June 17, 2010

MEMORANDUM TO: To Those on the Attached List

FROM: R. W. Borchardt **/RA/**
Executive Director for Operations

SUBJECT: SENIOR MANAGEMENT REVIEW OF GROUNDWATER TASK FORCE REPORT

On March 5, 2010, I established a Groundwater Task Force (GTF) to evaluate the completeness of U.S. Nuclear Regulatory Commission (NRC) actions to address recent incidents of radioactive contamination of groundwater wells and soils. As described in the charter (ML100640188), the purpose of the GTF was to determine whether the actions we have taken, or plan to take, in response to recent events and to the recommendations made in the Liquid Radioactive Release Lessons Learned Task Force Final Report should be augmented. For several months, the GTF worked independent of Commission and NRC management direction to complete its review. On June 11, 2010, the GTF issued its final report (Enclosed - ML101740509). It is important to note that the findings, conclusions, and recommendations discussed in the GTF final report have not received Commission or NRC management review, nor have they been shared with other Federal agencies.

The GTF identified 16 conclusions and four recommendations which are now available for NRC review and consideration. By this memorandum, I am appointing you as a member of a senior management review group (SMRG) to be chaired by Martin J. Virgilio. The purpose of this SMRG is to decide whether the NRC agrees with the findings of the GTF and how best to act upon the conclusions and recommendations contained in the final report.

The SMRG is tasked with the following activities:

1. Review the GTF final report including the conclusions, recommendations, and their bases.

2. Identify the policy issues associated with the NRC's groundwater protection regulatory framework. Develop options for addressing the policy issues and prepare a paper presenting the options to the Commission.

3. Identify the conclusions and recommendations that do not involve policy issues. Determine actions the staff should take to address them and timeframe for completion.

4. Determine whether the GTF conclusions or recommendations should be expanded.

5. Seek feedback from external stakeholders, including appropriate Federal departments and agencies, on how the NRC should address the conclusions and recommendations of the GTF

The SMRG should convene within two weeks of the date of this memorandum. Interim milestones (i.e., identification of conclusions and recommendations that do not involve policy issues and outreach to external stakeholders) should be completed by August, 2010. The final deliverable, a Commission paper(s) presenting options for addressing the policy issues, should be completed by end of November, 2010.

Support for the SMRG will be provided by staff from the Office of Nuclear Reactor Regulation (NRR). In addition, the SMRG should conduct its activities such that there is coordination with ongoing work in NRR to address buried piping issues.

Enclosure:
As Stated

cc: Chairman Jaczko
Commissioner Svinicki
Commissioner Apostolakis
Commissioner Magwood
Commissioner Ostendorff
SECY
OPA
OCA
OGC

MEMORANDUM TO THOSE ON THE ATTACHED LIST DATED: June 17, 2010

SUBJECT: SENIOR MANAGEMENT REVIEW OF GROUNDWATER TASK FORCE REPORT

	Mail Stop	
Martin J. Virgilio, Deputy Executive Director for Reactors and Preparedness Programs, OEDO	O-16	E-15
Stephen G. Burns, General Counsel	O-15	D21
Charles L. Miller, Director, Office of Federal and State Materials and Environmental Management Programs	T-8	D22
Michael R. Johnson, Director, Office of New Reactors	T-6	F15
Catherine Haney, Director, Office of Nuclear Material Safety and Safeguards	EBB	1D2M
Eric J. Leeds, Director, Office of Nuclear Reactor Regulation	O-13	H16M
Mark A. Satorius, Regional Administrator, Region III	RIII	

U.S. Nuclear Regulatory Commission

Groundwater Task Force Final Report

June 2010

ENCLOSURE

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GROUNDWATER TASK FORCE
FINAL REPORT

1. Background

Recent incidents[1] at Oyster Creek, Oconee, and Vermont Yankee nuclear power plants resulting in the detection of tritium in groundwater monitoring wells have caused U.S. Nuclear Regulatory Commission (NRC) licensees and NRC to take actions to address the source of the tritium (e.g., buried piping leaks) and to communicate the impact to the public and other external stakeholders. Each Regional Office has addressed the individual licensee actions; the Office of Nuclear Reactor Regulation has taken actions to address buried piping leaks; and the nuclear industry has undertaken additional initiatives to address buried piping leaks. NRC actions in each individual case have been successful in identifying the source and assuring that the licensee investigates the source of contamination. Nevertheless, some stakeholders believe these incidents raise questions regarding NRC actions to date and whether those actions needed to be augmented.

In order to answer these two questions, NRC's Executive Director for Operations established a Groundwater Task Force (GTF) in a memorandum to Bruce Mallett and Charles Casto dated March 5, 2010 (ADAMS Accession No. ML100640188). The GTF Charter is included in that memorandum.

The GTF has reviewed the specific items contained in the Charter. The GTF has also compiled facts and developed observations, conclusions, themes, and recommendations. It should be noted that this report is primarily focused on NRC's programs for operating reactor oversight.

2. Themes

After a thorough review, the GTF determined that NRC is accomplishing its stated mission of protecting public health, safety, and protection of the environment through its response to groundwater leaks/spills. Within the current regulatory structure, NRC is correctly applying requirements and properly characterizing the relevant issues. In doing so, NRC is adhering to its mission, principles of good regulation and organizational values. Although the leaks/spills seen to date have not posed a hazard to human health, they have impacted public confidence for some stakeholders and led them to question NRC's interest in environmental protection.

[1] "List of Historical Leaks and Spills at U.S. Commercial Nuclear Power Plants," ADAMS Accession No. ML101270439. Note: The GTF reviewed selected events since 2006.

There are further observations, conclusions, and recommendations that NRC should consider in its oversight of licensed material outside of its design confinement.[2] While completing the actions required by the Charter, the GTF identified the following four major crosscutting themes that provide focus for the conclusions (which are described in greater detail in the appendices):

- Theme 1 – Reassess NRC's Regulatory Framework for Groundwater Protection
- Theme 2 – Maintain Barriers as Designed to Confine Licensed Material
- Theme 3 – More Reliable NRC Response
- Theme 4 – Strengthen Trust

2.1. Theme 1 – Reassess NRC's Regulatory Framework for Groundwater Protection

As an independent regulatory agency, NRC's stated mission to "…license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, promote the common defense and security, and protect the environment," is key in ensuring that NRC's regulations and actions are designed to protect the public's health and safety. This responsibility is crucial to formulating regulations, policies, guidance, and enforcement on groundwater incidents, and in effectively communicating these issues to NRC stakeholders. NRC regulates exposure pathways that can result in a dose, regardless of whether the pathway is ingestion, inhalation or exposure, through 10 CFR Part 20. Specific to reactors, the requirements in 10 CFR Part 50, including the General Design Criteria in Appendix A to Part 50, and the numerical objectives for limiting radiation releases in Appendix I to 10 CFR Part 50, set out general design and operational objectives for controlling and limiting potential exposure pathways.

During this review, the issue of environmental protection was raised by stakeholders with many different perspectives. Some external stakeholders were concerned with NRC's regulation of radioactive contamination in groundwater, while others indicated that, because the releases to the environment were far below regulatory limits, increased regulatory actions were not necessary. The issue of environmental protection, as mentioned in NRC's mission statement, is addressed through NRC's implementation of NEPA to assure that agency decision makers are fully aware of the environmental impacts of the agency's decisions in making individual licensing actions and adopting regulations.

There are divergent views on how NRC should regulate licensed material that could enter groundwater. Although not a human health hazard, due to the very low levels of radioactivity found in recent incidents involving tritium leaks, it is a challenging issue from the perspective of communications around environmental protection. The stimulus for this

[2] As used in this report and defined by the International Atomic Energy Agency (IAEA), the term "confinement" is defined as prevention or control of releases of radioactive material to the environment in operation or in accidents [(IAEA 2008); see references, Appendix E].

challenge has been the pressure from various stakeholders for explicit demonstrations of protection of the environment, separate from demonstrations of protection of individuals.

Challenges to NRC's authority to protect the environment from inadvertent releases of licensed materials exist with respect to the interplay between NRC regulations and existing State and Federal regulations. Several States have become more active in their desire to enforce their regulations on NRC licensees. Although these challenges have existed for years, the issue became most evident after the Braidwood groundwater contamination event identified in 2005 when the State of Illinois pursued enforcement for "degradation" of a natural resource. State officials questioned the GTF on why NRC would not step aside in areas where they thought it was unclear whether NRC has statutory authority. This is especially the case when the State has delegated authority for groundwater protection from the Environmental Protection Agency (EPA).

In an effort to reach out to interested stakeholders, the NRC conducted public meetings. During the April 19-20, 2010, public meetings, the GTF heard from several State representatives, local officials, and members of the public regarding their disagreement and concern with NRC's human, dose-based approach to protecting groundwater. NRC's statutory authority in the Atomic Energy Act of 1954, as amended, is limited to regulation based on "health and safety of the public" and "common defense and security" (See Sec. 3 of the AEA). Regulation based solely on environmental protection is generally not within NRC's statutory authority, with limited exceptions, such as with respect to uranium mill tailings (commonly referred to as 11(e)(2) material). In addition, the backfit rule[3] for reactors further complicates changes to the regulatory framework. Promulgation of any rule that would result in a change to an existing system or structure would need to meet the standard of the backfit rule such that any backfitting would achieve a substantial increase in the overall protection of the public health and safety or common defense and security and that the costs of the backfitting, both direct and indirect, are justified in light of the overall increased protection. These factors impact NRC's ability to respond to leaks/spills to groundwater as some members of the public would like. These issues will likely become more significant as the nation's environmental stewardship increases and some countries adopt more direct approaches to protecting the environment from the effects of radiation.[4] NRC's regulatory framework for oversight of licensed material confinement appears to contribute to the distrust and dissatisfaction of NRC by some stakeholders.

