History of REMP

Facts and Perspective

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What Do You Know About REMP History?????

Better Question…

WHAT IS REMP HISTORY?

REMP

- ‘REMP’ is an acronym for Radiological Environmental Monitoring Program
- The key word is “Monitoring”
- REMP serves as validation that effluent controls are ALARA
- Useful in defense against accusations… assist licensee and regulator to document and defend degree of impact through long-term trending and analysis

REMP Objectives

- Validate Adequacy of Effluent Controls to Minimize Effluent Releases
  - ALARA
- Systematic Approach to Monitor Major Pathways… demonstrate "no significant impact"
  - Primary Concern for Human Pathways
  - Secondary Concern for Assessing Dose to non-human Organisms in the Environment
- Individual Licensees' Commitments Vary

NRC REMP Guidance

- Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants" (1975)
  - Revision issued in 2009, new construction
- Regulatory Guide 4.8, "Environmental Technical Specifications for Nuclear Power Plants" (1975)

NRC REMP Guidance (continued)

- NUREG-0475, "Radiological Environmental Monitoring by NRC Licensees for Routine Operations of Nuclear Facilities" (1978)
- Branch Technical Position on Environmental Monitoring (1979)
- NUREG-1301/1302 (1991)
- Reg Guide 1.109 "Calculation of Annual Doses To Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I (Existing plants Rev 1, new plants Rev 2)

REMP Progression

- Pre-operational Environmental Monitoring Program
  - Provided baseline data for comparison
  - Important during atmospheric weapons testing era
  - Extent & magnitude of other sources of radioactivity (natural, hospitals, industry)
- Implemented as RETS/ODCM Requirement for Operational Plants
- REMP established for independent plant locations

Elements of REMP

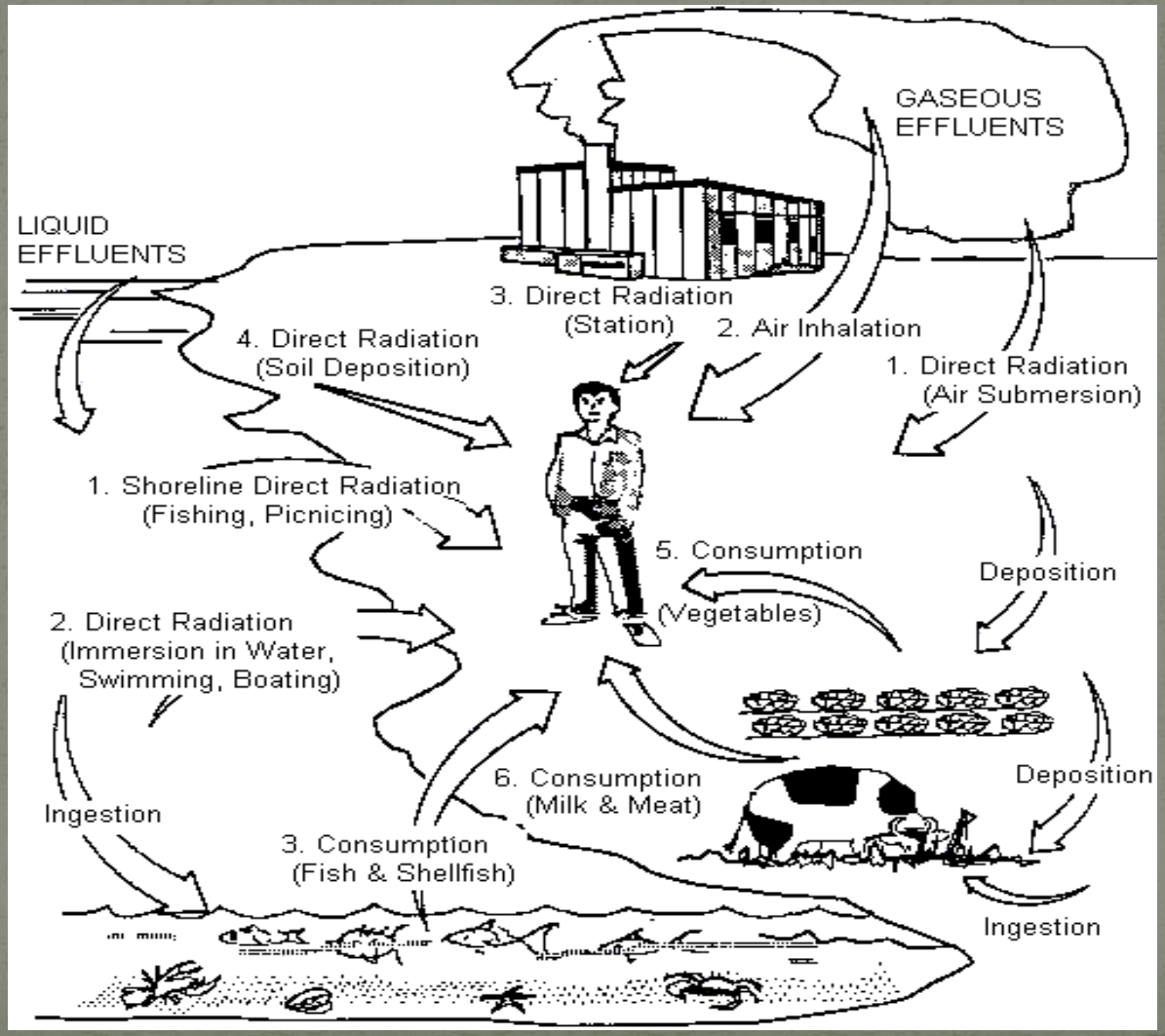
- Sample Media
- Sampling Locations
- Sampling Schedule and Frequency
- Required Analyses & Detection Sensitivity
- Annual Report

