3}$

11Q) Can we have some idea on measuring units used? How do you define Sv & R ?

The SI unit of dose equivalent

1 Sv = 1 J /kg (one 'Joule' of energy deposited 1 kg of air)

Roentgen (R) : Is defined as the exposure that results in the generation of 1 electro static unit of charge (2.0 g X 10⁹ ion pairs) per 1 cm³ of air STP (0.001293 gms)

1= 2.58 X 10⁻⁴ C/Kg.

Gray: Absorbed dose is a measure of energy deposition in any medium by all types of ionizing radiation and 1GY = 1J/Kg

Since an exposure of 1 R results in an energy deposition of 869 X 10⁻⁵ J/Kg in air it follows that

1 R = 869 X 10⁻⁵ Gy

1 R = 8.69 m Gy milli (m) = 10⁻³

1 R = 10 m Gy micro (?) = 10⁻³

1 R = 10 m Sv nano (n) = 10⁻⁹

1 Sv = 1R/10m

1 Sv = 100 R

12Q) Can we have some conversions between Sv & R ?

1 Sv/hr = 100 R/hr

1 mSv = 100 mR/hr

1 μ Sv = 100 μ R/hr

10 nSv = 1 μ R/hr

10 μ Sv/hr = 1000 μ R/hr

= 100 mR/hr

0.1 μ Sv/hr = 10 μ R/hr

13Q) What is Becquerel (Bq)?

SI unit of activity. It is defined as no. of radioactive transformations or isomeric transitions per second = 1 Bq. It defines the source 'activity' or 'strength'

14Q) What are the clearance levels radioactive contamination in European countries, UK & USA?

Allowable Limits for Radioactive Contamination Analyzer in steel in different countries are given below. USA it is nil.

European Union = 1.0 Bq/gm

Germany = 0.1 Bq/gm

U.K = 0.4 Bq/gm

Japan = 1.0 Bq/gm

IAEA (BSS) = 1.0 Bq/gm

For Material upto one tones IAEA = 0.1 Bq/g

For bulk material without limit ICRP= 0.1 Bq/ gm

However it may be good practice to observe the limit as <0.1 Bq / gm

15Q) What is Natural background radiation?

A) In the nature exists background radiation, due to geo-structure, terrain, rocks, cosmic radiation flooring, tiles, walls etc. also contribute to background radiation levels. Natural background varies from place to place and could be in the range of (3-4) μ R/h to (30-40) μ R/h. (0.03 μ Sv/h to 0.4 μ Sv/h). At a single location also, natural background varies and this is called statistical variation. For practical purposes, we take the highest observed reading in a location as natural background.

Rad check meter is an instrument which measures radiation dose rates from natural background radiation levels onwards. Its sensitivity is typically 1 μ R/hr or 0.01 μ Sv /hr.

16Q) Is natural background level different at different places?

A) Yes, it is different in different cities & places, for e.g. in Hyderabad, India it is more, it is approx 30 μ R /hr. In Mumbai, India it is approx (6 to 8) μ R/hr. (About FIVE times less than that in Hyderabad).

17Q) Whether contamination reading as shown in the display will be same in different places for the same sample under same measurement condition?

A) No, unless the background level is same at two different places where you would have made measurement, meter reading will be different for the same contamination levels. This is because the background at these two places may be different.

Please note that natural background levels get added up to the meter reading along with reading due to sample contamination, i.e.,

Meter reading = Sample contamination + Natural Background

However if you account for reading due to background, then reading due to sample will be same, in the different places.

18Q) What is check source & why is it required?

A) Check source is a small (low level) Radioactive Gamma Source (Cs137). This is basically required to check whether your Rad Check Meter RC705 is responding to radiation.
To check your Rad Check Meter, place the radioactive source close to the front face of the meter & observe the meter reading to go up. When you take the source away, the reading drops.
This check source also could be used for carrying out QA of the product by verifying the stability of the reading with source over the one year period when calibration is valid. In case there is a drift of more than 10% with respect to the initial reading when procured from factory, contact factory as there could be some problem with the instrument.

19Q) Does this "Rad Check Meter" indicate nuclide type and absolute level of contamination?

A) No, this meter primarily indicates (gross) or total contamination in relative terms. The reading also varies with distance from the sample.
If your interest is to know absolute nuclide which has contaminated (such as Co-60, Cs-137, Am-241 etc.) and its contamination level in terms of Bq/gm, then you need to go in for our Radioactive Contamination Analyzer (Bq / gm system) RA 1006. This is a foolproof test and recommended for steel industry having smelting/ induction furnaces.

20Q) Is there any Equipment offered by Nucleonix Systems to know the exact nuclide which has contaminated? Whether the equipment can quantify the contamination level in Bq/gm or Bq/Kg?

