Next Generation Drinking Water Radiation Safety Monitor

Model Nexgen-SSS

Features

- World's Only PAG-Level aβγ Water Monitor Measures at or Below EPA/DHS PAG Levels
- Protective Action Guideline Levels and Military Drinking Water Limits
- Real Time, In-Line, Continuous
- Detects Alphas, Betas and Gammas
- Isotope Identification
- No Reagent Tanks to Fill
- No Waste Stream
- Easy Calibration
- Prevent Acute Health Effects; Reduce Risk of Chronic Exposure
- Full Scada or Modbus Compatibility
- Easy Integration Into Central Control System
- Optional: Tritium Detector
- Optional: Radon Detector
- Optional: Rawa

Application

- Monitor drinking water against any and all Radioactive contaminants
- Monitor for contamination in ground or surface water
- Monitor liquid-waste-stream from laboratory or plant

Problems

Drinking water sources are vulnerable to accidental or knowing contamination by individuals, groups, industry, medical labs, terrorists, and from naturally occurring radioactive materials (NORM).

As yet very few water districts have real-time radiation monitors in place to protect the water and the public.

Soultions

For the first time in a Continuous Real-Time Water Monitor the Model NEXGEN-SSS solves this problem; continuously monitoring water using Alpha, Beta and Gamma detectors. Detector data is analyzed and displayed in units of picoCuries per liter. Calculations are updated every two (2) minutes, every hour and every day. The longer update times correspond with greater precision and increased sensitivity. Sensitivities in the daily updates each meet or exceed the DHS protective Action Guideline Levels for drinking water. Please see attached chart of measurements.

Using TA's tried and true sample collection and measurement technology these detectors measure Alpha, Beta and Gamma from any radioactive liquids.

Measurements of radiation concentration and total discharge are logged 24 hours/day, 7 days/week.

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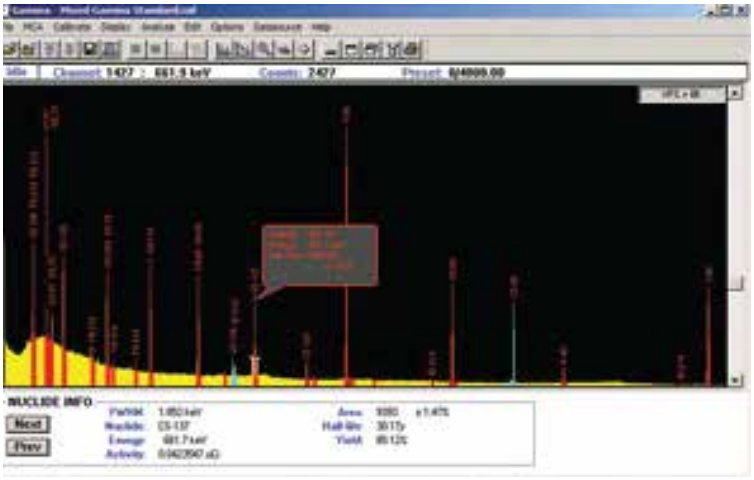
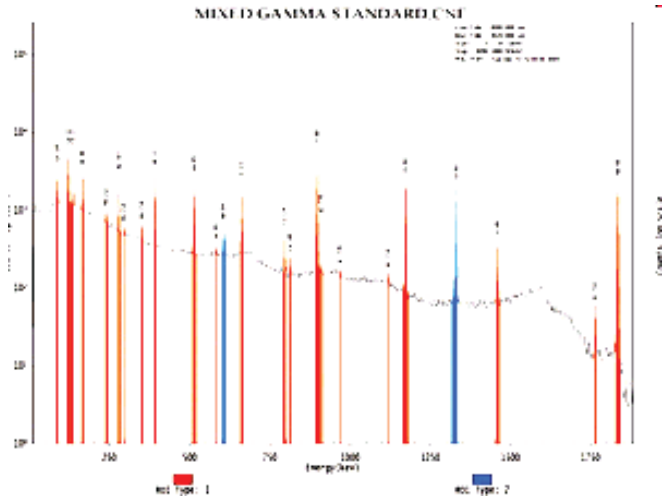


Gamma-MCA Isotope Identifier



Multi-Source Gamma Spectrum

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Description

Model NEXGEN-SSS is a multi-detector water monitor /controller for simultaneous measuring of alpha, beta and gamma-emitting radio nuclides. The electronics are microprocessor with color LCD display. The pre-amps are plug in modules allowing change or addition of functions at a later date, and allow rapid repair by module replacement in the field. The modular system is covered by TA's unique exchange warranty system in addition to the full one year warranty. On-site warrantees available in many areas.

