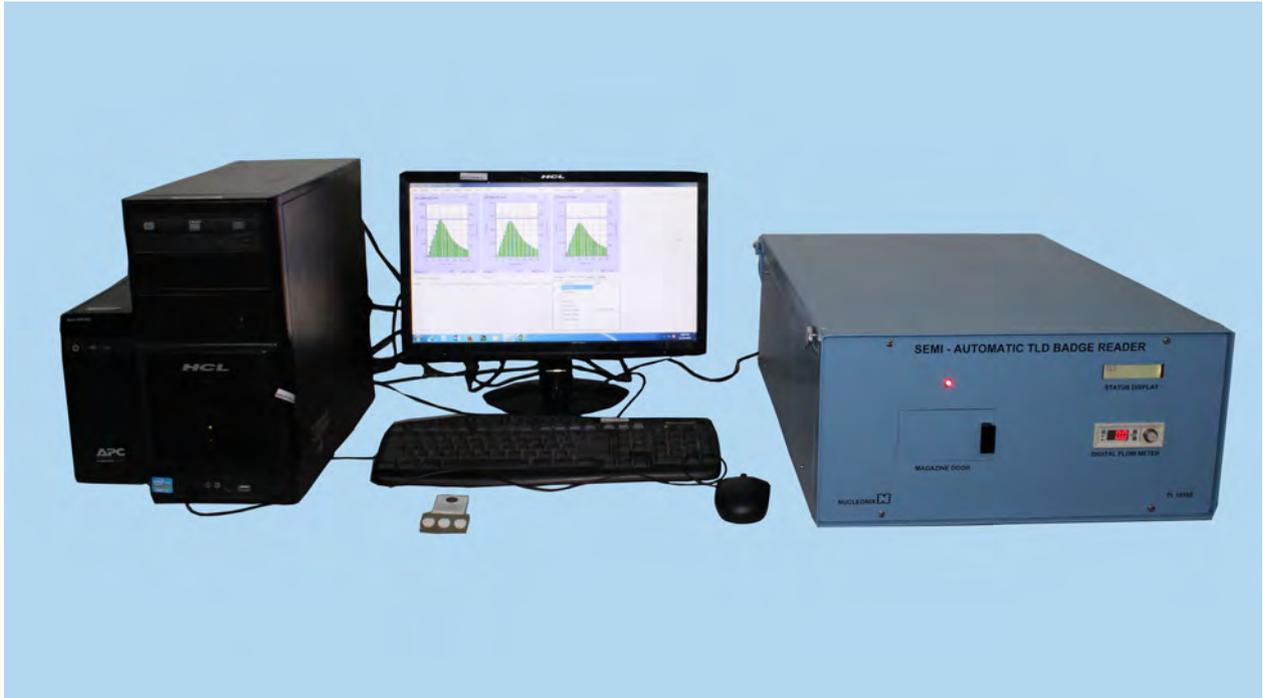


**SEMI-AUTOMATIC TLD BADGE READER**



**TYPE: TL1010S**

**NUCLEONIX SYSTEMS PRIVATE LIMITED**

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**FILE NAME : NSPL/DOC / MAN / TL1010S/01**

**VER\_20170124**

Head of the Dept.

*M. Pulla Rao*

Approved By



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## CHAPTER – I

### INTRODUCTION

**The improved Semi-Automatic TLD Badge Reader TL1010S** is a personnel monitoring system, developed & manufactured by Nucleonix Systems is primarily designed to read the TLD card (TL dosimeters) worn by radiation workers. Several Personnel radiation monitoring systems such as photographic films, pocket ionization chambers and thermoluminescent dosimeters (TLD) have been used for the routine evaluation of radiation exposures to personnel. Recently there has been a rapid increase in the use of TLD for personnel monitoring of radiation workers. The TLD systems are preferable over other systems because of several reasons such as,

- a. The availability of a variety of highly sensitive TL phosphors.
- b. Wide measurable range.
- c. Reusability of the dosimeters.
- d. Good post irradiation stability.
- e. Rapid read-out capability and
- f. Low cost and ease of preparation.

The TLD personnel monitoring system essentially consists of two major parts: TLD badge and the TLD badge reader.

The TLD Badge comprises of a plastic cassette containing a TLD Card made of aluminum with three Teflon TLD discs (13.3mm and 0.8mm thick) that are mechanically clipped on to circular holes (12.0mm) punched on it (52 x 30 x 1mm). Each TLD Card also comprises of a unique punched hole ID which is readout during the acquisition cycle for identifying the wearer of the TLD

This Semi-Automatic TLD Badge Reader is primarily designed to read Bhabha Atomic Research Centre (BARC) developed CaSO<sub>4</sub> (D<sub>4</sub>) PTFE disc dosimeter based TLD cards. These cards utilize three dosimeters.

The TLD Badge Reader is designed to measure X, Gamma and Beta radiation dose. The metal filter combination (1mm Al + 0.9mm Cu) is provided to reduce the photon energy dependence of the TL discs. The TL badge reader is calibrated such that the TL output of the disc under the metallic filter reads directly the gamma radiation dose.

The TLD Badge Reader system is designed using state of art electronics, stepper motor based electro-mechanical system, embedded code and software to load and read the TLD cards for TL glow curve / dose along with personnel ID. The system facilitates entry / printout of Dose records and glow curve for the personnel. TL dosimeter is heated by hot gas (N<sub>2</sub>) jet to 285°C using a Nichrome heater assembly & TL output is recorded using PMT whose integral of the current output is proportional to the dose.

In this thermoluminescent dosimeter based personnel-monitoring system, the radiation workers wear the dosimeter & the radiation exposure is estimated on the basis of TL dosimetric reading. Thermoluminescent dosimeters make use of the property of certain materials, which absorb energy when exposed to X, Gamma or Beta radiation. On heating, the absorbed energy is released in the form of visible light. A plot of light intensity emitted against temperature is known as a glow curve. For a given heating rate, the temperature at which the maximum light emission occurs, is called the glow-peak temperature and it is characteristic, of the individual TL material (also called phosphor).

The quantity of the visible light emitted (TL output) is found to be proportional to the energy absorbed by the TL material. The estimation of radiation exposure may be based either on the height of the glow curve (differential method) or the area under the glow curve (integral method).

#### **Accessories :**

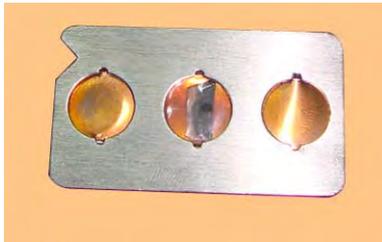
1. Light Source Card
2. TLD Card
3. Cassette
4. Magazine
5. Nitrogen Cylinder
6. Gas Regulator



Front View



Rear View



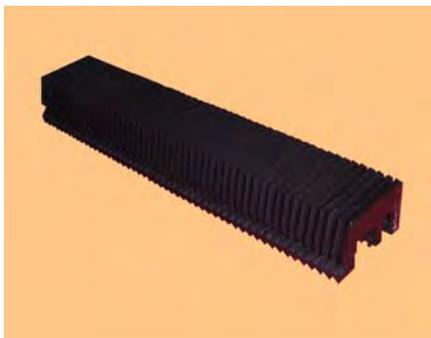
Light Source card



TLD card



TLD cassette



TLD Magazine



Gas Regulator



Nitrogen Gas Cylinder

**CHAPTER - II**  
**IMPORTANT IMPROVEMENTS & MAJOR DESIGN CHANGES INCORPORATED IN**  
**THIS SYSTEM INCLUDE**

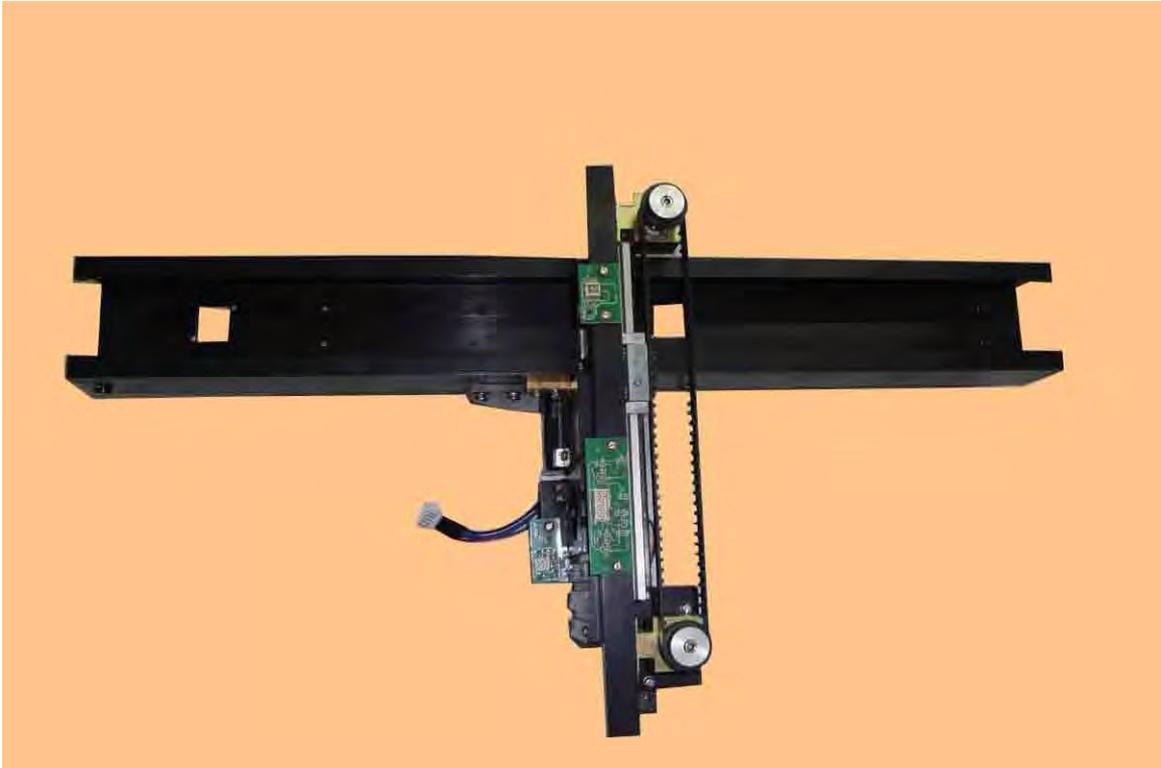
- Digital flow rate meter indication.
- Precision stepping motors for (a) Disc positioning (b) Magazine movement.
- Linear actuator control for shutter opening and card raise.
- Compact microcontroller based electronic circuit boards.
- All PCB interconnections are through mother board for better reliability & leading to minimal wiring.
- SMPS power supplies are use to achieve minimum size & also to accept wider mains input voltage range.
- Highly reliable electro-mechanics, to eliminate any TLD card skipping or strucking problems.
- Design ensures identicality of Auto & Semi-Auto TLD reader Electro-mechanical system, excepting for change of 'Magazine' & personal ID sensor electronics majority of electronics hardware embedded code & software is same in both cases, but for the additional required changes.
- Advantage of this system design is if one buys semi-auto reader they can get it upgraded to auto TLD badge reader with minimal changes & cost. This system design uses minimal parts. No adjustments or alignments required, as was the case in the old design.



**Semi-auto TLD reader setup with PC & Nitrogen gas cylinder adjacent**



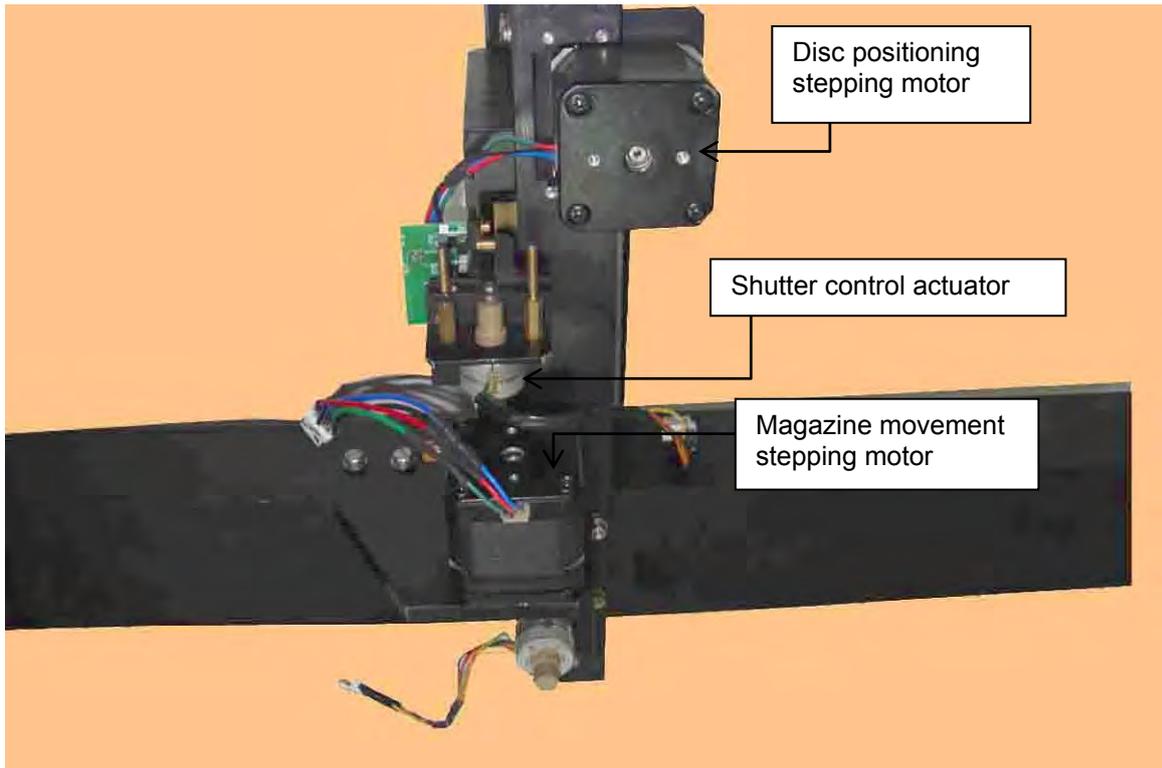
Top inside view of the Semi-Automatic TLD Badge Reader



Magazine channel assembly with stepper motor drive system



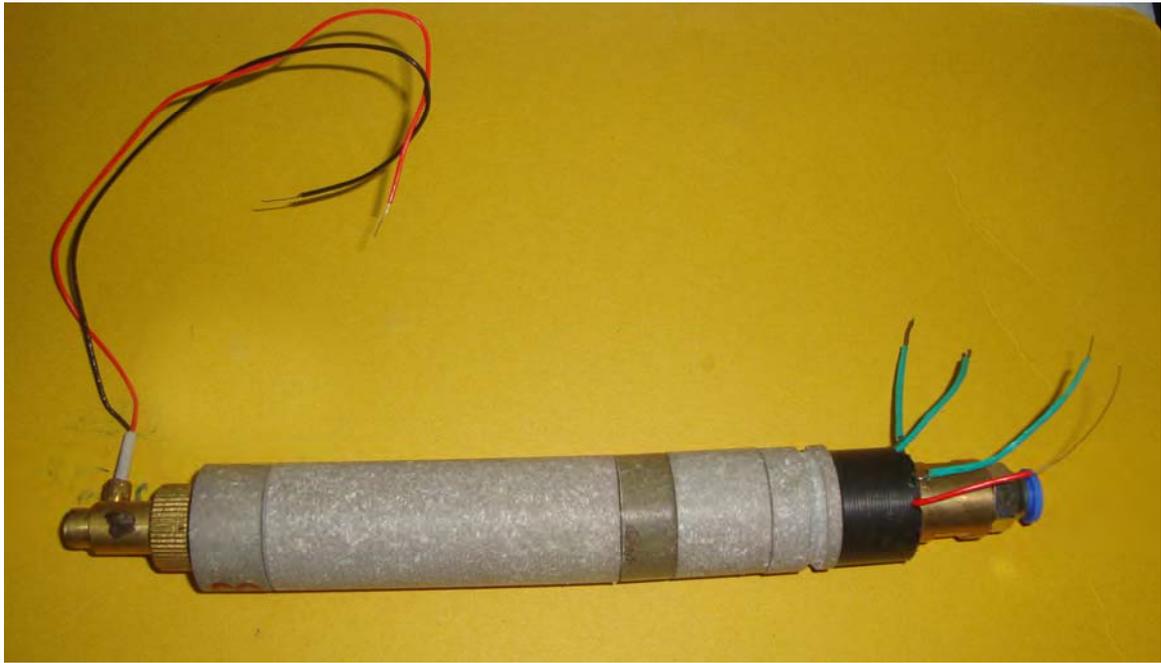
SMPS power supplies are in this design resulting in no use of bulky power transformers



High precision stepping motors have been used in this design.