A) Yes, we have a system already in our manufacturing range, which is being used now by many customers in steel industry who have induction furnaces & manufacture products like billets, bars, flats, rods etc.
This system is called Radioactive Contamination Analyzer (Bq / gm system) RA 1006.
This system records gamma ray spectra of different isotopes present in the sample under test & spectra can be analyzed to know the type of nuclide & also its contamination level in terms of Bq/gm or Bq/kg.

21Q) Which unit of measurement is recommended for measurement in Rad Check Meter?

A) Since 'Seivert' is used in EU & UK it is better to measure in nSv/hr using Rad Check meter. Of course one can also measure in ?R/hr, but has to use conversion factor for interpretation in ?Sv/hr or nSv/hr if required.

22Q) Can we have conversion from $\mu\text{R/hr}$ or $\mu\text{Sv/hr}$ or nSv/hr to Bq, as Rad Check Meter does not measure in Bq?

A) Conversion from $\mu\text{R/hr}$ or $\mu\text{Sv/hr}$ or nSv/hr to Bq for a contaminated steel sample is difficult. Conversion factor cannot be given right away for the following reasons.
One is size, shape, mass of sample & sample orientation distance from the detector probe face etc influence while making measurement & hence one cannot give exactly any conversion. Also detector efficiency, Background, also are to be accounted. Further since contaminated source is embedded into steel, there will be self absorption.
It is possible to give conversion for a point source (standard source) if we know the type of nuclide.
Also in respect of contaminated steel samples, we are not sure that contamination spread, is uniform (homogeneous) throughout the mass. Precisely what we measure is what is emanating from the contaminated sample which is measured & quantified. What is embedded deep inside, which may not be emanating because of energy loss when the gamma photons reaches the surface of the sample will not be detected. Since it is not emanating it is of no consequence.

However, it is possible to make a fair judgment & arrive at a conclusion to declare a component as

i. CLEAN

ii. CONTAMINATED Or

iii. SUSPECTED CONTAMINATION/LOW LEVEL CONTAMINATION CASE

Please go through our website www.nucleonix.com & read the content under "case studies report". This will clearly give an idea on declaring a product into three categories as said above.

By going through our case studies report-1 & by making proper measurements & analysis one can perhaps say that contamination is less than 0.1Bq/g. But for exact quantification one has to go through analysis by Radioactive Contamination Analyzer only. Using Rad Check Meter you can definitely classify the product and say whether it is

i. CLEAN

ii. CONTAMINATED Or

iii. SUSPECTED CONTAMINATION CASE

Also if your industry is a steel mill / Foundry having induction / smelting furnaces, it is absolutely necessary to go in for Radioactive Contamination Analyzer to obtain contamination in Bq/g & also to identify type of nuclide that has contaminated.

23Q) Is Rad check meter a Radiation calibrated meter? What calibration standard Nucleonix Systems has at their works / factory? Up to what accuracy it reads.

A) Nucleonix Systems has two calibration labs.

i. Low Level Calibration Lab :

ii. High Dose Rate Calibration Lab

Rad Check meters are calibrated at low level calibration lab using a Gamma survey instrument calibrator make Amersham , UK/USA. It has NIST (National Institute of standards & technology, USA) traceability.

Rad check meter is calibrated upto 15% accuracy for readings above 100 μ R/hr.

24Q) Whether this Rad Check meter measure natural background radiation accurately at any Place?

A) No, this gives a background reading slightly lower than the actual natural BG. This reading we can call it as the base value. Rad check meter is designed to be more sensitive on the front face of the detector so that it can detect Radioactive Contamination (RaC) from a longer distance compared to an ordinary Micro-R-Survey meter. It is for this reason the meter will show less reading of natural BG.

25Q) When do we say that the product under inspection is contaminated?

A) If you are making measurement with Rad Check Meter & if the reading (when you touch the component closely with meter) goes even slightly higher than the background then one can declare that component as contaminated.

Even, if the reading remains equal to BG or goes marginally lower than BG when you touch front face of the meter to the sample under test then also it is a case of suspected contamination. Under this condition checkup more thoroughly & it could be a case of low level contamination.

Best way is to take more mass or material & touch the meter close to the mass & if the reading increases than the previous one then it is a contamination case.

