Status of EPRI Radiation Management Program

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Abstract: The EPRI Radiation Management Program is focused on supporting the NEI/EPRI/INPO RP 2020 Initiative. The RP 2020 Initiative has two key challenges: 1) supporting utilities to meet the expected dose limit changes from 50 mSv/year to a variant on 20 mSv/year, and 2) supporting the industry need for secured future workforce and infrastructure. The EPRI Radiation Management program supports this effort through radiation field source term reduction and implementation of advanced radiation protection technologies. This paper shows the highlights of the current program activities.

Introduction

The EPRI Radiation Management Program is focused on supporting the NEI/EPRI/INPO RP 2020 Initiative. The RP 2020 Initiative has two key challenges: 1) supporting utilities to meet the expected dose limit changes from 50 mSv/year to a variant on 20 mSv/year, and 2) supporting the industry need for secured future workforce and infrastructure.

The United States and Mexico are the only two countries that do not have a version of the ICRP 103 recommendations to limit workers to 100 mSv over five years with a 50 mSv limit, and Mexico is expected to implement the dose limit shortly. Recently, the United States Nuclear Regulatory Commission as indicated that the authority will review and revise the radiation protection rulemaking, and it is expected that some form of the ICRP limits will be adopted. While the overwhelming majority of the United States workers are under the 2 Rem limit, the impact to specialized personnel and adaptation to utility administrative limits will need to be considered. EPRI supports the upcoming individual dose limit changes by reducing radiation fields (Source Term Reduction Program) and improving ALARA practices through improved technologies.

Source Term Reduction Highlights

The United States nuclear plants consist of Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR). The shutdown radiation fields of PWRs are collected from the utilities and reported on a biannual basis to the Standard Radiation Monitoring Program. The BWR plants report their radiation fields to the BWR Radiation Assessment and Control (BRAC) program. Updates of both programs are in the following subsections.

Standard Radiation Monitoring Program (SRMP) Update

The contact dose rate measurement points for the SRMP are shown in Figure 1. The most common points referenced are the hot leg, cold leg, and center of the channel head bowl. Figure 2 shows the most recent available hot leg center channel head data for reporting Westinghouse plants available as of August 21, 2009. The range varies from 0.3 to 8 R/hr (30 to 800 mSv/hr), and the error bars are $\pm$ one standard deviation. There is considerable variation among the plants. Reasons for the variation include plants that have implemented electropolishing of the channel head bowl during steam generator replacement, usage of zinc injection, and also using low-cobalt Inconel 690 tubing. In the cases of the lowest four dose rate plants, all have used zinc injection and electropolished channel heads.

Most recently available cold leg loop piping dose rates are shown in Figure 3. The range varies from 10 to 250 mR/hr (0.1 to 2.5 mSv/hr), and the error bars are $\pm$ one standard deviation. Similar to the channel head data, those plants that have implemented zinc injection and replaced steam generators

tend to be the lower values, although there have been indications that the boiling duty of the core is a contributing factor.

BWR Radiation Assessment and Control (BRAC) Update

Figure 4 shows the locations of the BRAC monitoring points, in general they are located at the suction and discharge of the recirculation pumps. Figure 5 shows the BRAC dose rates for reporting United States and international members. The range varies from 10 to 900 mR/hr (0.1 to 9.0 mSv/hr). The markers are grouped according to the mitigation strategy. Most United States plants combine noble metals chemical application (NMCA) with hydrogen water chemistry, while others use hydrogen water chemistry only or normal water chemistry. As can be seen, by combination of decontamination and zinc injection, low dose rates can be obtained regardless of the mitigation strategy.

Radiation Protection Technology Highlights

To improve radiation protection infrastructure and attract new radiation protection workers, the EPRI Radiation Management program is seeking to implement technologies focused on high individual and cumulative dose tasks. This multi-year project focuses on the following objectives: indentifying high dose tasks and analyzing to determine the technology needs for dose reduction, seeking to fill the technological needs by reviewing applications outside the industry or developing new technologies based on the task requirements, and identifying utilities to participate in technology demonstrations.

