Radiation Protection Reactor Oversight Process Enhancements: Industry Perspectives

NRC Public Meeting

December 14, 2018

NUCLEAR ENERGY INSTITUTE

Introduction

- Thank you for the opportunity to engage with NRC on both 15 November and today on possible enhancements to the Radiation Protection Reactor Oversight Process.
- As discussed on 15 November, the nuclear industry has identified 3 areas in which the NRC inspection process could be more performance-based and still continue to provide adequate protection to our workers and the pubic, namely:
  - ALARA;
  - Radiation Protection Instrumentation; and
  - Radiological Environmental Monitoring Program.
- Today, we will provide our risk-informed proposals in these areas along with a proposal for the use of thorough, structured self assessments.

Introduction

- **Willie Harris**, RP CFAM for Exelon Nuclear will discuss ALARA;
- **Roy Miller**, RP CFAM for PSEG will discuss Instrumentation;
- **Craig Sutton**, Radiation Protection Manager for Diablo Canyon will discuss Radiological Environmental Monitoring Programs; and
- **Dave Wood**, Radiation Protection Manager at the D.C Cook Plant will provide a proposal on self assessments.

Background

- **NRC Radiation Protection Inspections are defined in IP 71124**

IP 71124-03, Section 03.01 (a) Adequate Protection:

"The regulatory requirements in Title 10 of the Code of Federal Regulations (10 CFR) Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," Part 20, "Standards for Protection against Radiation," and Part 50, "Domestic Licensing of Production and Utilization Facilities," ***ensure that licensees provide adequate protection of occupational workers and members of the public*** *from exposure to radiation and radioactive materials during the normal operation, including anticipated operational occurrences, of a nuclear power plant.* ***In general, adequate protection from routine exposures is demonstrated by maintaining the resultant doses below the applicable limits and consistent with the as low as reasonably achievable (ALARA) requirements of 10 CFR 20.1101, "Radiation Protection Programs," and 10 CFR 50.36(a).*** *However, in certain instances (such as where the potential for a substantial acute dose is high, or a defective respiratory protection device has been used), the risk to health and safety is not reflected in the resulting dose and must be evaluated individually."*

Background

- **(c) Risk-Informed, Performance-Based Inspections:**

  "The NRC inspection program covers only small samples of licensee activities in any particular area. The principle of "smart sampling" is employed by the inspector in selecting items to review in each area, as opposed to a statistically based random selection. Smart sampling uses risk information and insights (gained from the licensee's quality assurance (QA) audits, independent evaluations, or operational experience) to focus on those aspects of plant operations and licensee activities that could pose the greatest risk to public health and safety. ***Performance-based inspections evaluate licensee performance by focusing on the outcomes of licensee programs (in terms of the risk of impacting the cornerstone objectives), as opposed to drawing conclusions on whether the licensee is in compliance with a regulation or standard irrespective of the risk impact."***

Background

Radiation Protection Inspections & Frequency:

1. Radiological Hazard Assessment and Exposure Controls (A)
2. **Occupational ALARA Planning and Controls (B)**
3. In-Plant Airborne Radioactivity Control and Mitigation (B)
4. Occupational Dose Assessment (B)
5. **Radiation Monitoring Instrumentation (B)**
6. Radioactive Gaseous and Liquid Effluent Treatment (B)
7. **Radiological Environmental Monitoring Program (B)**
8. Radioactive Solid Waste Processing and Radioactive Material Handling, Storage, and Transportation (B)