- 26Q) If it is suspected contamination case (SCC.) what to do? How to analyze further to ascertain on the status of contamination?
- A) In a suspected contamination case it is essential to make a through check. Take large amount / mass of sample and if the meter reading goes up with increased mass, then, it is definitely a contamination case. Also you can send the samples (1kg) to Nucleonix systems for further analysis using Rad Check Analyzer which is a 100% foolproof method of identifying RaC.
- 27Q) When do we say & can declare a product to be clean from RaC? (using Rad Check Meter)
- A) First record the background (BG) & then go to acquire mode & record BG. Now touch the meter to the surface of the component under inspection if the reading shown goes 10 to 20% lower than the BG reading, then the sample can be declared as clean.
- (If the reading is very close to BG & marginally less or equal to BG it is a suspected contamination case).
- 28Q) Is fixing preset alarm level advised or not for RaC inspection? Or one should look at the readings carefully & interpret?
- A) Please do not fix any preset alarm level for RaC inspection. Best way is to touch the meter to the component & observe the reading (dose rate) to check how closely it is to BG or away from BG or lower than BG. Based on this reading only one should interpret.
- Fixing preset alarm level above BG & checking or interpreting for RaC can be misleading & one can miss definitely low level contamination cases. Hence never do this for RaC inspection.
- 29Q) What is the difference between suspected contamination case (SCC) & sure contamination case?
- A) Suspected contamination case is a situation, when the Rad Check Meter reading is very marginally lower or same as the BG. This happens if the contamination levels are very low of the order of 0.1 to 0.4 Bq/g.
- Under this condition take larger mass of 3/4 kg or much more & touch the meter if the reading goes higher then it a sure contaminated case. Also initially it when you touch the component / part if the reading goes higher than BG, even slightly more, then it is a sure contamination case. Reading need not be 2 times or 1.5 time BG. It can be slightly higher than BG. If you are not sure & think that the sample needs thorough investigation, then send it to Nucleonix for detailed analysis.
- 30Q) What should be the minimum mass & size of the sample to check for RaC using Rad Check Meter?
- A) It is advised for one to take a sample of mass at least of three Kg (approx) or more but not less. Also the size & shape of the component should be large enough to cover the complete front face of the detector probe / meter, so that detector face is covered by the sample when touched. Higher the mass, results of inspection will be more authentic.
- If your product is small in size & less in wt, then put multiples of these components together such that mass & front face of the meter covering criteria, is met. This is important.
- 31Q) What should be technical qualifications of the person operating the instrument?
- A) The person should be a basic science graduate or a diploma engineer with an understanding of radiation. He/she should be very responsible and meticulous in taking the measurements.

32Q) What is Calibration Factor:

A) This is set at factory by Nucleonix when the equipment is calibrated in Radiation calibration lab. It may be from (0.75 to 1.5) depending upon the sensitivity of the detector. It is not same for all meters. It can be different for different meters of same type. Customer should not change this calibration factor, which is password protected. If changed will give wrong results and data.

33Q) How many background readings are to be noted and averaged to take as authentic background reading.

A) Typically 3 to 5 Background readings, averaging should be alright.

34Q) Whether Non-Ferrous Metals, such as copper, aluminum, zinc, brass & non-metals such as plastics, wood etc also can get Radioactive Contamination?

A) Normally not. Not heard of.

35Q) Can only packaging materials such as packing nail, metal strap (MS) etc. get contaminated and not the actual product under export?

A) Yes, there are such cases which have happened and hence, even these packing nails / metal straps are also to be checked for radioactive contamination.

36Q) We manufacture SS, billets rounds, square bars which are longer. Our question is at how many locations we should make measurements with Rad check meter? If it is contaminated, will it be uniform throughout the length?

A) Measurement at 2/3 locations in full length may be enough approximately one reading per meter may be enough. If it is contaminated, largely it will be distributed homogenously. Of course a non-uniform distribution of RaC is not ruled out. Your measurement readings at two/three locations will give you an idea on this.

37Q) Our Industry manufacturers small sized components such as fasteners, SS rings, door hinges, latches etc., Question is if the components are small in size do we have to check each component? If we check each component separately whether results are meaningful?

A) If the components are small in size, then you can group them to make about 3 kg, put them in a plastic pouch & cover complete front face of the detector. This will satisfy the mass & size criteria. Measurements are to be carried out in this fashion only. If you check each component separately results will not be meaningful as mass & size criteria are not met.

38Q) Can Garments such as Jackets having iron rings, and fancy buttons of iron / SS get contaminated

A) Yes, It is possible and hence exporter of these goods with iron rings and fancy buttons of ferrous and SS materials have to check for radioactive contamination.

39Q) Can one avoid making measurements at product processing level or check only final packed wooden crate containing finished products in packed condition?

A) It is quite risky & since you will not be touching the components very closely, as wooden crate will prevent you meter touching the components, there is a possibility of low level contamination being not detected. This can be damaging to you. Hence we recommend inspection at different stages of production cycle. Also by detection at early stage of production cycle, you will save on processing costs by not processing the contaminated input material.

40Q) If you suspect radioactive contamination in your products, (final or raw materials) what is to be done by you?

A. After, ascertaining that there is a strong case of Radioactive Contamination by measuring with any of the suggested products, you can approach, Atomic Energy Regulatory Board (AERB) in India or appropriate regulatory authority in your country for further help & guidance, who will advise, actually after they inspect, your premises, on what do & how to dispose contaminated material. Please contact Head, Radiological Safety Division, AERB, (Address given below is for Indian customers)

Contact: Head

Radiological Safety Division,
Atomic Energy Regulatory Board,
Niyamak Bhavan, Anushaktinagar,
Mumbai 400 094.
Fax : 022-25990650
Mobile : 9820864880

41Q) You have mentioned that for clean sample BG reduces by 15% in your user manual. How did you get this figure? How one should really make meaningful measurements to declare a sample a) Clean, b) Contaminated & c) Suspected contamination case ?

