RCTEM

WebiSmarts Radiation Monitoring System Installation Guide

Software Version: 1.0.2.0

March 2023

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Safety

Under no circumstances can the detectors be connected or disconnected when the Unit is under power.

Considering local regulation in force: person and equipment protection against electric shocks, Rotem Industries Ltd. recalls that ANY WORK ON A POWERED EQUIPMENT SHALL MANDATORILY BE PERFORMED BY QUALIFIED AND AUTHORIZED PERSONNEL.

Ionizing radiation of the sources used is dangerous for the worker whenever the protective measures are not strictly applied.

Although our equipment items are built in compliance with the most severe safety standards, the ionizing radiation source represents a danger when the worker is not qualified or not warned.

ANY HANDLING OF RADIOACTIVE SOURCES SHALL MANDATORILY BE PERFORMED BY QUALIFIED ANO AUTHORIZED PERSONNEL.

Consequently, all precautions shall be taken to prevent any non-authorized or non-qualified person from using this equipment, endangering others and themselves.

Prior to any handling, those qualified and authorized to use this equipment shall get information on the protective measures set forth by the national standards in force.

Abandon or destruction of equipment containing a radioactive source is FORBIDDEN. If no longer required, the user must inform Rotem Industries Ltd. who will arrange to take the source back (according to the contract) and establish a certificate stating that the source has been taken back. In the event that the source is lost or stolen, the user must inform the appropriate authorities soon as possible

Directive 2002196/EC of the European parliament and of the council of January 2003 on waste electrical and electronic equipment (WEEE). At the end of the product's useful life, please dispose of it at appropriate collection points provided in your country

Revision Log

Date	Issued by	Verified by	Origin and designation of modification	Modified pages
November 2019	Laurence Kaplan		Initial document	Initial document
June 2021	Laurence Kaplan		Addition of Default Users and Passwords	22
July 2021	Laurence Kaplan		Addition of External Signal Interface section	23-26
December 2021	Laurence Kaplan		Added Adding and Editing New Users Adding Maps and Adding Points	 49 52 and 53
March 2023	Laurence Kaplan		Added: Instructions for Migration from SQL Express to SQL standard edition Updated Installing the Coincidence Stack Monitors Installation Instructions for Peripheral equipment, Coincidence Stack Monitors and WebiWatch application Added Appendix D Applying the efficiency factors Added WebiWatch Setup Added Fine Tuning the Coincidence results	 45 21-32 33-39 78-84 21-32 63-66 91-128 54 33

Contents

1 Introduction

1.1 About WebiSmarts

WebiSmarts **(Web**-based **S**urvey **M**apping **A**utomatic **R**adiation **T**racking **S**ystem) provides a comprehensive solution to regulatory, health safety and production monitoring in cyclotron facilities and PET centers.

WebiSmarts combines a radiation monitoring system and a control system to measure and collect radiation data automatically and continuously from various radioactive areas, including the exhaust stack.

WebiSmarts is based on the following basic components:

- Detector(s)
- Data Processing Unit's (DPU-3)
- Server
- Clients

Main features:

- Web-based analysis software
- Monitors different areas of the facility
- Monitors various aspects of the production process
- Compatible with many types of radiation detectors
- Modular, local alarms, and control system

1.2 About this Document

This document includes information related to every phase of the installation process. It also includes a description of the WebiSmarts system architecture.

Although your server comes with WebiSmarts already installed and configured, this document also includes instructions for installing the WebiSmarts software in case it is ever needed.

1.3 Overview of the WebiSmarts Installation Process

The WebiSmarts installation process has the following stages:

1. The site Radiation Safety Officer (RSO) determines the required positions of the DPU-3's and detectors.
2. You send Rotem a map of the facility with the positions of the DPU-3's and detectors clearly marked.
3. You send Rotem the required technical information (see section 5.2 "Site Preparation").

4. Rotem sends a package of equipment to you, including:
   - A server with all software installed, including a map of your facility with the detector points already set up.

     Note

     If WebiSmarts is an update to the MediSmarts software, send your archives from the last year to Rotem for importing into the new WebiSmarts system.

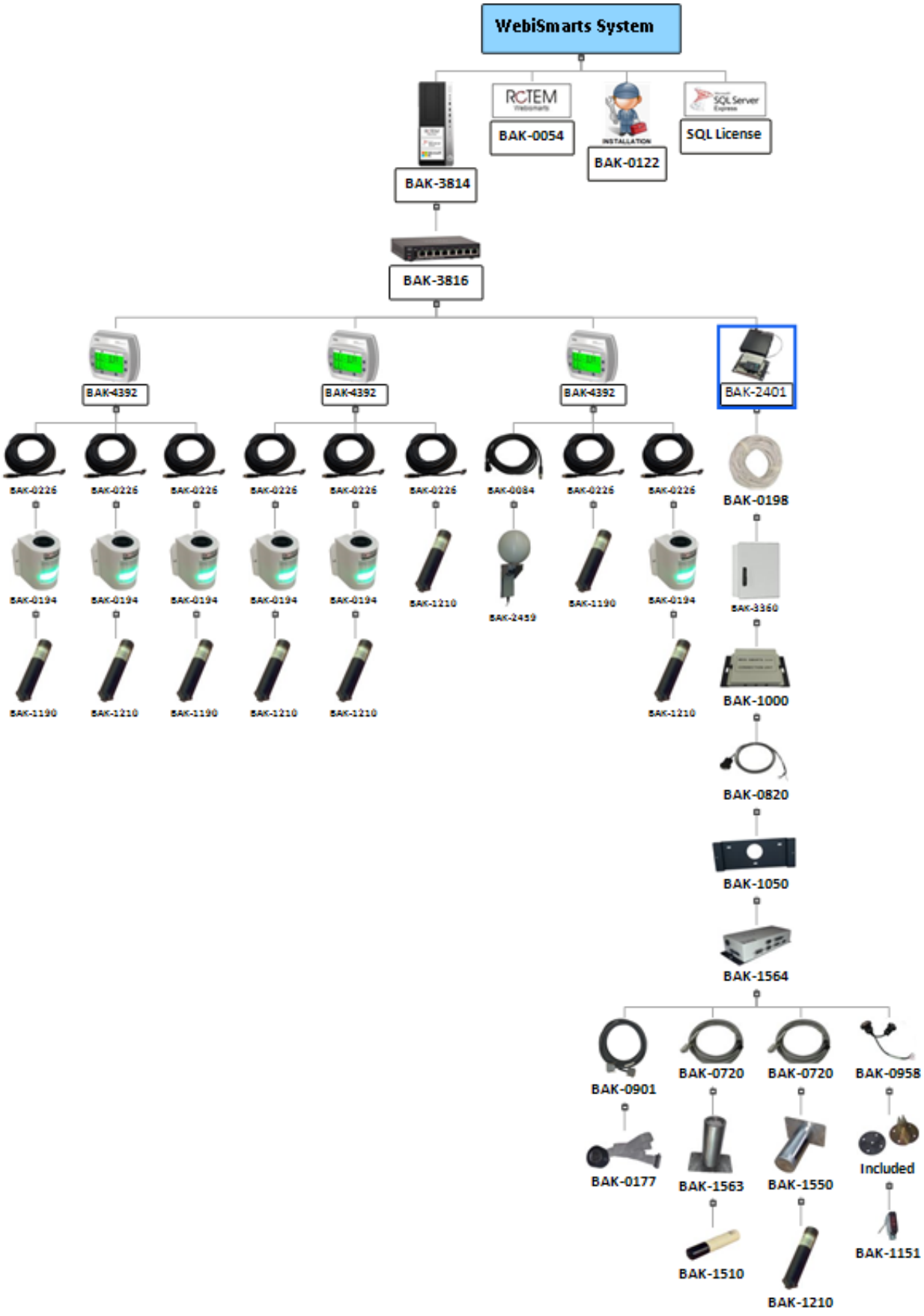
   - DPU-3's, detectors and flowmeters
   - All required cables and mounting brackets
5. Lay out the Ethernet cables in your facility according to the plan set out in steps 1 and 2.
6. The WebiSmarts System is installed as a standalone network on the Server provided by Rotem.
7. Connect the Rotem Server to your network and install any third-party software that you require (such as anti-virus software) and test it to make sure it does not interfere with the WebiSmarts system, and vise-versa.

2 System Architecture

WebiSmarts measures and collects radiation data automatically and continuously from various radioactive areas, including the exhaust stack. WebiSmarts is based on three basic components:

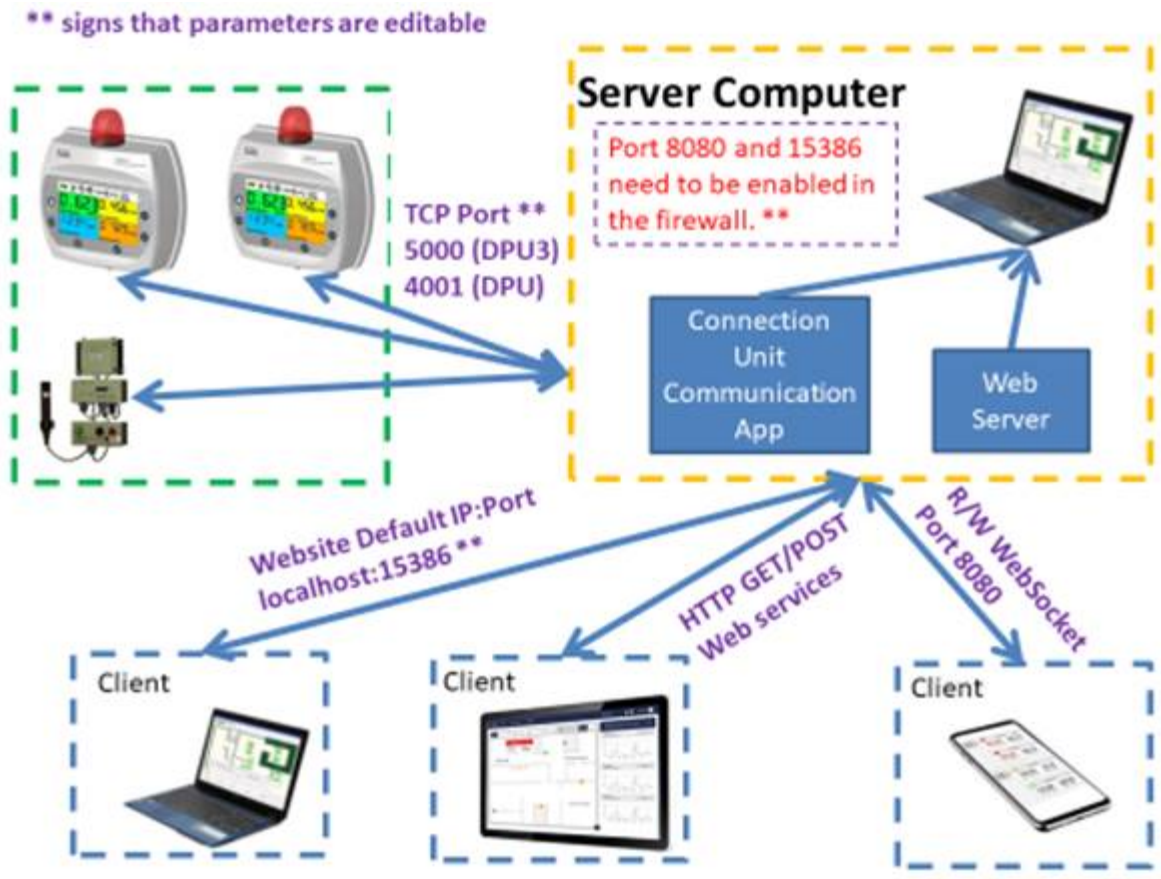
- Data Processing Units (DPU-3's)
- Detectors
- Server

The following diagram describes the WebiSmarts system architecture:


WebiSmarts System
BAK-3814
BAK-0054
BAK-0122
SQL License
BAK-3816
BAK-4392
BAK-4392
BAK-4392
BAK-2401
BAK-0226
BAK-0194
BAK-1190
BAK-1210
BAK-0084
BAK-2459
BAK-0198
BAK-3360
BAK-1000
BAK-0820
BAK-1050
BAK-1564
BAK-0901
BAK-0177
BAK-0720
BAK-1563
BAK-1510
BAK-0720
BAK-1550
BAK-1210
BAK-0958
Included
BAK-1151

- Every DPU-3 has one internal detector and connections for three external detectors.
- For a detailed drawing of the parts of the DPU-3, see Appendix B.

System Application Architecture



3 Required Equipment

3.1 Required Software

To install WebiSmarts, you will need the following software:

- WebiSmarts software
- MS SQL Server Express 2017 (or later) – **Please Note !!!** that for a system containing more than 10 detectors, you need to purchase a licensed version of the SQL Server

- IIS Server

3.2 Required Hardware

To install WebiSmarts, you will need the following hardware:

Server PC (standard or high-power)

Switch (8, 24, or 48 ports)

Note

The DPU-3 includes an internal POE PD Module that uses the 802.3af protocol standard. If you are using a switch it is recommended to make sure that it supports the 802.3af protocol standard.

DPU-3 Monitor(s) with optional, wide, high, or low range internal detectors

External detector(s)

Mounting brackets for detectors, exhaust stack, and flowmeters of the appropriate types (wall-mounted, table-top, weatherproof, etc.)

DPU-3 cables

Ethernet cables

Flowmeter cables

3.2.1 Bill of Materials (BOM)

The following table lists all supported equipment for running WebiSmarts. Select the appropriate equipment from this list to suit your specific needs.

Note

For assistance with selecting the appropriate equipment, consult your Rotem representative.

No	CAT	DESCRIPTION
1	Control Station and Software	
5	BAK-0054	WebiSmarts Software
9	BAK-3816	Cisco Catalyst 3560-CX 8 GigE PoE 240 W Port PoE IP Base
13	BAK-3817	Cisco Catalyst 2960-XR 24 GigE PoE 370W, 2 x 10G SFP+, IP Lite
17	BAK-3818	Cisco Catalyst 2960-X 48 GigE PoE 740W, 4 x 1G SFP, LAN Base
25	BAK-3814	HP EliteDesk 800 G4 Server
29	BAK-3812	All in One Touchscreen Computer (optional)
37	BAK-4384	DPU-3 Monitor
45	BEN-2415	Wide Range Internal Detector (0.1 uSv/h - 10 Sv/h)
49	BEN-2416	High Range Internal Detector (250 µSv/hr - 10 Sv/hr)
53	BEN-2418	Low Range Internal Detector (0.1 µSv/h - 40 mSv/h)
59	External Detectors	
64	BAK-1210	GM-42 Detector
69	BAK-1510	PM-11M Detector

69	BAK-1190	GM-41 Detector
74	BAK-3591	Gamma Wide Range
79	BAK-1170	GM-10 Detector
84	BAK-1180	GM-40 Detector
89	BAK-0120	AMP-50 Detector
94	BAK-0220	AMP-100 Detector
99	BAK-0330	AMP-200 Detector
104	BAK-1230	IC-10 Detector
109	BAK-4481	AMP-300 Detector
114	BAK-2685	SFP-100 Detector
119	BAK-1517	PM-33M Detector
124	BAK-1290	Ludlum 42-30 Neutron Detector
129	BAK-1204	Ludlum Prescila Neutron Detector
130	BAK-1151	Flowmeter
131	Brackets	
132	MEC-9285	DPU-3 Wall Bracket
133	BAK-4641	DPU-3 Tabletop Bracket
135	BAK-1160	Flowmeter Bracket
137	BAK-1200	Standard 1" Detector Wall Brackets
141	BAK-0062	AMP Wall Brackets
145	BAK-0063	IC-10 and SFP-100 Wall Brackets
149	BAK-1550	GM-42 Exhaust Stack Weatherproof Bracket
153	BAK-1560	PM-11 Exhaust Stack Weatherproof Bracket
160	Cables	
161	BAK-0081	Cable Assy DPU-3 to external Detector 1.5m (5ft)
165	BAK-0082	Cable Assy DPU-3 to external Detector 9m (30ft)
169	BAK-0083	Cable Assy DPU-3 to external Detector 30m (98 ft)
173	BAK-0084	Cable Assy DPU-3 to external Detector 70m (230 ft)
177	BAK-0085	Cable Assy DPU-3 to external Detector 100m (328 ft)
181	BAK-0087	DPU-3 Flowmeter Cable 30 cm (12")
185	BAK-0088	DPU-3 Flowmeter Cable 30 m (100 ft)
189	BAK-0089	DPU-3 Flowmeter Cable 50 m (165 ft)
193	BAK-0091	DPU-3 Flowmeter Cable 100 m (100 yds)

4 Installing the Hardware

4.1 Hardware Components

The hardware components that need to be installed include:

- DPU-3's:
- Brackets
- Detectors
- Flowmeters
- Exhaust stack brackets
- Ethernet cables
- Hub/Switch (optional)
- Server

> **Note**
>
> For complete instructions on installing the hardware, see the DPU-3 Operating Manual.

4.2 Site Preparation

Before installation day, prepare your facility accordingly:

1. Lay out the Ethernet cables to match the required position of the DPU-3's.

> **Notes**
>
> - To determine the proper locations, consult your RSO.
> - Detectors must be placed at about the same height from the floor as a human heart. This is approximately 142 cm (4.65 ft).
> - The DPU-3 has an opening on the back cover for connecting it to an Ethernet wall socket. This way it is possible to mount the DPU-3 cleanly on the wall.

2. Lay out the Ethernet cables and connect them to the switch (hub).
3. Set aside an appropriate place for the server. This room should:
   - Be free of dust
   - Have an adequate power supply
   - Have adequate ventilation with a temperature that is ideally between 20°C and 22°C (68°F and 71°F) and not below 10°C (50°F) or above 28°C (82°F).
4. Send your Rotem representative the following information:
   - The type of server, detectors, flowmeters, and other equipment required (see section 4.3 "Bill of Materials (BOM)")
   - A list of switches that are used for the WebiSmarts system.

- The domain details, such as DNS addresses and Subnet Masks
- The range of IP addresses that can be used for WebiSmarts
- For existing MediSmarts users: the archive files for at least two years prior. Rotem will add these files to your new WebiSmarts system.

  In Windows Explorer, navigate to the MediSmarts directory > Archive and zip the appropriate folders. Send the zip file to Rotem.

4.3 Configuring the DHCP Server on Cisco Switches

This section explains how to configure the DHCP service on a Cisco switch to act as the DHCP server.

Connect a Router/Switch Through the Console Port

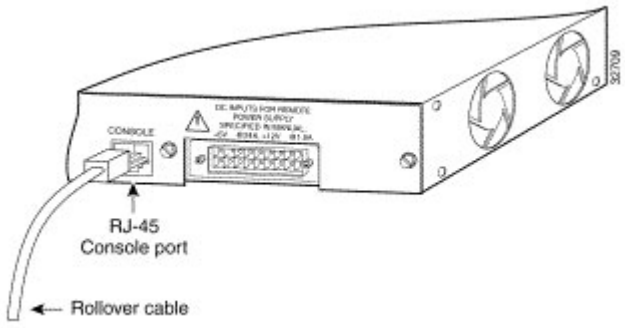
Cisco router/network switch has a console port on its front. It is there to provide a way to hookup a terminal to the router in order to work on it. The console port (sometimes called the management port) is used by administrators to log into a router directly — that is, without a network connection. The console must be used to install routers onto networks because, of course, at that point there is no network connection to work through.

Use the supplied rollover cable and the DB-9 adapter to connect a PC to the Cisco console port. The PC or terminal must support VT100 terminal emulation. The terminal emulation software—frequently a PC application such as Microsoft Windows HyperTerminal or Symantec Procomm Plus—makes possible the communication between the switch and your PC or terminal during the setup program.

Follow these steps to connect the PC to the Cisco unit:

Connect the 9 pin to RJ-45 adapter to the console cable.(Depending on your source for the console kit, you may already have this step done for you as sometimes I get one piece console kits.)

Connect the 9 pin adapter to COM1 on your PC With the supplied rollover cable, insert the RJ-45 connector into the console port.



Launch HyperTerminal and name the console session.

Select COM number as your “Connect Using” port (make sure you connected the console cable to COM1 on your PC.

Configure the baud rate and character format of HyperTerminal to match these console port default characteristics:
o 9600 baud
o 8 data bits
o 1 stop bit
o No parity
o NO FLOWCONTROL

Turn the Cisco unit on and now you should see the boot process in HyperTerminal of your unit.

Press ENTER to connect to your Cisco unit. This will bring you in User mode.

At the router> prompt, type in a question mark (?) This will list all the User mode commands. Feel free to play with all the available commands. You are in a safe zone.
Nothing will be damaged.
First configuration will show up:
All naming question set **WebiSmarts** name
All password set **rotemi09** password**.**
When asked to set vlan number set **vlan1.**

Configuring DHCP service on the switch

The DHCP service allows hosts to automatically obtain their IP configuration from the DHCP server. The DHCP service is available on Cisco switches. This means, if you have a Cisco switch in your network, you can also use it as a DHCP server.
The following table lists the commands that are required to configure a switch to act as a DHCP server.

Command	**Description (*command used for*)**
Switch>enable	To enable the switch and to enter privileged-exec mode.
Switch#configure terminal	To enter global configuration mode.
Switch(config)#ip dhcp excluded-address [*starting address*] [*ending address*]	To create a range of excluded IP addresses.
Switch(config)#ip dhcp pool [*pool name*]	To create a DHCP pool and enter DHCP pool configuration mode.
Switch(dhcp-config)#network [*network ID*] [*subnet mask*]	To define the range of IP addresses that the DHCP server should offer to clients.
Switch(dhcp-config)#default-router [*IP address of default gateway*]	To set the IP address of the default gateway.

Switch(dhcp-config)#dns-server [*IP address of DNS server*]	To set the IP address of the DNS server.
Switch(dhcp-config)#exit	To exit DHCP pool configuration mode.
Switch(config)#interface vlan 1	To enter VLAN configuration mode of the VLAN 1.
Switch(config-if)#ip address [*any available IP address from the pool*] [*subnet mask*]	To set an IP address on the VLAN1.
Switch(config-if)#no shutdown	To enable the VLAN.
Switch(config-if)#exit	To exit VLAN configuration mode.
Switch(config)#exit	To exit global configuration mode.
Switch#copy running-config startup-config	To copy running configuration to startup configuration.

Access the command prompt of the switch and run the following commands:

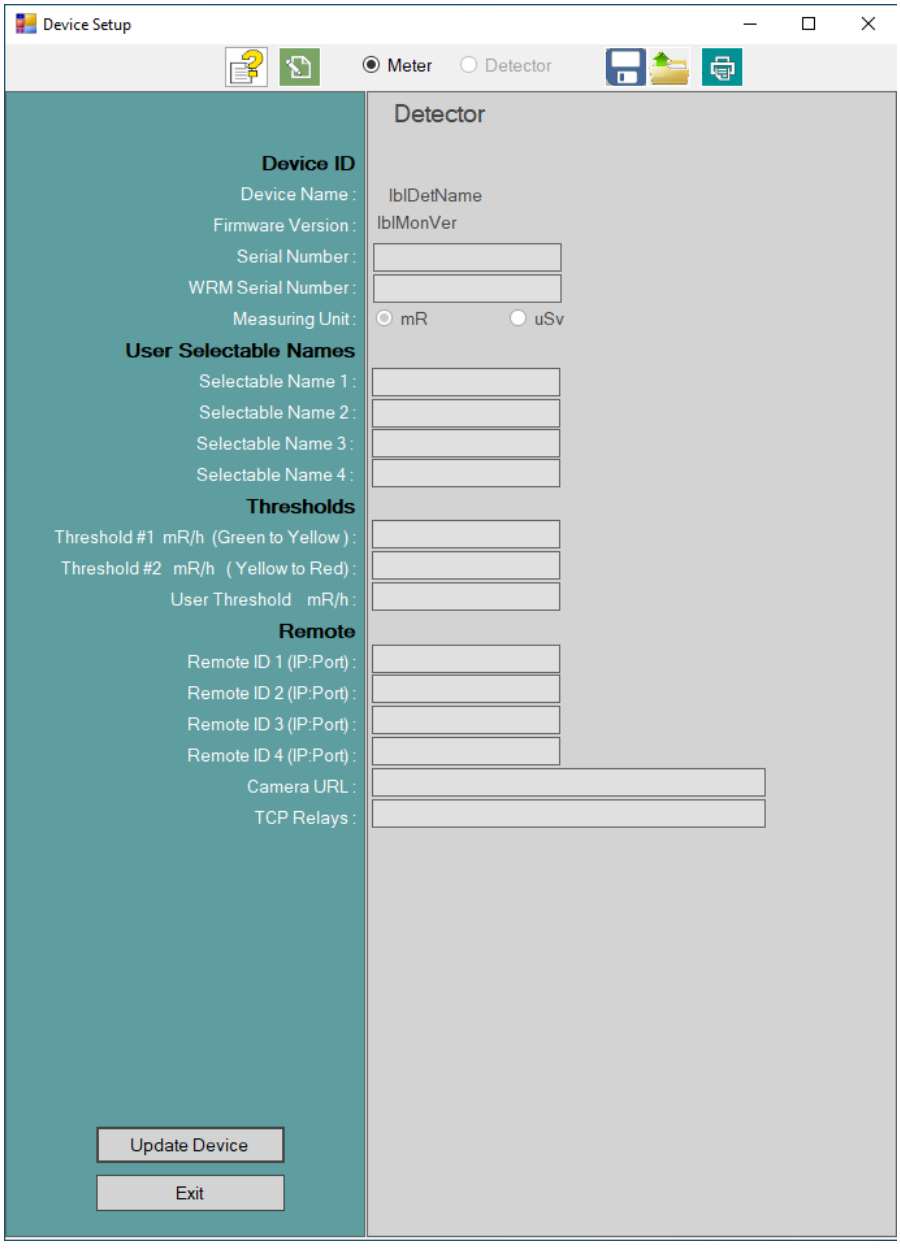
```
Switch>enable
Switch#configure terminal
Switch(config)#ip dhcp pool test
Switch(dhcp-config)#network 10.0.0.138 255.255.255.0
Switch(dhcp-config)#default-router 10.0.0.138
Switch(dhcp-config)#dns-server 10.0.0.138
Switch(dhcp-config)#exit
Switch(config)#interface vlan 1
Switch(config-if)#ip address 10.0.0.138 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch# copy running-config startup-config
Switch#
```

4.4 Setting Up and Updating the DPU-3

When you have installed the DPU-3's in their required locations, set them up so that they function properly, and update their firmware to the latest version.

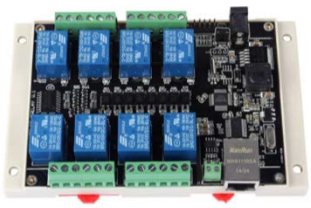
4.4.1 Setting up the DPU-3

1. From the RMVC software, access the Device Setup screen.
2. Click **Device Setup**. The following screen appears.



The following table describes each of the fields on this screen.

Device ID	
Device Name:	Internal Name of Detector
Firmware Version:	Firmware version of Detector
Device Type:	See Device Type Table Below
Password:	Must be 4 digits, consisting of 1-3 in any order. Each button represents a number 
Communication Port:	5000 is our default value and is set in the DPU-3, RMVC software and WebiSmarts Software to be the same number so that all can communicate.
IP Configuration:	Can be configured to either Dynamic or Static Setting. In any case the IP addresses should be static so as to maintain contact with the Server and database
Serial Number:	Serial Number of Detector
WRM Serial Number:	Serial Number associated with WRM packets
Measuring Unit:	mR or uSv
WRM Detector Transmission:	On/Off
Wireless (WRM/WiFi) Transmission:	You can select between On/Off, WRM or Wi-Fi, depending on the hardware installed in the DRM-3000
Wi-Fi SSID:	Parameter required for Wi-Fi Communication
Wi-Fi Password:	Parameter required for Wi-Fi Communication
Status:	Latch (Alarm remains after radiation subsides), Unlatch (Alarm disappears after radiation subsides)
User Selectable Names	
Selectable Name 1:	User can associate names to each of the 4detectors to help identify their location in the field. If the name is defined here, WebiSmarts will display the same name in the point and vice versa
Selectable Name 2:	
Selectable Name 3:	
Selectable Name 4:	
Intervals	
Rate Interval (Sec):	
Thresholds	Clicking on any of the buttons on the Control Panel resets the Alert condition, silences the buzzer and deactivates the solenoid
Threshold #1 (Green to Yellow)	Sets lower threshold level and influences the background color of the display
Threshold #2 (Yellow to Red)	Sets the higher threshold level and influences the background color of the display
User Threshold:	Sets an alarm threshold which when activated changes the background color to red, activates the buzzer and the internal solenoid. The alarm will not be activated for detectors where the User threshold is set to zero so the meter can be setup so that only a specific detector will activate the solenoid.
Remote	
Remote ID 1 (IP Port): **Remote ID 2 (IP Port):** **Remote ID 3 (IP Port):** **Remote ID 4 (IP Port):**	You can create a library of four remote detectors (according to their IP addresses) for use in the display of this DPU-3. You can select to display any of these four remote detectors in any of the four display slots
Camera URL:	If a remote camera is required, the URL of the camera is

	inserted here and the picture will occupy one of the four display slots. The URL address is normally supplied by the manufacturer of the camera **i.e., http://admin:admin@xxx.xxx.xxx.xxx/h264**
TCP Relays: 	This utilizes relays on an External Signal Interface, which is a bank of relays mounted on a PC Board and accessed via the intranet by the DPU-3after it has been programmed to activate a number of relays following a breach of the User Threshold. For example: 10.0.0.19-3; 10.0.0.19-4 (Last Line page 41) means .. Activate relays number 3 and 4 on the External Signal Interface which has an IP address of 10.0.0.19 when the User threshold is breached

4.4.2 Updating DPU-3 Firmware

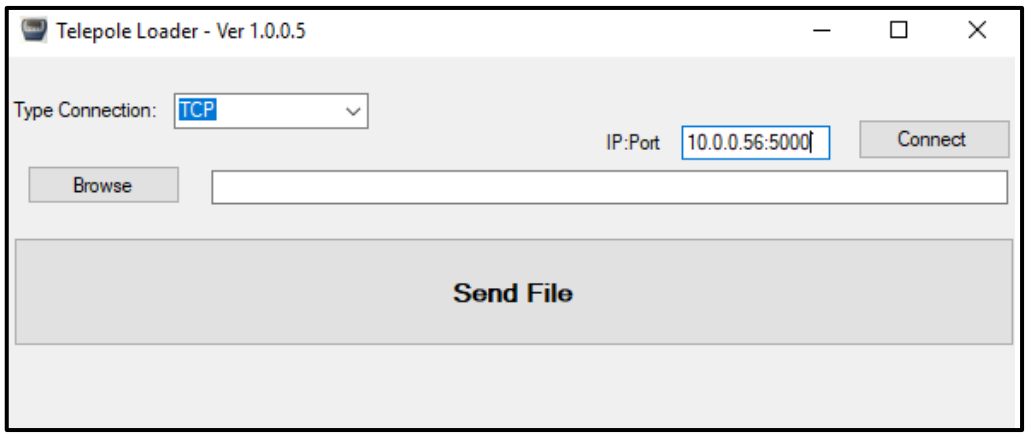
The DPU-3 contains two separate CPUs:

- The Mainboard (CPU) – considered “Main”
- The Detector Board (CPS) – considered “Secondary”.

The CPS firmware handles both the internal and external detectors. It is updated through the Loader function in the RMVC Software.

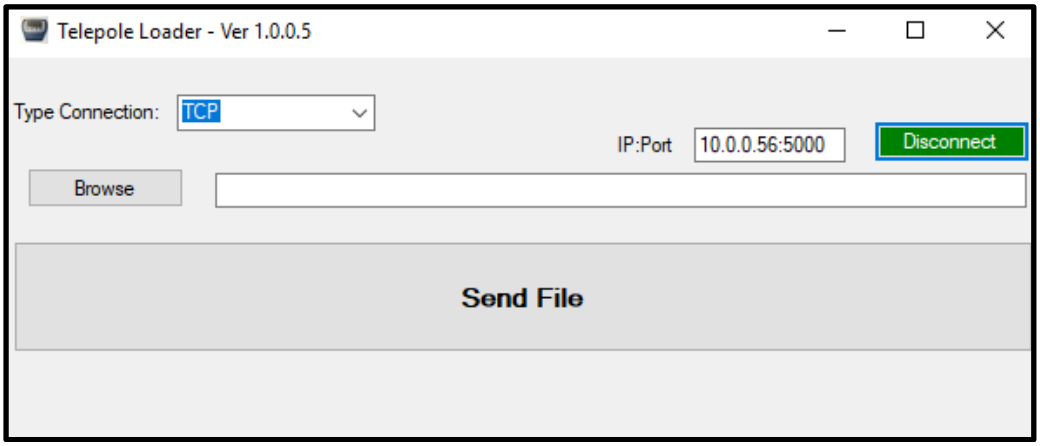
The CPU firmware controls the User Interface General administration of the DPU-3 and is uploaded according to the following procedure:

1. On the Server computer, click Loader. The loader app appears.
2. Make sure that the DPU-3 is connected to the RMVC software, and enter in the “IP:Port” field – “XX.XX.XX.XX:5000”.
3. Replace the X’s with the device’s IP address and add the “5000” port, as shown below.



3. Click **Connect**.

   If all is correct, the button turns green.



4. Click **Browse**, find the new firmware file, and open it.
5. To start the update, click **Send File**.

   Make sure the progress bar is showing progress and the screen of the DPU-3000 displays “UPDATING…”.

When the update is complete, the following message appears:

> Programming Completed Successfully! Pls switch of and power up to reset.

6. Wait for a few seconds and then turn the device off and on again.
7. Make sure the startup menu reflects the modifications and shows the latest version of the firmware.

5 Installing the Coincidence Stack Monitors

The WebiSmarts Coincidence System provides the most advanced stack monitoring capabilities available today by combining a unique coincidence algorithm that determines if the activity seen by the highly sensitive PM-11 detector is inside the exhaust stack or originates from an outside source.

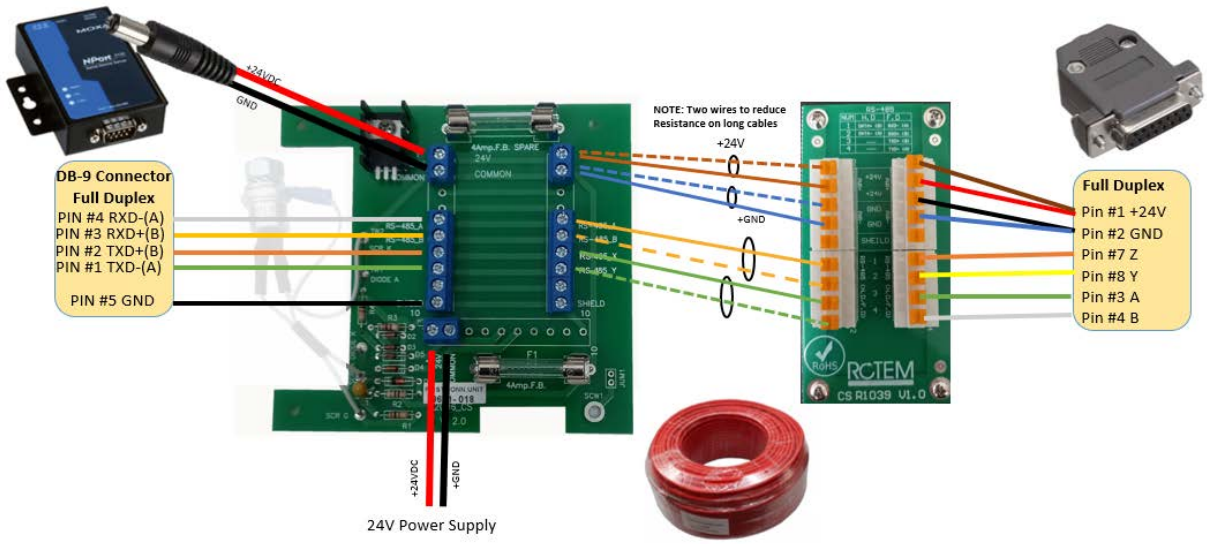
The WebiSmarts System comprising of four detectors:

From Left to Right…

1) Flowmeter
2) GM-42 inside its weatherproof bracket
3) PM-11 inside its weatherproof bracket
4) Coincidence Beta Detector inside the PM-11's weatherproof bracket

Unlike the DPU-3's in the lab, which are connected to the WebiSmarts Server via ethernet cables, the Coincidence Stack Monitoring System connects to the network in the lab through a First Connection Unit mounted in the lab, which is connected to the Coincidence Connection Box on the roof, via a RS-485 Full Duplex Cable. The RS-485 connection is used for two reasons: 1) We cannot assume that an Ethernet connector will be available on the roof and 2) To allow existing MediSmarts customers to upgrade their system without needing to replace their existing detectors and cables. The requirement for a Full Duplex allows us to upgrade the firmware of the Coincidence Stack Monitoring system remotely

without climbing onto the roof. Full Duplex allows us to connect directly with the system on the roof and perform the upgrade remotely.



In the new Coincidence Configuration the four cables are run from the detectors to a Coincidence Connection Box which is mounted inside a Weatherproof Box mounted on the roof. The cables and detectors are the same that have been used for years in the previous MediSmarts system which simplifies retrofitting by simply remove the existing old DPU's and replace them with this Coincidence Connection Box

This section will explain the following stages:

Installation of the detector brackets inside the exhaust stack

Installing and Configuring the flowmeter

Installation of the Coincidence System

Installation of the First Connection Unit and Setup of the Nport module

5.1 Installation of the detector brackets inside the exhaust stack

The picture above shows the three detectors mounted on the side of the exhaust stack which is a comfortable position for the person undertaking the installation and for the person replacing the detectors for their annual calibration but we suggest that you consider mounting the detectors under the exhaust stack which would protect them from the heat of direct sunlight and rain.

Positioning the detectors in the Exhaust Stack

The PM-11 and GM-42 detectors are used to measure and report on contamination levels of effluent as they leave the building and therefore should be installed as close to the exit point of the exhaust as possible.

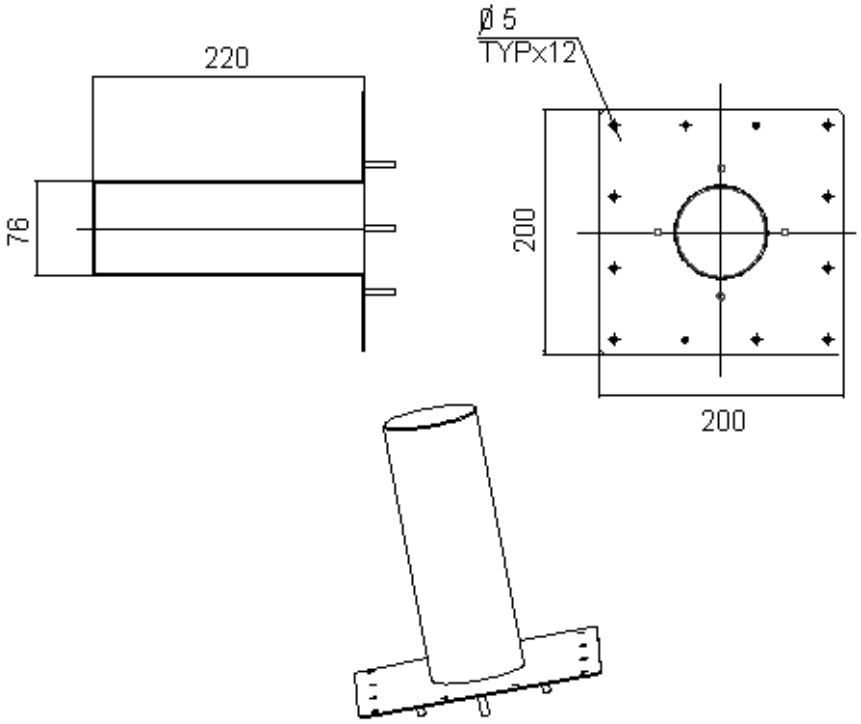
They should not be installed after corners in the exhaust stack and should be installed at least 50 cm apart to avoid turbulence influencing the accuracy of the measurement

The flowmeter measures the velocity of air moving through the exhaust stack and along with the cross section provides data of the volume of air moving through the exhaust stack and its position is not important

Both the PM-11 and GM-42 are inserted into stainless steel brackets which are fixed to the exhaust stack. The PM-11 bracket is open in the front to facilitate the Beta detector. The GM-42 bracket is closed.

For the stainless-steel PM-11 and GM-42 detector brackets, drill holes of 77- 80 mm diameter.

For the flowmeter drill a hole of 9 mm



5.1.1 Installing and Configuring the Flowmeter

The flowmeter draws a lot of current upon startup therefore we utilize two wires (as shown in the diagram above) to reduce resistance.

