Highly Sensitive for Nuclear Power Plants

Real-Time Continuous Water Monitor

Model: NPP-H_2O and NPP-H_2O-G
NPP-GAMMA, NPP-GAMMA-G,
NPP-BETA, NPP-ALPHA

Features

- World's Only PAG-level αβγ Water Monitor
- Measures at or Below EPA/dhs PAG-Levels (EPA's Protective Action Guideline Levels)
- Real Time, In-Line, Continuous
- Detects Alphas, Betas and Gammas
- Gamma-MCA Isotope Identifier
- Detector Type: Nai (Tl) Or HPGe
- Tritium and C-14 **Optional Detection**
- No Reagent Tanks to Fill
- No Waste Stream
- Easy Calibration
- Full SCADA Compatibility

Problem

Most nuclear power stations have high range water monitors for monitoring coolant leaks, but low range water monitors for real-time, on-line use have not been available until now. Very few nuclear power plants have real-time radiation monitors in place to **protect the water and the public, to spot problems early, and to ensure compliance with current regulations.**

Solution

For the first time in a **Continuous Real-Time Water Monitor** the Model ***NPP-H_2O*** solves this problem by continuously monitoring the water using Alpha, Beta and Gamma detectors and Gamma-MCA identifiers. Determines and identifies individual radionuclides.

Sources of Radioactive Material

- Coolant leaks into pipes or
- Drains
- Deposition of air borne materials
- Make-up water

Location of Contaminated Water

Onsite "Inventory"

- Pipes, drains, pools, surface water

Underground

- Drainage pipe
- Vado – zone / soil air

In the Aquifer

Crossing site boundaries

- Liquid waste stream
- Storm drains

Off-Site/Environmental

- Surface Water
- Rivers
- Local drinking water

CBRN Real - Time Air & Water Specialists

TECHNICAL ASSOCIATES
OVERHOFF TECHNOLOGY

DIVISIONS OF US NUCLEAR CORP

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Description

Model NPP-H_2O 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 quick change, addition of functions, and rapid repair 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. The Gamma Spec shield can be opened for cleaning with little effort. All connections are sealed against leaks. The standard water moving system is based on a high precision pump with a 10 liter per minute capacity.

A wide range of pump capacities are available to meet user's specific needs. The entire system is mounted in a wheeled, self-contained rugged cabinet. The NPP-H_2O 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.

System has Three Principal Detectors

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.

Measurement of Gamma-Emitter Content

An advanced high definition multi-channel analyzer (MCA) with drift free operation is utilized. The energy range is user settable. For example the MCA can be set for Gamma energy of 10 KeV to 3 MeV, (or 10 MeV).

This system consists of NaI (Tl) Scintillation crystals, a photomultiplier tube and provides pulse height and duration analysis. Sensitivity is enhanced with a high gain, low noise pre amp.

Use of the HPGe solid state consists of an intrinsic Germanium P-Type Coaxial detector. High count and excellent baseline are achieved.

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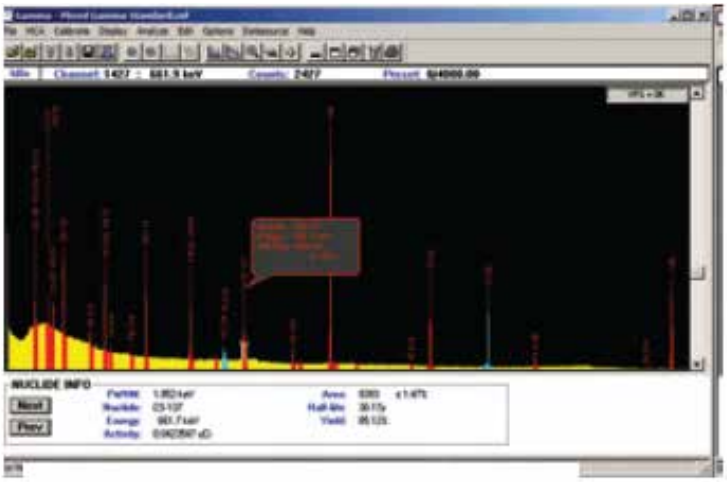
Peak Detection Isotope Identification System

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 the water.

