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Protecting People and the Environment

Tritium in Groundwater At Commercial Nuclear Power Plants

Richard Conatser
U.S. Nuclear Regulatory Commission

National State Liaison Officers Meeting
Rockville, Maryland
August 19, 2009

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Outline

- Introduction (Communication)
- Tritium basics
- History (up to 2006)
- Update since 2006
  - NRC Information Notice 2006-13
  - Industry Initiative, NEI 07-07
  - NRC Task Force Report
  - EPRI, GW Protection Guideline
  - NRC Regulatory Guides 1.21 & 4.1

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Introduction

- Leaks / spills occur at nuclear power plants
- Can contaminate on-site ground water
- Potential for migration to offsite areas
- Regulatory aspects (on-site and offsite)
- Key events in Salem, IP, Braidwood
- Much attention (media, public, & political)
- Stakeholder concerns
- Environmental stewardship / good neighbor
- Communication

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The Challenge of Informing the Public

"The professional person's standing in the community depends, in the final analysis, on the public's insight of his work, that is, on the educational level of the man in the street. When specialized knowledge of professional people is incomprehensible to the average man, he is apt to flounder between frustrated suspicion and excessive awe, leading him either to interfere unduly with professional independence or to accept naively every claim made by anyone who calls himself a professional."

H. G. Rickover

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Natural Tritium

- Tritium is produced naturally ($t_{1/2}$ = 12 yrs)
- Produced in the atmosphere
- Pre-nuclear, natural, surface waters contained 1-5 atoms tritium for every 10^{18} atoms of hydrogen (1-5 TU)
- 1 TU = 3.2 pCi/l (5 TU = 16 pCi/l)
- Rainfall has higher natural tritium than natural surface water
- Low-energy beta emitter (18 keV)
- Potassium-40 is natural (1000-3000 pCi/l)

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Tritium Production

- Natural production = 4-8 MCi/yr
- Pre-nuclear global inventory = 80 MCi
- Nuclear weapons = 6-7 MCi/megaton
  - Hiroshima Bomb ~ 0.13 MCi tritium
- Industry (e.g., exit signs) 0.00003 MCi/sign
- Produced in nuclear reactors (0.0001 to 0.0005 MCi/yr per U.S. reactor, nominal)
- Nuclear reactors can temporarily increase local tritium inventory

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Tritium from Nuclear Power Plants

- Rad releases from reactors are allowed
- 0.0001 to 0.0005 MCi/year per reactor
- 0.0000000643 MCi tritium leaks at a site
- These numbers are unwieldy => pCi
- Safe drinking water standard is 20,000 pCi/l tritum (4 mrem/year, EPA)
- NRC reporting level is 20,000 pCi/l

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Regulations

- Radioactivity is routinely discharged from NPPs
  - to air and water
  - using NRC authorized methods.
- NRC requires reporting of discharges (before)
- NRC requires monitoring environment (after)
- Information is summarized in annual reports
- You can view reports on NRC Web site
- NRC inspectors review and verify public health and safety standards are met.