Sample Media

- Represent Major Exposure Pathways
  - Direct or Ambient Exposure from Plant
  - Gaseous Effluent Pathways
  - Liquid Effluent Pathways

- Licensee/Plant Specific Requirements
  - Specialized or Unique Agricultural Products
  - Local Customs or Culture

REMP Pathways



Sampling Locations

- Sampling in Areas Affected by Plant Operations (bases in FSAR's)
  - Meteorological Patterns
  - Distance and direction from plant
  - Water Flow Patterns… flow, tides
  - Sub-surface water flow gradients
  - Population Distribution, critical receptors
- Control Location Selection
  - Other sources of radioactivity (hospitals, industry, sewage treatment plants)

Sampling Locations (continued)

- Updated based on Changes in Agricultural or Food Production Patterns and Practices
- Land Use Census to Detect Changes in Population and Production
- Detailed Maps of Sampling Locations
  - Illustrate Location and Extent of Sampling to Regulator and Public

Schedule & Frequency

- Seasonal Availability
  - Availability of Media… biological patterns and feeding habits
  - Time/season of Harvest… crops
  - Season of Livestock on Pasture… more frequent than when animals eat stored feed

- In general, More Frequent Sampling for higher-impact pathways (airborne, milk)

Required Analyses & Sensitivity

- Nuclides Dependent on Media/Pathway
  - Liquids vs. Solids
  - Foodstuffs vs. Basal Media (soil, sediment)

- Detection Sensitivity Dependent on Nuclide
  - Lower Limit of Detection (LLD) Methodology Specified by NRC for Consistency
  - Originally based on [then] state of the art detection sensitivity, rather than dose impact
  - Major gamma emitters: 150-300 pCi/kg in solids

Required Analyses & Sensitivity

- Currently doesn't require LLDs for hard-to-detect nuclides in REMP samples
  - Primarily C-14, Fe-55, Ni-63, Sr-89/90…others?
  - Some foreign plants do monitor for HTD in REMP
  - Results in gaps when applying REMP LLDs to other situations – material release, groundwater monitoring, etc.

Annual REMP Report

- Present Results of Monitoring Efforts
  - Plant-related vs. Natural Radioactivity
  - Reporting natural radioactivity should be encouraged
  - Assess Impact of Plant Operations… dose based, compared to dose from natural exposure
- Presentation and Discussion of Deviations from Required Sampling Program
- Results of Land Use Census
- QA/QC Efforts and Results

Environmental LLDs -- Additional Applications

- NRC defaulted to environmental LLDs as basis for unconditional free-release of bulk materials
  - "Reasonable" survey within capabilities of licensee
  - "Clean" = No Detectable Activity… no acceptable level below regulatory concern
  - Comparability/conflict with more recent MARSSIM free-release criteria; REMP LLDs based on 1960s technology and guidance
  - Technology has set new "acceptable" standards for LLD release below requirements in ODCM's

Unconditional Release

- MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual
  - Recent development -- Late 1990s
  - 'Standardized' approach agreed upon by multiple regulatory agencies (NRC, Department of Energy, Department of Defense, Environmental Protection Agency)
  - Risk-based approach based on dose impact