This procedure is in two main parts:

- Installing the flowmeter
- Configuring the flowmeter

5.1.2 Flowmeter Inputs and Outputs

The Aux Connector (D-type 26 Pin High Density Female Connector) provides the following inputs and outputs for the flow meter:

Pin #10	+24VDC OUT	Red
Pin #11	Flow Monitor Input (4-20mA)	White
Pin #12	24V GND (Power to Flow Monitor)	Black

Set up the flowmeter as follows:

Range/Units	**Run**	**Filter**	**Range**	**Span**	**4mA**	**20mA**
				A	B	C
15 MPS	0	1	1	1	0	0

The Flow Meter is factory set to provide a maximum range of 15 MPS, remove the cover and press the SELECT button until the RANGE LED lights up, along with the SPAN and FILTER LED's as shown in the picture. This is the correct setting.

If, upon reaching the range LED, other LED's light up, you need to click ENTER, the LED will blink, then gently adjust the potentiometer until the three correct LED's are lit up. To save your selection, press and hold ENTER. The RANGE LED will blink at a faster rate for about 2.5 seconds then all of the LEDs will flash indicating the value was saved.

5.1.2.1 Installing the Flowmeter

Install the flowmeter on your facility's exhaust stack (duct) as follows:

1. Locate an appropriate position for the flowmeter, which is at least one meter away from the nearest turn in the exhaust duct or detector.
2. At the place on the stack where you want to place the flowmeter, measure out the four corners of a 40mm X 40mm square for the flow meter bracket.
3. Drill four 4.5mm Φ (diameter) holes and secure the bracket with self-tapping screws.
4. Drill a 9mm Φ (diameter) hole in the center for the flowmeter holder.

5. Insert the flowmeter through the bracket into the exhaust duct, making sure that the end of the probe is centered inside the duct.
6. Make sure that the probe is facing the correct direction according to the arrow on the nut at the end of the probe. This arrow shows the flow direction.

5.1.2.2 Configuring the Flowmeter

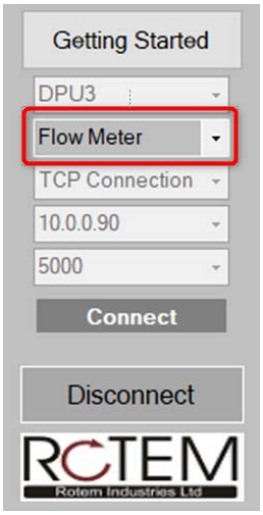
For the New Coincidence Stack Monitoring system, there is no need to calibrate the flowmeter. The instructions below are still valid for systems where the Stack Monitoring system was connected to a DPU-3

Once the flowmeter is installed, you need to configure it. This involves setting the minimum and maximum currents of the DPU-3 (4mA and 20mA) fixing these currents into the DPU-3.

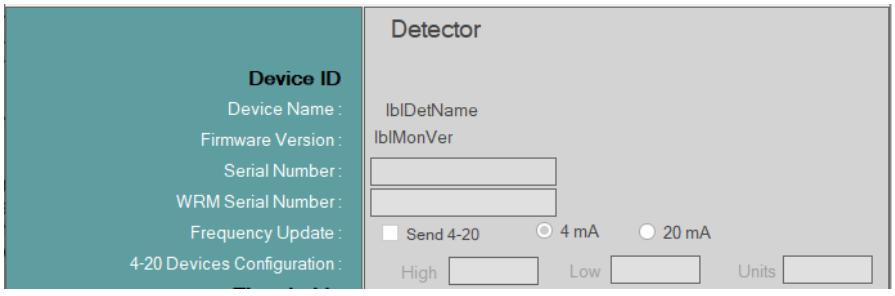
DPU-3 Configuration Procedure:

1. Power up the DPU-3

   The flowmeter is not shown on the display of the DPU-3 .
2. Open the RMVC software and connect to the DPU-3 .
3. Select the Flow Meter option.



4. Set the 4-20 mA boundaries in the DPU-3 :
   a. In the Device Setup screen, select **4 mA**.
   b. Select **Send 4-20**.
   c. On the flowmeter, repeated press the SELECT button until the LED next to the 20 mA lights up.
   d. In the Device Setup screen, clear the **Send 4-20** checkbox.



The Digital Display on the panel of the flowmeter shows the velocity in m/sec. This reading should be identical to the reading in WebiSmarts. The flowmeter is now ready for operation.

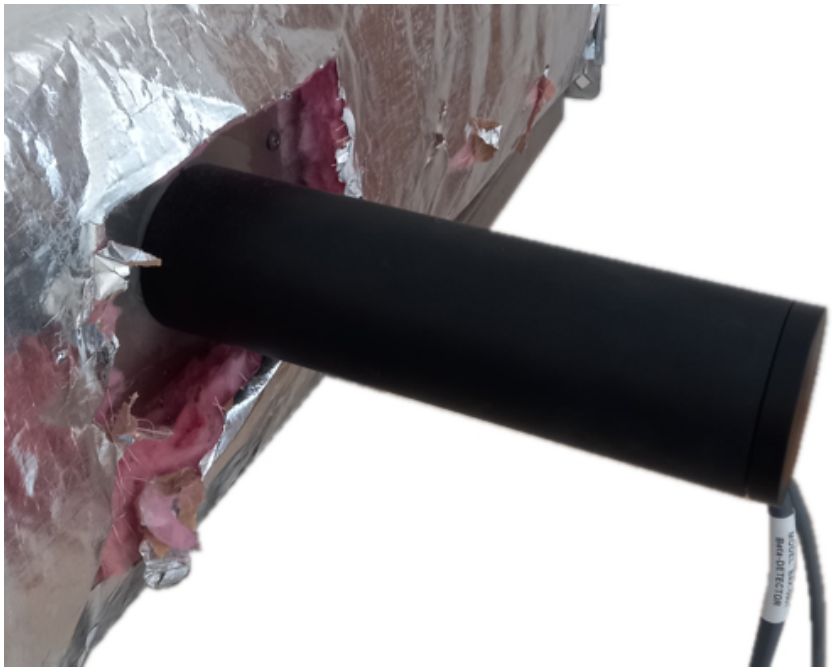
5.1.3 Installation of the Coincidence System

Install the PM-11 stainless steel bracket with the opening in the front along with the GM-42 stainless steel bracket and flow meter. If you are upgrading an existing site then you need to replace the existing PM-11 bracket (closed front) with the new PM-11 bracket (open front).

Using tape, connect the Beta detector to the end of the PM-11 detector and slide both into the stainless-steel bracket, the open side of the beta detector with the silver cover should be facing out.

There is no need to set the 4mA-20mA boundaries when using the Coincidence Box.

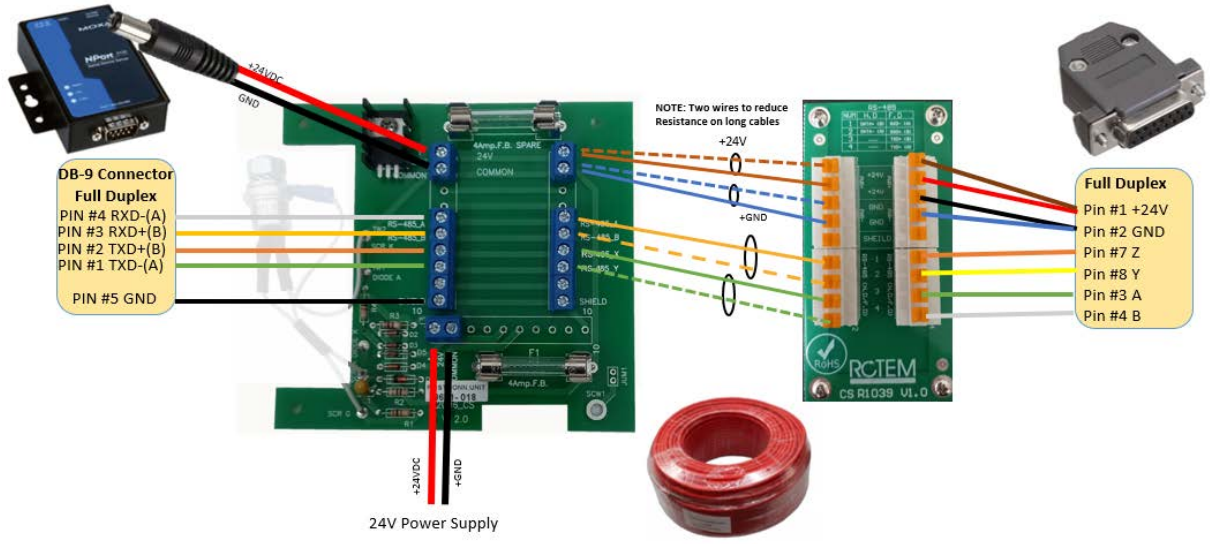
Connect the Beta Detector cable to the flat cable and push both connectors into the cavity so that the connector is inside the cover and only the two cables are visible after the cover is fitted onto the bracket.



If you are retrofitting the site then remove the three DPU's for the flowmeter, PM-11 Detector and GM-42 Detector

Connect the 4 cables from the detectors to the new Coincidence Box

Insert the Coincidence Box onto its bracket and connect the new 6 wire cable (BAK-0821) to the PWR & RS-485 Connector on the one side to the new Connection Box (BAK-1001) on the other side.



5.2 Setting up the Coincidence System

Once you have the hardware and WebiSmarts software installed, you can return to this section to set up the Coincidence System in the WebiSmarts application.

This section will describe the following stages required when setting up the Coincidence system:

5.2.1 Adding the coincidence points into the Connections Screen

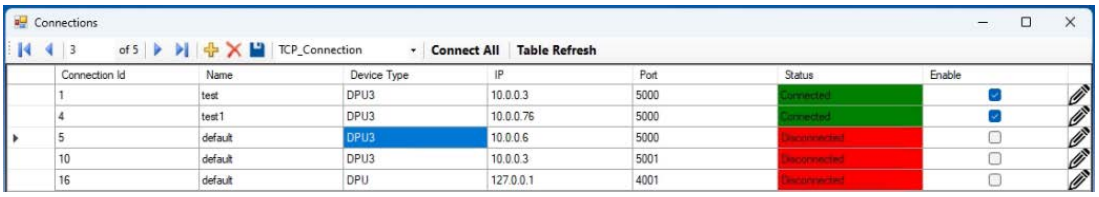
5.2.15.2.2 Adding the Coincidence points onto a Map

1.1.1 Adding the Coincidence points to the database

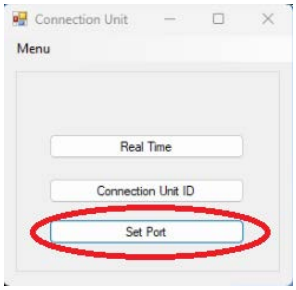
5.2.3 Setting the background levels for the GM-42 and PM-11 detectors to allow them to report on emissions only without any background noise

5.2.4 Setting the efficiency factor of the PM-11 detector using the tables from page 100*Appendix D Applying the efficiency factors*

5.2.1 Adding the Coincidence points into the Connections Screen



Before adding a point to a map, it must be defined in the Connections screen shown above. The Connections screen is made available by clicking on the Set Port button in the Connection Unit:



The Connections Screen should be populated as follows:

Connection Id: Provided automatically

Name: Coincidence or any other name that reminds you of the detector

Device Type: Must be Stack

IP: IP Address provided to the NPort of the First Connection Unit

Port: 4001

Status: Updates

Enable: Should be Enabled

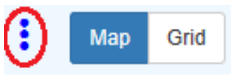
5.2.2 Adding the Coincidence points onto the Map

Unlike the DPU-3 where the point # is a function of its connecting position, the Coincidence system automatically recognizes each detector and assigns them the following numbers:

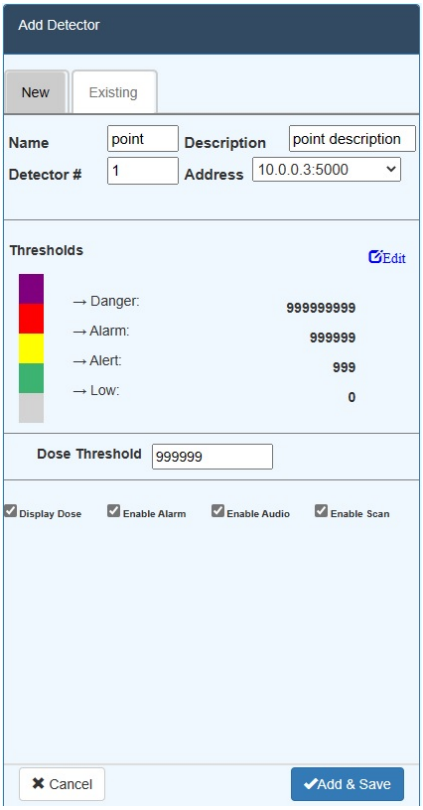
PM-11 Point #1

GM-42 Point #2

Flow meter Point #3

To add a Point to the map, click on the Drop-Down Icon 

And select **Add Point,** the side bar will be displayed:



Select the relevant Tab (New or Existing). This means that if the Point does not yet exist in the database, select ***New*** and if the Point exists on another Map, select ***Existing.***

From the Address drop down box, select the IP address of the Connection Box, as set in the Connections Screen (Nport RS-485 to TCP Converter)

Assign a Name to the new Point – Name must be a single word without spaces, this should be the name of the detector; PM-11, GM-42 and Flow_Meter, each as a new point.

Assign a description if required.

Set the Threshold levels. Threshold levels for stack detectors are not really useful in the stack monitors because regulations require an annual report of the total released effluent, and a typical system releases effluent in bursts which may momentarily seem high but recede in importance when diluted by clean air between bursts.

Display Dose – The accumulated dose of detectors situated in rooms may be interesting from a health and operations point of view, but for detectors mounted in the exhaust stack the accumulated dose is not interesting, use this option to unselect and clean up the display of the map.

Enable Alarm – Provides a visual alarm (color) on the point in WebiSmarts and does not write to reports, again irrelevant for the stack monitors.

Enable Audio – activates/deactivates sound upon threshold breach for each threshold and writes information to reports. In the case where more than one detector is connected to a Meter and if the user chooses to change only one detector in meter, all of the detectors will be muted because the meter has only one on/off audio control.

Enable Scan – WebiSmarts scans (queries) each DPU-3 according to the IP addresses of the points on the maps, one after the other, every customer set period. If a detector is malfunctioning and is out for service then the Enable Scan option can deselected and WebiSmarts will skip this detector.

1.1.1 Adding the Coincidence points to the database

The user should add also points 11-15 for each of the 5 windows to the map and database and then remove them from the map but not from the database by using the Remove option in the point

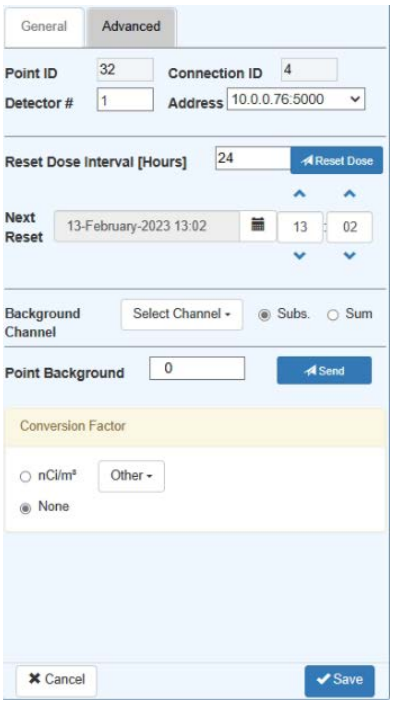
Each point will be used to present the graphs and automatic identification.

Point #	Point Name
11	Win-1
12	Win-2
13	Win-3
14	Win-4
15	Win-5

5.2.3 Setting the background levels for the PM-11 and GM-42

The background level is set by allowing the PM-11 and GM-42 to collect data from the site when there is no radiation being created. Once you have a good idea of the radiation levels you can insert that number (cps and mR/h/uSv/h) into the Point Background window and click Send. You should see a difference in the graph being created before and after the background subtraction

To set this up click on the Advanced Tab of the existing points, the following screen will appear:



Reset Dose Interval (Hours) should be 24 hours

Next Reset is OK as set

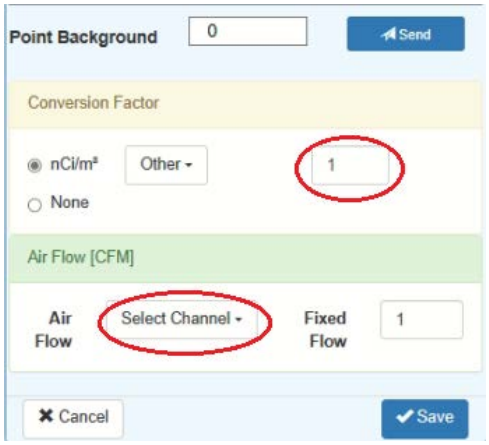
Background Channel is not relevant for stack monitoring. It is used when an application is required to provide the difference between two detectors where one detector is measuring the background and this detector is measuring radiation, and the user wants to see only the difference between the two.

Click Send after you have typed the background average into the window

5.2.4 Setting the efficiency factors

See Appendix DAppendix D Applying the efficiency factors for a comprehensive explanation of why efficiency factors are necessary and how they were calculated along with a table of the factor as a factor of the cross section of the exhaust duct.

To add an efficiency factor, click on the nCi/m3 or Bq/m3 (depending on your selection) radio button, the following screen will appear:



Open the Drop Down Box and select the first isotope you want to define, then add in the efficiency factor instead of (circled) 1 according to the appropriate isotopes table which can be found in Appendix D and cross section of the air duct. Click Save.

Select the next isotope, add its efficiency factor and click save. Repeat this until all isotopes you require are defined. WebiSmarts automatically detects and defines the release into a peak for the first five isotopes in the list.

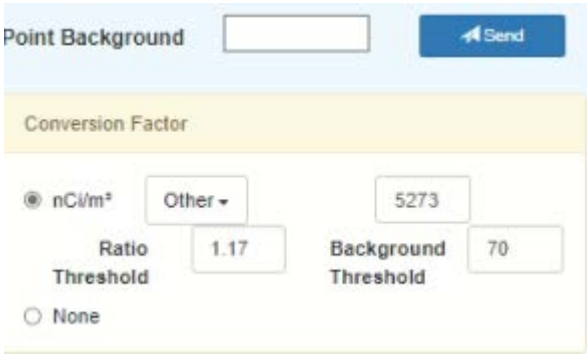
You also need to define a flow rate in the exhaust stack by opening the drop-down list and selecting the flow meter. If your flow meter is not available, you can set a Fixed Flow Rate

Don't forget to click Save after each step to be sure

5.2.5 Fine Tuning the Coincidence results

This procedure should be carried out as soon as your site has produced a week's worth of real effluent data. Once you have set the parameters you can check the results by activating the *Recalculate Peaks* command and seeing the results of your modifications. The Recalculate Peaks option only modifies effluent data for a period of one week and is only available if the user selects a period of one week or less in the graph. It is part of the installation procedure and should be done immediately following the installation of the WebiSmarts system.

The two parameters used to fine tune the automatic selection of the peak are found in the Advanced Tab of the Point Details Screen once you select the units of Activity and Concentration (nCi/m^3 or Bq/m^3) and are *Ratio Threshold* and *Background Threshold*.



Ratio Threshold:

Parameter of W1/PM (CPS) where W1 is the dose rate (CPS) of the first window of the beta detector and PM is the dose rate of the PM-11 detector (CPS).

Upon each release the PM-11 detector detects gamma radiation only while the beta detector detects both gamma and beta radiation, so at the onset of a release the dose rate of the

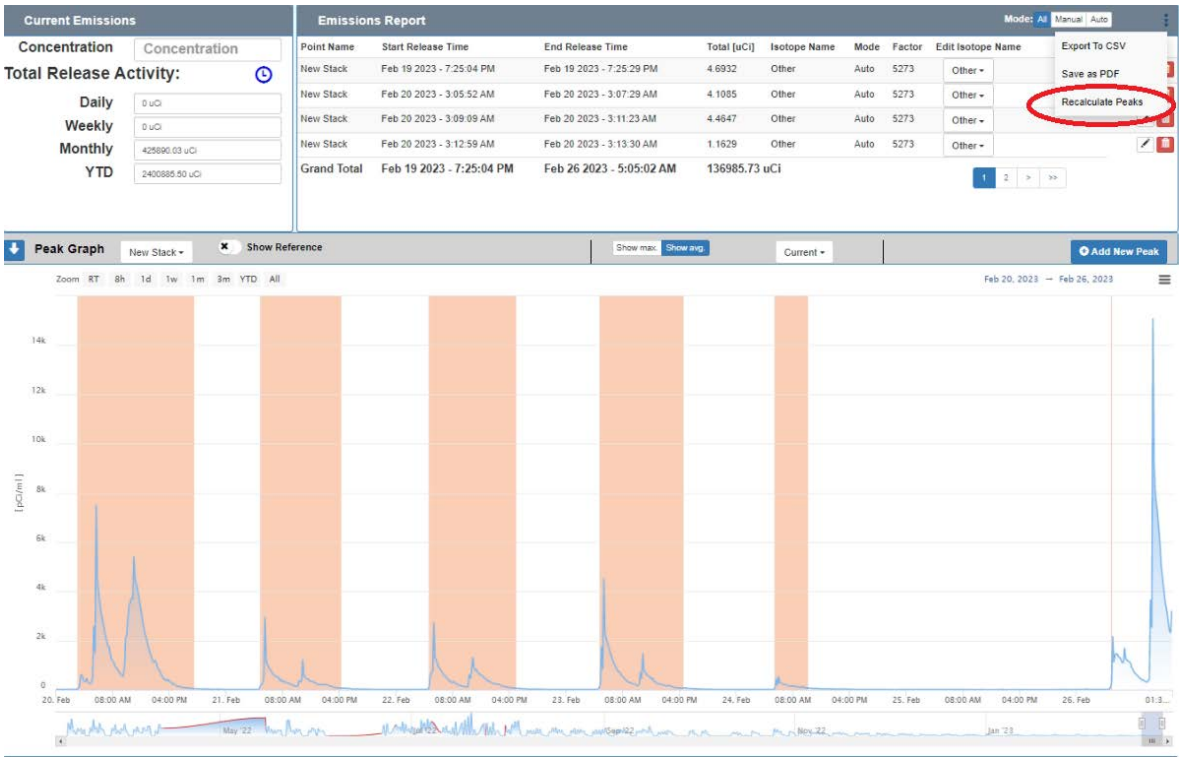
detectors may be similar, and the ration will be 1 but as the peak progresses the beta detector will begin to detector more and more radiation. By setting the Ration Threshold to 1.17 we are setting the software to mark the start and end of the peak only when the ratio between the beta detector and the PM-11 detector is greater than 1.17.

Background Threshold:

Sets the background level of the beta detector much like we set the background setting of the PM-11. By setting the background level of the beta detector to 70 (CPS) we are ignoring the background “noise” and showing peaks only where the beta detector is detecting more than 50 cps.

Recalculate Peaks:

To help you fine tune the Coincidence parameters we have developed a tool whereby you can modify the parameters and then activate the Recalculate Peaks command to see the results of the last modification you made. This command is visible only to users with Administration access levels and only if the graph shows a weeks’ worth of data or less.



6 Peripherals

6.1 The External Signal Interface

The External Signal Interface is an Ethernet based bank of relays which are activated directly by the DPU-3's in the laboratory. The DPU-3 is programmed using our RMVC software to activate specific relays upon User Alarm condition.

The External Signal Interface (Relay Card, Potential Free Contacts) Board provides eight-volt free contact relay outputs with a current rating of up to 16A.

The WebiSmarts system can support more than one External Signal Interface.

The External Signal Interface is supplied along with a 12VDC Power Supply so the unit should be mounted close to an external power source and an Ethernet Socket.

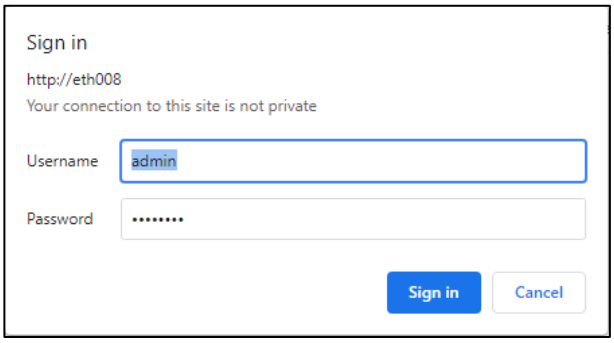
The IT department of the site should set the IP address of the External Signal Interface to be fixed.

Wires should be run from this position to the peripherals using this Interface.

6.1.1.1 **Identifying the IP address of the External Signal Interface**

Showing the status of the External Signal Interface

Open your browser and type http://ETH008, you will be prompted for a password as shown below:

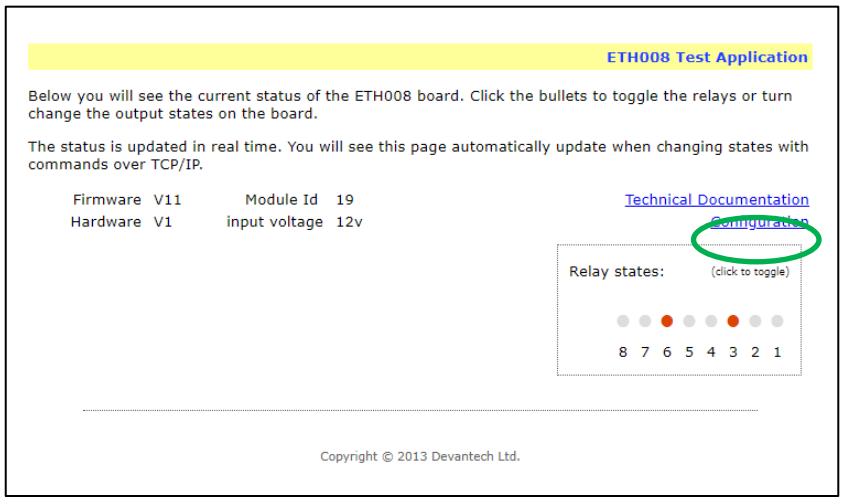


The default login is:

Username: admin

Password: password

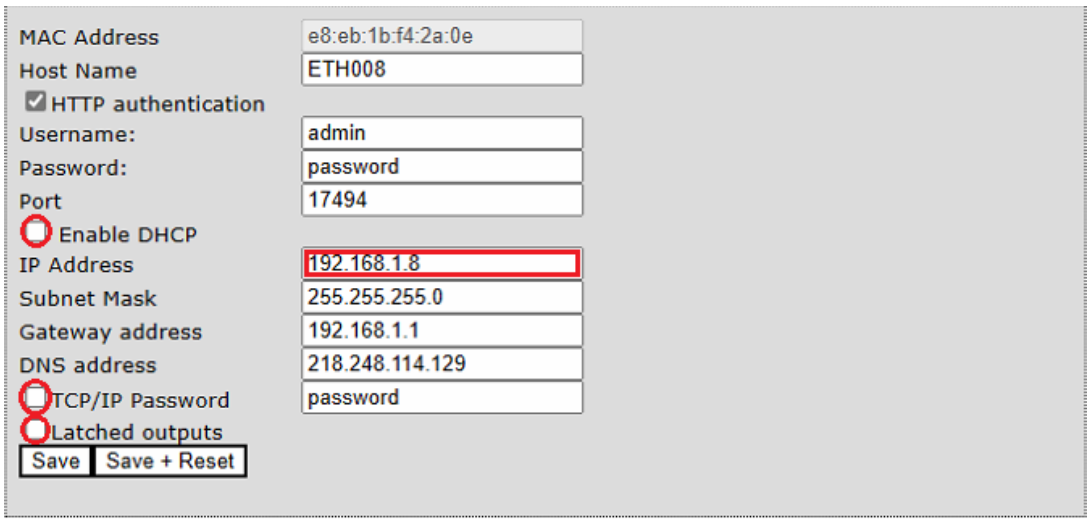
The flowing status screen appears; as you can see the two relays 3 and 6 are shown to be activated



Use the Configuration link to set up a permanent IP address

6.1.1.2 **Setting a permanent IP Address**

Click on the Configuration link, circled in green above, the following screen will appear:



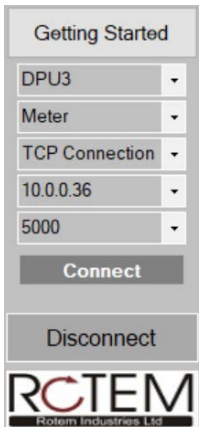
To connect to the TCP relay, it has to use static IP. Make sure the circled check boxes are unchecked. Enter the desired IP address in the circled checkbox and click **Save + Reset** to assign the new IP address to the board

6.1.1.3 Setting up the External Signal Interface

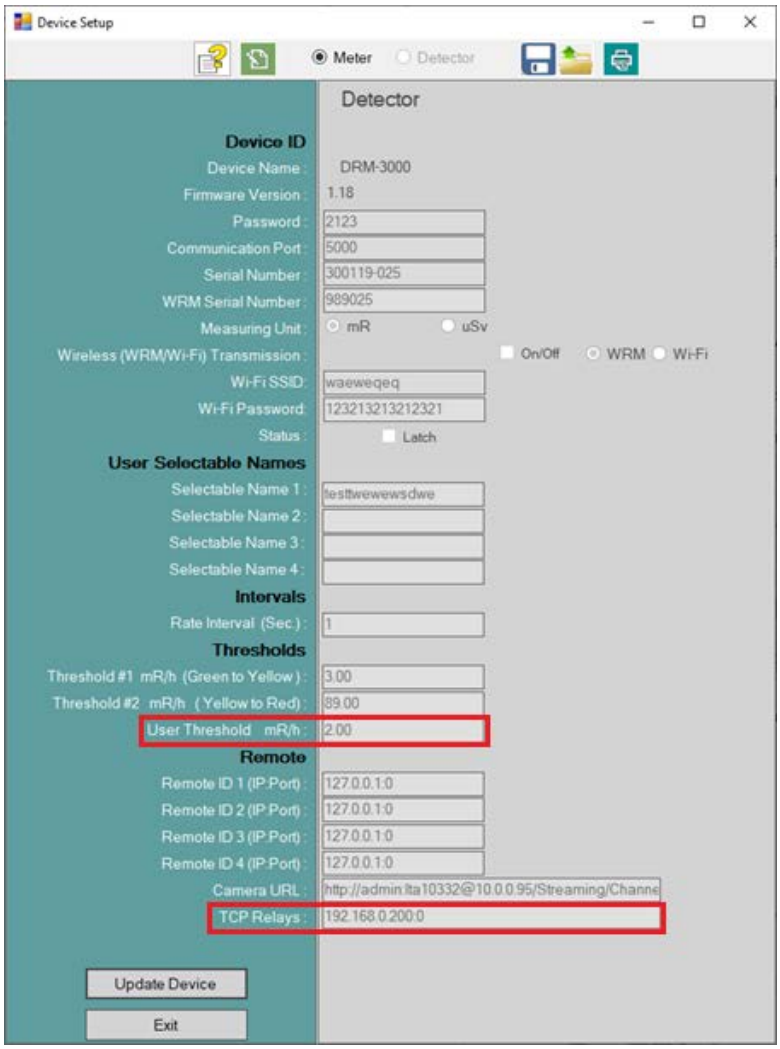
The RMVC Software (version 1.0.9.5 onwards) can be downloaded from our website at https://www.rotem-radiation.co.il/service2/rotem-meter-view-3000/

Please follow the installation instructions until the software is installed.

Select the DPU-3 Connect Details, and click Connect.



Click Device Setup, the following screen appears:



Let's assume you have identified the IP address of the External Signal Interface as 10.0.0.109 and you want to activate relay #1, then the TCP Relays content line should be updated as follows: 10.0.0.109-1

Click Update Device

From now on each time the radiation level goes above the User Threshold, relay #1 will be activated.

You can activate up to 10 separate relays by separating each command with a semi-colon ;

10.0.0.109-1;10.0.0.109-2;10.0.0.109-3 or even activate relays on other External Signal Interfaces 10.0.0.110-1;10.0.0.109-1;10.0.0.109-3

Once you have set up the DPU-3, reboot it (Power off, Power On) for the settings to take effect.

6.2 The Light Tower

In cases where the DPU=3 is mounted inside a room and you want to have an indication of the radiation levels before entering the room, we provide an external light tower to provide a quick preview of the radiological conditions by lighting up a green, yellow or red LED according to the **worst-case scenario** after comparing the threshold levels for each of the four detectors mounted on the DPU-3000.

The Light Tower cable configuration is as follows:

DPU-3 Auxiliary Connector	Light Tower End of Cable
13 ---White----	------White------
14---Orange---	------Orange----
15---Green-----	------Green------
16---Blue-------	-------Blue-------
17---Red--------	-------Red-------
18---Purple----	-------Purple----
21---Yellow----	-------Yellow----

We supply the Light Tower along with its cable to allow the installer to run the Auxiliary Connector cable from the position of the DPU-3 to the position of the Light Tower and then connect the same colors together after running the cable through the wall bracket.

The nuts that are used to connect the Light Tower to the Bracket are found in the Box of the Light Tower.

Mount the wall bracket in the desired position and then push the spare cable back into the wall before connecting light tower to the bracket.

Once Connected the LED's light up in the following test sequence when the DPU-3 is powered up; Green Red and then Orange and finally the buzzer is sounded.

6.3 The 4-20mA Output

THE DPU-3 can provide a 4-20mA output from each of the four detectors. The DPU-3 converts the current displayed dose rate to 4-20 mA outputs on the AUX connector. Those outputs are a logarithmic function of the current displayed dose rate. The outputs are scaled by the full-scale value and low scale value.

Auxiliary(PIN Number)	4-20mA
1	4-20mA Output Det.#1
2	4-20mA Output Det.#2
3	4-20mA Output Det.#3
4	-
5	4-20mA Output Det.#Internal Det.
12	GND(-)

Output current is calculated using the following equations:

Maximum output current available - $\mathrm{I_{out\_max}} = 20\mathrm{mA}$

Minimum output current available - $\mathrm{I_{out\_min}} = 4\mathrm{mA}$

Full scale dose rate value - $F_{FSV} = 10{,}000\mathrm{R/h}$

Low scale dose rate value - $F_{LSV} = 0.1\mathrm{mR/h}$

Current displayed dose rate - F_{det}(R/h)

Current displayed dose rate, expressed in a decimal number - $\boldsymbol{F_{det\_dB}}$

$$\mathrm{F_{det\_dB}} = \log_{10}\frac{\mathrm{F_{det}}}{\mathrm{F_{LSV}}}$$

$$\mathrm{I_{out}} = \frac{\mathrm{F_{det\_dB}}}{8}\left(\mathrm{I_{out\_max}} - \mathrm{I_{out\_min}}\right) + \mathrm{I_{out\_min}}$$

For example, Assume:

$$\mathrm{F_{det}} = 100\mathrm{R/h}$$

$$\mathrm{F_{det\_dB}} = \log_{10}\frac{100\mathrm{R/h}}{0.1\mathrm{mR/h}} = \log_{10} 1{,}000{,}000 = 6$$

$$\mathrm{I_{out}} = \frac{\mathrm{F_{det\_dB}}}{8}\left(\mathrm{I_{out_{max}}} - \mathrm{I_{out_{min}}}\right) + \mathrm{I_{out_{min}}} = \frac{6}{8}(20\mathrm{mA} - 4\mathrm{mA}) + 4\mathrm{mA} = 16\mathrm{mA}$$

If the current displayed dose rate is above the full-scale value (10,000R/h), the 4-20mA output will be forced to maximum output current (20mA). If the current displayed dose rate is below the low scale value (0.1mR/h), the 4-20mA output will be forced to minimum output current (4mA).

6.4 The Advanced Detector Bracket

The Advanced Detector Bracket provides a local interface (Audio and visual) when the DPU-3is mounted in another location and not visible from the detectors' location.

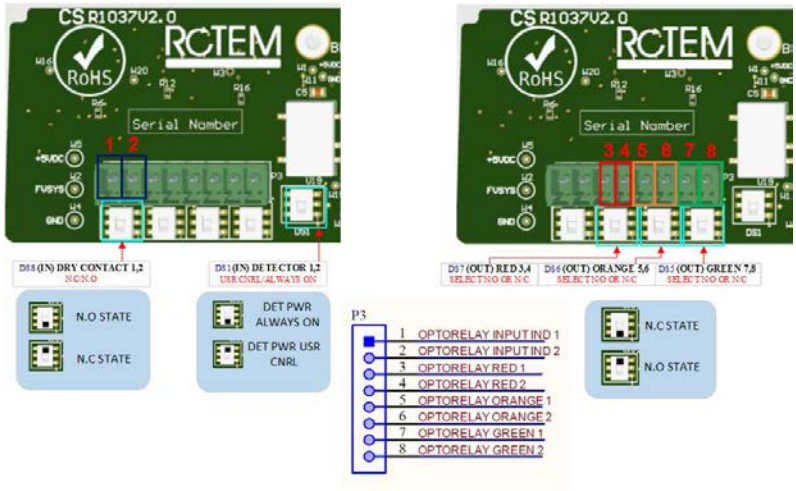
The following detectors can be mounted inside the Bracket: Wide Range, GM-40, GM-41, GM-42, GM-10 and IC-10 and AMP-50, AMP-100, AMP-200 and AMP-300. Other bulkier detectors can be mounted next to the Bracket with a longer interconnection cable.

The Bracket is controlled directly by the DPU-3and provides Visual feedback of the dose rate levels by lighting one of the three LED's, green yellow or red using the same threshold levels as set in the DRM-3000.

Audio feedback is provided by a volume adjustable buzzer on the bottom of the bracket. Each time a threshold level is breached the buzzer will sound to alert users nearby. Users can mute the buzzer by pressing on the LED cover until the next threshold is breached.

If the buzzer is not required then the red button situated on the underside can be pushed to permanently mute the buzzer and in this case the button will light up to indicate to users that no audible alarm will be issued.

The Bracket also contains a bank of optocoupler relays for each threshold level (3,4 5,6 7,8) that can be used to interface with external controllers. It also contains a single input channel (1,2) that can be connected to an accelerator controller and in the case of BEAM ON, power is cut to the detector (User Controlled) and restored when the Beam is turned off. This is useful for prolonging GM Tube Life Time



6.5 Installation Day

- Make sure that the cyclotron and other radiation-emitting equipment is not in use on installation day.
- Make sure that the Rotem service engineers have appropriate access to the relevant parts of your facility.
- Make sure that the following personnel are available during the entire installation process:
  - A certified electrician with knowledge of your facility's wiring specifications
  - An IT support person with appropriate network access permissions
  - An RSO

Depending on the complexity of your set-up, installing and testing the WebiSmarts system can take between three and five days, including one day of training.

7 Installing the Software

7.1 Default User and Password Settings

The WebiSmarts is shipped with the following default Users and Passwords but if you are installing WebiSmarts for the first time locally we suggest you create the two Users and Passwords.

Windows Login: User: Webi Password:1234

WebiSmarts Users:

Administrator: User: Admin Password: Admin_2021

User: User: User Password: User_2021

We recommend that you set your own regime of passwords but keep the above two in case you require online support from us.

> **Note**
>
> Your server arrives with all software already installed. This section is only relevant if you need to re-install the software on the server.