Preliminary work is underway for project planning, identifying high-dose tasks and candidate utilities. Five overall project tasks are planned for the project starting in 2010:

1. Collect high dose individual task information and dose data from utilities and utility groups.
2. Contact internal EPRI programs, utilities, and vendors to develop sub-tasks lists that can be improved with technology.
3. Organize tasks and diagnose the causes of high dose in terms of time reduction (improved work practices, enhanced communication, evaluation of the need for certain maintenance practices, improved valve designs), distance improvement (enhanced remote monitoring technologies) and shielding (advanced shielding techniques).
4. Seek technologies that are either outside the nuclear industry that may be applicable to RP needs or develop the technology based on the needs.
5. In parallel, identify utilities that are willing to implement a technology demonstration.

The roadmap for the project is given in Figure 6. Several promising technologies are already being considered such as customizable shielding and advanced survey tools.

Conclusions

The United States nuclear industry is proactively addressing expected regulatory changes by implementing key source term reduction initiatives and new radiation protection technologies. Highlights of source term reduction include the continued benefits of zinc injection for BWR and PWR plants, as well as using surface preconditioning techniques such as electropolishing.

Technology selection and applications will continue, candidate utilities are welcome to contact EPRI if collaboration is desired.

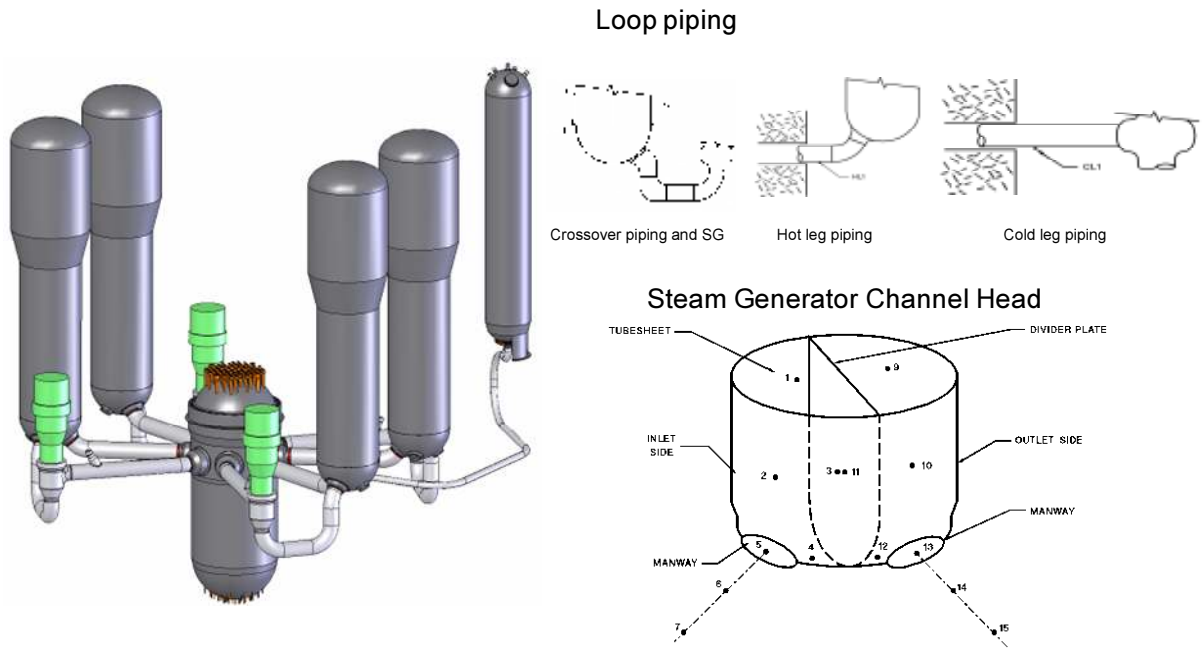

Figure 1 Standard Radiation Monitoring Program Points

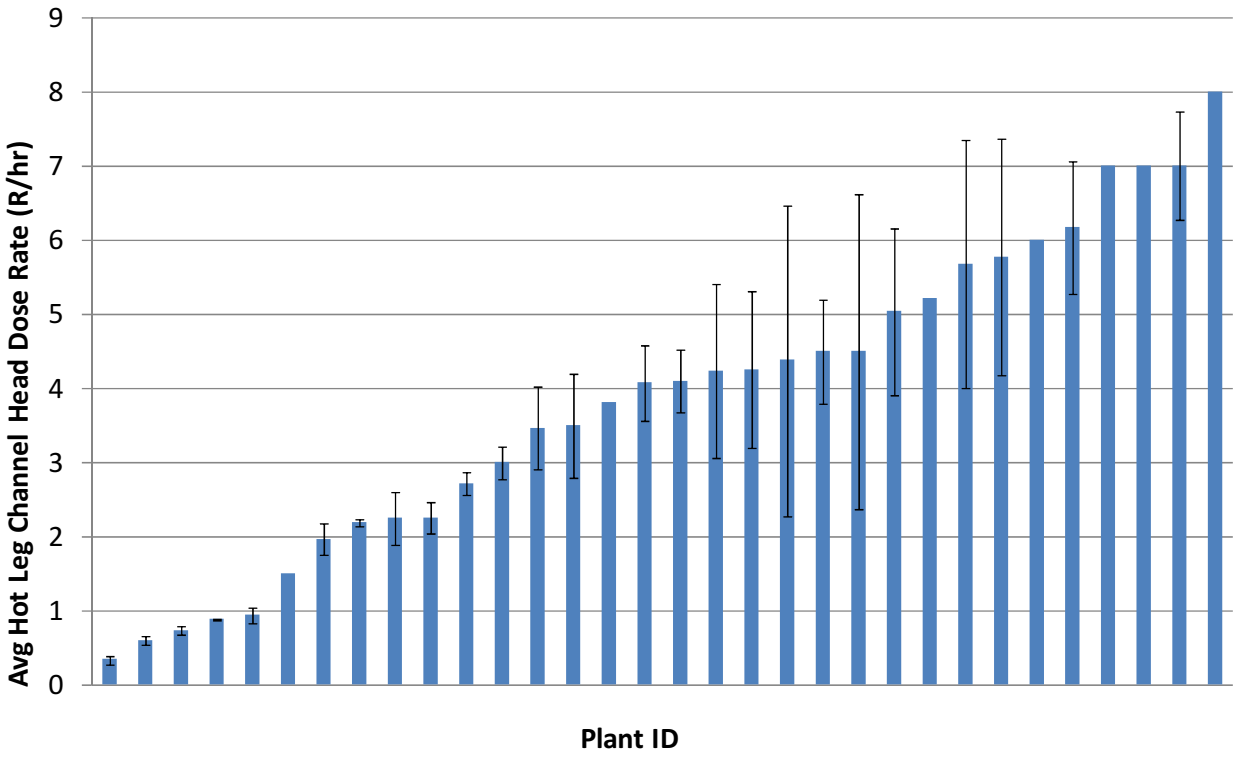

Figure 2 Hot Leg Center Channel Head Dose Rates for US PWRs, Most Recent Available Cycle

