

FUEL POOL TOOL

FPT-H3 Tritium Only (Air & Water) FPT-H3-ABG (Tritium & Alpha-Beta-Gamma - Water)

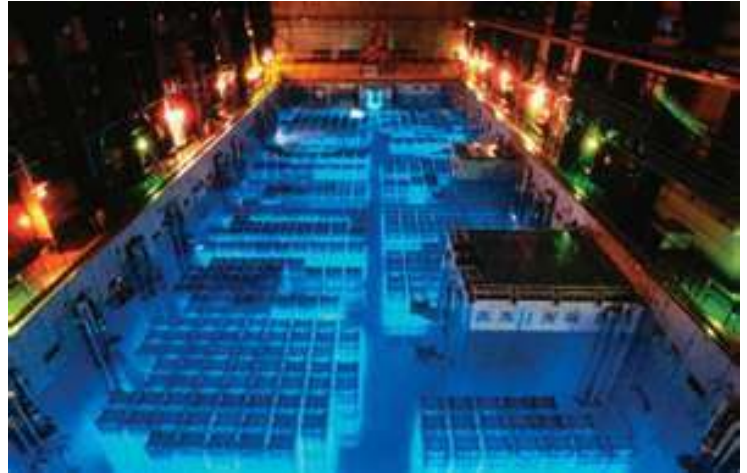
燃料池监测器

FPT-H3只测量氚（空气&水）

FPT-H3-ABG（氚& α - β - γ -水）

FEATURES: 产品特点

- DETECTS TRITIUM CONCENTRATION IN POOL WATER AND AIR
检测燃料池中水和空气中的氚浓度
- REAL TIME CONTINUOUS IN-LINE INSTRUMENTATION
实时连续在线监测仪器
- NO WASTE STREAM
无废水流产生
- EASY CALIBRATION
容易标定
- FULL SCADA COMPATIBILITY & CONTROL ROOM INTEGRATION
全SCADA系统兼容，与控制室兼容
- USER FRIENDLY CLEANING & DECONTAMINATION
用户容易清理&去污
- TA SMARTPEAK SOFTWARE
TA公司SMARTPEAK软件
- DATA STORAGE / HISTORICAL RETRIEVAL SYSTEM
数据存储/历史数据检索
- OPTIONAL – ALPHA-BETA-GAMMA DETECTORS FOR WATER
选择- α - β - γ 水探测器
- **DETECTORS: IP67** 探头防护等级
- **ELECTRONICS: IP 64** 电子学防护等级



APPLICATION: 应用

- Monitor nuclear power plant fuel pool: water, and air condensation for Tritium and other radioactive agents.
监测核电站燃料池：水和空气中水汽的氚和其它辐射核素
- Control room monitoring of spent fuel pool conditions: water level, temperature, radiation.



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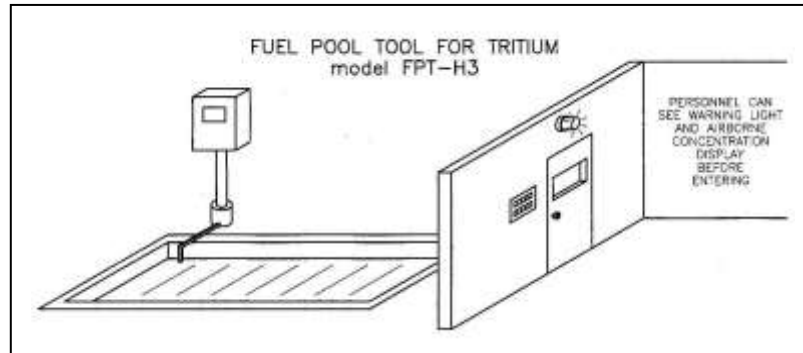
FPT-H3-ABG（氚& α - β - γ -水）

控制室监控乏燃料池状况：水量，温度，辐射

- Real time data enables command and control to limit exposure or release on and off site.
实时数据控制场内外辐照和释放

PROBLEM: New NRC rules will require close real-time monitoring of spent fuel pool status and parameters including control and active inventory of on site material including Tritium oxide.