GAMMA-MCA ISOTOPE INDENTIFIER



DATA: Analysis - Display - Hard - Copy - Archive

In each peak or area of interest, the net counts are automatically converted to user settable units, of picoCuries/liter or KBq/m^3 (using the detector efficiencies automatically measured and stored previously by 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. All data is saved to the hard drive in spreadsheet format.

Historical data is easily displayed on-screen and may be printed out with optional graphics printer in tabular or graphical format, showing quantitative information as well as trends. Data is recorded frequently providing excellent time-resolution.

Ethernet and USB ports (with security) provides easy access for archiving and further data analysis.

Continuous, Reliable Data – YES False Alarms – NO

Our systems have multiple layers of protections and redundancy in both the software and the physical act of reporting an alarm which prevents false alarms. This can include an optional alarm voting system providing activation of alarms only if all the data is consistent and conclusive. Data is continuously recorded to allow user interpretation.

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

Optional Triggered Aliquot: This feature automatically collects and stores a small water sample for independent analysis whenever an alarm or event of interest occurs.

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System includes

UV Lamp: Used on inlet as algae-cide
Flat Screen Monitor: LCD High Color Graphics
Hard Drive: 1 Terabyte
DATA Acquisition: Board and All Cables
High Speed Ethernet access: LAN or SCADA hookup
Specialized software: Designed for Gamma Spectrum Detection; user friendly adaptability for your needs
Optional: MODBUS or other protocols

System Flow Rate

Optional: Per Customer Requirement:
Very wide range of flow rates is available
Sample temperature standard: Up to 80° F liquid (optional to higher temperatures)
Ambient temperature: 65° F - 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 AND/OR for increased precision measurements

Note for Selection of *INTRINSIC HPGe* DETECTOR ~ NPP-H_2O-G or NPP-GAMMA-G:

NPP-H2O-G or NPP-GAMMA-G Systems include an installed Dewar to maintain HPGe crystal at proper temperature range.
Optional: An electronic cryo-cooler is available
A sample pre-**Cooler-33-G** includes an installed in the **NPP-H_2O-G or NPP-GAMMA-G** system

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 / 837 lbs - excluding shielding
Note: Lead Shot for shielding can be shipped with instrument or shipped separately
Overseas customers may wish to buy locally

SPECIFICATIONS	PARTICULATE DETECTOR	PRINCIPAL DETECTOR CHOICES	
Monitoring	Pre-Filter	Sample Flow	Sample Flow
Radiation Detected	GAMMA	GAMMA	GAMMA
Materials Monitored	Particulates	Water Borne Radioactivity	Water Borne Radioactivity
Scintillator Shape	2" x 2"	3" x 3"	3" x 3"
Scintillating Crystal	NaI (TI) Spectroscopic Grade	NaI (TI) Spectroscopic Grade	Intrinsic HPGe
Shielding	None – Standard ½" Recommended	2" Standard	2" Standard

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DETECT	PAG LEVEL	LOWER LIMIT OF SENSITIVITY	TOP OF RANGE	SENSOR/METHOD USED	TIME	MAINTENANCE ACTION FOR FINISHED WATER
NPP-Alpha	**U-238** 3,000 pCi/l			5" dia. Dual PM Tube, crushed scintillation bed of crystals	3-6 mos	Replace particulate filter cartridge
30 min 24 hr		25,000 pCi/l 3,000 pCi/l	2×10^7 pCi/l			
NPP-Beta	**K-40** 30,000 pci/l			5" dia. Dual PM Tube, 1,000 mi chamber	3-6 mos	Replace particulate filter cartridge
30 min 24 hr		30,000 pCi/l 3,000 pCi/l	2×10^7 pCi/l	1100 cm^2 Beta Scintillator		
OPTIONS						
NPP-Tritium		0.2 µCi/l	1×10^6 pCi/l	Crushed scintillation bed of crystals	As Needed	Replace pre-filter
NPP C-14		20,000 pCi/l	1×10^6 pCi/l	Crushed scintillation bed of crystals	As Needed	Replace pre-filter
NPP-Radon		100 pCi/l	2,000 pCi/l		1-3 mos	Clean or replace vapor trap
PRE-CONDITION						
Expel Radon					As Needed	Clean or replace vapor trap

