# RADIATION MONITOR
# FOR WATER & EFFLUENT DISCHARGE

## REAL-TIME CONTINUOUS

**Model ~ Nex-Beta**

**FEATURES:**

- AVAILABLE IN DESKTOP OR PORTABLE SYSTEMS
- MEASURES AT OR BELOW EPA/DHS PAG LEVELS
  Protective Action Guideline levels and Military Drinking water limits
- REAL TIME, IN-LINE, CONTINUOUS
- HIGH SENSITIVITY TO BETAS (low sensitivity to Gammas)
- NO REAGENT TANKS TO FILL
- NO WASTE STREAM
- EASY CALIBRATION
- PREVENT ACUTE HEALTH EFFECTS
- REDUCE RISK OF CHRONIC EXPOSURE
- WORLD'S ONLY PAG-LEVEL **β WATER MONITOR**

**NEX-BETA allows radiation users to be good community members by controlling & measuring their effluent.**

**APPLICATION:**

**USERS:**

- Hospitals
- Power Plants
- Oil & Gas Extraction
- National Laboratories

**USE FOR:**

- Internal Testing
- Locate Problems / Leaks
- Develop Compliance Strategies

**DETECT:**

I-131, Sr-90, Sr-89, Cs-137, Cs-134 etc.

**The PRIMARY Radioactive contaminants in water are Beta emitters.**
**NOW there is instrumentation to detect these Beta emitters in water.**

- Monitor drinking water against **any & all Beta Emitter Contaminants** except H-3, C-14, S-35
- Monitor for contamination in ground or surface water
- Monitor liquid-waste-stream from laboratory or plant


CBRN Real - Time Air & Water Specialists

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| NUCLIDE | BETA ENERGY | SECONDARY BETA |
|---|---|---|
| Sr-89 | 1,481 KeV | |
| Sr-90 | 546 KeV | |
| Y-90 | 2270 KeV | |
| Mo-90 | 1230 KeV | |
| Tc-99 | 292 KeV | |
| I-131 | 606 KeV | |
| Cs-134 | 662 KeV | |
| Cs-136 | 341 KeV | 650 KeV 7% |
| Cs-137 | 514 KeV | 1176 KeV 7% |

Many labs, universities, hospitals, government and pharmaceutical facilities handle some liquid radioactivity. Some portion of this is collected as radioactive waste and sent for storage or burial. But a significant portion goes down the drain directly or into short term storage tanks. More and more of this is being seen as a hazard by regulators or community members.

The solution is for the various facilities to quantitate these materials to make sure the liquid effluent or waste water is being disposed of into the correct flow path.

Technical Associates Models, the **NEX-BETA** and **NEX-BETA-ABG,** are designed especially for this purpose of quantitating waste water and liquid effluent.

## PROBLEM:

Ground water and drinking water sources are vulnerable to contaminants coming from a variety of sources.

These include but are not limited to hospitals, power plants, oil exploration and other industrial uses, accidental or knowing contamination by individuals, groups, and from naturally occurring radioactive materials (NORM). This is especially true for Isotopes: I-131, Sr-90/Y-90, & Cs-137.

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

## SOLUTION:

For the first time in a **Continuous Real-Time radiation water monitor** the Model **NEX-BETA** solves this problem by continuously monitoring the water using ultra-sensitive, Beta radiation detector.

The information from this detector is analyzed and displayed in units of picoCuries per liter. The count times are user settable & calculations are automatically updated every 2 minutes, every hour and every day. Measurements of radiation concentration and total discharge are logged 24 hr/day, 7 day/week.

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 (PAG) for drinking water. Please see attached chart of measurements.

Using TA Tried and True sample collection & measurement technology this detector measures Beta emissions from any radioactive liquids.

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## DESCRIPTION:

Model **NEX-BETA** is a Beta detector water monitor /controller for measuring of Beta emitting radio nuclides. The electronics are microprocessor with LED/LCD display with plug in modules facilitating quick change or addition of functions at a later date. Modular design allows for 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 service contracts available in many areas.

The Beta flow cell is easily changed via quick disconnect fittings. 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. System can also be operated using city water pressure in which case no pump is required.

A wide range of pump capacities are available to meet users specific needs. The system electronics is mounted in a rugged cabinet. It 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.

## Beta Detector Assembly:

- Beta Detector: Consists of a light-tight detector assembly which interfaces with the sample via quick disconnect coax cables and medical grade hoses. The sample is viewed by a matched pair of 5" diameter photo-multiplier tubes.
- Beta Scintillation detector has 1,100cm$^2$ sensitive area.

**The Beta pulse analysis portion** of this system conditions and analyzes the output from the photo-multiplier tubes by pulse height, duration and coincidence.

