

MOLTEN SALT THORIUM REACTOR WATER MONITOR

Real-Time Continuous Water Monitor

钍基熔盐堆水监测器
实时连续水监测器

THORIUM, TRITIUM, & OTHER NUCLIDES

钍、氚、其它核素
Model – MSTR-H₂O

•FEATURES: 特点

- REAL TIME, IN-LINE, CONTINUOUS
- 实时、在线、连续
- DETECTS: 检测:
 - ALPHAS (including THORIUM 232 & Uranium 238)
 - α (包括钍-232 & 铀-238)
 - BETAS
 - β
 - GAMMAS
 - γ
 - TRITIUM
 - 氚
- NO REAGENT TANKS TO FILL
- 无需填充试剂
- NO WASTE STREAM
- 无废水流
- EASY CALIBRATION
- 容易刻度
- PREVENT ACUTE HEALTH EFFECTS
- 预防急性健康影响
- REDUCE RISK OF CHRONIC EXPOSURE
- 减少慢性辐射暴露危险
- Full SCADA compatibility
- SCADA全兼容



TECHNICAL ASSOCIATES OVERHOFF TECHNOLOGY

7051 Eton Ave., Canoga Park, CA 91303
818-883-7043 (Phone) 818-883-6103 (Fax)

tagold@nwc.net

WWW.TECH-ASSOCIATES.COM

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PROBLEM: 问题:

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.

现在美国，中国，印度和日本在建钍基熔盐堆，基于其结构特殊性，要求特殊辐射监测设备。

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.**

大多数核电站安装了用于监测冷却剂泄露的高量程水监测器，但是用于实时在线的低量程水监测器直到现在才出现，因此很少有核电站现场安装实时辐射监测器以保护水和公众，及时锁定问题，确保符合目前规定。

SOLUTION: 方案

For the first time in a **Continuous Real Time** water monitor the Model **MSTR-H₂O** solves this problem by continuously monitoring water measuring Thorium 232, its decay products, fission products, and its activation products including Tritium.

首次，**连续实时水监测器MSTR-H₂O** 通过连续测量水中钍-232，其衰变产物，裂变产物和包括氚在内的活化产物来解决这个问题。

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.

使用 α β γ 和氚监测器和**Gamma-MCA核素分析仪（多道核素分析仪）**，探测器数据被分析显示，单位pCi/L，计算每2分钟，每小时，每天更新，更新时间越长，精度和灵敏度越高。此仪器使用TA公司“Tried and True”采样和测量技术，测量辐射流出物中的 α β γ ，测量浓度和测量结果一天24小时记录

Sources of Water Borne Radioactive Material 水中辐射物来源

- Coolant leaks into pipes or drains 冷却剂泄露到管道和排水管中
- Deposition of air borne materials 气溶胶物质积累
- Make-up water 补给水



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Model – MSTR-H₂O

APPLICATION: MSTR-H₂O

MSTR-H₂O 应用

Sources of Radioactive Material

辐射物来源

- Coolant leaks into pipes or drains 泄露到管道或排水管的冷却剂
- Deposition of air borne materials 气溶胶辐射物积累
- Make-up water 补给水

Location of Contaminated Water 污染水的位置

Onsite/ “Inventory” 现场 “库存”

- Pipes, drains, pools, surface water 水管，排水，池子，地表水

-Underground 地下水

- Drainage pipe 排水管道
- Vado –zone/soil air 土壤中气层

-In the Aquifer 蓄水层

Crossing site boundaries 穿过边界

- Liquid waste stream 液体流出物
- Storm drains 雨水

-Off-site/environmental 现场外环境中

- Surface Water 地表水
- Rivers 江河
- Local drinking water 本地饮用水



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DESCRIPTION:描述

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.

MSTR-H2O是一款多探头水监测器同时用于测量辐射核素中的 α β γ ，电子学为带彩屏微处理器。模块式前置放大器允许将来功能变动与拓展，允许通过现场更换模块快速检修。

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.

伽马专用屏蔽容易打开清理。所有连接均密封以防泄露。标准水动系统基于高精泵，每分钟10升容量

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.