Detector shields are made of lead encased in welded housing for long useful life and easy decontamination. The Alpha and Beta flow cells are easily changed via disconnect fittings. Gamma Spec shield can be opened for cleaning with minimum effort. All connections are sealed against leaks. The standard water moving system is based on a high precision pump. It has a 10 liter per minute capacity.

A wide range of pump capacities are available to meet users specific needs. The entire system is mounted in a wheeled, self-contained rugged cabinet. The NEXGEN-SSS comes complete with all cabling tubing and connectors in place and is ready to operate. 115 Volt 60Hz is standard; 220 Volt 50/60 Hz is optional.
Three principal detectors make up the NEXGEN-SSS system.

1. **Alpha Detectors:**
   A special plastic Alpha scintillator that consists of a light-tight detector assembly interfaces with the sample via quick disconnect coax cables and medical grade hoses. A matched pair of 5" diameter photo-multiplier tubes display the sample.
2. **Beta Scintillation Detectors:**
   Sensitive area: 1,100cm^2.
3. **Gamma Detectors:**
   Choice of NaI (Tl) Scintillation or HPGe Solid State:

Description of Alpha, Beta Pulse Analysis

This system conditions and analyzes the output from the photo-multiplier tubes by pulse height, duration and coincidence. In this way the system eliminates counting most background and noise counts. Sensitivity is enhanced by the use of stochastic resonance plus high gain, low noise PM tubes and pre-amps.

Isotope Identification System

Peak Detection and Isotope Identification

TA SMART-PEAK™ Software detects radiation peaks even at very low gamma concentration, in the event of high activity and during system calibration; the isotope identifier function takes over and displays the exact radioactive nuclides in water.

Gamma Detector: Water is measured for Gamma-emitter content, using a MCA analyzer with greater than 1,000 channels and a user setter energy range. For example the MCA can be set for Gamma energy of 10 KeV to 3 MeV.

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Data: Analysis – Display, Hard-Copy Archive

In each peak or area of interest, the net counts are automatically converted to concentration units, of picoCuries/liter (using the detector efficiencies automatically measured and stored previously by NEXGEN-SSS semi-automatic self-calibration procedure).

The concentration and total activity released and MDA levels are continuously calculated and recorded. This real time information will alert the notification system. Also, all data is saved to the hard drive in spreadsheet format.

Historical data is easily displayed on-screen (and/or printed out on the optional printer) in tabular or graphical format, showing quantitative information as well as trends. Data is recorded frequently so time-resolution is excellent.

Ethernet and USB ports (with security) make it easy to archive and further analyze data.

Continuous, Reliable Data – **YES** False Alarms – **NO**

Our newest systems have multiple layers of protections and redundancy in both the software and the physical act of reporting an alarm, that prevent false alarms. This includes an alarm voting system so that alarms will come on only if all the data is consistent and conclusive The data is continuously recorded to allow human interpretation.

Each alarm activates fail-safe relays. Relay contacts are available to user to operate external devices.

Triggered Aliquot: This feature automatically collects and stores a small water sample for independent analysis whenever an alarm or event of interest occurs
UV Lamp: Used on inlet as algae-cide
Optional: Ozone System

3 GHz Computer Includes

3 GHz Processor, 600 Gig Hard Drive, 4 GIG Ram
USB Ports
Optional: Full Graphics Printer, Color and B/W

15" LCD Monitor, Keyboard, Mouse
10 Channel Data Acquisition Board, All Cables
Ethernet for hook up to your LAN

Windows Specific Software for Alpha, Beta, Gamma Counting. Software is easily customized by user for special needs.
Data from the 1024 channel MCA- multi-channel analyzer
Port: Full SCADA compatibility
Optional: MODBUS or DNP3 or other protocols