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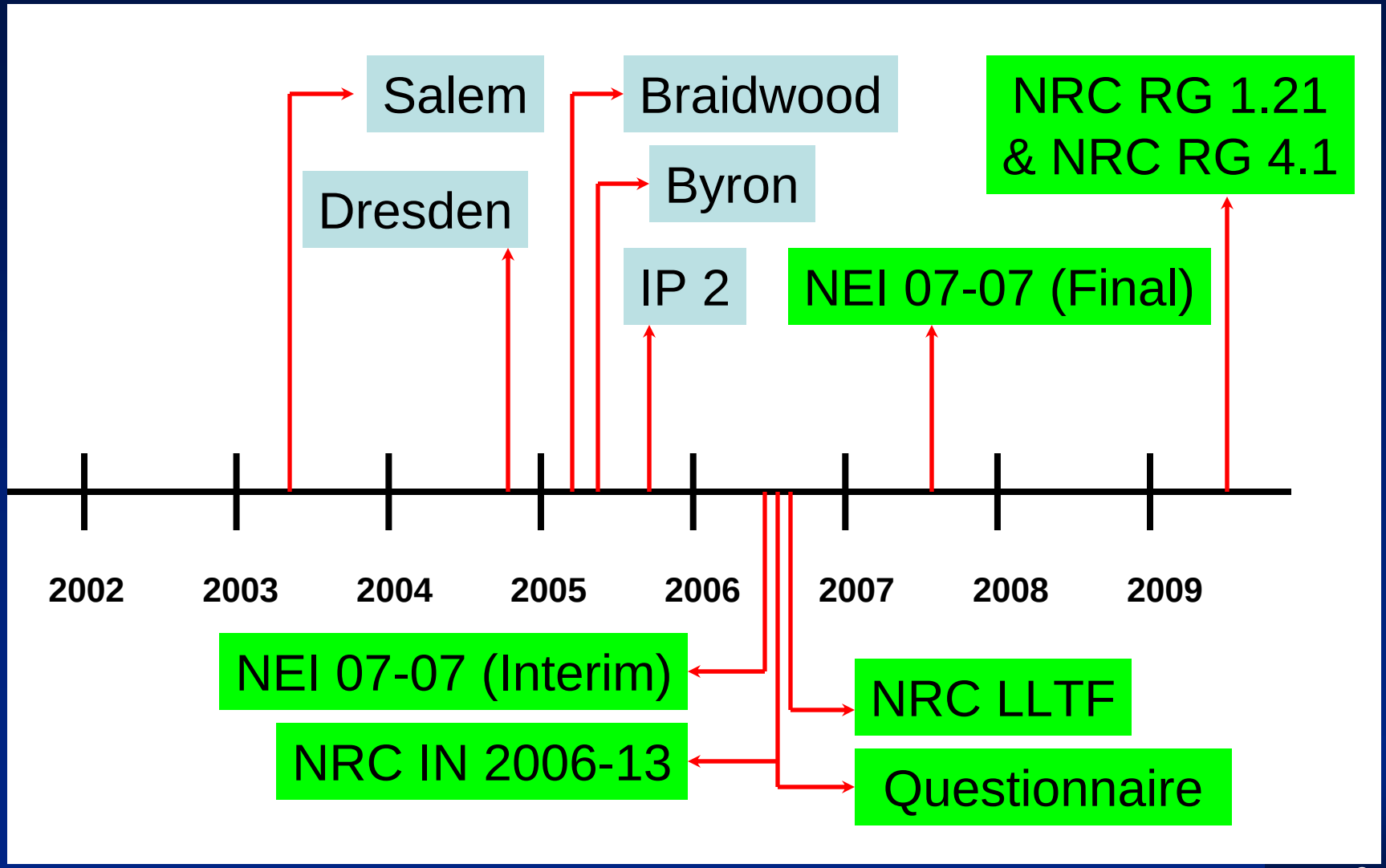
Key Events Timeline



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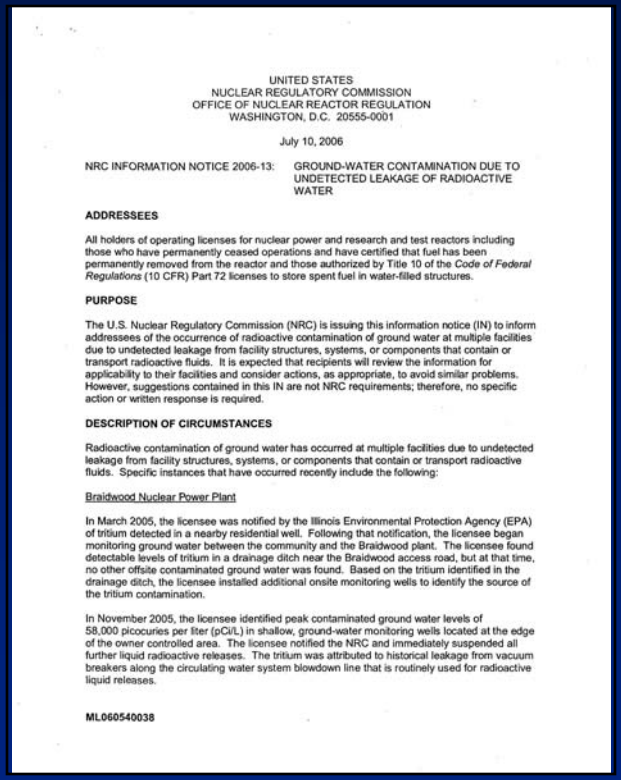
NRC Information Notice 2006-13