宽量程泵容量可满足用户具体需求。整个系统安装在单独的带轮的坚固柜子中，**MSTR-H2O**自带全部线路管套，连接器以备操作。标准115伏，60赫兹；可选购220伏，50/60赫兹。

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

除了一年保修期外，此模块系统还享有TA公司包换服务，许多地区提供现场维修，伽马探测器铅屏装入焊接壳内，寿命长且易于去污；通过断开装置很容易更换 α β 流室。

Four Principal Detectors: 四个主要探测器

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.

α 探测器 包括钍232：闪烁体探头，不透光探头组件通过快速断开的同轴缆线和医疗级软管与样品连接，由一对直径5"光电倍增管监测着。

2. **Beta Scintillation detector:** With a 1,100cm² sensitive area.

β 闪烁探头敏感面积达1,100cm²



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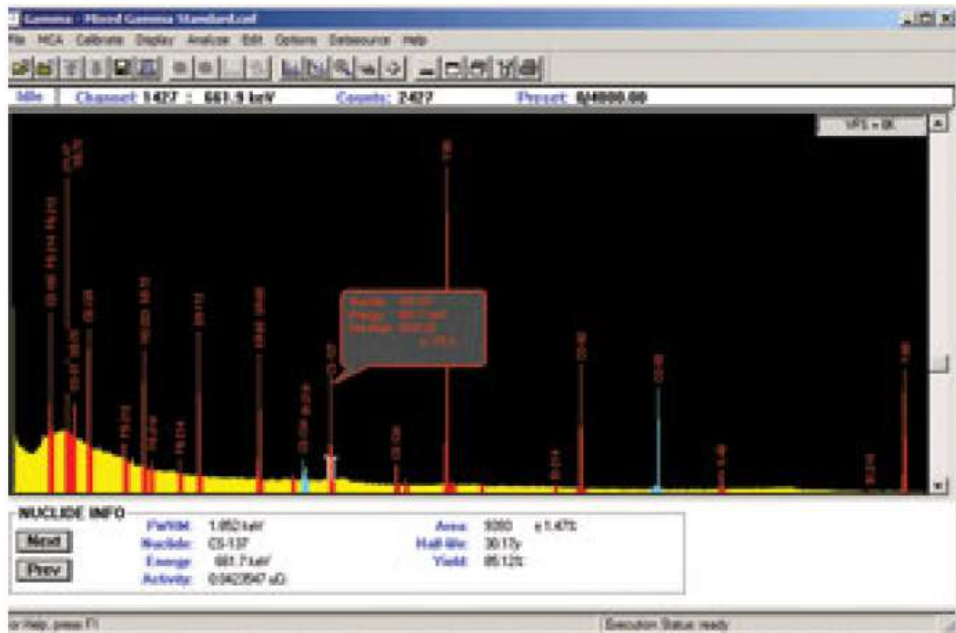
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The Alpha, Beta Pulse Analysis:

GAMMA-MCA ISOTOPE IDENTIFIER

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.

系统αβ脉冲分析部分通过脉冲高度，持续时间和耦合事件调整分析光电倍增管输出，以便系统清除大多数本底计数和噪音计数。随机共振，加上高增益，低噪音PM管和前置放大器提高了灵敏度。

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).

Gamma-MCA分析仪使用优于1000道的多道分析仪测量水中伽马发射物，能量范围用户设定，例如MCA可设定伽马能量为10 KeV - 3 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.

氚探测器: 闪烁体探头，不透光探头组件通过快速断开的同轴缆线和医疗级软管与样品连接，由一对直径5"光电倍增管观察着。



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Isotope Identification System 核素识别系统

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.