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Detect	PAG Level	Lower Limit of Sensitivity	Top of Range	Sensor Method Used		Maintenance
					Time	Action
ALPHA	**U-238** 3,000 pCi/l			Special Alpha Scintillator	3 mos	Replace Particulate Filter Cartridge
U-238	**30 min.** **24 hr**	2,000 pCi/l 500 pCi/l	2 x 10^7 pCi/l			
Po-210	**30 min.** **24 hr**	2,000 pCi/l 500 pCi/l	2 x 10^7 pCi/l			
BETA	**K-40** 30,000 pCi/l			5" dia. Dual PM Tube 1,000 ml Chamber	3-6 mos	Replace Particulate Filter Cartridge
Cs-137	**30 min.** **24 hr**	1,200 pCi/l 200 pCi/l	2 x 10^7 pCi/l	1100 cm^2 Beta Scintillator		
K-40	**30 min.** **24 hr**	30,000 pCi/l 100 pCi/l				
Sr-90	**30 min.** **24 hr**	200 pCi/l 15 pCi/l				
GAMMA	**Co-58** 30,000 pCi/l			MultiChannel Analyzer, Smart-Peak Detection Software	3-6 mos	Simple MCA Check
Co-58	**30 min.** **24 hr**	1,000 pCi/l 250 pCi/l	2 x 10^7 pCi/l	75 75 mm NaI(Tl) Crystal		
Co-60	**30 min.** **24 hr**	400 pCi/l 100 pCi/l				
I-131	**30 min.** **24 hr**	600 pCi/l 150 pCi/l				
OPTIONS:						
TRITIUM		20,000 pCi/l	1 x 10^6 pCi/l	Bed of Crushed Scintillation Crystals	1-3 mos	Replace Filter Cartridge
RADON		100 pCi/l	2,000 pCi/l		1-3 mos	Clean or Replace Vapor Trap
Pre-Condition						
Expel Radon						Clean or Replace Vapor Trap

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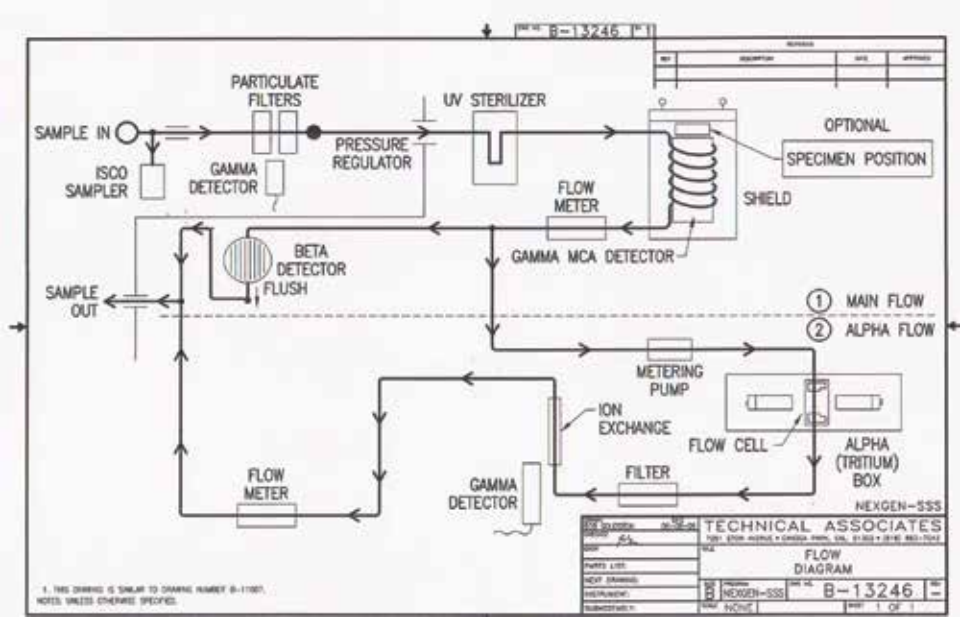
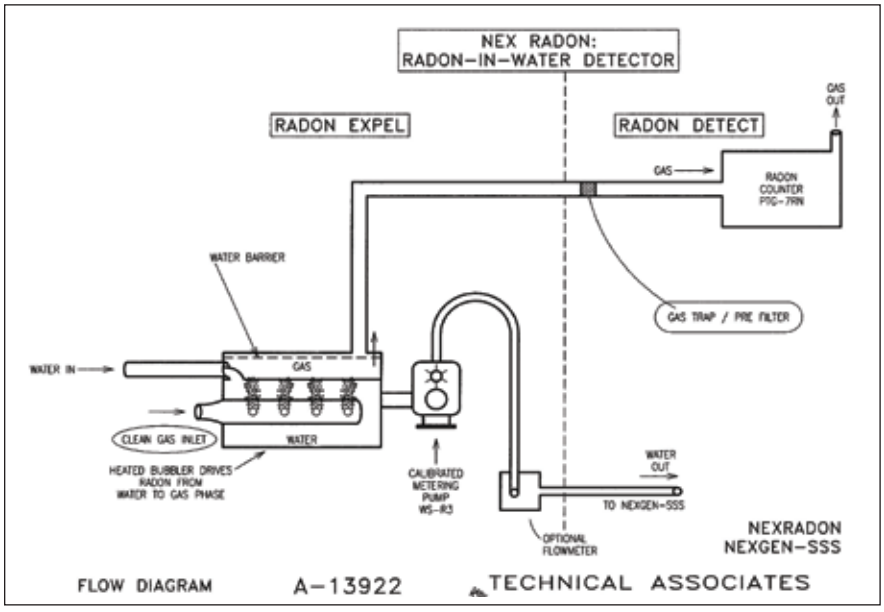