Note: A refers to annual; B refers to biennial

Risk Informed ALARA Inspections

Willie Harris, Exelon Nuclear

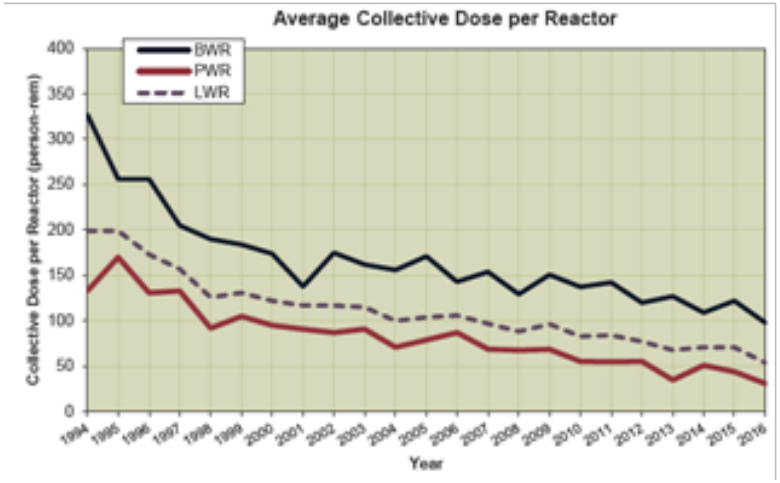
ALARA Definition

"ALARA is an acronym for "as low as (is) reasonably achievable," which means making every reasonable effort to ***maintain exposures to ionizing radiation as far below the dose limits as practical****, consistent with the purpose for which the licensed activity is undertaken,* ***taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations****, and in relation to utilization of nuclear energy and licensed materials in the public interest."*

From NRC Glossary

Trend in Collective Dose

- Indicates an average decline in collective dose per reactor
- Radiation Protection Programs continue to demonstrate strong and effective ALARA performance and philosophies



NRC REIRS Report (NUREG-0713, Volume 38, 2016)

ALARA – 71124 – Current Status

- Inspection hours
  - Biennial inspection
  - Inspection hours per year – min of 36 hours, max of 68, with an average of 48
- Licensee Hours
  - Varies – but generally report that spend 160 to 200 person-hours equally split between preparation and inspection support
  - Report minimum of 2 to 4 inspections over the cycle

ALARA Inspection Procedure – 71124 Attachment 2

- Inspection Basis (Bold emphasis added)
  - Licensees use, to the extent practical, **procedures and engineering controls** based on sound radiation protection principles to achieve occupational doses that are as low as is reasonably achievable (ALARA).
  - Performance in this area is judged on whether the licensee **has taken appropriate measures to track, and if necessary, to reduce exposures** and not whether each individual exposure and dose represent an absolute minimum, or whether the licensee has used all possible methods to reduce exposures.
- These elements are contained in licensee procedures/programs

ALARA – 71124 Attachment 2

- Inspection Objective
  - Assess licensee performance with respect to maintaining individual and collective radiation exposures ALARA. **This inspection will determine whether the licensee's ALARA program**, including administrative, operational, and engineering controls, is effectively maintaining occupational exposure ALARA
  - To conduct a Routine Review of problem identification and resolution activities per Inspection Procedure (IP) 71152, "Problem Identification and Resolution.
- These program controls are defined in licensee procedures.
- These procedures are revised periodically but rarely undergo a complete revision.
- Implementation could clearly be demonstrated in a periodic self assessment to these elements.

Drivers for Change

- Individual Collective Radiation doses continue to be reduced;
  - Current values listed in recent NUREG 0713 indicate that individual exposure average has decreased to 0.1 rem
- Collective Radiation Exposure continues to be reduced;
  - As shown previously – CRE has been on a downward trend since 2000
- Total number of high risk jobs are trending downward.

Inspection Requirements

- Radiological Work Planning
- Verification of Dose Estimates and Exposure Tracking Systems
- Implementation of ALARA and Work Controls
- Radiation Worker Performance
- Problem Identification and Resolution

Recommendations

- Licensee provide documentation for jobs that exceed 5 person-rem and exceed 50% of the intended dose
  - Outage reports or ALARA Post Jobs
  - Documentation of results versus estimate
  - Capture Lessons Learned
- Licensee provide self assessment
  - programmatic elements as primary focus
- Observation of in-field work as part of 71124 Attachment 1
- Inspection hours based on performance
  - Full INPO Points – 2 to 4 hours per year – consideration for remote inspection
  - Plants not meeting full INPO points - 8 to 16 hours