1. Temperature Controller PCB
2. Controller PCB
3. Motor Driver PCB
4. Mother board (most of the inter PCB wiring is through mother board)



Heater assembly



Magazine loading door

Digital flow rate meter

LCD dot matrix display (16x2) status LCD display indicates, (card position, Temperature OK, EHT OK, Flow rate etc.)

## CHAPTER – III

### SPECIFICATIONS

<b>Dosimeter</b>	:	Three-element BARC CaSO <sub>4</sub> (Dy) PTFE disc dosimeter badge with personnel ID.
<b>Light Measurement System</b>	:	Photo-Multiplier tube (R 6094) Light measuring system (LMS).
<b>Dark current</b>	:	Dark current is 1 $\mu$ Sv (CaSO <sub>4</sub> ) equivalent with software-based sampling & subtraction.
<b>Heater Element</b>	:	Nichrome heater assembly.
<b>Heating Method</b>	:	Hot gas (N <sub>2</sub> ) heating
<b>Nitrogen flow rate measurement</b>	:	Digital flow rate meter
<b>Heating Cycle</b>	:	The temperature is raised to 280°C in 8 sec and clamped at 285°C
<b>Dose Range</b>	:	50 $\mu$ Sv-10Sv (Gamma) and 100 $\mu$ Sv-10Sv (Beta)
<b>Dose Threshold</b>	:	<50 $\mu$ Sv
<b>Readout time</b>	:	Approx 100 sec per badge
<b>Residual Signal</b>	:	≤10% of reading
<b>Facilities Available</b>	:	Entry of calibration factor, etc. Storage of dose and glow curve data of badges in Hard Disk. Stepper motor driver assembly for automatic feeding of 50 dosimeter cards loaded in a magazine.
<b>Software</b>	:	Windows 7 (32 bit) / XP-SP3 compatible software facilitates storage and display of glow curves, computations of dose & generation of dose reports, transfer of data to user defined file, etc.
<b>Temperature Monitoring</b>	:	Chromel-Alumel thermocouple in hot gas stream.
<b>Range Selection</b>	:	Automatic
<b>Calibration</b>	:	Coarse adjustment by varying the EHT through a potentiometer in the EHT circuit.
<b>Safeguards</b>	:	Heater / Gas flow / EHT / Card ID failure: The heater temperature, gas flow rate, card ID and EHT are checked for failure in every dosimeter readout cycle. In the event of failure of heater or gas flow rate or EHT or card ID, the readout is terminated and a message indicating corresponding failure message is flashed on the PC monitor.
<b>Mechanical Failure and failure message</b>	:	Any mechanical failure during readout cycle is sensed online & cycle is terminated with an option for the user to restart the cycle. EHT or the input circuit (I-F converter) is sensed and reading cycle is terminated in case of failure.
<b>Nominal Power Supply</b>	:	Power supply: 230V, 50Hz: Power requirements: 500VA (max including PC)
<b>Minimum PC Requirements</b>	:	Intel Core I3 3.7 GHz, 4GB DDR2, 500 GB SATA, internet ready optical scroll, 22" TFT monitor, Windows 8 Licensed OS CD & Dot Matrix printer (Monochrome).
<b>Applications</b>	:	Personnel monitoring of radiation workers in Nuclear power stations, Isotope laboratories, Industrial radiography installations, diagnostic & therapeutic radiology centers, etc.

## CHAPTER – IV

### INSTRUMENT BLOCK DIAGRAM & DESCRIPTION

**4.1.** Semi-Automatic TLD Badge Reader is specifically designed to measure TL output of the discs fixed on to the card. It utilizes the integral method of TL measurement as it involves less stringent requirements on heating rate. The reader basically provides a programmed heating cycle to the TL dosimeter and senses the instantaneous light emitted by the dosimeter (glow curve signal) and displays the total integrated light output in terms of  $\mu\text{Sv}$  (unit of equivalent dose).

#### **4.2. CONTROLS**

The mechanical assembly & the microcontroller based control circuits are housed in the instrument enclosure. Apart from a digital flow meter with a control knob for the adjustment of the gas flow and a 16x2 character LCD display for status information the instrument panel does not have any operating controls. All the operations are carried out from the PC connected to the instrument through a USB link. The status indication LCD indicates the instrument ON status.

#### **4.3 BLOCK DIAGRAM & SYSTEM DESCRIPTION**

As the block diagram shown indicates, this product is a PC based system where the primary commands are issued to a micro-controller board through USB port (Virtual communication port is used). Based on the commands issued, the micro-controller responds accordingly by executing the required function and sends back acknowledgement code.

The system essentially comprises of the following:

- a. Stepper & DLA motor based Electro-mechanical system along with optical sensors for precise noise-free motion & feedback
- b. Nichrome Heater based gas heating assembly along with digital flow measurement system.
- c. Photomultiplier Tube, along with heat absorbing glass as a light measurement system.
- d. Data acquisition & control circuits comprising of micro-controller circuits, heater controller circuits, high voltage module, I to F convertor module, Stepper / DLA motor drivers module & LV power supplies. Majority of the circuits are EURO type PCBs sitting on a mother board PCB. This facilitates easy maintenance in the event of breakdown.
- e. Personal Computer (PC) system with TLD data acquisition analysis & report generation software.

#### **Stepper / DLA motors & driver units:**

The magazine positioning is controlled by a stepper motor based on the feedback received from the 2 optical sensors underneath the magazine.

The optical sensors sense the grooves made on the magazine which generates signature code for home position & each channel advance. Using this method, precise noise-free positioning at any of the 50 positions can be done.

Once positioned at a specific card location, the TLD card can be raised by using the card raise DLA motor for taking readout of the current card.

In the next step, the card is drawn through a optical sensor arrangement so that personnel ID can be readout. This is followed by positioning at D1, D2 or D3 positions using the belt drive stepper motor. Before acquisition can begin for a TLD card, the shutter can be opened using shutter DLA motor. After this acquisition begin.

Using the above motors positioning for readouts TLD card are done.

## Temperature controller board design requirement :

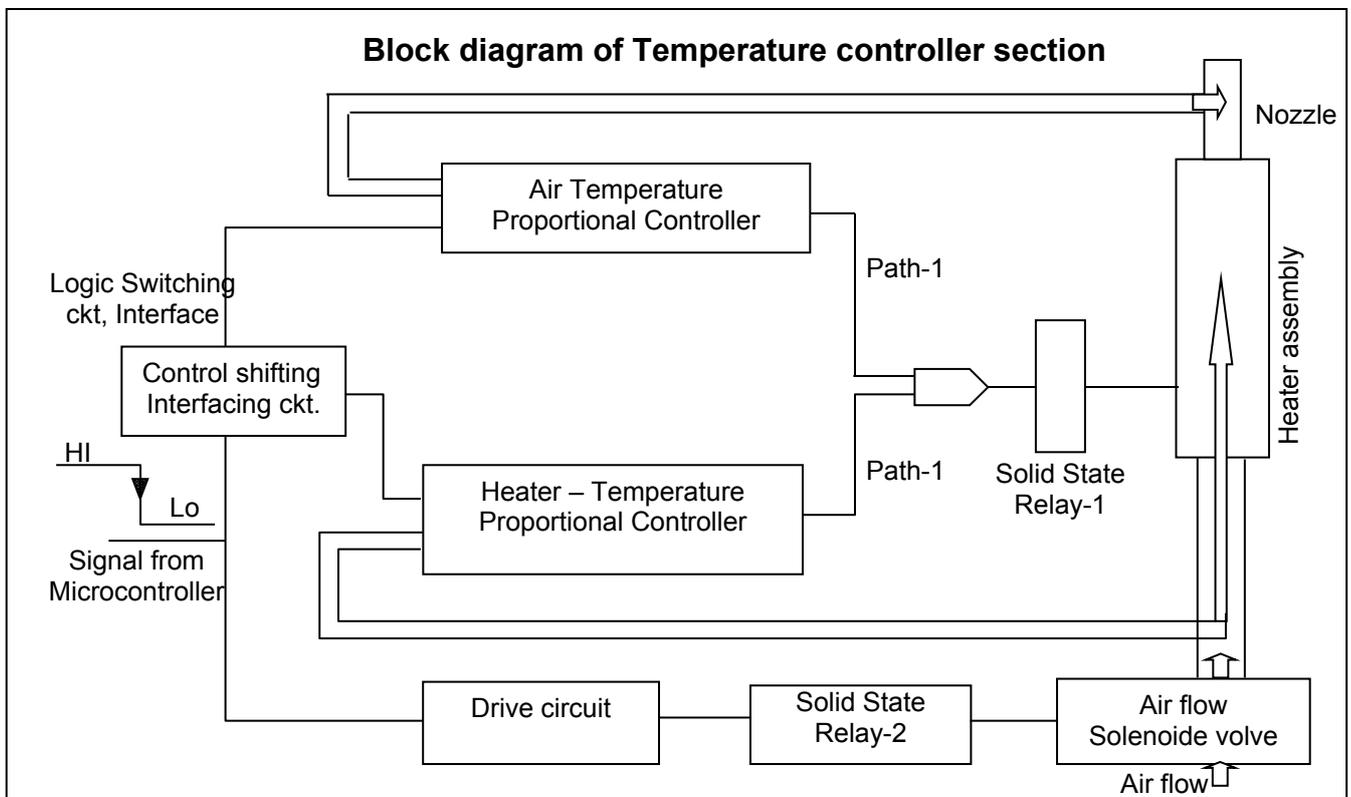
The design principle of the system is that the temperature should rise to 285° C within 10-12 seconds and remain clamped till completion of 30 seconds in disc read mode. So that the temperature of the disc goes upto 285° C.

To raise the temperature of the disc to 285° C. The air thermocouple should attain 12mV (44 mV/°C Cr-A1,K-type thermocouple) in a leakage free air path. The TL disc emits the glow curve peak at 240°C. But for getting maximum glow curve emission the TL Disc is heated upto 285°C.

The temperature controller board is designed to meet the above requirement. It is a dual proportional temperature controller. The purpose of using two proportional controller is to optimize the temperature of heater in case of idle state. And to increase the temperature of heater in case of readout state. Two feed back thermocouples are provide for each proportional controller. To simply the explanation the one proportional controller having heater thermocouple feedback is termed as heater temperature controller and the other one having air thermocouple is termed as air temperature controller. When the system is in readout state solenoid valve switched ON and the temperature of the heater is controller by the feedback from air thermocouple. And when the system is in idle state the temperature of the heater is controlled feedback from the heater thermocouple. The signals from microcontroller switches the controls in between the two proportional controllers as well as regulate air flow.

The problem in the temperature section of the TLD system may be due to solenoid malfunctioning, thermocouple wires and heater element breakdown and leakages in the path and loose connections leading to irratic switching of solenoid volve.

In case of breakdown replace the faulty component with new one in heater assembly. In due course of time TC board may have to be calibrated. If there is a variation observed in the readings. On receiving the command (HI to LO signal) from the microcontroller, through transistor driver circuit solid state relay (SSR2) opens solenoid volve to all Nitrogen gas to flow through the flow system consisting of Digital flow meter & is let into Heater assembly.



**1. With readout cycle ON:**

Initially the Heater set point at this stage will assume 6000 & through this (path-2) relay (SSR-1) goes ON & AC mains power is up rapidly.

With gas flow being on now, gas gets proportional band, resulting into proportional band making SSR-1 ON/OFF through path-1. Thus temperature controller controls gas temperature constant during readout cycle for 30sec of disc exposure or 30X3 sec for the card exposure time.

**2. When the Dosimeter readout is not ON:**

Heater set point will be 190<sup>o</sup> C. Pulse width modulator control ON/OFF of the SSR-1, to regulate the heater temperature to 190<sup>o</sup>C. During this time gas flow is cut-off & hence gas temperature is LOW. Air flow path proportional controller comparator will be outside the proportional band & path-1 controls signal is OFF. Temperature controller through controls the heater temperature.

**3. Heater Assembly:**

Heater assembly consists of a ceramic tube into which Nichrome heater coil is passed. This heater is pushed into a steel tube. Over this syndania tube is covered for greater insulation. At hot end of the heater coil there is air thermocouple mounted to measure hot Nitrogen temperature & in the middle of the heater ceramic tube toward hot end at (2/3) distance from cold end heater thermocouple is placed. Nichrome heater coil terminals & thermocouple terminals are all fixed onto a terminals block.

**Photomultiplier Tube :**

R6094 PMT of ETL is used for detection of the light signal. The light signal is converted to proportional current signal by the PMT.

**Data acquisition & control circuits :**

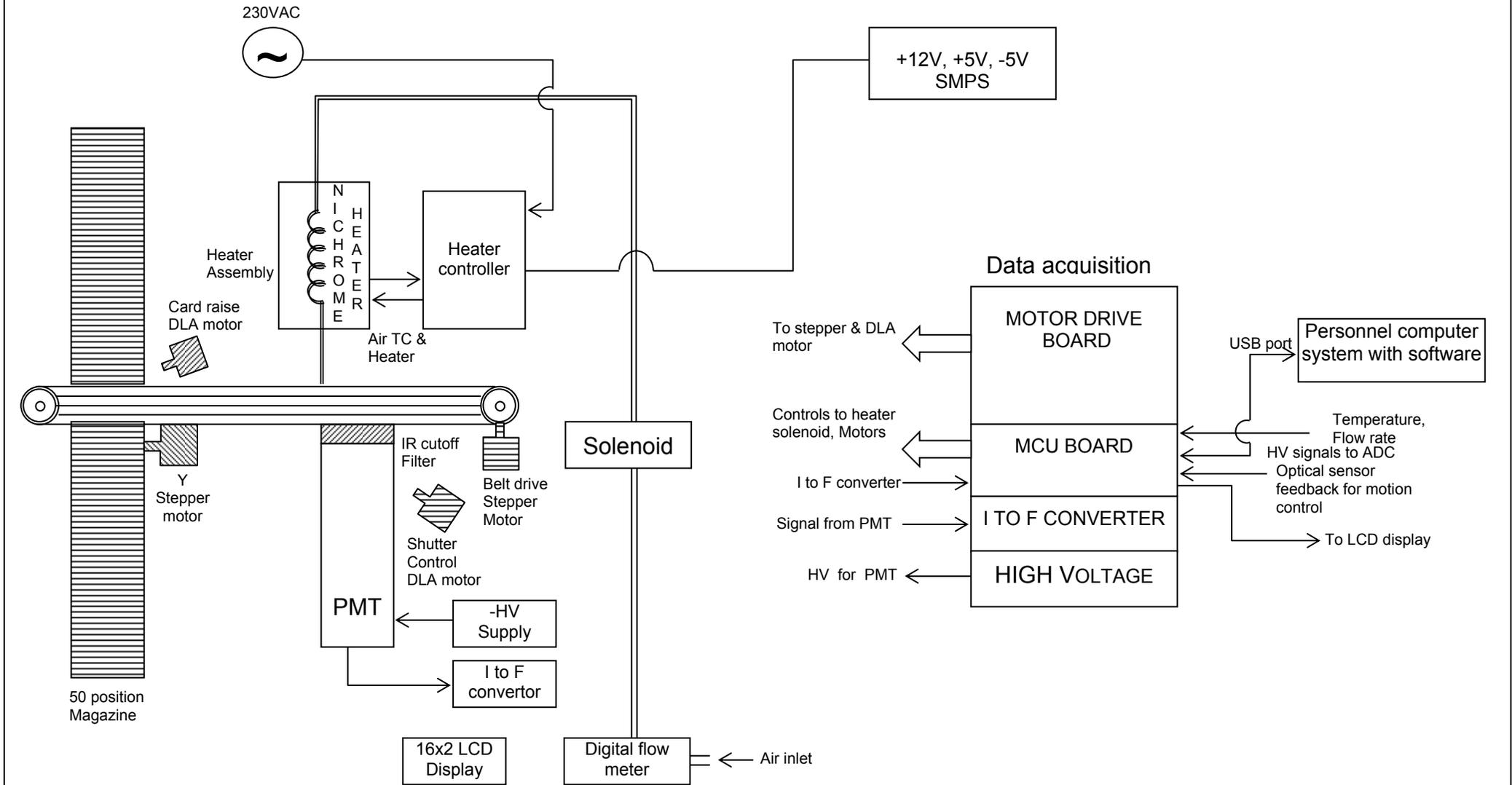
The Data acquisition & control circuits are powered by 1 no. of SMPS supplies generating +5V, +/- 12V respectively. The heater assembly is powered by a separate linear transformer mounted on it. The other SMPS powers rest of the electronics like digital circuits, analog section, stepper motors, high voltage etc.