Main System Flow Chart

- Discharge water is clean and can go back into the source
- No liquid scintillate or reagents are added.
- No toxic or radioactive waste of any kind

Flow Path

- Water Inlet Port
- 15 – 90 PSIG (Typical)
- ISCO Sampler
- Particulate Filter (with Gamma Detector)
- Ulta Violet Sterilizer
- Gamma Spec Shield
- Main Gamma Detector with MCA
- Mass Flow Meter
- Metering Pump for Alpha Detector Loop
- Alpha Detector Flow Cell
- Alpha Loop Flow Meter



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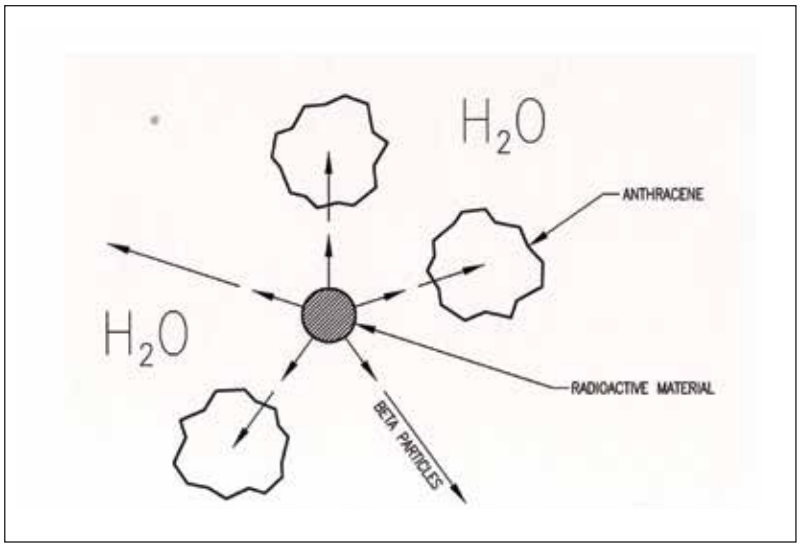
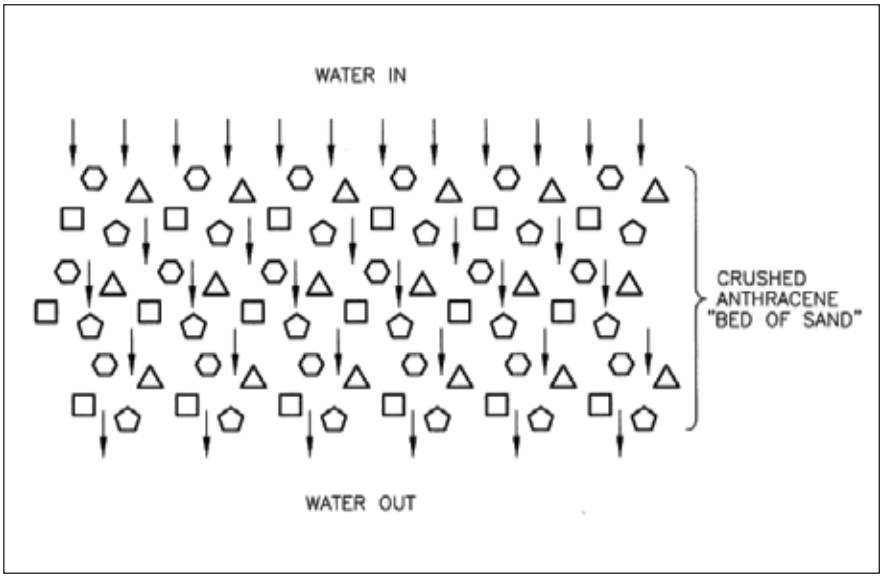
Optional Tritium Detection Process