问题: 新的核管局规定要求密切实时监测乏燃料池情况并测量包括氚水在内的控制及现场辐射存量情况。



SOLUTION: For the first time in a **Continuous Real Time** monitor the Model **FPT-H3** solves this problem by continuous monitoring of the spent fuel pool water and air space using tritium and optional alpha, beta and gamma detectors. 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. Please see attached chart of measurements.

解决方案: 通过使用氚和可选 α ， β 和 γ 探测器连续监测乏燃料池的水及空气，型号 **FPT-H3** 首次解决了这个问题。探测器信息被分析，显示单位pCi/l。计算每2分钟，每小时或每天更新，更新时间越长，精度和灵敏度越高，请查看测量表。

Using **TA/OTC Tried and True** sample collection & measurement technology these detectors measure alpha, beta and gamma from any radioactive liquids. Measurements of radiation concentration and total discharge are logged 24 hr/day, 7 day/week.

使用**TA/OTC Tried and True**样品收集及测量技术，这些探测器测量任何辐射液体中的 α ， β ， γ 。辐射浓度测量及总排放一天24小时记录。



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Optional Detectors-Model FPT-H3-ABG

可选监测器- Model FPT-H3-ABG

FPT-H3-ABG incorporates Alpha, Beta, and Gamma detectors for water.

此型号配备测量水中 α , β , γ 探测器

IC-25-HT is a pressurized ion chamber designed for hostile radiation, high temperature environments, & LOCA conditions. It is closely suspended above the water surface of fuel or reactor pools.

此加压电离室为强辐射、高温环境及失水事故设计。仪器悬在燃料池水面正上方

Alpha Detector: Anthracene scintillator; 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.

α 探头: 蒽闪烁体密光探头组件通过快速断开同轴缆线和医药级软管与样品对接, 一对直径5"光电倍增管显示样品

Beta Scintillation detector with 1,100cm² sensitive area. **The alpha, beta pulse analysis portion** of this system conditions and analyzes the output from the photo-multiplier tubes by pulse height, duration and coincidence; eliminating most background and noise counts. Sensitivity is enhanced by the use of stochastic resonance plus high gain, low noise PM tubes and pre-amps.

β 闪烁探头: 灵敏面积1,100cm²。此系统的 α , β 脉冲分析部分对光电倍增管输出结果通过脉冲高度, 脉宽和脉冲符合进行调整并分析, 排出绝大部分本底和噪音计数。通过使用随机共振和高收益低噪音PM管和前置放大器提高灵敏度。

Gamma Detector: Gamma emitter content is measured using an MCA analyzer with greater than 1,000 channels with a user settable energy range. For example the MCA can be set for Gamma energy of 10 KeV to 3 MeV.

伽马探头: 多于1,000道的多道分析仪在用户可设定的能量范围内测量伽马发射体, 例如多道分析仪可设定伽马能量为10 KeV - 3 MeV.

OPTIONAL: Isotope Identification System –TA SMART-PEAK™ Software detects even low gamma concentrations. The isotope identifier specifies and displays radioactive nuclides in water. Radon rejection is standard for airborne measurement and optional for water.

选项:同位素识别系统 –TA SMART-PEAK™ 软件探测低伽马浓度。同位素识别器锁定并显示水中辐射核素; 标准气溶胶辐射测量具备氦抑制功能, 水测量则为可选项。