- Issued July 2006
- Outlines industry experience
- References existing NRC regulations
- Concludes leaks could lead to unassessed exposure pathways



UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

July 10, 2006

NRC INFORMATION NOTICE 2006-13: GROUND-WATER CONTAMINATION DUE TO UNDETECTED LEAKAGE OF RADIOACTIVE WATER

ADDRESSEES

All holders of operating licenses for nuclear power and research and test reactors including those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor and those authorized by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 72 licenses to store spent fuel in water-filled structures.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of the occurrence of radioactive contamination of ground water at multiple facilities due to undetected leakage from facility structures, systems, or components that contain or transport radioactive fluids. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Radioactive contamination of ground water has occurred at multiple facilities due to undetected leakage from facility structures, systems, or components that contain or transport radioactive fluids. Specific instances that have occurred recently include the following:

Braidwood Nuclear Power Plant

In March 2005, the licensee was notified by the Illinois Environmental Protection Agency (EPA) of tritium detected in a nearby residential well. Following that notification, the licensee began monitoring ground water between the community and the Braidwood plant. The licensee found detectable levels of tritium in a drainage ditch near the Braidwood access road, but at that time, no other offsite contaminated ground water was found. Based on the tritium identified in the drainage ditch, the licensee installed additional onsite monitoring wells to identify the source of the tritium contamination.

In November 2005, the licensee identified peak contaminated ground water levels of 58,000 picocuries per liter (pCi/L) in shallow, ground-water monitoring wells located at the edge of the owner controlled area. The licensee notified the NRC and immediately suspended all further liquid radioactive releases. The tritium was attributed to historical leakage from vacuum breakers along the circulating water system blowdown line that is routinely used for radioactive liquid releases.

ML060540038

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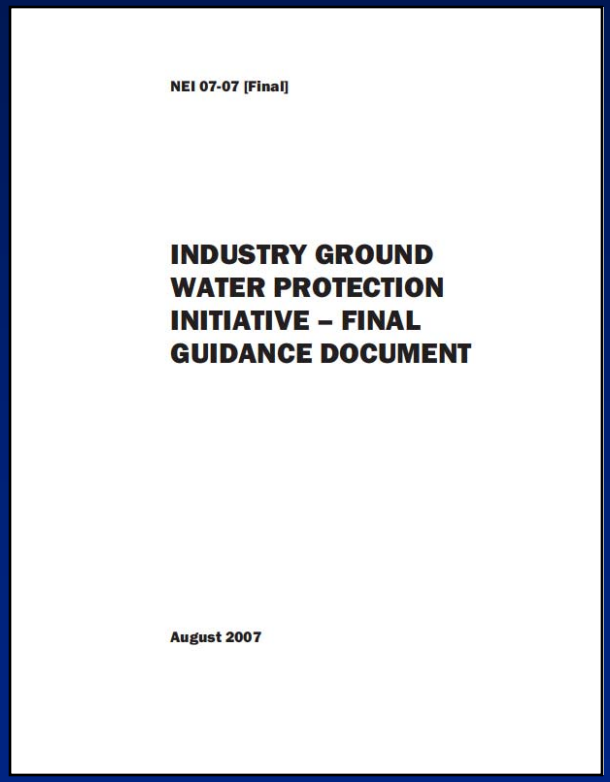
NEI Ground Water Protection Initiative

- NEI 07-07
- Issued May 2006 (Interim)
- Written Action Plan
- Outlines communication protocol
- Licensees contact local and state officials
- Issued August 2007 (Final)


NEI 07-07 [Final]