NOTE: This is supported by the conclusions A.3.1, A.3.2, C.3.1, C.3.2, C.3.3, and E.3.4 in the attached appendices.

[3] Specifically, 10 CFR 50.109 defines a *backfit* as "the modification of or addition to systems, structures, components, or design of a facility; or the design approval or manufacturing license for a facility; or the procedures or organization required to design, construct or operate a facility; any of which may result from a new or amended provision in the Commission's regulations or the imposition of a regulatory staff position interpreting the Commission's regulations that is either new or different from a previously applicable staff position."

[4] Refer to the International Committee for Radiation Protection (ICRP) Publication 103 and the 2007 ICRP Recommendations at http://www.icrp.org/annals_list.asp.

2.2. Theme 2 – Maintain Barriers as Designed to Confine Licensed Material

The GTF heard many comments from stakeholders in public meetings regarding a desire for NRC to ensure that licensees prevent leaks/spills to groundwater and soil contamination. In their view, NRC's approach has been reactive rather than proactive.

Most incidents since 2006, and those reviewed by the GTF, involved fluids containing radioactive tritium leaking from non-safety related underground structures and pipes. Because these leaks/spills are not likely to result in doses that approach NRC radiation protection limits, NRC has not placed an emphasis on preventing these types of leaks/spills. While licensees are required to design systems to confine radioactive material, NRC's regulatory framework does not explicitly state that all activities under a licensee's control must be accomplished with no leakage. Instead, when applying for a license from NRC, the applicant describes in its application how radioactive material will be used, secured and controlled. For example, power reactor licensees are required by 10 CFR § 50.34(b)(3) to describe the kinds and quantities of radioactive materials expected to be produced and the means for controlling and limiting radioactive effluents and radiation exposures within the limits set forth in 10 CFR Part 20 in their Final Safety Analysis Reports. In addition, 10 CFR Part 50, Appendix I, requires specific information on the description of criterion "As Low As Reasonably Achievable" for control radioactive material in light-water cooled nuclear power reactor effluents. The license granted by NRC only permits the licensee to engage in activities authorized in the license, and specific effluent points are included in the licensing bases. There may be additional State and Federal permits, licenses or approvals required for effluent discharges. In addition to the general licensing bases there are specific license conditions related to effluent discharges in reactor and non-reactor NRC licenses. A thorough review of the licensing bases, both general and specific conditions, should be performed by NRC staff whenever a leak not associated with an approved discharge occurs as it may be a violation of applicable requirements, e.g., 10 CFR Part 50, Appendix I.

NOTE: This is supported by conclusions C.3.1, C.3.3, and B.3.1 in the attached appendices.

2.3. Theme 3 – More Reliable NRC Response

The GTF received input from many stakeholders including the public, industry, and NRC staff. Because any leakage of radioactive material, regardless of the hazard to individuals is of significant public interest, the GTF concludes that NRC response to incidents could be enhanced to be more reliable. The GTF identified the following three elements that comprise this theme: event response guidance, performance indicators (PI)[5], and dissemination of information (internal/external).

[5] For further discussion of NRC's Performance Indicators, see http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/cornerstone.html

With regard to the first element (event response guidance), the GTF reviewed existing NRC guidance related to the response and monitoring of leaks/spills of radioactive material and determined that the guidance could be enhanced to ensure a more reliable response when leaks/spills are identified at licensed facilities. The current approach has resulted in a significant variation of expenditures of inspection resources from follow-up by the resident inspection staff to a team of health physics inspectors, hydrologists, and/or materials engineers independently assessing the licensee's performance. Additionally, the reporting of NRC inspection results also varied greatly with stand alone inspection reports, "quick-look" letters, or reporting the results in the next quarterly inspection report.

The second element was determined to be the lack of predictive PIs. An effective PI should provide a meaningful distinction when there is a change in performance. The Public Radiation Safety Cornerstone has one PI – Radioactive Effluent Technical Specifications/Offsite Calculation Dose Manual. This PI assesses the performance of the licensee's radiological effluent control program for both liquid and gaseous effluents. It is not a robust indicator of licensee performance with respect to groundwater and does not measure out-of-normal performance unless the release is large enough to challenge safety limits. For example, this PI did not change as a result of the leak identified at Braidwood in 2005. Additionally, the GTF noted that the industry has never had one reportable occurrence under this indicator. This PI also does not address leaks/spills. An effective PI for groundwater protection would change as a function of the number, quantity, and type(s) of radionuclide, and/or locations of leaks/spills for groundwater protection. Some of the recent responses to incidents have resulted in the staff working from the extreme edges of the Reactor Oversight Process (i.e., taking no actions for some leaks while issuing Demands for Information or Reactor Oversight Deviations for others). This has resulted in a significant range of NRC responses and stakeholder confusion.

The third element identified was access to, and timely dissemination of information (internal/external). The information on NRC's Knowledge Management Center and Operating Experience (OpE) web pages related to leaks/spills that could affect groundwater contamination is limited, difficult to locate, and in some cases, dated. The low risk to public health and safety from these incidents has resulted in a failure to address the trends in groundwater incidents in internal NRC information. The information contained on the public website is provided through a complex set of links that has frustrated many users. Additionally, some of the information has not been updated in several years and contains outdated or incorrect information.

NOTE: This is supported by conclusions A.3.1, B.3.1, B.3.2, B.3.3, B.3.4, D.3.1, D.3.2, and E.3.3 in the attached appendices.

2.4. Theme 4 – Strengthen Trust

The GTF observed and received input from some members of the public, media, licensees, and domestic and international regulators on the need to communicate promptly, effectively,

and clearly regarding NRC's response and assessment of unplanned, unmonitored releases to the environment. There exists a misalignment of viewpoints between NRC and some stakeholders. Some stakeholders view leaks as an indication of inadequate maintenance of the entire facility. NRC's regulatory framework treats confinement of licensed material as a design rather than an operational or maintenance consideration. Also, during the past several years, when leaks occurred, they have been of very low risk and dose to individuals. NRC uses a risk communication method as described in NUREG/BR-0308, "Effective Risk Communications" to describe consequences of releases to individuals.[6] This risk communications framework does not directly address the primary concerns of some NRC stakeholders. Some view any radiological releases as a public health issue rather than an issue of risk. Furthermore, instead of waiting to remediate onsite contamination when the facility is decommissioned, they see a need for immediate cleanup and enforcement.

As a result, a belief by some that NRC fails to require adequate maintenance fosters doubt and uncertainty over NRC's and licensee's ability to protect people and the environment. Some stakeholders have fear and anxiety regarding their health. The overall impacts of leaks to the environment are viewed by some stakeholders as an environmental insult, which results in an increased sense of anger, frustration and distrust.

Those stakeholders tend to seek third-party validation of NRC's assessments regarding groundwater incidents. They expect a discussion of the public health perspective when communicating the risks and consequences of leaks to groundwater.

NOTE: This is supported by conclusions D.3.3, E.3.1, E.3.2, E.3.3, and E.3.4 in the attached appendices.

3. Analysis and Recommendations

3.1. NRC Mission Analysis

Loss of licensed material confinement incidents represents a significant challenge to NRC. Policies that protect public health and safety and policies that protect the environment are not always consistent with each other. One instance where policies designed to protect public health and safety may not coincide with policies to protect the environment is when leaks from non-safety-related components occur that have low dose consequences. Such incidents may impact the environment but pose little or no health and safety concern. Fundamentally, NRC's regulatory framework covers these incidents as situations to monitor, document, and remediate, if necessary at decommissioning. From a public health and safety perspective, these incidents are acceptable if the doses are within NRC regulatory limits. However, some stakeholders view leaks/spills as indicative of a failure to maintain the plant, a risk to public health, and requiring immediate remediation. This disagreement over how a release should be handled undermines trust in NRC among those stakeholders.

[6] http://www.internal.nrc.gov/communications/riskcommunication.html

Further complicating this challenge is the issue of the interplay between State and Federal regulations. The EPA and some States regulate groundwater differently than NRC. Their regulations seek to protect the environment as a natural resource in contrast to NRC's approach of protecting the environment through protection of public health. The EPA uses its authority under the Safe Drinking Water Act to set the Federal legal limits for contaminants in drinking water and to protect underground sources of drinking water. Water suppliers must provide water that meets these standards, known as "maximum contaminant levels." EPA's drinking water standards do not apply to private drinking water wells, such as those that may be impacted by tritium that is inadvertently released (within NRC regulatory limits) from nuclear power plants. However, many State authorities have adopted the EPA's drinking water standards as legally enforceable standards, and those standards are often used in assessing laboratory test results of water from private wells.[7]

Going forward, incidents involving a loss of confinement of licensed material may increase. Because of power uprates and longer life reactor cores, the inventory of tritium in the fleet has been and is increasing. These facilities will likely have more losses of confinement from non-safety related systems, and with a low reporting threshold established by the voluntary industry initiative NEI-07-07 (ADAMS Accession No. ML072600295), more leaks/spills may be reported and stakeholder interest will remain high.