MEASUREMENT CHARTS

测量表



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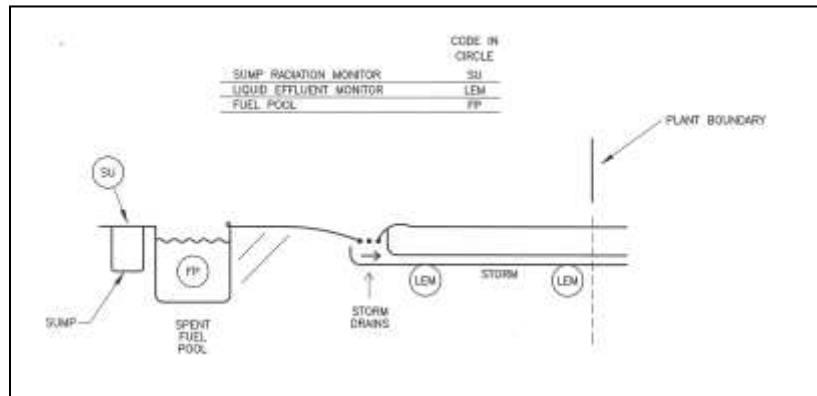
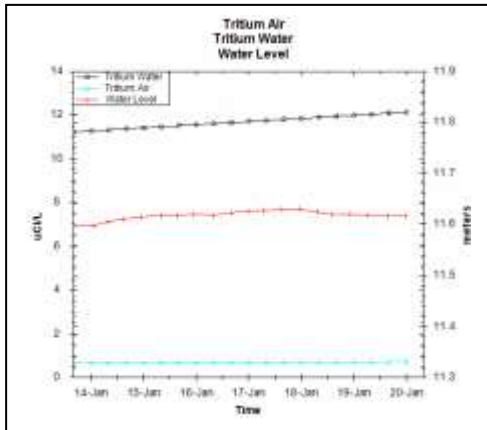
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Measurements/Displays 测量/显示	Water 水	Air 空气
Tritium Concentration 氚浓度	uCi/L	uCi/
Gamma Ion Chamber Surface Detector 伽马电离室表面探测器	Suspended above Reactor or Fuel Pools 悬在反应堆或燃料池上方	
Temperature 温度	°F / °C	°F / °C
Humidity 湿度		RH%
Dew Point 露点		Optional
Water Level 水深	Optional 可选	NA
Alpha-Beta-Gamma Content α-β-γ	Optional	Optional
Turbidity 浊度	Optional	NA
PH 酸碱度	Optional	NA
Conductivity 传导性	Optional	NA
Warning/Alarm Settings 报警设定	Yes	Yes
Remote Readouts 远程读数	Optional	Optional



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Data:-Analysis-Display-Hard-Copy-DVD-ROM Archive

数据：-分析-显示-硬拷贝-DVD-ROM存档

In each peak or area of interest, the net counts are automatically converted to concentration units, of picoCuries/liter (using the detector efficiencies automatically measured and stored previously by **FPT-H3** semi-automatic self-calibration procedure).

在每个峰值或兴趣区，净计数自动转换为浓度单位pCi/L（使用半自动自校准的程序**FPT-H3**自动测量并储存的探测器效率）

The concentration and total activity released and MDA levels are continuously calculated and recorded. This real time information will alert the notification system. All data is saved to the hard drive in spreadsheet format. Historical data is easily displayed on-screen (and/or printed out on the included graphics printer) in tabular or graphical format, showing quantitative information as well as trends. Data is recorded frequently so time-resolution is excellent.

浓度和释放的总活度及最小探测限连续计算并记录，这些实时信息将报警通知系统。所有数据以电子表格形式存到硬盘，历史记录以表格或图形形式容易地屏显出来（可带图形打印功能），显示定量或趋势信息。数据频繁记录所以时间分辨率非常出色。

DVD drive, Ethernet and USB ports (with security) make it easy to archive and further analyze data.

DVD驱动，以太网，USB接口（带锁）很容易进行数据存档并进一步分析。

Continuous, Reliable Data – YES, False Alarms – NO

连续，可靠数据-是，虚报-无

Our newest systems have multiple layers of protections and redundancy in both the software and the physical act of reporting an alarm, prevent 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.