To run the WebiSmarts system, install and configure the following software on the server:

- Internet Information Services (IIS) 10.0 Express
- MS SQL Server Express 2017 or later and SQL Server Management Studio (SSMS)
- Migrate from SQL Server Express to a standard license if your system contains more than 10 detectors.
- REBOOT THE COMPUTER

- WebiSmarts Setup

7.2 Installing the IIS Server

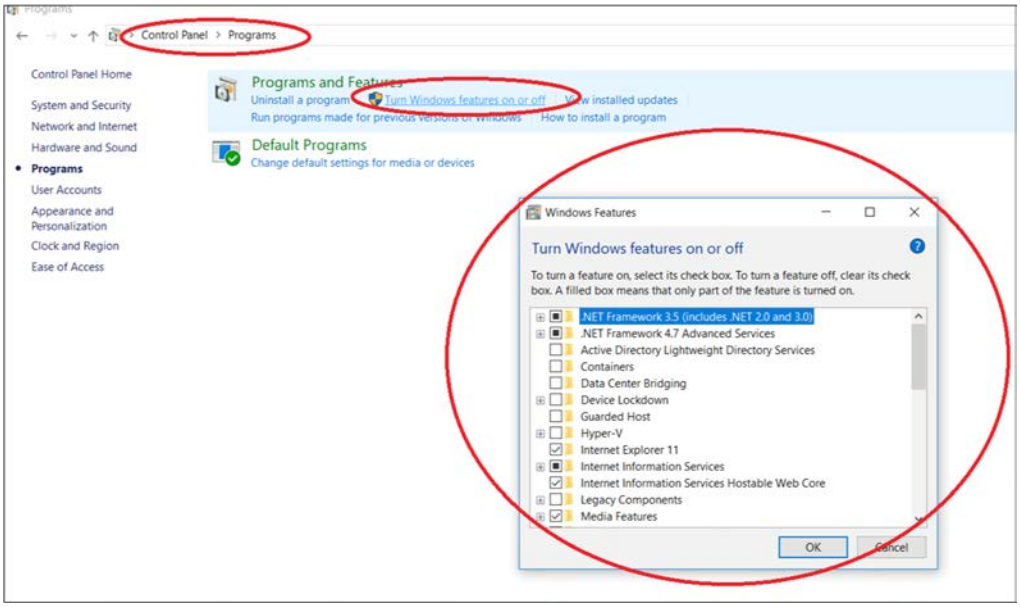
7.2.1 Windows 10 Procedure:

For installation on a Virtual Server, see paragraph 7.2.2

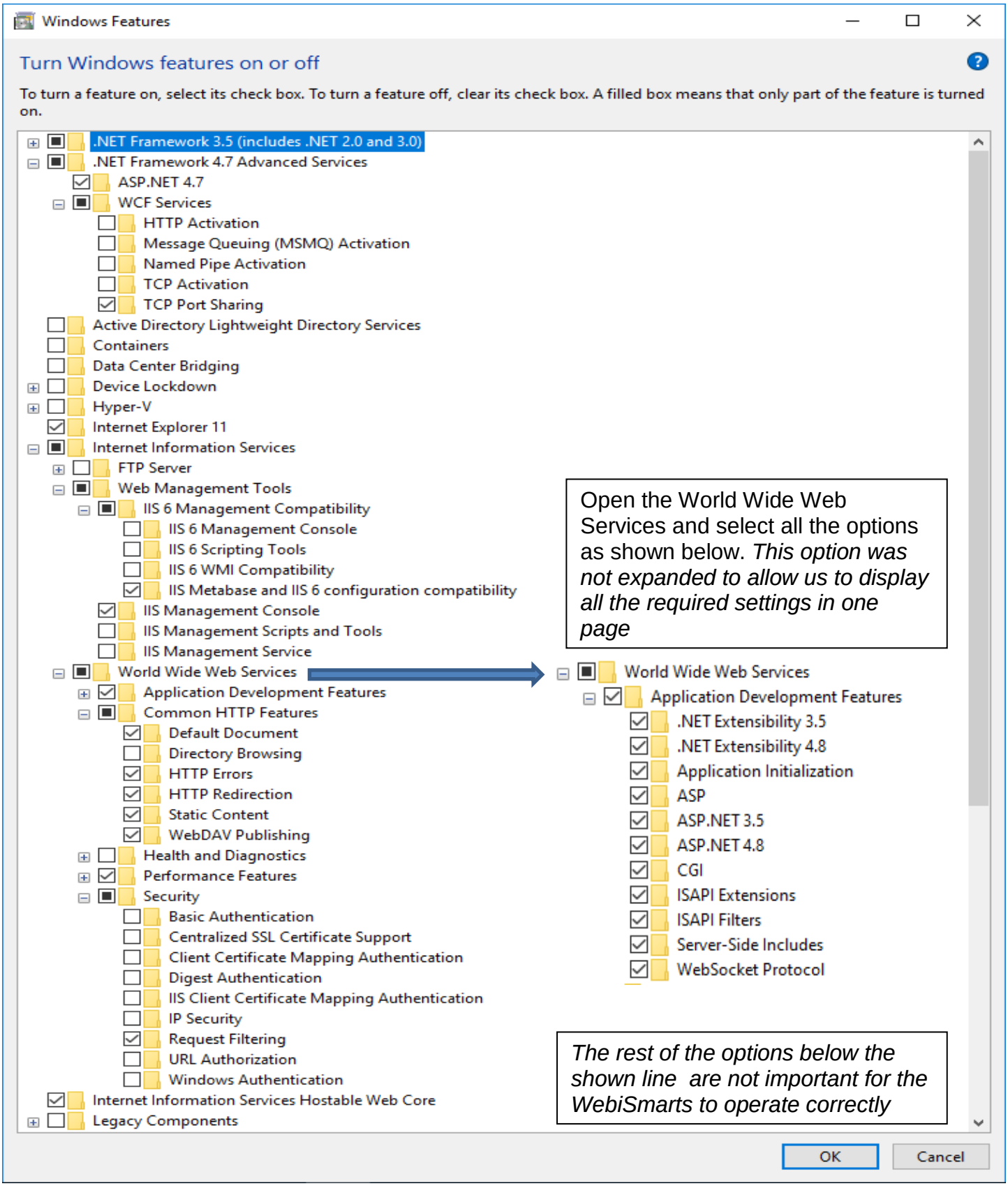
In the Windows search field, enter `Windows Features` and click the search result **Turn Windows Features On and Off**.

Or

Navigate to **Control Panel** > **Programs and Features** > **Turn Windows features on or off**.



Activate the features as indicated in the following image:


Windows Features
Turn Windows features on or off
To turn a feature on, select its check box. To turn a feature off, clear its check box. A filled box means that only part of the feature is turned on.
.NET Framework 3.5 (includes .NET 2.0 and 3.0)
.NET Framework 4.7 Advanced Services
ASP.NET 4.7
WCF Services
HTTP Activation
Message Queuing (MSMQ) Activation
Named Pipe Activation
TCP Activation
TCP Port Sharing
Active Directory Lightweight Directory Services
Containers
Data Center Bridging
Device Lockdown
Hyper-V
Internet Explorer 11
Internet Information Services
FTP Server
Web Management Tools
IIS 6 Management Compatibility
IIS 6 Management Console
IIS 6 Scripting Tools
IIS 6 WMI Compatibility
IIS Metabase and IIS 6 configuration compatibility
IIS Management Console
IIS Management Scripts and Tools
IIS Management Service
World Wide Web Services
Application Development Features
Common HTTP Features
Default Document
Directory Browsing
HTTP Errors
HTTP Redirection
Static Content
WebDAV Publishing
Health and Diagnostics
Performance Features
Security
Basic Authentication
Centralized SSL Certificate Support
Client Certificate Mapping Authentication
Digest Authentication
IIS Client Certificate Mapping Authentication
IP Security
Request Filtering
URL Authorization
Windows Authentication
Internet Information Services Hostable Web Core
Legacy Components
Open the World Wide Web Services and select all the options as shown below. This option was not expanded to allow us to display all the required settings in one page
World Wide Web Services
Application Development Features
.NET Extensibility 3.5
.NET Extensibility 4.8
Application Initialization
ASP
ASP.NET 3.5
ASP.NET 4.8
CGI
ISAPI Extensions
ISAPI Filters
Server-Side Includes
WebSocket Protocol
The rest of the options below the shown line are not important for the WebiSmarts to operate correctly
OK
Cancel

7.2.2 Windows Server Procedure

The following section describes how to enable IIS and the required IIS components on **Windows Server 2016.** If you are using **Win10**, this section is not relevant.

1. Open **Server Manager** and click **Manage > Add Roles and Features**. Click **Next**.
2. Select **Role-based or feature-based installation** and click **Next**.
3. Select the appropriate server. The local server is selected by default. Click **Next**.
4. Enable **Web Server (IIS)** and click **Next**.
5. No additional features are necessary to install the Web Adaptor, so click **Next**.
6. On the **Web Server Role (IIS)** dialog box, click **Next**.
7. On the **Select role services** dialog box, verify that the web server components listed below are enabled. Click **Next**.
8. Verify that your settings are correct and click **Install**.
9. When the installation completes, click **Close** to exit the wizard.

Required IIS components

The IIS components listed below satisfy the minimum requirements to run WebiSmarts.

- Web Server
  - Common HTTP Features
    - Default Document
    - Static Content
  - Security
    - Request Filtering
    - Basic Authentication
    - Windows Authentication
  - Application Development
    - .NET Extensibility 4.7
    - .NET Extensibility
    - ASP.NET 4.6
    - ASP.NET
    - ISAPI Extensions
    - ISAPI Filters
    - WebSocket Protocol
- Management Tools
  - IIS Management Console
  - IIS 6 Management Compatibility
    - IIS 6 Metabase Compatibility
  - IIS Management Scripts and Tools
  - Management Service

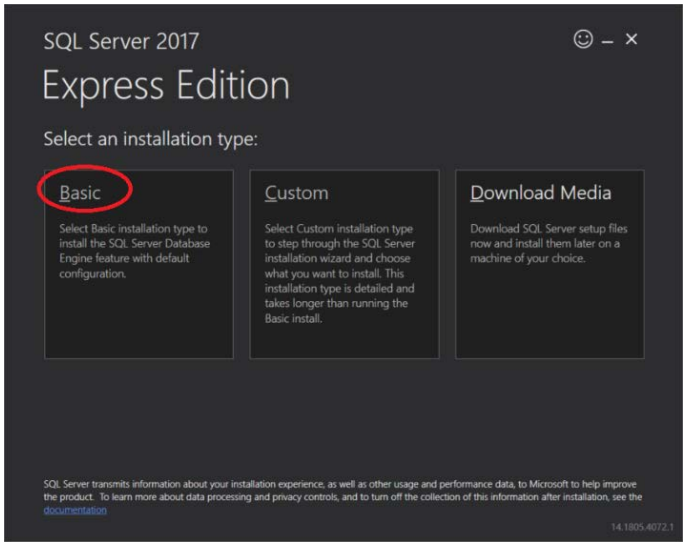
For more detailed information see Enabling IIS and required IIS components on Windows Server 2016 (Standard/DataCenter)—ArcGIS Enterprise | Documentation for ArcGIS Enterprise

7.3 Installing MS SQL Server Express

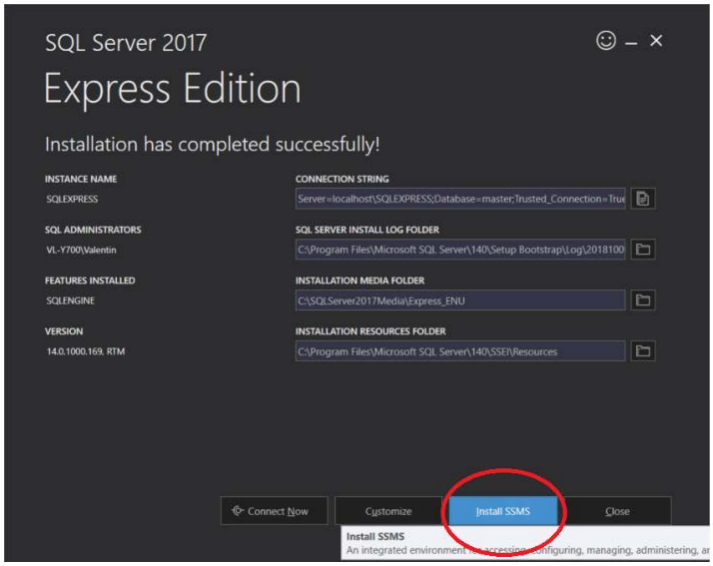
Install MS SQL Server **Express** on the server computer.

Procedure:

1. Download the MS SQL Server Express installation file from this link: https://go.microsoft.com/fwlink/?linkid=866658
2. Run the MS SQL Server Express installation file.
3. Install the Basic installation type.



When the installation is complete, install SSMS. To do so, on the installation complete dialog, click **Install SSMS**.



The Button above should be a link to the following address:

https://aka.ms/ssmsfullsetup, you should download the latest SQL Server Management Studio ver 18.9.1. or above.

If the installation is unsuccessful, and you get the Oops message, reboot the Computer and run the installation again.

7.4 Migration from SQL Express to SQL standard edition

As already mentioned you may need to upgrade your SQL Express version to a SQL Standard edition because WebiSmarts is supporting more than 10 detectors.

Here are the steps:

Upgrade a SQL Express installation to a full version of SQL using a media which does not include a service pack, or higher, using one of the following methods.

Note: A server console backup is recommended before performing either of these methods
Method One

1. Run the full version of SQL setup application.
2. Select Maintenance > Edition Upgrade.
3. Select the AutodeskVault instance and start the upgrade.
4. After the upgrade is complete, apply the latest SQL service pack since this upgrade actually does not have on and it is not transferred from SQL Express.

Method Two

1. Create a full backup of your vault using the server console. Note: In later steps, you delete all your vault databases. Validate that you can restore this backup on a test server before proceeding. Do not continue if your test restore fails. Correct any problems you have with the backup before continuing these steps.
2. After the test restore is successful, open the ADMS Console and delete all vaults and libraries listed. Then select Detach Master Vault from the Tools menu.
3. Make sure that all users are logged out of the vault.
4. Completely uninstall SQL Express, including the following applications in this order:
   - Microsoft SQL Server 2XXX Note: If you have more than one instance of SQL Express installed, be sure to uninstall only the AutodeskVault instance. DO NOT uninstall any other part of SQL after this step is complete.
   - Microsoft SQL Server 20XX Browser
   - Microsoft SQL Server 20XX Native Client
   - Microsoft SQL Server 20XX Setup Support Files
   - Microsoft SQL Server VSS Writer
5. Delete the SQL Express folders from Program Files (including data files). If your Vault databases are located on a different drive, be sure to delete the files in this location as well.
6. Install the full version of SQL with an AUTODESKVAULT instance as in the "Pre-install Microsoft SQL Server" section.

7. Install the Microsoft SQL release for your Vault product.

   Note: Refer to the chart on this page or see your Vault System Requirements for which SQL release you should install.
8. Restore the backup that you created in step one using ADMS Console.

7.5 Installing and Configuring WebiSmarts

After installing the SQL Server Express – REBOOT THE COMPUTER

Once you install WebiSmarts, you will need to:

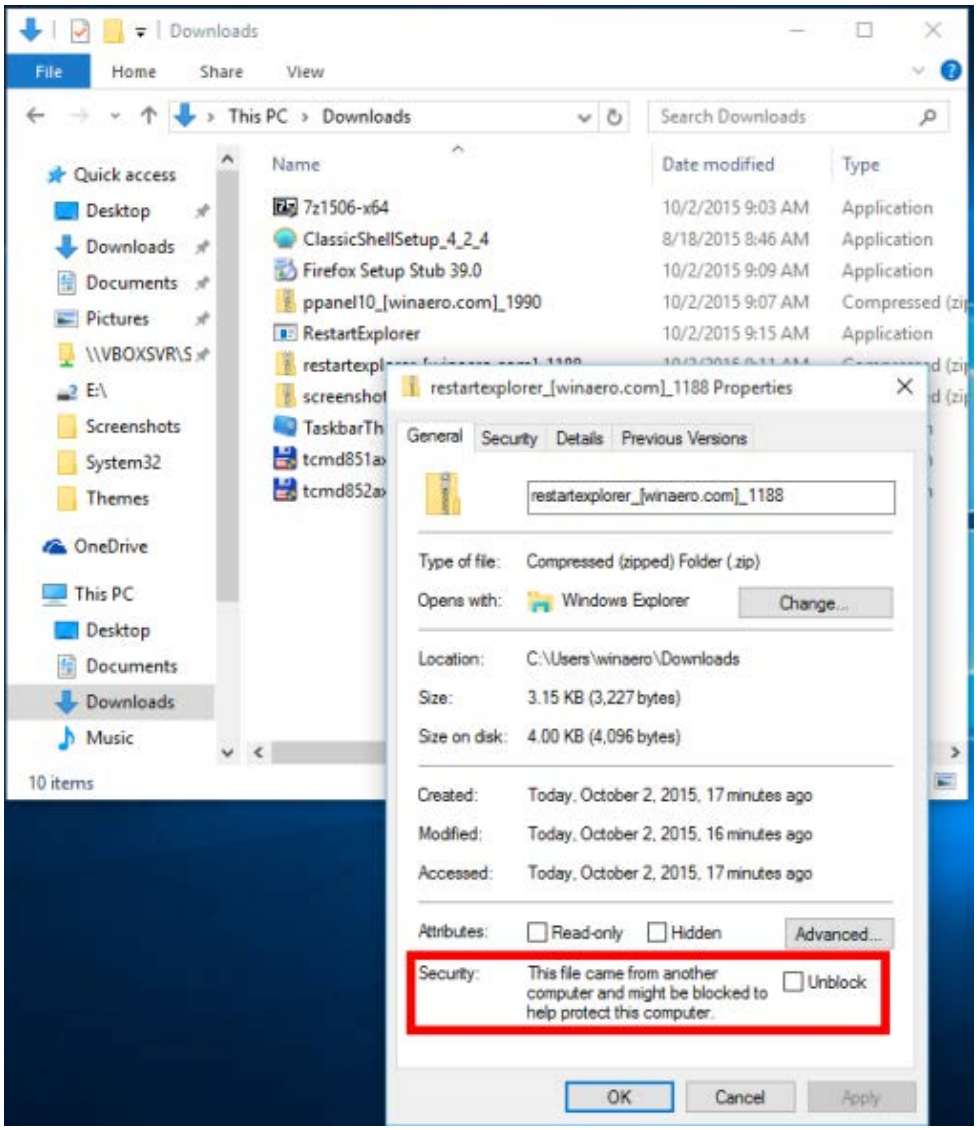
- Connect WebiSmarts to the SQL server
- Configure IIS settings
- Assign permissions to WebiSmarts directories

This section describes each of these procedures.

7.5.1 Installing WebiSmarts

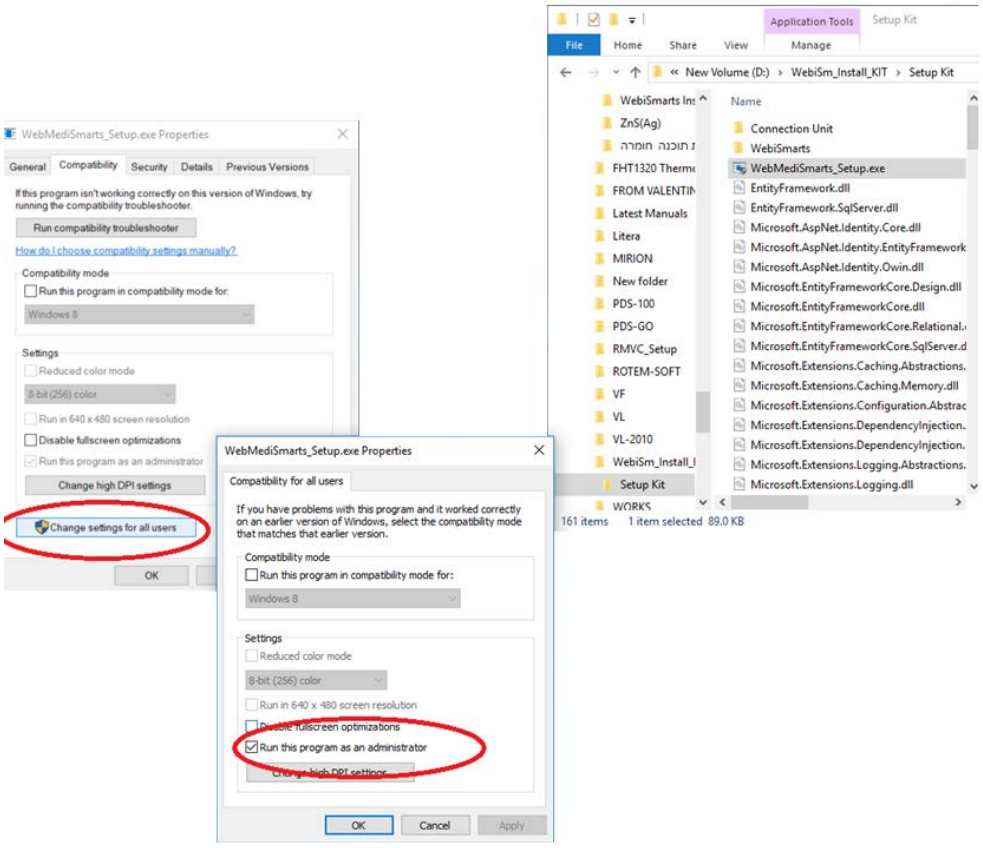
From the Setup Kit, install the WebiSmarts system by first unzipping the contents into a temporary folder of your choice.

Note that in some cases, Windows may block the zipped file for security reasons. We recommend that you check the properties of the zipped file and active unblock if available


Downloads
File
Home
Share
View
This PC › Downloads
Search Downloads
Quick access
Desktop
Downloads
Documents
Pictures
\\VBOXSVR\S
E:\
Screenshots
System32
Themes
OneDrive
This PC
Desktop
Documents
Downloads
Music
10 items
Name
Date modified
Type
7z1506-x64
10/2/2015 9:03 AM
Application
ClassicShellSetup_4_2_4
8/18/2015 8:46 AM
Application
Firefox Setup Stub 39.0
10/2/2015 9:09 AM
Application
ppanel10_[winaero.com]_1990
10/2/2015 9:07 AM
Compressed (zip
RestartExplorer
10/2/2015 9:15 AM
Application
TaskbarTh
tcmd851a
tcmd852a
restartexplorer_[winaero.com]_1188 Properties
General
Security
Details
Previous Versions
restartexplorer_[winaero.com]_1188
Type of file:
Compressed (zipped) Folder (.zip)
Opens with:
Windows Explorer
Change...
Location:
C:\Users\winaero\Downloads
Size:
3.15 KB (3,227 bytes)
Size on disk:
4.00 KB (4,096 bytes)
Created:
Today, October 2, 2015, 17 minutes ago
Modified:
Today, October 2, 2015, 16 minutes ago
Accessed:
Today, October 2, 2015, 17 minutes ago
Attributes:
Read-only
Hidden
Advanced...
Security:
This file came from another computer and might be blocked to help protect this computer.
Unblock
OK
Cancel
Apply

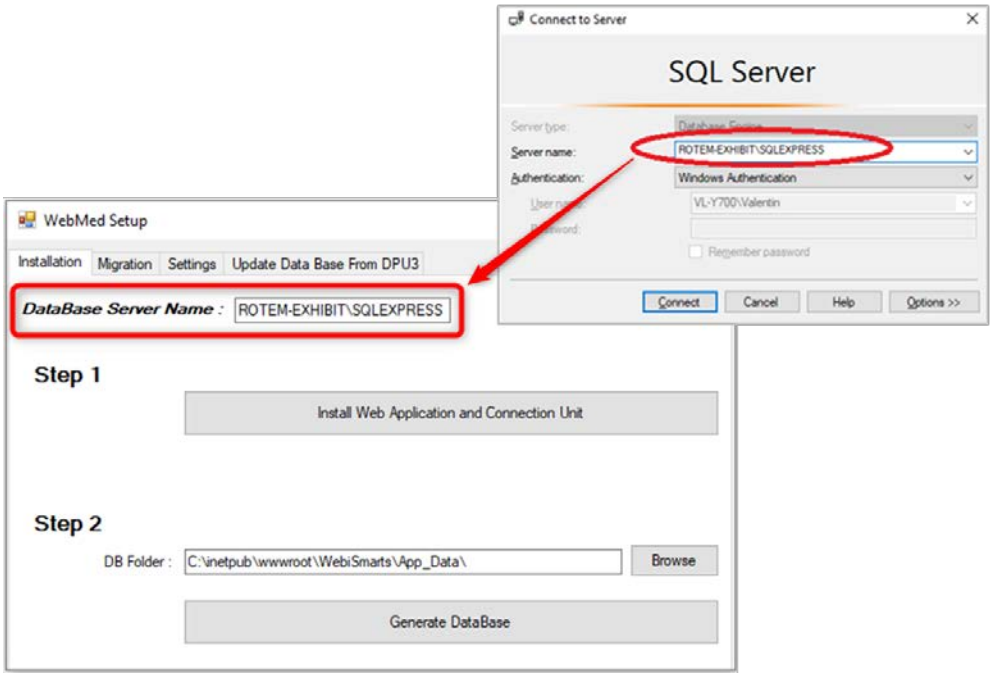
Procedure:

1. In Windows, navigate to the Setup Kit folder.
2. Right-click WebiSmarts_Setup.exe and click **Properties**.
3. From the **Compatibility** tab, click **Change settings for all users**.
4. Select **Run this program as an administrator** and click **OK**.

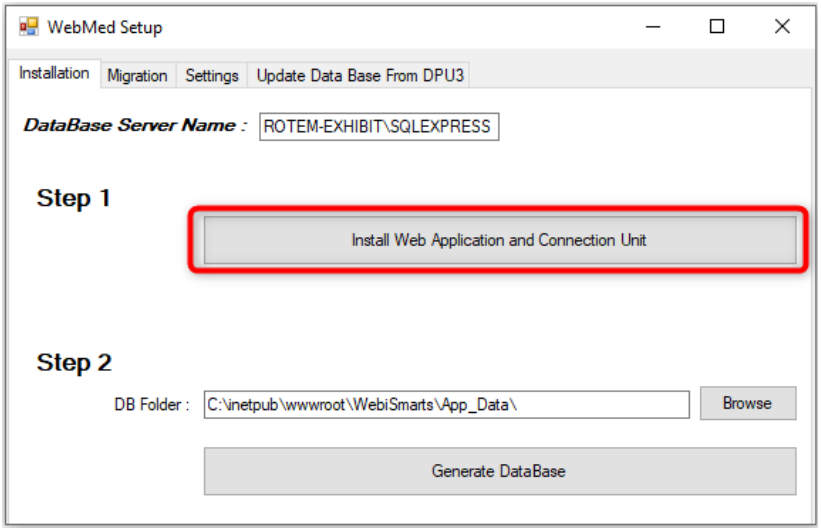


WebiSmarts Setup opens.

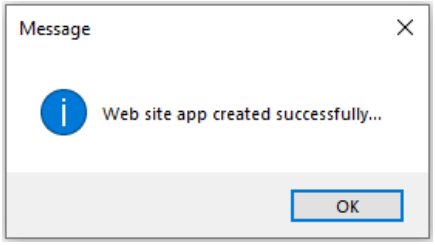
5. **Run** the WebiSmarts_Setup.exe application **as an Administrator (**Right click on command line and select **Run as Administrator)**
6. Open the SSMS and copy the Database Server Name field from the window. Enter the database server name that you chose during the SQL installation process (see section 6.2)



7. Click **Install Web Application and Connection Unit**.

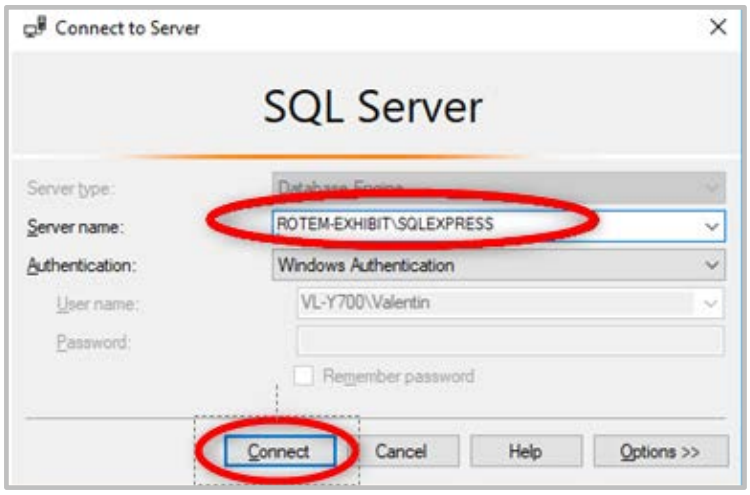


When the operation is successful, the following message appears:



7.5.2 Connecting the SQL Server

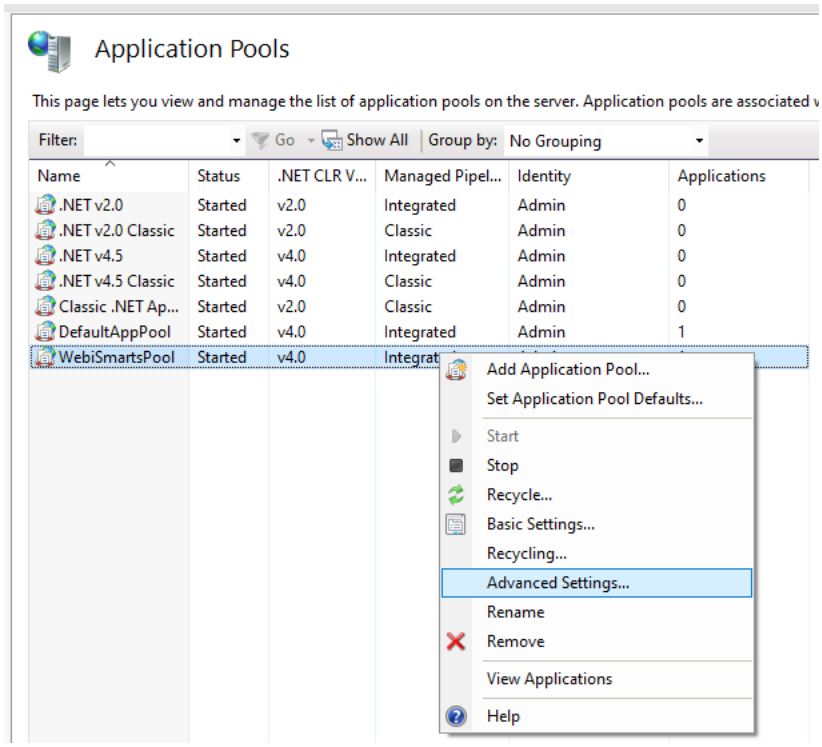
In MS SQL Express, test the connection to the server.



7.5.3 Configuring IIS Settings

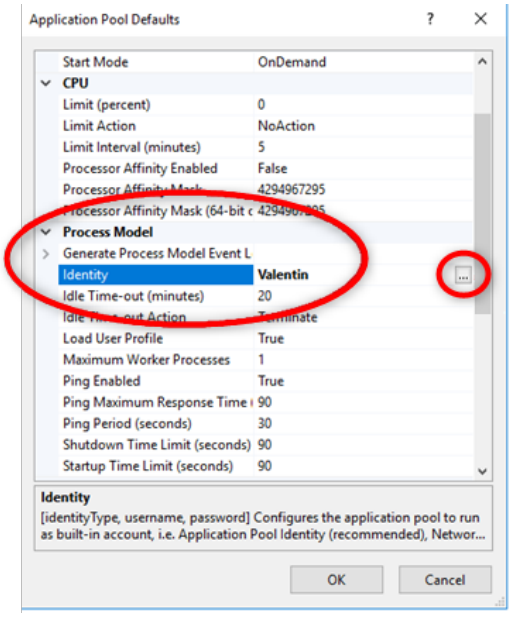
If the Windows PC is password protected, do the following:

1. Open IIS by searching in Windows for *Internet Information Services Manager*.
2. In the Connections pane, expand the connection and click **Application Pools.**
3. Right-click WebiSmartsPool and select **Advanced Settings**

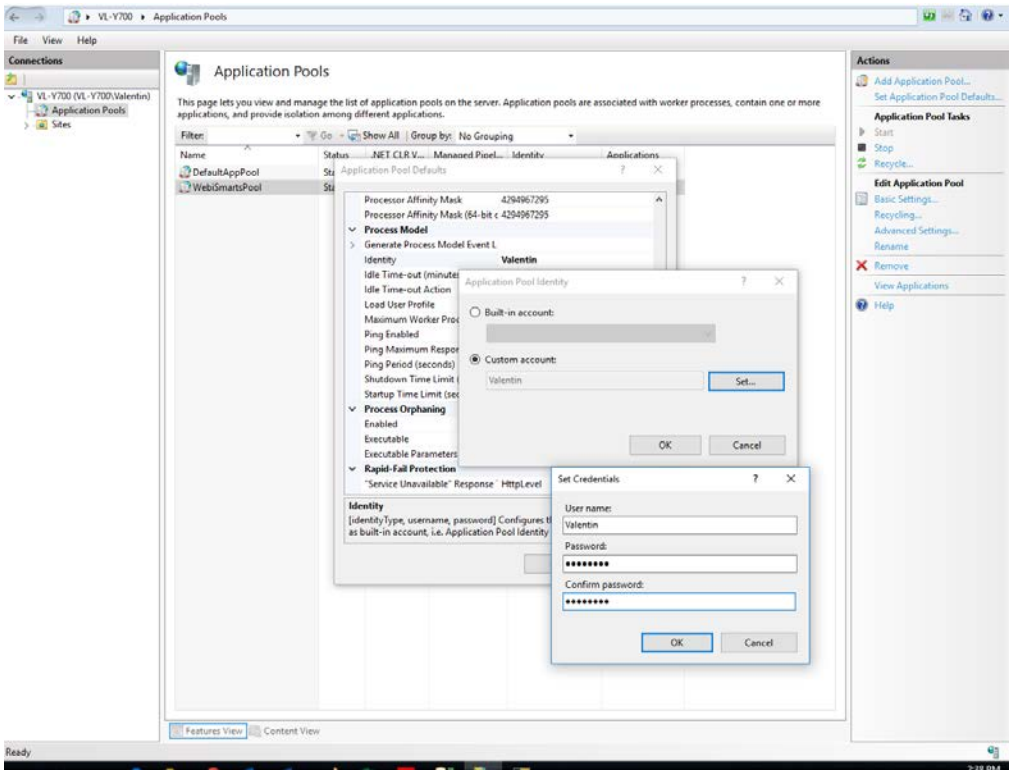


4. Scroll down to the Process Model section.

5. Click the **Identity** field and then click ....



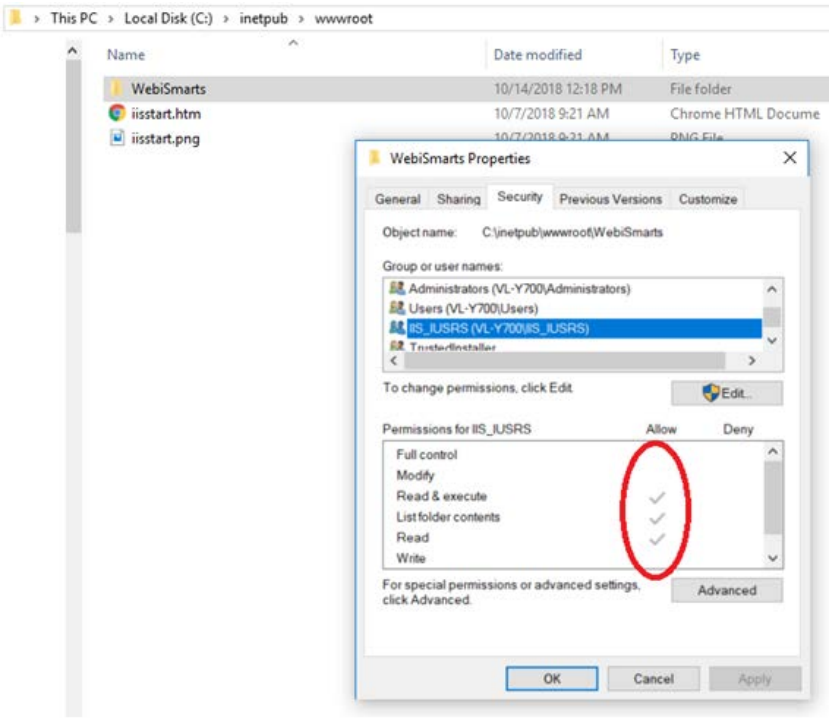
6. Select **Custom account** and click **Set**.
7. Enter the Windows username and password.
8. Click **OK**.



7.5.4 Assigning Permissions to the Database Directories

WebiSmarts needs to connect to the database folder. To enable access, provide “full control” Windows permissions, as follows:

1. Navigate to the database folder. By default, this is: `C:\intetpub\wwwroot\`.
2. Right-click the WebiSmarts directory.
3. Select **Properties**.
4. Click the **Security** tab and then **Edit**.
5. In the “Group or user names” section, select IIS_IUSRS.
6. In the “Permissions for IIS_IUSRS” section, next to Full control, select **Allow**.



7. Repeat these steps (5 & 6) to give the local Users Full control permissions.
8. Check that all Groups and User names have full permission, if not provide it to them by selecting Full Control and Allow.

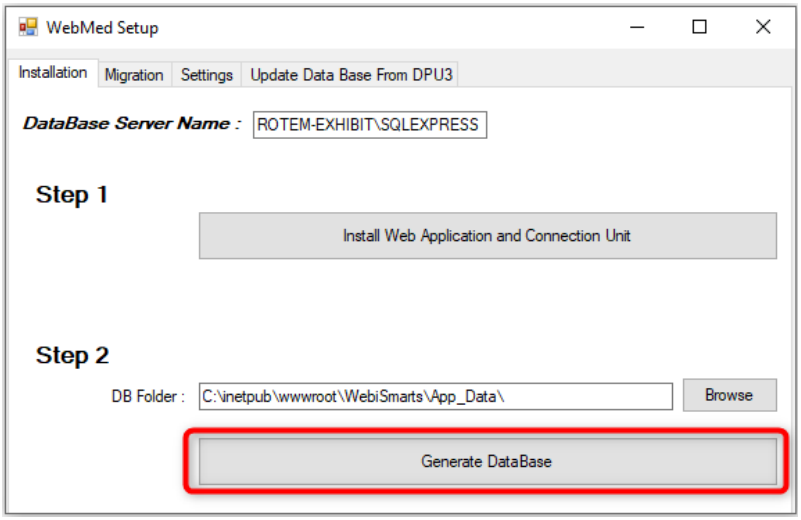
7.6 Generating the Database

Before generating the database, make sure that the following are set:

- IIS settings (see section 6.4.3 “Configuring IIS Settings”)
- Database directory permissions (see section 6.4.4 “Assigning Permissions to the Database Directories”).

> **IMPORTANT!**
>
> Every time you click “Install Web Application and Connection Unit” you need to reset IIS and database directory permission settings.

To generate the database, in WebiSmarts Setup, click **Generate Database**.



When the success message appears, click **OK**.

7.6.1 Troubleshooting Generate Database

If you receive an error message when attempting to generate the database, try the following:

- Make sure that you are running WebMed_Setup as “Administrator”.
- Make sure that the Database server name in WebMed_Setup exactly matches the database server name in MSSQL.
- Make sure that you have given full access permissions to the database directory (see section 6.4.4 “Assigning Permissions to the Database Directories”).
- Make sure that you have correctly configured IIS settings. Check that:
  - Custom account is selected
  - The username is correct
  - The password is correct

If you are still unable to generate a database, contact your Rotem representative.

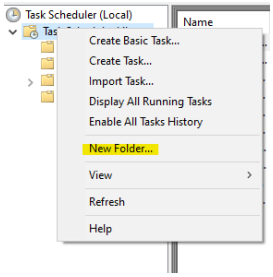
7.7 WebiWatch Setup

WebiWatch is a watchdog application runs in the background of the server to make sure that the connection between the DPU-3's in the laboratory are sending data to the WebiSmarts database.

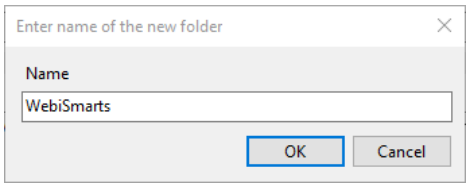
WebiWatch is installed as part of the WebiSmarts Setup and this section explains how to setup WebiWatch so that it is automatically activated upon startup of the Server and that it periodically checks that the Connection Unit is up and running at all times.

Here are the procedures:

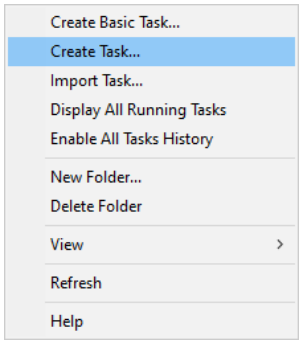
Enter task scheduler.
Right click "Task Scheduler Library and click "New Folder".



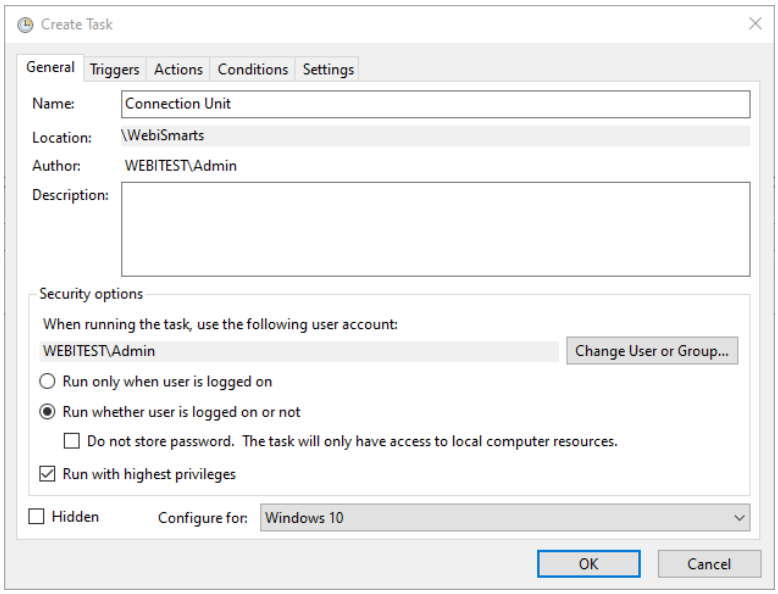
Add a new folder named: "WebiSmarts".



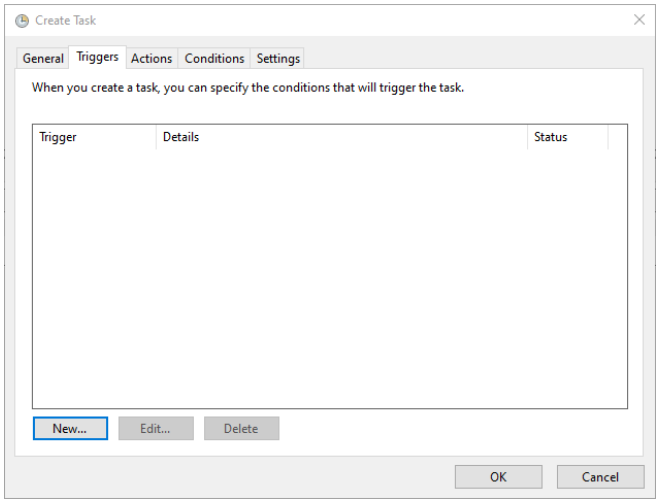
Right click the new folder and click "Create Task".