Radiation Monitoring Instrumentation Inspection

Roy Miller, PSEG

Inspection Procedure 71124.05
Radiation Monitoring Instrumentation

Inspection Basis:

- …surveys be made as necessary to comply with 10 CFR Part 20; are reasonable under the circumstances to evaluate the magnitude and extent of radiation levels and concentrations or quantities of residual radioactivity; and the potential radiological hazards…
- …instruments and equipment used for quantitative radiation measurements be calibrated periodically for the radiation measured…

RP Instrumentation – IP 71124.05

Objectives

- To verify that the licensee is ensuring the **accuracy and operability of radiation monitoring instruments** that are used to monitor areas, materials, and workers to ensure a **radiologically safe work environment**. The instrumentation subject to this review includes equipment used to monitor radiological conditions related to normal plant operations, including anticipated operational occurrences, and conditions resulting from postulated accidents
- To conduct a Routine Review of problem identification and resolution activities per Inspection Procedure (IP) 71152, “Problem Identification and Resolution.

Current Objectives

- Biennial inspection
- Inspection hours per year – min of 28 hours, max of 36, with an average of 32 hours.
- Varies – but generally spend 160 to 200 person-hours equally split between preparation and inspection support
- Report minimum of 2 to 4 inspections over the cycle

Drivers for Change

- New instrument designs have eliminated moving parts and other similar factors that were prone to failure, converting to digital components that are rugged and reliable.
- New instrument employ self-diagnostics software to continuously assess instrument performance and take appropriate actions to ensure measurement quality, including placing itself out of service.
- Mature industry procedures and practices have resulted in sustained program excellence, experiencing very low instrument failure rates. (0.27%, EPRI 0421207)

Recommendations

- Reduce the frequency of on-site inspection.
- Licensee provide self assessment
  - programmatic elements as primary focus
- The inspection steps performed during the on-site visit are:
  - Walk Downs and Observations (steps a-c)
  - Post-Accident Monitoring Instrumentation (step 4)
  - Portable Survey Instruments, ARMs, and Air Samplers/CAMS (step 1)

Recommendations

- Stations provide a self assessment that communicates the performance of the instrument program and any changes that occurred that could impact the quality of measurements, such as adverse trends or changes in calibration sources. The following areas would be included in the self assessment:
  - PMs, PCMs and TEMs
  - Post-Accident Monitoring (steps 1-3)
  - Instrument Calibrator
  - Electronic Alarming Dosimeters
  - Portable Survey Instruments, ARMs, and Air Samplers/CAMS (steps 1-2)
  - Whole Body Counting
  - Laboratory Instrumentation
  - Calibration and Check Sources
  - Walk Downs and Observations

Radioactive Effluent Inspections

Craig Sutton, Pacific Gas &Electric

Doses to the Workers & the Public from Effluents

"Doses to the public due to effluents from NPPs are less than 0.1 percent (one-tenth of one percent) of what the average person receives each year from all sources of radiation. Doses to workers from occupational exposures, including those received from work at NPPs, also are less than 0.1 percent of the dose to members of the public from all sources."

NUREG/CR-2907, Volume 20 (November 2018), page 11

Long Term Trend in Gaseous Effluents

- "*As a result of improved radioactive effluent control programs,* ***the amount of activity of radioactive effluents has steadily decreased over time.*** *The trend in the median noble gas activity of gaseous effluents since 1975 is shown in Figure 3.15.*" from NUREG/CR-2907, Volume 20 (November 2018): **In the last decade noble gas effluent radioactivity from PWRs has decreased by a factor of 10 and BWRs have decrease by a factor of 5**