我们最新系统在软件和硬件报警方面具有多重保护和冗余以防止虚报；这包括报警表决系统，如果所有数据表现出一致性和确定性才报警。数据持续记录以供分析。

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

每次报警激活故障安全继电器，提供继电器触片。

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



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Detect 检测	PAG Level 行动指南标准	Lower Limit of Sensitivity 下限灵敏度	Top of Range 上限	Sensor/Method Used 使用探测器		Maintenance 维护
Standard FPT-H3 标准型					Time	Action
Tritium in Water 水氚		20,000 pCi/l	1 x 10 ⁶ pCi/l	Bed of Crushed Scintillation Crystals 碎闪烁晶体床	3 mos 3 个月	Replace Filter Cartridge 更换过滤盒
Tritium in Air 气氚		0.1mCi/m ³ 2,000 mCi/m ³	1 x 10 ⁶ pCi/l	Single 2L Wire Grid Ion Chamber 单 2L 丝壁式电离室	3 mos	Replace HEPA Filter 更换 HEPA 过滤纸
FPT-H3-ABG ABG 型						
ALPHA α	U-238 3,000 pCi/l			5" dia. Bed of Crushed Scintillation Crystals 直径 5"碎闪烁晶体床	3 mos	Replace Particulate Filter Cartridge 更换过滤盒
30 min. 24 hr		25,000 pCi/l 3,000 pCi/l	2 x 10 ⁷ pCi/l			
BETA β	K-40 30,000 pCi/l			5" dia. Dual PM Tube 1,000 ml Chamber 直径 5"双光电倍增管, 1,000 毫升探测室	3-6 mos	Replace Particulate Filter Cartridge 更换粒子过滤盒
30 min. 24 hr		30,000 pCi/l 10,000 pCi/l	2 x 10 ⁷ pCi/l	1100 cm ² Beta Scintillator β 闪烁体		
GAMMA γ	Co-58			MultiChannel Analyzer, Smart-Peak Detection Software 多道分析仪及软件	3-6 mos	Simple MCA Check 检查多道分析仪
30 min. 24 hr		20,000 pCi/l 5,000 pCi/l	2 x 10 ⁷ pCi/l	75 75 mm NaI(Tl) Crystal		
GAMMA IC-25--HT						
0.5 – 3 Sec at 5 Decades	All Gammas	1 μG/h	0.1 G/h Optional 1 G/h	Ion Chamber mineral Insulated	6-12 mos	Clean Exterior if Necessary 必要外部清洁
RADON		100 pCi/l	2,000 pCi/l		1-3 mos	Clean or Replace Vapor Trap 清理或更换水汽盒
Pre-Condition 前提条件						
Expel Radon 除氡					1-3 mos	Clean or Replace Vapor Trap 清洁或更换水汽盒



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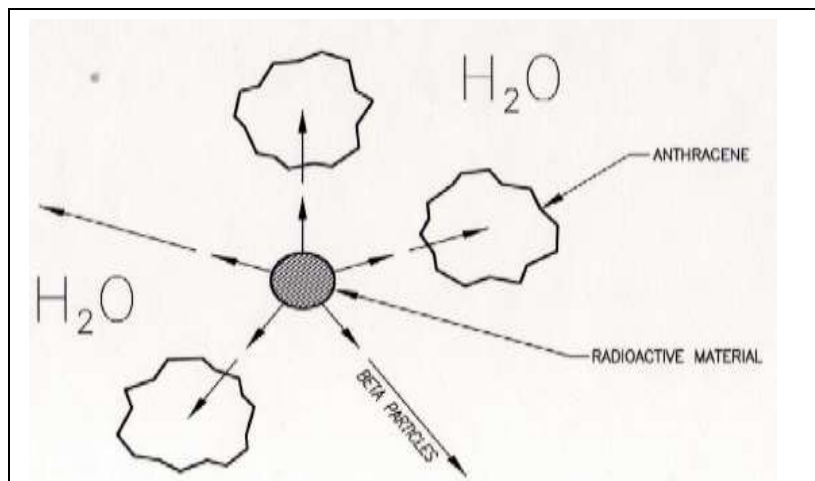
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FLOW PATH: 流路