3.2. Recommendations

In the Appendices to this report, the GTF developed 16 conclusions on issues associated with the oversight of groundwater incidents. While those conclusions also provide some recommended approaches to strengthening the NRC oversight of groundwater, a policy analysis should be completed before developing specific recommendations/actions. Nevertheless, the GTF suggests the staff consider the following recommendations to strengthen NRC response to groundwater incidents:

- Identify the policy issues associated with an assessment of the NRC's groundwater protection regulatory framework
- Once the policy issues are addressed, implement conforming changes to incorporate appropriate enhancements in the Reactor Oversight Program
- Consider development of specific actions to address the key themes and conclusions in this report
- Conduct a focused dialogue with EPA, States and international regulators[8] to develop a collaborative approach for an enhanced groundwater protection strategy

For further details on the conclusions refer to Appendices A through E of this report.

[7] For more information on drinking water and health, visit http://www.epa.gov/safewater/dwh/index.html

[8] As the GTF completed its report, the Canadian Nuclear Safety Commission published "Tritium Studies Project Synthesis Report," that provides an extensive review of Canadian regulatory oversight of tritium processing and tritium releases in Canada. Reference: CMD-07-M34; E-DOCS #3533394, May 21, 2010.

4. Summary of Appendices

During its work to complete the Charter, the GTF reviewed material related to NRC's oversight on groundwater incidents, and documented this review in five appendices. This work is summarized below.

4.1. Appendix A – Response to Recent Groundwater Incidents

Groundwater incidents occurring since 2006 were reviewed by the GTF to better understand the approaches used by the Regions under the auspices of the Reactor Oversight Program. The results of this review are detailed in Appendix A. The GTF concluded that NRC inspection response to incidents of leaks/spills has varied widely. As a result, NRC's response has been inconsistent and unpredictable, and expenditures of inspection resources have varied significantly. Consequently, NRC's credibility in the view of some stakeholders has suffered.

The implementation of the industry voluntary groundwater initiative has resulted in increased reporting by licensees of the discovery of leaks/spills that could affect groundwater. However, the reports only identify the initial indications of incidents and do not provide information describing the results of activities to identify and resolve leaks/spills, the root causes of the leaks/spills and corrective actions or conclusions with respect to the consequences. Thus, the limited public information leads to distrust by some stakeholders. The increased numbers of incident reports lead some stakeholders to believe that the nuclear industry has serious maintenance issues that need enforcement action. NRC's ability to take enforcement action based on a voluntary industry initiative is limited to enforcing those items in the industry initiative that are required by NRC rules.

4.2. Appendix B – Agency Actions

The GTF reviewed many of the incidents since 2006 to determine if gaps exist or additional NRC actions are needed for responding to groundwater incidents. That review is detailed in Appendix B.

The GTF concludes that the current Reactor Oversight Program Performance Indicator does not provide a meaningful distinction in licensee performance with respect to groundwater protection. Further, the GTF concludes that because of the low risk of these events, Operating Experience information is limited. Finally, the GTF concludes that there is an inconsistency between the Public Radiation Safety Cornerstone in the reactor oversight program significance determination process and the associated technical basis document regarding the use of "public confidence" factor. Consideration of public confidence in this part of the reactor oversight process would result in a higher level of significance than would be warranted based solely on the risk from exposure to the radioactive material.

4.3. Appendix C – Regulatory Framework for Groundwater Incidents Involving NRC Licensees

The GTF reviewed the existing regulatory framework for addressing leak/spills. Appendix C details the results of this review. Maintaining system integrity is a fundamental principle in minimizing leaks/spills and groundwater contamination. For systems outside the scope of license renewal, existing regulations for inspection, maintenance, and aging management issues do not adequately address preventing leakage from non-safety systems containing licensed material.

NRC's regulatory framework with respect to groundwater varies for different licensees (e.g., reactors, fuel cycle, and in-situ leach facilities). NRC has been regulating groundwater quality using projected dose calculations for some licensees and by measurements of groundwater concentration for other licensees consistent with applicable regulations. Furthermore, some licensees are regulated with respect to both radiological and non-radiological constituents. Some licensees are required to conduct groundwater characterization and implement ongoing close-in monitoring while others are not. NRC's regulatory framework among licensed facilities, which is consistent with Federal law, can be a source of both internal and external stakeholder confusion. As a result, NRC may be perceived as a less effective regulator by some stakeholders.

The requirements for groundwater monitoring for non-reactor facilities are specific to each type of license and may not be consistent. Additionally, the NEI Voluntary Groundwater Protection Initiative is not applicable to all types of licensees; it is only applicable to power reactors. The effectiveness of groundwater monitoring programs across all types of licenses has not been thoroughly evaluated for consistency.

The proposed final decommissioning rule now before the Commission (SECY-09-0042) would require licensees to identify and evaluate subsurface contamination, maintain records of contamination, and account for the cost of remediation of residual contamination for site-specific decommissioning cost estimates. This rule is directed at decommissioning planning and would not alter the regulatory framework for confinement of licensed material, incorporate the voluntary industry initiative or require immediate remediation.

4.4. Appendix D – Communications on Groundwater Incidents

The issue of leaks/spills at operating nuclear power plants has generated considerable attention by the public, media, and Congress. Recognizing this, and consistent with its charter, the GTF reviewed the results of the April 19 and 20, 2010, public meetings, media reports, Congressional correspondence issued between 2006 and 2010, and the content of NRC's public website. Further, the GTF sought public comments. Appendix D details this review and provides the GTF, facts observations, and conclusions.

Themes from Congressional correspondence indicate interest both in the House of Representatives and in the Senate (Congressional Members). They expressed concern that

NRC enforce its rules and regulations when incidents occur and that NRC issue effective "punishment." Some Congressional Members want "continued independent audits" of licensee activities. In the area of communications, some Congressional Members insisted that we share information quickly after an event with Congress and the public. They want to be "warned" of the health and safety impacts and would want NRC to provide detailed descriptions for each event.

Themes from press clippings reviewed by the GTF were focused primarily on the public's lack of trust with licensees and NRC's ability to effectively respond to tritium incidents.

The public workshops focused on the consequences resulting from tritium leaks from pipes at nuclear power plants. The GTF concluded that the main challenge was how to communicate those consequences with external stakeholders (i.e., the public and interest groups) to strengthen public trust, confidence, and respect. For some stakeholders, public trust of NRC as a regulator is being eroded as result of continuing leaks/spills. Some members of the public expressed their concerns and distrust of NRC's response and enforcement of groundwater incidents.

In the opinion of some stakeholders, NRC's communications have been insufficient in assuring them of NRC's interest in their health. Public health experts have suggested that NRC engage the public in a dialogue on the potential health effects of radiation before entering into a discussion of comparable risks with those stakeholders.

4.5. Appendix E – Summary of International Input on Groundwater Incidents

A review of the regulatory approaches used by NRC's international counterparts is detailed in Appendix E. Although the majority of the countries contacted by the GTF did not have an official policy for regulatory responses to incidents involving reports of releases of radioactivity below the regulatory limits, all countries did have licensee (operator) reporting requirements for periodic environmental effluent monitoring. In addition, international regulatory authorities effectively communicated licensee's radiological monitoring results annually in a report to their legislative body, which was also made available to the public on their websites. International regulatory staff contacted by the GTF emphasized the need to monitor migration of radioactivity into the public domain before decommissioning, and consequently encouraged the emphasis on specific programs for groundwater monitoring and investigation.

The GTF noted that the issues concerning recent U.S. tritium contamination events have raised similar questions worldwide. Recently, one international regulator received an inquiry from their applicable Ministry regarding concerns over the control of tritium with respect to nuclear power plants in their country. These questions have been raised by the Ministry because of the Vermont Yankee tritium contamination issues and the possible applicability of similar issues in their country.

As illustrated by other international regulators, establishing a position statement and key objectives on buried piping activities and groundwater initiatives would be helpful in providing clear communication to stakeholders on the actions taken by both NRC and licensees at the affected sites.

In order to promptly and more effectively communicate the safety significance of incidents to the public, the GTF noted that more than 65 countries use the IAEA's INES to explain incidents associated with various sources of radiation. Use of INES in communicating the safety significance of incidents such as leaks from underground piping may aid in third-party validation of NRC's assessment of groundwater incidents and in helping strengthen public trust.

Several international regulators commented on the need to cooperatively investigate, through an international expert meeting, corrosion incidents that have caused leaks in buried pipes and related systems at nuclear power plants in order to obtain international consensus on approaches to communicate the safety significance of such incidents effectively and to share experiences on related issues.

4.6. Appendix F – Acronyms

For convenience, Appendix F contains a list of acronyms used in this report and its appendices.

5. Task Force Membership

Subsequent to the issuance of the EDO memorandum, the GTF was established with the following membership:

- Team Leader – Charles A. Casto, Region IV
- Assistant Team Leader – Mark Cunningham, Office of Nuclear Reactor Regulation
- Team Members
    - William Ford, Office of Nuclear Materials Safety and Safeguards
    - James Shepherd, Office of Federal and State Materials and Environmental Management Programs
    - Thomas Nicholson, Office of Nuclear Regulatory Research
    - Cynthia Jones, Office of Nuclear Security and Incident Response
    - Lisa London, Office of the General Counsel
    - Ronald LaVera, Office of New Reactors
    - Mel Gray, Region I
    - Mark Lesser, Region II
    - George Kuzo, Region II
    - John Cassidy, Region III
    - Michael Shannon, Region IV

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Appendix A

Response to Recent Groundwater Incidents

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Appendix A

Response to Recent Groundwater Incidents

A.1. Overview of U.S. Nuclear Regulatory Commission's (NRC) Response to Recent Groundwater Incidents

NRC's requirements associated with leaks/spills establish the basis for its oversight of licensee operations with respect to groundwater incidents. Recognizing this, the Groundwater Task Force (GTF) reviewed this regulatory framework in Appendix C for operating reactors as well as those for other NRC-licensed facilities. This appendix describes recent leaks/spills and NRC's response to these incidents.