INDUSTRY GROUND WATER PROTECTION INITIATIVE – FINAL GUIDANCE DOCUMENT

August 2007

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Ground Water Questionnaire

- Letter issued June 2006 (NEI)
- All licensees submit info by 31-Jul-06
- All leaks and spills per 10 CFR 50.75(g)
- Questionnaires are on NRCs Web Site
- This was a one-time “snapshot”
- More recent information is in the licensee’s Annual Reports

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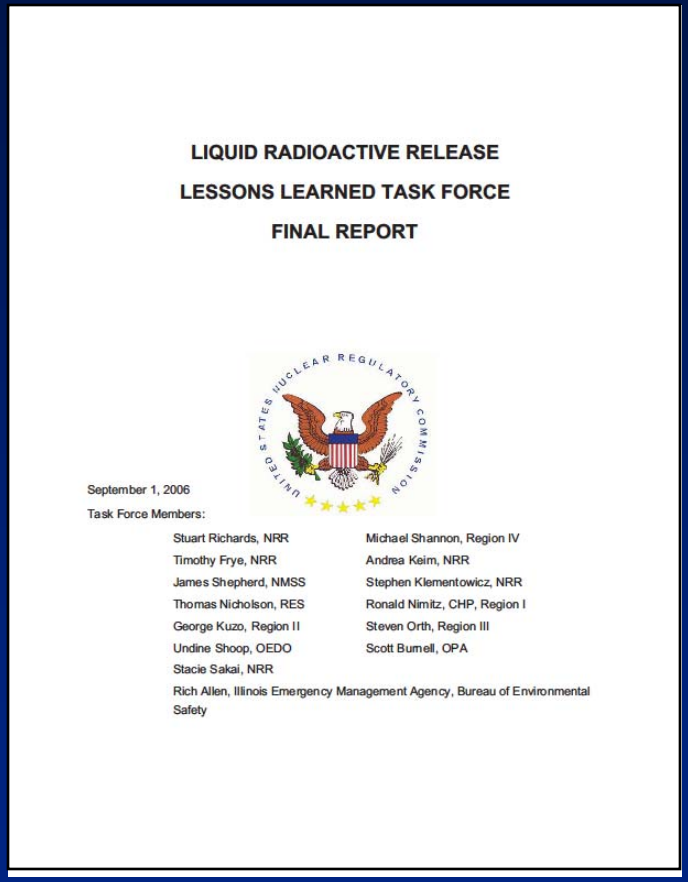
NRC Task Force Report

- Issued Sep 2006
- 26 Recommendations
- 25 of 26 are closed
- Public Concerns
- No impact on health and safety of the public



LIQUID RADIOACTIVE RELEASE

LESSONS LEARNED TASK FORCE

FINAL REPORT

September 1, 2006

Task Force Members:

Stuart Richards, NRR
Timothy Frye, NRR
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Thomas Nicholson, RES
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Rich Allen, Illinois Emergency Management Agency, Bureau of Environmental Safety

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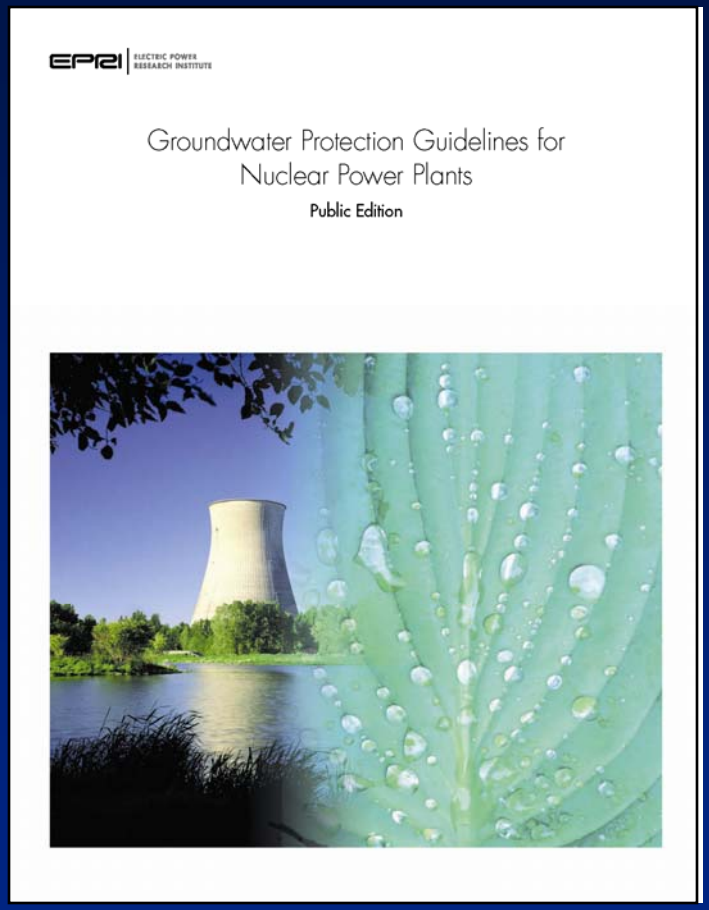
EPRI GW Guidelines