The data acquisition and control unit essentially comprises of a micro-controller board at the heart which essentially controls all hardware during acquisition or otherwise. Micro-controller receives commands from PC based on which it responds. It works in slave configuration with PC. Micro-controller board generates signals for precise motion of stepper and DLA motors based on optical feedback received from corresponding optical sensors during data acquisition. The following movements are controlled by the micro-controller – Magazine Eject / Home, Magazine move option, Card raise / lower, card position Home / D2 / D2 / D3, shutter Open / close by the aid of optical sensors. Once positioning is complete, the acquisition of TL card / light source card / Dark current is done by the micro-controller. Before acquiring for TL card, the solenoid & heater controller are turned ON to enable gas heating upto 285<sup>o</sup>C. Once gas temperature is reached, the TL card is moved to position D1 or as selected and acquisition is carried out. After each disc readout, card is moved to next disc position & acquisition repeats for that disc. After all readouts are completed solenoid & heater are turned OFF automatically. All the above motors are driven by stepper driver modules located on stepper drive card based on signal received from micro-controller. The PMT is biased by a miniature HV module located on the mother board. The PMT o/p is processed and converted to frequency o/p by a I to F convertor module which is located in the micro-controller board.

A Ni63 based Light source TLD sized Card is provided separately which can be used for stability check of the PMT during the acquisition cycle. A light source check command may be issued after pausing acquisition cycle to check for stability. The Light source TLD card has to be placed in Magazine Position 1 before carrying out light source check and after acquisition it has to be removed before proceeding for personnel dosimetry.

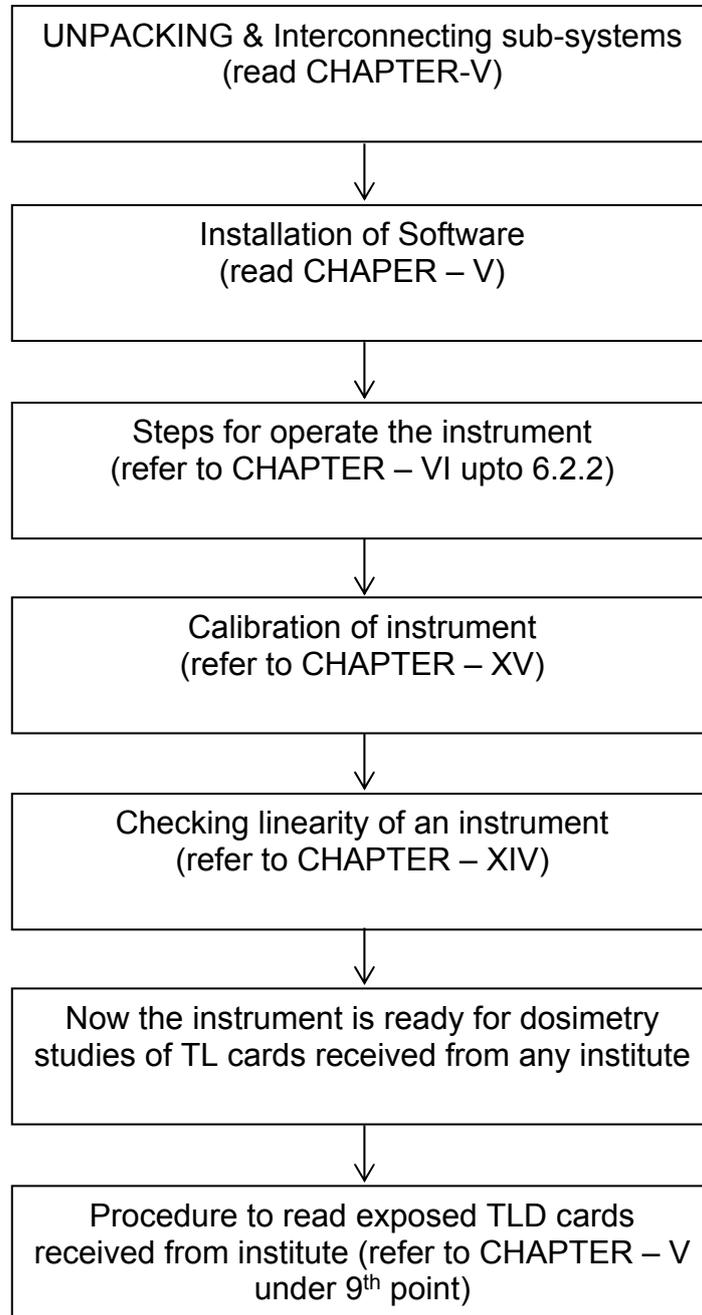


# SEMI-AUTOMATIC TLD BADGE READER SYSTEM TYPE: TL1010S



**CHAPTER – V**  
**INSTALLATION AND SETUP**

**Flow chart for installing, operating, calibration & using system for personal monitor of TLD cards for dosimetry studies.**



- i) **Choosing a place for installation:** Find a flat, firm surface with enough room to put the TLD Badge Reader unit along with the Personnel Computer and a Printer. The entire place must be clean and free from dust and air-conditioned so that the temperature is around 25°C. Do not operate any noisy equipment near the reader system. Provision should be made for installing a N<sub>2</sub> gas cylinder on the right side of the reader. (refer to photographs indicated in this CHAPTER-III, as you read it)
  
- ii) **Procedure for assembling the reader system:** The back panel of the reader unit is provided with a 9 pin D connector for connecting the reader system to a USB port of a Win XP / Win 7 based system.  
Ensure that the USB drivers are installed by TLBadgeReader.bat file. Connect the communication cable from TL Badge Reader Electronic Unit to PC USB port. TL Badge reader provides a virtual USB connectivity to PC. This means that the USB will appear as a COM port on the PC. For establishing connectivity with the reader, COM port number corresponding to this connectivity must be identified. To do this, Right click on “My computer” icon on Desktop. Select Properties -> Device Manager -> Ports. You will find the COM port number. For e.g. If you find “COM3”, it means that COM port number is 3.
  
- iii) A gas inlet is also provided on the back panel of the reader unit. Connect a Nitrogen cylinder with the tube provided to the gas inlet of the reader unit. Set the pressure at 2 kg/cm<sup>2</sup> in the pressure gauge.
  
- iv) **PC installation:** The minimum required computer configuration is computer system (Branded) with Intel Core 2 Duo 2.8 GHz Intel G31, 2GB DDR2, 500 GB SATA, internet ready optical scroll, 19” TFT monitor, Windows 7 Licensed OS CD & LaserJet printer install the PC and printer with the standard procedure given in PC user's guide. **Win XP 64-bit is currently not supported by the system.**
  
- v) **Software installation:** To install the software, execute TLBadgeReader.bat in the installation CD. Follow instructions in Readme file. Click through the options, until you get the message that installation is completed successfully. In case of any errors, please take a screenshot of the error message and email to Nucleonix Customer Support.
  
- vi) **Digital Flow meter:** At the time of installation, Ensure that the flow control knob provided on the Digital Flow meter is turned fully clockwise. Turn the knob slowly to anti-clock direction to maintain the flow rate in the range of 5 – 6 lpm when gas flow is ON.

- vii) **Power Supply Connections:** Connect the reader unit and computer to the power supply (230V, 50Hz). To provide protection to the reader system from spikes in the supply line, take the power supply connections through a spike buster. It is advisable to use a 500 VA un-interruptible power supply (UPS) for the Automatic TLD reader system including the PC to ensure data integrity in the event of a power failure.

**Starting the Program:** Switch on the computer, Click on Start -> Programs -> Nucleonix Systems -> TLBadgeReader or Double click TLBadgeReader icon on Desktop to run the application. Then the software of TLD Badge Reader will be displayed on the PC monitor. The program details are discussed under SOFTWARE chapter, and the working is discussed under 'INSTRUCTIONS FOR HARDWARE/ SOFTWARE'.

- viii) **Switching the Reader System:** Make sure that the Nitrogen cylinder is connected to the gas inlet of the reader unit. Now, switch on the reader unit. The reader should be switched on at least 30 minutes before the reading operations to allow for the stabilization of PMT and rest of the electronics.

- ix) **Procedure to read exposed TLD cards :**

- On receiving the TLD cards from an institution, take out TLD cards from the cassettes, label them, arrange them orderly.
- As the instrument is already calibrated, start "prepare reader" through software. Refer to CHAPTER-VI under 6.2.3. There you can check Light leakage, heater and light source.
- Load the TLD cards in magazine and enter the card details through software.
- Place a **control card** in magazine first position.
- Start acquisition – refer to CHAPTER – VI under 6.2.3. \*Start\* point.
- After completion of acquisition a message window appears as '**Acquisition completed**'. All data saved in reports as per file name given.
- Finally evaluate dose as per your dose evaluation procedure.

## CHAPTER – VI

### OPERATING INSTRUCTIONS FOR HARDWARE/ SOFTWARE

#### SYSTEM REQUIREMENTS:

PC (Minimum configuration): Intel i3 CPU or better, 2 GB RAM, 160 GB HDD.

OS: Windows 7 (**32 bit**). (Windows Vista / XP is not supported)

Antivirus: Norton / Quickheal / Kaspersky

Internet connectivity & Teamviewer/Skype software: For remote trouble-shooting

#### INSTALLATION:

To install the software, execute TLBadgeReader.bat in the installation CD. Follow instructions in Readme file. Click through the options, until you get the message that installation is completed successfully.

In case of any errors, please take a screenshot of the error message and email to Nucleonix Customer Support (info@nucleonix.com).

#### MAKING CONNECTIONS AND IDENTIFYING COM PORT:

Ensure that the USB drivers are installed by TLBadgeReader.bat file. Prepare the Reader as per Hardware user manual and Power it on. Connect the communication cable from TL Badge Reader Electronic Unit to PC USB port. TL Badge reader provides a virtual USB connectivity to PC. This means that the USB will appear as a COM port on the PC. For establishing connectivity with the reader, COM port number corresponding to this connectivity must be identified.

To do this, Right click on “My computer” icon on Desktop. Select Properties -> Device Manager -> Ports. You will find the COM port number. For eg. If you find „COM3”, it means that COM port number is 3.

#### EXECUTING THE APPLICATION:

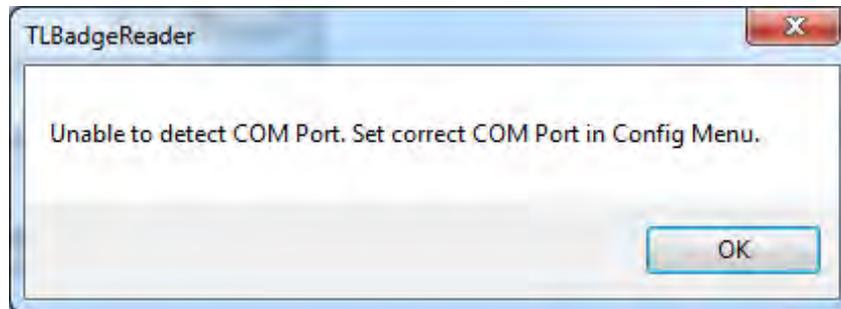
Click on Start -> Programs -> Nucleonix Systems -> TLBadgeReader or Double click TLBadgeReader icon on Desktop to run the application. A login window appears as below.

Enter “admin” as Username, “Nucleonix” as password and click on Login button. This password can be changed to User’s choice, using the controls on lower part of the screen.



## SOFTWARE OPERATION AND FEATURES:

After Login, software performs certain checks before displaying the main screen. The first check is **COM port check**. If COM port settings are incorrect, then following windows appear.



Main screen of the software is displayed after user clicks on Ok button.

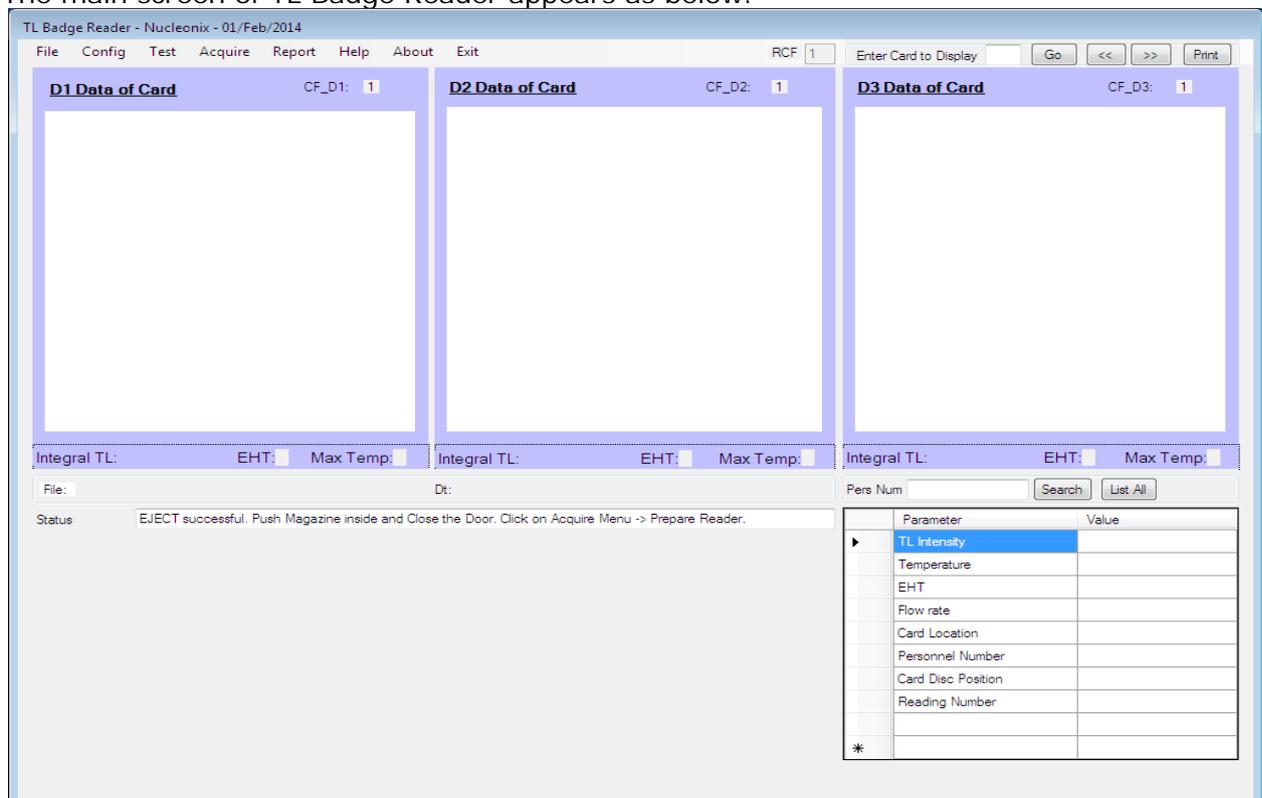
Recheck the COM port number and enter the correct COM port number in "Config-> Set COM Port" menu.