峰值检测与同位素识别软件**TA SMART-PEAK™**甚至在非常低伽马浓度情况下检测辐射峰值；在高辐射和仪器标定情况下，同位素识别功能开始工作，显示水中确切的辐射核素。

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/m³ (using the detector efficiencies automatically measured and stored previously by **MSTR-H₂O** semi-automatic self-calibration procedure).
- 在每个峰值或兴趣区，净计数自动转换成浓度单位pCi/L或KBq/m³（使用由**MSTR-H₂O**半自动自校准程序预先测量并存储的探测效率）
- 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.
- 浓度和释放总活度及最低探测活度水平持续计算并记录，这些实时信息将警告通报系统。所有数据被储存在电子表格格式的硬盘中。
- 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.
- 历史数据很容易以表格或图形格式显示在屏幕上（同时/或选择图形打印机打印出来），显示定量信息和走势。数据频繁被记录因此时间分辨率特别出色。
- Ethernet and USB ports (with security) make it easy to archive and further analyze data.
- 以太网和USB接口（带锁）容易存档和进一步分析
- **Continuous, Reliable Data – YES, False Alarms – NO**
- 连续，可靠数据-有，虚报-无
- 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.
- 我们最新系统无论在软件方面还是在实际应用中有多层保护和多余度，防止虚假报警。这包含一个报警表决系统，只有所有数据一致和确定情况下才报警。持续数据录入以便人们解读
- Each alarm activates fail-safe relays. Relay contacts are available to user.

每一次报警激活故障安全继电器，提供继电器触片



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SYSTEM INCLUDES:	系统包括
UV Lamp:	Used on inlet as algae-cide.
UV灯:	用于入口, 作为除藻剂
Flat Screen Monitor:	LCD High Color Graphics
平面显示器:	LCD高显图形
Hard Drive:	1 Terabyte
硬盘:	1TB
DATA Acquisition:	Board and All Cables
数据采集:	采集卡和缆线
High Speed Ethernet access:	LAN or SCADA hookup.
高速以太网:	本地或SCADA接口
Specialized software:	Designed for Gamma Spectrum Detection; user friendly adaptability for your needs.
专用软件:	设计用于 γ 图谱检测, 符合用户需求
OPTIONAL:	MODBUS or other protocols
选择:	MODBUS或其它协议
	Printer
	打印机
Triggered Aliquot:	This feature automatically collects and stores a small water sample for independent analysis whenever an alarm or event of interest occurs.
触发式等分测量:	在报警或兴趣区事件发生时, 此功能自动收集并储存少量水样进行独立分析测量
	.
System flow rate	系统流量
Optional:	Per Customer Requirement: Very wide range of flow rates is available
选购:	根据用户要求: 提供不同流量
Sample temperature standard:	Up to 80° F liquid. (optional to higher temperatures)
样品温度:	液体到80° F (可选更高温度)
Ambient temperature:	65° F - 100° F (wider temperatures ranges optional)
环境温度:	65° F - 100° F (可选更宽温度范围)
Optional:	Cooler model Cool-33 for detector & sample is used in case of higher sample or ambient temperatures AND/OR for increased precision measurements.
选择:	在更高样品和环境温度情况下和/或增加测量精度时可选购Model Cool-33



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SIZE AND WEIGHT:

尺寸和重量

Dimensions:

尺寸:

One cabinet: 23" wide X 31" deep X 36" high including wheels

单个机柜23"宽 X 31"深 X 36"高, 包括轮子

Wheels:

轮子:

5" dia, high capacity, rugged wheels with lock & rubber tires.

直径5"高承重坚固轮子, 带锁和橡胶胎

Shipping weight:

邮寄重量:

Standard unit: 380kg / 837 lbs - excluding shielding

标准380kg / 837磅 (不含屏蔽)

NOTE:

注:

Lead Shot for shielding can be shipped with instrument or shipped separately.
Overseas customers may wish to buy locally.