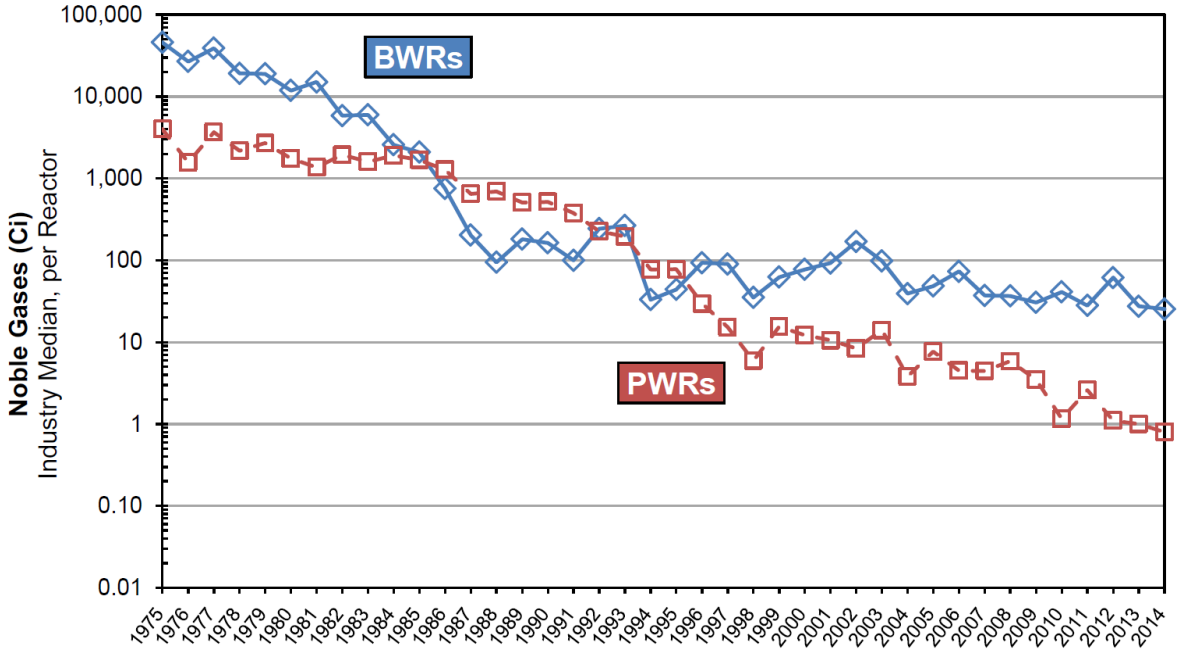


Figure 3.15 Long-Term Trend in Noble Gases in Gaseous Effluents

Long Term Trend in Liquid Effluents

- *"As a result of improved radioactive effluent control programs,* ***the amount of activity of radioactive effluents has steadily decreased over time.*** *The trend in the median MFAP activity of liquid effluents since 1975 is shown in Figure 3.16."* from NUREG/CR-2907,Volume 20 (November 2018): **In the last decade mixed fission and activation product radioactivity in effluents has also decreased nearly 10 times at BWRs and PWRs are half.**