A) Please understand, all our observations made are based on case studies go through website done by us, for identification of Radioactive Contamination (RaC) for three situations a) Clean (b) Contaminated or c) Suspected contamination case. We have clearly mentioned in our case studies, for a clean sample when you touch the sample, background (BG) reduces from its initial value depending of the thickness/mass of the material. If the sample is clean as it is preventing natural background entering the probe the reading will fall, that is the theory.

These case studies were done in Hyderabad, India in Hyderabad BG is 30 μ R/hr. we observed this phenomena of BG reducing by more than 15% for all clean samples. In some other locations/cities, BG could be low and reduction BG could be 10% to 15%, even in such cases also the material could be clean. For e.g., in case studies table for sp4 which we have classified as low level contamination, we find that by Radioactive Contamination Analyzer (Bq/gm System) method Bq/g was found to be 0.076 Bq/g which is a permissible level(<0.1 Bq/g). Hence this is a relative comparison and a guide for you to make measurements and arrive at meaningful conclusion. (These are the relative figures). You must understand the logic of making measurements.

Another situation, if it is contaminated to higher levels then reading will go higher than the BG. In which case you can say that the sample is contaminated. In case of low level contamination, reading may remain same as BG or it may fall by upto to 7% than BG, then it is a suspected contamination case. So in this kind of situation it is difficult to identify by Rad check meter some times. May be you can send one kg sample from that heat to our Radio-analytical lab for detailed analysis by our Radioactive Contamination Analyzer (Bq/gm System) which will indicate nuclide type that has contaminated & also quantify in Bq/g (This is a fool proof method)

Please go through our case study reports closely as given in the website, from that you will observe in case of suspected low level contamination the BG fall is relatively less (By 1% to 7.5%). All these case studies were undertaken by Nucleonix Systems with the interest to help the Steel Industry in identifying & tackling the radioactive contamination in their products. It is up to you to use this data for your benefit & advantage. We are not aware whether anybody else has done this kind of case study. You please check up with AERB/BARC on this subject if you wish to know further. Our studies are to help our customers in using our products to identify a contaminated sample.

One can notice from the case studies that as % BG fall, reduces contamination levels in Bq/g increase. Fair conclusions : We can say that if BG falls by more than 8 to 10% by meeting the mass / size criteria to cover the detector face, then one can conclude that sample is having contamination levels < 0.1 Bq/g which are in acceptable limits. If the BG falls more than 12 to 15% or above then the sample can be declared as clean.

If BG falls 1% to 8% or remains same as BG then it is a suspected contamination case & if the levels are above 0.1 Bq/g then it is a contamination case.

41Q) Allowable limits of contamination being less than 0.1 Bq/gm, where as Rad Check meter measures in $\mu\text{R/hr}$ or nSv/hr mode only?. How one can one correlate or come to conclusion that the contamination is less than 0.1Bq/g? (of course in other European countries acceptable level is less than 0.5Bq/g).

- A) This is partly answered in the previous QA 40. We would request you to go through our website, Information about case studies, thoroughly.
Quality Control person has to know how to identify a component as
- Clean (BG falls more than 12% on contact with sample)
 - Contaminated or (increases more than BG)
 - Suspected contamination case (BG falls marginally up to 8% or remains same on touching the Sample)

In (a) & (b) cases, it is easily identifiable by Rad check meter. of course the sample size, thickness, mass criteria etc should be ensured, it should cover the front face of the detector completely when you touch the detector to the component (If the components are small in size, then you can group them to make about 2/3 kg, put them in a plastic pouch & cover complete front face of the detector).

To identify suspected contamination we have also given criteria. In such a situation, by going through our case studies reports & by making proper measurements & analysis one can perhaps say intuitively that contamination is less than 0.1Bq/g. But for exact quantification one has to go through analysis by Radioactive Contamination Analyzer (Bq/gm System) method only. Analysis by Radioactive Contamination Analyzer (Bq/gm System) Bq/g method for exact quantification is 100% authentic & foolproof. In case you encounter suspected contamination case, then you can send such type of suspected samples of about 1 kg from each 'heat' for analysis to our Radio-analytical lab.

Another important thing is all the Steel mills and also the foundries who have furnaces at their factory can purchase Radioactive Contamination Analyzer (Bq/gm System) install it at their QC department, which becomes an important analytical tool. And it will help in identifying & quantifying in Bq/g. Simply what they need to do is from each heat they have to take about one kg sample & put it for analysis to identify and quantify the contamination in bq/g .They can do self certification. As part of their QC. Already more than companies have purchased our systems for this purpose. This they can issue certificate to all their customers when they supply their products (Billets, Bars, flats, Castings etc).