In response to leaks/spills of radionuclides by nuclear power plants NRC implemented the inspection and assessment activities described in the Reactor Oversight Process (ROP). Regional managers were informed of incidents typically through resident inspector daily plant status activities and by public notification reports made by licensees to NRC. In response to these leaks/spills, resident inspectors and regional health physics (HP) specialist inspectors gathered information regarding the potential impact of the leaks/spills on the health and safety of onsite staff and the public. Inspectors reviewed licensee evaluations of the consequences of the leakage and independently assessed whether the projected doses to the public, if any, were within regulatory requirements. As licensees determined the leak sources, NRC inspectors assessed the technical adequacy of the licensee's operational and functionality assessments of the leaking component's capability to accomplish their intended function. Staff further independently assessed the adequacy of licensee actions to identify and resolve the leaks/spills.

Regional staff and managers reported these leak/spill incidents to NRC headquarters stakeholders through formal morning plant status meetings and through informal communications. These internal discussions were accompanied in some cases by significant activities to convey NRC's safety perspectives to external stakeholders including Congressional, State, and local government officials, and the public. These activities were coordinated with personnel from the Office of Congressional Affairs (OCA), Office of Public Affairs (OPA), Office of the Executive Director for Operations (OEDO), and the Regional State Liaison Officers.

The staff's assessments formed the technical basis for determining the appropriate inspection response to these groundwater incidents in accordance with the Management Directive 8.3, "NRC Incident Investigation Program," (MD 8.3) (ADAMS Accession No. ML031250592) and the guidance in Inspection Manual Chapter (IMC) 0309,

"Reactive Inspection Decision Basis for Reactors" (ADAMS Accession No. ML092790408). Staff considered whether the leakage incidents were significant operational events that required further review using the guidance in IMC 0309. For leakage incidents that were considered significant operational events as defined in IMC 0309, evaluations were documented and completed to develop recommendations for either the Reactor Oversight Process (ROP) baseline inspections or augmented inspections. Senior regional managers provided oversight for the implementation of the IMC 0309 process and determined the appropriate inspection response. The majority of leak/spill incidents were inspected through ROP baseline inspections.

The ROP Action Matrix as described in IMC 0305, "Operating Reactor Assessment Program" (ADAMS Accession No. ML0305206111), provides a risk-informed, objective, and predictable framework that guides NRC inspection and oversight for licensee safety and security performance. The ROP recognizes there may be rare instances in which the regulatory actions dictated by the Action Matrix may not be appropriate. In a few instances, senior regional managers in consultation with the NRC program office managers considered whether the leaks/spills warranted NRC regulatory inspection and oversight actions that deviated from the Action Matrix. In regards to two plant sites with leaks, NRC issued an internal ROP Deviation Memorandum that identified additional NRC inspections and oversight tailored to address the unique underlying technical and performance issues related to the leaks.

Communications of these incidents were consistent with ROP guidance on report issuance. The licensees notified NRC of their report to the State as required by the industry voluntary initiative.

A.2. Facts and Observations

A.2.1. Vermont Yankee

On January 7, 2010, Entergy personnel at the Vermont Yankee (VY) nuclear plant provided a voluntary report to NRC that a routine sample result from a groundwater monitoring well indicated tritium levels of 17,000 pCi/L [Event Notification 45613][9]. The samples were taken as part of VYs implementation of the voluntary industry groundwater monitoring program (NEI-07-07) ADAMS Accession No. ML072600295). The monitoring well is located outside the protected area but within the owner controlled area and about 30 feet from the Connecticut River. Entergy managers established an evaluation team to determine the source of the tritium and developed enhanced sampling plans that included installation of additional groundwater monitoring wells. Entergy staff conducted further hydro-geological surveys and data collection to better characterize groundwater behavior on the site including

[9] Event notifications (ENs) are available via NRC's website at http://www.nrc.gov/reading-rm/doc-collections/event-status/event/.

the potential to affect drinking water wells on- and off-site. Entergy staff also conducted bounding analysis to confirm that the consequence of this leakage would not (a) affect public health and safety or (b) exceed any NRC regulatory requirements. Subsequently, in February 2010, Entergy personnel determined that the groundwater contamination was the result of a leak from an underground concrete pipe vault associated with the Advanced Off-Gas (AOG) system. The vault contained pipe that conveyed steam used in the hydrogen recombiners. A pipe leak in the vault occurred and a vault drain line was found clogged. As the vault subsequently filled with water, a release to the environment resulted. Entergy staff took action to terminate the leakage from this location and initiated actions to repair the degraded piping. At the drafting of this GTF report, Entergy is conducting a root cause evaluation to confirm the causes of the leak and develop further corrective actions. Entergy has continued to sample and analyze the Connecticut River and several on- and off-site drinking water wells for the presence of any plant-related radioactivity. There has been no activity distinguishable from normal background detected from these sites. To date, only shallow groundwater monitoring wells in the vicinity of the known leak source have produced groundwater with tritium levels above background.

In response to the VY notification of the presence of tritium in a groundwater sample, NRC regional staff independently reviewed the information and closely monitored Entergy's investigation and analytical dose assessments. Regional staff completed a review of the available information in accordance with IMC 0309 and developed a recommendation that baseline inspections be performed. Health Physics (HP) inspectors conducted ROP baseline inspections related to follow-up activities and reviewed Entergy's actions to implementing the industry voluntary groundwater initiative. These inspection activities were accompanied by a very high level of internal and external stakeholder communication and outreach activities.

Although tritium was identified in on-site groundwater monitoring wells, NRC staff to date has not identified a hazard to public health and safety, and the staff expects any off-site radiological releases to be very small (i.e., offsite doses, if any, would be negligible with respect to normal background radiation levels). However, considering the extraordinary level of interest and concern by stakeholders, including numerous congressional, state, and local officials, NRC concluded that increased NRC oversight of the characterization, mitigation, and remediation of the tritium contamination is warranted. As a result, a ROP Deviation Memorandum, dated April 5, 2010, was issued to provide for increased inspection and oversight to, in part, help address stakeholder concerns and improve public confidence (ADAMS Accession No. ML100960321).

NRC preliminary inspection results were documented in a letter dated April 16, 2010 (ADAMS Accession No. ML101060419). NRC determined (a) that Entergy appropriately evaluated the contaminated groundwater with respect to off-site effluent release limits and the resulting radiological impact to public health and safety and (b) that Entergy complied with all applicable regulatory requirements and standards pertaining to radiological effluent

monitoring, dose assessment, and radiological evaluation. NRC also determined that, as of the end of 2009, Entergy had completed certain essential elements of the industry voluntary initiative program. However, some aspects of the industry voluntary initiative had not been completed within the timeframe specified.

A.2.2. Oyster Creek

On April 15, 2009, Oyster Creek personnel performing unrelated maintenance activities observed approximately twelve inches of standing water in an emergency service water cable vault. Sampling results indicated tritium concentrations in this water. Oyster Creek personnel pumped the water from the cable vault into drums for planned and controlled monitoring and release to the environment. Oyster Creek reported the condition to NRC in EN 44993 because notification was being made to another government agency (State of New Jersey as required by the industry voluntary initiative) for a situation related to the health and safety of the public. Oyster Creek staff completed sampling of monitoring wells and concluded there was likely a leak from underground or vaulted condensate storage tank related pipes. Oyster Creek personnel subsequently identified and replaced two carbon steel non-safety related buried pipes associated with the condensate system that had experienced localized corrosion resulting in a leak to the environment.

Regional staff reviewed the available information in accordance with IMC 0309 and recommended that baseline inspections be performed. This recommendation was accepted and inspectors completed baseline inspections related to initial event response by Oyster Creek and documented the results in the next quarterly integrated inspection report dated July 30, 2009 (ADAMS Accession No. ML092110491). A team of NRC inspectors with specialties in HP and materials completed additional baseline inspections in August 2009 and documented the results in a stand-alone inspection report dated September 8, 2009 (ADAMS Accession No. ML092510218). The inspectors concluded that in one instance the leak was due to improper application of underground pipe coatings and in the other instance an erroneous assumption on the part of Oyster Creek staff regarding the pipe material. The team did not identify any radiological public health and safety consequences associated with the leaks, or violation of NRC requirements or standards. Although tritium contaminated groundwater was detected on-site in the vicinity of the leaks, this condition did not, nor was it expected to, result in exceeding any regulatory dose limit to the public. Additionally, the GTF noted that plant-related radioactivity (including tritium) has not been detected at any off-site environmental monitoring location. Finally, the GTF concluded that, while some performance deficiencies in the early 1990s contributed to the cause of the leaks, these deficiencies had minor significance on operational and radiological safety. As a result, there were no findings of significance identified.