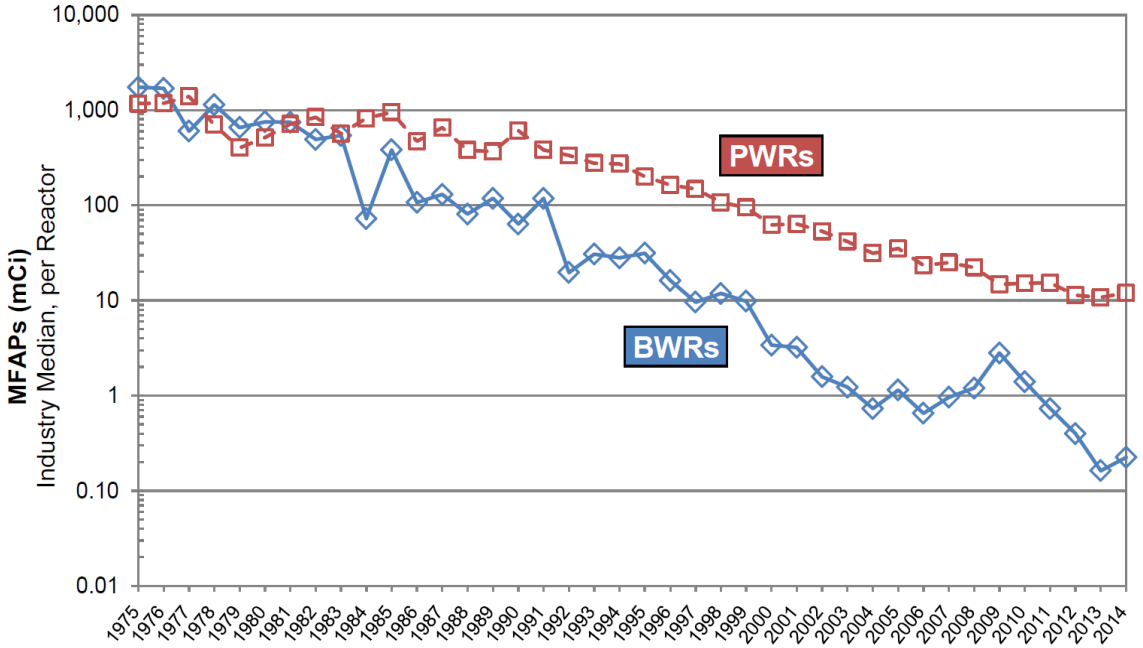


Figure 3.16 Long-Term Trend in MFAPs in Liquid Effluents

REMP – 71124.07 – Current Status

- Biennial inspection
- Inspection hours per year – min of 28 hours, max of 36, with an average of 32 hours.
- Generally 160 to 200 person-hours equally split between preparation and inspection support.

Radiological Environmental Monitoring Program Inspection Procedure– 71124 Attachment 7

INSPECTION BASIS

- Licensees **take appropriate surveys** of the unrestricted and controlled areas and effluents released into these areas **to demonstrate compliance with the dose limits for individual members of the public**.
- Plant Technical Specifications **(Tech Specs) are established to keep releases of radioactive materials ALARA**. Tech Specs are further defined by the plant's **Off-Site Dose Calculation Manual (ODCM).**
- Licensees **establish surveillance and monitoring programs** that provide data on **measurable levels of radiation and radioactive material** in the environment to **evaluate the relationship** between the quantities of radioactive materials released in effluents and **resultant radiation doses to individuals from principal pathways of exposure**.

Drivers for Change

- The ODCM at each site is well established and has been audited numerous times.
  - No site operating less than 20 years.
  - Annual land use census and Met Data is used to update the ODCM as required.
- Adoption by all sites of NEI 07-07 and NEI 09-14.
- Technological improvements in sampling and measurement equipment
- Better TLD data reporting using guidance in ANSI N-13.37

Effluents Recommendations

- Reduce the frequency of on-site inspection.
- Licensee perform and provide a self assessment
  - Programmatic elements as primary focus

Industry Self Assessments

Dave Wood, American Electric Power

Industry Self Assessment Proposal

- Documents Reviewed:
  - NEI 18-07
  - NCRP Report Number 162
  - NRC Inspection Procedures
  - DOE RadCon Manual
  - Station Procedure

Self Assessment

Goals

- Industry initiative to reduce burden on regulator and licensee;
- Reduced inspection frequency/scope based on performance;
- Rigorous and formal process…don't accept absence of events as evidence of excellent performance;
- No reduction in assurance to public and workers.

Self Assessment

Proposal

- Revise NEI 18-07 to provide framework for industry led self assessments (beyond engineering);
  - Could revise or rewrite
- Incorporate Inspection Procedures to use as self-assessment template;
- Licensee provide self assessment completed every 3 years
  - per NRC guidance
  - programmatic elements as primary focus
- Conduct pilot self-assessment on Occupational ALARA Planning and Controls;
- Self assessment deficiencies would be addressed in station's Appendix B Corrective Action Program.

Questions and Discussion