铅粒可随机邮寄, 或分开装运, 或海外客户可以当地购买。

SPECIFICATIONS 规格	PARTICULATE DETECTOR 粒子探头	PRINCIPAL DETECTOR 主探头
Monitoring 监测	Pre-Filter	Sample Flow
Radiation Detected 检测辐射	GAMMA	GAMMA
Materials Monitored 监测物质	Particulates	Water Borne Radioactivity
Scintillator Shape 闪烁体形状	2" x 2"	3" x 3"
Scintillating Crystal 闪烁晶体	NaI (TI) Spectroscopic Grade	NaI (TI) Spectroscopic Grade
Shielding 屏蔽	None – Standard 1/2" Recommended	2" Standard



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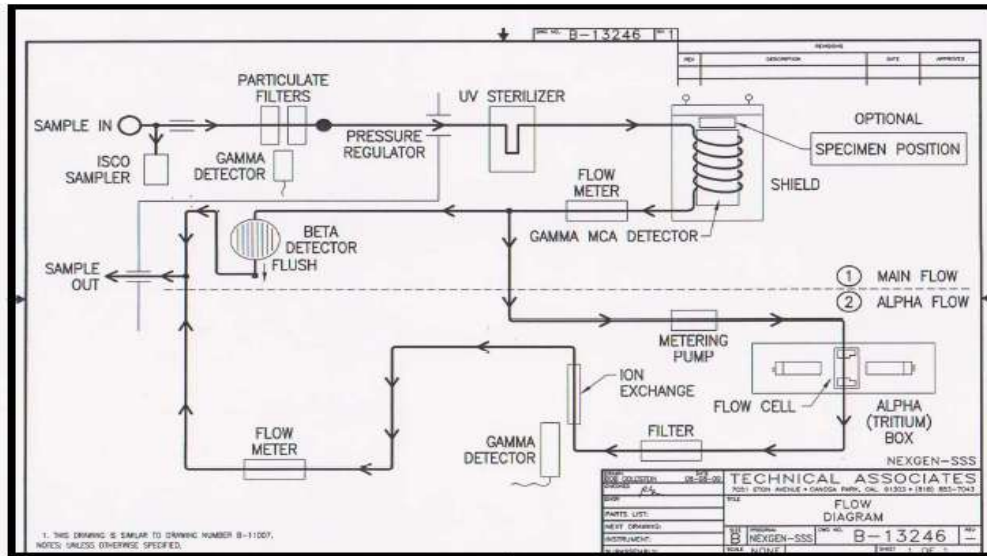
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FLOW CHART



FLOW PATH		流路	
1	Water Inlet port 水进口	11	Alpha Loop flow meter α回路流量计
2	Pressure relief valve 压力释放阀	12	Ion Exchange with gamma detector 伽马探头离子交换系统
3	ISCO Sampler ISCO 采样器	13	Discharge water is clean and can go back into drinking water line. 排放水干净可回到饮用水管道
4	Particulate Filter (with Gamma Detector) 粒子过滤器 (伽马探头)		
5	Ultra Violet Sterilizer UV杀菌	14	No liquid scintillate or reagents are added 无需添加闪烁体或试剂
6	Gamma spec shield γ专用屏蔽		
7	Main Gamma Detector with MCA 带多道分析仪伽马探头	15	No toxic or radioactive waste of any kind. 无有毒或辐射废物产生
8	Mass Flow Meter 质量流量计		
9	Metering pump for Alpha detector loop. α探头回路计量泵		
10	Alpha Detector flow cell (with Anthracene crystals) α探头流室 (蒽晶体)		