A second unrelated pipe leak at Oyster Creek was identified in August 2009 when Oyster Creek personnel observed increased water levels in the turbine building perimeter sump. Investigation identified a leak in a 6-inch non-safety related condensate storage tank (CST)

pipe in a location where the pipe passed through the turbine building foundation. Oyster Creek personnel replaced the leaking pipe. NRC inspectors reviewed the licensee's bounding radiological public dose calculations, root cause analysis report, and environmental sampling activities and concluded there was no radiological impact to the public. There were no findings of significance identified, and this inspection was documented in an NRC inspection report dated January 26, 2010 (ADAMS Accession No. ML100260020).

As the GTF was finalizing this report, the State of New Jersey reported that tritium from Oyster Creek may have migrated off-site. Because of the late-breaking nature of this information, the GTF was unable to consider it in formulating its conclusions and recommendations.

A.2.3. Oconee

On February 9, 2010, Oconee voluntarily notified the NRC in EN 45690 that groundwater monitoring samples taken from two wells, in support of the industry groundwater initiative, indicated tritium levels of 24,400 pCi/L and 35,400 pCi/L. The levels triggered the reporting threshold of the voluntary industry groundwater initiative of 20,000 pCi/L. The monitoring wells are located on the site property and are not drinking water wells. The licensee issued a press release stating that the results from 52 other wells sampled on the site did not show tritium levels above the industry voluntary initiative reporting threshold criteria. Samples from surrounding monitoring wells indicated the tritium has not migrated off the plant site in groundwater. The licensee is continuing to try to determine the leak source.

The regional staff determined that the issue did not warrant a reactive inspection because NRC guidance thresholds were not met in IMC 0309, "Reactive Inspection Decision Basis for Reactors." Media interest in the issue was very low. The regional staff and the senior resident inspector continue to monitor the licensee's actions through routine plant meetings and observations.

A.2.4. Other Plants with Groundwater Contamination Conditions Since 2006

The GTF determined that there were six other plants since 2006 that had identified inadvertent releases of radioactive liquid to the environment (Indian Point, Millstone, Fort Calhoun, Fitzpatrick, Brunswick and Monticello). The GTF considered whether there were significant additional insights to be gained from our inspection, assessment, and oversight of licensee performance related to groundwater incidents at these plants. This review concluded the NRC experience related to groundwater contamination at the Indian Point site provides significant insights into the effectiveness of the ROP. Additionally, an NRC inspection finding of very low safety significance at the Brunswick plant was illustrative of inspection and assessment activities related to licensee response to a leak/spill. The GTF noted event reports were submitted by licensees for leaks/spills at other nuclear power

plants (Millstone, Fort Calhoun, Fitzpatrick, and Monticello). The GTF concluded the implementation of the ROP oversight, inspection, and enforcement processes for these issues did not provide significant additional insights beyond that gained in considering NRC's oversight at Oyster Creek, Vermont Yankee, Oconee, Brunswick, and Indian Point.

A.2.4.1. Indian Point Units 1 and 2 Spent Fuel Pools

NOTE: The 2006 Liquid Radioactive Release Lessons Learned Task Force (ADAMS Accession No. ML0626503120) considered the Indian Point Unit 1 and 2 spent fuel pool leakage conditions prior to 2006. The following discussion includes NRC inspections and observations from 2006 to the present.

Leakage from the Indian Point Unit 2 (IP2) spent fuel pool (SFP) was identified in August 2005, when Entergy personnel began excavating an area adjacent to the IP2 SFP south wall. The excavation revealed a hairline crack with moisture along the south wall of the spent fuel pool. Initial samples did not detect any radioactivity and spent fuel pool leakage was not suspected. On September 1, 2005, contamination was first detected on a sample from the crack. A second crack was discovered two weeks later and Entergy personnel installed a collection device to capture leaking liquid. Analyses of the moisture indicated that the material had the same radiological and chemical properties as spent fuel pool water. In September 2005, Entergy personnel sampled water from an existing monitoring well in the IP2 transformer yard, and the results indicated an unexpected concentration of tritium in onsite groundwater. Prior to this sample, the well was last analyzed for tritium in 2000 and none was detected. In addition to the detection of tritium, the radionuclides nickel-63, cesium-137, strontium-90, and cobalt-60 were detected onsite at Indian Point. Entergy suspected these isotopes were the result of leakage from the Indian Point Unit 1 (IP1) SFP which resulted in the contamination of onsite groundwater.

NRC initiated a special inspection team (SIT) in September 2005 to (a) better understand the source of the radiological contamination, the causes, the extent of the condition, and any potential impact on spent fuel pool integrity and (b) confirm that public health and safety was being maintained as required by the regulatory requirements (ADAMS Accession No. ML0526400030).

Because the available information indicated that the leakage had been ongoing for some time and that the leakage included other radionuclides in addition to tritium, NRC issued a ROP Deviation Memorandum in October 2005 (ADAMS Accession No. ML053010404). This Deviation Memorandum authorizes the regional office to provide for increased inspections beyond the baseline required by the ROP. The Deviation Memorandum provided for oversight of Entergy's performance and progress in implementing its action plans for, in part, determining the location of the IP2 SFP leakage, effecting repairs, characterizing the on-site contamination, determining the sources, and establishing

appropriate monitoring and control. The Deviation Memorandum also provided for coordination with New York State and local government officials regarding split sampling of on-site and off-site groundwater samples and results to enhance confidence in the sampling process.

As directed by the ROP Deviation Memorandum, the SIT continued into 2006 and closely monitored Entergy's actions to identify, evaluate and correct the leaks. The SIT's report dated March 16, 2006 (ADAMS Accession No. ML060750842), concluded that (a) that the existence of onsite groundwater contamination as well as the underlying source of leakage warranted continued efforts to achieve resolution, and (b) that, to date, the conditions do not present significant risk to public health and safety or to the environment. NRC staff determined that (a) public health and safety had not been, nor was likely to be, adversely affected, and (b) the dose consequence to the public that can be attributed to current onsite conditions was negligible with respect to established NRC regulatory limits.

Subsequent to the SIT report, NRC's independent on-site groundwater sample analysis results demonstrated that strontium-90 was also a contaminant in the onsite groundwater, and further analyses by Entergy and the State of New York confirmed these analyses. This determination resulted in a significant expansion of the on-site groundwater characterization effort because the source of the strontium-90 contaminant was traced to leakage from the IP1 SFP. A full site-wide hydro-geologic investigation was subsequently instituted to include the IP1 and IP3 SFPs.

NRC continued augmented inspections (inspections beyond the required baseline), split groundwater sampling, and increased oversight of Entergy's activities in accordance with successive approved Deviation Memoranda through 2009 (ADAMS Accession No. ML063480016, ML073480290, ML083590057). During this period, NRC staff closely monitored Entergy's groundwater characterization efforts, performed independent inspections and testing, and independently evaluated radiological and hydrological conditions affecting groundwater onsite. NRC quarterly integrated inspection reports describe the results of augmented inspections under these Deviation Memorandums.

In January 2008, Entergy submitted the results of its comprehensive groundwater investigation, and included its plan for remediation and long-term monitoring of the on-site groundwater conditions (ADAMS Accession No. ML0803205390). Entergy described the sources of the groundwater contamination to be the IP1 and IP2 SFPs. While both pools contributed to the tritium contamination of groundwater, the leaks from the IP1 SFP was determined to be the source of other contaminants such as strontium-90, cesium-137, and nickel-63. Entergy described the repairs and assessment of the IP2 SFP and plans to remove all fuel from the IP1 SFP to an on-site dry storage location and drain the IP1 SFP by the end of 2008, thereby essentially eliminating the source of the groundwater contamination from IP1.

NRC completed a team inspection under the Deviation Memorandum and concluded in their inspection report dated May 13, 2008 (ADAMS Accession No. ML081340425), that Entergy's response to the identified leaks was reasonable and technically sound. This team reviewed the circumstances surrounding the causes of the leaks and previous opportunities for identification and intervention and did not identify significant findings. This team further determined that (a) public health and safety has not been, nor is likely to be, adversely affected and (b) the dose consequence to the public that can be attributed to the leaks is negligible. The inspection report noted that Entergy planned to incorporate the implementation requirements of their Long Term Monitoring Program (LTMP) as additional actions to be taken under their Off-site Dose Calculation Manual, which assures that the LTMP is an extension of their other radiological monitoring programs.

NRC followed Entergy's actions to remove all fuel from the IP1 SFP and drain the pool in 2008. In September 2009, NRC completed a team inspection under the ROP Deviation Memorandum to, in part, assess the establishment, implementation, and maintenance of the LTMP and inspect and assess radiological effluents monitoring and control activities. The team concluded that Entergy's LTMP for the Indian Point units was effectively implemented and maintained in a manner that provided continued radiological monitoring of the groundwater conditions to confirm conformance with NRC regulatory requirements. In February 2010, NRC concluded that, based on these inspection results and split sampling results, the baseline inspection and oversight provided by the ROP were adequate to monitor Entergy's performance at the Indian Point site and a Deviation Memorandum was not warranted in 2010 (ADAMS Accession No. ML1006208631).