ABOUT AUTHOR:

Sri. J. Narender Reddy, Founder & Managing Director of M/s. Nucleonix Systems Private Limited holds master's degree in Engineering with specialization of advanced Electronics from Jawaharlal Nehru Technology University, Hyderabad. Authorized more than TEN technical papers & presented in National seminars & Symposia. Is a Life member of Quite a few professional bodies such as Indian Nuclear Society, Indian Association for Radiation Protection, Indian Society for Radiation Physics, etc. Successfully executed several large-scale projects, Responsible for development of several first-of-its-kind products at Nucleonix systems.

CHAPTER - X

CASE STUDIES OF CONTAMINATED SAMPLES & REPORT

Components / Samples from a few Steel industries / steel component manufacturers / exporters were analysed at Radio-analytical lab of Nucleonix Systems for Radioactive Contamination (RaC). Also it is important to note that these measurements were made in the presence of Natural Background (BG) of 190 nSv/hr & $20\ \mu\text{R/hr}$ (approx). Applicability of these results/ summary is to be verified where the natural BG's are of the order of $5/6\ \mu\text{R/hr}$ or 50 to $60\ \text{nSv/hr}$. Our next case study with all these samples will be carried out at a location where the natural BG will be of this order.

Analysis was carried out by using three following types of equipments manufactured & offered by Nucleonix Systems.

1. Rad Check Meter (with Internal detector)
2. Rad Check Meter (with External Detector probe)
3. Gamma Ray Spectroscopy System with MCA

Measurement summary has been tabulated. As part of the study three clean samples (SP1, SP2 & SP3), low level contaminated samples (SP4 to SP8) & high level contaminated samples (SP9 & SP10) were studied. Data was recorded with Rad Check Meters in both nSv/hr & $\mu\text{R/hr}$ with sample in contact including Background (BG) as well. In respect of MCA data was recorded in Bq/g after acquiring the spectrum.

For analysis sample dimension / size & weight criteria as desired was observed. The following are the important conclusions one can make.

Clean sample : Both with Rad Check meters (Internal / external probe) when the samples were touched in contact, BG reduced from its initial value by almost above 18%. Hence from the tabulated data of case studies for samples Sp1 to Sp3 & Sp4 to sp8, we can make a fair conclusion that if the BG reduced by more than 10%, the sample is CLEAN. Of course it is very important that sample weight is at least 2 to 3 kg or more but not less & it covered full face of the detector / probe when measurement are made. If the components are small (page7, Fig - Sp9) then add up them to make it to meet the above mass/dimensional criteria, for better measurement data.

Effect of Weight factor : One more conclusion is if the sample is less in weight & thickness then, reduction of BG Percentage is found to be less.

Low Level Contaminated Samples : It is important to notice here in respect of samples (SP4 TO SP8) that BG has marginally reduced up to maximum of -7.5% when the meter is touched to component. Samples with level Low level contamination, when checked with MCA were found to have activity in the range of $0.076\ \text{Bq/g}$ to $0.264\ \text{Bq/g}$. **Percentage fall in BG is more if the contamination is less.** Perhaps one can fairly conclude if the percentage fall in BG is more than 10% then contamination could be less than $0.1\ \text{Bq/g}$.

However measurement by MCA analysis is most authentic. It is tricky & difficult to identify low level contamination, & quantity actual level in terms of Bq/g by Rad Check Meter. However one can say that it is a **suspected contaminated case** & needs to more study & thorough investigation. Now by increasing the mass, of the sample under measurement & by recording observations if one finds that % BG has come (that when the mass was less) close to BG, then, certainly it is a contamination case. However whether it is less than $0.1\ \text{Bq/g}$ can not be quantified by this measurement. One has to analyse this by GRS-MCA method.

High Level Contamination Samples: Samples (SP9 & SP10) were analysed & BG was found to increase from 40% to 80%. Hence when BG increases even by a small margin or remains same, one should suspect of contamination.

Rad Check Meter with Internal Verses External Probe : From the tabulated data one can notice that external probe behaved to be more sensitive – percentage reduction in BG was less compared with internal probe for low level contamination cases & for high level contamination, % increase was more compared with internal detector probe version. Hence we advise all steel industry people to prefer external detector probe version, though it is slightly costly.

In What unit, one should measure ?Is it nSv/hr or $\mu\text{R/hr}$: % BG increase for higher contamination case is found to be high in nSv/hr mode relatively compared to $\mu\text{R/hr}$ mode of dose rate measurement. Hence nSv/hr mode of measurement one should prefer. Also 'Sv' is an 'SI unit' & universally accepted (including in EU, UK & Germany and USA). Hence make measurements in nSv/hr preferably.

Hope this summary of conclusions will help you better in your day to day analysis & measurements. You may email us (info@nucleonix.com , info@nucleonix.net) for more information or send your sample for (Bq/g) analysis by MCA method in case of suspected contamination cases.