- Issued Jan 2008
- Detailed Guidance for GW Monitoring



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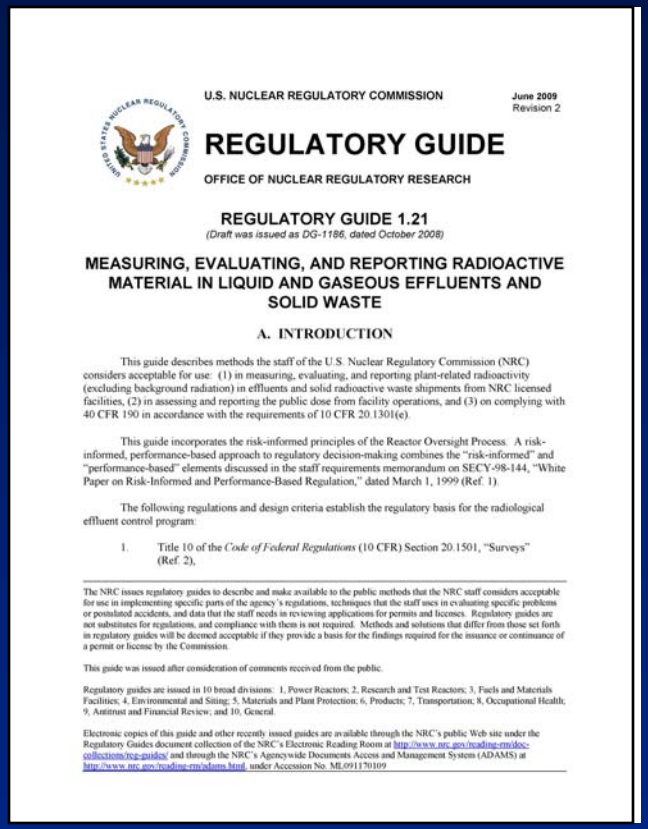
RG 1.21, Radioactive Effluents

- Rev 2 issued June 2009
- Includes guidance on leaks and spills
- Monitor unmonitored release points
- Report discharges (including leaks/spills)



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June 2009
Revision 2

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.21

(Draft was issued as DG-1186, dated October 2008)

MEASURING, EVALUATING, AND REPORTING RADIOACTIVE MATERIAL IN LIQUID AND GASEOUS EFFLUENTS AND SOLID WASTE

A. INTRODUCTION

This guide describes methods the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for use: (1) in measuring, evaluating, and reporting plant-related radioactivity (excluding background radiation) in effluents and solid radioactive waste shipments from NRC licensed facilities, (2) in assessing and reporting the public dose from facility operations, and (3) on complying with 40 CFR 190 in accordance with the requirements of 10 CFR 20.1301(e).

This guide incorporates the risk-informed principles of the Reactor Oversight Process. A risk-informed, performance-based approach to regulatory decision-making combines the "risk-informed" and "performance-based" elements discussed in the staff requirements memorandum on SECY-98-144, "White Paper on Risk-Informed and Performance-Based Regulation," dated March 1, 1999 (Ref. 1).