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Specifications

System Flow Rate

Standard Main Flow: 10 l/minute
Alpha - Tritium Flow: 100 ml/minute

Optional: Very wide range of flow rates is available

Sample temperature standard:
Up to 80° F liquid (Optional to higher temperatures)

Ambient temperature:
65 - 100° F (Wider temperatures ranges Optional)

Optional: Cooler Model Cool-33 for detector and sample is used in case of higher sample or ambient temperatures.

Size and Weight

Dimensions: One cabinet: 34" wide x 31" deep x 72" high including wheels

Wheels: 5" dia, high capacity, rugged wheels with lock and rubber tires

Shipping Weight: Standard unit: 380kg - excluding shielding

Note: Lead shot for shielding can be shipped with or stripped separately or overseas customers may wish to buy lead shot locally.

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Filter Detectors

SPECIFICATIONS	PARTICULATE DETECTOR	ION EXCHANGE DETECTOR
Detector	Pre-filter	De-ionizer
Radiation detected	GAMMA	GAMMA
Materials monitored	Particulates	Dissolved metals and salts
Scintillator shape	2" x 2" dia	2" x 2" dia
Scintillating crystal	NaI Tl Spectroscopic grade	NaI Tl Spectroscopic grade
Shielding	None	None
More Shielding (Optional)	1/2" 2pi	1/2" 2pi

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MODEL	NexGen-SSS
MAJOR USE PROTECTIVE-ACTION GUIDELINE	**NEXT GENERATION WATER MONITOR**
Serve as Accident/Attack Alarm	
Serve as Alarm in case of major pollution event	
MEASURES AT OR BELOW	
Acute Health Effects Rad Level	Reads at Full Scale
Chronic RAD levels leading to severe health risk	Yes
Military Limits for Drinking Water	Yes
DHS Protective Action Guideline Levels	Yes
Public Drinking Water Limits	Send sample for lab analysis
DETECTS	
Detects Alpha and Beta as well as Gamma OPTIONAL: Tritium Detection	Has never been done before in real time, in liquids
False Alarm Protection	Yes
Action	Saves water sample for independent analysis
Local and remote Alarms	Yes
Local and remote data availability and data archive	Yes
Response Time	Prompt response – 2 min & 1 hr warn or alarms
Efficient	Continuous, automatic, unattended operation
Maintenance interval	30 days or longer see “Maintenance Schedule”
Serviceable	Easy Maintenance, low cost
Durability	Rugged, dependable
Customer Support	Annual upgrades are available on request
Software upgrades	No Charge
Hardware upgrades	At Cost

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Frequently Asked Questions

Question: Since the scintillation material is inside the cell and contacts the water sample directly, is it OK to measure drink water by this way?

What is done when contaminated water goes through? Does this mean when it is contaminated and background rises, then the whole detector should be replaced by a new one? Could customer replace by themselves on site, or a technician from your factory should travel to do this job?

You are correct, flow through style detectors can be subject to contamination.

Two points to consider (1) how susceptible is the Alpha flow cell to contamination and (2) how difficult is the corrective action.

(1) Susceptibility when measuring drinking water with possible low level contamination.

Please note that the **NexGen-SSS** system has particulate pre-filters that remove particulates from the water sample stream, so the Alpha emitters that flow through the Alpha detector are either dissolved (liquid phase) materials or else extremely fine (small) particles. Neither of these is likely to adhere to the scintillator material or the inner surfaces of the flow cell or to become trapped in the flow cell.

As you say, if over time, large amounts of Alpha emitters flow through the cell, the background level in the cell can increase enough to require detector replacement.

(2) Alpha Detector assembly replacement

Removal of the Alpha Detector assembly requires disconnection of two hoses, two quick disconnect (BNC) cables, four mounting bolts, draining or blowing out residual water and that is all. A fairly simple process.

(3) The old detector can be returned to TA for a trade-in allowance or to be refurbished and returned to the user as a back-up detector, if desired.