In this way the system is able to eliminate 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.

| DETECT | PAG LEVEL | LOWER LIMIT of SENSITIVITY | TOP OF RANGE | SENSOR / METHOD USED | | MAINTENANCE for finished water |
|---|---|---|---|---|---|---|
| | | True for both models | | | **TIME** | **ACTION** |
| **Beta** | **K-40** 30,000 pCi/l | | | 5" dia. Dual PM Tube 1000ml chamber | 3--6 mo | Replace particulate pre-filter cartridge |
| 30 min<br>24 hr | | 30,000 pCi/l<br>10,000 pCi/l | 2 x $10^7$pCi/l | 1100cm$^2$ Beta Scintillator | | |
| | | | | | | |
| **OPTIONS:** | | **LOWER LIMIT** | **TOP OF RANGE** | | | |
| **DETECT** | | | | | | |
| **Tritium** | | 20,000pCi/l | 1 x $10^6$pCi/l | Crushed scintillation bed of crystals | | Replace ion exchange cartridge |
| **Radon** | | 100pCi/liter | 2000pCi/liter | | 1-3 mo | Clean or replace vapor trap |
| **PRE- CONDITION** | | | | | | |
| **Expel Radon** | | | | | 1-3 mo | Clean or replace vapor trap |


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## SPECIFICATIONS:

**Alarms:** Each alarm activates a relay. Relay alarms are available to the user.

**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 & sample is used in case of higher sample or ambient temperatures.

**SIZE AND WEIGHT:**

**Dimensions:** One assembly: 14” wide x 29” tall including wheels
Electronics may be separated from detector electronics.

**Electronics:** 7” wide x 10” tall (23lbs)

**Shipping weight:** **S**tandard unit: 22Kg - excluding optional shielding

**NOTE:** Optional thin Lead Sheet for shielding can be shipped with or shipped separately or overseas customers may wish to buy the lead sheet locally.

## Data: - Analysis – Display - Archive ~ NEX-BETA

The concentration and total activity released and MDA levels are continuously calculated and recorded.

All data can be saved to the hard drive in spreadsheet format.

**NEX-BETA Electronics**



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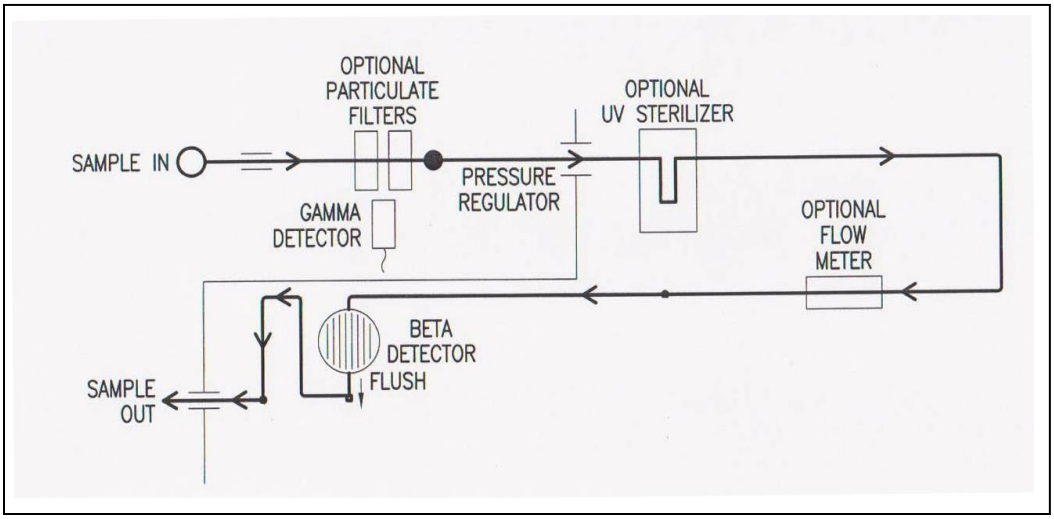
### FLOW CHART




## Flow Path

- Water Inlet port
- Pressure relief valve
- Particulate Pre-Filter (with optional Gamma Detector) Ultra Violet Sterilizer (Optional)
- Mass Flow Meter (Optional)

Discharge water is clean and can go back into drinking water line.

No liquid scintillant or reagents are added

No toxic or radioactive waste of any kind.

| | NEX-BETA |
|---|---|
| **Read-out Units (Typical)** | Bq/m3 pCi/l |
| **Measures** | Waterborne Concentration |
| **Upgraded Hardware** | Calculations by Imbedded Processor in NEX-BETA-9 |
| **Available options** | Optional Electronic mass flowmeter |


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**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 In-114m Sn-113 | 8.05E+03 | 8.26E+03 | Ta-182 | 1.20E+05 | 2.97E+05 | | | |
| | 4.54E+04 | 2.33E+05 | W-187 | 2.94E+05 | 7.47E+07 | | | |
| | 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 | | | |

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