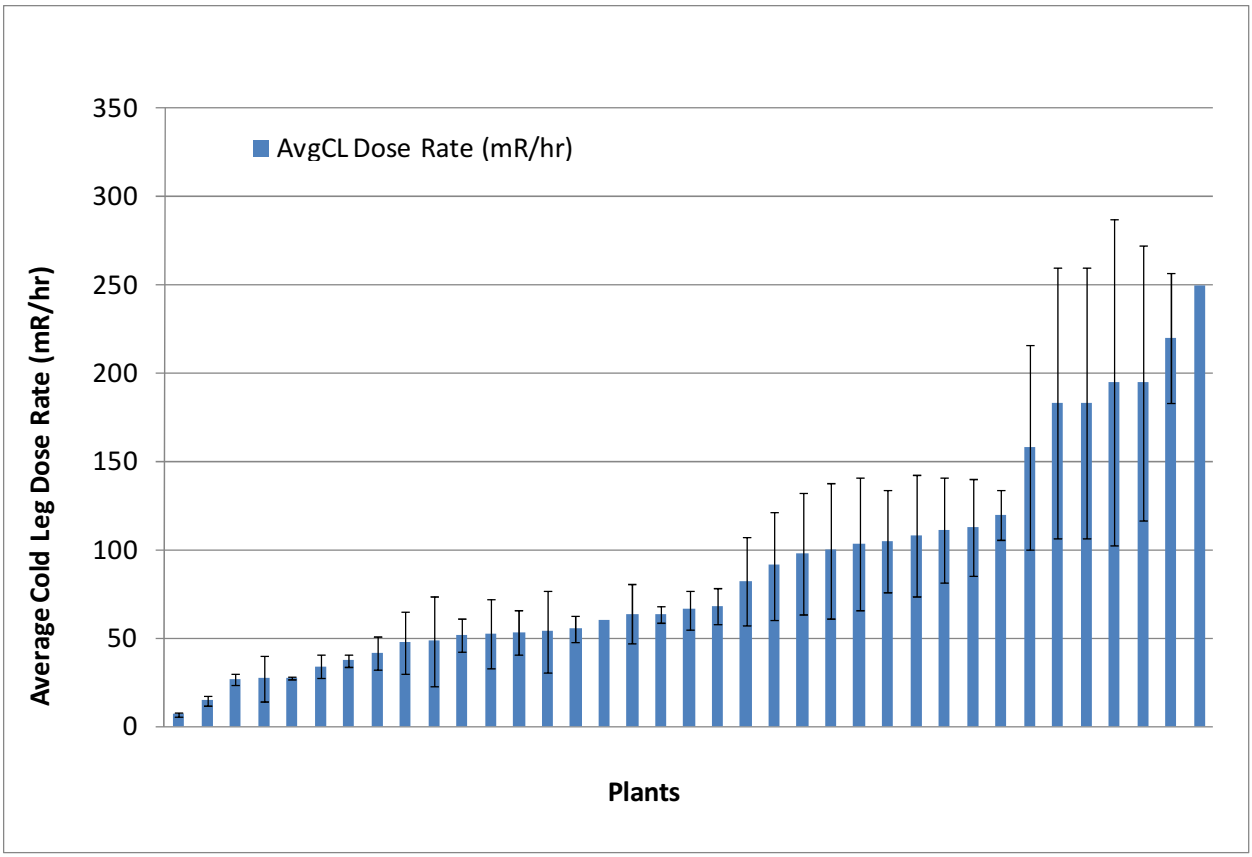

Figure 3 Average loop piping cold leg dose rates for US PWRs

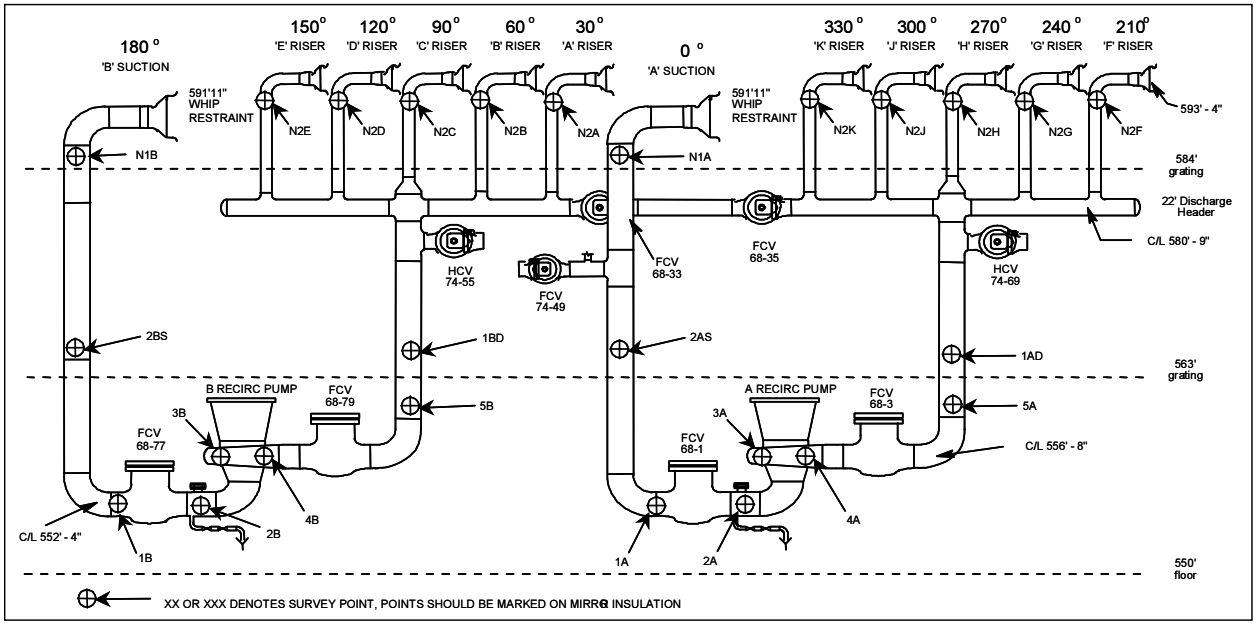