A.2.4.2. Indian Point Unit 2 Condensate Storage Tank Pipe Leak

On February 15, 2009, IP2 staff observed indications of wetness in a floor pipe sleeve where an underground pipe from the condensate storage tank entered the IP2 auxiliary feedwater pump building. Staff sampled the wetness and determined that the results indicated approximately 2000 pCi/L of tritium, which was consistent with water in the CST return line from the suction of the auxiliary feedwater (AFW) pumps. This carbon steel pipe is classified as safety-related and American Society of Mechanical Engineers (ASME) Class 3 material and subject to the regulatory requirements in the IP2 technical specifications (TS) for the CST. Entergy informed the resident inspectors of this leak. The resident inspectors completed baseline inspections and verified that Entergy operators entered the applicable TS 7-day action statement for this condition and took required actions to administratively determine that the back-up on-site city water tank was available, if needed, to provide water to the AFW pumps. Entergy personnel excavated a portion of the AFW pump building floor and identified the CST return pipe was leaking through a localized one and a ½-inch diameter hole where a small area of a protective coating was missing. Entergy staff replaced this section in accordance with ASME code requirements and returned the CST to operability within the time required in the associated TS action

statement. Subsequent evaluation of the removed pipe section indicated structural integrity had been maintained.

NRC resident inspectors completed baseline inspections reviewing Entergy's operability evaluations, post maintenance testing, and temporary modifications related to the leak identification and pipe replacement activities. Regional inspectors also reviewed chemistry and radiological sample results and determined the releases were below regulatory requirements. Subsequent baseline inspections utilizing the problem identification and resolution inspection procedure were completed to review the Entergy root cause analysis and corrective actions and determine if there were prior opportunities to identify the leak. Entergy determined the leak occurred due to original construction specifications that allowed for large rocks in the backfill surrounding the pipe that likely damaged the pipe coating during installation of the pipe and allowed corrosion to occur on the surface of the pipe. Entergy staff determined the excavated pipes were found to be in good condition where the coating was intact. Entergy personnel planned actions to further monitor and inspect this piping. The inspectors did not identify any significant findings or violations of regulatory requirements (ADAMS Accession No. ML0922240592).

A.2.4.3. Brunswick

Prior to 2007, the Brunswick nuclear plant utilized an unlined storm drain stabilization pond (SDSP) to receive turbine building (TB) chiller condensate containing elevated tritium concentrations exceeding 1.0×10^6 (1,000,000) pCi/L (resulting from extensive steam leaks to the TB atmosphere). The chiller condensate was routed through storm drain piping (non-radioactive waste piping) and ultimately to the SDSP. Brunswick voluntarily reported (via EN 43420 in June 2007) that elevated tritium concentrations were identified in two manholes in close proximity to the SDSP.

NRC completed an inspection and identified documents indicating unanticipated tritium contamination in liquids sampled from onsite structures (i.e., electrical manholes), in seepage from the SDSP to the intake canal, in shallow groundwater monitoring wells installed adjacent to the SDSP, and in shallow groundwater wells installed to monitor a previous spill from a degraded radioactive waste (radwaste) line near the onsite switchyard. In 2008, an NRC inspection reviewing Brunswick's implementing procedure related to monitoring of elevated tritium concentrations in groundwater led the inspectors to conclude that Brunswick personnel did not properly evaluate and initiate actions to address increasing tritium concentrations reported from 2003 through 2007 for quarterly samples collected from onsite monitoring wells established to monitor previously identified radioactive waste line leaks (ADAMS Accession No. ML0821300890). Specifically, the inspectors identified a performance deficiency, the licensee continued to attribute the tritium increases to a previous radioactive liquid effluent waste line break and not investigate the potential for releases resulting from the Brunswick Unit 2 storm drain piping leaks. This resulted in delayed actions by the licensee to address and correct abnormal liquid releases within the

switchyard area. The inspectors identified a finding of very low safety significance (Green finding) because the performance deficiency did not result in offsite releases or result in offsite doses to members of the public. The inspectors determined the performance deficiency involved a "cross-cutting aspect" (a safety culture assessment feature of the ROP) in the area of human performance related to work practices and supervisory oversight because Brunswick staff did not properly evaluate monitoring well sample data to determine the possible radiological effects of plant operation on groundwater.

A.3. Conclusions

A.3.1. Conclusion

The NRC inspection response to leaks/spills has varied widely and has been case specific. In some cases the staff only monitored leak/spill incidents while in other comparable incidents significant deviations to the baseline inspection program were approved.

A.3.2. Conclusion

Event Reports created through the NRC (Event Notifications) in response to State reporting required by the industry's voluntary groundwater initiative do not provide information describing the results of activities to identify and resolve leaks, the root causes of the leaks, corrective actions, or dose consequences. The public is informed of the leaks. However, they are not updated on the progress of identification of the final root cause of the leaks.

A.4. References

MD 8.3. Management Directive 8.3, "NRC Incident Investigation Program," March 27, 2001, ADAMS Accession No. ML031250592.

IMC 0309. NRC Inspection Manual Chapter 0309, "Reactive Inspection Decision Basis for Reactors," February 2, 2010, ADAMS Accession No. ML092790408.

IMC 0305. NRC Inspection Manual Chapter 0305, "Operating Reactor Assessment Program," December 24, 2009, ADAMS Accession No. ML0305206111.

NUREG-1022. Event Reporting Guidelines: 10 CFR §§ 50.72 and 50.73, Rev. 2, October 2000, ADAMS Accession No. ML0037625950.

EN 45613. Event Notification 45613 related to Vermont Yankee dated January 7, 2010[10].

[10] Event notifications are available via NRC's website at http://www.nrc.gov/reading-rm/doc-collections/event-status/event/.

NEI 07-07. Nuclear Energy Institute, “Industry Ground-Water Protection Initiative – Final Guidance Document,” Washington, DC, August 2007, ADAMS Accession No. ML072600295.

EN 44993. Event Notification 44993 related to Oyster Creek dated April 15, 2009, NRC Public website.

NRC Inspection Report (IR) -- Integrated Inspection Report 05000219/2009003, July 30, 2009, ADAMS Accession No. ML092110491.

NRC IR 05000219/2009008, September 8, 2009, ADAMS Accession No. ML092510218.

NRC IR 05000219/2009005, January 26, 2010, ADAMS Accession No. ML100260020.

EN 45690. Event Notification 45690 related to Oconee dated February 9, 2010

EN 43813. Event Notification 43813 related to Millstone dated November 29, 2007

EN 43355. Event Notification 43355 related to Fort Calhoun dated May 10, 2007

EN 45593. Event Notification 45593 related to Fitzpatrick dated December 28, 2009

EN 45338. Event Notification 45338 related to Monticello dated September 9, 2010

LRRLLTF. NRC Liquid Radioactive Release Lessons Learned Task Force Final Report, September 1, 2006, ADAMS Accession No. ML0626503120.

Memorandum to John R. White, Manager Special Inspection and James D. Noggle, Senior Inspector, Special Inspection, from A. Randolph Blough, Director, Division of Reactor Safety, Special Inspection Charter – Indian Point Unit No. 2, September 20, 2005, ADAMS Accession No. ML0526400030.

ROP Deviation Memorandum – Request for Deviation from the Reactor Oversight Process Action Matrix to Provide Increased Oversight of Specific Issues at Indian Point Energy Center, dated October 28, 2005,” ADAMS Accession No. ML053010404.

NRC IR 05000247/2005011, March 16, 2006, ADAMS Accession No. ML060750842.

ROP Deviation Memoranda -- Request for Deviation from the Reactor Oversight Process Action Matrix to Provide Increased Oversight of Specific Issues at Indian Point Energy Center dated December 11, 2006; Adams Accession No. ML063480016, December 19,

2007; Adams Accession No. ML073480290, and December 16, 2008; ADAMS Accession No. ML083590057.

Letter from J.E. Pollock, Entergy Indian Point Energy Center, to U.S. NRC Document Control Desk, Results of Ground Water Contamination Investigation, ADAMS Accession No. ML0803205390.

NRC IR 05000003/2007010, 05000247/2007010, May 13, 2008, ADAMS Accession No. ML081340425.

Letter to J.E. Pollock, Entergy Indian Point Energy Center, from David C. Lew, Director, Division of Reactor Projects, March 3, 2010, ADAMS Accession No. ML1006208631.

NRC IR 05000247/2009003, August 12, 2009, ADAMS Accession No. ML0922240592.

EN43420. Event Notification 43420 related to Brunswick dated June 13, 2007.

NRC IR 05000325/2008003 and 05000324/2008003, July 30, 2008, ADAMS Accession No. ML0821300890.

Appendix B

Agency Actions

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Appendix B

Agency Actions

B.1. Introduction

The Groundwater Task Force (GTF) reviewed the following documents to assess whether additional staff actions are needed regarding groundwater at nuclear power plants. These items were selected as a direct result of the charter or they may be used by the NRC to review, inspect, and assess groundwater contamination incidents:

- Liquid Radioactive Release Lessons Learned Task Force Final Report
- Management Directive 8.3 and Inspection Manual Chapter 0309
- Public Radiation Safety Cornerstone Performance Indicator
- Knowledge Management and Operating Experience
- Temporary Instruction 2515/173
- Public Radiation Safety Significance Determination Process

The results of these reviews and the ADAMS Accession numbers for each of these documents are provided below.

B.2. Reviews

B.2.1. Liquid Radioactive Release Lessons Learned Task Force (2006)

B.2.1.1. Overview

The focus of the September 2006 Liquid Radioactive Release Lessons Learned Task Force (LRRLLTF) was on releases of radioactive liquids that were neither planned nor monitored (ADAMS Accession No. ML062650312). Most of the incidents that occurred before LRRLLTF had involved tritium. However, the GTF did not limit its review to tritium-related incidents as other radioactive isotopes had been also inadvertently been released to the environment. An example included leaks from spent fuel pools, particularly where the pool contained fuel with degraded outer cladding material, which allowed some fission products to be released from the fuel into the pool water.