If COM port number is correct, the software then **checks for the Reader response**. If Reader is not detected, appropriate message is displayed and Main screen of the software is displayed.

Test and Acquire Menu commands cannot be used until correct COM port is set and Reader is detected.

If reader is detected, the magazine is automatically ejected. At this point, User can load the cards in magazine, insert magazine into the reader and close the door.

The main screen of TL Badge Reader appears as below:



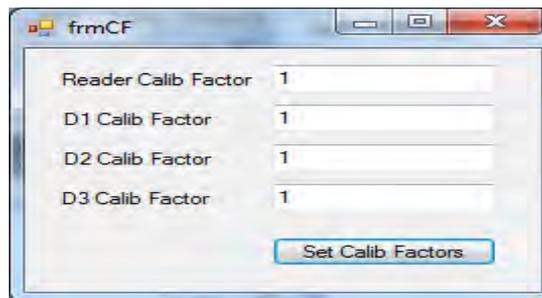
## Config Menu

### Setting the COM Port

To set COM port, select Config menu and click on "Set COM port". In the window that pops up, enter the COM port number and click Ok. The application is terminated for the new settings to take effect. Now ReRun the application.

### Setting Calibration Factors

Software provides the facility to set Calibration Factors for D1, D2, D3 data as well as Reader Calibration Factor for the purpose of normalization of data. By default all the values are set to 1. These factors are multiplied with each acquired data point and plotted.



The screenshot shows a dialog box titled "frmCF" with four input fields, each containing the value "1":

Reader Calib Factor	1
D1 Calib Factor	1
D2 Calib Factor	1
D3 Calib Factor	1

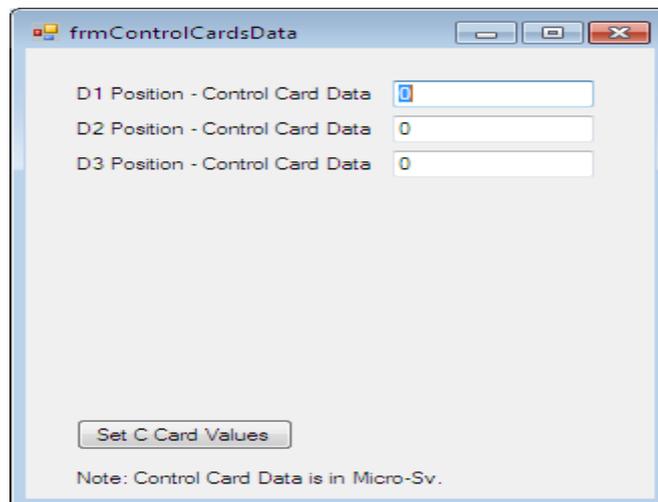
At the bottom of the dialog is a button labeled "Set Calib Factors".

### Setting Control Cards Data

Initial few cards that are loaded into the Magazine are normally Control cards. The data obtained from these cards will be utilized for Dose calculations. Hence, User shall first acquire data from these Control cards by clicking on "Acquire" Menu and "Start". Once Control cards data is obtained, User shall click on "Stop" to stop the acquisition and note Control cards data. This shall be entered in the below form by clicking on "Config" Menu and "Set Control Cards data".

User will be able to view calculated Dose while acquisition itself.

In case it is desirable to enter Control cards data during Report generation after acquisition, it can be done so.



The screenshot shows a dialog box titled "frmControlCardsData" with three input fields, each containing the value "0":

D1 Position - Control Card Data	0
D2 Position - Control Card Data	0
D3 Position - Control Card Data	0

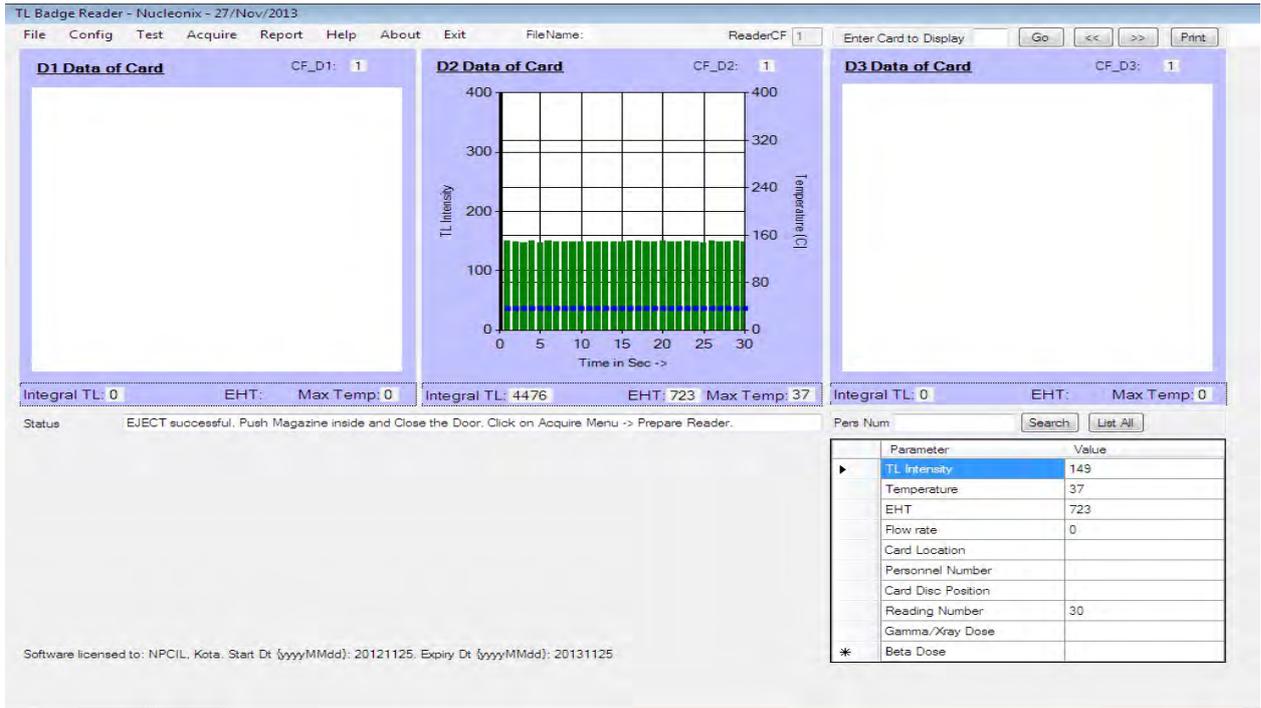
At the bottom of the dialog is a button labeled "Set C Card Values".

Note: Control Card Data is in Micro-Sv.

### Check Light Source Mode

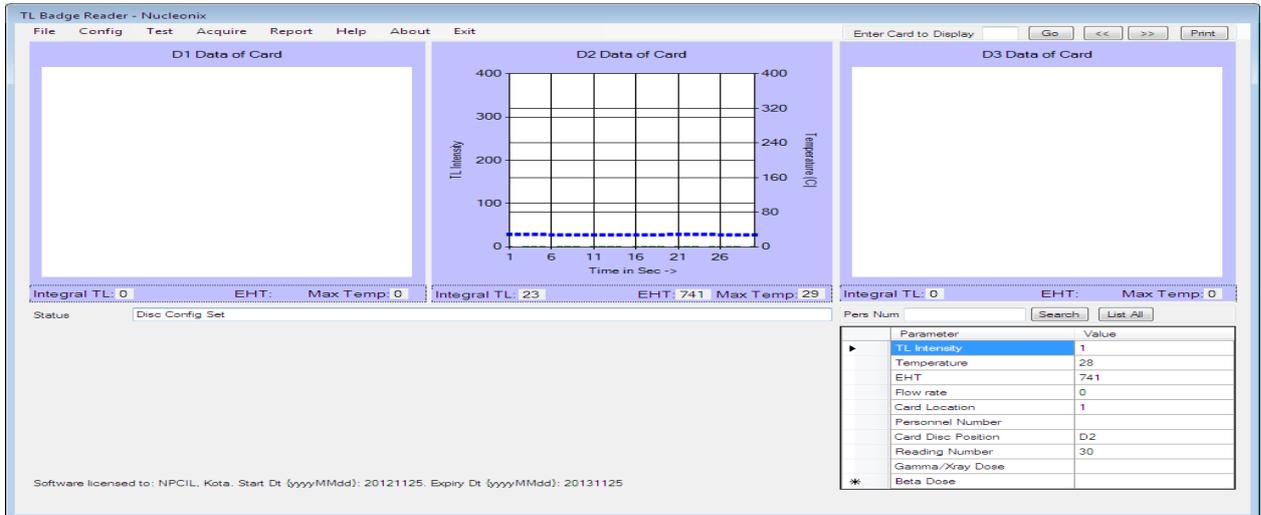
Before starting this test, insert the Light source Badge provided. A constant light output is generated by temperature stabilized Ni-63 source in the badge. After clicking on Light source test, a window will appear for confirmation on presence of Light source badge in magazine first position. Light source signal is acquired and plotted at D2 position.

After completion of Test, Magazine is ejected for removal of Light source badge from magazine.



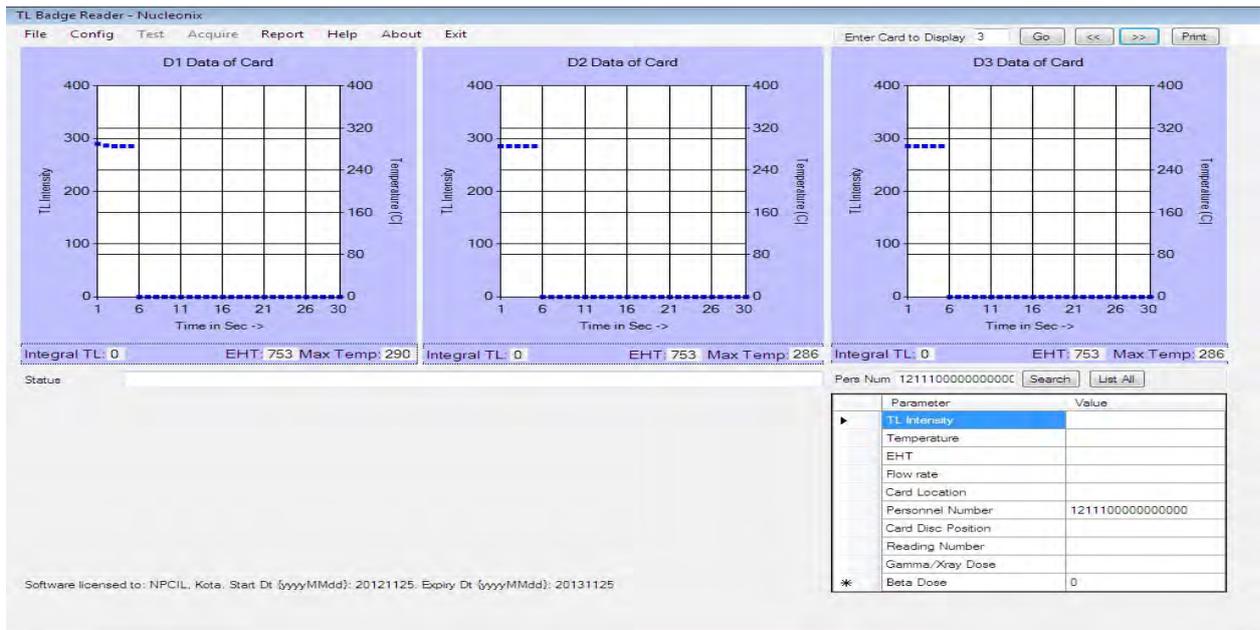
### Check Dark Current Mode

In this mode, shutter is Open and Heating is OFF. Dark Current data is acquired and plotted at D2 position. Typical data is shown in the figure below:



### Test Acquisition for 5 sec:

In this mode we can check readiness of instrument for Acquisition. User needs to select number of badges to test for 5 sec (It's better to check for 50 cards with dummy badges). Data can be reviewed in file. The window of this test is as shown below



### Check Heater

In this check, the Heater is turned ON and the time in which it attains the Set temperature is recorded. The duration in which Set temperature is attained is displayed. In case Set temperature is not attained, then Flow rate and Heater working must be verified.

### Dose Calculator

Dose Calculator is provided to manually calculate Dose values by Entering Card type („W“ - Worker By default), Calibration factors, Control cards data, TL Integral values for D1, D2, and D3 positions.

### Acquire Menu

#### Prepare Reader for Acquisition

Prior to acquisition, Tests can be individually done using commands in “Test” menu. Alternatively, user can click on “Acquire” menu and “Prepare reader for acquisition” to conduct various tests in sequence. The following operations are done in sequence when this command is given: Dark Current Mode check, Adjust Flow rate, Setting 3 Disc positions mode, Setting Auto/Semi-Auto mode, Heater check and light source Mode check will be performed.

### Start

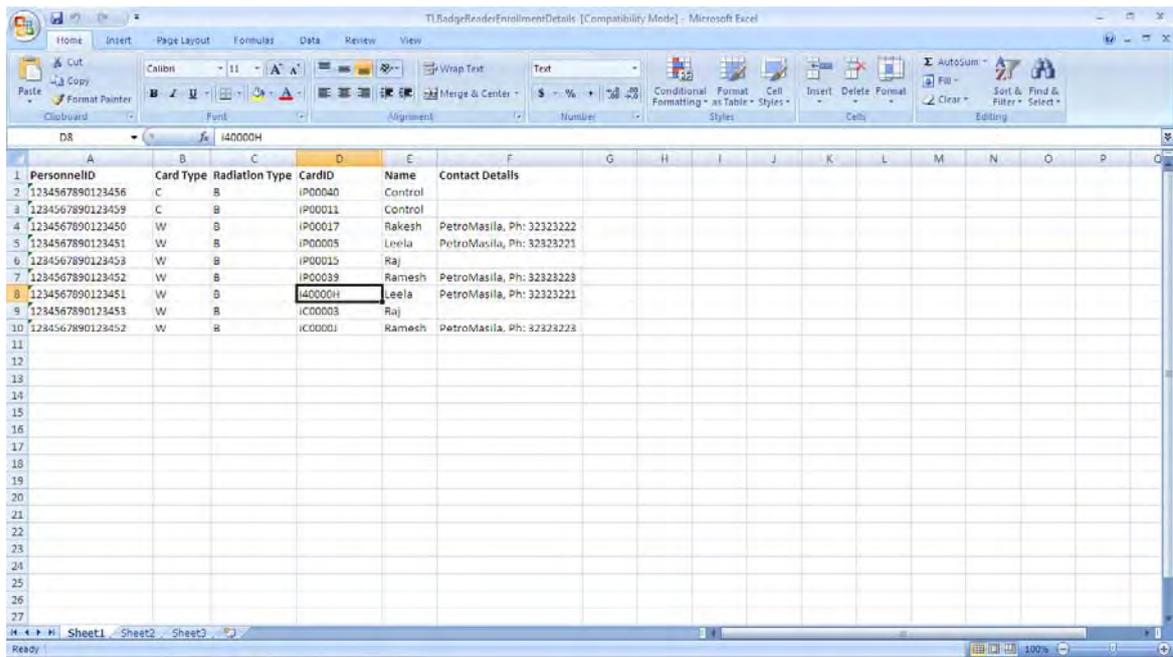
Having performed all the Hardware Tests and ensuring the settings are at desirable values, User is ready to start acquisition. Clicking on “Start” will display the below message:

#### Setting the Card details

Before proceeding for acquisition, the details of Cards loaded in the magazine are to be provided to the software.