Groundwater Protection Initiative

- Tritium identified in groundwater at several sites in 2005-2006 timeframe
- Led to voluntary industry initiative to institute groundwater monitoring at all commercial sites, coordinated through NEI and later EPRI
- REMP LLDs have been commonly accepted as *de facto* LLDs for groundwater analyses
- Many sites have incorporated groundwater monitoring as part of their REMP, especially for offsite wells

Protection of non-human Biota

- Protection of non-human species from radiation effects is element of many European programs
- Canadian Environmental Protection Act of 1999 recognized the need to assess impact on non-human biota.
- In 2003, ICRP issued ICRP-91, "A framework for assessing the impact of ionising radiation on non-human species" to provide guidance; ICRP Committee 5 activities
- IAEA activities in the 'Biota Working Group' and 'Coordination Group on Radiation Protection of the Environment'

Protection of non-human Biota (cont.)

- US DOE includes non-human biota when assessing dose impact at their facilities; formed Biota Dose Assessment Committee in 1998; website: http://homer.ornl.gov/nuclearsafety/env/bdac/

- DOE-STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota"

- Some computer models exist for assessing impact to biota
  - "BIOTA" tool within RESRAD decommissioning software suite
  - "ERICA" tool from European community

- Resource link http://www.ceh.ac.uk/protect/pages/env_protect_radio.html#top

Protection of non-human Biota (cont.)

- Much of the existing guidance appears intended for assessment of residual activity following decommissioning, as opposed to real-time effluent releases
- The NRC is considering establishment of guidance regarding assessment of impact to non-human biota for new construction; questions regarding applicability to currently operating plants

Summary

- REMP provides a systematic framework to assess impact of plant operations on the public and environment…
  - Sample media
  - Sample locations
  - Sampling frequency
  - Analytical sensitivity
  - Importance of Control samples
  - Importance of naturally-occurring radioactivity

Summary

- Aids in validating effluent controls are ALARA
- Applicability to other situations, such as material release and groundwater monitoring
- Somewhat dated, based on 1960s technology and guidance; changes imminent with new construction on the horizon, but with delay due to competing natural gas prices

Perspective…

And You Say…

- Tritium Ground Water Contamination at Nuclear Power Plants (NRC)
- Liquid Radioactive Release Lessons Learned Task Force Final Report (NRC Sep 1 2006)

SO
WHAT?

REMP Allows Us To Use

But One Must First Understand RISK

- Were there radiological risks that could negatively impact human health?
- Were there risks that would cause significant long-term environmental impact?
- Were these releases unacceptable in regulatory space?

The following table summarizes the plant events described above:

Nuclear Power Plant	Date of Release Discovery	Source of Release	Radionuclides Detected
Braidwood	March 2005	Vacuum breaker valves on the circulating water blowdown line	Tritium
Byron	February 2006	Vacuum breaker valves on the circulating water blowdown line	Tritium
Callaway	June 2006	Vacuum breaker valves on the circulating water blowdown line	Tritium, cobalt-58, cobalt-60, cesium-134, cesium-137
Dresden	August 2004, January 2006	Non-safety related HPCI suction and return line	Tritium
Hatch	December 1986	Fuel transfer canal due to operator action	Tritium
Indian Point	August 2005 - Unit 1 leakage predates August 2005	Unit 1 and Unit 2 spent fuel pools	Tritium, nickel-63, cesium-137, strontium-90, and cobalt-60
Oyster Creek	September 1996	Condensate transfer system due to operator action	Tritium
Palo Verde	March 2006	Rain condensing onto property after a gaseous release	Tritium
Perry	March 2006	Feedwater venturi	Tritium
Point Beach	1999	Retention pond	Tritium, cesium-137
Seabrook	June 1999	Spent fuel pool	Tritium
Salem	September 2002	Spent fuel pool	Tritium
Three Mile Island	May 2006	Condensate storage tank	Tritium
Watts Bar	August 2002	Effluent release pipe and SFP transfer tube sleeve	Tritium and mixed fission products

Table 1 Summary of Inadvertent Releases of Radioactive Liquids at NPPs

failure

- Failed to be aggressive assessing releases and developing long-term mitigation strategies
- Failed to win public trust and confidence
- Failed to understand power of the “people’s voice” in a political world
- Failed to effectively communicate