Figure 4 Locations for the BRAC points

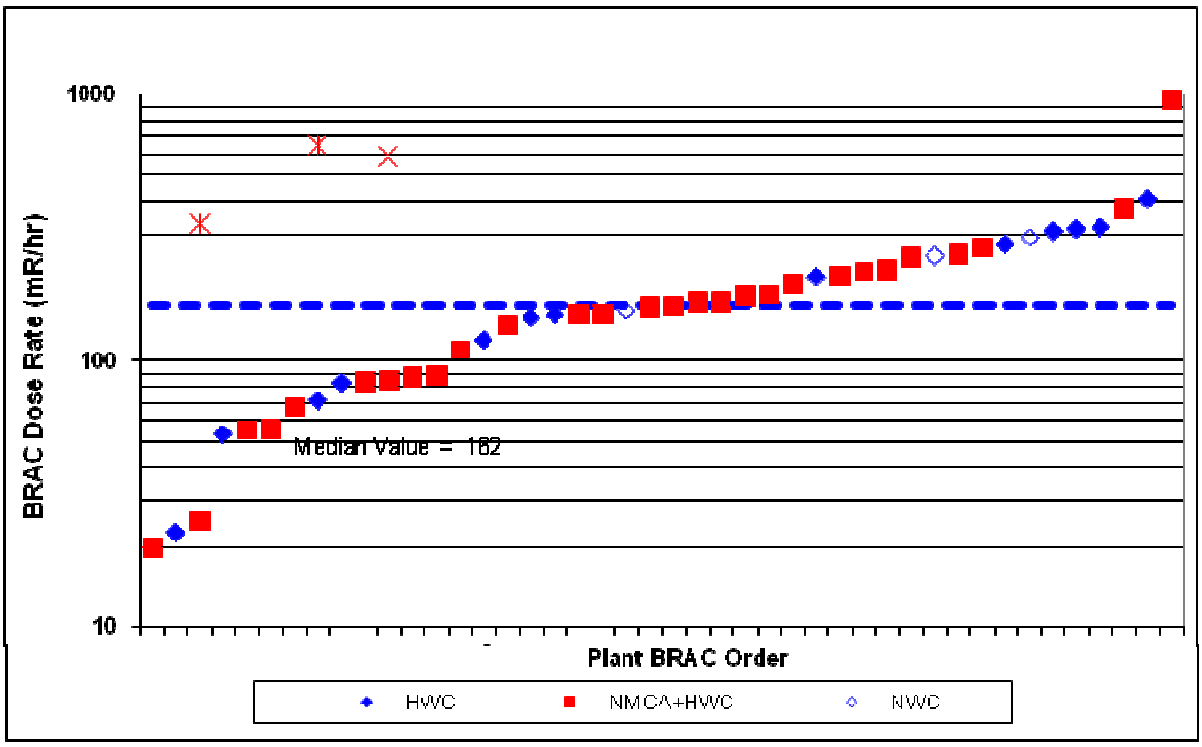

Figure 5 BRAC dose rates as of June 2008