However if one or more **NexGen-SSS** will be used in a laboratory that handles high levels of Alpha emitters and thus possibly requiring frequent replacement or decontamination; then please let us know. Our engineering department can explore any appropriate design changes.

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FAQ

Question: About the Detectors

1. Alpha Detector Does Not Use a Particulate filter cartridge
   ALPHA: The **NexGen-SSS** Alpha Detector is a flow-through Alpha detection cell there is NO Alpha particulate filter to replace.
2. **There are two Beta detectors**
   BETA-1: The **NexGen-SSS** main Beta Detector is a flow-through Beta detection cell with NO Beta particulate filter to replace.
   BETA-2: The Detector labeled "Particulate Filters" also measures ENERGETIC Betas. This detector does use a filter.
3. **PAG Level**
   The **NexGen-SSS** detector and software easily allows simultaneous display and records in 30 minute, 24 hour and 48 hour (or longer) readings for EACH detector.

Question: Concerning long and short counting periods for radiation measurement for the purpose of detecting extremely low contamination levels:

Unlike measurement in many other fields that use analog sensors, radiation measurement consists of detecting, recording and analyzing a series of distinct pulses. This is why radiation measurement is often referred to as "counting."

The pulses we are interested in come from decay of a single radioactive atom in the water sample stream. Of course there are other pulses as well, that come from detector or circuit noise or from external radioactive materials.

The fact that we are counting pulses allows us to do statistical analysis and greatly improve our low end sensitivity, especially when we count for longer and longer periods.

Prior to computers and smart software, a water sample might be placed in a dish, and allowed to evaporate. Then the remaining solids were manually placed in drawer under a detector for one day, seven days or even longer.

The total counts were added up, and sometimes this process was repeated for another week etc. In this case the user had no information until the count was completed, a very frustrating, inefficient, time wasting and, depending on lab fees, costly process.

But now we have computers and smart programmers and we can do better. When water flows through a detector in the **NexGen-SSS** each pulse is recorded into multiple buffers that simultaneously count the pulses for different time periods.

The user can set these as he pleases, to 2 minutes, 1 hour, and 24 hours OR to 30 minutes, 24 hrs and 48 hrs OR other count times of their choice. The result is that the user gets a quick warning in case of high levels and also achieves excellent low end sensitivity over longer count times.

The on-screen display allows the user to view both the immediate count rate and the long term average which gives more and more precise value for the concentration of radioactivity in the water as each minute and each passes.

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2009 Revisions to the Protective Action Guides Manual for Radiological Incidents

Table 4-1 Derived Response Levels (DRLs) Associated with a Committed Effective Dose (CED) of 0.5 rem Resulting from 1 Year of Ingestion