- Water Inlet Port 进水口
- Pressure Relief Valve 压力释放阀
- ISCO Sampler 取样器
- Particulate Filter (With Gamma Detector) 粒子过滤器（带伽马探头）
- Ultra Violet Sterilizer 紫外线杀菌剂
- Gamma Spec Shield 伽马屏蔽
- Main Gamma Detector With MCA 主伽马探头带多道分析仪
- Gross Beta Detector 总贝塔探测器
- Mass Flow Meter 流量计
- Metering Pump for Alpha Detector Loop. 用于 α 探头环路的计量泵
- Alpha Detector Flow Cell (With Anthracene Crystals) α 探头流室
- Alpha Loop Flow Meter α 环路流量计
- Tritium Beta Detector 氚 β 探测器
- Ion Exchange with Gamma Detector 离子交换伽马探头
- Discharge Water is Clean and can be returned to Fuel Pool 排放水清洁可排回燃料池
- No Liquid Scintillant Or Reagents are Used 无液体闪烁体或添加剂
- No Toxic Or Radioactive Waste of any kind. 无毒或辐射废物产生



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WARNING LEVEL
SCREEN



SPECIFICATIONS:

SYSTEM FLOW RATE:

系统流量:

TEMPERATURE:

温度:

OPTIONAL:

选项:

SIZE AND WEIGHT

规格:

Standard: 100 to 1,000 ml/minute.
Optional: Wide range of flow rates available.

标准: 100 - 1,000 ml/min.

可选: 宽量程流量

Sample Standard: up to 80° F

样品可达80° F

Ambient Temperature: 65° - 100° F

环境温度: 65° - 100° F

Higher Temperature Sample Range

Wider Ambient Temperature Range

Cooler model COOL-33 for detector & sample used in situations of higher sample or ambient temperatures.

较高温度样品量程, 较宽环境温度量程

One Cabinet: 34" wide X 31" deep X 72" high including wheels.



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尺寸和重量:

每个箱柜: 34" 宽X 31" 深 X 72"高, 含轮子

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

Shipping Weight: Standard unit – 380 kg, **excluding shielding.**

(Lead Shot for shielding may be shipped separately. Overseas customers may want to purchase Lead Shot locally.)

轮子: 直径5", 高负载结实, 带锁和橡胶轮胎

运输重量: 标准380千克, 不含屏蔽（铅粒可单独运输, 海外用户可当地购买）

NRC Fuel Pool Monitoring Documents 核管会燃料池监测文件

REFERENCES: *Petition for Rulemaking to Revise the following:*

- **10 CFR 50:** Radionuclide Monitoring;
- **10 CFR 20** and other applicable regulations as well as
- Regulatory Guides **1.21**
- **(2008), 4.16 (2010), 4.21 (2008), 8.25 (1992),**
- **NUREG-1400 (1993)** and other applicable Regulatory Guides.

REFERENCES QUOTED:

NRC, -- The Near-Term Task Force Review Of Insights From The Fukushima Dai-Ichi Accident, **RECOMMENDATIONS FOR ENHANCING REACTOR SAFETY IN THE 21ST CENTURY**, July 12, 2011

2011-0137scy, NRC, -- **Staff Assessment and Prioritization of NTF Recommendations**, October 3, 2011

NRC, -- **Liquid Radioactive Release Lessons Learned Task Force Final Report**, September 1, 2006

ML091170109-Regulatory Guide 1.21 -- **Measuring Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste**, October 2008

EPRI Final Technical Report #1021106 -- **Estimate of Carbon-14 in Nuclear Power Plants Gaseous Effluents**, EPRI Project Manager Karen Kim, December 2010

ML091310141-Regulatory Guide 4.1 -- **Radiological Environmental Monitoring for Nuclear Power Plants**, November 2008

Radioactive Tritium Leaks Found At 48 Nuke Sites -- AP, Jeff Donn, 6/21/2011



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10 CFR 20 Subpart B -- Radiation Protection Programs, § 20.1101 (c) Radiation Protection Programs. Source: 56 FR 23396, May 21, 1991, amended 63 FR 39482, July 23, 1998.

10 CFR 50.109 -- Backfitting, amended Jan. 1, 2003

10 CFR Appendix A to Part 50 -- General Design Criteria for Nuclear Power Plants, amended 72 FR 49505, Aug. 28, 2007

10 CFR Appendix I to Part 50 -- Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents, amended 72 FR 49507, Aug. 28, 2007



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