This procedure is slightly different for AUTO and SEMI-AUTO readers.

**For AUTO readers**, the CardID, Personnel Number, and other details are to be entered manually in “d:\TLBadgeReaderEnrollmentDetails.xls”. This is the Master file where Enrollment details are to be maintained. Given below is a screenshot of this file with sample data:



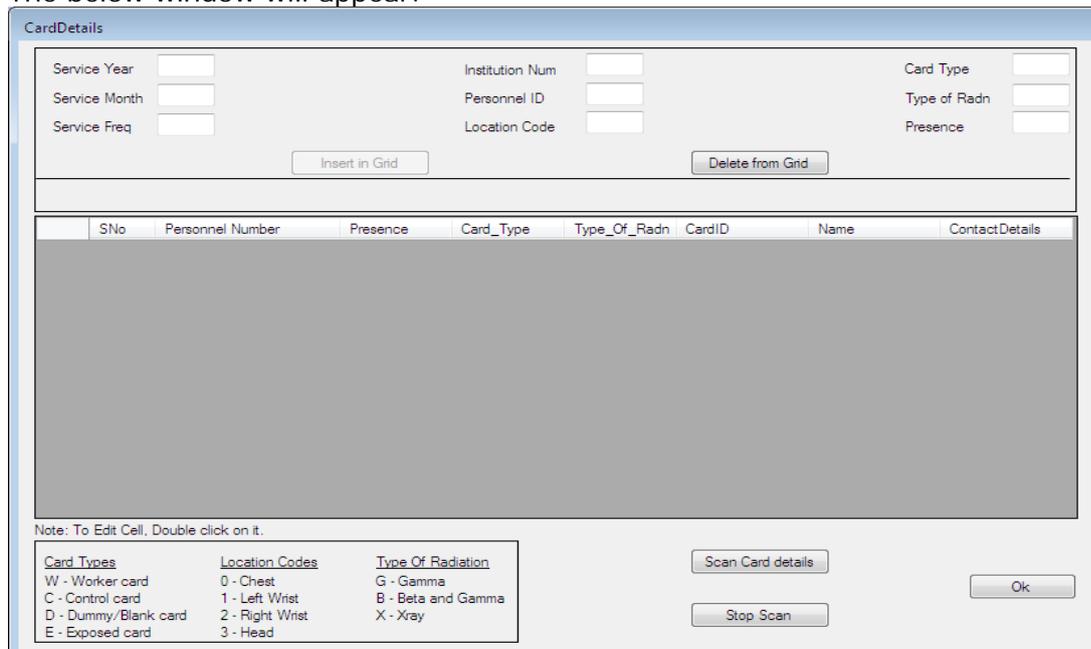
Note that CardType must be entered as C or W or D or E depending on whether it is Control Card or Worker Card or Dummy card or Exposed card. Radiation type is optional & can be entered as G or B or X depending on whether the Radiation is Gamma or Beta+Gamma or Xray. It is evaluated during Dose calculation automatically.

Personnel number is 16 digit and Code must be 6 character in length consisting of (0 to 9 or A to P).

This file is read by the software automatically to obtain Card details for a given CardID. User shall ensure that CardIDs are unique.

To load the above Card details into software, User shall click on “Config” Menu and “Set Card Details”.

The below window will appear.



User shall click on “Scan card details” button. At this point, software will scan CardID of each card loaded in the magazine, retrieve respective Card details like Personnel number, Card type, Radiation type, Name, Contact details and populate the grid (table).

**For SEMI AUTO readers**, the screenshot of Card Details Form is given below:

CardDetails

Service Year  Institution Num   
Service Month  Card Type  Location Code   
Service Freq  Personnel ID

Note: Personnel ID can be entered as a) Single number like 3450 (or) b) A range like 3456-3459 (or) c) Combination like 3450, 3456-3459, 3465-3469

SNo	Personnel Number	Card_Type	CardID
-----	------------------	-----------	--------

Note: To Edit Cell, Double click on it.

Card Types	Location Codes
W - Worker card	0 - Chest
C - Control card	1 - Left Wrist
D - Dummy/Blank card	2 - Right Wrist
E - Exposed card	3 - Head

Various card details like Institution Number, Service Year, Month, Frequency, Personnel ID, Location code (Chest / Left or Right Wrist / Head), Card type (Worker card/ Control card / dummy or Blank card / Exposed card) can be entered in the Textboxes provided. Clicking on "Insert in Grid" button will add the card to the list.

It is very convenient to enter a range of Personnel IDs in one go. For example, if it is desirable to enter Personnel IDs from 1 to 10, 15, 17 and 20-28 in one go, type the following in the Personnel ID text box: **1-10, 15, 17, 20-28**.

User needs to finally click on "Ok" to complete the entries. (OR) Card details can be directly read from the Excel file "**d:\TLBadgeReaderCardDetails.xls**" by clicking on "**Read from file**" button.

After click on read from file the below popup is displayed:

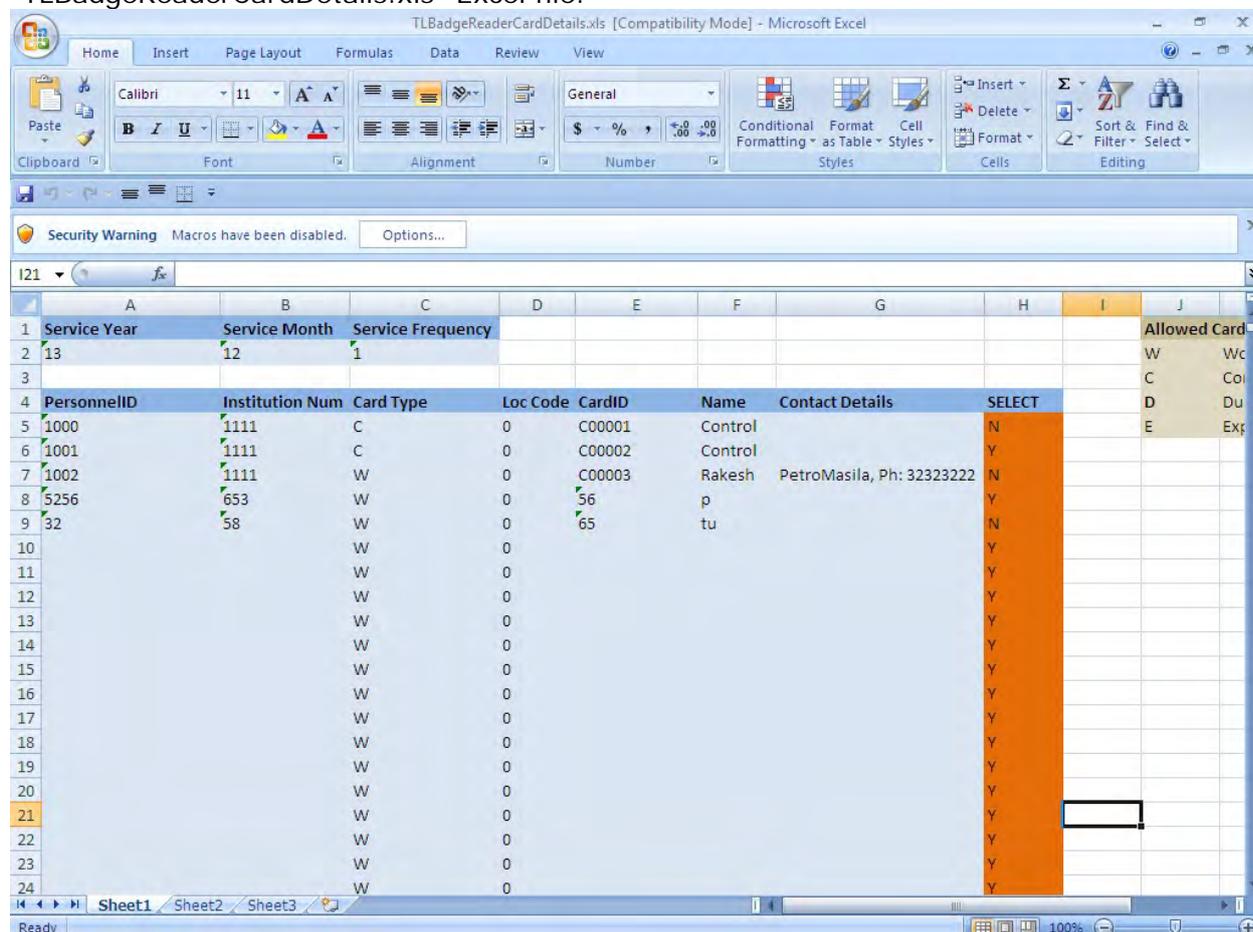
Read Card details from Excel File

Read from Excel Row Starting at:

Read until Excel Row Ending at:

After click on OK user can check the card details whether correct or incorrect by clicking on 'Check' button. After this acquisition will start by clicking on 'Acquire' button. User can save the present card details wherever user wants by clicking on 'Save the file'.

Given below is a screen shot of Card details entered by the user directly in "TLBadgeReaderCardDetails.xls" Excel file:



For user's convenience, double clicking on the Worksheet copies the contents of last entered row to next empty row. Card type and Location code can be selected from Drop down.

**Note: User can enter card details randomly/sequence in "Set Card Details" window from 'Read from File', she/he 'SELECT' option as "Y/N" .If the user choose "Y" Particular card details added in the grid else it is "N" not added to the grid.**

"Will acquire for "n" cards". "n" is the number of Cards entered in Card Details window. User is now asked to enter the Card number from which to start acquiring the data. User can enter "1". In case User is resuming acquisition after "Stopping" to enter Control cards data or for any other reason, then the appropriate Card number can be entered.

User is then asked to enter the Filename to save spectrum data.

**Note: User wants to save current spectrum file in the name of already existing file name, it will ask for overwrite but it will not overwrite (because it's a windows files properties). Current data will be appended to the same file.**

The acquisition starts and continues for all the Cards. During acquisition, encrypted data is stored to a secure location on the User PC. **Data integrity is protected during acquisition from virus, malicious user as well as powercut. Post acquisition data is stored in multiple file formats (Text, Encrypted, Excel) to preserve the integrity. It is also printed.**

**Spectrum Data** for all cards is saved as a **Text file** as well as an **Encrypted file** in c:/Program Files/Nucleonix Systems/TLBadgeReader/TLReader\_Spectra folder. Additionally, it will be stored in **User selected folder**.

**Raw Data** for all cards is saved as an Excel file in c:/Program Files/Nucleonix Systems/TLBadgeReader/TLReader\_Reports folder.

**Dump file** containing D1, D2, D3 Integral values along with Personnel ID is saved in TLReader\_Dump folder as a **text file** as well as an **Encrypted file**.

Dump file is automatically **printed** at the end of acquisition to the default printer.

If "Data Export to Excel" option is enabled, detailed data of each card is written to an Excel file in "TLReader\_Reports" folder, with same name appended with PersonnelID.

**Note:** User must not perform any other operations in this application while acquisition is On. However, other applications can be run in the background during this time. Doing this might disturb the plot.

### **Stop**

This command is useful to stop acquisition either for Setting Control Card values or any other reason. The acquisition will stop after acquiring for all 3 Disc positions. To resume after stopping, User must click on "Start" again and enter the next Card position from which acquisition must resume.

### **Recover from Power cut**

In case of Power cut or abrupt termination of software, data can be recovered fully. User shall re-run the software and must first retrieve the data before proceeding to do anything else. Clicking on 'Full Spectrum' retrieves the data from Registry and generates Spectrum file at the specified location. The current card details (Integral TL values for D1, D2, D3 positions, if available) can be retrieved by clicking on 'Current Card details'. Acquisition can be resumed from the card at which power cut occurred.

### **Eject**

This command can be used to eject the Magazine.

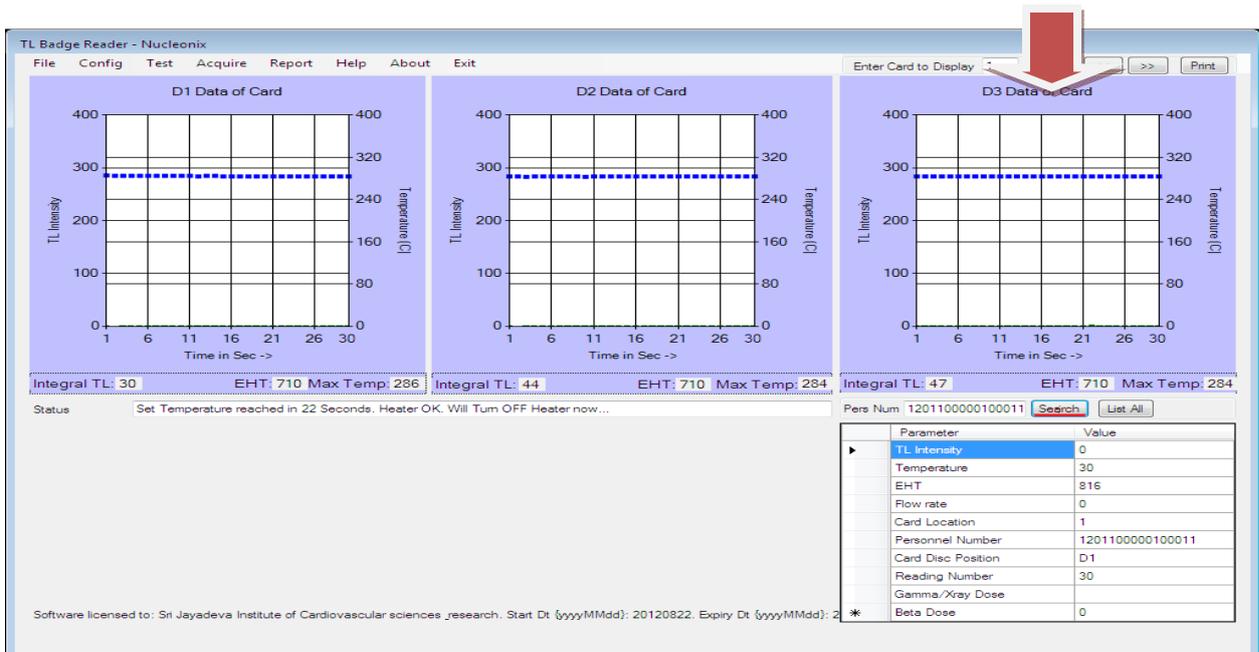
### **File and Report Menu**

#### **Viewing Saved Spectra**

Saved Spectra can be viewed in TLBadgeReader application or in Excel. To view in application, click on "File" Menu and "Open Spectrum File". Select the filename to open and click ok.

The spectra are retrieved into Memory. To view the spectra, enter the card position number in the textbox next to "Go" button and click on "Go" button. To maneuver, use the "Next" and "Prev" buttons. Personnel number and Dose details are displayed in the Grid at bottom right.