The following regulations and design criteria establish the regulatory basis for the radiological effluent control program:

1. Title 10 of the *Code of Federal Regulations* (10 CFR) Section 20.1501, "Surveys" (Ref. 2),

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This guide was issued after consideration of comments received from the public.

Regulatory guides are issued in 10 broad divisions: 1, Power Reactors; 2, Research and Test Reactors; 3, Fuels and Materials Facilities; 4, Environmental and Siting; 5, Materials and Plant Protection; 6, Products; 7, Transportation; 8, Occupational Health; 9, Antitrust and Financial Review; and 10, General.

Electronic copies of this guide and other recently issued guides are available through the NRC's public Web site under the Regulatory Guides document collection of the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/doc-collections/reg-guides/ and through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML091170109

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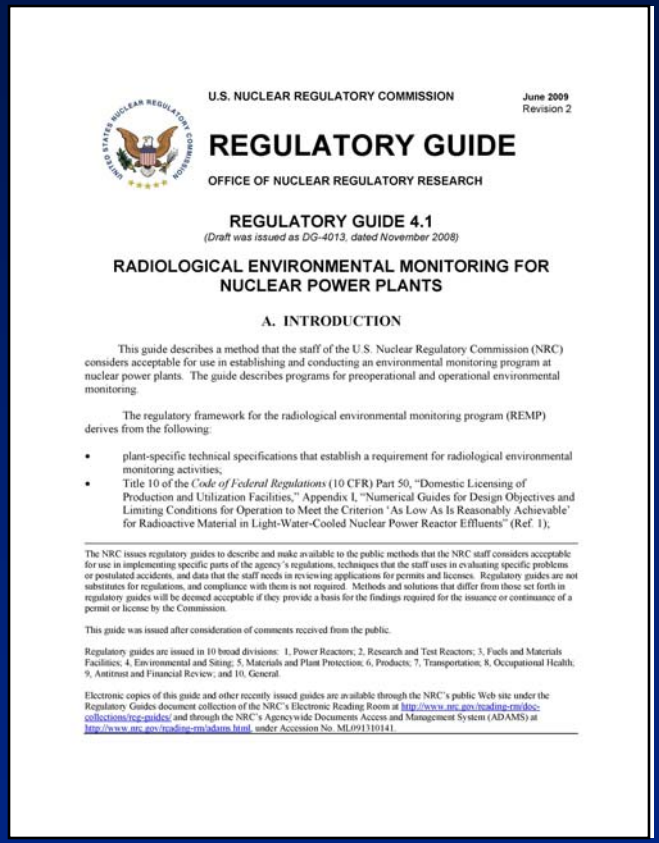
RG 4.1, Monitoring the Environment

- Rev 2 issued June 2009
- Includes guidance on leaks and spills
- Evaluate leaks and spills for unassessed routes of exposure



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June 2009
Revision 2

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 4.1

(Draft was issued as DG-4013, dated November 2008)

RADIOLOGICAL ENVIRONMENTAL MONITORING FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

This guide describes a method that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for use in establishing and conducting an environmental monitoring program at nuclear power plants. The guide describes programs for preoperational and operational environmental monitoring.

The regulatory framework for the radiological environmental monitoring program (REMP) derives from the following:

- plant-specific technical specifications that establish a requirement for radiological environmental monitoring activities;
- Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix I, "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" (Ref. 1);

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Recent Industry Experience

- Sites still experience leaks and spills
- Reported per communication protocol in their Action Plan
- Much more communication now
- No instance where tritium in drinking water exceeded the EPA 4 mrem/yr std
- Visit NRC Web Site
- http://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html

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Summary

- Everyone is exposed to natural radiation (e.g., H-3)
- NPPs routinely discharge radioactive materials IAW NRC regulations
- Leaks have occurred at most NPPs
- Utilities report leaks to local and state authorities
- NRC requires monitoring before and after radioactive discharges
- Effluent reports are available on the NRC web site
- NRC inspectors verify public health and safety standards are met
- Communicate, communicate, communicate