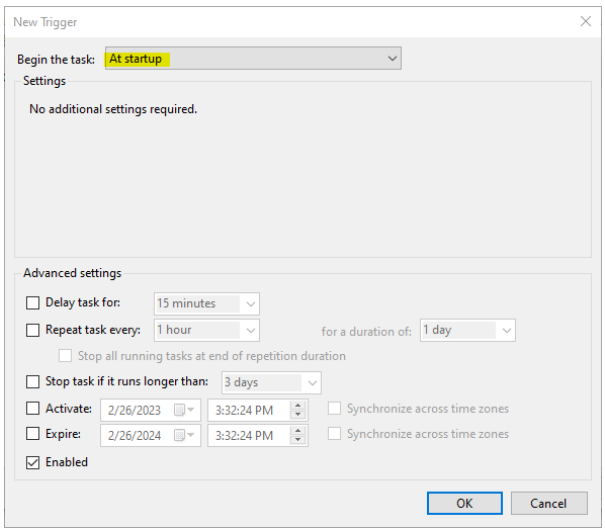
Enter the following information:



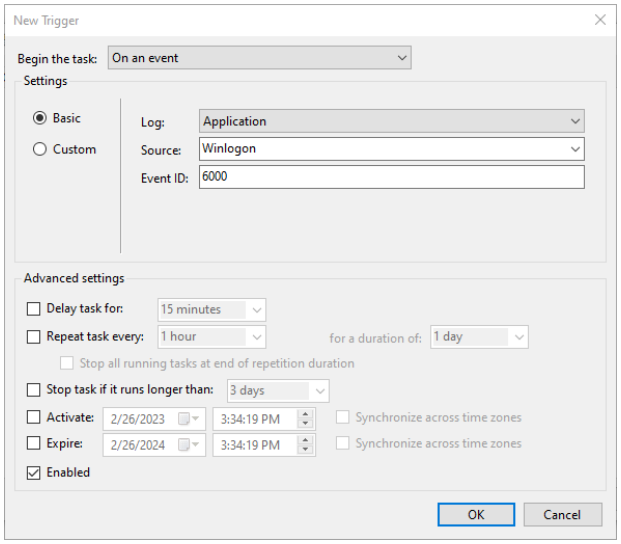
On Triggers click “New”.



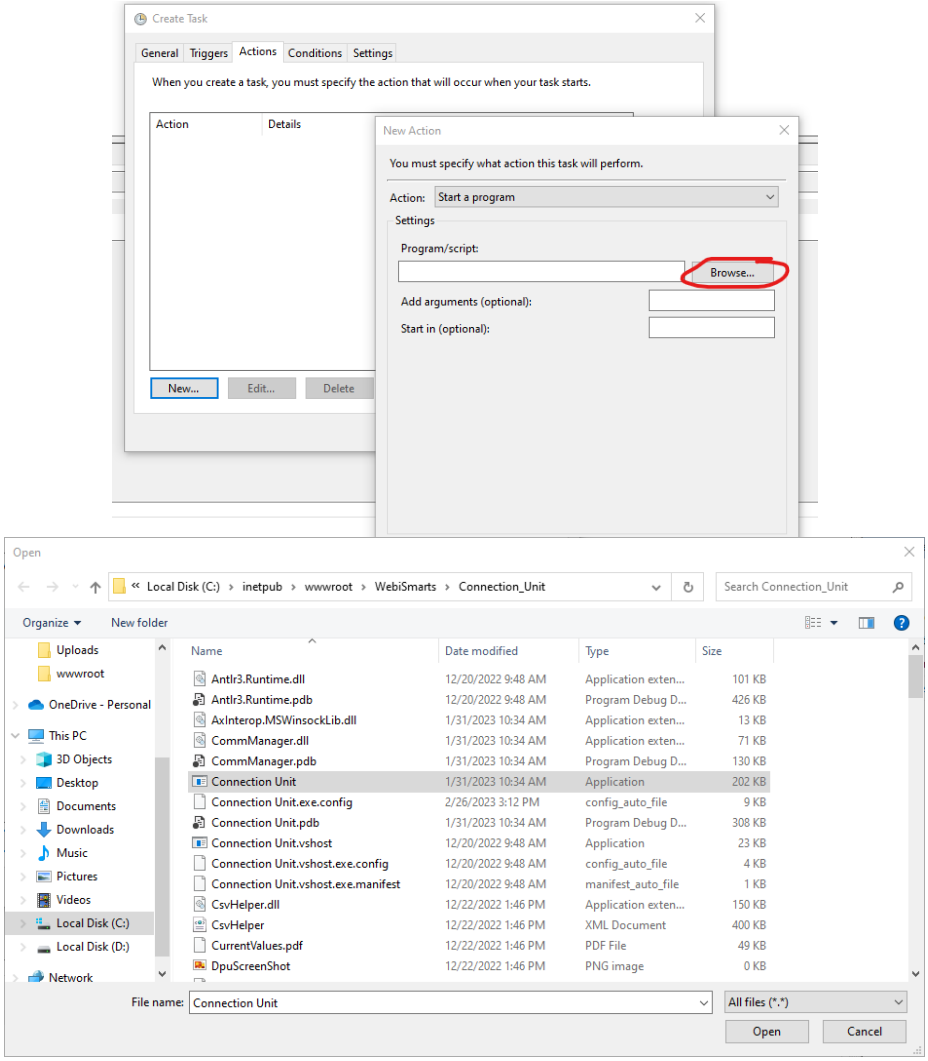
Choose “At startup” and press ok.



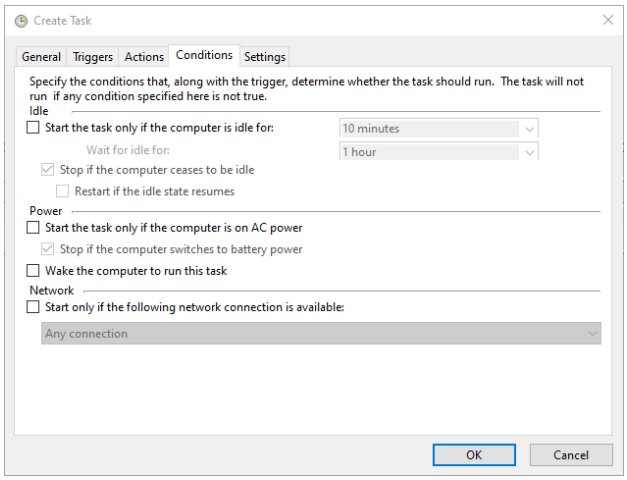
And another trigger for log off from user. Use the parameters in the picture below.



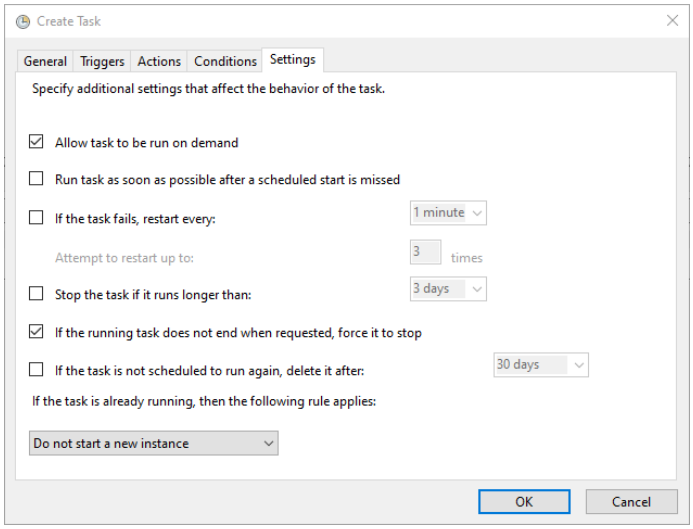
Move to “Actions” and click new. Click on “Browse...” and choose the “Connection Unit.exe”. then click “Open”.



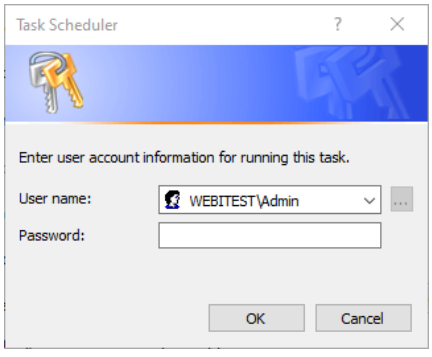
In conditions uncheck everything.



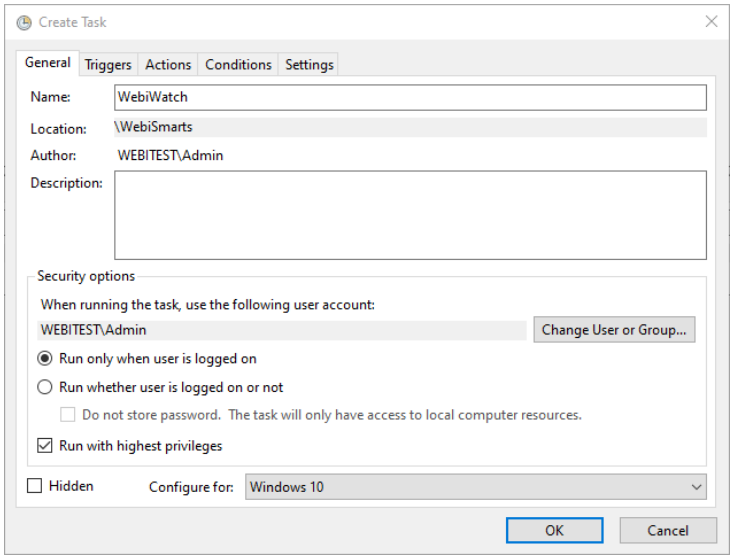
In settings check the boxes as in the picture below



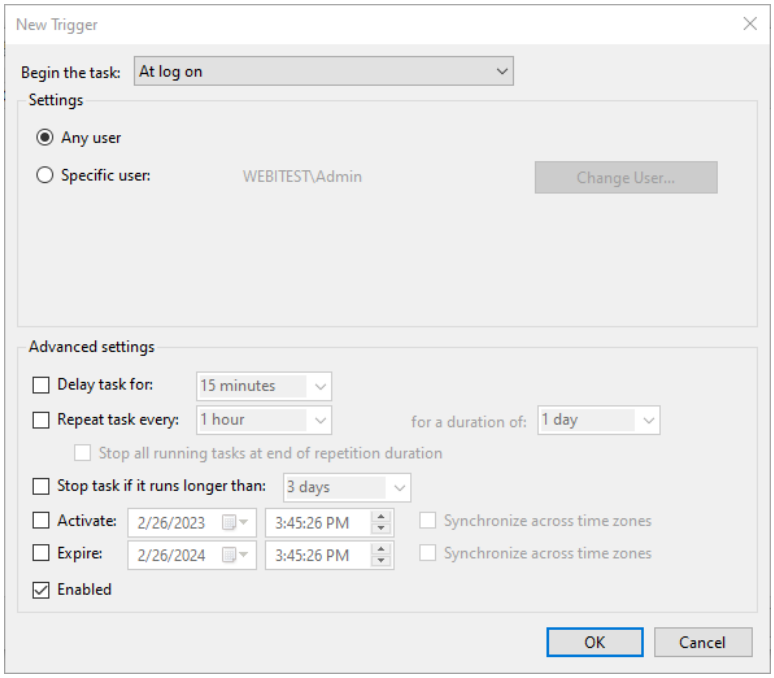
Press ok and enter the user's password.



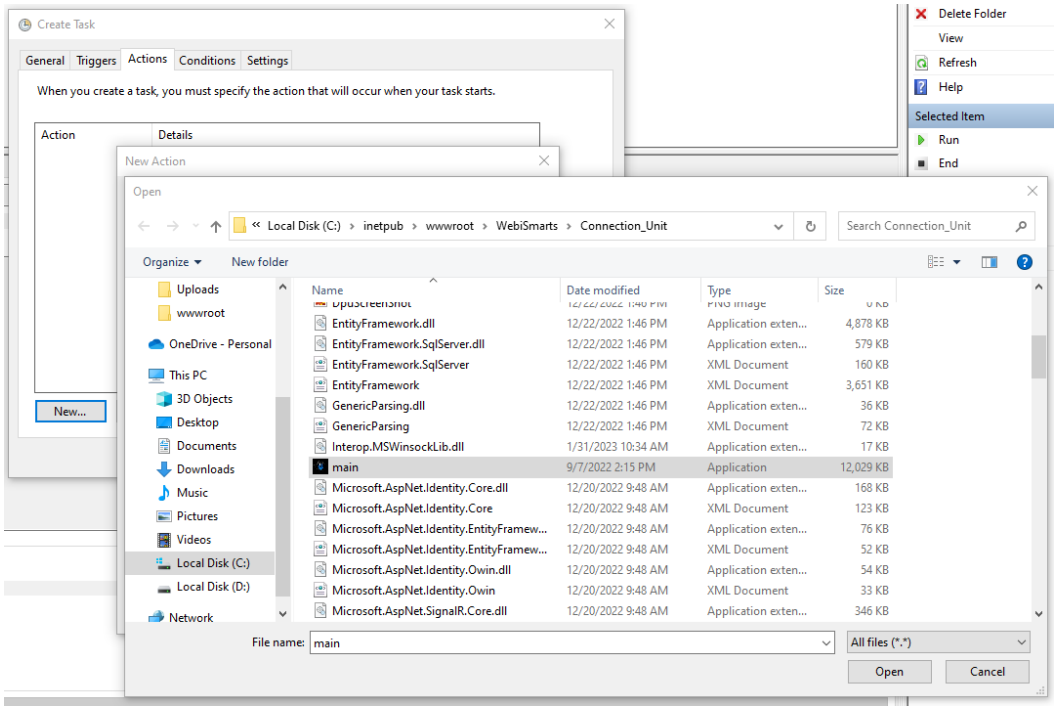
Add another task.



Add trigger for user login.



Add action for main.exe program.



Conditions and Settings the same as the first task.
Click ok and enter password again.

8 Upgrading the Software version

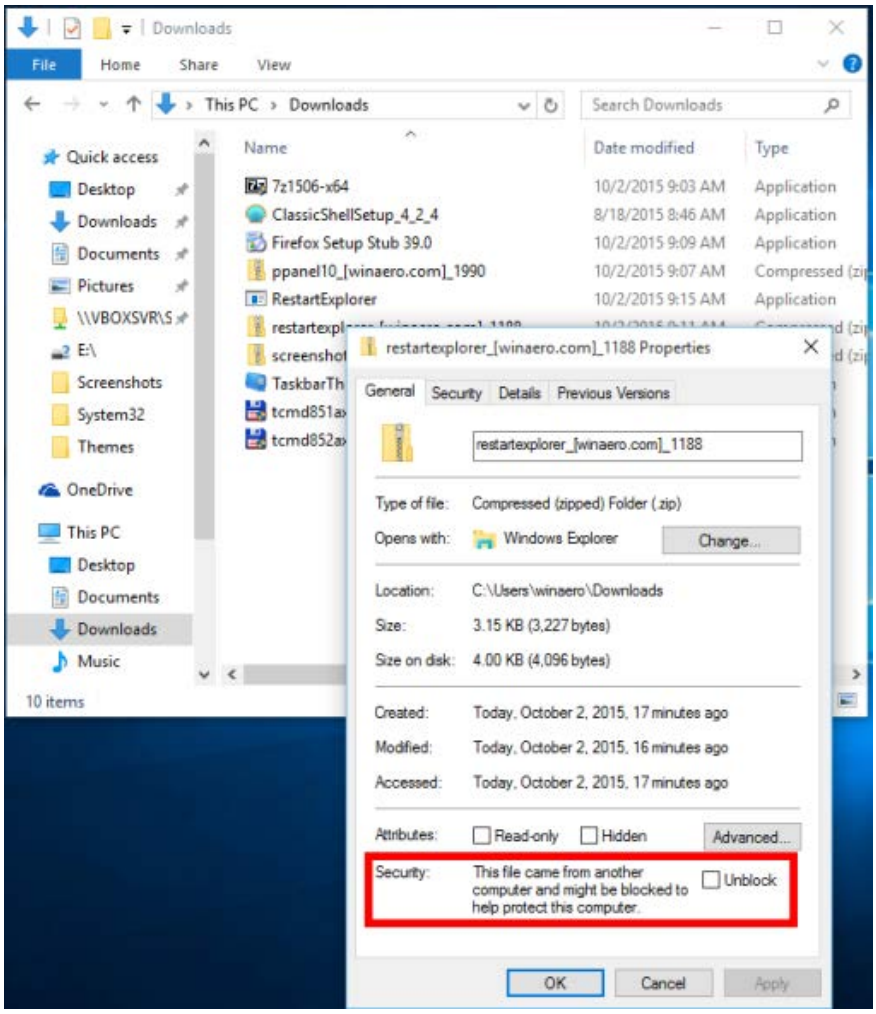
To upgrade WebiSmarts, you will need to:

- Install the upgrade version
- Configure IIS settings
- Generate database
- Assign permissions to WebiSmarts directories

8.1 Installing the upgraded WebiSmarts

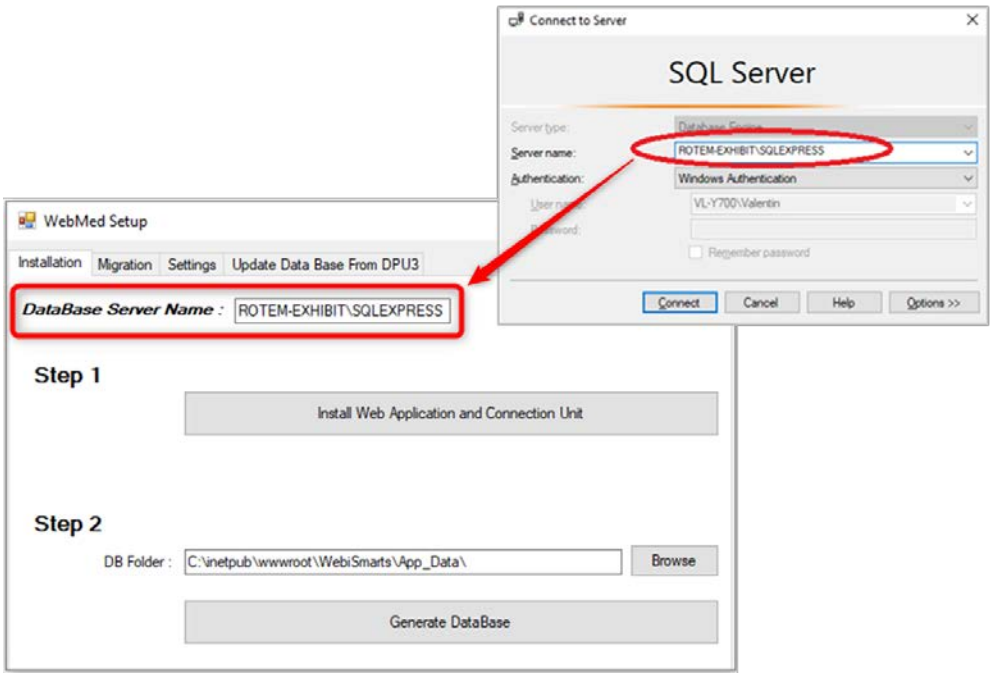
From the Setup Kit, install the WebiSmarts system by first unzipping the contents into a temporary folder of your choice.

Note that in some cases, Windows may block the zipped file for security reasons. We recommend that you check the properties of the zipped file and active unblock if available

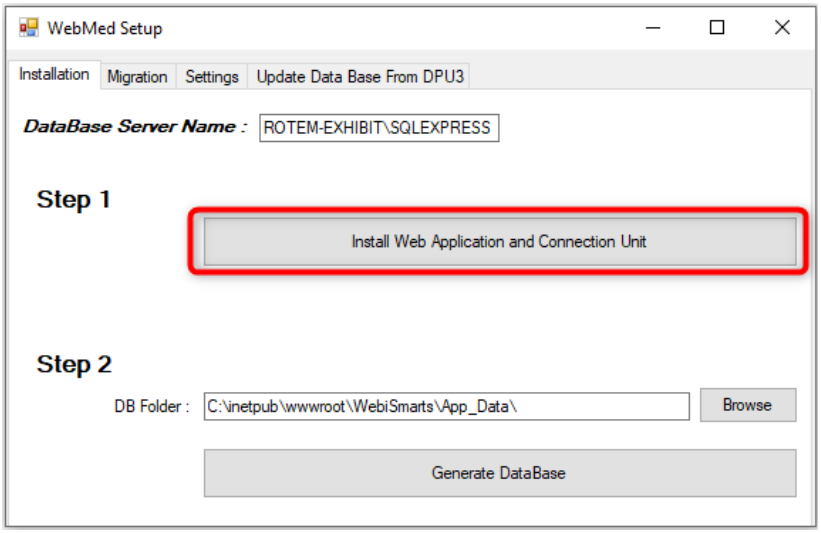

Downloads
File
Home
Share
View
This PC › Downloads
Search Downloads
Quick access
Desktop
Downloads
Documents
Pictures
\\VBOXSVR\S
E:\
Screenshots
System32
Themes
OneDrive
This PC
Desktop
Documents
Downloads
Music
10 items
Name
Date modified
Type
7z1506-x64
10/2/2015 9:03 AM
Application
ClassicShellSetup_4_2_4
8/18/2015 8:46 AM
Application
Firefox Setup Stub 39.0
10/2/2015 9:09 AM
Application
ppanel10_[winaero.com]_1990
10/2/2015 9:07 AM
Compressed (zip
RestartExplorer
10/2/2015 9:15 AM
Application
restartexplorer_[winaero.com]_1188 Properties
General
Security
Details
Previous Versions
restartexplorer_[winaero.com]_1188
Type of file:
Compressed (zipped) Folder (.zip)
Opens with:
Windows Explorer
Change...
Location:
C:\Users\winaero\Downloads
Size:
3.15 KB (3,227 bytes)
Size on disk:
4.00 KB (4,096 bytes)
Created:
Today, October 2, 2015, 17 minutes ago
Modified:
Today, October 2, 2015, 16 minutes ago
Accessed:
Today, October 2, 2015, 17 minutes ago
Attributes:
Read-only
Hidden
Advanced...
Security:
This file came from another computer and might be blocked to help protect this computer.
Unblock
OK
Cancel
Apply

Procedure:

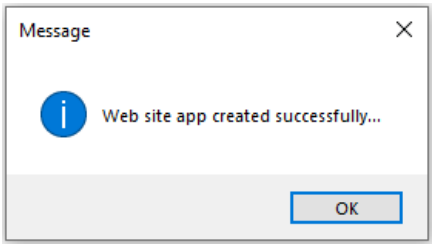
1. In Windows, navigate to the Setup Kit folder.
2. Right-click WebiSmarts_Setup.exe and click **Properties**.
3. Check that the setup files is set to **Run as an administrator** and click **OK**.
4. Check that the database server name is correct against the SSMS setting.



5. Click **Install Web Application and Connection Unit**.



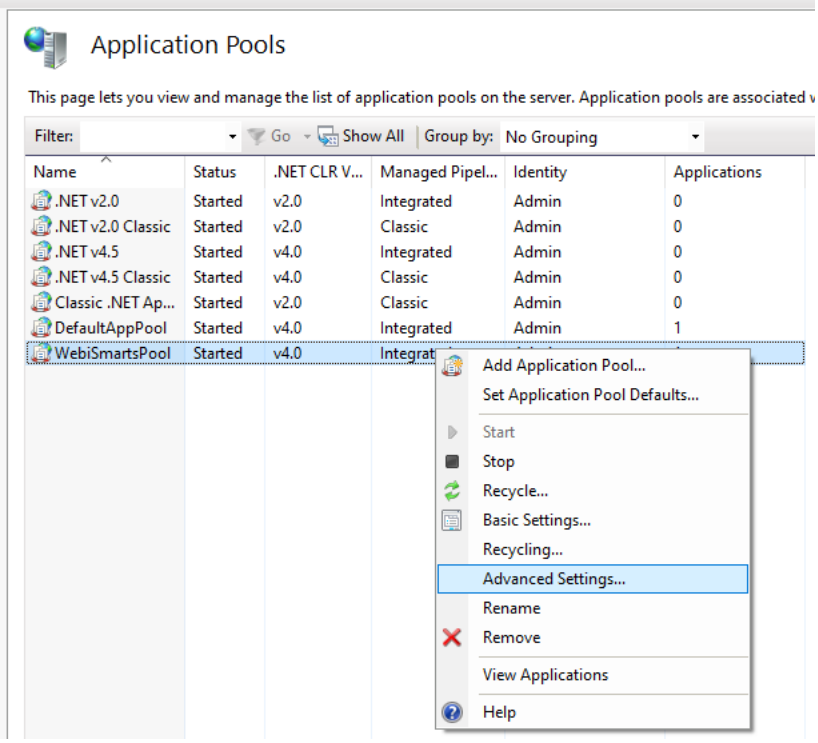
When the operation is successful, the following message appears:



8.2 Configuring IIS Settings

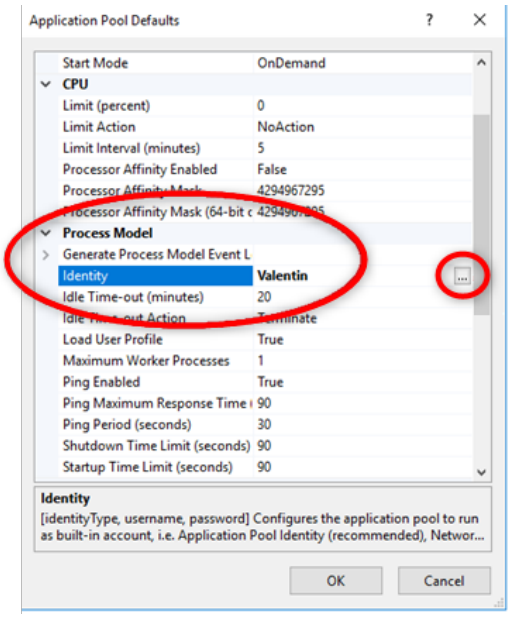
If the Windows PC is password protected, do the following:

1. Open IIS by searching in Windows for *Internet Information Services Manager*.
2. In the Connections pane, expand the connection and click **Application Pools.**
3. Right-click WebiSmartsPool and select **Advanced Settings**

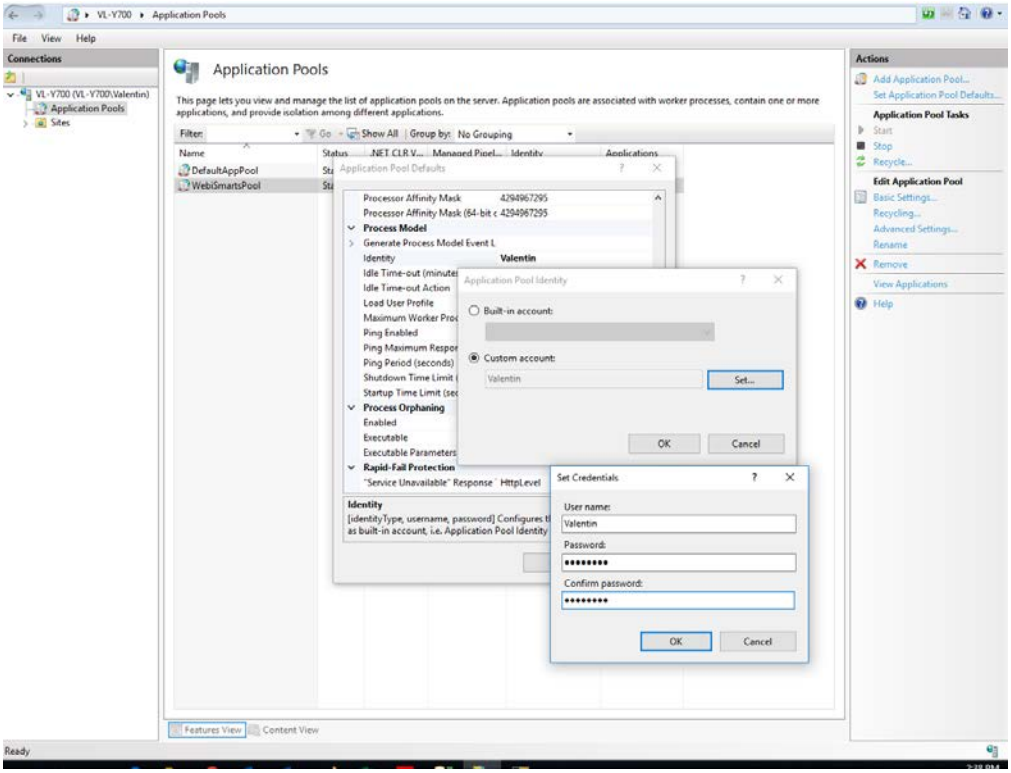


4. Scroll down to the Process Model section.

5. Click the **Identity** field and then click ....



6. Select **Custom account** and click **Set**.
7. Enter the Windows username and password.
8. Click **OK**.



9 Configuring the Connection Application

The Connection Unit (connection application), manages communication between the WebiSmarts database and the DPU-3's in the laboratory it manages the connection between the detectors via the DPU-3's, the WebiSmarts software and the WebiSmarts database.

A word of warning… Upon startup of the Connection Application, all the DPU-3's in the laboratory will update their time stamps according to the Time stamp of the server running the Connection Application. Please check that the time stamp is correct.

Provide Administrator access level to the Connection Application

Procedure:

1. In Windows, navigate to the Setup Kit folder which is situated at `c:/inetpub/wwwroot/Webismarts/Connection Unit`
2. Right-click **Connection_Unit.exe** and click **Properties**.
3. From the **Compatibility** tab, click **Change settings for all users**.
4. Select **Run this program as an administrator** and click **OK**.

9.1.1 Starting the Connection Application

When WebiSmarts is installed, a shortcut to Connection Unit is created on the Windows desktop, if not create a shortcut.

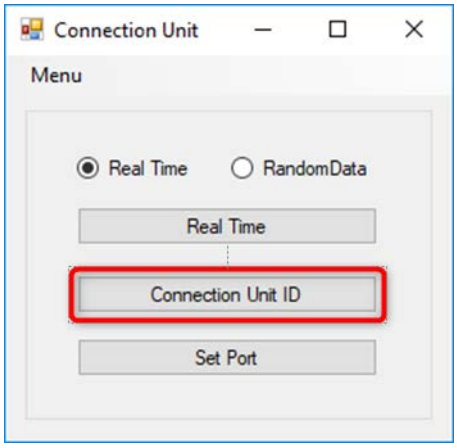
To start the connection application, click **Connection Unit**

The main menu displays the following options:

- Real Time
- Connection Unit ID
- Set Port

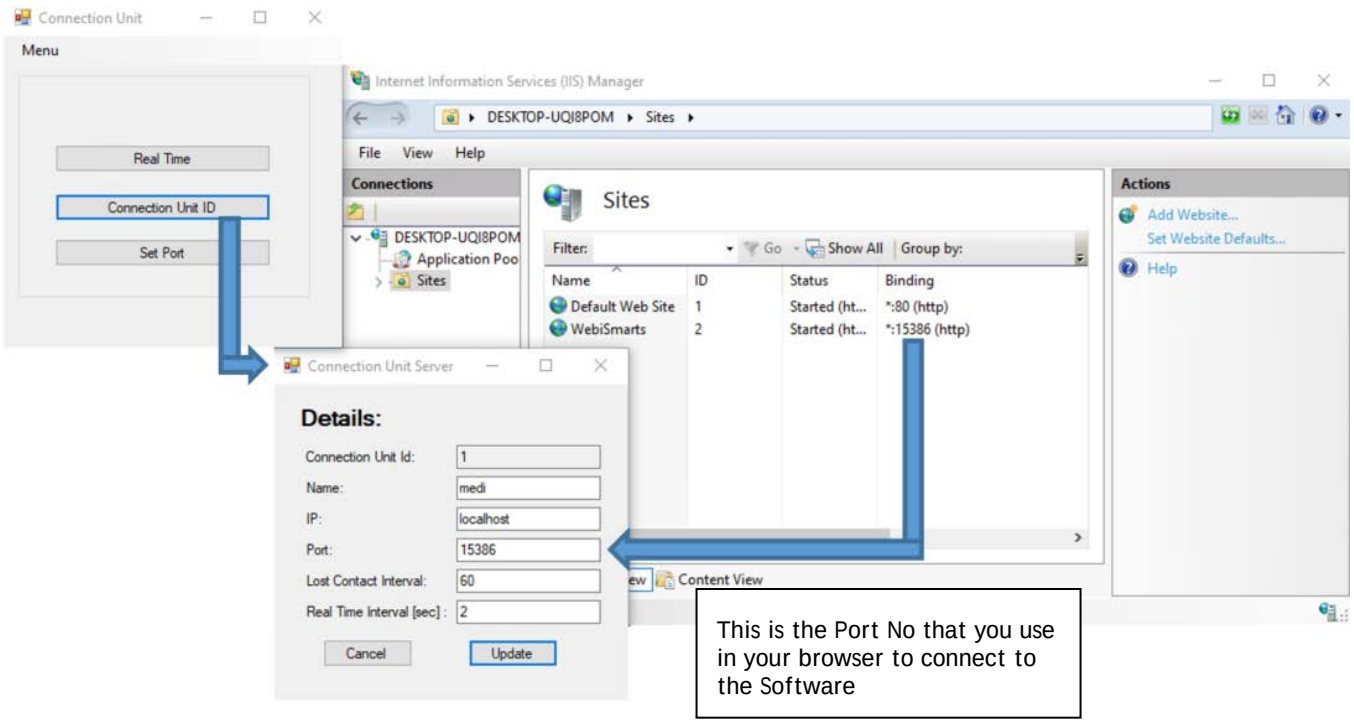
9.1.2 Configuring the Connection Unit ID

To configure the Connection Unit Server, on the main menu, click **Connection Unit ID**.



Enter the required information. The following table describes each field.

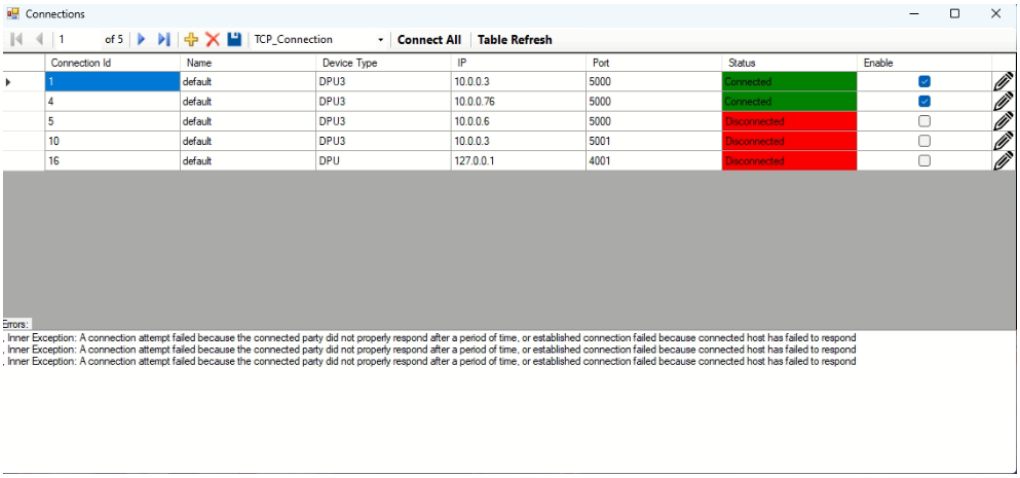
Connection Unit Id	An automatically generated ID. You cannot change this value.
Name	The name of the connection. You can assign any name you like.
IP	■ If WebiSmarts is to be used locally on the server, the value should be `localhost`. ■ If WebiSmarts is to be used on the network/internet, the value should be its IP address on the network/Internet and permission should be granted on the firewall to allow external browsers access.
Port	This value is automatically assigned from when you defined the Internet Information Services (IIS) and can be seen by clicking on the `Sites` window in the IIS Manager. If you save WebiSmarts on the web, change this value as appropriate.
Lost Contact Interval	The number of seconds between which the system checks the connection to the database. The default value is 60 seconds.
Real Time Interval	The number of seconds between which the system checks the connection to the detectors. The default value is 7 seconds, and the minimum is 1 second.



9.1.3 Adding a new DPU-3 – Using the Connections Window

To add a new DPU-3 click **Set Port** on the main menu, the Connections window opens. **Note that only DPU-3's exist in this list**. No need for detectors because WebiSmarts will use the combination of the IP address and Detector # to query each detector.

1.



2. To add a new connection, click **+**.
3. In the top bar, select the connection type between CommPort_Connection and/or TCP_Connection. Both can be defined on the Connection Unit so that WebiSmarts can receive data both the two options simultaneously.
4. In the table, enter the connection details:

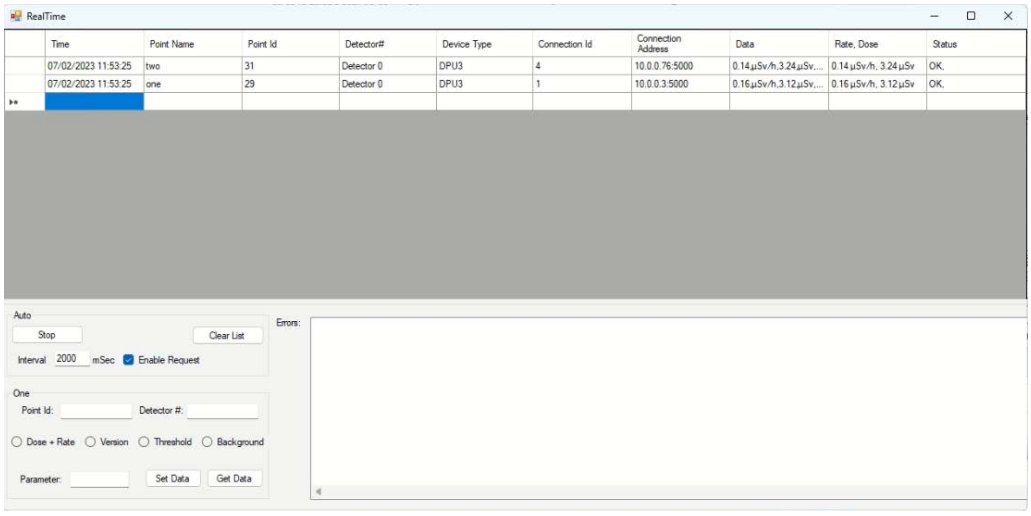
   Connection Id: Automatically assigned by WebiSmarts

   Name: Enter any name

Device Type:	Can be DPU3 for DPU-3 **DPU** for old type DPU **DRM3000** for DRM-3000 **Stack** for Coincidence Stack Monitor
IP:	This is the IP address of the Meter. All connected detectors will use the same IP address as the meter with their own suffix signifying which connector they are connected to. 10.0.0.31:0 = internal detector 10.0.0.31:1 = Left external detector 10.0.0.31:2 = Middle external detector 10.0.0.31:3 = Right external detector
Port:	DPU-3 utilizes port no 5000 Old type DPU utilizes port no 4001 The Stack also utilizes port no 4001
Status:	Automatically updated from disconnected to Connected when a connection between the DPU-3/DPU and WebiSmarts database has been achieved
Enable:	After defining the DPU, you need to click on the radio button and enable the connection

5. To edit a connection, click [PENCIL].

9.1.4 The Realtime Window



The Realtime window is used for the following:

Verify that data is being sent from the DPU-3's to the WebiSmarts database. The list will refresh automatically

Set the querying rate interval between 1000-7000 milliseconds between the WebiSmarts Software and DPU-3's in the laboratory.