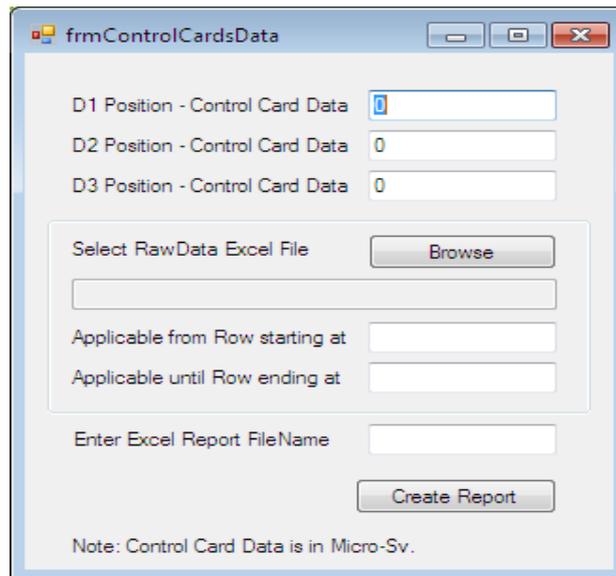
A sample is shown below



User can also view **consolidated data** of all Cards in Excel by clicking on Reports Menu and “View in Excel” and selecting the appropriate filename. This applies to the case when Control cards data is entered before acquisition. Typical data is shown in figure below.

SNo	Personnel Number	Card Type	Radn Type	Date	Gamma Dose	Beta Dose	Xray Dose	D1 - Int TL	D2 - Int TL	D3 - Int TL	CardID	Name
1	1312100000100011	W		02-12-2013				261	185	168		
2	1312100000100021	W		02-12-2013				102	87	84		
3	1312100000100031	W		02-12-2013				154	149	142		
4	1312100000100041	W		02-12-2013				129	113	119		
5	1312100000100051	W		02-12-2013				80	72	68		
6	1312100000100011	W		02-12-2013				236	159	142		
7	1312100000100021	W		02-12-2013				87	71	70		
8	1312100000100031	W		02-12-2013				136	131	125		
9	1312100000100041	W		02-12-2013				110	93	103		
10	1312100000100051	W		02-12-2013				69	61	57		

In case user wants to enter Control cards data now, calculate dose & generate report, he/she may do so by clicking on Reports Menu followed by ‘Dose Evaluation’. The below Screen popup:



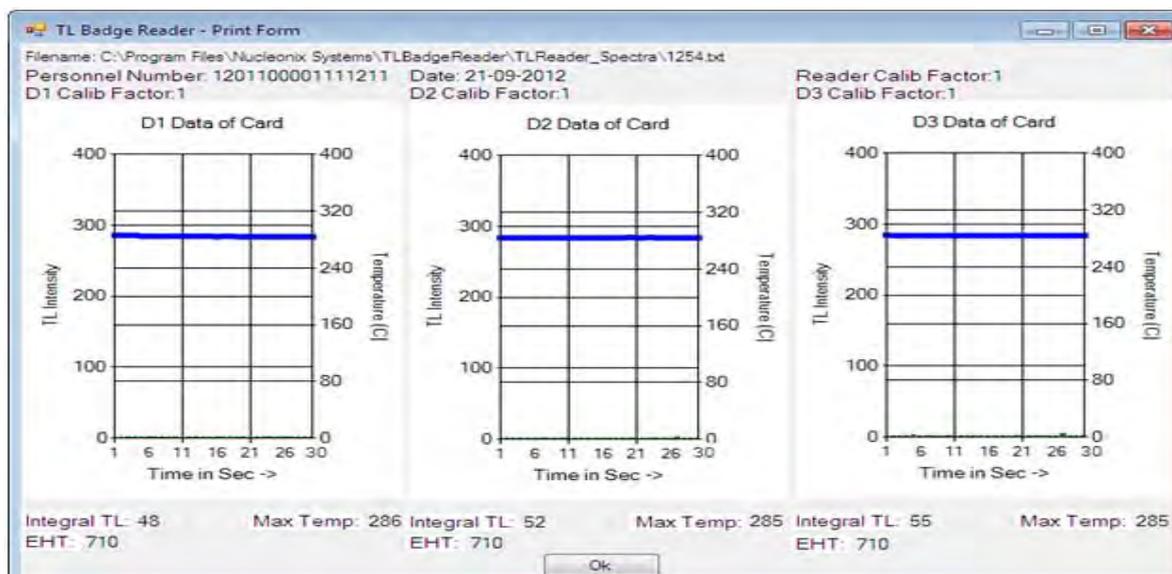
In the above, 'Raw data Excel file' is the one generated during acquisition, from which Excel reports can be generated.

Given below is the Summary of all files generated by this software:

File	Location	Purpose
MyFile.txt	../Spectra/	Contains spectrum info
MyFile_Encrypted.txt	../Spectra/	Same as above, but encrypted
MyFile.txt	../Dump/	Contains D1,D2, D3 info
MyFile_Encrypted.txt	../Dump/	Same as above, but encrypted
MyFile.xls	../Reports/	Raw data
MyFile_Report.xls	../Reports/	Dose details, Editable

**Printing spectra file:**

Display the spectra of desired Card by entering the Card Number in Textbox on top right of screen & Clicking on "Go" button. Click on "Print" button and a window appears as shown below:



Click Ok to start printing. Close the Window after printing.

**About this Software**

The version number of this software is displayed when "About" menu is clicked. Please check with Nucleonix for the latest upgrades.

**Maintenance and Customer Support**

Periodic functional checks of system must be performed whenever possible. 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.

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

In case of any queries or issues with the software, you may contact us by email / phone / letter / fax. Details are given below:

**Nucleonix Systems P Ltd**

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Hyderabad - 500051. Phone: + 91 7207034546

Mobile No: 7331104480, 7331104481,

7331104482, e-mail: [info@nucleonix.com](mailto:info@nucleonix.com).

## CHAPTER – VII

### GENERAL GUIDELINES FOR USE OF TLD BADGE READER

**Temperature & N<sub>2</sub> Gas Flow Rate Adjustments:** The life & reusability of the dosimeters critically depend on the maximum temperature to which the dosimeter is subjected to while reading the dosimeter. Hence the following precautions are to be observed while adjusting these parameters.

**Flow Rate:** The flow rate should not exceed 6LPM and the inlet pressure of the gas should be adjusted to 2 Kg/cm<sup>2</sup>.

**Temperature Adjustment:** The optimum maximum temperature will be the one that corresponds to a left-out TL (i.e., the TL output from the dosimeter in a subsequent readout) of the order of 10%. Too large a left-out TL would mean insufficient heating and too less a left-out TL indicates over heating. Over heating, apart from reducing the life of the dosimeter, results in deformation of the Teflon based dosimeter. The deformed dosimeter often causes jamming of the card carrier mechanism in the Reader.

The temperature can be adjusted, if necessary, with the potentiometer P3 on the temperature controller PCB using the 'Heater Check' from the Test Menu of the TL Badge Reader software. If any adjustment of temperature is made, the ADC value corresponding to the temperature set point reading on the PC should be stored as the Temperature Limit Value in Settings Text File. This is necessary as the computer waits for the heater to stabilize to the ADC value corresponding to the Temperature Limit value

**Waiting period for temperature to stabilize:** At the initiation of the start command, the system opens the solenoid valve for the gas, starts the heating cycle and waits for the temperature of the gas to reach 285°C before starting the readout cycle. The waiting period is about 1-2 minutes depending on the ambient conditions. If it exceeds 2 minutes then heater failure is prompted by the PC and the temperature controller may need adjustment or could be faulty. Flow rate should not be unduly increased beyond 6 LPM as it is likely to deform the dosimeters.

When the temperature reaches 285°C, the readout process starts within 1 or 2 seconds delay. A readout time per dosimeter is 30 seconds and the 50 cards are read in about 100 minutes. The readings are stored in the database at the end of readout of each card

**Calibration:** The reader can be calibrated using a calibration factor which is entered manually at the time of starting the readout or by varying the EHT which in turn varies the gain of the PMT. However, in the reader an optimum EHT for the PMT used has been selected (600 – 800V) to obtain the best signal-to-noise ratio in the light collection system. Hence the user is advised to use the calibration factor to calibrate the reader.

The calibration factor can be obtained using 10 or more cards exposed to a uniform dose of 5 mSv and reading them in the reader using the above procedure. After the readout is over, 'S' (Statistical analysis) option in the tool bar can be used to evaluate dose. The software has a provision to exclude readings, which have a large deviation from the mean. The calibration factor is then the ratio of the actual dose given to the cards to the mean dose.

## CHAPTER - VIII

### DOSE EVALUATION

Dose evaluation is carried out using some empirical relations which have been arrived at after thorough experimental work. Usually a minimum reporting value (RV) is decided on the basis of the uncertainties in the dose evaluation process including those inherent in the basic dosimetry. After calculation of the dose, if the computed value is less than the RV (default values is 0.2 mSv), dose is reported as zero.

A 16 digit ID code is used for the personnel number. The first 4 digits are assigned for the Institution to which the person belongs. The last four digits are the personal ID number of the person. The middle four digits are to indicate the service month (two digits, 1 to 12), frequency of service (one digit, 1 for monthly, 2 for bimonthly & so on) and the nature of radiation environment (one digit, 1 for gamma, 1 for beta / gamma, 2 for X rays / gamma and 4 for diagnostic X-rays) in which the person works. The dose evaluation software evaluates the dose depending on the code entered as per the following relation:

Keys to abbreviation:

- D1 : Reading of dosimeter under Cu-Al filter.
- D2 : Reading of dosimeter under plastic window.
- D3 : Reading of dosimeter under open window.
- RV : Reporting value. Default value is 0.2 mSv. User selectable.
- CR21 : Ratio of D2 reading to D1 reading when exposed to calibration dose. (Default Value 1.1)
- CR31 : Ratio of D3 reading to D1 reading when exposed to calibration dose. (Default Value 1.15)

Empirical constants:

A1 = 2.6017, A2 = -15.8861, A3 = 45.5412, A4 = -53.2834, A5 = 22.612.

D1', D2', D3' are D1, D2, D3, minus the control card reading. D1' D2' D3' are equated to zero if less than zero.

Depending on the nature of the radiation (user selected) one of the following four equations are used.

**Gamma :**

Gamma dose = D1' (equated to zero if less than RV)

**Beta – Gamma :**

Gamma dose = D1' (equated to zero if less than RV)

Beta dose = BMF X (D3'-CR31 X D1')

= zero if less than RV.

Where

BMF (Beta Modification Factor) = 1.397437 + 0.2002848 x K1

Where

K1 = (D3 – CR31 X D1') / K

Where

K = D2 – CR21 X D1 (If K < 20, then K = 20)

**X – Gamma :**

If D1' or D2' or D3' <5, then D1' or D2' or D3' = 5

R12 = D1' / D2'

If R12 ≥ 0.7 then Dose = D1' (If less than RV equate to zero)

Else Dose = D1' X (A1 + R12 X A2 + R12 X A3<sup>2</sup> + R12 X A4<sup>3</sup> + R12 X A5<sup>4</sup>)  
(Equate to zero if less than RV)

**Diagnostic X- Rays:**

If D1' / D2' < 5 then dose is evaluated as above.

If D1' / D2' ≥ 5 then

Dose = (D2' + D3') / 20 with the following message

**Badge worn over lead apron  
or lead apron not used.**

## **CHAPTER - IX**

### **REUSE OF DOSIMETERS**

There is a 10% left over TL after the 30 sec readout in the reader. The cards, therefore, are required to be annealed before reuse as per the following procedure.

TLD cards are first cleaned in acetone to remove grease, dust particles, if any, sticking to the dosimeter discs. This done by keeping the cards immersed in acetone container for about an hour. Thereafter, acetone is removed by pouring out into another container. The cards are kept overnight in the container so as to completely remove traces of acetone. These cleaned cards are transferred to a stainless steel tray and introduced into a programmable temperature oven with air circulation. The oven is then switched on and the temperature of the oven is raised to  $240^{\circ}\text{C} \pm 2^{\circ}\text{C}$  in about 60 minutes. The temperature is maintained at  $240^{\circ}\text{C}$  for 4 hours and then the oven is allowed to cool to less than  $50^{\circ}\text{C}$ . The cards are then taken out and are ready for reuse.

## CHAPTER - X

### TROUBLE SHOOTING

In case of any failure in instrument during acquisition, that failure will reflect in LCD display of Instrument as below Failure Code format and a failure message will appear in software

<b>FAILURE CODE ON LCD DISPLAY</b>	<b>SOFTWARE MESSAGE</b>
CRF	Card rise Failure
CLF	Card lower Failure
CPHF	Card Home Failure
MHF	Magazine Home Failure
S0F	Shutter Open Failure
SCF	Shutter Close Failure
MPF (n=1 to 50)	Magazine position n Failure (n=1to 50)
CP1F	Card position 1 Failure
CP2F	Card position 2 Failure
CP3F	Card position 3 Failure
TEMPF	Temperature controller Failure
FLOF	Flow Failure
EHTF	EHT Failure
T1#F!	Temperature / Gas flow failure

## FAULT DIAGNOSIS

Nature of Problem	Remedy
Door open	Close the door tightly until LED goes on front panel. Check using <b>Command Prompt</b> by entering “:MD#”. Response should be “:MD#0!” when door is Closed
Magazine home Failure	Check by entering “:MH#” in command prompt ,its response should be “:MHO”;Check whether magazine is moving or not , if not there may be problem in Magazine drive motor. Check all connections to the magazine motor. If magazine stops at wrong position ;there may be mismatch of position sensor arrangement, by adjusting that problem will be resolved
Card lower Failure	Check by Entering “:cDL#” ; its response should be “CLO” ,if not ,check all connections of Card raise/lower sensor PCB and Z-motor .
Card raise Failure	Check by entering “:cDR#” in command prompt, its response should be “CRO” ,if not ,check all connections of Card raise/lower sensor PCB and Z-motor .
Card Home Position Failure	Check by entering “:cSH#” in command prompt , its response should be “CPHO”;if not check all connections of Card home position sensor PCB
Card Position n failure n=1 to 3	Check by entering “:cS1#” / “cS2#” / “cS3#” in command prompt. Its response should be “CP1O” / “CP2O” / “CP3O” ”;if not check all connections of Disc position sensor PCB
Magazine position n Failure ;n = 1 to 50	Check by entering “:mnn#”(n=1 to 50)in command prompt ,its response should be “MPnnO”; if not check position sensor arrangement
Shutter Open Failure	Check by entering “:s0#”. Its response should be “SOO”. If not check all connections of shutter control PCB and Shutter motor
Shutter Close Failure	Check by entering “:s1#”. Its response should be “SCO”. If not check all connections of shutter control PCB and Shutter motor
Flow rate Failure	Read Flow Rate by turning Solenoid ON. If it is not set properly then adjust and recheck Flow rate on display. Otherwise check connections Flow+ and Flow –
Temperature controller Failure	Check this by Heater check option in software or by entering “:T1#”and wait for 30 sec. Ensure flow rate is showing 6 LPM during acquisition. Now issue a fresh command “:T1#” and its response should “:T1#1400!”. If not, check Temperature Controller board as given in temperature calibration.
EHT Failure	Measure EHT at MHV socket on Temperature controller / HV PCB cable. If it is not coming then there is a problem with EHT module. It needs repair / replacement

