MOLTEN SALT THORIUM REACTOR WATER MONITOR
Real-Time Continuous Water Monitor

THORIUM, TRITIUM, & OTHER NUCLIDES

Model – MSTR-H_2O

•FEATURES:

- REAL TIME, IN-LINE, CONTINUOUS
- DETECTS:
  - ALPHAS (including THORIUM 232 & Uranium 238)
  - BETAS
  - GAMMAS
  - TRITIUM
- NO REAGENT TANKS TO FILL
- NO WASTE STREAM
- EASY CALIBRATION
- PREVENT ACUTE HEALTH EFFECTS
- REDUCE RISK OF CHRONIC EXPOSURE
- Full SCADA compatibility

PROBLEM:

Molten Salt Thorium Reactors are now under development in the U.S., China, India,and Japan. They have a unique architecture and require unique radiation monitoring instrumentation.

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. So, as yet very few 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 **MSTR-H_2O** solves this problem by continuously monitoring water measuring Thorium 232, its decay products, fission products, and its activation products including Tritium.

Using Alpha, Beta and Gamma, and Tritium detectors and Gamma-MCA isotope identifier (multi-channel analyzer) the information from these detectors is analyzed and displayed in units of picoCuries per liter. The calculations are updated every 2 minutes, every hour and every day. The longer update times correspond with greater precision and increased sensitivity. Using TA Tried and True sample collection & measurement technology these detectors measure Alpha, Beta and Gamma from any radioactive liquids. Measurements of radiation discharge concentration are logged 24 hr/day, 7 days a week.

TA CBRN Real - Time Air & Water Specialists

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Sources of Water Borne Radioactive Material

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

APPLICATION: MSTR-H_20

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

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DESCRIPTION:

MSTR-H2O Model 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.

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.

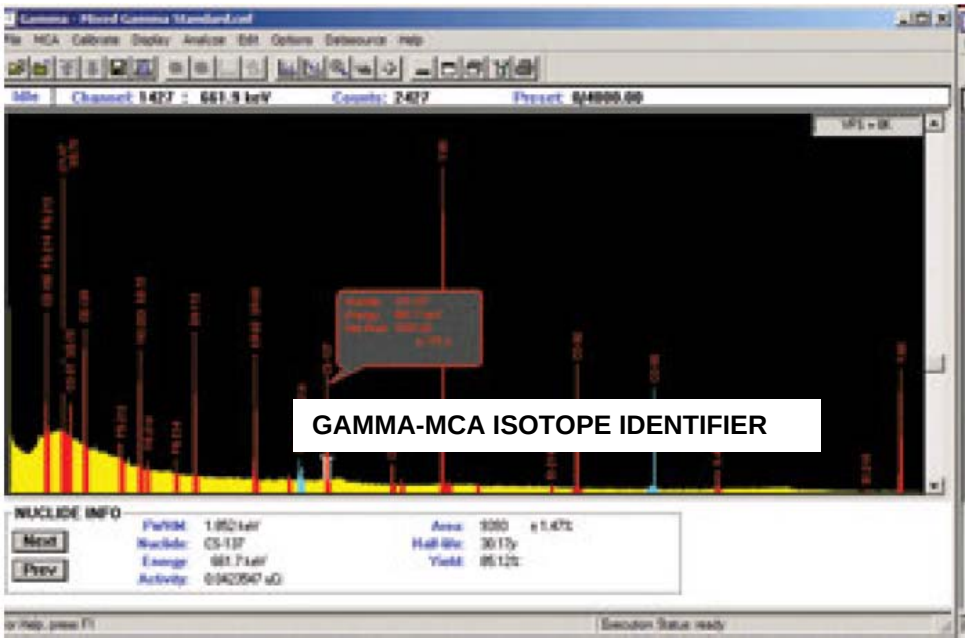
A wide range of pump capacities are available to meet users specific needs. The entire system is mounted in a wheeled, self-contained rugged cabinet. The **MSTR-H2O** comes complete with all cabling tubing and connectors in place and is ready to operate. 115 Volt 60Hz is standard; 220 Volt 50/60 Hz is optional.

The modular system is covered by TA's unique exchange warranty system in addition to the full one year warranty. On-site warrantees are 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.