You can query a single point for:

Insert the **Point Id** and **Detector #** under the One heading

See Dose and Rate updating in the table above each time you click **Get Data**

See the firmware **Version** of the CPS board in the DPU-3

See the **Threshold** levels of the detector [0.00,1.00,0.00,-0,

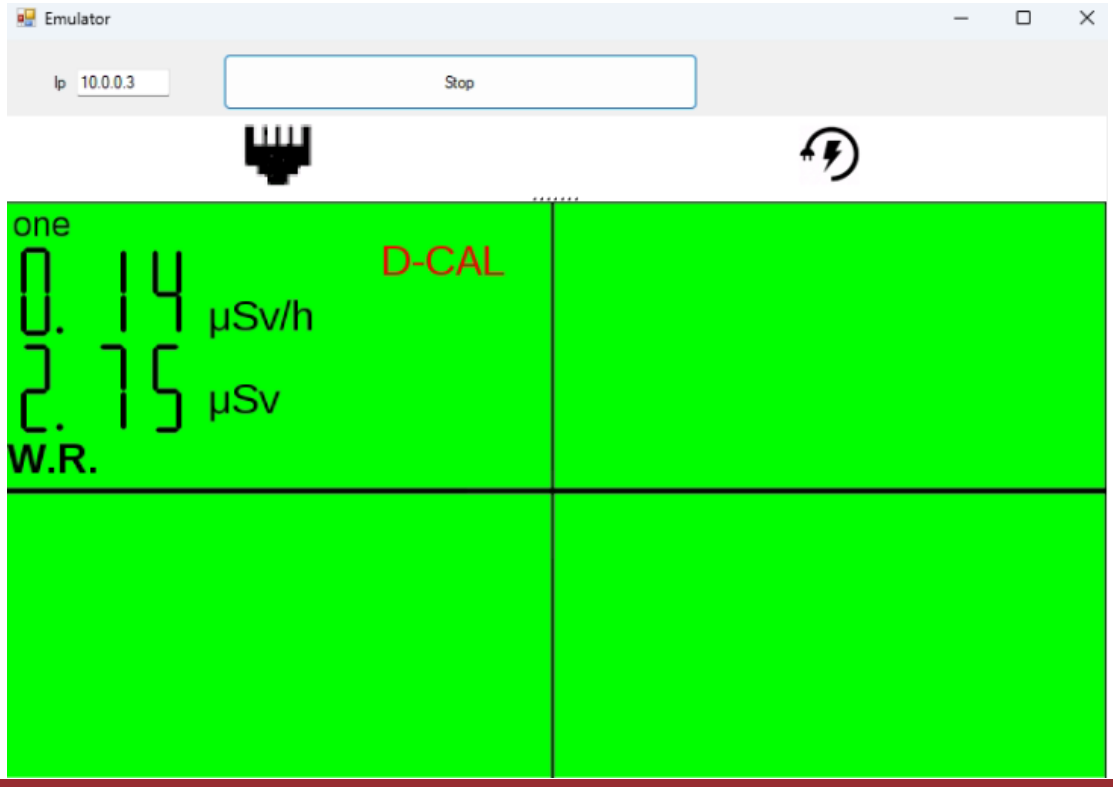
Background – Click Get Data to see current background setting and then enter a new background level (using the same units of measurement as seen in the window above) in the Parameter window and click Set Data.

9.1.5 The Connection Unit Menu

The Connection Unit Menu contains the following Commands:

Login:	Used to access sensitive settings, e.g. adds the command *Settings* to the end of the drop-down list, which is used to reconstruct Lost contact time. See *Activating the Reconstruction* section in the WebiSmarts User Manual for more information.
Emulator:	Used to emulate the Display of the DPU-3 for diagnostic purposes. Type in the IP address of the DPU-3 you are interested in querying and click Start. See screenshot below
IP Scanner:	Very useful during the installation for scanning the IP address of the DPU-3's connected to the network.
Network Alarm Messages:	Used to set up the recipients of the alarms via email messages. Emails are sent from medismartssystem@gmail.com as a default but you can set up any email account as long as you know the address and password. Use the *provide outgoing email…* radio button to set this up.
Print Current Values:	Click to print out a table of the current values in WebiSmarts
Settings:	Available after logging in – password is rotemi19 – used to setup the time for reconstruction of lost contact in graphs

Emulator Screen



10 The WebiWatch

The WebiWatch is the WebiSmarts watchdog which makes sure that data will continue to be transferred from the DPU-3's in the laboratory to the WebiSmarts database even after a power failure recovery.

After each startup of the Server, the Connection Unit is run as a service and if an Administrator logs into the computer, the service is closed and then re-opened as an application showing the various screens and running the service.

This closing and re-opening is done to provide the User with a visual indication that the Connection Unit is up and running and avoids opening the connection unit a second time which could cause problems

The WebiWatch application should be located in the WebiSmarts Server/ c:/inetpub/wwwroot/WebiSmarts folder.

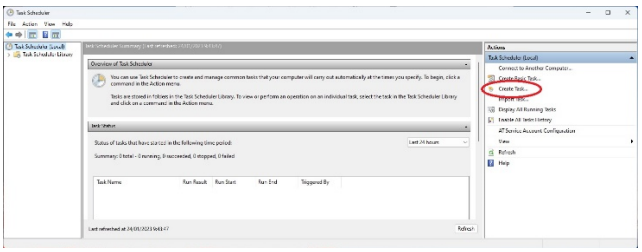
10.1.1 WebiWatch installation procedure

We need to create two tasks using the Windows Task Schedular:

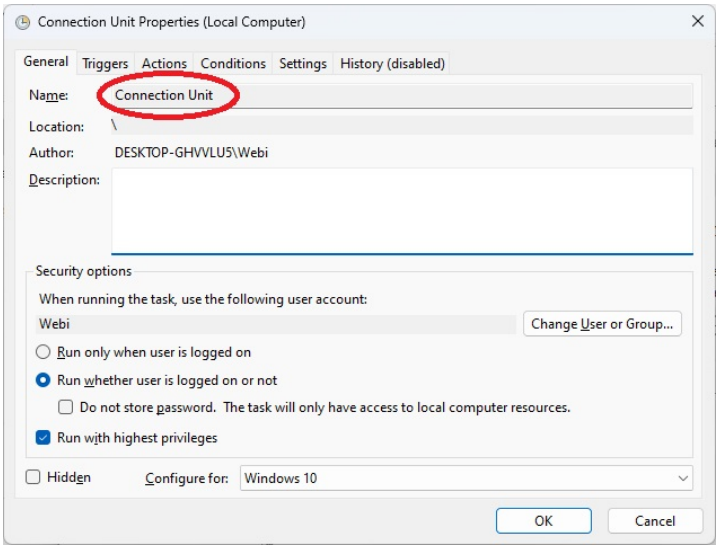
1) Connection Unit – To activate the Connection Unit upon startup
2) WEbiWatch – To close the Connection Unit Service and Open the Connection Unit application if a User with Administrator level logs into the server

10.1.1.1 Connection Unit Task - Installation Instructions

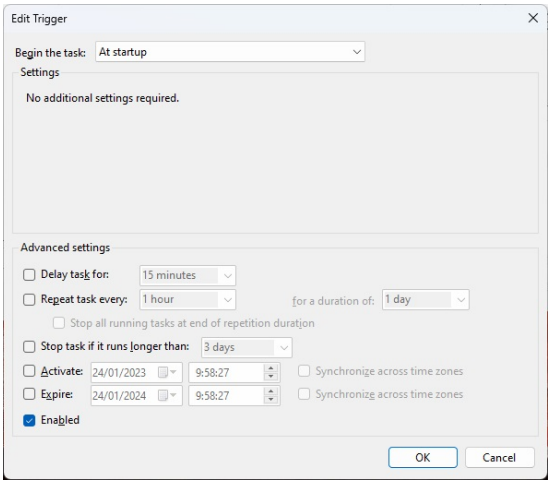
1. Open Task Schedular



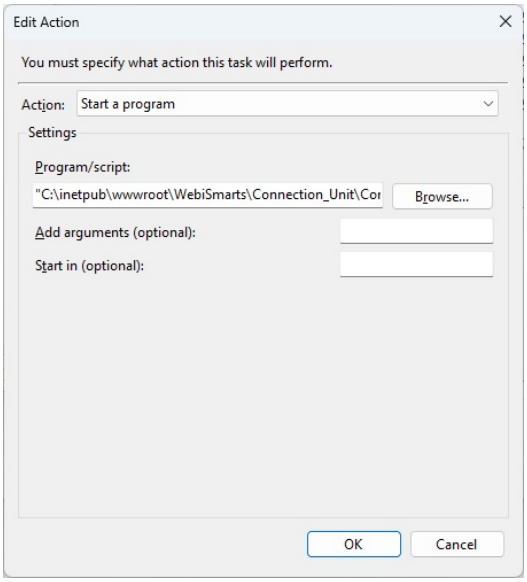
2. Click Create Task, the following screen will appear:
3. Type Connection Unit in *Name*, Select Run *whether user is logged on or not* and Select *Run with highest privileges*



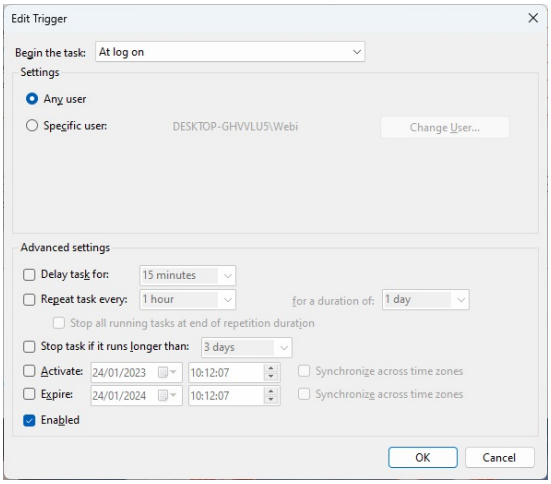
4. Click OK
5. Select Configure for: Windows 10
6. Open Triggers Tab, click New…
7. Select *At startup* from the **Begin the Task:** drop-down list



8. Click OK
9. Open Actions Tab, Click New…
10. Select *Start a program* from the **Action:** drop-down list
11. Select the Connection Unit.exe file in the **Program/script** window: by using the Browse button to local the executable



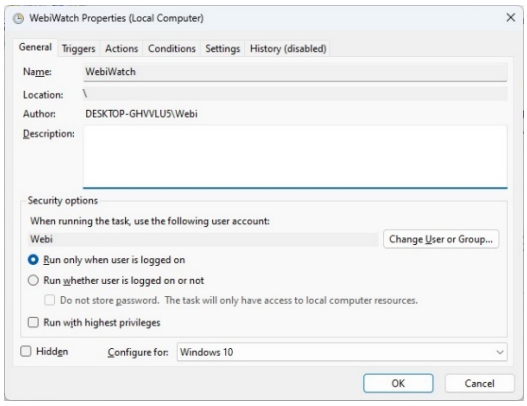
12. Click OK
13. Open the Settings Tab and set as shown below



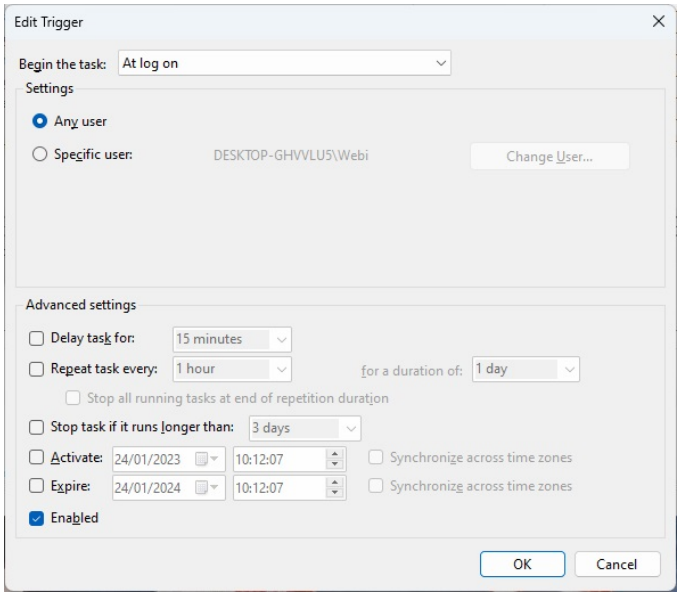
14. Click OK

10.1.1.2 WebiWatch Task - Installation Instructions

1. Open Task Schedular
2. Click Create Task, the following screen will appear:
3. Type WebiWatch in Name, Select *Run* only *when user is logged on*



4. Select Configure for: Windows 10
5. Click OK
6. Open Triggers Tab, click New…
7. Select *At Logon* from the **Begin the Task:** drop-down list and Select *Any user*



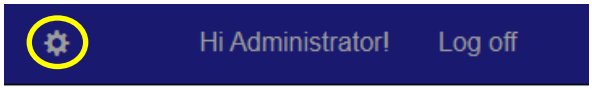
8. Click OK
9. Open Actions Tab, Click New…
10. Select *Start a program* from the **Action:** drop-down list
11. Select the WebiWatch.exe file in the **Program/script** window: by using the Browse button to local the executable
12. Open the Settings Tab and set as shown above

11 Adding and editing new Users

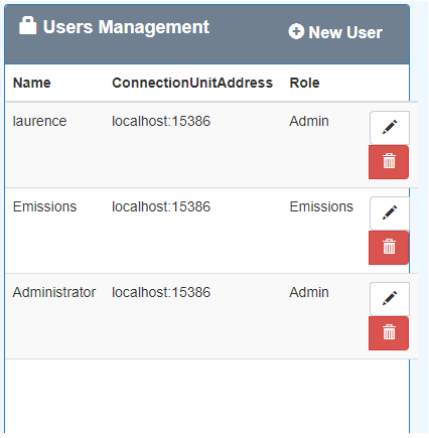
As mentioned in Section 6.1 the preloaded software contains two users:

Administrator: User: Admin Password: Admin_2021

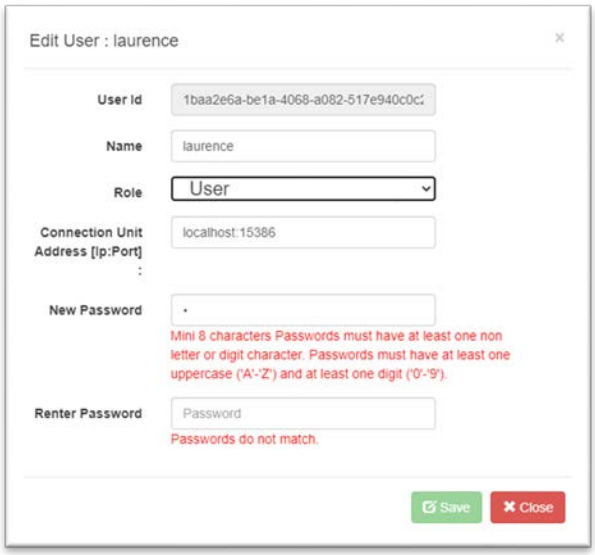
User: User: User Password: User_2021

To add a new User click on the setup icon 

The following screen appears:



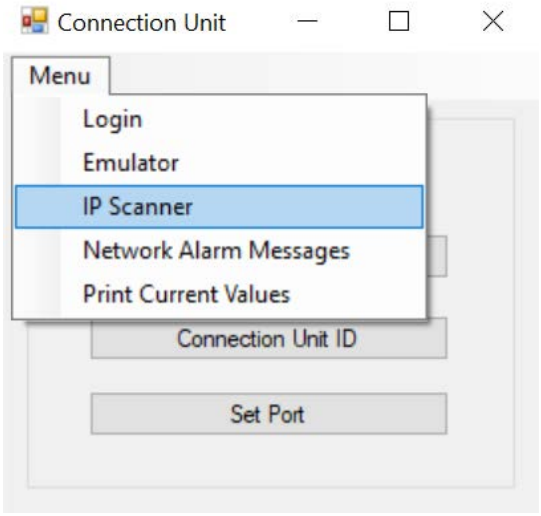
Click New User and fill in the details



12 Adding Maps and Points to the WebiSmarts software

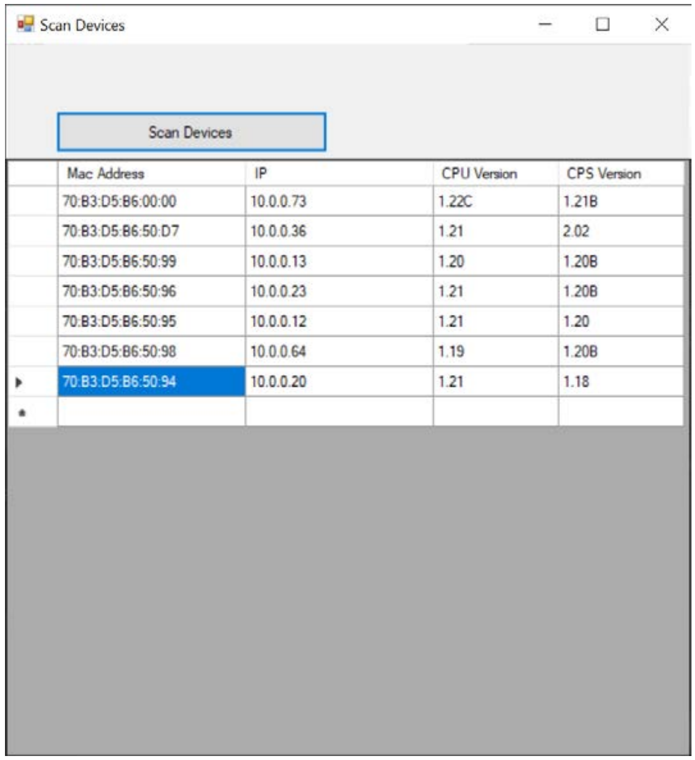
For setting up a new system follow the steps below

1) Connect all the DPU-3's and their external detectors to the Switch via the Ethernet network, its good idea to check that the DPU-3's maintain their IP addresses after a powering down and up cycle.
2) Check the details of the connected DPU-3's by opening the Connection Unit and selecting IP Scanner from the drop down list

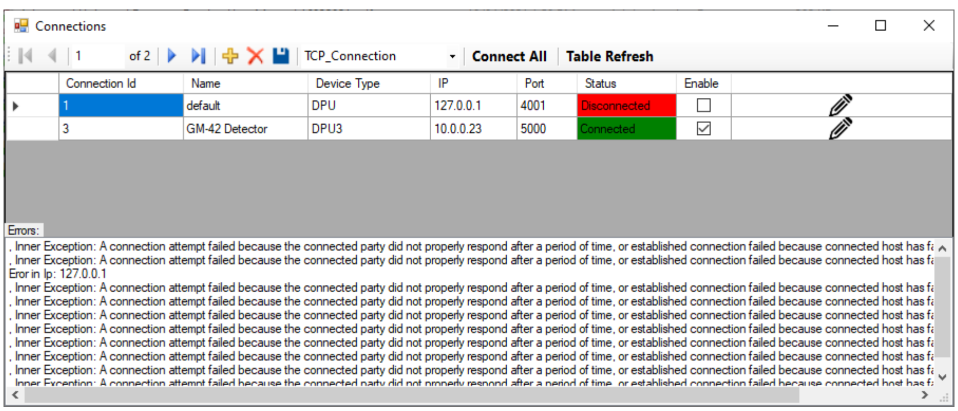


Click Scan Devices and a list of DPU-3 IP address will appear along with their CPU and CPS versions.

There are certain instances where this simple tool will not discover all the DPU-3's in the field so we recommend that you have a hard copy of the IP addresses available.



3) Add the IP address of the DPU-3's to the Connections Table. This will enable you to select the DPU-3 from a drop down list in the WebiSmarts software.



Connection Id: A unique identifier automatically provided by the software

Name: User selectable

Device Type: Must be either DPU-3 or DPU as spelled here

IP: As per each DPU-3 in the field

Port: For DPU-3, the Port should be 5000 and for the older version DPU, the Port should be 4001

Status: Real-time feedback of the connection status

Enable Must be selected to enable querying the DPU-3

Used to Edit the Name, Device IP address and Port number

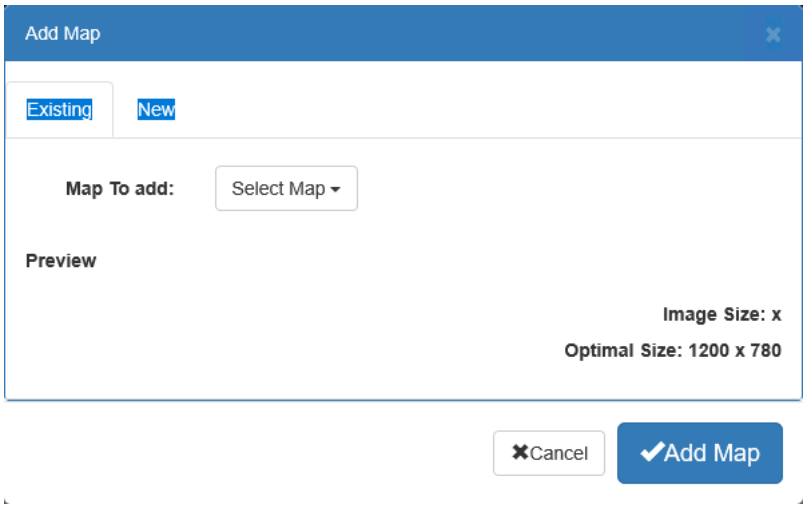
Once all the DPU-3's have been added to the list, click **Save** and **Connect All**

12.1 Adding Maps

Open your browser and type in the WebiSmarts Site :localhost:15386

Click on the Main icon

To add a Map click on the + button found on the top left hand corner of the screen.



Note the Optimal Size as defined by your display

You can select an **Existing** (in the WebiSmarts database) map or a **New** Map.

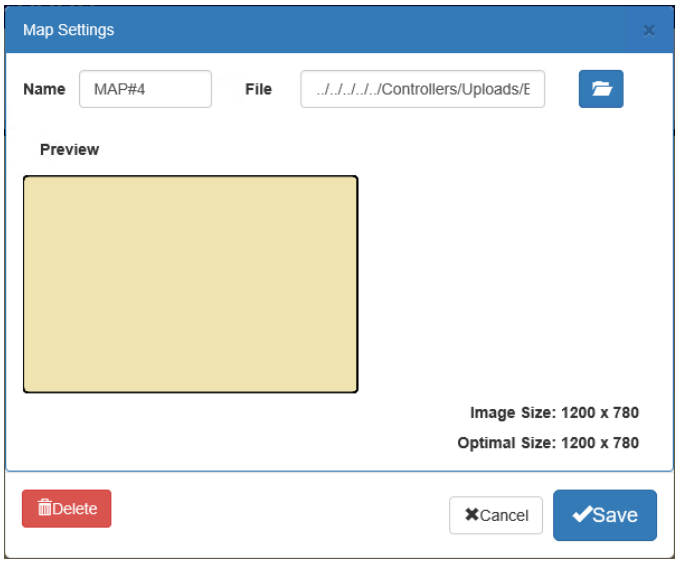
Click New and use the Access Folder icon to find the required picture.

WebiSmarts supports gif, jpg, jpeg, png, htm, html, and bmp pictures.

Create a Name for the map Icon and click ***Add Map.***

The Map will appear on the top toolbar

To delete the map icon or modify the map name or picture, click on the icon with a right click, the following screen will appear:



You can Delete the Map from the database and map icon from the screen, or modify the picture and/or modify the Name.

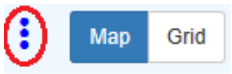
12.2 Adding Points

Some ground rules

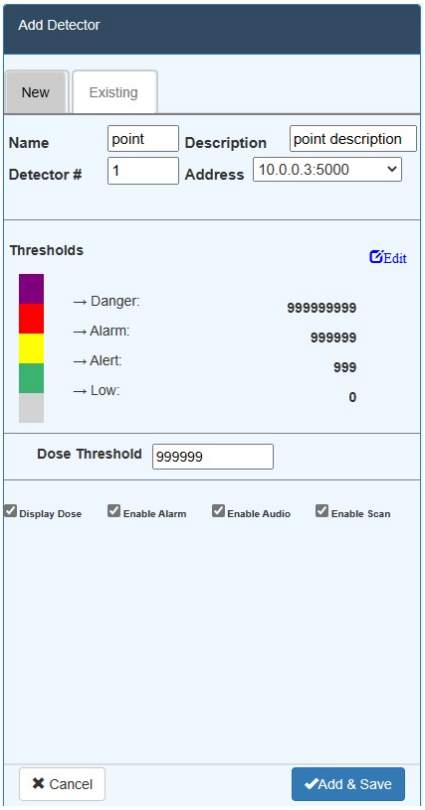
WebiSmarts will not allow you to add an existing point to the same map. If you try you will see the message in red **Point Already Exists in Map**

You can add the existing point to a new map by opening the *Existing Tab* and selecting the Point from the drop-down list

If you add a New point, with the same Detector Number and Address of the existing point, WebiSmarts will add the second point to its database and you will receive a warning that this point is already being used and continuing to use two points from the same source may cause communication problems.

To add a Point to the map, click on the Drop-Down Icon 

And select **Add Point,** the side bar will be displayed:



Select the relevant Tab (New or Existing). This means that if the Point does not yet exist in the database, select ***New*** and if the Point exists on another Map, select ***Existing.***

Assign a Name to the new Point – Name must be a single word without spaces

Assign a description if required.

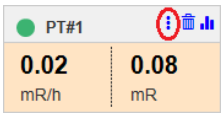
Set the Threshold levels and click Add & Save, the Point will appear on the map.

Display Dose – The accumulated dose of detectors situated in rooms may be interesting from a health and operations point of view, but for detectors mounted in the exhaust stack the accumulated dose is not interesting, use this option to unselect and clean up the display of the map.

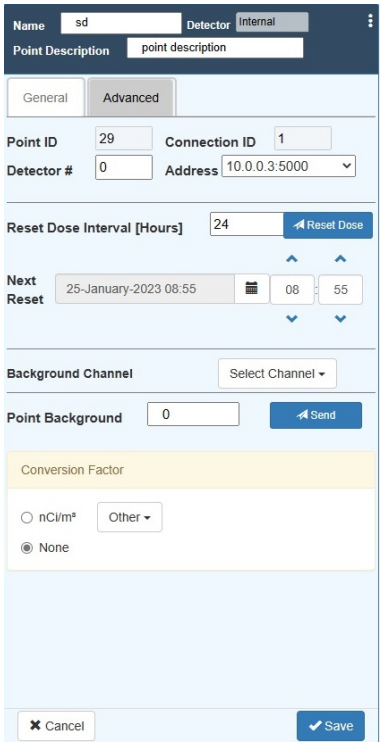
Enable Alarm – Provides a visual alarm (color) on the point in WebiSmarts and does not write to reports

Enable Audio – activates/deactivates sound upon threshold breach for each threshold and writes information to reports. In the case where more than one detector is connected to a Meter and if the user chooses to change only one detector in meter, all of the detectors will be muted because the meter has only one on/off audio control.

Enable Scan – WebiSmarts scans (queries) each DPU-3 according to the IP addresses of the points on the maps, one after the other, every customer set period. If a detector is malfunctioning and is out for service then the Enable Scan option can deselected and WebiSmarts will skip this DPU-3.

Click on the 

Settings option and in the Point Details screen, select Advanced, the following is displayed



Point ID – assigned by the system

Connection ID – Assigned by the system

Detector # – DPU-3: No of Detector (internal =0, Left =1, Middle=2, Right=3 and flowmeter/4-20mA input =4)

For the old DPU: DPU Number is set by the DIP switches

For the Coincidence Stack Monitoring system: The number of detector is set by the type of detector: PM-11 detector =0, GM-42 detector=1, Flowmeter =2 and Beta detector (5 channels): 11,12, 13, 14 and 15

Conn – DPU-3: IP address of the DPU-3:Port No (10.0.0.216:5000)

Reset Dose Interval -

and Conversion factors if the detector is part of the exhaust stack.

Click Save

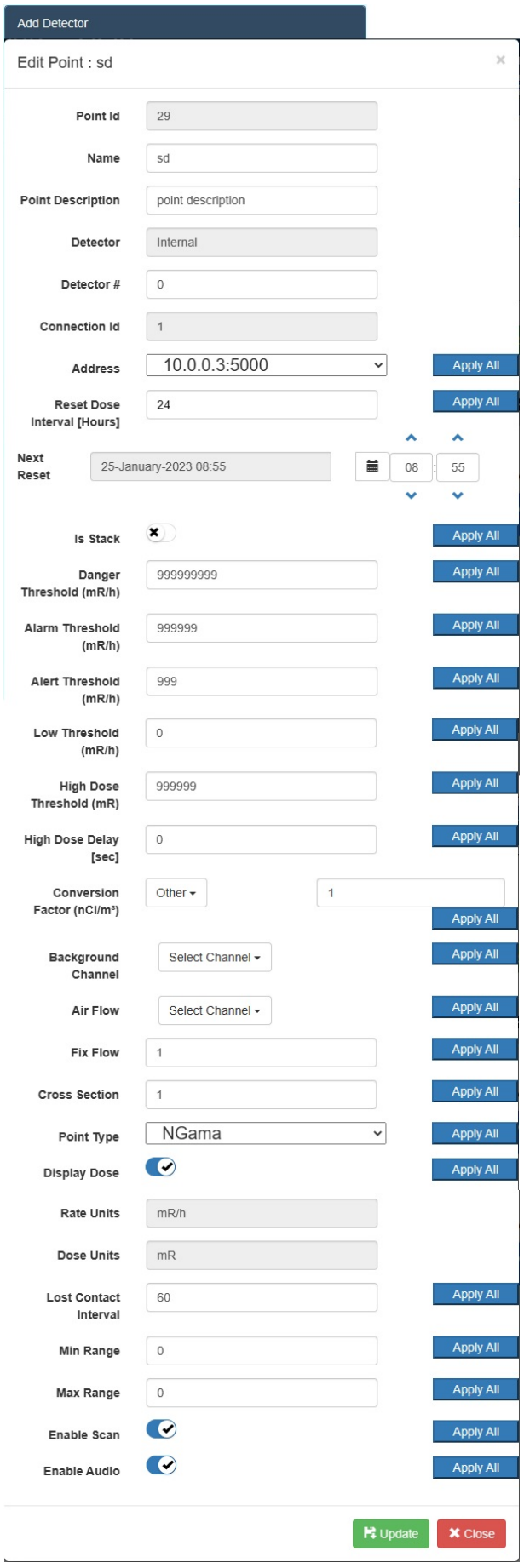
Once you have assigned an IP address to a point, the system will activate the connection and the point will appear after a few moments in the Connection Studio causing the Dose Rate and Dose fields to populate with online data in the Point on the Map.

To fine Tune the parameters of the point access the Global Settings icon as shown below

12.3 Point Details Explanation

The final table after adding a point to a map is found by clicking on the Global Settings icon 

Clicking on the Edit pencil, displays the following:


Add Detector
Edit Point : sd
Point Id
29
Name
sd
Point Description
point description
Detector
Internal
Detector #
0
Connection Id
1
Address
10.0.0.3:5000
Apply All
Reset Dose Interval [Hours]
24
Apply All
Next Reset
25-January-2023 08:55
08
55
Is Stack
Apply All
Danger Threshold (mR/h)
999999999
Apply All
Alarm Threshold (mR/h)
999999
Apply All
Alert Threshold (mR/h)
999
Apply All
Low Threshold (mR/h)
0
Apply All
High Dose Threshold (mR)
999999
Apply All
High Dose Delay [sec]
0
Apply All
Conversion Factor (nCi/m³)
Other
1
Apply All
Background Channel
Select Channel
Apply All
Air Flow
Select Channel
Apply All
Fix Flow
1
Apply All
Cross Section
1
Apply All
Point Type
NGama
Apply All
Display Dose
Apply All
Rate Units
mR/h
Dose Units
mR
Lost Contact Interval
60
Apply All
Min Range
0
Apply All
Max Range
0
Apply All
Enable Scan
Apply All
Enable Audio
Apply All
Update
Close

See Table below for explanations

Point Id	**Explanation**	**Set in the following Screen**
Name	Shown on the Point Header and Reports.	General Tab Side Bar Header
Point Description	Shown in Side Bar	
Detector	Shown in Side Bar	
Detector #	Number of the Detector in the DPU-3 from 0 (internal detector),1,2and 3 external detectors.	Advanced Tab, Side Bar
Connection ID	Unique ID number for each connection	
Address	IP address of the DPU-3	Advanced Tab, Side Bar
Reset Dose Interval (hours)	Period for every Dose reset. Before resetting the dose, the Dose is recorded into the Exposure Dose Report.	Advanced Tab, Side Bar
Next Reset	Displays Time stamp of upcoming Dose Reset	
Is Stack	Marks this detector as part of the Exhaust Stack and will appear in the Peaks review screen.	Global Settings
Danger Threshold (mR/h)	Point changes color if radiation level is above this limit	
Alarm Threshold (mR/h)	Point changes color if radiation level is above this limit	
Alert Threshold (mR/h)	Point changes color if radiation level is above this limit	
Low Threshold (mR/h)	Point changes color if radiation level is below this limit	
High Dose Threshold (mR)	Point changes color if radiation level is above this limit	

High Rate Delay (sec)	In cases where you are aware of short periods of time where the background radiation levels spike, you can delay the alerts and alarms to reduce the “nuisance” alarms	
Conversion Factor	Used for detectors in the Exhaust Stack to set the calibration factor	Advanced Tab
Background Channel	Used to define another detectors’ readings as the base line.	
Air Flow	Defines the flow meter that can be related to a detector and part of the Exhaust Stack that will appear in the Peaks review screen.	Global Settings
Fix Flow	Defines the point as a flow meter that can be related to a detector and part of the Exhaust Stack that will appear in the Peaks review screen.	Global Settings
Cross Section	Defines the cross section of the exhaust stack to allow calculation of the flow	Global Settings
Point Type	User can select between Ngamma, Air Flow, Fix Flow or 4-20mA	Global Settings
Display Dose	Display or not the Accumulated Dose. In some instances (e.g. flow rate) the accumulated amount of released air is simply not interesting and we recommend to unselect this option	Global Settings
Rate Units	Global Selection of Roentgen or Sievert units of measurement	Global Settings
Dose Units	Global Selection of Roentgen or Sievert units of measurement	Global Settings
Lost Contact Interval	Set time period before alerting	Global Settings
Min Range	Used specifically for 4-20 mA Instrument	Global Settings
Max Range	Used specifically for 4-20 mA Instrument	Global Settings
Enable Scan	Can be deselected in case the point is temporarily under service	Global Settings
Enable Audio Message	Can be used to provide Audible messages	Currently under construction

12.4 Migrating from a Previous Version

If you have a previous version of WebiSmarts (MediSmarts) installed, you can migrate its database to the new version of WebiSmarts.

Procedure:

1. In WebMed Setup, click the **Migration** tab.
2. In the “Old Version Data Folder” field, enter the path of the previous database version, or click **Browse** to locate it.
3. Click **Start**.

The database files from the old version are copied to the new version.

13 Peripherals

13.1 Using the External Signal Interface

The External Signal Interface is an Ethernet based bank of relays which are activated directly by the DPU-3’s in the laboratory. The DPU-3 is programmed using our RMVC software to activate specific relays upon User Alarm condition.

The External Signal Interface (Relay Card, Potential Free Contacts) Board provides eight-volt free contact relay outputs with a current rating of up to 16A.

The WebiSmarts system can support more than one External Signal Interface.

13.1.1 Installing the External Signal Interface.

The External Signal Interface is supplied along with a 12VDC Power Supply so the unit should be mounted close to an external power source and an Ethernet Socket.

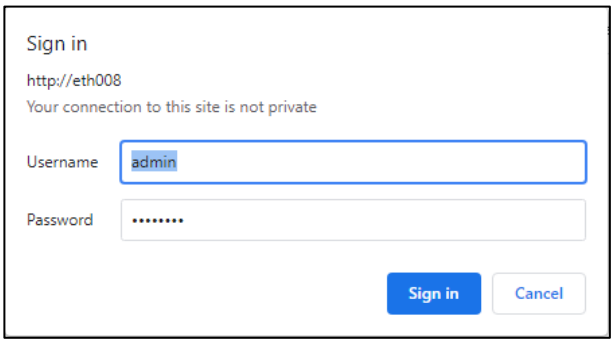
The IT department of the site should set the IP address of the External Signal Interface to be fixed.

Wires should be run from this position to the peripherals using this Interface.

13.1.1.1 Identifying the IP address of the External Signal Interface

Showing the status of the External Signal Interface

Open your browser and type http://ETH008, you will be prompted for a password as shown below:

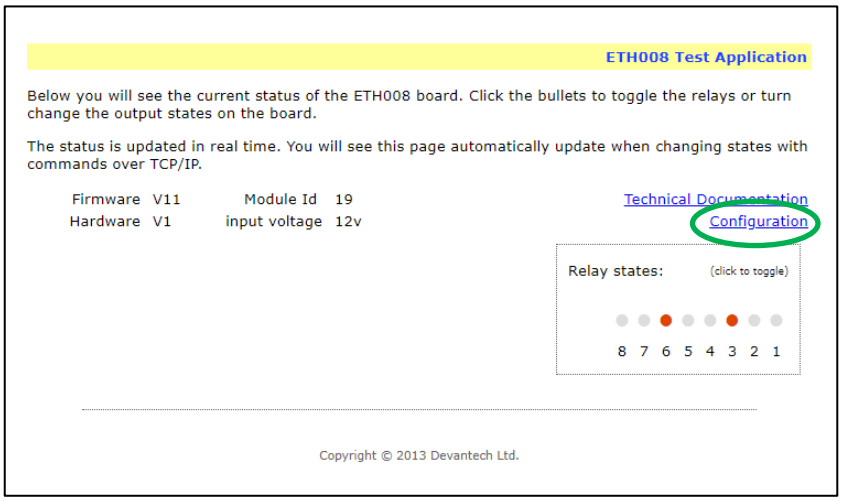


The default login is:

Username: admin

Password: password

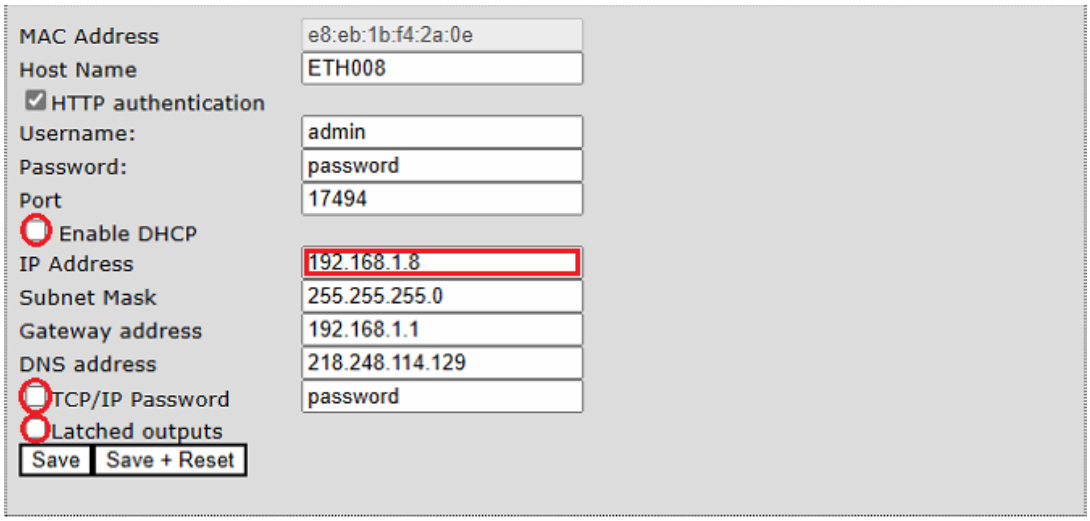
The flowing status screen appears; as you can see the two relays 3 and 6 are shown to be activated



Use the Configuration link to set up a permanent IP address

13.1.1.2 Setting a permanent IP Address

Click on the Configuration link, circled in green above, the following screen will appear:



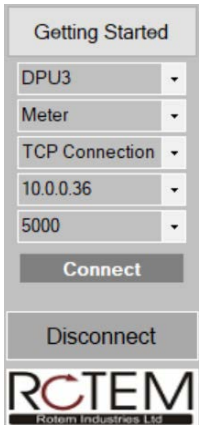
To connect to the TCP relay, it has to use static IP. Make sure the circled check boxes are unchecked. Enter the desired IP address in the circled checkbox and click **Save + Reset** to assign the new IP address to the board

13.1.1.3 Setting up the External Signal Interface

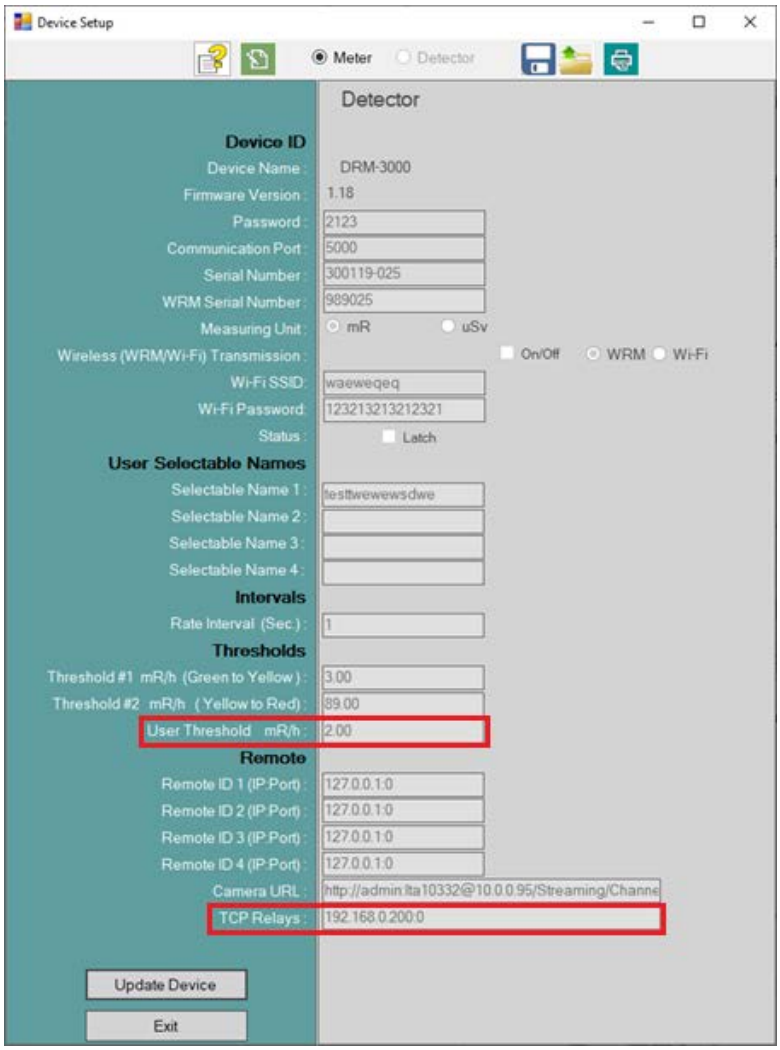
The RMVC Software (version 1.0.9.5 onwards) can be downloaded from our website at https://www.rotem-radiation.co.il/service2/rotem-meter-view-3000/

Please follow the installation instructions until the software is installed.

