

# HIGHLY SENSITIVE FOR NUCLEAR POWER PLANTS

## Real-Time Continuous Water Monitor

Model ~ NPP-H<sub>2</sub>O & NPP-H<sub>2</sub>O-G

NPP-GAMMA ~ NPP-GAMMA-G ~ NPP-BETA ~ NPP-ALPHA

### FEATURES:

- WORLD'S ONLY PAG-LEVEL  $\alpha\beta\gamma$  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 (TI) 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<sub>2</sub>O** 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



#### **TECHNICAL ASSOCIATES OVERHOFF TECHNOLOGY**

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### DESCRIPTION:

**Model NPP-H<sub>2</sub>O** 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 warranties 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<sub>2</sub>O** 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<sup>2</sup>.

#### 3. Gamma Detectors:

Choice of NaI (TI) 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 (TI) 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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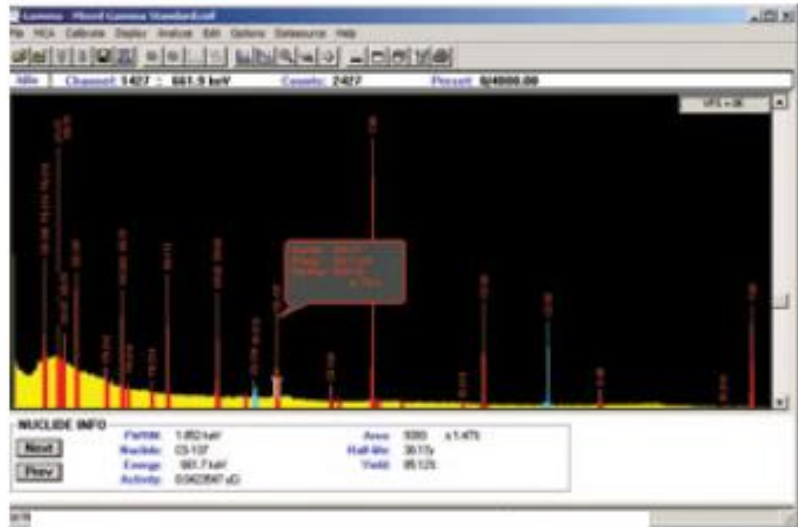
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### Peak Detection Isotope Identification System

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 IDENTIFIER



### 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<sup>3</sup> (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 & 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<sub>2</sub>O-G or NPP-GAMMA-G:

**NPP-H<sub>2</sub>O-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<sub>2</sub>O-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 & 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	Nal (Tl) Spectroscopic Grade	Nal (Tl) 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	$2 \times 10^7$ 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	$2 \times 10^7$ pCi/l	1100 cm <sup>2</sup> Beta Scintillator		
<b>OPTIONS</b>						
NPP-Tritium		0.2 µCi/l	$1 \times 10^6$ pCi/l	Crushed scintillation bed of crystals	As Needed	Replace pre-filter
NPP C-14		20,000 pCi/l	$1 \times 10^6$ 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 ~ NPP-ALPHA**

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



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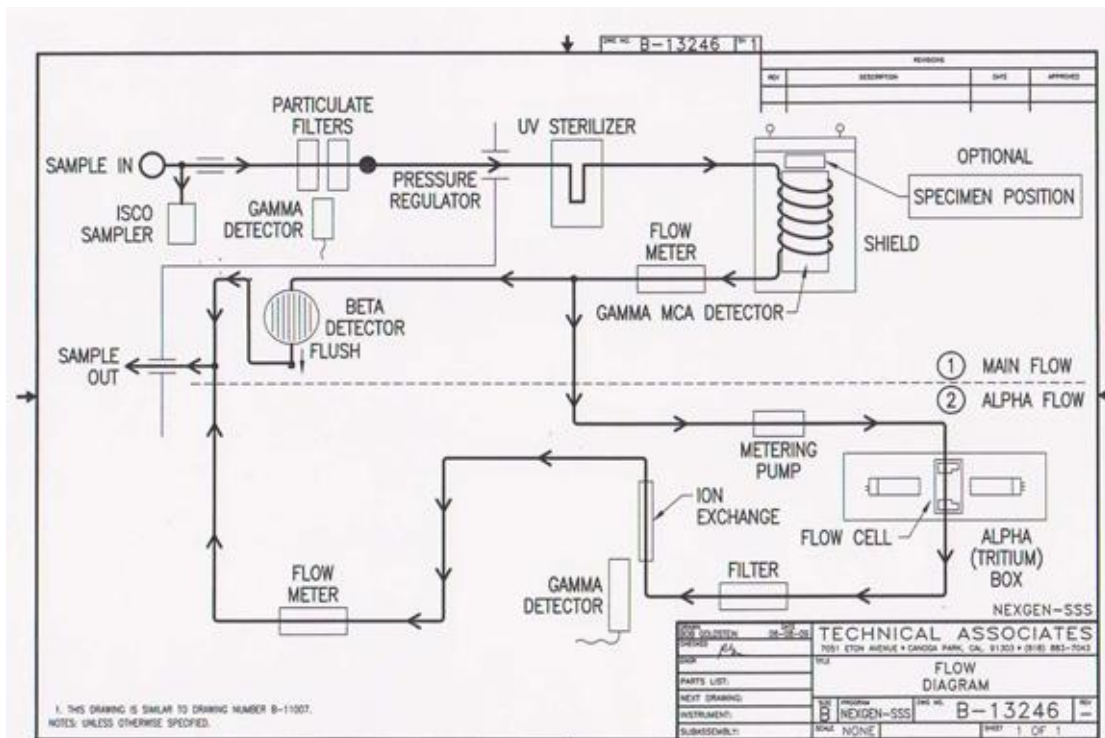
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**NPP-H<sub>2</sub>O FLOW CHART**

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 <sub>2</sub> O
<b>MAJOR USE</b>	<b>NEXT GENERATION WATER MONITOR</b>
<b>PROTECTIVE-ACTION GUIDELINE</b>	
Serve as Accident/Attack Alarm	
Serve as Alarm in case of major pollution event	
<b>MEASURES AT OR BELOW</b>	
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
<b>DETECTS</b>	
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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