MOTIVATE
LEADERSHIP
CREATE
COMMUNICATE
DRIVE CHANGE

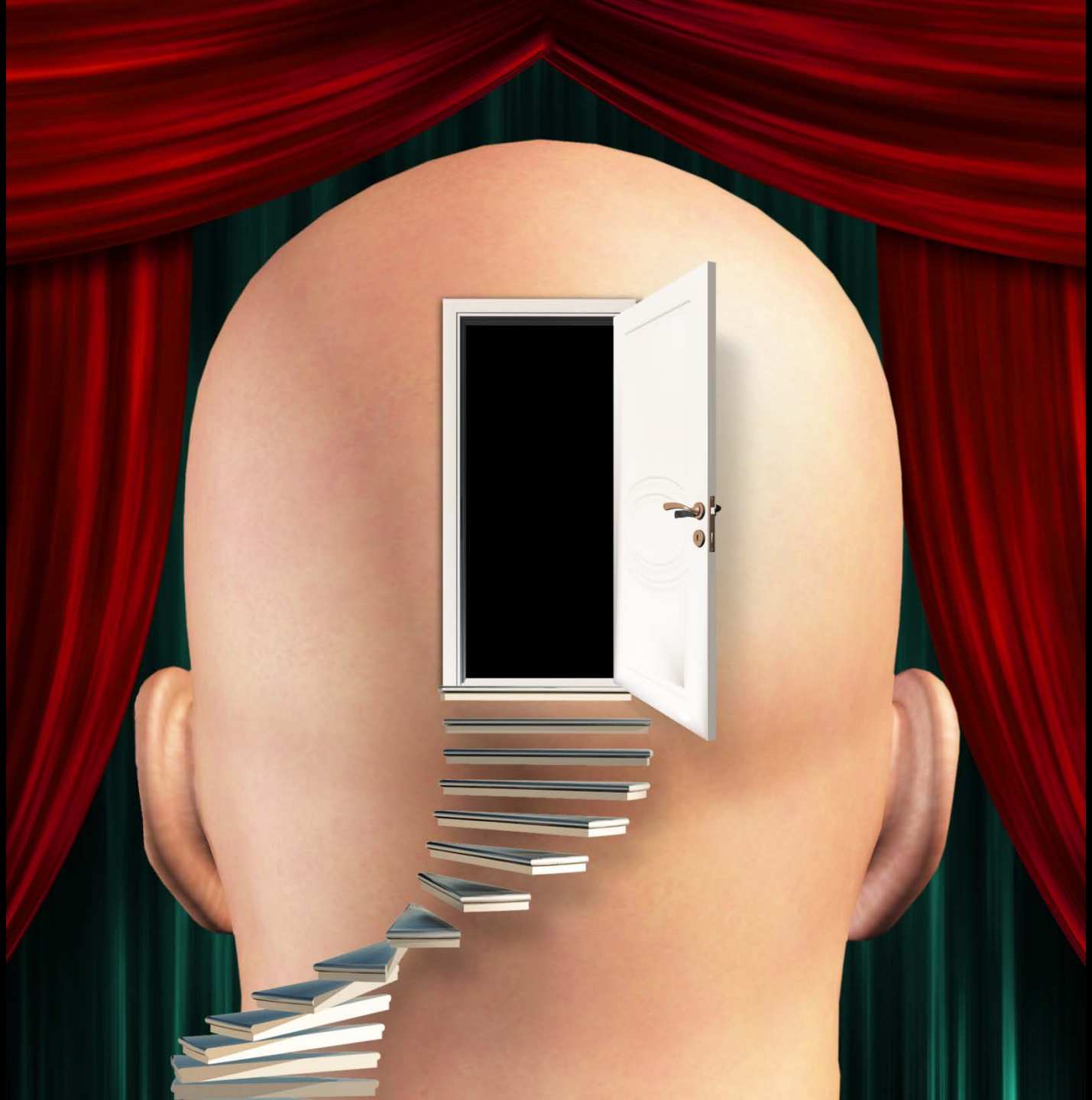
ROAD TO
CHANGE

Your Role

- Become an technical expert
- Accept and pursue challenge
- Be engaged with local organizations
- Be engaged with NRC, State, and Federal agencies
  - Nuclear Energy Institute (NEI)
  - Institute for Nuclear Power Operations (INPO)
  - American National Standards Institute (ANSI)
  - RETS-REMP Community (Yahoo Group Member)

Your Role (con't)

- Be passionate in pursuing excellence in RETS-REMP
- Know your data (and the math behind it!!!!)
- KNOW your STAKEHOLDERS and how to communicate to each person/community
- Your task -



Do Not Minimize Your

Thanks and credit to:

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- Jim Key
- Julia Holden (never ending patience)
- Riley and Cassie (my Jack Russells)

You can work a lifetime and retire, or you can work a lifetime and create a legacy.

I choose the latter.

Dale Holden