Select the DPU-3 Connect Details, and click Connect.



Click Device Setup, the following screen appears:



Let's assume you have identified the IP address of the External Signal Interface as 10.0.0.109 and you want to activate relay #1, then the TCP Relays content line should be updated as follows: 10.0.0.109-1

Click Update Device

From now on each time the radiation level goes above the User Threshold, relay #1 will be activated.

You can activate up to 10 separate relays by separating each command with a semi-colon ;

10.0.0.109-1;10.0.0.109-2;10.0.0.109-3 or even activate relays on other External Signal Interfaces 10.0.0.110-1;10.0.0.109-1;10.0.0.109-3

Once you have set up the DPU-3, reboot it (Power off, Power On) for the settings to take effect.

13.1.2 Installing the Light Tower

In cases where the DPU=3 is mounted inside a room and you want to have an indication of the radiation levels before entering the room, we provide an external light tower to provide a quick preview of the radiological conditions by

lighting up a green, yellow or red LED according to the **worst-case scenario** after comparing the threshold levels for each of the four detectors mounted on the DPU-3000.

The Light Tower cable configuration is as follows:

DPU-3 Auxiliary Connector	Light Tower End of Cable
13 ---White----	------White------
14---Orange---	------Orange----
15---Green-----	------Green------
16---Blue-------	-------Blue-------
17---Red--------	-------Red-------
18---Purple----	-------Purple----
21---Yellow----	-------Yellow----

We supply the Light Tower along with its cable to allow the installer to run the Auxiliary Connector cable from the position of the DPU-3 to the position of the Light Tower and then connect the same colors together after running the cable through the wall bracket.

The nuts that are used to connect the Light Tower to the Bracket are found in the Box of the Light Tower.

Mount the wall bracket in the desired position and then push the spare cable back into the wall before connecting light tower to the bracket.

Once Connected the LED's light up in the following test sequence when the DPU-3 is powered up; Green Red and then Orange and finally the buzzer is sounded.

13.1.3 Utilizing the 4-20mA Output

THE DPU-3 can provide a 4-20mA output from each of the four detectors. The DPU-3 converts the current displayed dose rate to 4-20 mA outputs on the AUX connector. Those outputs are a logarithmic function of the current displayed dose rate. The outputs are scaled by the full-scale value and low scale value.

Auxiliary(PIN Number)	4-20mA
1	4-20mA Output Det.#1
2	4-20mA Output Det.#2
3	4-20mA Output Det.#3
4	-
5	4-20mA Output Det.#Internal Det.
12	GND(-)

Output current is calculated using the following equations:

Maximum output current available - $\mathrm{I_{out\_max}} = 20\mathrm{mA}$

Minimum output current available - $\mathrm{I_{out\_min}} = 4\mathrm{mA}$

Full scale dose rate value - $F_{FSV} = 10{,}000\mathrm{R/h}$

Low scale dose rate value - $F_{LSV} = 0.1\mathrm{mR/h}$

Current displayed dose rate - F_{det}(R/h)

Current displayed dose rate, expressed in a decimal number - $\boldsymbol{F_{det\_dB}}$

$$\mathrm{F_{det\_dB}} = \log_{10}\frac{\mathrm{F_{det}}}{\mathrm{F_{LSV}}}$$

$$\mathrm{I_{out}} = \frac{\mathrm{F_{det\_dB}}}{8}\left(\mathrm{I_{out\_max}} - \mathrm{I_{out\_min}}\right) + \mathrm{I_{out\_min}}$$

For example, Assume:

$$\mathrm{F_{det}} = 100\mathrm{R/h}$$

$$\mathrm{F_{det\_dB}} = \log_{10}\frac{100\mathrm{R/h}}{0.1\mathrm{mR/h}} = \log_{10} 1{,}000{,}000 = 6$$

$$\mathrm{I_{out}} = \frac{\mathrm{F_{det\_dB}}}{8}\left(\mathrm{I_{out_{max}}} - \mathrm{I_{out_{min}}}\right) + \mathrm{I_{out_{min}}} = \frac{6}{8}(20\mathrm{mA} - 4\mathrm{mA}) + 4\mathrm{mA} = 16\mathrm{mA}$$

If the current displayed dose rate is above the full-scale value (10,000R/h), the 4-20mA output will be forced to maximum output current (20mA). If the current displayed dose rate is below the low scale value (0.1mR/h), the 4-20mA output will be forced to minimum output current (4mA).

13.1.4 Using the Advanced Detector Bracket

The Advanced Detector Bracket provides a local interface (Audio and visual) when the DPU-3is mounted in another location and not visible from the detectors' location.

The following detectors can be mounted inside the Bracket: Wide Range, GM-40, GM-41, GM-42, GM-10 and IC-10 and AMP-50, AMP-100, AMP-200 and AMP-300. Other bulkier

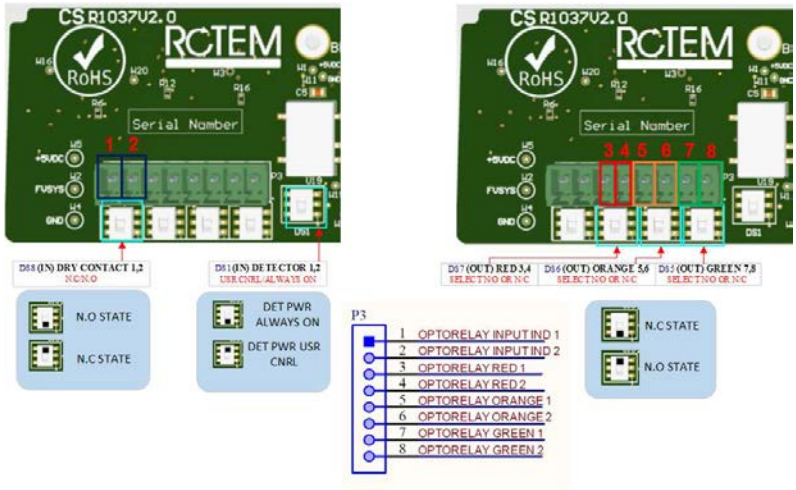
detectors can be mounted next to the Bracket with a longer interconnection cable.

The Bracket is controlled directly by the DPU-3and provides Visual feedback of the dose rate levels by lighting one of the three LED's, green yellow or red using the same threshold levels as set in the DRM-3000.

Audio feedback is provided by a volume adjustable buzzer on the bottom of the bracket. Each time a threshold level is breached the buzzer will sound to alert users nearby. Users can mute the buzzer by pressing on the LED cover until the next threshold is breached.

If the buzzer is not required then the red button situated on the underside can be pushed to permanently mute the buzzer and in this case the button will light up to indicate to users that no audible alarm will be issued.

The Bracket also contains a bank of optocoupler relays for each threshold level (3,4 5,6 7,8) that can be used to interface with external controllers. It also contains a single input channel (1,2) that can be connected to an accelerator controller and in the case of BEAM ON, power is cut to the detector (User Controlled) and restored when the Beam is turned off. This is useful for prolonging GM Tube Life Time



14 Post Installation Procedures

14.1 Checklist and Acceptance Test

When you have installed all of the WebiSmarts components, check off the items on the Installation Checklist (section Appendix A) and in the Acceptance Test (section Appendix C).

For some of the items you might need to refer to the WebiSmarts User Guide.

14.2 Using WebiSmarts

To use WebiSmarts you will need to create a map of the areas you are monitoring and add points to it at the locations where you installed the DPU-3s.

For instructions on uploading the map into WebiSmarts and creating points, see the WebiSmarts User Guide.

14.3 Setting up the Coincidence System

See Section 5.2 Setting up the Coincidence System

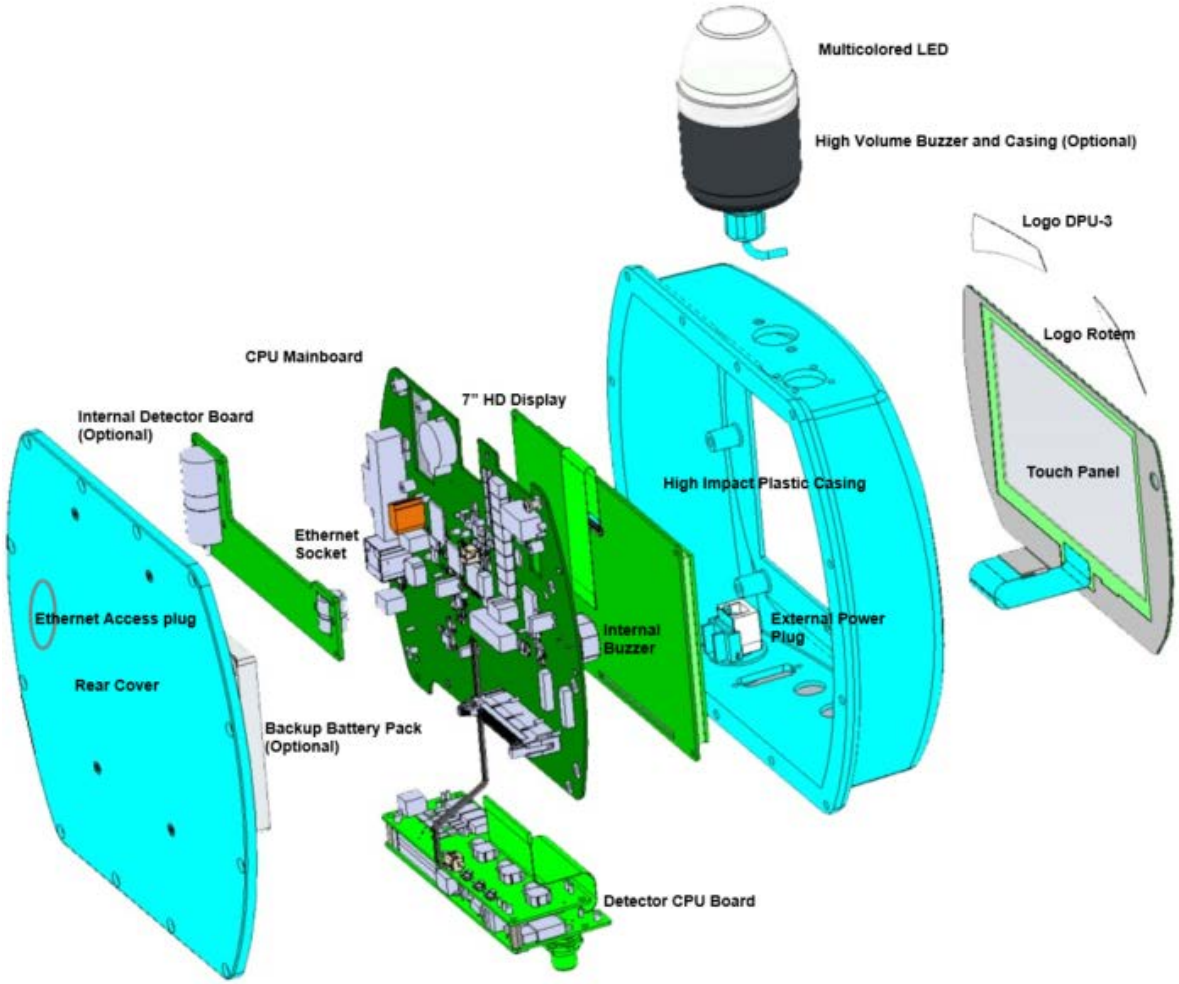
Appendix A Installation Checklist

Use the following checklist to make sure that your facility is prepared for installation day:

Tasks	Done?	Notes
Required positions of the DPU-3 s and detectors are determined	☐	
Map of the facility with positions of the DPU-3 s and detectors clearly marked sent to Rotem	☐	
Ethernet cables are laid out	☐	
Site prepared for the server	☐	
Type of server, detectors, flowmeters, and other equipment sent to Rotem	☐	
List of switches used for WebiSmarts sent to Rotem	☐	
Domain details, such as DNS addresses and Subnet Masks sent to Rotem	☐	
Range of IP addresses that can be used for WebiSmarts sent to Rotem	☐	
For MediSmarts users: Archive files for last two years sent to Rotem	☐	
WebiSmarts components received from Rotem	☐	
DPU-3 s, detectors, and exhaust stack brackets are mounted	☐	
Ethernet cables are connected to the switch (hub)	☐	
Facility is ready for installation day	☐	
Appropriate personnel are available on installation day	☐	

Appendix B Drawings

B.1 DPU-3 Components



14.3.1.1.1 Cable Assy DPU-3 to external Detector

DPU-3	Color	DETECTOR
1	BROWN	4
2	BLUE	1
3	WHITE	-
4	GREEN	3
5	PINK	2
6	YELLOW	5
7	BLACK	-
8	GRAY	-

DPU-3	Color	DETECTOR
9	RED	6
10	PURPLE	7
11	GRAY/PINK	8
12	RED/BLUE	-
13	WHITE/GREEN	1
14	BROWN/GREEN	1
15	WHITE/YELLOW	1
16	YELLOW/BROWN	-
17	WHITE/GRAY	-

Appendix C Acceptance Test

After installing the system, work through this acceptance test to ensure that everything is working and that all requirements are met.

Date: _____Site: _____Order: _____

C.1 System Checklist

Check off the following items when you have verified that they have been properly installed.

	Done?	Description
1.	☐	DPU-3 Meters
2.	☐	DPU-3 Internal Detector
3.	☐	DPU-3 Wall Bracket
4.	☐	DPU-3 Mounting button screws to Wall Bracket
5.	☐	DPU-3 Ethernet Cable DPU-3 to wall connection
6.	☐	DPU-3 Cables to Detectors
7.	☐	GM-42 Detector
8.	☐	GM-41 Detector
9.	☐	PM-11M Detector
10.	☐	Flow meter: 0 – 15 m/sec
11.	☐	Other Detectors
12.	☐	Calibration Certificates for all Detectors
13.	☐	Detector Brackets
14.	☐	Power supply: 15V Volt for every flowmeter supplied
15.	☐	PM-11 Weatherproof Bracket
16.	☐	GM-42 Weatherproof Bracket
17.	☐	User Manuals for WebiSmarts

C.2 Computer installation

Check off the following items when you have verified that they have been properly installed.

	Done?	Description
1.	☐	Server with Partitions: C: WebiSmarts , D: Old MediSmarts
2.	☐	WIN-10 Installed
3.	☐	SQL Installed – For more than 10 detectors SQL license required
4.	☐	WebiSmarts Installed
5.	☐	RMVC Installed
6.	☐	TeamViewer Installed
7.	☐	Maps Included
8.	☐	Points Included
9.	☐	Check Audio, Video, Net.
10.	☐	Set time zone

C.3 WebiSmarts Setup

Check off the following items when you have verified that they have been properly installed.

> **Note**
>
> Some of these items require you to refer to the WebiSmarts User Guide.

	Done?	Description
1.	☐	Create Users Passwords
2.	☐	Set Communication Ports
3.	☐	Create a map
4.	☐	Edit Points
5.	☐	Enable audio alarms
6.	☐	Set Units Metric/Imperial

7.	☐	Set Units Ci/Bq
8.	☐	Set Thresholds
9.	☐	Set Zero Background
10.	☐	Fine Tune Coincidence factors
11.	☐	For DPU-3 with flow meter, set 4-20 mA boundaries

C.4 Factory Acceptance Test

Radioactive source for testing: _____

Units: uSv/h or mR/h

Copy the following table to Excel and populate it.

	DPU Number	1	2	3	4	5	6	7	8	9
1.	MAC Address									
2.	DPU IP Address									
3.	Detector type									
4.	Alarm Threshold value									
5.	Reading without source									
6.	Reading with source									
7.	Setting threshold to the DPU									
8.	Activating Rest Dose on the DPU									
9.	Lost contact test (set 15 sec for the test)									
10.	Detector Fail test.									
11.	Test Alert Report									
12.	Test Log									

Authorized By:

Date: _____

Place: _____

Name: _____

Appendix D Applying the efficiency factors

During the production of isotopes for medical imaging applications, airborne effluent releases occur. ROTEM designed a new PM11 detector to monitor these effluents within the stack effluent stream.

Rotem authorized RSCS (https://www.radsafety.com) to create, using Los Alamos National Laboratories' (LANL) transport code Monte-Carlo N-Particle V6.2 (MCNP6), to determine nuclide specific efficiency factors for the remodeled PM11 detector system mounted in stacks of various shapes and sizes. The new detector contains a 2x2 NaI with three energy windows and a plastic scintillator with one window.

RSCS calculated efficiency factors for 12 isotopes. Table 1 presents the isotopes included in the study and the detector used to quantify the activity of each of these isotopes in the stacks.

Table 1: isotopes included in the study and corresponding detectors

Detector	Nuclide
NaI Energy Window 1 (390 – 730 keV)	F-18, Ga-68, O-15, C-11, N-13
NaI Energy Window 2 (300 – 420 keV)	I-131
NaI Energy Window 3 (40 – 240 keV)	Tc-99m, Ga-67, Tl-201, I-123
Plastic Scintillator	I-125, Lu-177

Revision 01 of this report is issued to add I-123 to the list of isotopes included in the study.

D.1 Summary of previous study

In 2008, RSCS used MCNP5 to model the response of the PM11 detector during the release of PET isotopes for different stack geometries. The results of the MCNP calculations were documented in RSCS TSD 08-009 (Reference 1). The report provided an efficiency in cps/nCi for each stack geometry.

Table 2: Efficiencies for the PM11 detector calculated by RSCS in 2008

Stack Index	Ratio of Width to Depth	Diameter (cm)	Width (cm)	Depth (cm)	Cross Section (cm2)	Photopeak Efficiency: 437-590 keV (cps/nCi)
1	1:1	N/A	26.60	26.60	7.08E+02	8.49E-02
2	3:2	N/A	32.48	21.76	7.07E+02	8.97E-02
3	2:1	N/A	37.60	18.80	7.07E+02	8.68E-02
4	Circular	30	N/A	N/A	7.07E+02	8.76E-02
5	1:1	N/A	39.88	39.88	1.59E+03	6.25E-02
6	3:2	N/A	48.72	32.64	1.59E+03	6.04E-02
7	2:1	N/A	56.40	28.20	1.59E+03	5.83E-02
8	Circular	45	N/A	N/A	1.59E+03	6.21E-02
9	1:1	N/A	53.17	53.17	2.83E+03	4.70E-02
10	3:2	N/A	64.96	43.52	2.83E+03	4.47E-02
11	2:1	N/A	75.20	37.60	2.83E+03	4.25E-02
12	Circular	60	N/A	N/A	2.83E+03	4.57E-02

D.2 MCNP calculations and assumptions

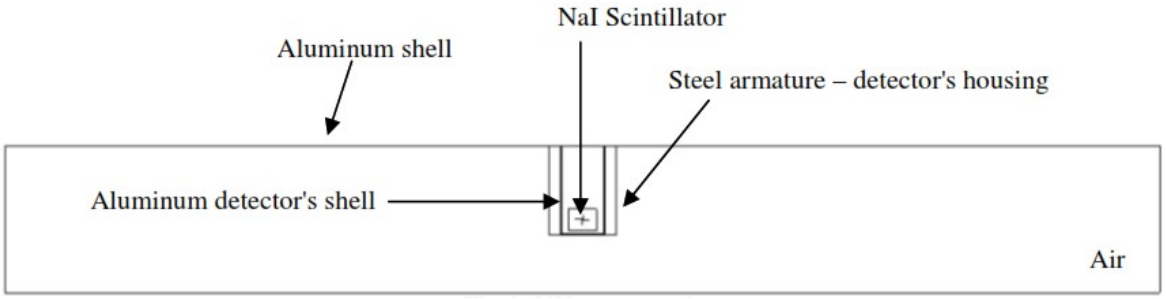
D.2.1 Model

An example of MCNP input deck for the combination F-18 / Geometry #1 is provided in Attachment B.

D.2.2 Geometry

The MCNP geometries for the calculations were created using drawings and dimensions provided by ROTEM (Appendix A). The PM-11 detector is placed in a steel housing positioned at the center of a 2-meter section of stack.

Figure 1: Position of the PM-11 detector along the stack (figure provided by ROTEM)



Descriptions of the MCNP geometry are provided on Figure 2 through Figure 4.

Figure 2: PM11 detector in a rectangular stack (36 x 36 cm) – XY projection

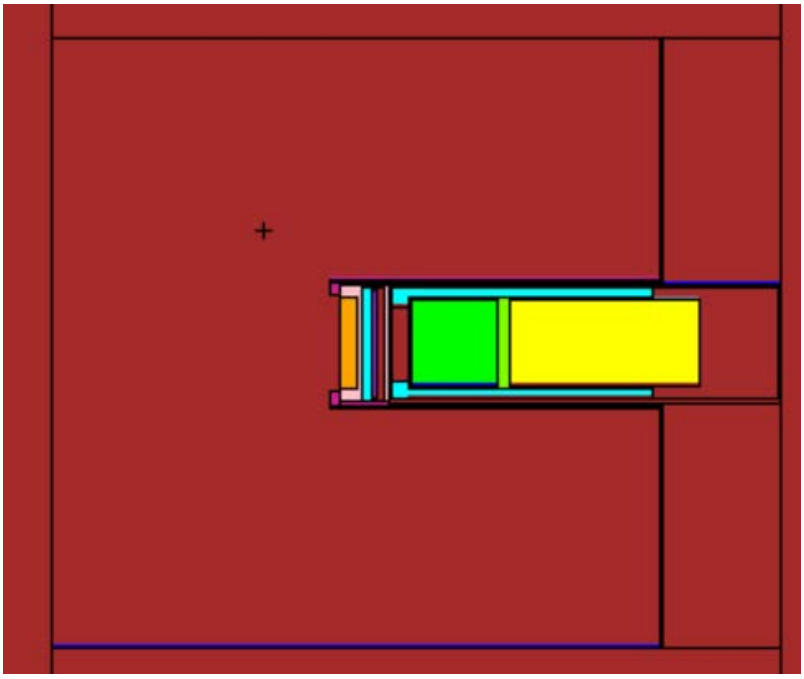


Figure 3: PM11 detector in a rectangular stack (36 x 36 cm) – YZ projection

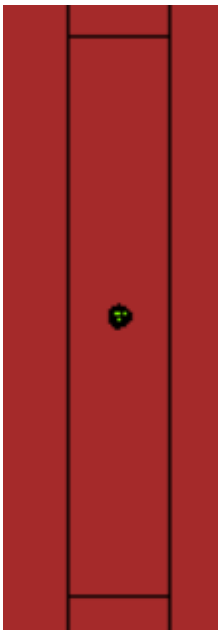
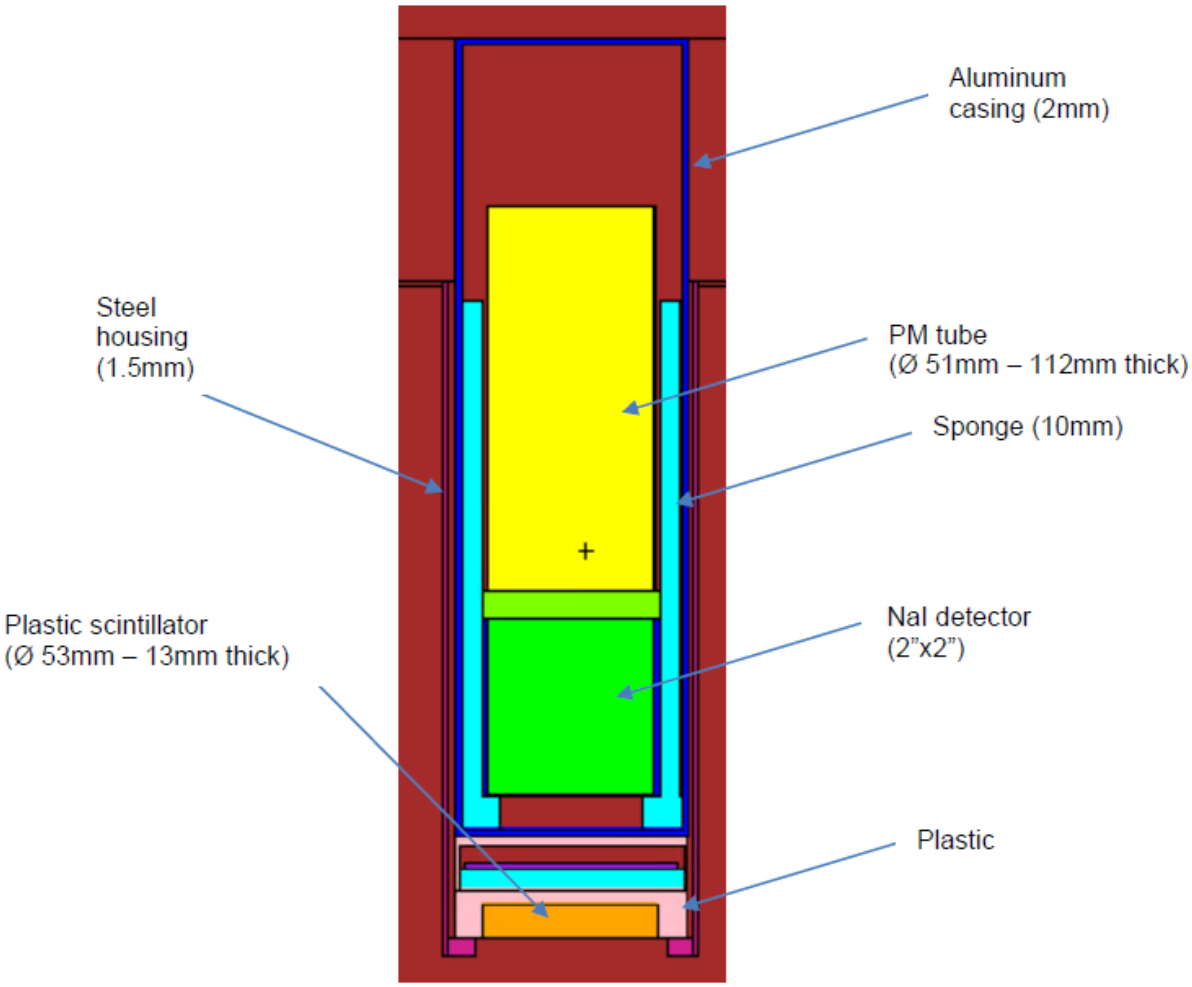


Figure 4: PM11 detector – ZX projection



D.2.3 Stacks

Table 3 lists the 10 stack geometries used for the calculations.

Table 3: Stack geometries used for the calculations.

Geometry #	Shape	Dimensions (cm)	Cross section area (m2)	Volume (m3)
1	Square	36 x 36	0.130	0.259
2	Square	41 x 41	0.168	0.336
3	Square	46 x 46	0.212	0.423
4	Circular	Ø 30	0.071	0.141
5	Circular	Ø 40	0.126	0.251
6	Circular	Ø 50	0.196	0.393
7	Rectangular	50 x 70	0.350	0.700
8	Circular	Ø 25	0.049	0.098
9	Circular	Ø 60	0.283	0.565
10	Square	50 x 50	0.250	0.500

D.2.4 Material

Pipe materials were defined in MCNP using parameters provided in "Compendium of Material Composition Data for Radiation Transport Modeling, Report number PNNL- 15870 Rev1" (Reference 3)

Table 4: Material composition

Material	Element	Composition (%)
Aluminum	Al	100
Co-Netic Type AA	Ni	80
	Mo	4
	Fe	16
Dry Air	C	0.012
	N	76
	O	23
	Ar	1.3
NaI	Na	15.3
	I	84.7
Netic Type S3-6	Fe	100

Material	Element	Composition (%)
Polyethylene	H	14
	C	86
PMT Composite 80% Pyrex Glass, 20% SS304 by Mass	O	37
	Na	8
	Si	27
	Ca	9
	Fe	14
	Cr	4
	Ni	2
	Mg	0.4
Stainless 304L	C	0.03
	Mn	2
	P	0.045
	S	0.03
	Si	0.75
	Cr	18
	Ni	8
	N	0.1
	Fe	71.045
Sponge Poron	Al	10
	O	40
	H	49
	Si	0.2
	C	0.3
Plastic scintillator	H	8.5
	C	91.5
PVC	H	8.5
	C	91.5
PC board fiberglass Type R	O	48.7
	Mg	3.6
	Al	13.2
	Si	28.1
	Ca	6.4

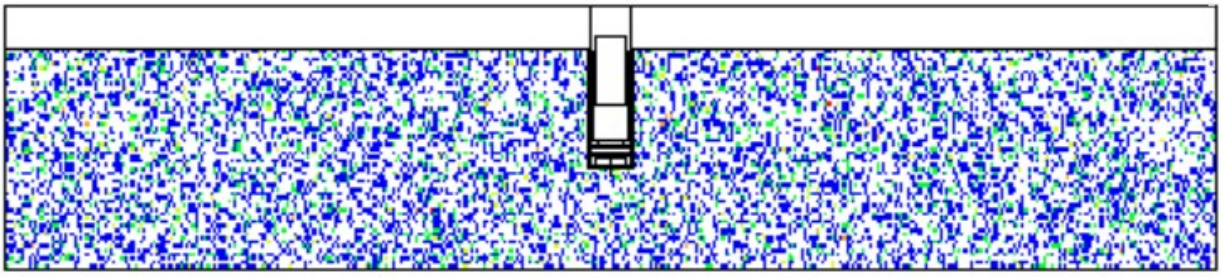
Material	Element	Composition (%)
Mylar	H	4.2
	C	62.5
	O	3.3
Borosilicate glass (pyrex)	B	4
	O	54
	Na	2.8
	Al	1.2
	Si	38
	K	0.3

D.2.5 Source

D.2.5.1 Distribution

The source is assumed to be homogeneously distributed over a two-meter section of stack. The number of particles generated for the calculations was adjusted to pass all the 10 MCNP statistical checks for each isotope / stack configurations (1e7 particles for positron emitters, 2e7 particles for beta emitters and 4e7 to 6e7 particles for gamma emitters).

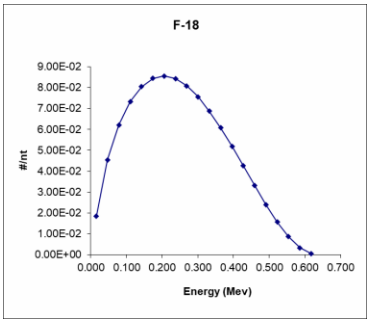
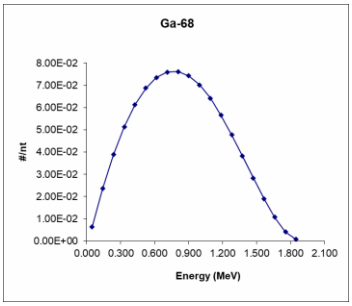
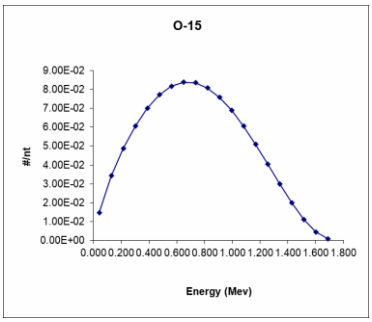
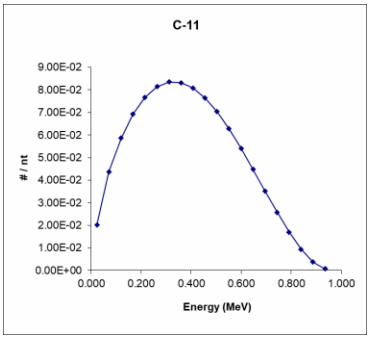
Figure 5: Source distribution – ZX projection

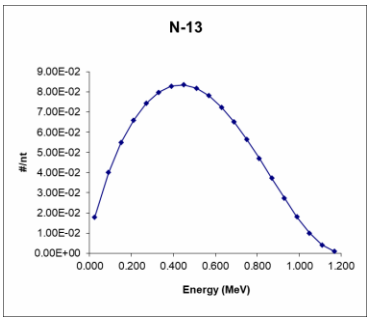


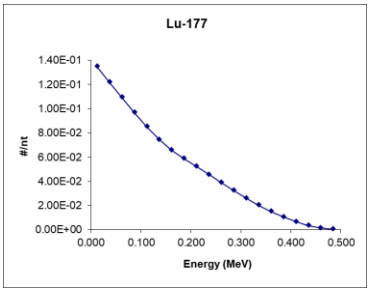
D.2.5.2 Isotopes

Table 5 provides a list of isotopes used for the MCNP calculations. Data for positron and beta emitters were taken from Reference 4 and data for gamma emitters were taken from Reference 5. The previous study modelled a 511KeV photon source as a surrogate for annihilation events. MCNP v6.2 can perform this function directly using positron emissions.

Table 5: Nuclear Decay data for isotopes used in the calculations.

Isotope	Particle used for the MCNP source	Particle Yield	Spectrum
F-18	e^+	96.8%	
Ga-68	e^+	100%	
O-15	e^+	100%	
C-11	e^+	100%	

<table>
<tr><th>Isotope</th><th>Particle used for the MCNP source</th><th>Particle Yield</th><th>Spectrum</th></tr>
<tr><td>N-13</td><td>e^+</td><td>100%</td><td> 
</td></tr>
<tr><td>I-131</td><td>p</td><td>100%</td><td><table><tr><th>Energy (keV)</th><th>Intensity (%)</th></tr><tr><td>364.5</td><td>81.2</td></tr><tr><td>637.0</td><td>7.1</td></tr><tr><td>284.3</td><td>6.1</td></tr><tr><td>29.8</td><td>2.8</td></tr><tr><td>80.3</td><td>2.6</td></tr><tr><td>722.9</td><td>1.8</td></tr><tr><td>29.4</td><td>1.5</td></tr></table></td></tr>
<tr><td>Tc-99m</td><td>p</td><td>100%</td><td><table><tr><th>Energy (keV)</th><th>Intensity (%)</th></tr><tr><td>140.5</td><td>88.5</td></tr><tr><td>18.4</td><td>4.2</td></tr><tr><td>18.3</td><td>2.2</td></tr><tr><td>20.7</td><td>1.1</td></tr></table></td></tr>
<tr><td>Ga-67</td><td>p</td><td>100%</td><td><table><tr><th>Energy (keV)</th><th>Intensity (%)</th></tr><tr><td>93.3</td><td>38.1</td></tr><tr><td>8.6</td><td>33.0</td></tr><tr><td>184.6</td><td>21.0</td></tr><tr><td>8.6</td><td>17.0</td></tr><tr><td>300.3</td><td>16.6</td></tr><tr><td>9.6</td><td>7.1</td></tr><tr><td>393.5</td><td>4.6</td></tr><tr><td>91.2</td><td>3.1</td></tr><tr><td>208.9</td><td>2.4</td></tr><tr><td>1.03</td><td>1.8</td></tr></table></td></tr>
<tr><td>Tl-201</td><td>p</td><td>100%</td><td><table><tr><th>Energy (keV)</th><th>Intensity (%)</th></tr><tr><td>70.8</td><td>46.4</td></tr><tr><td>11.8</td><td>42.7</td></tr><tr><td>68.9</td><td>27.3</td></tr><tr><td>80.3</td><td>15.7</td></tr><tr><td>167.5</td><td>10.0</td></tr><tr><td>82.7</td><td>4.6</td></tr><tr><td>135.3</td><td>2.6</td></tr></table></td></tr>
<tr><td>I-123</td><td>p</td><td>100%</td><td><table><tr><th>Energy (keV)</th><th>Intensity (%)</th></tr><tr><td>159.0</td><td>83.3</td></tr><tr><td>27.5</td><td>46.0</td></tr><tr><td>27.2</td><td>24.7</td></tr><tr><td>31.1</td><td>13.2</td></tr><tr><td>4.1</td><td>9.0</td></tr><tr><td>31.8</td><td>2.9</td></tr><tr><td>529.0</td><td>1.3</td></tr></table></td></tr>
</table>

<table>
<tr><th>Isotope</th><th>Particle used for the MCNP source</th><th>Particle Yield</th><th>Spectrum</th></tr>
<tr><td>I-125</td><td>p</td><td>100%</td><td>
<table>
<tr><th>Energy (keV)</th><th>Intensity (%)</th></tr>
<tr><td>27.5</td><td>73.2</td></tr>
<tr><td>27.2</td><td>39.3</td></tr>
<tr><td>31.1</td><td>20.9</td></tr>
<tr><td>4.1</td><td>14.7</td></tr>
<tr><td>35.5</td><td>6.6</td></tr>
<tr><td>31.8</td><td>4.5</td></tr>
</table>
</td></tr>
<tr><td>Lu-177</td><td>e^-</td><td>100%</td><td> 
</td></tr>
</table>

D.2.6 Detector

The MCNP F8 tally was used to tally the energy deposited in the detectors. For the NaI detector, the deposited energy was tallied in 1keV discrete energy widows and the MCNP GEB card was used to approximate characteristics of a NaI detector coupled with a photomultiplier tube with a resolution of 10% (Reference 1).

For the plastic scintillation detector, the F8 tally was used to tally the total energy deposited in the detector.

The MCNP tally cards used for the calculations are shown below:

NaI detector

f8:p 13

e8 0 1e-5 1e-3 798I 0.8

ft8 GEB -.02429 .0697159 2.05748

Plastic scintillator detector

f8:e 5

Note: for pulse-height tallies photons/electrons, F8:P,E is the same as F8:P and F8:E.

D.2.7 Results

For each isotope / stack configuration, the MCNP output provides a count efficiency per source particle generated. The detector efficiency is then calculated using the following equation:

Equation 1

$$E = \frac{1}{37 \times y \times cnts \times V}$$

With:

E: detector efficiency in nCi/cps*m3

37: conversion particle to nCi

y: particle yield

cnts: count efficiency per source particle generated (MCNP output for detector or energy window)

V: stack volume in m3

Sections 4.1 to 4.12 provide for each isotope included in the study:

- ✓ The detector and energy window used to quantify the isotope in the stacks.
- ✓ An energy spectrum for Geometry #1 (only for the NaI detector).
- ✓ A table presenting the detector efficiencies for the 10 stack geometries.
- ✓ A chart representing the detector efficiency as a function of the stack cross sections for rectangular and circular stacks.