Four Principal Detectors:

1. Alpha Detector includes Thorium 232: Alpha scintillation sheets that consist 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.

2. Beta Scintillation detector: With a 1,100cm^2 sensitive area.



GAMMA-MCA ISOTOPE IDENTIFIER

The Alpha, Beta Pulse Analysis:

Conditions and analyzes the output from the photo-multiplier tubes by pulse height, duration and coincidence. This permits the system 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.

3. Gamma-MCA analyzer: The water is measured for Gamma-emitter content with greater than 1,000 channels. 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).

4. Tritium Detector: Scintillation sheets that consist 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.

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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 the water.

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 **MSTR-H_2O** 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 may be printed out with optional graphics 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 systems have multiple layers of protections and redundancy in both the software and the physical act of reporting an alarm preventing false alarms. This includes an alarm voting system so that alarms will come on only if all the data is consistent and conclusive Data is continuously recorded to allow human interpretation.
- Each alarm activates fail-safe relays. Relay contacts are available to user.

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
	Printer
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 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.

SIZE AND WEIGHT:

Dimensions: One cabinet: 23" wide X 31" deep X 36" 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
Monitoring	Pre-Filter	Sample Flow
Radiation Detected	GAMMA	GAMMA
Materials Monitored	Particulates	Water Borne Radioactivity
Scintillator Shape	2” x 2”	3” x 3”
Scintillating Crystal	NaI (TI) Spectroscopic Grade	NaI (TI) Spectroscopic Grade
Shielding	None – Standard ½” Recommended	2” Standard

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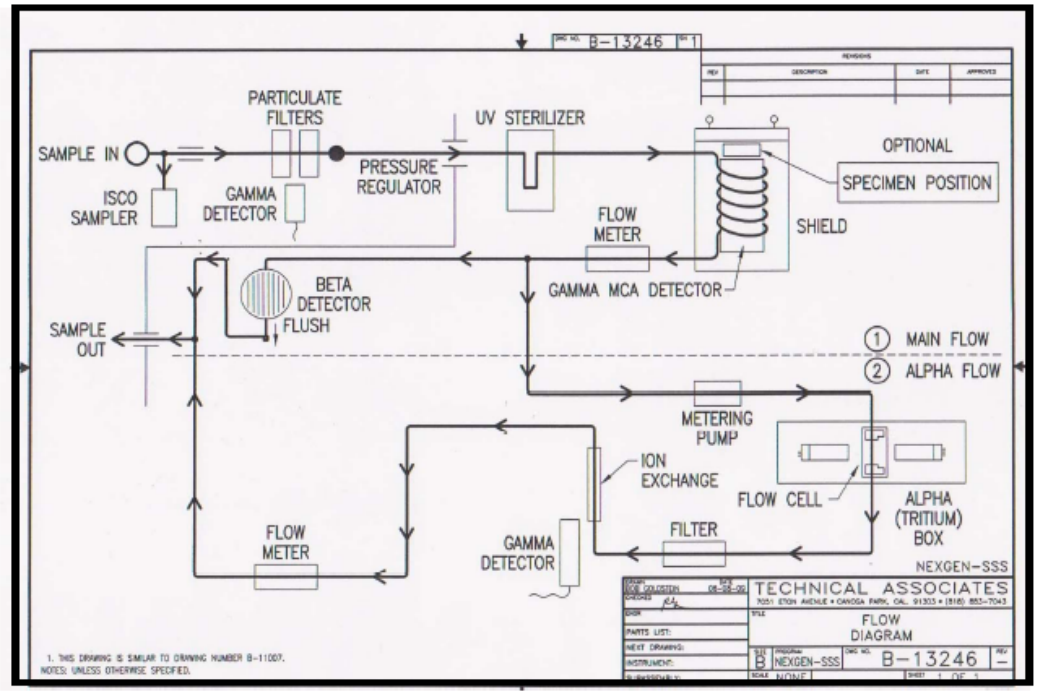
FLOW CHART