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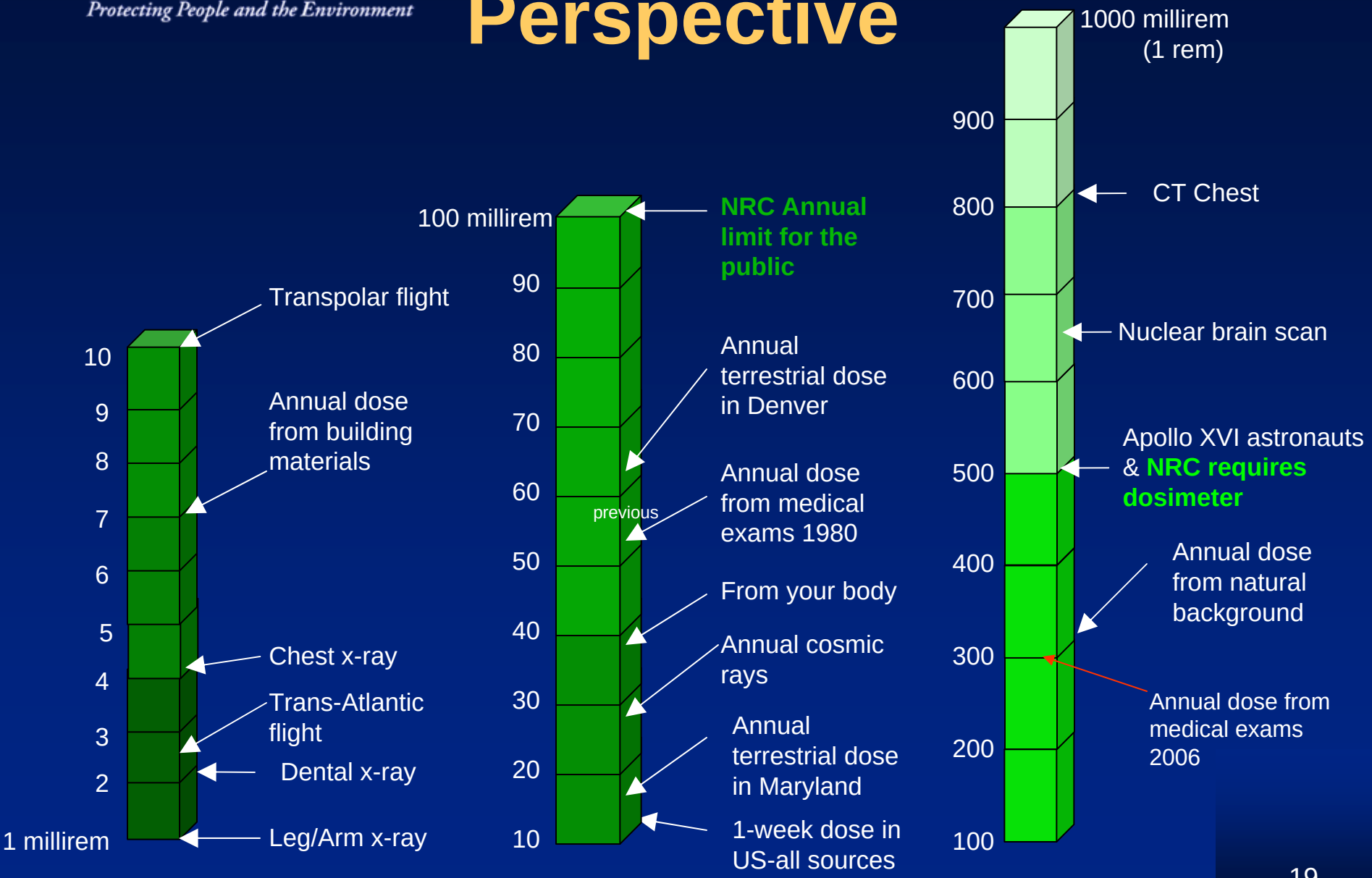
Radiation Doses in Perspective



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Questions?

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