CASE STUDIES SUMMARY REPORT

Instruments used	Clean sample			BG (nSv/hr)	Contaminated samples									
					Low level contamination samples					High level contamination samples				
	Sp1	Sp2	Sp3		Sp4	Sp5	Sp6	Sp7	Sp8	Sp9	Sp10			
1. Rad Check Meter (Internal)	145	142	155	190	180	178	178	180	355	294				
% reduction, % increase for contaminated sample	-23%	-24%	-18%	-	-7.6%	-5.2%	-6.3%	-5.2%	+80%	+54.7%				
2. Rad Check Meter (External)	135	140	150	185	175	172	173	170	350	300				
% reduction, % increase for contaminated sample	-27%	-24%	-16%	-	-5.4%	-4.3%	-6.4%	-8.1%	+89%	+62%				
3. Contamination by GRS-MCA method (Bq/g)	Nil	Nil	Nil		0.076	0.136	0.14	0.264	1.8	1.8				
4. Size (Height* dia cm) and shape	Rectangular	Rectangular	Grinding ball		2 Rectangular block	Cylindrical	Cylindrical	Cylindrical	Nuts	Cylindrical				
5. Weight (grams)	1140	1074	867		1160	2150	2035	1407	630	1224				

Important Note:

- 1) For **low level contamination** cases, BG reduces marginally/ slightly when touched, by approx upto a max of 6% approx.
- 2) For **Heavy contamination** readings increased above background by a percent, depending on contamination level.
- 3) For **clean sample** reading decreased lower than BG to the extent of 10 to 25% depending upon the size/ shape & thickness of sample, obstructing the front face of the detector.
- 4) BG = Background Sp1 to Sp3: clean Sp4 to Sp8: 2 blocks, 47φ, 57φ, 38φ, 54φ Sp9: nuts Sp10: 37φ

CASE STUDIES SUMMARY REPORT

Instruments useds	Clean sample			BG (µR/hr)	Contaminated samples									
	Low level contamination samples				High level contamination samples									
	Sp1	Sp2	Sp3		Sp4	Sp5	Sp6	Sp7	Sp8	Sp9	Sp10			
1. Rad Check Meter (Internal)	15.95	16.1	16.6	20.5	19	19.65	18.95	19.3	19.37	29	28.1			
% reduction, % increase for contaminated sample	-22.1%	-21.4%	-19%	-	-7.8%	-4.3%	-7.51%	-5.8%	-5.51%	+40%	+37%			
2. Rad Check Meter (External)	16.1	16.4	17.9	20.9	19	20.1	20.65	20.0	20.1	34	33.5			
% reduction, % increase for contaminated sample	-23%	21.55%	-14.3%	-	-9%	-3.6%	-1.2%	-4.3%	-3.6%	+61%	+60%			
3. Contamination by GRS-MCA method (Bq/g)	Nil	Nil	Nil		0.076	0.136	0.14	0.16	0.264	1.8	1.8			
4. Size (Height* dia cm) and shape	Rectangular	Rectangular	Grinding ball		2 Rectangular block	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Nuts	Cylindrical			
5. Weight (grams)	1140	1074	867		1160	2150	2035	1407	1262	630	1224			

Important Note :

- 1) For **low level contamination** cases, BG reduces marginally/ slightly when touched, by approx up to a max of 6% approx.
- 2) For **Heavy contamination** readings increased above background by a percent, depending on contamination level.
- 3) For **clean sample** reading decreased lower than BG to the extent of 10 to 25% depending upon the size/ shape & thickness of sample, obstructing the front face of the detector.
- 4) BG = Background Sp1 to Sp3: clean Sp4 to Sp8: 2 blocks, 47φ, 57φ, 38φ, 54φ Sp9: nuts Sp10: 37φ

STEEL SAMPLES ANALYSIS FOR RADIOACTIVE CONTAMINATION & REPORT GENERATION



Sp1 - Clean sample



Sp2 - Clean sample



Sp3 - Clean sample



Sp4 - '2 valve' blocks manufactured by a steel industry are found to be contaminated



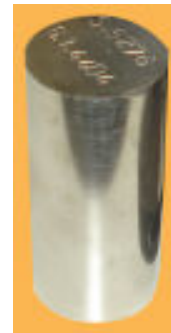
Sp5 - Steel rod sample from a steel industry found to have low level contamination



Sp6 - Steel rod sample from a steel industry found to have low level contamination



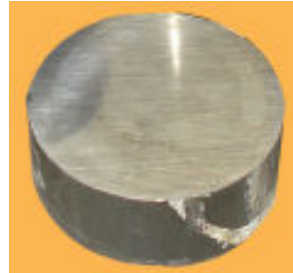
Sp7 - Steel rod sample from a steel industry found to have low level contamination



Sp8 - Steel rod sample from a steel industry found to have low level contamination



Sp9 - 'Steel Nuts' manufactured by a steel industry are found to have high level contamination



Sp10 - Cylindrical sample manufactured by a steel industry are found to have high level contamination

CHAPTER – XI

CALIBRATION CERTIFICATE

This is to certify that the following unit(s) has been calibrated at the Radiation Standards and Calibration Lab, using Gamma Survey Instrument Calibrator Model 773 of Nuclear Associate. This calibrator is traceable to NIST, USA.