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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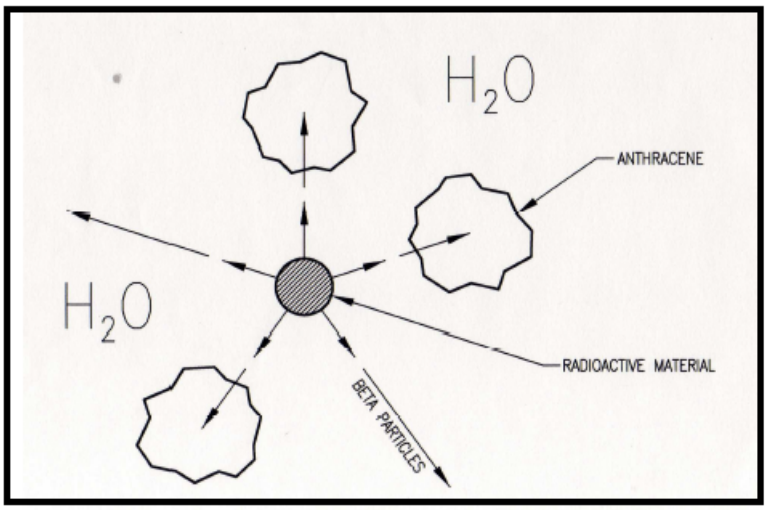
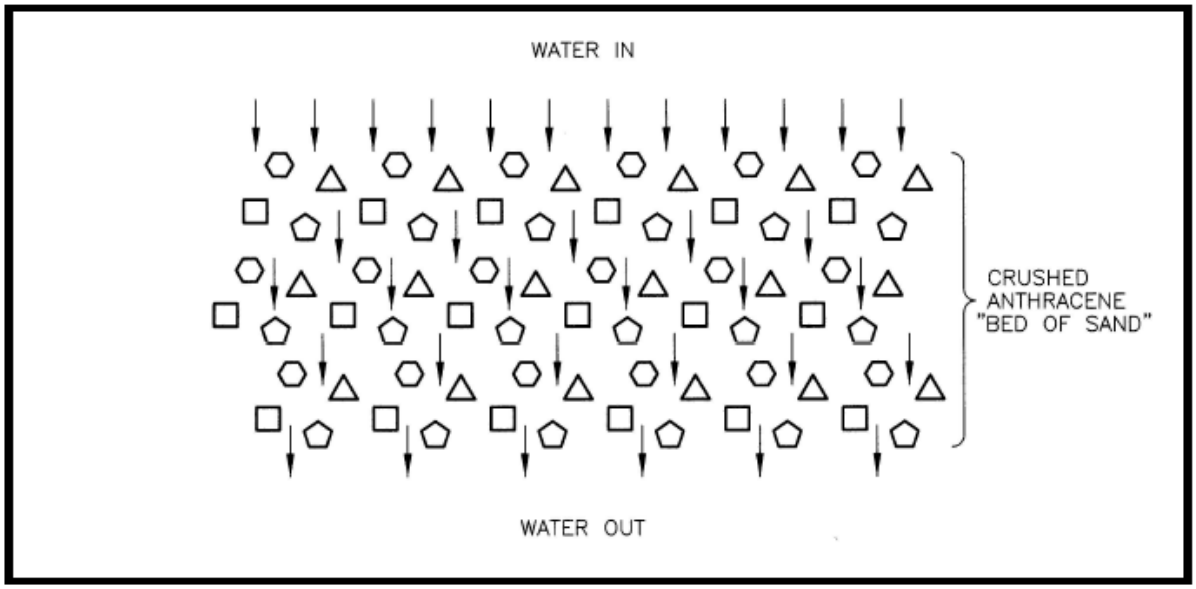
ANTHRACENE SCINTILLATE





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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	**Thorium-232** **U-238** 3,000 pCi/l			5" dia. Dual PM Tube, crushed scintillation bed of crystals	3 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		
NPP-Gamma	**Co-58** 30,000 pci/l			Multi-Channel Analyzer, Smart Peak Detection Software	3-6 mos	Simple MCA check
30 min 24 hr		20,000 pCi/l 5,000 pci/l	2×10^7 pCi/l	75 x 75 mm Nal (TL) Crystal		
OPTIONS						
NPP-Tritium & C-14		20,000 pci/l	1 x 106 pCi/l	Crushed scintillation bed of crystals		Replace ion exchange cartridge
NPP-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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