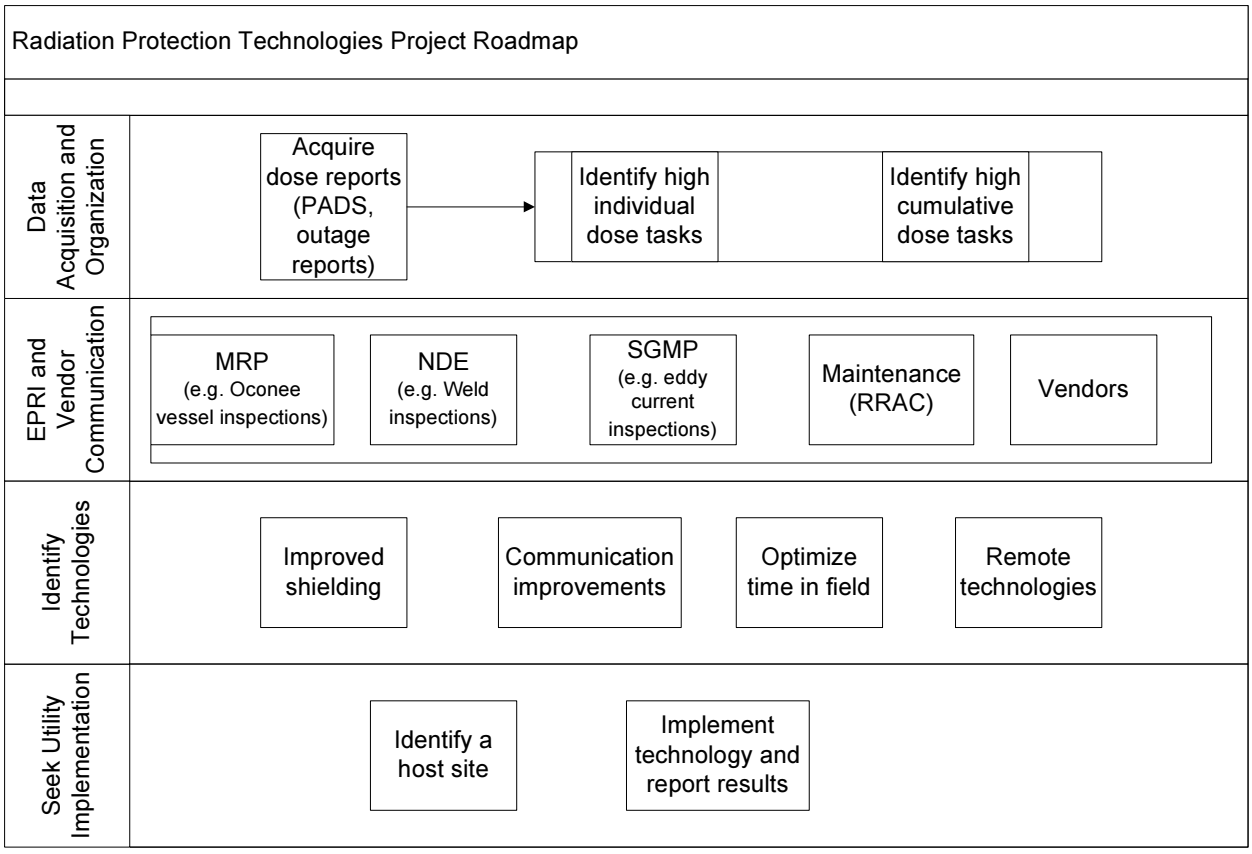

Figure 6 RP 2020 Radiation Protection Technologies project roadmap