Instrument Name : RAD CHECK METER (EXTERNAL - INTERNAL)
Nal Detector

SI.No. : _____

Type No. : RC 705B

Calibration Date : _____

Range Covered : 0 – 10, 000 μ R/hr

Calibration Accuracy : Within +/-15% (WITH CS 137)

Validity : One Year from the date of calibration

Over Load Test Passed : 10 times

Calibration Factor : _____

Head of R.S.O

Nucleonix Services Division

TO

CHAPTER - XII

EQUIPMENT MAINTENANCE SERVICES AND WARRANTY CLAUSE

12.1 GENERAL

As per the warranty clause of the company we provide one year warranty during which period we provide free service at our works. Hence in case of any mal-function in our instruments you are requested to send the unit back to our works by RPP/COURIER/SPEED POST PARCEL/GATI/XPS/door delivery. We shall arrange immediate rectification/replacement within two weeks from the date of receipt of the equipment at our place. Please note that the equipment will be serviced at our works only.

The equipment is to be sent to :

The Servicing Department
NUCLEONIX SYSTEMS PRIVATE LIMITED
Plot No : 162 A & B, PHASE II, I.D.A.Cherlapally,
Hyderabad - 500 051 Ph : 040-27263701/329145448/32918055
e-mail : info@nucleonix.com www.nucleonix.com

For all the Radiation monitoring equipment, detectors built-in or external probes will not have one-year warranty, only inspection warranty at the time of supply is provided. Since detectors will / may have fragile glass construction we do not provide warranty. In case of failure of these components at cost price as per Nucleonix price list user has to buy.

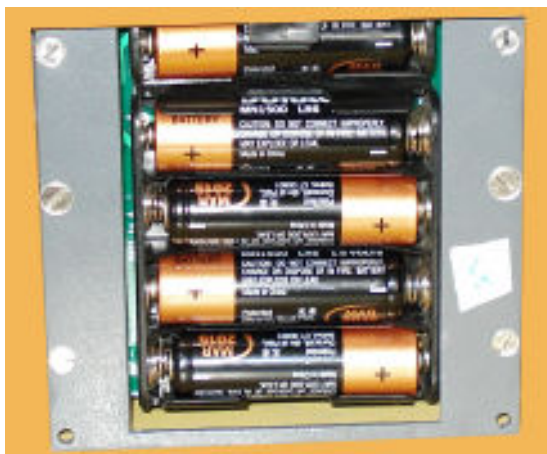
Note : In respect of all types of portable radiation monitors, it may be necessary to checkup and recalibrate the equipment once a year at our works.

12.2 HOW TO REPLACE BATTERY

When you observe battery low voltage indication 'LB', on left corner of LCD display, it is advised that the battery be replaced to ensure correct calibration and indication of the dose rates.

Follow the below procedure for replacement of battery

- a) Lift the two latches and disengage the top unit from its bottom cover. Now holding the bottom cover lift off the top unit by its handle.
- b) Notice battery holder on the bottom side of instrument electronic unit cover for battery holder is to be removed by unscrewing holder lid screws.
- c) Now the existing batteries mounted in the **battery holder** are to be removed and replaced with new set of batteries ensuring proper polarity.
- d) Now check battery voltage again, for that switch 'ON' the unit and see that 'LB' is not displayed on LCD display.
- e) Now assemble back the top unit in its bottom cover and close the unit using the latches provided.



12.3 HOW TO AVAIL SERVICES FOR EQUIPMENT REPAIRS (DURING & AFTER WARRANTY)

12.3.1 DURING WARRANTY

The following procedure is to be followed by the customers with in India for availing services / repairing facility during warranty period.

- For all equipments, costing less than 3.0 lakhs or equipments weighting not more than 20Kg, one year warranty & free service is offered, when the equipments are sent to our works only.
- Equipment is to be properly packed with adequate cushion to prevent any damages in transit. Nucleonix Systems is not responsible for damages or loss during transportation.
- Packing / Freight charge is to be borne by customer when he sends the equipment to our works. However when we return after servicing packing will be Nucleonix responsibility & Freight charges will be to your account.
- Please indicate in your correspondence equipment model & serial number.
- All the equipments are to be sent to our works only on door delivery basis.
- For Door Delivery Transportation contact XPS/GATI cargo in your city / town or a reliable courier service to pick the consignment from your place. For their nearest local address & phone no's look into their websites. Transit insurance if the customer feels is necessary it is to be covered.
- Nucleonix Systems will not receive the equipments sent by other modes of transportation, such as Rail/Road.
- After servicing equipments will be send back by same mode of transport such a XPS/GATI/COURIER/RPP.
- All types of Radiation detectors, glass ware, PMTs etc., which are fragile are not covered in warranty.
- You can also send the equipment personally to our works for repairs either during or after warranty, after fixing up with our service dept (Customer Support Division). If possible we may repair on same day or your person can stay for a day & get it repaired.