Single Channel Systems Are Available: NPP- GAMMA, NPP-BETA, and NPP-ALPHA

	GAMMA DETECTION LIMITS				
ISOTOPE	**LOW**	**LOW**	**HIGH**	**SENSOR METHOD**	
				RESPONSE RATE - SLOW	**RESPONSE RATE - FAST**
^{58}Co	3.7×10^{-1} KBq/m^3	10 pCi/L	1×10^7	3" x 3" NaI (Tl) Crystal	Intrinsic HPGe
^{60}Co	1×10^0 KBq/m^3	27 pCi/L	1×10^7	3" x 3" NaI (Tl) Crystal	Intrinsic HPGe
^{131}I	5×10^{-1} KBq/m^3	13.5 pCi/L	3×10^6	3" x 3" NaI (Tl) Crystal	Intrinsic HPGe
^{137}Cs	6×10^{-1} KBq/m^3	16.2 pCi/L	6×10^6	3" x 3" NaI (Tl) Crystal	Intrinsic HPGe

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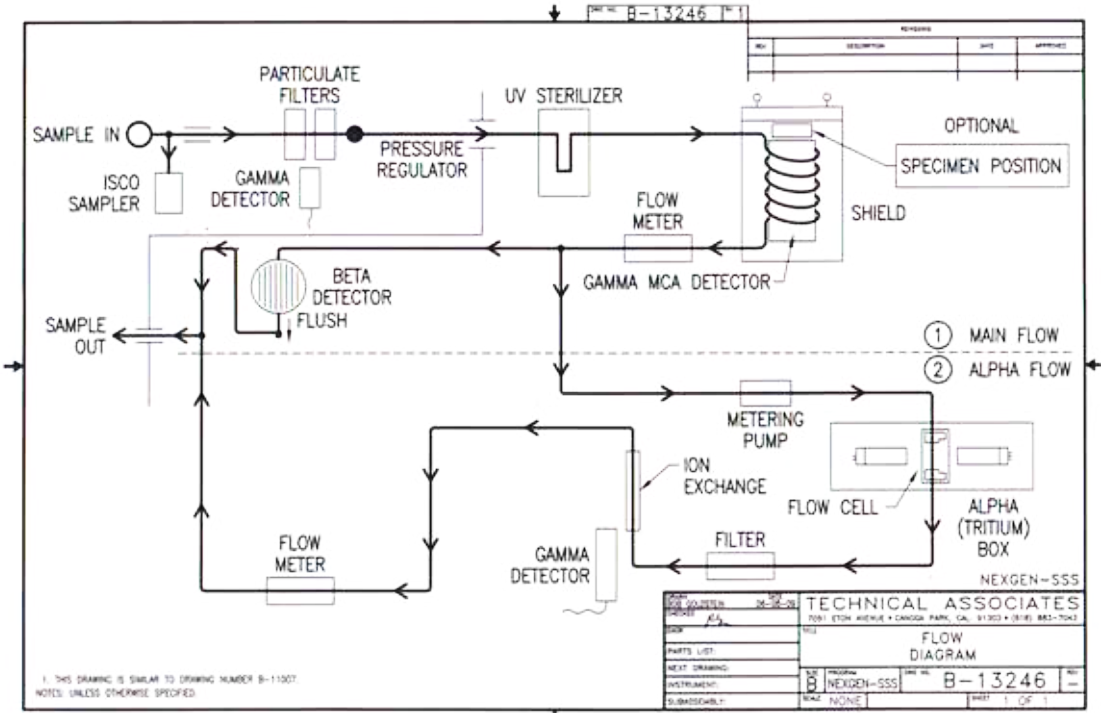

NPP-H_2O FLOW CHART

FLOW PATH			
1	Water Inlet port	11	Alpha Loop flow meter
2	Pressure relief valve	12	Ion Exchange with gamma detector
3	ISCO Sampler	13	Discharge water is clean and can go back into drinking water line
4	Particulate Filter (with Gamma Detector)	14	No liquid scintillate or reagents are added
5	Ultra Violet Sterilizer	15	No toxic or radioactive waste of any kind
6	Gamma spec shield		
7	Main Gamma Detector with MCA		
8	Mass Flow Meter		
9	Metering pump for Alpha detector loop		
10	Alpha Detector flow cell (with Anthracene crystals)		

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DESIGN CRITERIA

MODEL	NPP-H_2O
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	
Detect alpha and beta as well as gamma	Has never been done before in real time, in liquids
False Alarm Protection	Yes
Action	Save water sample
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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