The most significant conclusion of the LRRLLTF regarded public health impacts. Although there had been a number of industry events where radioactive liquid was released to the environment in an unplanned and unmonitored fashion, based on the data available, the LRRLLTF did not identify any instances where the health of the public was impacted. When considering recommendations to be made as the result of the review, the LRRLLTF members were challenged to weigh the likely benefit of implementing recommendations

against the cost. The LRRLLTF concluded that the potential for long-term undetected radioactive leaks resulting in a more than a minor radiation dose to members of the public was low. However, as illustrated by the Braidwood and Indian Point incidents, the LRRLLTF concluded that the positive benefit to the NRC's goal of openness could be significant. The recommendations contained in the report reflected that judgment.

B.2.1.2. Facts and Observations

The LRRLLTF generated a report contained 26 recommendations that were intended to generally: enhance regulations or regulatory guidance for unplanned, unmonitored releases; review areas of decommissioning funding and license renewal; and enhance public communications. LRRLLTF prompted the revision of two guidance documents, Regulatory Guide (RG) 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste" (ADAMS Accession No. ML091170109) and Regulatory Guide 4.1, "Environmental Monitoring For Nuclear Power Plants" (ADAMS Accession No. ML091310141).

LRRLLTF recommendations implementation status as of July 10, 2009 (ADAMS Accession No. ML091900252), provided a summary of the activities that closed each of the 26 recommendations in the LRRLLTF report. This document shows Regulatory Guides 1.21 and 4.1 were used as the basis to close 12 of the 26 recommendations. The LRRLLTF report included one recommendation on the development of a consensus standard on the evaluation of radionuclide transport in groundwater. This standard was developed and is identified as American National Standard (ANSI/ANS) 2.17 (ADAMS Accession No. ML101310455). Since completion of the LRRLLTF report, development of this standard continued, and as of the writing of this GTF report, the draft standard has been completed, comments solicited and addressed. On March 31, 2010, a proposed final standard was provided to ANS for approval by the parent committee. Additionally, nine other recommendations were closed without any changes to NRC practices. These recommendations were developed for NRC to review programs, policies, and regulations related to activities that could impact groundwater protection in the following areas:

1. Spent fuel pool (SFP) telltale drains
2. Impact of SFP leakage (boric acid) on safety significant structures (concrete and rebar)
3. Applicability of Maintenance Rule for SSC that contain radioactive liquids
4. License renewal process for SSCs that contain liquid radioactive material.
5. Dialogue with State officials regarding application of the National Pollutant Discharge Elimination System (NPDES) for discharges of radioactive materials
6. Inspection guidance to review contamination incidents that could impact groundwater
7. Decommissioning funding
8. Immediate notification process

9. Policies to recommend licensees to consider agreement with state/local officials to voluntarily report radioactive liquid releases.

The creation of the ANSI/ANS standard and revisions to Regulatory Guides are not substitutes for regulations, as compliance with these documents is not required. In most cases, licensees may use previously established, acceptable alternative methods for complying with specified portions of the NRC's regulations. Consequently, there has been no impact on operating reactors from these LRRLLTF recommendations.

B.2.2. MD 8.3 – NRC Incident Investigation Program

B.2.2.1. Overview

Management Directive (MD) 8.3, "NRC Incident Investigation Program" (ADAMS Accession No. ML031250592) is the policy that NRC uses, in part, to ensure that significant operational incidents involving reactor and material licensees regulated by the NRC are investigated in a timely, objective, systematic, and technically sound manner; that the factual information pertaining to each event is documented; and that the cause or causes of each event are ascertained. The incidents may involve responses by an incident investigation team (IIT), less formal responses by an augmented inspection team (AIT), or a special inspection team (SIT), depending upon the level of response required. The objectives of MD 8.3 are to promote public health and safety, instill public confidence, and provide for the common defense and security by understanding the cause or causes of incidents and preventing accidents.

Inspection Manual Chapter (IMC) 0309 provides guidance to the Office of Nuclear Reactor Regulation (NRR) and the Regional staff for implementing the requirements prescribed in MD 8.3.

B.2.2.2. Facts and Observations

MD 8.3 discusses an objective of instilling public confidence. Stakeholder response to groundwater contamination incidents suggests that this objective has not been fully met. Currently MD 8.3 states, in part that an: (1) IIT should be considered for a significant radiological release (levels of radiation or concentrations of radioactive material in excess of 10 times any applicable limit in the license or 10 times the concentrations specified in 10 CFR Part 20, Appendix B[11], Table 2, when averaged over a year) of byproduct, source, or special nuclear material to unrestricted areas; and (2) AIT should be considered for a radiological release of byproduct, source, or special nuclear materials to unrestricted areas that resulted in an occupational exposure or exposure to a member of the public in excess of the applicable regulatory limit (except for shallow-dose equivalent to the skin or extremities from discrete radioactive particles). MD 8.3 does not have predefined criteria for

[11] http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appb.html

when a special inspection is warranted for incidents that involve leaks/spills of radioactive material that are below the regulatory limits. However, Section 04.05 (Radiation Safety) of IMC 0309, issued February 2, 2010, does establish criteria for conducting a special inspection. This criterion is: [a release] that led to a large (typically greater than 100,000 gallons), unplanned release of radioactive liquids inside the restricted area that has the potential for groundwater, or offsite, contamination.

B.2.3. Public Radiation Safety Cornerstone Performance Indicator

B.2.3.1. Overview

The NRC assessment program collects information from inspections and performance indicators (PIs) in order to enable NRC to arrive at objective conclusions about a licensee's safety performance. Based on this assessment information, the NRC determines the appropriate level of NRC response, including supplemental inspection and pertinent regulatory actions. The purpose of the Radiation Safety Cornerstone PI is to assess the performance of the licensee's radiological effluent control program for both liquid and gaseous effluents. As with any PI, licensees have volunteered to report the needed information quarterly to the NRC. In accordance with NEI 99-02 Revision 6, (ADAMS Accession No. ML092931123), a radiological occurrence is when dose to a member of the public exceeds any or all of the following values: (1) Liquid radiological effluents release in excess of, 1.5 mrem/quarter (whole body) and 5 mrem/quarter (organ); and (2) gaseous radiological effluents released in excess of, 5 mrads/quarter (gamma dose), 10 mrads/quarter (beta dose), and 7.5 mrem/quarter (organ dose from I-131, I-133, H-3, and particulates).

B.2.3.2. Facts and Observations

An effective PI should provide a meaningful distinction when there is a change in performance. The Public Radiation Safety Cornerstone has one PI - RETS/ODCM (Radiological Environmental Technical Specifications/Offsite Dose Calculation Manual Radiological Effluents). From a review of the PI data submitted since the beginning of Reactor Oversight Process (ROP) (calendar year 2000), the GTF noted that the industry has never had one reportable occurrence even though there have been various levels of performance, as evidenced by the number of previously unmonitored leaks/spills that were identified when the industry groundwater protection initiative was implemented. The GTF identified that the effectiveness of this PI was questioned previously in an open Reactor Oversight Process Feedback Form that requests some changes to the Public Radiation Safety Cornerstone Performance Indicator. Specifically, Feedback Form 0308.1-1140 submitted in May 2007 stated: "The Performance Indicator for the Public Radiation Safety Cornerstone does not appear to be a robust indicator of licensee performance and does not appear effective in identifying out-of-normal performance."

B.2.4. Knowledge Management and Operating Experience Program

B.2.4.1. Overview

NRC's Operating Experience (OpE) program supports NRC's mission to protect public health, safety, and the environment by administering an effective, coordinated program to systematically collect, communicate, and evaluate domestic and international reactor operating experience, and apply the lessons learned. This effort is designed to support rulemaking, licensing, oversight, and incident response programs. This program functions as the focal point of NRC's reactor operating experience program and is designed to ensure operating experience information is processed effectively and efficiently in a risk-informed manner. The stated goals of the program are:

- OpE information is collected, evaluated, communicated, and applied to support the NRC goal of ensuring safety.
- OpE is used to improve the effectiveness, efficiency, and realism of NRC decisions.
- The public, Congress, and other external stakeholders are provided with accurate, timely, and balanced information regarding OpE, including actual or potential hazards to health and safety.

In addition, NRC's Knowledge Management Center has been built as an interactive internal webpage to assist NRC to collect, capture, and share knowledge/information relevant to functions within NRC to create an organizational library readily available to all and which is designed to serve the staff. The Knowledge Management Center is overseen by a group of technical staff drawn from across NRC.

B.2.4.2. Facts and Observations

NRC Actions. A search of the internal OpE webpage by the GTF using the terms "tritium" or "groundwater," between May 2004 and May 2010, retrieved six documents related to domestic and international communications of buried piping issues or leaks/spills that could result in groundwater contamination.

The OpE program includes an annual review of industry events. In 2008, NRC's Technical Review Group (TRG) identified that the number of plants with on-site tritium leaks had increased. It also stated that the number of plants reporting tritium leaks would continue to increase as plants begin to implement the NEI voluntary groundwater protection initiative. In 2009, the TRG confirmed that the initiative identified additional leaks/spills and correctly reported that leaks/spills have received a high level of public and political interest. The 2009 report also stated that groundwater protection issues became an issue of NRC-wide attention. However, these reviews did not provide context to the events, an evaluation of the events, nor any conclusion regarding NRC decisions regarding the previously unplanned and unmonitored leaks/spills.