## CHAPTER - XI

### PRECAUTIONS

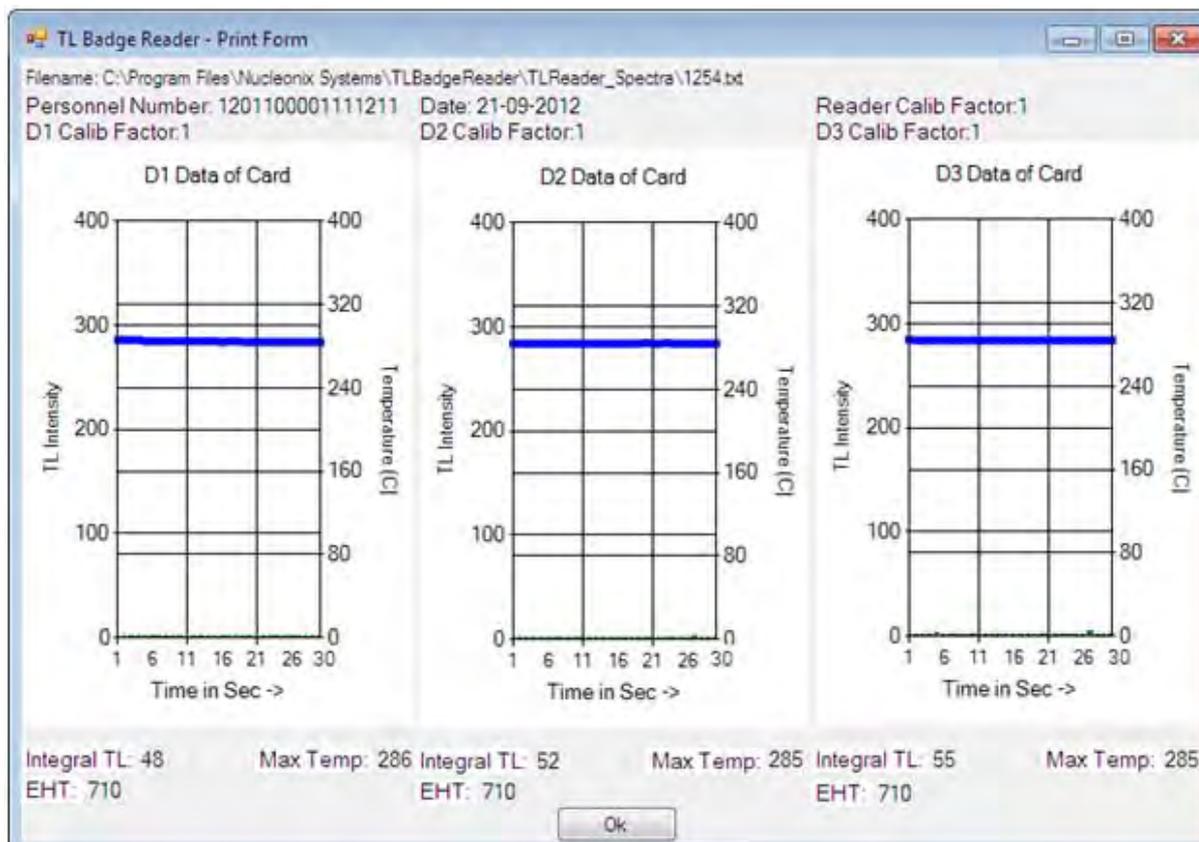
1. The light-tight compartment should be closed when the unit is in ON condition. If the upper cover is to be open in ON condition, remove the HV connector from PMT before switching the unit ON.
2. Removal of PMT from PMT housing should be done in a dark room only. (PMT is sensitive to light).
3. While readouts are in progress if Hardware Failure occurs due to mechanical failure then follow the below procedure.
  - a. If the failure is mechanical in Nature, then switch OFF the TLD unit to prevent mechanical damage to channel / magazine. Next try to restore the jammed TLD Card first into its magazine slot and powering unit back ON. Card will automatically get lowered back into its slot in the magazine.
  - b. Remove any / all deformed TLD Cards to prevent the magazine from getting stuck
  - c. Reload the magazine and close the Reader dark chamber cover and Top hinged cover.
  - d. Switch ON the system and read the remaining cards.
4. The channel should be regularly cleaned with cotton to remove dust & foreign particles.
5. In case of communication error message, ensure correct COM port assignment in software & check for cable connectivity.
6. Check for the Door LED ON/OFF. When door is closed only RED LED has to glow. Door Open Error should get reported in software during Acquisition if door is opened

**Important Note:**

Ensure the light tight compartment & upper cover is in closed condition before switching it ON.

## CHAPTER - XII

### SAMPLE GLOW CURVE



### DUMP TEXT FILE

This can view directly from software "file" option tends "Open text file"

The screenshot shows a Notepad window titled 'new nepal.txt - Notepad'. The text content is as follows:

```

0001 05-10-2012 1210200123100211 00000084 00000091 00000100
0002 05-10-2012 1210200123100221 00000325 00000384 00000458
0003 05-10-2012 1210200123100231 00000769 00000675 00000633
0004 05-10-2012 1210200123100241 00000525 00000380 00000360
0005 05-10-2012 1210200123100251 00000356 00000331 00000348
0006 05-10-2012 1210200123100261 00000314 00000296 00000297
0007 05-10-2012 1210200123100271 00000231 00000165 00000155
0008 05-10-2012 1210200123100281 00000493 00000330 00000330
0009 05-10-2012 1210200123100291 00000042 00000046 00000052
0010 05-10-2012 1210200123100301 00000045 00000049 00000052
0011 05-10-2012 1210200123100311 00000340 00000315 00000363
0012 05-10-2012 1210200123100321 00000067 00000070 00000062
0013 05-10-2012 1210200123100331 00000070 00000072 00000075
0014 05-10-2012 1210200123100341 00000078 00000078 00000082
0015 05-10-2012 1210200123100351 00000058 00000058 00000060
0016 05-10-2012 1210200123100361 00000067 00000064 00000061
0017 05-10-2012 1210200123100371 00000063 00000064 00000065
0018 05-10-2012 1210200123100381 00000081 00000074 00000078
0019 05-10-2012 1210200123100391 00000086 00000092 00000099
0020 05-10-2012 1210200123100401 00000114 00000100 00000110
0021 05-10-2012 1210200123100401 00000087 00000096 00000104
0022 05-10-2012 1210200123100411 00000142 00000155 00000131
0023 05-10-2012 1210200123100421 00000066 00000071 00000074
0024 05-10-2012 1210200123100431 00000077 00000093 00000103
0025 05-10-2012 1210200123100441 00000093 00000104 00000101

```

The status bar at the bottom indicates 'Ln 1, Col 1'.

## READOUT SHEET

**Calibration Factor : 1.00**

000310000000010	D1	0000031	D2	0000057	D3	0000077
000310000000020	D1	0000034	D2	0000097	D3	0000065
000310000000030	D1	0000033	D2	0000052	D3	0000088
000310000000040	D1	0000031	D2	0000094	D3	0000078
000310000000050	D1	0000031	D2	0000082	D3	0000072
000310000000060	D1	0000031	D2	0000045	D3	0000056
000310000000070	D1	0000025	D2	0000065	D3	0000072
000310000000080	D1	0000030	D2	0000056	D3	0000051
000310000000090	D1	0000037	D2	0000074	D3	0000081
000310000000100	D1	0000040	D2	0000081	D3	0000084
000310000000110	D1	0000040	D2	0000084	D3	0000082
000310000000120	D1	0000046	D2	0000085	D3	0000099
000310000000130	D1	0000047	D2	0000076	D3	0000083
000310000000140	D1	0000045	D2	0000079	D3	0000089
000310000000150	D1	0000045	D2	0000095	D3	0000090
000310000000160	D1	0000049	D2	0000117	D3	0000105
000310000000170	D1	0000052	D2	0000102	D3	0000088
000310000000180	D1	0000047	D2	0000078	D3	0000083
000310000000190	D1	0000045	D2	0000092	D3	0000094
000310000000200	D1	0000053	D2	0000104	D3	0000238
000310000000210	D1	0000047	D2	0000081	D3	0000078
000310000000220	D1	0000046	D2	0000082	D3	0000081
000310000000230	D1	0000043	D2	0000091	D3	0000105
000310000000240	D1	0000047	D2	0000081	D3	0000088
000310000000250	D1	0000051	D2	0000088	D3	0000083
000310000000260	D1	0000046	D2	0000074	D3	0000072
000310000000270	D1	0000067	D2	0000106	D3	0000093
000310000000280	D1	0000060	D2	0000082	D3	0000094
000310000000290	D1	0000048	D2	0000077	D3	0000100
000310000000300	D1	0000053	D2	0000090	D3	0000082
000310000000310	D1	0000047	D2	0000088	D3	0000091
000310000000320	D1	0000047	D2	0000088	D3	0000097
000310000000330	D1	0000054	D2	0000076	D3	0000089
000310000000340	D1	0000047	D2	0000090	D3	0000079
000310000000350	D1	0000049	D2	0000092	D3	0000095
000310000000360	D1	0000050	D2	0000081	D3	0000083
000310000000370	D1	0000047	D2	0000096	D3	0000087
000310000000380	D1	0000053	D2	0000085	D3	0000099
000310000000390	D1	0000052	D2	0000086	D3	0000113
000310000000400	D1	0000052	D2	0000099	D3	0000094
000310000000410	D1	0000062	D2	0000102	D3	0000088
000310000000420	D1	0000054	D2	0000108	D3	0000101
000310000000430	D1	0000052	D2	0000082	D3	0000096
000310000000440	D1	0000058	D2	0000087	D3	0000100
000310000000450	D1	0000061	D2	0000088	D3	0000087
000310000000460	D1	0000058	D2	0000076	D3	0000093
000310000000470	D1	0000059	D2	0000136	D3	0000113
000310000000480	D1	0000061	D2	0000102	D3	0000095
000310000000490	D1	0000068	D2	0000088	D3	0000085
000310000000500	D1	0000088	D2	0000118	D3	0000110

## CHAPTER - XIII

### TESTING OF TLD BADGE READER

1. Light Leakage : Check the readout of freshly annealed card in bright room as well as in the dark room.
2. EHT to PM Tube : After warm up time of 30 minutes, EHT should not vary by more than  $\pm 1\text{v}$  throughout the read out process.
3. Light Source Reading : The repeated LS reading can be taken in the reader test mode. The light source reading should not vary by more than  $\pm 5\%$  throughout the day.
4. Read out temperature : The clamping temperature as per the display should be around  $285^{\circ}\text{C}$ .  $\pm 2^{\circ}\text{C}$  and should reach within 50-60s from the start of heating cycle. The flow rate of  $\text{N}_2$  gas should be set in between 5-6 lpm. Changes in the flow rate may cause significant variation in the readout.
5. Glow Curve and Uniformity in Readout: Expose 10 (Selected) TLD cards sandwiched between perspex build-up plates (thickness 4-5 mm) to about 4-5mSv of Cs-137 gamma rays. TL readouts of all the cards should be taken and uniformity of gas heating can be checked by recording glow curves and comparing their stability.
6. Residual TL check : Second readout of the above cards should be taken to check the residual TL. The second readout should not be more than 10-12% of the first readout. If it is more either flow rate or air temperature point has to be adjusted.
7. Reproducibility of the TL Readout: For this test, atleast 10 selected TLD cards should be used. The cards are to be annealed, exposed in build-up plates and read after one day after the exposure. Cycle to cycle variation of average TL readout should be within  $\pm 10\%$  and incase of any significant change, the response should have an established trend. Minimum three cycles of annealing, exposure and readout has to be carried out.
8. Minimum Measurable Dose : The readout of some freshly annealed TLD cards (atleast 10 cards) should be taken. The minimum measurable dose can be obtained from the value of  $2\sigma$ .
9. Linearity test : Expose freshly annealed cards (a minimum of 5 doses, 5 cards for each dose) in the dose range from 0.3mSv to 1Sv of Cs-137 gamma rays and readout of all cards should be taken in similar conditions. The TL response (average TL/mSv) should be within  $\pm 10\%$  in the entire dose range covered.

## CHAPTER - XIV

### CALIBRATION OF TLD BADGE READER

1. Setting of TLD Reader: The TLD readers should be kept "ON" for atleast half an Hour for warm-up before starting the actual measurements on it. After LS measurements, readout of 2-3 dummy TLD cards should be taken to check the temperature and heating profile. Then take readout of three exposed calibration cards to confirm the calibration of the reader and if required either Reader Calibration Factor (RCF) should be changed or EHT to the PM tube should be adjusted to indicate the counts in desired proportion to dose ( $1\mu\text{Sv} - 1\text{count}$ ).
2. Intermittent check of TLD Reader Sensitivity: The reading of  $^{63}\text{Ni}$  light source TLD Card & Calibration Cards can be taken intermittently in a day.

#### **NOTE**

CAUTION : Do not open light compartments in unit "ON" condition.

Incase of any Hardware failure while taking readouts, follow the below procedure

1. If the failure is mechanical in Nature, try to restore the jammed TLD Card first in its magazine slot by powering the unit OFF and powering it back ON. If the deformation on the Card is removed then the card will automatically go back into its slot.
2. Remove any / all deformed TLD Cards to prevent the magazine from getting stuck
3. Reload the magazine and close the Reader dark chamber cover and Top hinged cover.
4. Switch ON the system and read the remaining cards.

## CHAPTER – XV

### AVAILING OF MAINTENANCE/ CALIBRATION SERVICES AND WARRANTY CLAUSE (with in India)

#### **How to avail calibration services (For Indian Customers)**

Nucleonix Systems offers radiation calibration services to its customers. Calibration services are provided for Nucleonix Systems manufactured products and also to others manufactured products. Nucleonix Systems Calibration Facilities are now accredited by NABL - National Accreditation Board for Testing and Calibration Laboratories. Hence we are an authorized lab for offering Radiation calibration services. We are attaching the following documents namely

- 1) "Certificate of Accreditation". and
- 2) "Scope of Accreditation", given by National Accreditation board for testing & calibration laboratories, in the following pages.

#### **How to avail calibration services:**

As per the Atomic Energy Regulatory Board (AERB) guide lines, it is necessary to calibrate any Radiation Monitoring equipment once in two years. When you want to send your Radiation Monitor / Area Monitor / Contamination Monitor etc. for calibration to our works, you may send the equipment for calibration, by following the steps given below:

Our standard calibration charges per equipment (All types of Radiation Monitors including Portable Survey Meters, Contamination Monitors & Area Gamma Monitors) are Rs: 6000 + Packing + Freight charges. If the Radiation monitors of other makes or imported meters then the charges are Rs: 7000+ Packing + Freight charges. You can email a 'work order' accepting these charges and calibration certificate is valid for 2 years. These charges may vary from time to time, hence you may obtain fresh quotation when you want to send your unit for calibration.

Email your work order, and despatch / send the equipment to our works if it is 5 years old or less including details of mode of transport sent with docket particulars. If your unit is more than 5 years old, and it is in working condition we may accept the unit for calibration. If it is not in working condition, only on receipt of the unit at our works and on inspection by our engineer, we will confirm on its serviceability and calibration.

Also mention in your work order and clearly indicate that you will agree to pay calibration charges and also equipment repair charges additionally if the unit is faulty and requires repairs, before one can take it up for calibration.

You are requested to ensure good packing to avoid any transportation damages. Especially, if there are external detector probes, they are to be packed with sufficient soft foam to ensure no damage in transportation.

Use only the specified following mode of transportation system for dispatching on door delivery basis. FEDEX / 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). Also you can cover for transit insurance both ways if you wish. Nucleonix system is not responsible for any transportation damages or loss during transportation both ways.

Immediately on receipt of the equipment, we will send an acknowledgment & also a proforma bill by email / post. Based on the proforma bill, once we receive the payment, equipment will be dispatched back by similar mode of transportation as mentioned above.

### **8.5 How to avail calibration services (For Foreign Customers)**

Foreign customers can calibrate Nucleonix make Radiation Monitors / equipments in their country at any of their accredited Radiation calibration labs. Nucleonix systems will be happy to provide any help and guidance if needed, for calibration. Alternatively if you send the equipment here to India we can also provide calibration services. We can also undertake calibration of other make Radiation monitors at our NABL accredited calibration lab.