D.3 Fluorine-18

Detector: NaI - Energy window #1 390 – 730 keV

Figure 6: F-18 energy spectrum for Geometry #1

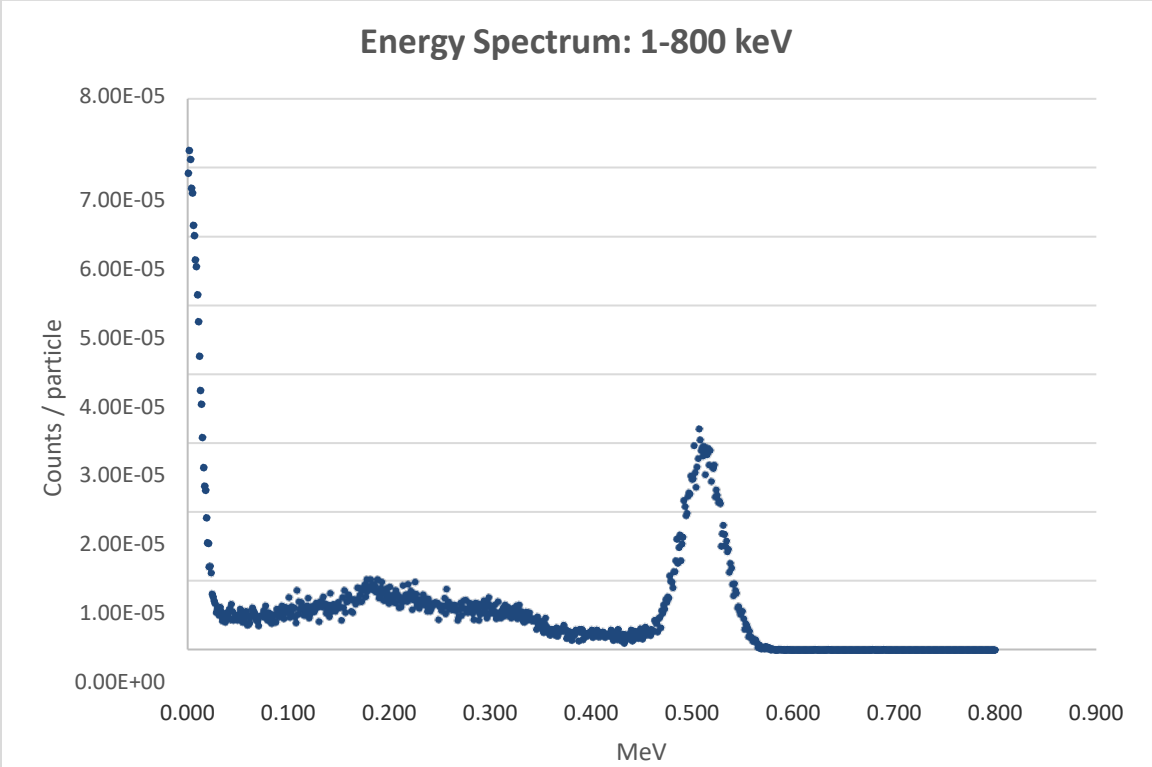
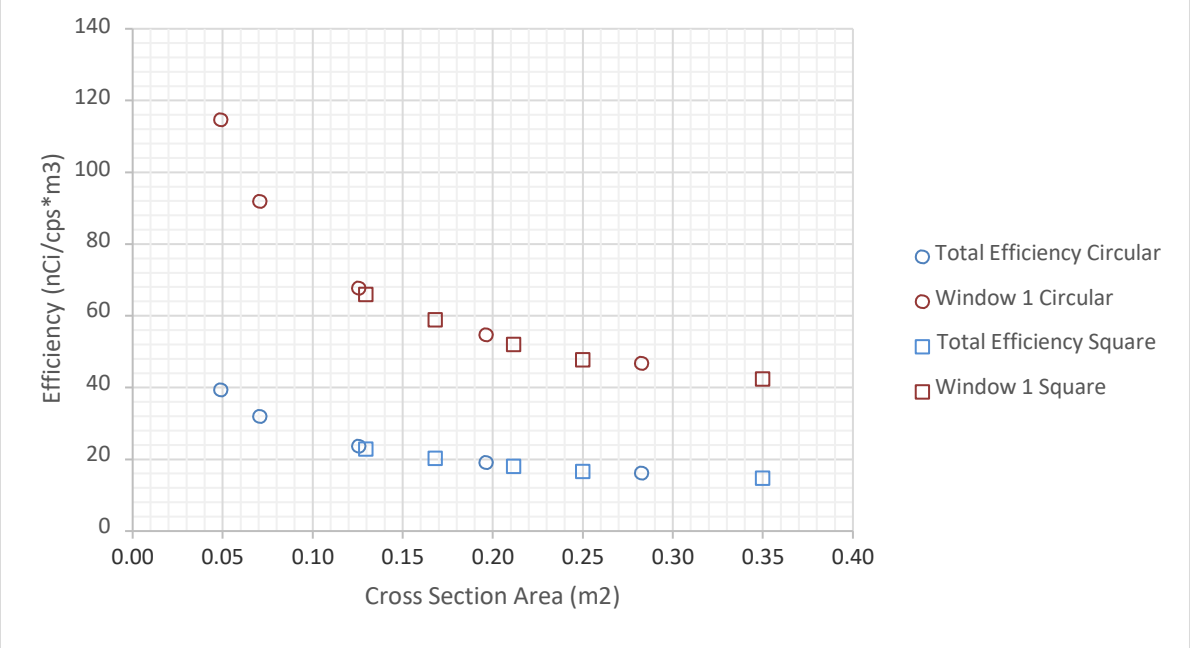


Table 6: PM11 efficiencies for F-18

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 1 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	22.78	65.92	0.77%
2	41 x 41	0.168	0.336	20.21	58.83	0.55%
3	46 x 46	0.212	0.423	18.03	51.96	0.76%
4	Ø 30	0.071	0.141	31.94	91.84	0.76%
5	Ø 40	0.126	0.251	23.65	67.71	0.76%
6	Ø 50	0.196	0.393	19.04	54.70	0.77%
7	50 x 70	0.350	0.700	14.66	42.37	0.76%
8	Ø 25	0.049	0.098	39.29	114.64	0.77%
9	Ø 60	0.283	0.565	16.14	46.72	0.76%
10	50 x 50	0.250	0.500	16.61	47.74	0.76%

Figure 7: F-18 detector efficiencies as functions of stalks cross sections



D.4 Carbon-11

Detector: NaI - Energy window #1 390 – 730 keV

Figure 8: C-11 energy spectrum for Geometry #1

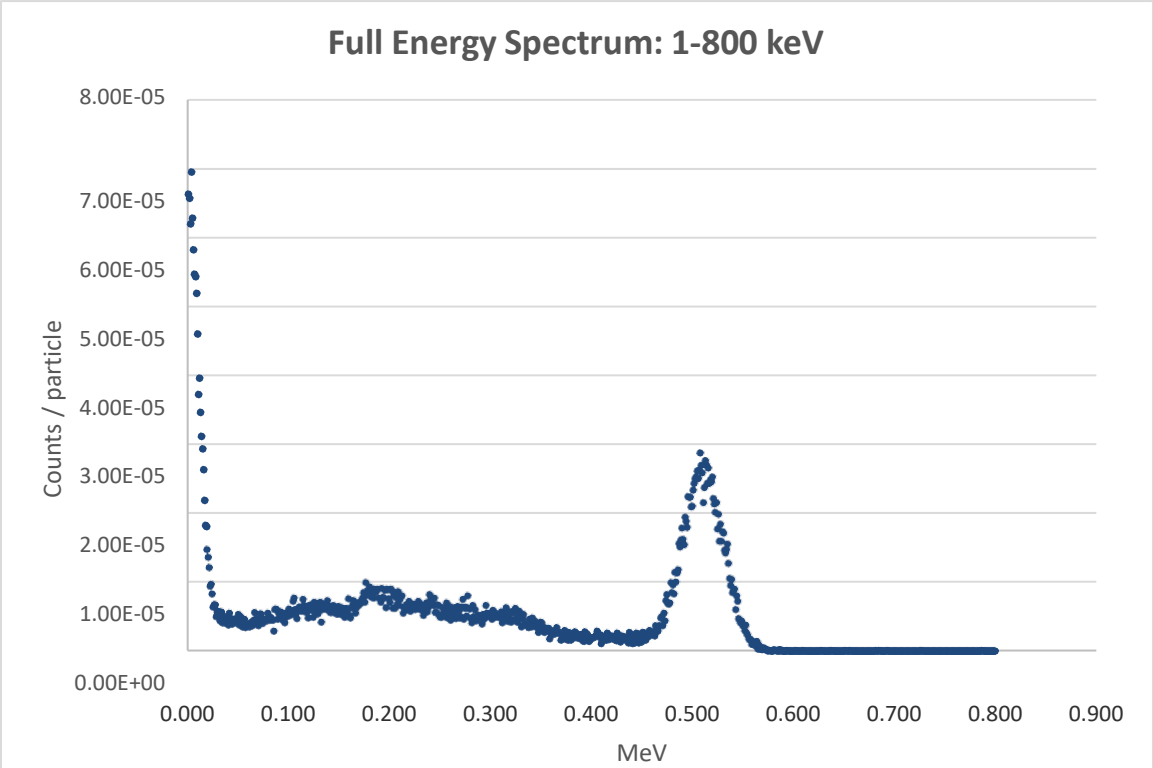
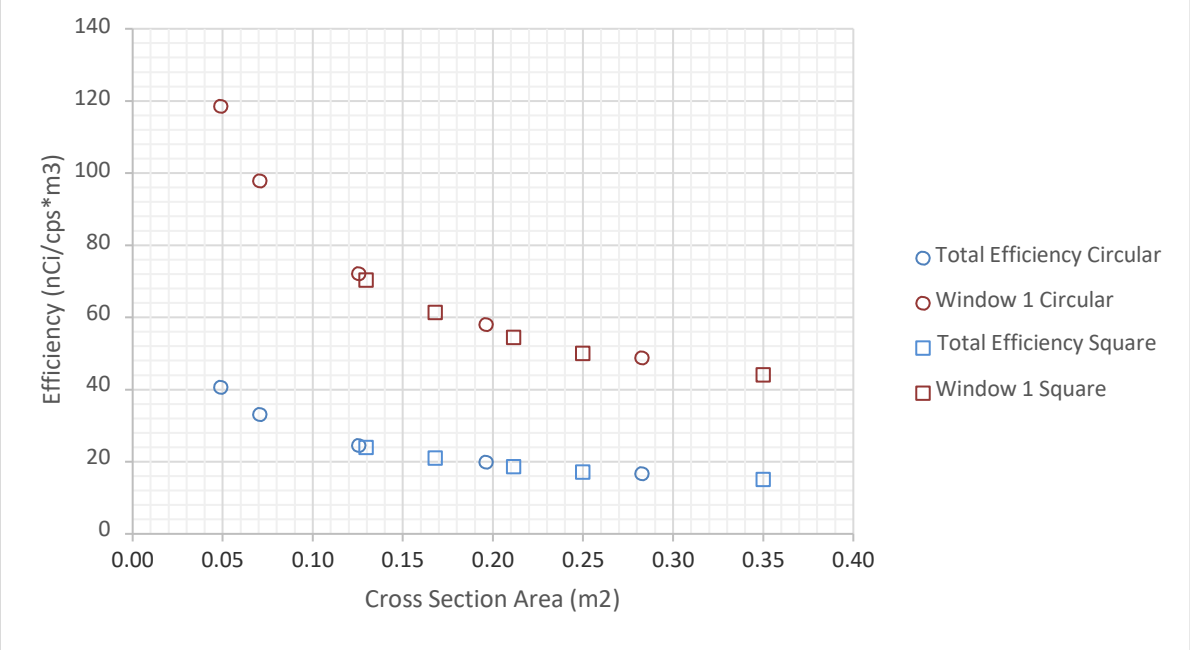


Table 7: PM11 efficiencies for C-11

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 1 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	23.88	70.28	0.77%
2	41 x 41	0.168	0.336	20.95	61.33	0.77%
3	46 x 46	0.212	0.423	18.57	54.39	0.77%
4	Ø 30	0.071	0.141	33.08	97.84	0.77%
5	Ø 40	0.126	0.251	24.48	72.08	0.77%
6	Ø 50	0.196	0.393	19.80	57.99	0.55%
7	50 x 70	0.350	0.700	15.08	44.06	0.76%
8	Ø 25	0.049	0.098	40.56	118.51	0.77%
9	Ø 60	0.283	0.565	16.63	48.78	0.76%
10	50 x 50	0.250	0.500	17.11	49.99	0.77%

Figure 9: C-11 detector efficiencies as functions of stalks cross sections



D.5 Gallium-68

Detector: NaI - Energy window #1 390 – 730 keV

Figure 10: Ga-68 energy spectrum for Geometry #1

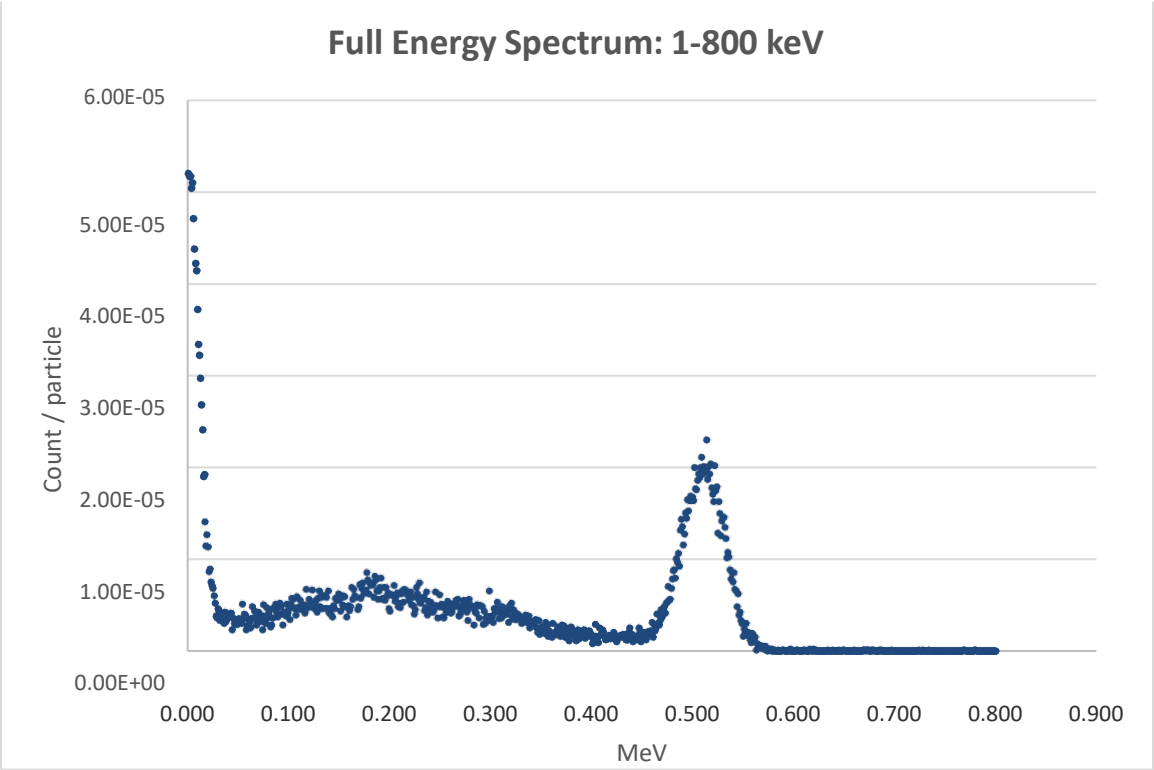
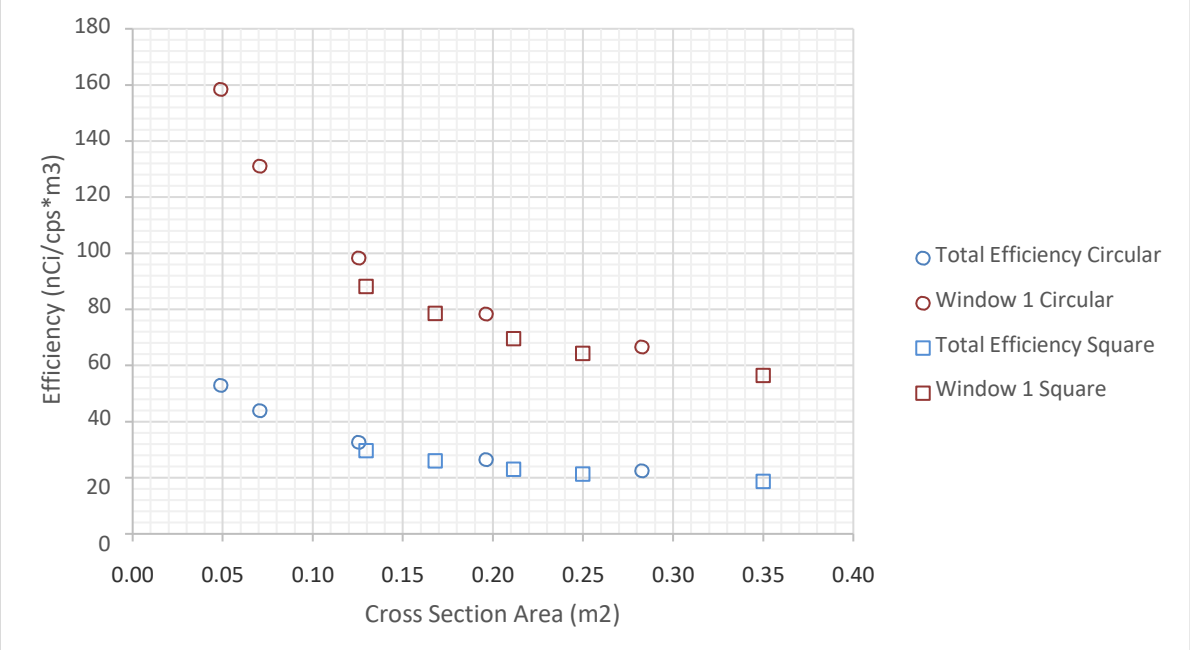


Table 8: PM11 efficiencies for Ga-68

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 1 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	29.57	88.05	0.78%
2	41 x 41	0.168	0.336	25.92	78.48	0.78%
3	46 x 46	0.212	0.423	23.04	69.57	0.78%
4	Ø 30	0.071	0.141	43.81	130.95	0.79%
5	Ø 40	0.126	0.251	32.58	98.25	0.79%
6	Ø 50	0.196	0.393	26.45	78.33	0.78%
7	50 x 70	0.350	0.700	18.65	56.36	0.77%
8	Ø 25	0.049	0.098	52.83	158.32	0.79%
9	Ø 60	0.283	0.565	22.42	66.56	0.78%
10	50 x 50	0.250	0.500	21.22	64.27	0.77%

Figure 11: Ga-68 detector efficiencies as functions of stalks cross sections



D.6 Oxygen-15

Detector: NaI - Energy window #1 390 – 730 keV

Figure 12: O-15 energy spectrum for Geometry #1

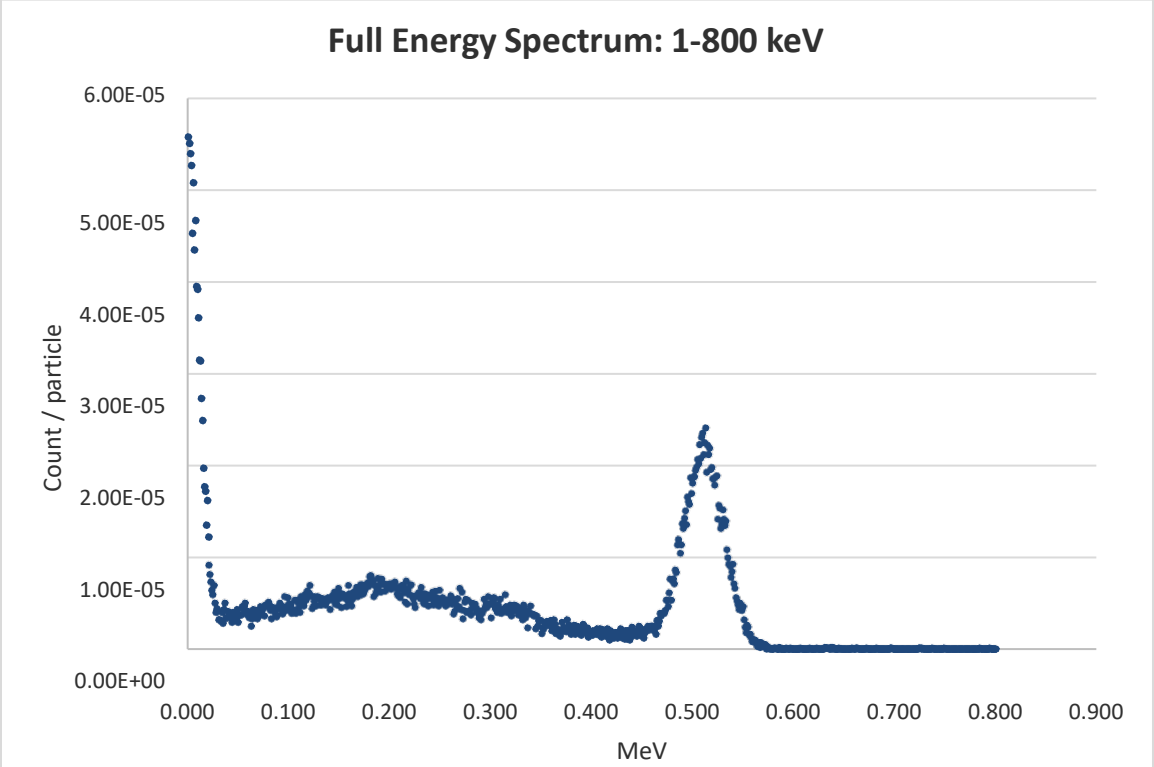
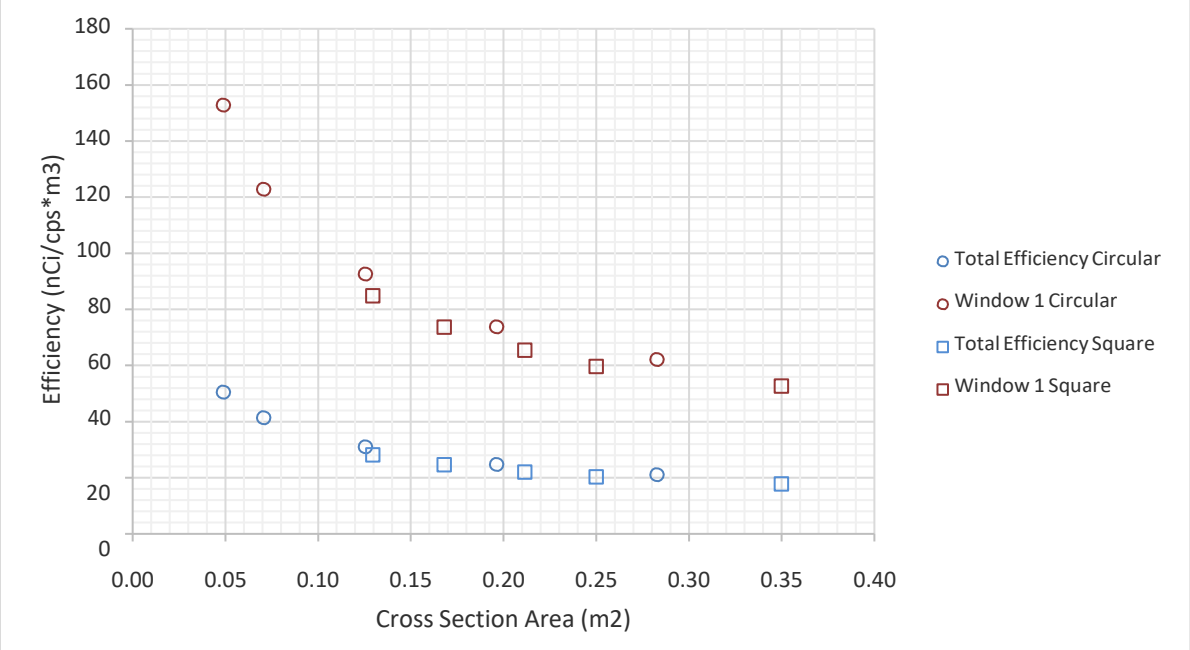


Table 9: PM11 efficiencies for O-15

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 1 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	28.15	84.84	0.78%
2	41 x 41	0.168	0.336	24.57	73.67	0.78%
3	46 x 46	0.212	0.423	21.95	65.41	0.78%
4	Ø 30	0.071	0.141	41.32	122.81	0.79%
5	Ø 40	0.126	0.251	30.99	92.52	0.78%
6	Ø 50	0.196	0.393	24.72	73.77	0.77%
7	50 x 70	0.350	0.700	17.77	52.58	0.55%
8	Ø 25	0.049	0.098	50.49	152.76	0.57%
9	Ø 60	0.283	0.565	21.02	62.13	0.77%
10	50 x 50	0.250	0.500	20.22	59.60	0.77%

Figure 13: O-15 detector efficiencies as functions of stalks cross sections



D.7 Nitrogen-13

Detector: NaI - Energy window #1 390 – 730 keV

Figure 14: N-13 energy spectrum for Geometry #1

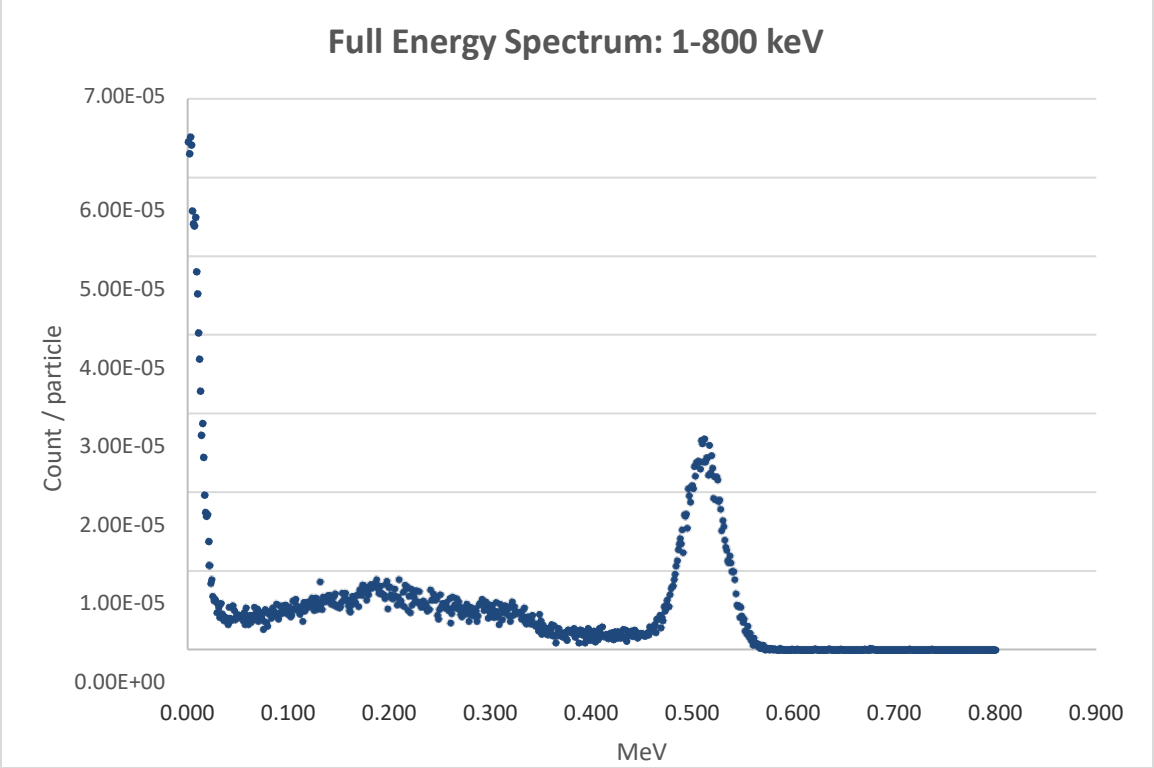
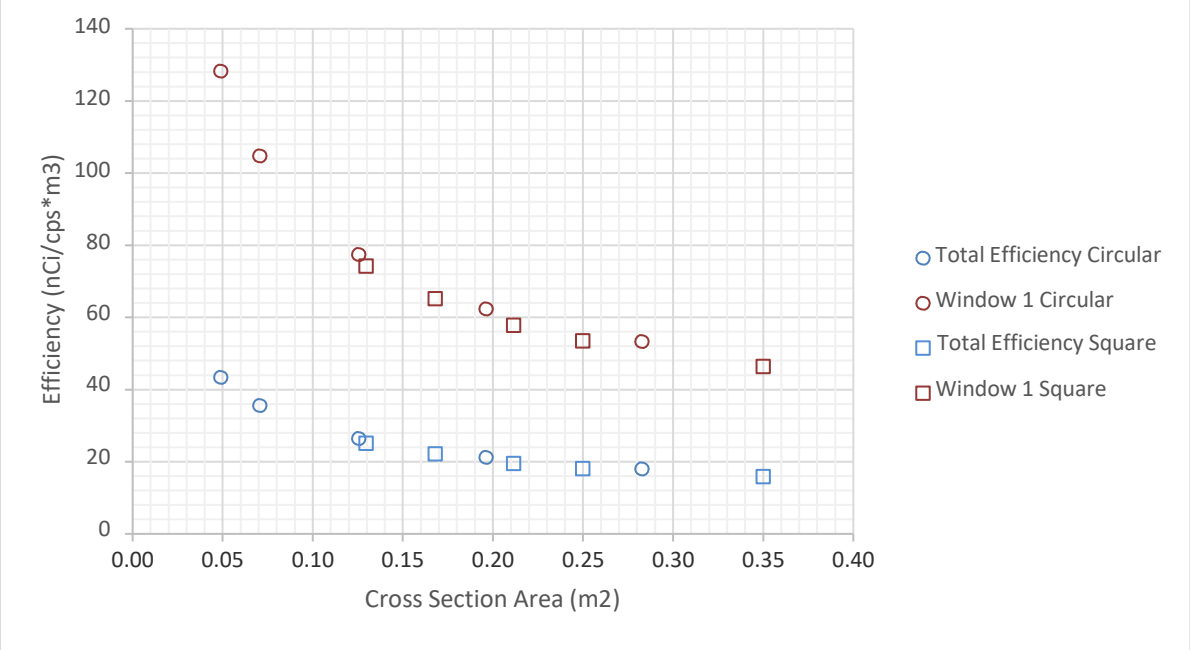


Table 10: PM11 efficiencies for N-13

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 1 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	25.10	74.20	0.77%
2	41 x 41	0.168	0.336	22.09	65.13	0.77%
3	46 x 46	0.212	0.423	19.49	57.77	0.77%
4	Ø 30	0.071	0.141	35.53	104.67	0.77%
5	Ø 40	0.126	0.251	26.41	77.36	0.77%
6	Ø 50	0.196	0.393	21.13	62.30	0.77%
7	50 x 70	0.350	0.700	15.87	46.39	0.76%
8	Ø 25	0.049	0.098	43.36	128.19	0.78%
9	Ø 60	0.283	0.565	18.00	53.23	0.77%
10	50 x 50	0.250	0.500	18.02	53.48	0.77%

Figure 15: N-13 detector efficiencies as functions of stalks cross sections



D.8 Iodine-131

Detector: NaI - Energy window #2 300 – 420 keV

Figure 16: I-131 energy spectrum for Geometry #1

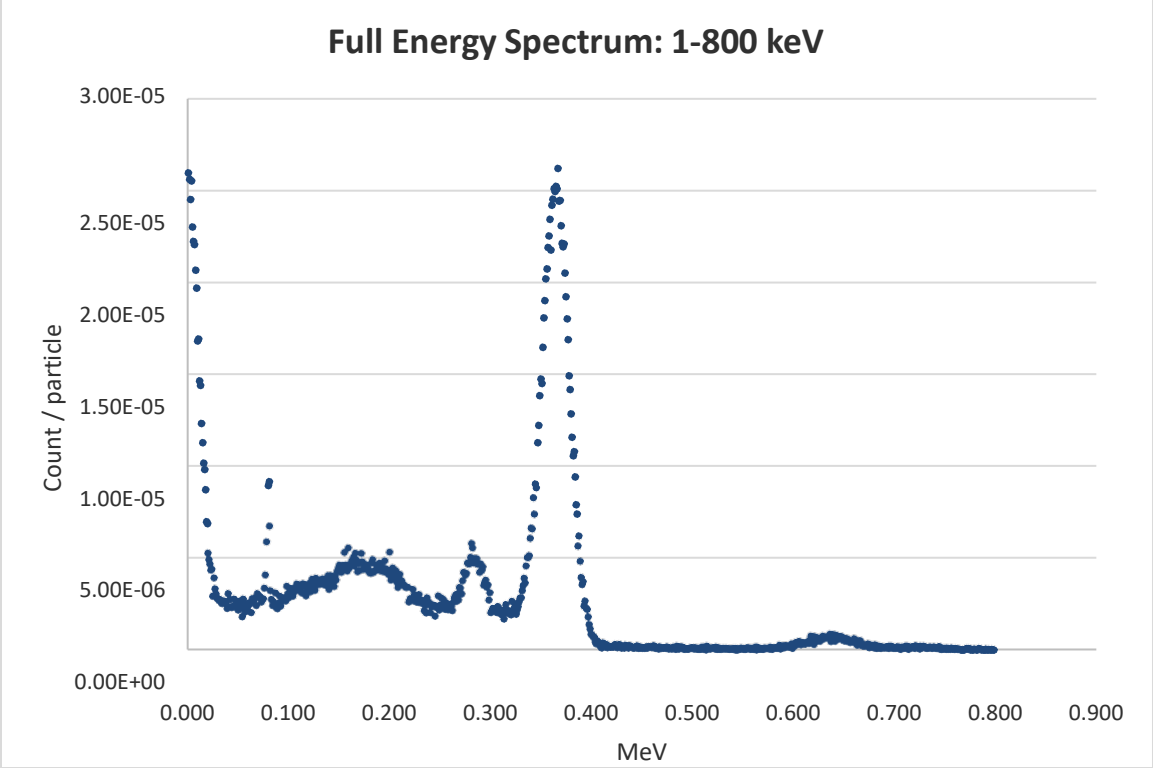
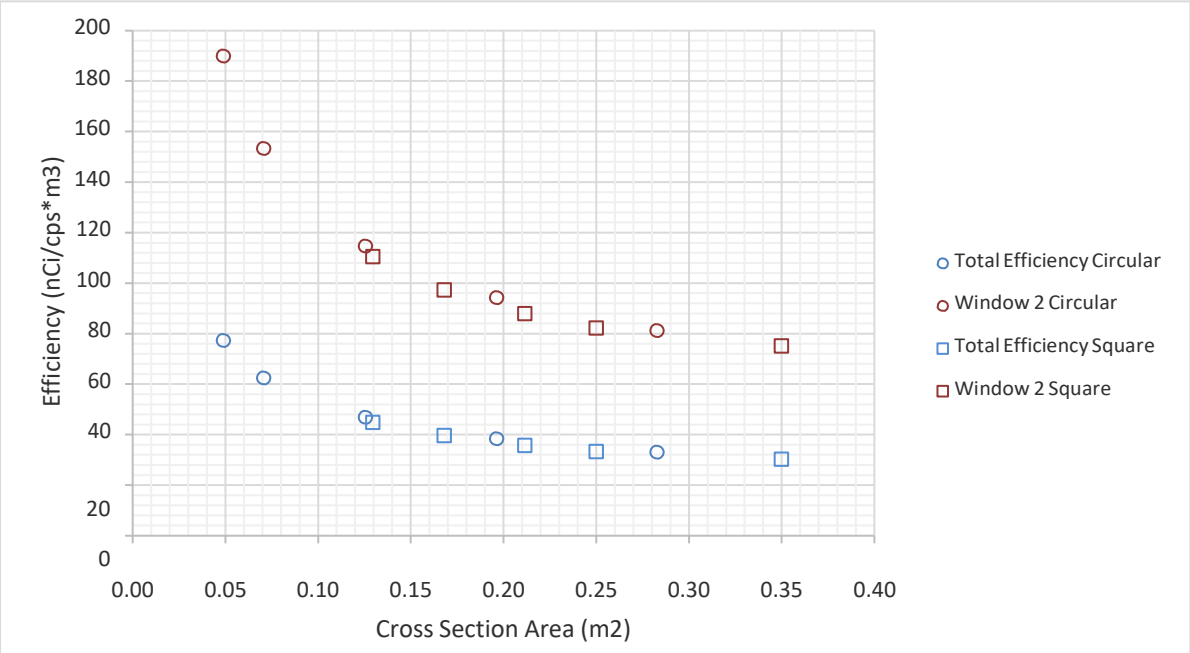


Table 11: PM11 efficiencies for I-131

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 2 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	44.90	110.46	0.29%
2	41 x 41	0.168	0.336	39.68	97.33	0.29%
3	46 x 46	0.212	0.423	35.75	87.97	0.24%
4	Ø 30	0.071	0.141	62.47	153.28	0.24%
5	Ø 40	0.126	0.251	46.87	114.70	0.24%
6	Ø 50	0.196	0.393	38.45	94.27	0.24%
7	50 x 70	0.350	0.700	30.31	75.19	0.23%
8	Ø 25	0.049	0.098	77.26	189.93	0.24%
9	Ø 60	0.283	0.565	33.03	81.17	0.24%
10	50 x 50	0.250	0.500	33.34	82.23	0.24%

Figure 17: I-131 detector efficiencies as functions of stalks cross sections



D.9 Technetium-99m

Detector: NaI - Energy window #3 40 – 240 keV

Figure 18: Tc-99m energy spectrum for Geometry #1

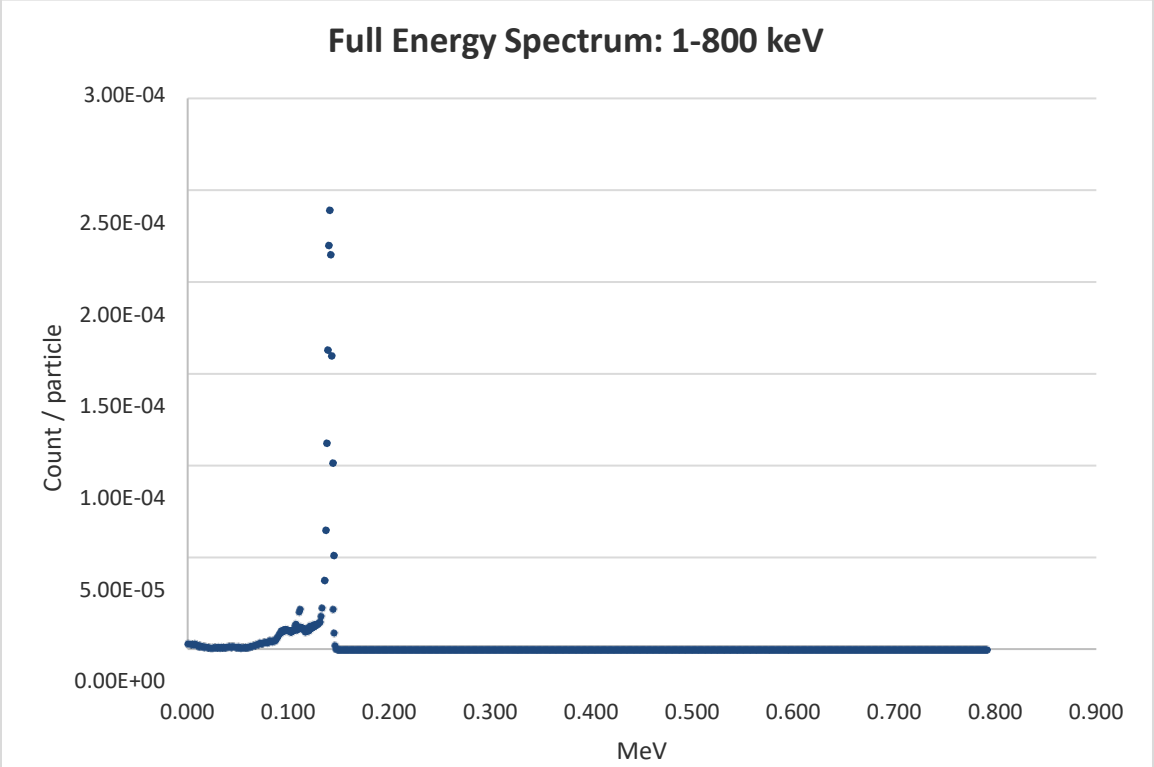
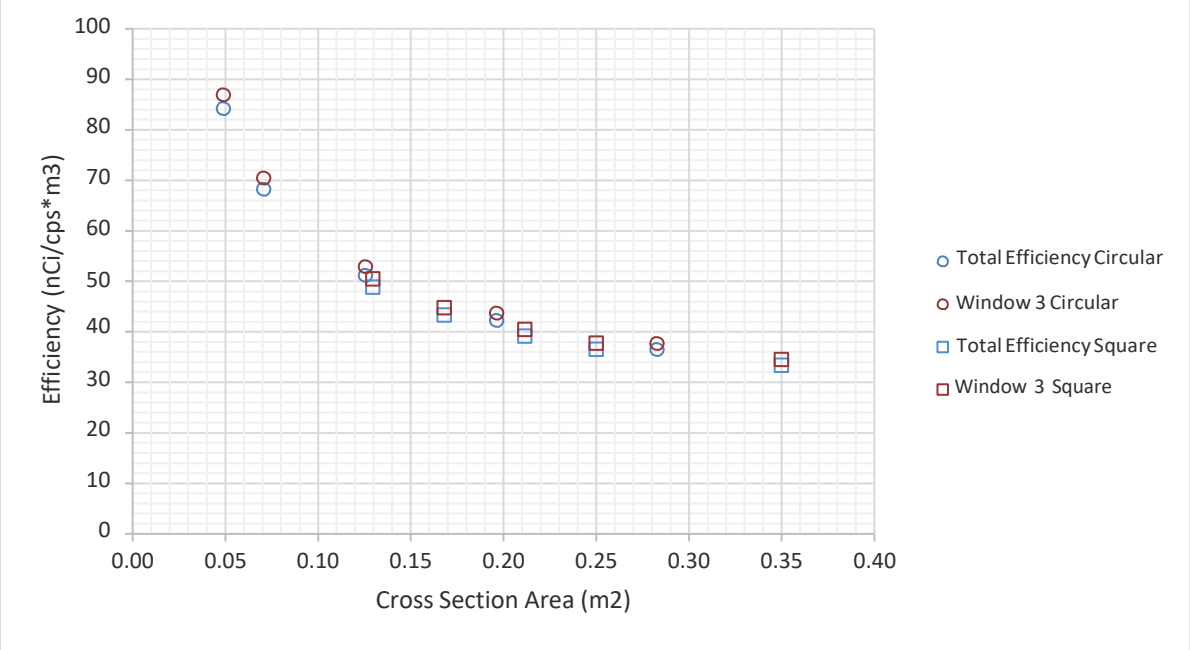