12.3.2 AFTER WARRANTY SERVICES

- On expiry of 1 year warranty if you like to send the equipment (low cost less than 3.0 lakhs & smaller in size & weight less than 20 Kg) of repairs to our works, you may please follow the following procedure.
- Submit, Service request form given here, mentioning that you agree to pay service charges which includes : Basic service charges per unit / module are RS:2000 + cost of components if it exceeds Rs:200 + packing charges (Rs:200) + Return Freight charges Rs:300 or actuals which ever is higher.
- Followed by this you can send the equipment straight way if it is within 5 years old. If the equipment is beyond 5 years old, then you can send it for repairs, only after you receive confirmation from Customer Support Division, that it is repairable & is not an obsolete model.
- For all equipments costing above Rs:3.0 lakhs which are to be attended in the field only, you can obtain a quotation with relevant details by submitting service request form & avail the services accordingly.
- For all field servicing jobs, since we need to depute engineers, it is likely, to take time & also it will cost more which includes Engineer's TA & DA etc., apart from basic service charges + cot of spares etc. Please note that basic service charges will be different for different products depending upon sophistication.
- For all jobs to be serviced in the field, customer is requested to provide adequate details on the nature of problems, to enable our engineer to come prepared with adequate spares.

12.4 CALIBRATION SERVICES (Applicable only for radiation monitors requiring calibration)

Nucleonix Systems offers radiation calibration services to its customers. Calibration services are provided for Nucleonix Systems manufactured products only, in general, as a company policy.

CALIBRATION STANDARDS LAB & FACILITY :

We have two calibration labs . (1) Low level Calibration Lab (2) High Dose Rate Calibration Lab

(1) Low level Calibration Lab : This has a Cs-137, 165 mCi standard. "Gamma Survey Instruments Calibration" from Amersham.

This has NIST Traceability Calibration of all portable radiation monitors, survey meters, contamination monitors, Area monitors etc., is carried out in this lab upto 1R/hr max doserates.



Gamma Survey Instruments calibration has Cs-137 source 161.5 mCi as on 5th Aug 2002. It is basically a Gamma Survey Instruments calibrator procured from AEA Technologies UK/USA. Has NIST traceability within +/- 7%.

(2) High Dose Rate Calibration Lab : This lab has a 8Ci, Co-60 standard housed in a CRC-2 camera, operated remotely viewed through CCTV arrangement. High dose rate survey meters, High level Area monitors etc are calibrated in this lab. This CRC-2 camera is housed in a separate concrete building. All the radiation monitors manufactured by Nucleonix Systems are authentically calibrated at this facility, before they are shipped / dispatched.



CRC-2 camera has Co-60 standard obtained from Bhabha Atomic Research Centre, Mumbai. It is a certified source

HOW TO AVAIL CALIBRATION SERVICES :

- It is best advised that each of the Radiation monitors including Area monitors are calibrated once in a year. When you want to send your Radiation monitor / Area monitor / Contamination monitor for calibration to our works, you may submit "**Calibration Services request form**" & send the equipment for calibration, by following the steps given below:
- Send your equipment along with your work order, if it is 5 years old or less.
- Also send work order & clearly indicate that you will agree to pay calibration charges & also equipment repair charges additionally if the unit is faulty & requires repairs before one can take it up for calibration.
- You are requested to ensure good packing to avoid any transportation damages.
- Use only the specified following mode of transportation system for despatching on door delivery basis. XPS/GATI cargo/Courier/RPP/Speed Post parcel etc., Send the equipment on freight paid basis. (Equipments sent by other methods such as Rail/Road etc., will not be collected).
- Immediately on receipt of the equipment, we will send an acknowledgement & also a proforma bill by email/post.
- Based on the proforma bill, once we receive the payment, equipment will be despatched back b similar mode of transportation as mentioned above.

CONTACT DETAILS

Contact us :

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Mobile : +91 9346645906
Land lines : 040-27263701/32918055
Fax : 040-27262146
E-mail : info@nucleonix.com or info@nucleonix.net
Website : www.nucleonix.com

General inquiry

Sales & Customer Support Division :

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Fax : 040-27262146
E-mail : info@nucleonix.com or info@nucleonix.net
Website : www.nucleonix.com

Sales inquiry, Product demonstration, equipment repairs, calibration, Installations & other services

Mr. J. Nishanth Reddy :

Head, sales & customer support division

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