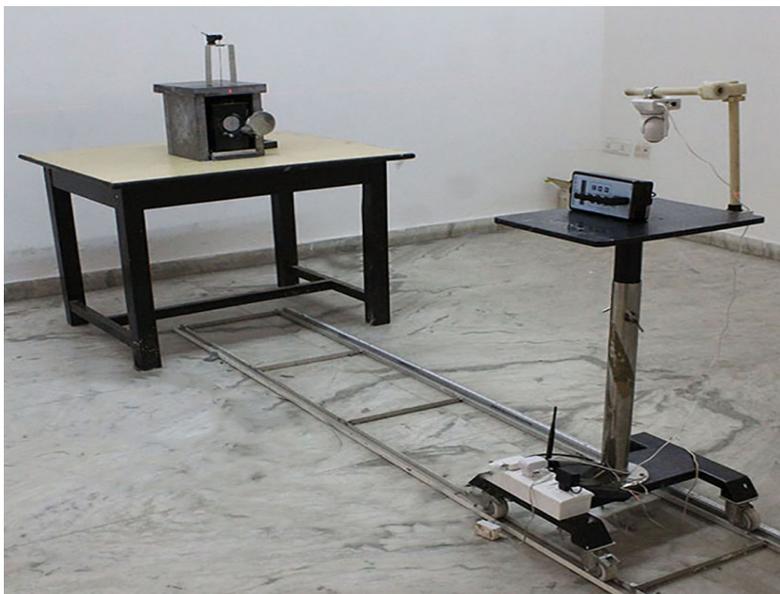
#### **Calibration Standards Lab & Facility:**

We have two calibration labs.

- i. Low Level Calibration Lab.
- ii. High Dose Rate Calibration lab.

Low Level Calibration Lab: This has a Cs-137, 107.43 mCi standard Traceable to RSSD, BARC. The uncertainty of the Standard is 5.2%.

Calibration of all portable Radiation Monitors, Survey Meters, Contamination Monitors, Area Monitors etc., is carried out in this lab up to 200 mR/hr max dose rates.



Gamma Survey instruments calibrator has Cs-137 source 107.43 mCi as on 01 Jan 2020. It is basically a gamma survey instruments calibrator procured from AEA Technologies UK/USA. Has NIST traceability accuracy within  $\pm 7\%$ .

**High Dose Rate Calibration Lab:** This lab has a 7.43 Ci, 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.

## Availing of Maintenance / Calibration Services and Warranty Clause

### 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 / FEDEX / 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.

Phone: 040-29706483 / 84 / 85, Mobile No: 7331104481 / 82.

E-mail: info@nucleonix.com Web : www.nucleonix.com.

For all the Radiation Monitoring equipment, detectors built-in or external probes will not have one-year warranty, but 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, Nucleonix will supply detector replacement at cost-cost price.

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

### EQUIPMENT REPAIRS / SERVICING POLICY (WITHIN INDIA)

#### During Warrantee

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

- Equipments are to be sent to our works for availing free repair services during warrantee, after the customer receives approval from our customer support division, by sending an e-mail.
- For all equipments, costing less than 6.0 lakhs, one year warrantee & free service is offered, when the equipments are sent to our works only. For larger systems such as installed systems, networked systems, specialized systems, costing more than 6.0 lakhs, during one year warrantee, free service is offered at site. Field Service Engineer will be deputed subject to warrantee terms & conditions.
- This does not include personal computer related problems, for which local computer service provider of the PC vendor is to be contacted. Also for software related problems, online support will be provided. Software support doesn't include cleaning of virus problems etc.
- When the equipments are sent to our works for warrantee services, they are to be properly packed with adequate cushion to prevent any transportation damages. 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 and Freight charges will be to your account. Only services are free.

- 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 FEDEX / GATI cargo in your city / town or a reliable courier service to pick the consignment from your place. For their nearest local address & phone Nos; 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 sent back by same mode of transport such as FEDEX / GATI / COURIER / RPP / SPEED POST.
- All types of Radiation detectors, glass ware, PMTs etc which are fragile are not covered in warrantee, if the failure is due to physical damage, external or internal due to shock, dropping, miss-handling etc. If the failure is due to a natural fault, then only it is covered under warrantee for a limited period of three months. However complete electronics is covered for 1 year warrantee.
- You can also send the equipment personally to our works for repairs either during or after warrantee, 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 or two and get it repaired / calibrated.

#### **After warrantee Services**

On expiry of 1yr warrantee, if you like to send the equipment (low cost less than 6.0 lakhs) for repairs to our works, you may please observe the following procedure.

- Send an e-mail with details mentioning that you agree to pay service charges which includes: Basic service charges per unit / module in the range of Rs: 2500 to Rs : 10,000 depending on the sophistication of the unit, calibration charges (if applicable for your equipment) + cost of components + packing charges + Return Freight charges @ actuals.
- Once our customer support department responds and requests you to despatch the equipment to our works for repairs, you may do so by following the steps given below.
- Followed by this you can send the equipment straight away if it is within 5 yrs old. If the equipment is beyond 5 yrs old, then also you can send it for repairs, however only after you receive confirmation from Customer Support Division, that it is repairable and is not an obsolete model. If the design is obsolete, then customer support division (CSD) may give you 'buy back' offer to replace with new model or upgrade it with electronic circuit boards & enclosure.
- For all installed equipments, costing above Rs. 6.0 lakhs, which are larger in size and for which field servicing only is recommended, you can obtain a quotation with relevant details by sending an e-mail & avail the services accordingly.
- For all field servicing jobs, since we need to depute engineers, it is likely, to take time and also it will cost more which includes Engineer's TA & DA etc., apart from basic service charges + cost of spares etc. Please note that basic service charges will be different for different products depending upon sophistication.
- Also in some cases it may not be possible to fix-up the problems in the field itself, and in such cases, we may advise you to send them to our works.
- 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.
- For any additional information, send an e-mail to [info@nucleonix.com](mailto:info@nucleonix.com), Atten: Customer Support Division.

## **EQUIPMENT REPAIRS / SERVICING POLICY (FOR EXPORTS)**

Equipments, manufactured and exported are subjected to a well defined quality assurance (QA plan & Factory acceptance tests (FAT. Nucleonix systems has the following policy to provide maintenance support to overseas customers either directly or through international dealers / distributors.

### **During & after warranty:**

- For minor problems, which can be handled by customers, servicing tips have been provided in the user manual / servicing manual.
- Also, most of the equipments have built-in fault diagnostic features which will indicate to the user nature of problem in the equipment. Based on the visual indication in the instrument Display, user can take corrective action or contact Nucleonix Systems by email for help.
- Nucleonix Systems will guide in localizing the defective part /module or sub-system by interacting with the customer if required. Skype will be used for communication.
- During warranty free replacement of sub-system or board (PCB) will be done. However customer has to send defective sub-system back to Nucleonix Systems within 15 days on arranging replacement.
- During & after warranty, any Freight charges & Customs clearance charges are to be borne by customers, both ways.
- If it is a manufacturing defect, then Nucleonix Systems will bear the replacement cost of sub-system / unit. However any Freight charges & Customs clearance charges in their country are to be borne by customer.
- After warranty, services will be similar to that of services during warranty. However, customer will have to pay for cost of parts replaced, freight charges both ways & Customs clearance charges in both the countries. Nucleonix Systems plans to introduce audio visuals on web or on CDs to facilitate product demonstration, installation & minor maintenance, very soon.

### **ANNUAL MAINTENANCE CONTRACT (AMC) Annual maintenance contract (AMC) services:**

For all sophisticated instruments & systems and also for installed monitors & networked systems in a Nuclear Facility or a Radiological Lab or in a Medical Cyclotron Facility where number of instruments are networked, it is advised that customers enter into an economical Annual maintenance contract with Nucleonix Systems. Detailed AMC proposal can be obtained from our customer support division (CSD), by giving required inputs.

### **Inputs required by our CSD to send you AMC proposal:**

Name, year & data of purchase, Sl. Nos. of equipments, Model No's, No. of equipments for which AMC is required. Additionally number of calls per annum required for preventive & breakdown maintenance may also be indicated.

**Advantage of entering into AMC:**

- Equipment services offered will be prompt & timely.
- Nucleonix systems maintain required spares, spare tested PCBs, detectors & other critical components which may become obsolete.
- Obsolescence in electronics is quite rapid. If you enter into AMC, guaranteed service for the period of AMC will be the responsibility of Nucleonix Systems.
- Nucleonix Systems will maintain Engineers at your disposal to attend to AMC calls on time
- Without AMC, prompt service calls are not guaranteed.
- If some critical components become obsolete, then Nucleonix systems may request you to upgrade the product with new model or new electronics which may be expensive, if you are not under AMC.

**Training on maintenance / servicing:**

- To a limited extent, we offer training on maintenance / repairs at our works to customers on chargeable basis. Details can be obtained from our Customer Support Division, by customers who may require such services.



National Accreditation Board for  
Testing and Calibration Laboratories

**CERTIFICATE OF ACCREDITATION**

**NUCLEONIX SYSTEMS PRIVATE LIMITED -  
CALIBRATION LABORATORY**

has been assessed and accredited in accordance with the standard

**ISO/IEC 17025:2017**

**"General Requirements for the Competence of Testing &  
Calibration Laboratories"**

for its facilities at

PLOT 162 AB, IDA, PH II, CHERLAPALLY, HYDERABAD, TELANGANA, INDIA

in the field of

**CALIBRATION**

Certificate Number: CC-3018

Issue Date: 17/07/2019

Valid Until:

16/07/2021\*

\*The validity is extended for one year up to 16.07.2022

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website [www.nabl-india.org](http://www.nabl-india.org))

Signed for and on behalf of NABL



N. Venkateswaran  
Chief Executive Officer



# National Accreditation Board for Testing and Calibration Laboratories

## SCOPE OF ACCREDITATION

**Laboratory Name :**

NUCLEONIX SYSTEMS PRIVATE LIMITED - CALIBRATION LABORATORY, PLOT 162 AB, IDA, PH II, CHERLAPALLY, HYDERABAD, TELANGANA, INDIA

**Accreditation Standard**

ISO/IEC 17025:2017

**Certificate Number**

CC-3018

**Page No**

1 of 1

**Validity**

17/07/2019 to 16/07/2021\*

**Last Amended on**

-

\*The validity is extended for one year up to 16.07.2022

S.No	Discipline / Group	Measurand or Reference Material/Type of instrument or material to be calibrated or measured / Quantity Measured /Instrument	Calibration or Measurement Method or procedure	Measurement range and additional parameters where applicable(Range and Frequency)	* Calibration and Measurement Capability(CMC)(±)
Permanent Facility					
1	RADIOLOGICAL - RADIOLOGICAL MEASUREMENT S	Radiation Dose & Dose Rate	Using Cs-137 Radio Nuclide (Amersham Corporation Model 773) as per Safety Report Series No. 16, IAEA, Vienna 2000	0.2 mR/h to 200 mR/h	5.2 %
2	RADIOLOGICAL - RADIOLOGICAL MEASUREMENT S	Radiation Dose & Dose Rate	Using Co-60 Radio Nuclide (CRC-2A Camera, BRIT Make) as per Safety Report Series No. 16, IAEA, Vienna 2000	0.2 mR/h to 50 R/h	5.1 %

\* CMCs represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k = 2.

## CHAPTER –XVI

### CONTACT US FOR AVAILING SERVICES

#### **Postal/Mailing Address (Phone / Fax / Email)**

Nucleonix Systems Pvt Ltd.  
Plot No. 162 A&B, Phase II, I.D.A.,  
Cherlapally, Hyderabad - 500 051, Telangana, India.  
Phone: 040-29706483 / 84 / 85  
Mobile No: 7331104481 / 82  
Email : info@nucleonix.com

**For any information, Contact by email is always appreciated.  
(This will help us to respond to you quickly)**

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#### **Marketing Department :**

##### **a) Sales / Commercial Information / Field installation and servicing**

For any Commercial, Price information, Product information, customer coordination & quotation of our products customer related commercial services, please contact front office marketing staff through the listed Email Ids or Phone Nos. given below

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#### **Whom to Contact:**

<b>Business</b>	<b>Contact Numbers</b>	<b>Contact by E-mail ID</b>
1. Surya Teja (Sr. Business Executive)	<b>Mob: 7331104481, Ph: 040-29706483 / 84 / 85</b>	info@nucleonix.com
2. <b>Amulya</b> (Business Executive)	<b>Mob: 7331104481, Ph: 040-29706483 / 84 / 85</b>	info@nucleonix.com
3. <b>Pranaya</b> (Business Executive)	<b>Mob: 7331104481, Ph: 040-29706483 / 84 / 85</b>	info@nucleonix.com

**Note:** Our business executives will also connect you to concerned Engineer or General Manager for any technical clarifications if required

##### **b) Factory Services**

For **Servicing and Calibration** factory services & follow up on the above jobs including dispatch related/payment related issues of serviced & calibrated items please contact

**Ms.Prasanna**  
**(Executive services)**

**Mob:7331104482**

**E-mail: info@nucleonix.com**

She will also connect you to concerned engineer or general manager if required, for any clarifications & deficiencies in services

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**c) Dispatch Related Issues (Production Items)**

For dispatch related issues of your ordered equipments, including delays, purchase order related document deficiencies, payment proofs, dispatch docket details and bills etc,.contact

**Renuka Devi**  
**(Executive Dispatch)**

**E-mail: info@nucleonix.com**

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**d) Product Technical Information / Clarifications**

**Whom To Contact:**

Contact any front office "Business Executive"- He/She will take your details and connect you to concerned product engineer for any technical clarifications. Best thing is to email your technical queries and obtain the reply, rather than on telephone.

You can also contact General Manager or Director (Tech) if required.

**e) Marketing Manager**

On business matters for all your marketing services / techno commercial requirements about Nucleonix Products contact:

**Bhaskara I.V.**  
**Mob:8019662500**  
**Email: info@nucleonix.com**

**f) General Manager**  
**Dr.M.S.R.Murthy PhD (Nuclear physics)**  
**Email: info@nucleonix.com**

Contact General Manager for all sales / servicing and technical information including customer support related issues, on the delays, gaps & lapses by our staff. Contact G.M. regarding field installations & field servicing jobs schedule etc.

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**g) H.R -Incharge**

Contact him regarding, job vacancies, sending resume for employment, H.R. related issues etc. contact

**T.Suresh Babu**

**Mob:7331104480**

**Email: recruit@nucleonix.com**

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**h) Director -Technical  
Mr. J. Dheeraj Reddy**

**Email: jdreddy@nucleonix.com**

**Mobile No. +91-7674009005**

Contact him for, any Technical Information and clarifications on products, which cannot be answered by General Manager / Customer support executives.

For any technical deficiencies in products, related issues & suggestions on product improvements you may contact by email or telephone. This will help the company to improve the product & serve you better.

Dealer's complaints, on commercials, lapses by our commercial staff, or any other discrepancy, or you like to give any feedback on any Nucleonix staff doing any wrong thing against cleaner / ethical business principles / practices can be complained to any of the directors or managing director.

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**i) Director - IT**

**Mr. J. Nishanth Reddy**

**Email: nishureddy@yahoo.com; info@nucleonix.com**

**Mobile No. +91-9966691000**

For any deficiencies in product software's, related issues, & any suggestions or improvisations in software's can be contact by email or telephone. This will help the company to improve the product & serve you better.

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**j) Managing Director**

**Shri. J.Narender Reddy (Managing Director)**

**Email : jnreddy@nucleonix.com; info@nucleonix.com**

**Contact Managing Director for**, Foreign relations, International Business co-operation, Joint ventures, Exports, Dealership in other countries, Policy matters, Technology tie-ups etc.

**k) Dealers Complaints :**

Dealers complaints, on commercials, lapses by our commercial staff, or any other discrepancy, or you like to give any feedback on any Nucleonix staff doing any wrong thing against cleaner / ethical business principles / practices can be complained to any of the directors or managing director.

**An innovative company working towards excellence  
in the field of Nuclear Instrumentation**



**NUCLEONIX SYSTEMS PVT. LTD.**

**Plot No.162 A & B, Phase-II, IDA, Cherlapally, Hyderabad-500051 INDIA.**

**Phone: 040-29706483 / 84 / 85, Mobile No: 7331104481 / 82**

**Email : [info@nucleonix.com](mailto:info@nucleonix.com) website : [www.nucleonix.com](http://www.nucleonix.com)**