Table 12: PM11 efficiencies for Tc-99m

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 3 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	48.84	50.45	0.17%
2	41 x 41	0.168	0.336	43.31	44.74	0.14%
3	46 x 46	0.212	0.423	39.14	40.43	0.14%
4	Ø 30	0.071	0.141	68.22	70.43	0.14%
5	Ø 40	0.126	0.251	51.18	52.88	0.14%
6	Ø 50	0.196	0.393	42.25	43.67	0.14%
7	50 x 70	0.350	0.700	33.36	34.47	0.14%
8	Ø 25	0.049	0.098	84.21	86.93	0.14%
9	Ø 60	0.283	0.565	36.46	37.69	0.14%
10	50 x 50	0.250	0.500	36.52	37.72	0.14%

Figure 19: Tc-99m detector efficiencies as functions of stalks cross sections



D.10 Gallium-67

Detector: NaI - Energy window #3 40 – 240 keV

Figure 20: Ga-67 energy spectrum for Geometry #1

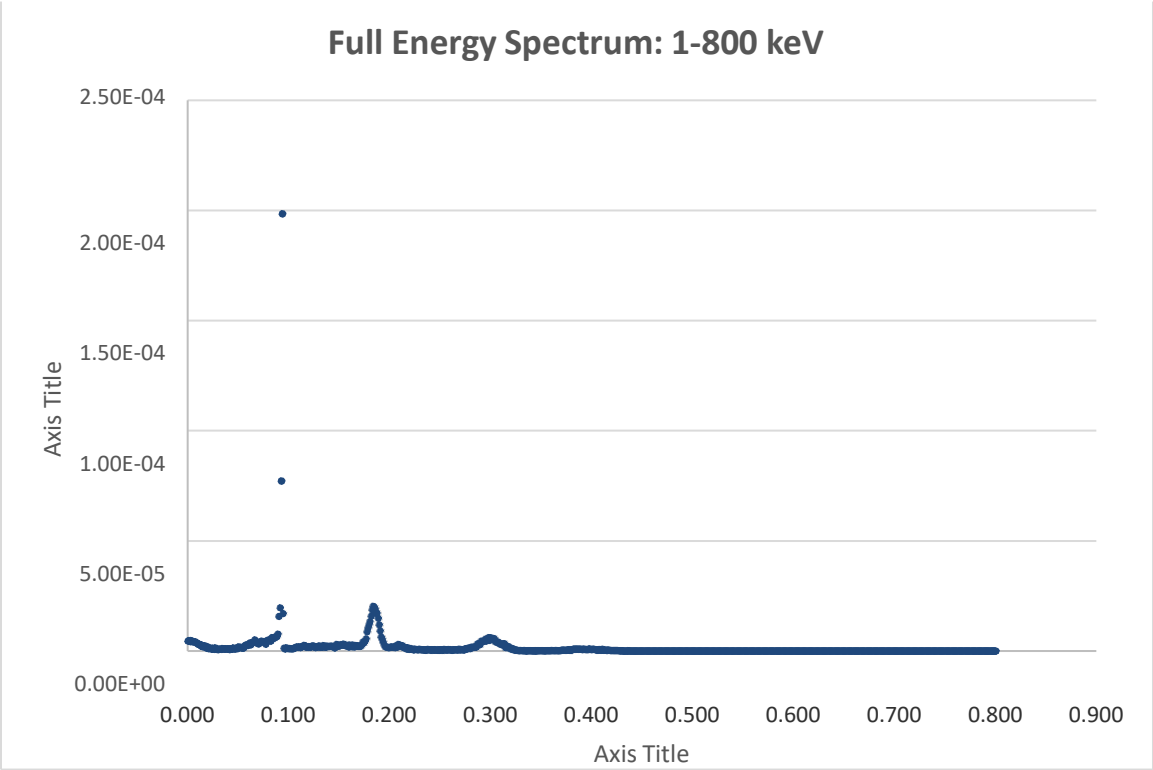
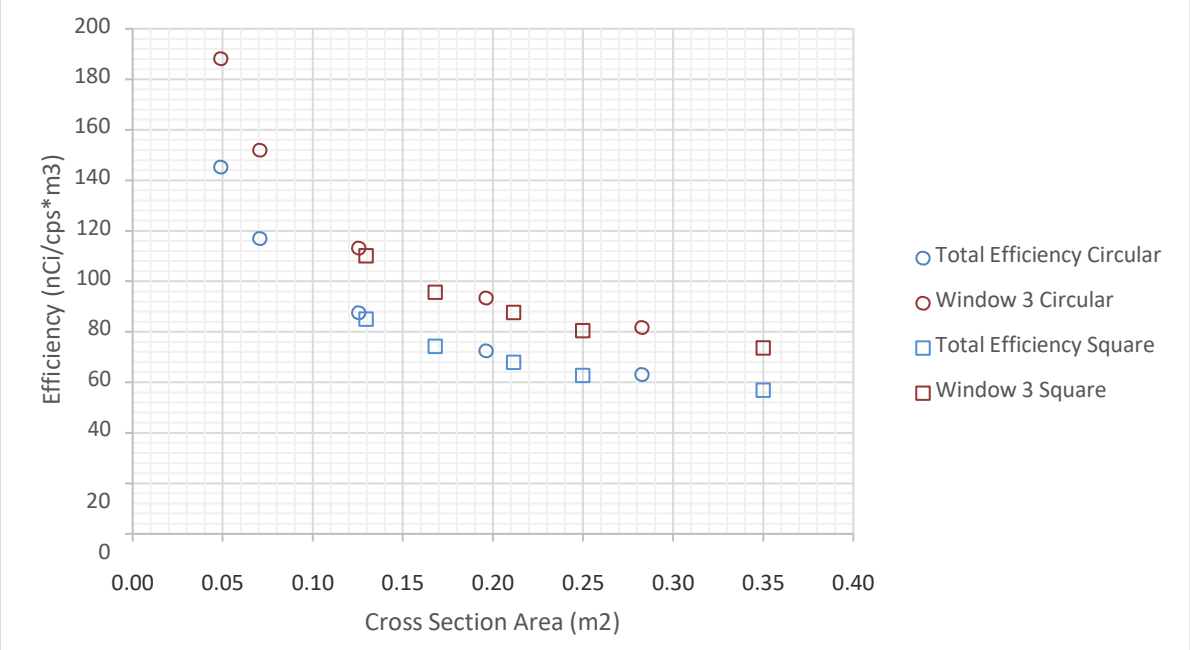


Table 13: PM11 efficiencies for Ga-67

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 3 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	85.00	110.05	0.32%
2	41 x 41	0.168	0.336	74.22	95.57	0.45%
3	46 x 46	0.212	0.423	67.86	87.60	0.32%
4	Ø 30	0.071	0.141	116.89	151.93	0.45%
5	Ø 40	0.126	0.251	87.44	113.13	0.45%
6	Ø 50	0.196	0.393	72.37	93.35	0.45%
7	50 x 70	0.350	0.700	56.87	73.54	0.45%
8	Ø 25	0.049	0.098	145.14	188.13	0.45%
9	Ø 60	0.283	0.565	63.05	81.73	0.32%
10	50 x 50	0.250	0.500	62.64	80.38	0.45%

Figure 21: Ga-67 detector efficiencies as functions of stalks cross sections



D.11 Thallium-201

Detector: NaI - Energy window #3 40 – 240 keV

Figure 22: Tl-201 energy spectrum for Geometry #1

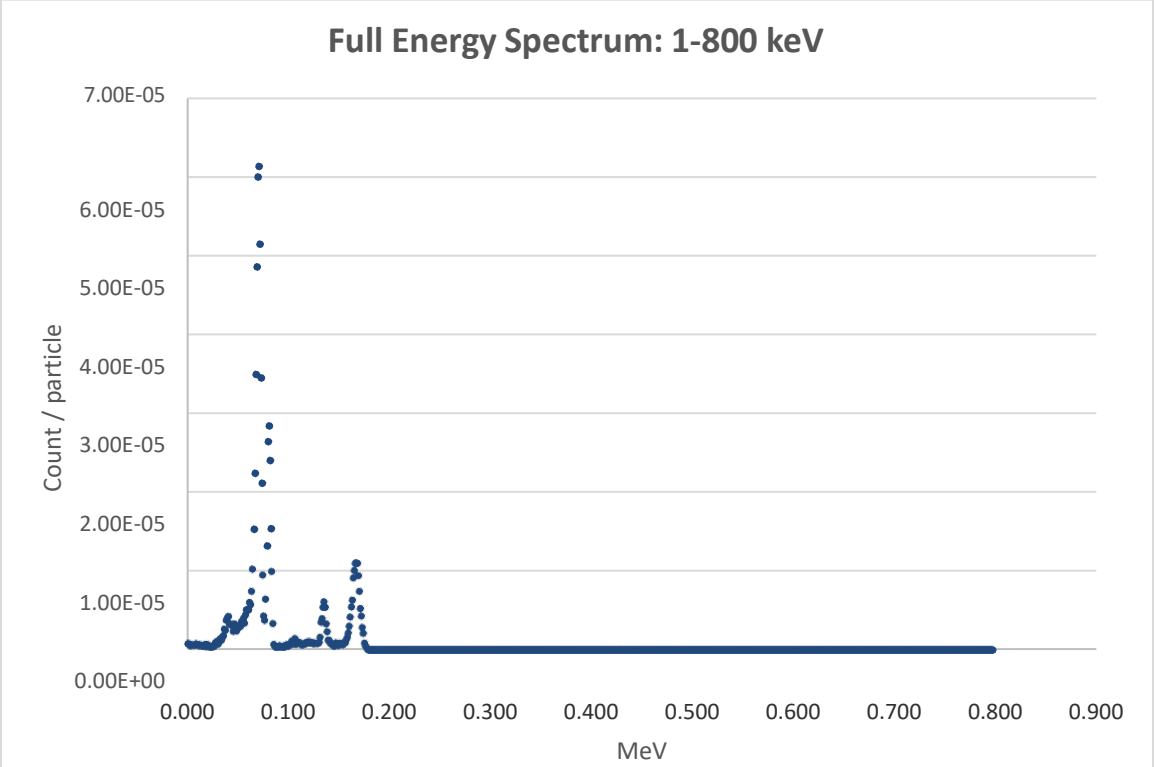
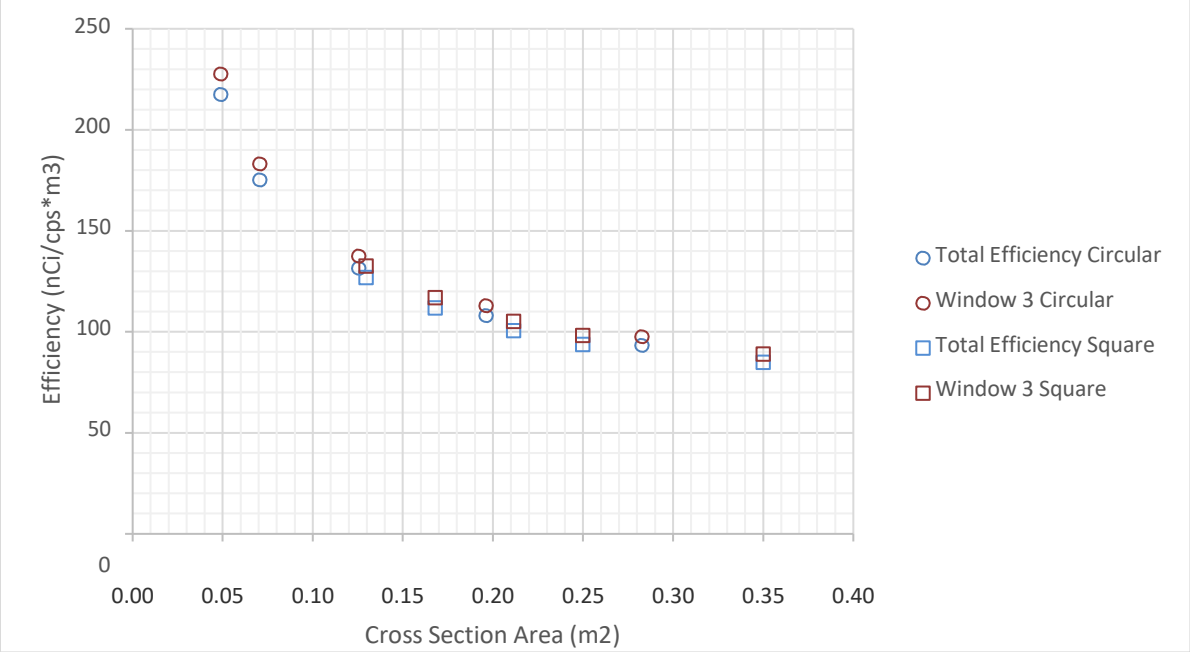


Table 14: PM11 efficiencies for Tl-201

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 3 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	126.82	132.51	0.19%
2	41 x 41	0.168	0.336	111.75	116.76	0.19%
3	46 x 46	0.212	0.423	100.47	105.07	0.19%
4	Ø 30	0.071	0.141	175.05	182.99	0.19%
5	Ø 40	0.126	0.251	131.45	137.38	0.19%
6	Ø 50	0.196	0.393	107.97	112.93	0.19%
7	50 x 70	0.350	0.700	84.91	89.00	0.19%
8	Ø 25	0.049	0.098	217.36	227.49	0.19%
9	Ø 60	0.283	0.565	93.20	97.57	0.19%
10	50 x 50	0.250	0.500	93.63	98.06	0.19%

Figure 23: Tl-201 detector efficiencies as functions of stalks cross sections



D.12 Iodine-123

Detector: NaI - Energy window #3 40 – 240 keV

Figure 24: I-123 energy spectrum for Geometry #1

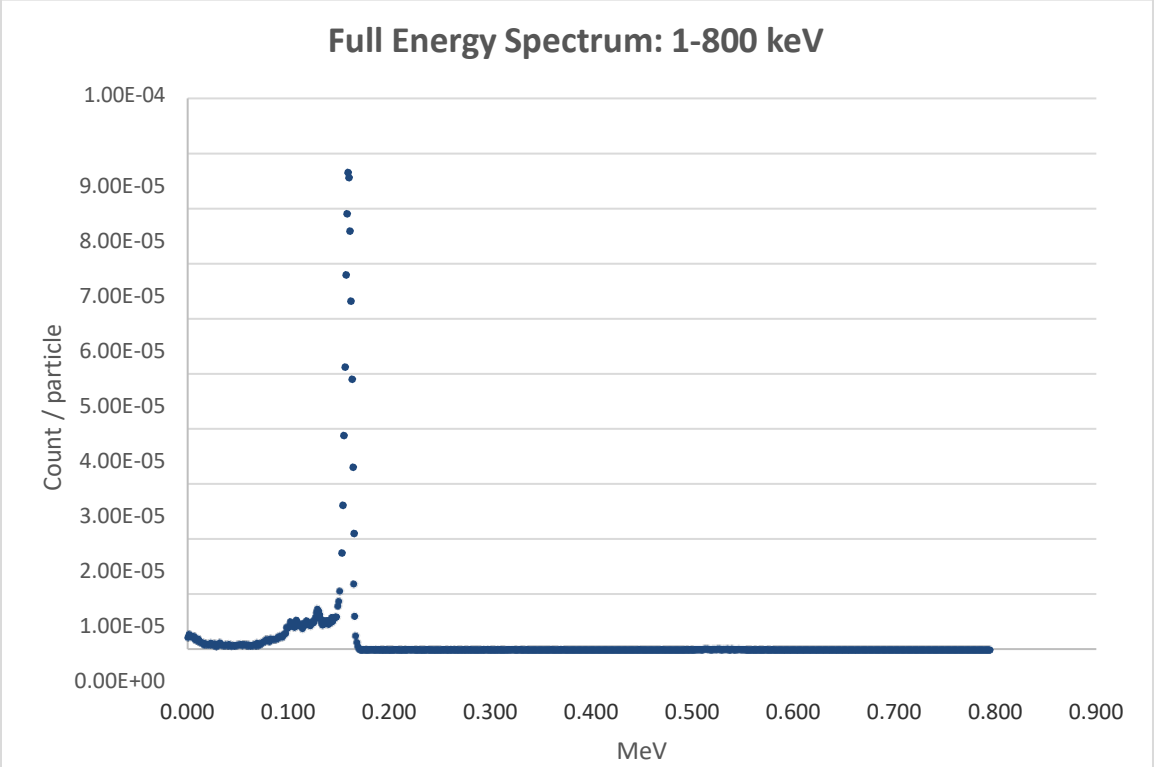
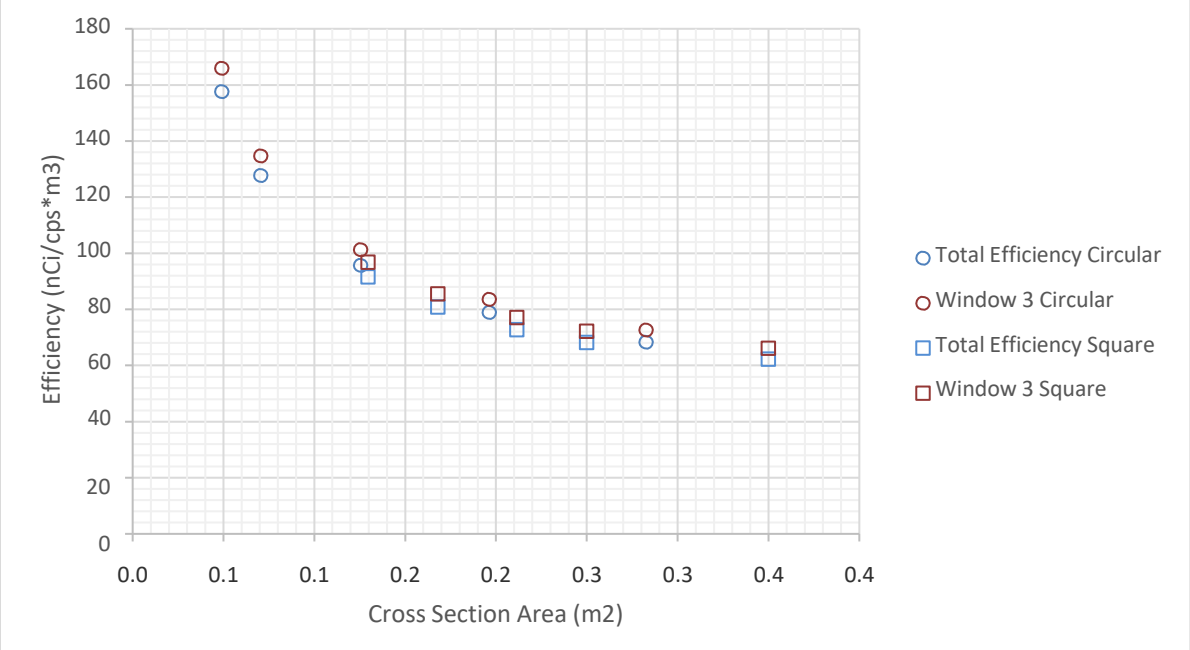


Table 15: PM11 efficiencies for I-123

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Efficiency Window 3 (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	91.54	96.77	0.21%
2	41 x 41	0.168	0.336	80.78	85.47	0.21%
3	46 x 46	0.212	0.423	72.76	77.02	0.21%
4	Ø 30	0.071	0.141	127.63	134.64	0.22%
5	Ø 40	0.126	0.251	95.61	101.19	0.21%
6	Ø 50	0.196	0.393	78.82	83.55	0.21%
7	50 x 70	0.350	0.700	62.23	66.12	0.20%
8	Ø 25	0.049	0.098	157.53	165.87	0.22%
9	Ø 60	0.283	0.565	68.32	72.55	0.21%
10	50 x 50	0.250	0.500	68.13	72.16	0.21%

Figure 25: I-123 detector efficiencies as functions of stalks cross sections



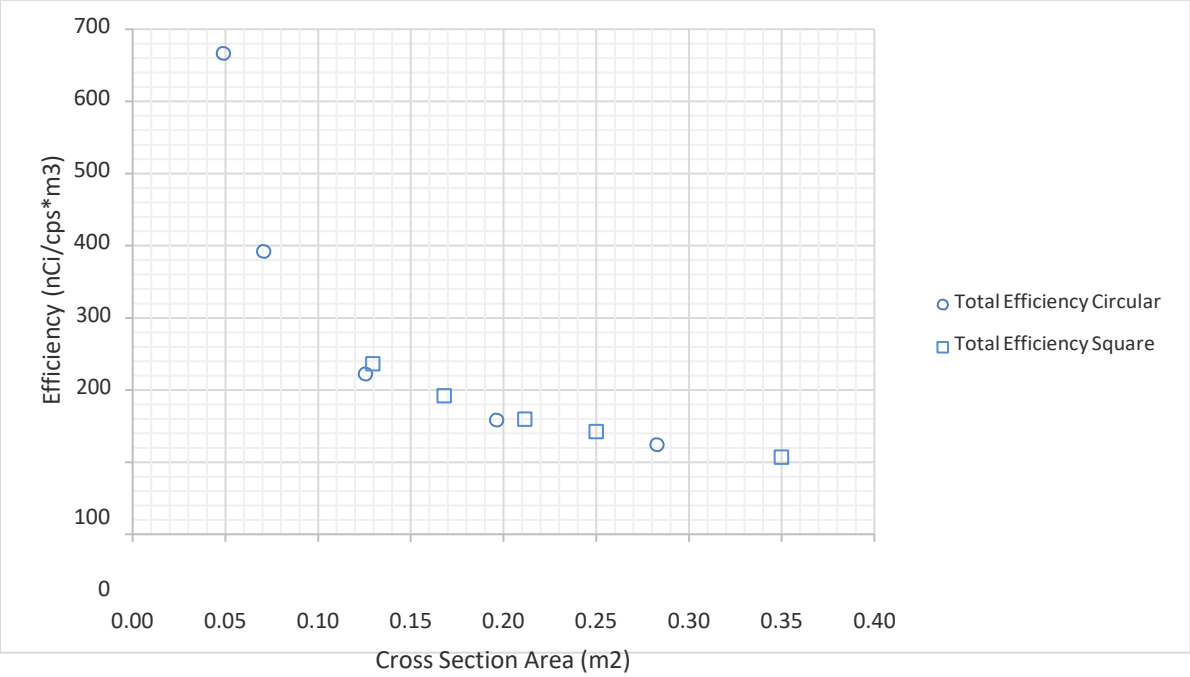
D.13 Iodine-125

Detector: plastic scintillator

Table 16: PM11 efficiencies for I-125

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	236.27	0.67%
2	41 x 41	0.168	0.336	192.23	1.09%
3	46 x 46	0.212	0.423	159.73	0.91%
4	Ø 30	0.071	0.141	391.97	0.83%
5	Ø 40	0.126	0.251	222.23	0.83%
6	Ø 50	0.196	0.393	158.56	0.88%
7	50 x 70	0.350	0.700	106.79	0.74%
8	Ø 25	0.049	0.098	666.52	0.90%
9	Ø 60	0.283	0.565	124.13	0.72%
10	50 x 50	0.250	0.500	142.28	0.94%

Figure 26: I-125 detector efficiencies as functions of stalks cross sections



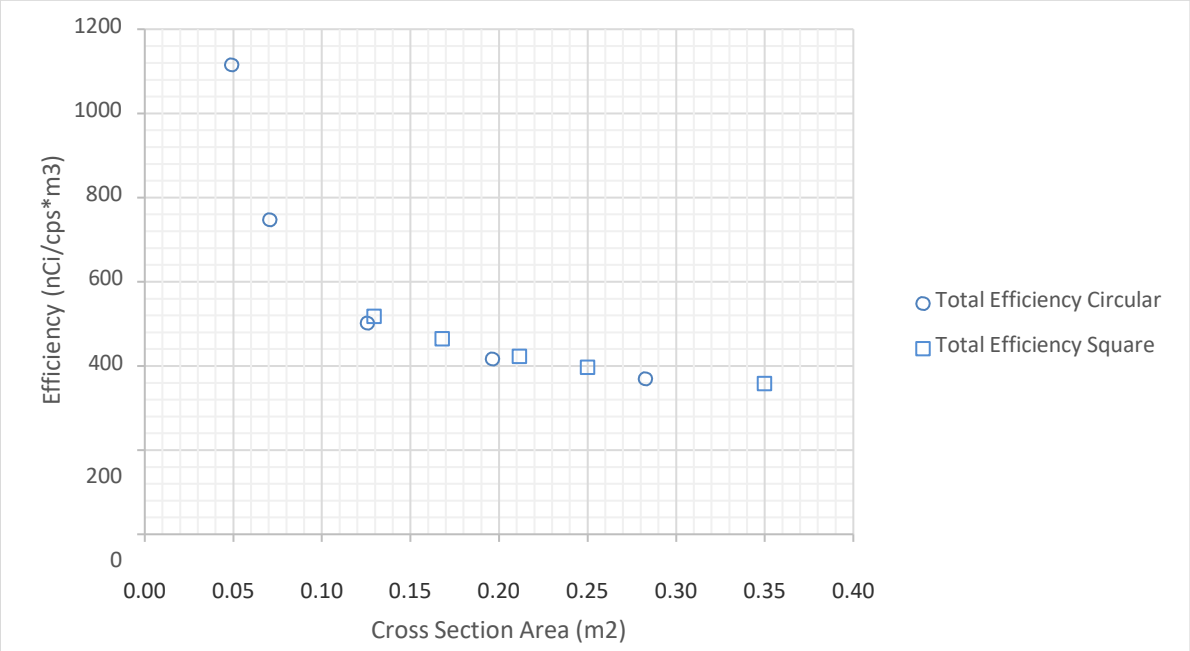
D.14 Lutetium-177

Detector: plastic scintillator

Table 17: PM11 efficiencies for Lu-177

Geometry #	Dimensions (cm)	Cross section area (m2)	Volume (m3)	Total Efficiency (nCi/cps*m3)	Uncertainty 1 σ
1	36 x 36	0.130	0.259	517.86	1.11%
2	41 x 41	0.168	0.336	464.41	1.70%
3	46 x 46	0.212	0.423	422.66	1.82%
4	Ø 30	0.071	0.141	747.66	1.40%
5	Ø 40	0.126	0.251	502.16	1.53%
6	Ø 50	0.196	0.393	416.48	1.74%
7	50 x 70	0.350	0.700	358.00	2.15%
8	Ø 25	0.049	0.098	1115.23	1.42%
9	Ø 60	0.283	0.565	369.64	1.97%
10	50 x 50	0.250	0.500	396.58	1.92%

Figure 27: Lu-177 detector efficiencies as functions of stalks cross sections



D.15 Conclusion

This TSD provided isotopes efficiencies for the new PM11 detector designed by ROTEM and positioned in 10 different stack geometries. These detector efficiencies in nCi/cps*m3 will be used by ROTEM to quantify the potential releases of F-18,

Ga-68, O-15, C-11, N-13, I-131, Tc-99m, Ga-67, Tl-201, I-123, I-125 and Lu-177.

The detector efficiencies calculated by RSCS range from 24 to 1,115 nCi/cps*m3.

D.16 References

[1] RSCS TSD #08-009 “MCNP Calibration of ROTEM stack monitors for PET isotopes”

[2] Los Alamos National Laboratory, "“MCNP6 Version 1.0” Los Alamos User’s Manual LA-CP-13-00634, Rev. 0".

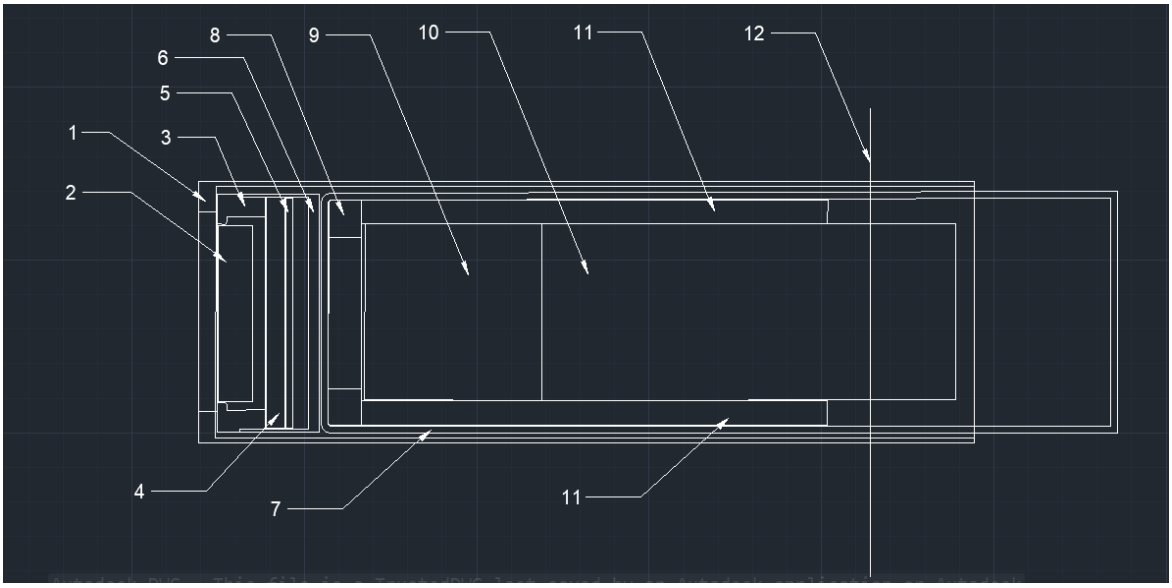
[3] "Compendium of Material Composition Data for Radiation Transport Modeling, Report number PNNL-15870 Rev1," Pacific Northwest Laboratory, 2011.

[4] K. F. Eckerman, R. J. Westfall, J. C. Ryman, and M. Cristy, "Availability of Nuclear Decay Data in Electronic Form, Including Beta Spectra not Previously Published," Health Phys. 67(4):338-345 (1994).

[5] ICRP, 2008. Nuclear Decay Data for Dosimetric Calculations. ICRP Publication 107. Ann. ICRP 38 (3).

Attachment A

PM11 dimensions and drawings provided by ROTEM



No	Description	Dimensions	Material
1	Stainless Steel Bracket	Outer Diameter (OD): 76.1 Inner Diamteter (ID): 73.1	Stainless Steel 304L/316L
1	Stainless Steel Bracket	Front Diameter for Beta Detector: 58 mm	Stainless Steel 304L/316L
2	Beta Detector	Diameter: 53 mm, Thickness: 13mm	Plastic Scintilator Polystyrene, Density: 1.05 g/cc
3	Beta Detector Front Cover	OD: 67 mm ID: 51 mm Thickness: 14mm	Plastic
4	Sponge	OD: 67 mm Thickness: 6mm	Sponge
5	PC BOARD	OD: 64 mm	PC BOARD
6	Beta Detector Back Cover	OD: 69 mm Width:23mm	Plastic
7	PM-11 Casing	OD: 70mm Thickness: 2mm	AL 6061
8	Sponge shock absorber	OD:66mm ID: 44mm Thickness:9.5mm (3/8")	Sponge
9	PM-11 Detector	OD: 57mm, Thickness: 60	Nal(Tl)
10	PMT Tube	OD: 51 mm, Length: 112 mm	
11	Sponge Sleeve	OD: 65 mm, ID: 55 mm, Length 145mm	Sponge PB 150 T6
12	Stainless Steel Bracket Plate	Used to connect Bracket to Exhaust Stack	Stainless Steel 304L/316L

Attachment B

Example of MCNP input deck (F-18 / Geometry #1)

```
This Problem is intended to model a PM11 detector according to the specifications submitted by Rotem on May 27, 2020
c Made by Jean Geslin
c Stack is square 36 cm x 36cm
c Origin is center of dettector - px=end of steel bracket
c Source is F-18
c
c Cell cards
c
1 12 -1.38 (45 -17 -6) imp:p,e=1                                    $Mylar in front of beta detector
2 1 -7.767 (14 -15 16 -29) imp:p,e=1                                $steel bracket
3 1 -7.767 (15 28 -29 -44) imp:p,e=1                                $vertical steel bracket
4 1 -7.767 (6 -14 16 -17) imp:p,e=1                                 $steel bracket around front cover
5 6 -1.05 (-3 17 -18) imp:p,e=1                                     $beta detector
6 7 -1.03 (-12 3 17 -18):(-12 18 -19) imp:p,e=1                     $beta detector front cover
7 5 -0.365 (-10 19 -20) imp:p,e=1                                   $sponge
8 8 -2.55 (-7 20 -21) imp:p,e=1                                     $PC board
9 7 -1.03 (-12 10 19 -22):(-12 22 -23) imp:p,e=1                    $beta detector back cover
10 9 -.00120479 (-10 7 20 -21):(-10 21 -22) imp:p,e=1               $air around beta detector
11 2 -2.6989 (-13 23 -24):(-13 9 24 -31): &
        (-13 31 -32) imp:p,e=1                                      $Al casing
12 5 -0.365 (-9 1 24 -25):(-8 46 25 -48):(-8 46 48 -27)  imp:p,e=1  $sponge shack absorber + sleeve
13 4 -3.667 (-5 47 -26) imp:p,e=1                                   $NaI detector
14 3 -.40687 (-2 48 -30) imp:p,e=1                                  $PMT tube
15 9 -.00120479 (-9 8 25 -27):(-46 43 48 -30): &
        (-9 46 27 -30): &
        (-9 30 -31) imp:p,e=1                                       $air inside Al casing
16 9 -.00120479 (-1 24 -25) imp:p,e=1                               $air at center of shock absorber
17 9 -.00120479 (-14 12 17 -19):(-14 12 19 -23):&
        (-14 13 23 -29) imp:p,e=1                                   $air inside steel bracket
18 9 -.00120479 (33 -28 35 -34 37 -36 15): &
        (-15 33 -16):(16 -45 -6) imp:p,e=1                          $air volume in slack (=source volume)
19 9 -.00120479 (-100 -39) imp:p,e=1                                $air outside slack
20 9 -.00120479 (-100 32) imp:p,e=1                                 $air outside slack
21 9 -.00120479 (-100 39 -32 -40) imp:p,e=1                         $air outside slack
22 9 -.00120479 (-100 39 -32 41) imp:p,e=1                          $air outside slack
23 9 -.00120479 (-100 39 -32 40 -41 -37) imp:p,e=1                  $air volume outside slack
24 9 -.00120479 (-100 39 -32 40 -41 36) imp:p,e=1                   $air volume outside slack
25 9 -.00120479 (-100 -32 29 40 -41 37 -36 13) imp:p,e=1            $air volume outside slack
26 10 -7.874    (2 -42 48 -30) imp:p,e=1                            $1st layer around PMT
27 11 -8.79024  (42 -43 48 -30) imp:p,e=1                           $2nd layer around PMT
28 2 -2.6989    (39 -33 40 -41 37 -36):(34 -41 33 -28 37 -36):&
                (40 -35 33 -28 37 -36): (28 -29 40 -41 44 37 -36) &
                imp:p,e=1                                           $stack 0.04 mm thickness
29 2 -2.6989    (-46 -47 25):(47 -26 -46 5) imp:p,e=1               $NaI detector Al casing
30 13 -2.23     (26 -48 -46) imp:p,e=1                              $borosilicate window
500 0           (100) imp:p,e=0                                     $end of the world
```

```
c
c Surface cards
c
1 cx 2.2         $ ID sponge shock absorber
2 cx 2.55        $ ID beta detector front cover + OD PMT tube
3 cx 2.65        $ Diameter beta detecor                 check value with rotem
5 cx 2.54        $ Diameter PM-11 detector
6 cx 2.9         $ Diameter front cover for beta detector
7 cx 3.2         $ OD PC board
8 cx 3.25        $ OD sponge sleeve
9 cx 3.3         $ OD sponge shock absorber + ID PM-11 casing
10 cx 3.35       $ OD sponge + OD beta detector front cover
12 cx 3.45       $ OD beta detector back cover
13 cx 3.5        $ OD PM-11 casing
14 cx 3.655      $ ID stainless steel bracket
15 cx 3.805      $ OD stainless steel bracket
16 px 0          $ Stainless steel bracket # 1
17 px 0.5        $ thickness of front cover
18 px 1.5        $ thickness of beta detector 0.5 + 1.5  Check value with Rotem (maybe 10 mm)
19 px 1.9        $ thickness of beta detector front cover 0.5 + 1.4
20 px 2.5        $ thickness of sponge 1.4 + 0.6
21 px 2.7        $ thickness of PC board 2.5 + 0.2
22 px 3.15       $ thickness of air 2.7 + 0.45
23 px 3.45       $ thickness of beta detector back cover 3.15 + 0.3
24 px 3.65       $ thickness of PM casing 3.45 + 0.2
25 px 4.6        $ thickness of sponge schock absotber 3.65 + 0.95
26 px 9.8        $ thickness of PM-11 detector 4.7 + 5.1
27 px 19.1       $ thichkness of sponge sleeve 4.6 + 14.5
28 px 19.5       $ stainless steel bracket
29 px 19.65      $ stainless steel bracket 1.5 mm thickness
30 px 21.8       $ thickness of PMT tube 10.6 + 11.2
31 px 26.5       $ end of PM casing
32 px 26.7       $ end of PM casinf thickness 2 mm
33 px -16.5      $ stack on x                            change (19.5 - width)
34 py 18         $ stack on y                            change
35 py -18        $ stack on y                            change
36 pz 100        $ stack on z
37 pz -100       $ stack on z
39 px -16.54     $ Al stack                              change (33 - 0.04)
40 py -18.04     $ Al stack                              change (34 - 0.04)
41 py 18.04      $ Al stack                              change (34 + 0.04)
42 cx 2.56016    $ 1st layer around PMT
43 cx 2.57032    $ 2nd layer around PMT
44 cx 10.0485    $ end of steel bracket
45 px 0.4956     $ 2 layers of mylar 0.022 mm each
46 cx 2.69       $ NaI detector Al casing
47 px 4.7        $ thickness of PM-11 detector casing 4.6 + 1
48 px 10.6       $ thickness of PM-11 detector glass window 9.8 + 0.8
100 so 150       $ outside world
```

```
c
c data cards
mode p e
c
c ***** start source definition region **********************
c
SDEF ERG=d1 X=d2 Y=d3 z=d4 PAR=f Cel=18 Eff=0.001
SI1 A   1.59E-02        4.75E-02        7.92E-02        1.11E-01        1.43E-01
        1.74E-01        2.06E-01        2.38E-01        2.69E-01        3.01E-01
        3.33E-01        3.64E-01        3.96E-01        4.28E-01        4.59E-01
        4.91E-01        5.23E-01        5.54E-01        5.86E-01        6.18E-01
SP1     1.86E-02        4.54E-02        6.21E-02        7.33E-02        8.05E-02
        8.44E-02        8.55E-02        8.43E-02        8.08E-02        7.55E-02
        6.87E-02        6.08E-02        5.19E-02        4.25E-02        3.31E-02
        2.40E-02        1.56E-02        8.64E-03        3.32E-03        6.08E-04
SI2 -100 100
SP2 0 1
SI3 -100 100
SP3 0 1
SI4 -150 150
SP4 0 1
c
c **** end source definition region ************************
c
c **** start tally card region **********************************
c
c This will Tally in the energy bin in MeV. Receptor is NaI crystal
f8:p 13
e8 0 1e-5 1e-3 798I 0.8
ft8 GEB -.02429 .0697159 2.05748
c
c **** start material def region ****************************
c material cards
m1 06000 -.0003 25000 -.02 15000 -.00045 16000 -.0003 14000 -.0075 &
     24000 -.18 28000 -.08 07000 -.001 26000 -.7064 $Stainless 304L
m2 13000 -1 $Aluminum
m3 08000 -.36784 11000 -.0771528 14000 -.2692424 20000 -.085764 26000 -0.139 &
     24000 -0.038 28000 -0.019 25055 -0.004 $PMT Composite 80% glass 20% SS304
m4 11000 -.153 53000 -.847 $NaI
m5 13000 -.10101 08000 -.4040 01000 -.49 14000 -.002465 06000 -.002525 $sponge
m6 01000 -0.085000 06000 -0.915000 $ plastic scintillator from PNNL-15870Rev1
m7 01000 -0.085000 06000 -0.915000 $ PVT from PNNL-15870Rev1 density 1.03
m8 08000 -0.486722 12000 -0.036182 13000 -0.132313 14000 -0.280461 20000 -0.064322 &
       $ PC board Fiberglass Type R from PNNL-15870Rev1 density 2.55
m9 06000 -0.00012 07000 -0.75527 08000 -0.23178 18000 -0.01283 GAS=1 $Dry Air
m10 26000 -1 $Netic Type S3-6
m11 28000 -.8 42000 -.04 26000 -.16 $Co-Netic Type AA
m12 1000 -0.041960 6000 -0.625016 8000 -0.333024 $Mylar from from PNNL-15870Rev1 density 1.38
m13 5000 -0.040064 8000 -0.539562 11000 -0.028191 13000 -0.011644 14000 -0.377220 19000 -0.003321 $borosilicate glass from PNNL-15870Rev1 density 2.23
c
c **** end material def region ****************************
c
nps 10000000
```