DRLs (pCi/L)			DRLs (pCi/L)			DRLs (pCi/L)		
Column 1: Radionuclide	Column 6: Without Radioactive Decay	Column 7: With Radioactive Decay Only	Column 1: Radionuclide	Column 6: Without Radioactive Decay	Column 7: With Radioactive Decay Only	Column 1: Radionuclide	Column 6: Without Radioactive Decay	Column 7: With Radioactive Decay Only
H-3	4.42E+06	4.54E+06	Sn-125	6.01E+04	1.58E+06	Hg-203	9.69E+04	5.29E+05
C-14	3.19E+05	3.19E+05	Sn-126	3.87E+04	3.87E+04	Tl-204	1.56E+05	1.70E+05
Na-22	5.80E+04	6.61E+04	Sb-124	7.29E+04	3.11E+05	Pb-210	2.65E+02	2.70E+02
P-32	7.71E+04	1.37E+06	Sb-126	7.53E+04	1.54E+06	Bi-207	1.46E+05	1.47E+05
P-33	7.53E+05	7.50E+06	Sb-127	1.11E+05	7.28E+06	Bi-210	1.41E+05	7.11E+06
S-35	2.39E+05	7.31E+05	Te-127	1.10E+06	7.12E+08	Po-210	1.53E+02	3.33E+02
Cl-36	1.99E+05	1.99E+05	Te-129	2.94E+06	1.53E+10	Ra-226	6.59E+02	6.59E+02
K-40	3.00E+04	3.00E+04	Te-129m	6.23E+04	4.68E+05	Ac-227	5.76E+02	5.85E+02
Ca-45	2.60E+05	5.13E+05	Te-131m	9.49E+04	1.92E+07	Th-227	2.05E+04	2.77E+05
Sc-46	1.25E+05	3.97E+05	Te/I-132	4.86E+04	3.78E+06	U-235	3.96E+03	3.96E+03
Ti-44	3.19E+04	3.20E+04	I-125	1.20E+04	5.12E+04	U-238	4.15E+03	4.15E+03
V-48	9.34E+04	1.46E+06	I-129	1.75E+03	1.75E+03	Np-237	1.73E+03	1.73E+03
Cr-51	4.79E+06	4.37E+07	I-131	8.49E+03	2.67E+05	Np-239	2.32E+05	2.49E+07
Mn-54	2.57E+05	3.74E+05	Cs-134	9.63E+03	1.13E+04	Pu-236	2.13E+03	2.40E+03
Fe-55	5.57E+05	6.31E+05	Cs-136	6.01E+04	1.16E+06	Pu-238	8.12E+02	8.15E+02
Fe-59	1.03E+05	5.91E+05	Cs/Ba-137	1.36E+04	1.38E+04	Pu-239	7.37E+02	7.37E+02
Co-58	2.47E+05	9.09E+05	Ba-133	1.21E+05	1.25E+05	Pu-240	7.37E+02	7.37E+02
Co-60	5.39E+04	5.76E+04	Ba-140	7.12E+04	1.41E+06	Pu-241	3.89E+04	3.99E+04
Ni-63	1.22E+06	1.22E+06	La-140	9.16E+04	1.38E+07	Pu-242	7.77E+02	7.77E+02
Zn-65	4.69E+04	7.54E+04	Ce-141	2.60E+05	2.03E+06	Am-241	9.07E+02	9.08E+02
Ge-68	1.44E+05	2.16E+05	Ce-143	1.65E+05	3.04E+07	Am-242m	9.69E+02	9.71E+02
Se-75	7.09E+04	1.70E+05	Ce/Pr-144	3.53E+04	5.33E+04	Am-243	9.12E+02	9.12E+02
Rb-86	6.59E+04	8.92E+05	Nd-147	1.71E+05	3.94E+06	Cm-242	1.58E+04	3.12E+04
Sr-89	7.20E+04	3.63E+05	Pm-145	1.60E+06	1.63E+06	Cm-243	1.24E+03	1.26E+03
Sr-90	6.65E+03	6.73E+03	Pm-147	7.09E+05	8.07E+05	Cm-244	1.51E+03	1.53E+03
Y-90	6.88E+04	6.53E+06	Pm-149	1.86E+05	2.13E+07	Cm-245	8.90E+02	8.90E+02
Y-91	7.81E+04	3.41E+05	Pm-151	2.53E+05	5.41E+07	Cm-246	8.94E+02	8.94E+02
Zr-93	1.67E+05	1.67E+05	Sm-151	1.89E+06	1.89E+06	Cf-252	1.95E+03	2.21E+03
Zr-95	1.92E+05	7.73E+05	Eu-152	1.35E+05	1.39E+05			
Nb-94	1.06E+05	1.06E+05	Eu-154	9.07E+04	9.43E+04			
Nb-95	3.14E+05	2.26E+06	Eu-155	5.66E+05	6.07E+05			
Mo-99	3.06E+05	2.81E+07	Gd-153	6.65E+05	1.07E+06			
Tc-99	2.88E+05	2.88E+05	Tb-160	1.15E+05	4.15E+05			
Ru-103	2.52E+05	1.62E+06	Ho-166m	9.34E+04	9.35E+04			
Ru/Rh-106	2.64E+04	3.65E+04	Tm-170	1.40E+05	3.20E+05			
Ag-110m	6.65E+04	1.06E+05	Yb-169	2.60E+05	2.06E+06			
Cd-109	9.26E+04	1.20E+05	Hf-181	1.65E+05	9.84E+05			
Cd-113m	8.05E+03	8.26E+03	Ta-182	1.20E+05	2.97E+05			
In-114m	4.54E+04	2.33E+05	W-187	2.94E+05	7.47E+07			
Sn-113	2.51E+05	6.20E+05	Ir-192	1.35E+05	4.77E+05			
Sn-123	8.82E+04	2.01E+05	Au-198	1.80E+05	1.69E+07			

CBRN Real - Time Air & Water Specialists

TECHNICAL ASSOCIATES
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