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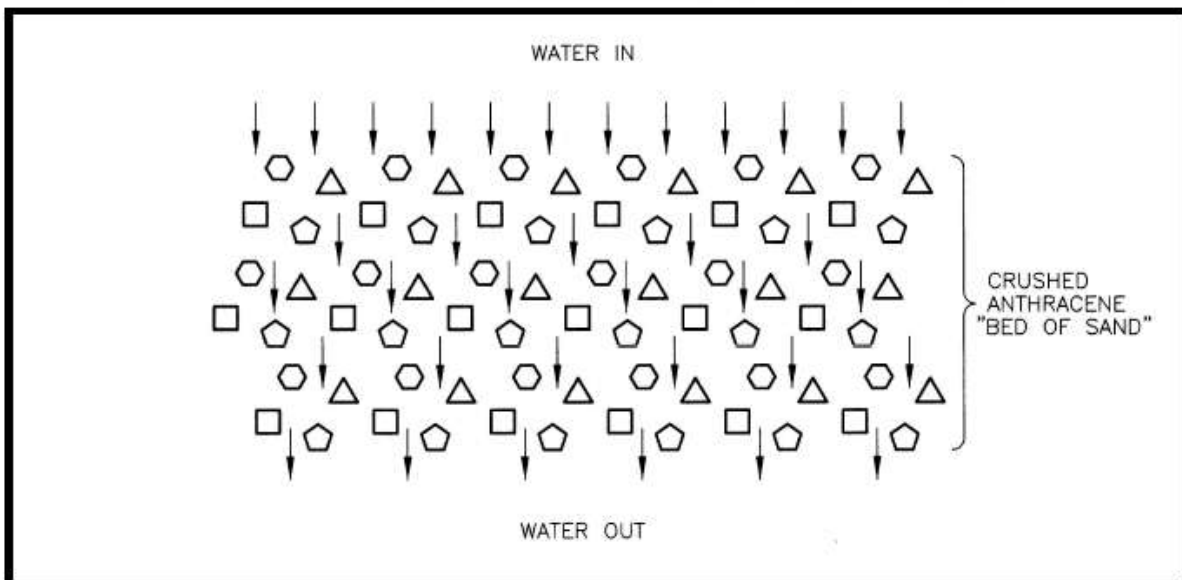
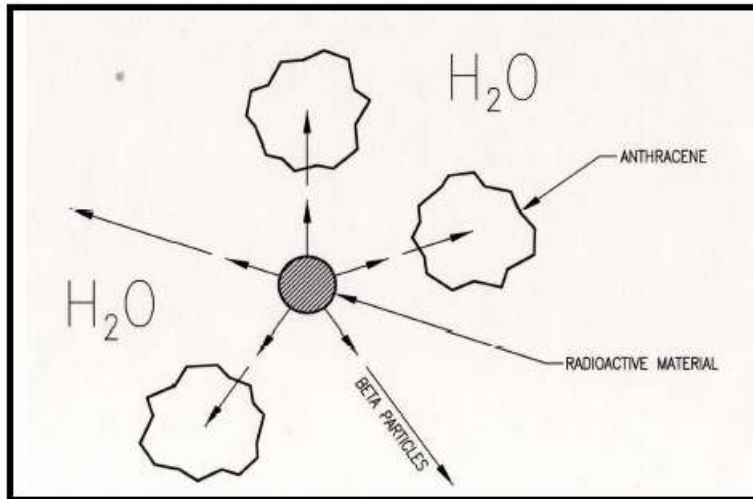
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ANTHRACENE SCINTILLATE



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DETECT 检测	PAG LEVEL 保护行动 指南标准	LOWER LIMIT OF SENSITIVITY 灵敏度下限	TOP OF RANGE 上限	SENSOR/METHOD USED 探测方法	TIME 时间	MAINTENANCE ACTION FOR FINISHED WATER 出厂水维护
NPP-Alpha	Thorium-232 U-238 3,000 pCi/l			5" dia. Dual PM Tube, crushed scintillation bed of crystals	3 mos 3个月	Replace particulate filter cartridge 更换粒子过滤盒
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 更换粒子过滤盒
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 检查多道分析仪检查
30 min 24 hr		20,000 pCi/l 5,000 pci/l	2×10^7 pCi/l	75 x 75 mm NaI (TL) Crystal		
OPTIONS						
NPP-Tritium & C-14		20,000 pci/l	1×10^6 pCi/l	Crushed scintillation bed of crystals		Replace ion exchange cartridge 更换离子交换滤盒
NPP-Radon		100 pCi/l	2,000 pci/l		1-3 mos 1-3个 月	Clean or replace vapor trap 清洁或更换除水阀
PRE- CONDITION						
Expel Radon						Clean or replace vapor trap 清洁或更换除水阀



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7051 Eton Ave., Canoga Park, CA 91303
818-883-7043 (Phone) 818-883-6103 (Fax)

tagold@nwc.net

WWW.TECH-ASSOCIATES.COM

Divisions of  US NUCLEAR CORP