The GTF also reviewed the NRC's Knowledge Management Center to determine the value of the Knowledge Management (KM) information regarding groundwater. There is one "thread" or "conversation" registered on the KM website regarding groundwater. This thread lists one NUREG document and several presentations. Otherwise, there is no thorough description of groundwater or the associated regulatory history. Three NRC staff members are registered on the thread with a total of 512 page views. The webpage has not been updated in the past 5 years.

The NRC commissioned NUREG/CR-6805, "A Comprehensive Strategy of Hydrogeologic Modeling and Uncertainty Analysis for Nuclear Facilities and Sites," (ADAMS Accession No. ML032470827) in 2003 which was used by the staff to better understand groundwater flow. The NRC has also revised inspections of nuclear power plants to evaluate licensees' programs to inspect, assess and repair equipment and structures that could potentially leak. In 2005, several presentations on groundwater flow and nuclide transport were given to NRC's Advisory Committee on Nuclear Waste.

The NRC has conducted lessons learned on groundwater events; nevertheless, in terms of OpE and Knowledge Management for groundwater incidents, due to its low safety/risk significance, NRC has not fully developed a learning environment that ensures lessons are captured and communicated within NRC.

Industry Actions. The industry has also taken actions to communicate lessons learned from leaks and spills. The annual RETS/REMP Workshop is a forum to exchange practical experiences and issues related to the Radioactive Effluent Technical Specifications (RETS) and Radiological Environmental Monitoring Programs (REMP) at commercial nuclear power plants. Groundwater contamination presentations have become a regular event at these workshops since 2005. Just as the public concern of groundwater contamination has risen over the years, so to have the number of presentations and knowledge exchange on this topic at this annual forum. For example, in 2005, there were two presentations at the RETS/REMP Workshop (approximately one hour each); however, in 2009, there were two days of presentations on loss of licensed material confinement and the lessons-learned.

B.2.5. Temporary Instruction 2515/173 "Review of the Implementation of the Industry Ground Water Protection Voluntary Initiative"

B.2.5.1. Overview

The objective of this Temporary Instruction (TI) (ADAMS Accession No. ML082770349) is to assess ground water protection programs to determine whether licensees have implemented the voluntary industry Groundwater Protection Initiative (GPI) (i.e., the objective is not to perform an assessment of the adequacy of the licensee's ground water monitoring program). The GPI was unanimously approved by a formal vote of the Nuclear Energy Institute (NEI) member utility chief nuclear officers, which establishes the industry's commitment to implement the initiative (ADAMS Accession No. ML062260198). The GPI

identifies the actions the industry deems necessary for implementation of a timely and effective ground water protection program. The information collected through the TI will be used to validate industry's implementation of the voluntary industry initiative and to aid in evaluating whether additional NRC regulatory actions are warranted.

B.2.5.2. Facts and Observations

At the time of the GTF's evaluation, NRC had completed TI 2515/173 at 47 of the 104 (45%) power reactors in the United States. The results indicate that 19 reactors satisfied all the requirements outlined in NEI 07-07, "Industry Ground Water Protection Initiative – Final Guidance Document" (ADAMS Accession No. ML072600295). An additional 7 reactors were only lacking the independent review performed under the auspices of NEI, but these reviews had already been scheduled for all 7 reactors. Objective 2.3 of NEI 07-07, "Thirty Day Reports" was successfully completed at all 47 reactors that were inspected.

Although no findings were identified in inspection reports, the inspectors identified discrepancies at 21 (40%) of the reactors where the TI was completed. The results indicate that 13 reactor sites had discrepancies associated with Objective 1.4," Remediation Process." Eleven reactor sites had a discrepancy with Objective 1.2,"Site Risk Assessment." As background information, a finding is identified when a licensee fails to meet a requirement or a standard (either a regulatory required standard or a self-imposed standard). The voluntary industry initiative is neither a requirement nor standard; therefore, the inspection reports used the term discrepancy to identify areas of incomplete implementation of the voluntary initiative.

The TI is scheduled to be completed in August 2010 and a full NRC report is planned to be issued in late Fall 2010.

B.2.6. Public Radiation Safety Significance Determination Process

B.2.6.1. Overview

When the ROP was first developed, it was recognized that probabilistic risk assessment techniques could not generally be applied to the ROP cornerstones of physical security, emergency preparedness, and radiation safety. Therefore, to establish the thresholds for categorizing the significance of findings, expert panels were formed during the ROP development in the late 1990's to define those thresholds. In part, these panels were guided by what the expected NRC response should be for various types of licensee performance deficiencies. These deterministic principles applied to the development of the Public Radiation Safety Significance Determination Process (SDP).

B.2.6.2. Facts and Observations

IMC 0308 Attachment 3, Appendix D[12] (Technical Basis for Public Radiation Safety Significance Determination Process), provides the technical basis for the public radiation safety significance determination process. In addition to the regulatory requirements, this cornerstone contains a "public confidence" factor that is used to define the significance of a finding. It was recognized by the NRC and stakeholders that a licensee's control of its radioactive material is a significant issue for members of the public; even when very low levels of radioactive material are involved. Because of this, the Public Radiation Safety SDP was developed with a "public confidence" factor, which provides for a higher level of significance than would be warranted based solely on the risk from exposure to the radioactive material.

In May 2006, the Commission directed the staff to engage stakeholders using existing ROP change guidelines to update the SDP in the public radiation cornerstone to ensure that it is consistent with the ROP program goals, including an appropriate risk-informed approach to radiation protection. From these efforts, the staff concluded that the radioactive environmental monitoring program branch would be better aligned with the risk-informed goals of the ROP by reducing the significance of a licensee's failure to assess the environmental impacts to very low significance (Green finding) because this program is a verification of the effluent release program. The SDP, contained in IMC 0609 Appendix D (ADAMS Accession No. ML072970802) was revised in 2007 to reflect this decision. However, the GTF identified that the basis document for the public radiation safety significance determination process retained the concept that control of its radioactive material is a significant issue for members of the public; even when very low levels of radioactive material are involved.

B.3. Conclusions

B.3.1. Conclusion

The current radiological effluent PI reporting requirement does not provide meaningful data. The staff could consider adopting the recommendations stated in Reactor Oversight Process Feedback Form 0308.1-1140 (2007) for the Public Radiation Safety Cornerstone Performance Indicator:

(1) Revise NRC IMC 0308 to more accurately explain the public radiation cornerstone PI, its basis, and the NRC's benchmarking. Review and revise baseline inspection procedure 71124.06 to ensure that it provides adequate inspection of areas that were deleted from the original PI, including radiation monitor reliability/availability.

[12] http://www.nrc.gov/reading-rm/doc-collections/insp-manual/manual-chapter/mc0308-att3-appd.pdf

(2) Revising the PI to include a more leading indicator of program degraded performance (e.g., radiation monitor performance, system availability, and unplanned/unmonitored releases).

Another option could involve changing the PI to track the number of incidents of leaks/spills based upon the voluntary notification process of NEI 07-07, making any event that triggers the threshold an occurrence. Three or more occurrences in a two-year cycle might be a reasonable threshold, which would represent a deficiency in licensee performance of enough significance to warrant additional follow-up inspection above the baseline program to independently review and evaluate licensee corrective actions.

B.3.2. Conclusion

In the areas of OpE and Knowledge Management for groundwater incidents, the staff should consider reassessing its processes to ensure that OpE associated with groundwater incidents collected at a lower threshold and is disseminated appropriately. A revision to its internal OpE procedure could improve management of emergent issues with high external interest that involve non-risk systems or issues of low safety significance. However, this would not be consistent with the existing risk-informed framework.

B.3.3. Conclusion

There is an inconsistency between the Public Radiation Safety Cornerstone SDP in IMC 0609 Appendix D and the associated technical basis document in IMC 0308, Attachment 3, Appendix D regarding the use of “public confidence” factor which provides for a higher level of significance than would be warranted based solely on the risk from exposure to the radioactive material. Consideration could be given to evaluating a deterministic assessment technique that recognizes loss of confinement is a concern even when very low levels of radioactive material are involved. Additionally, NRC should consider aligning the SDP in IMC 0609 Appendix D and the technical basis stated in IMC 0308 Attachment 3, Appendix D.

B.3.4. Conclusion

Incorporation of the voluntary industry initiative into any revised groundwater protection framework should be considered.

B.4. References

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Liquid Release Task Force Recommendations Implementation Status as of July 10, 2009 (ADAMS Accession No. ML091900252).

Regulatory Guide 1.21, “Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste,” Revision 2 (ADAMS Accession No. ML091170109).

Regulatory Guide 4.1, “Radiological Environmental Monitoring For Nuclear Power Plants,” Revision 2, June 2009 (ADAMS Accession No. ML091310141).

ANSI/ANS-2.17-20xx, “Evaluation of Subsurface Radionuclide Transport at Commercial Nuclear Power Production Facilities,” Draft Rev. 11 (ADAMS Accession No. ML101310455).

MD 8.3, Management Directive 8.3, “NRC Incident Investigation Program,” March 27, 2001 (ADAMS Accession No. ML031250592).

IMC 0309. Inspection Manual Chapter 0309, “Reactive Inspection Decision Basis For Reactors,” February 2, 2010, (ADAMS Accession No. ML092790408).

NEI 99-02. Regulatory Assessment Performance Indicator Guideline; Revision 6 (ADAMS Accession No. ML092931123).

NUREG/CR-6805, “A Comprehensive Strategy of Hydrogeologic Modeling and Uncertainty Analysis for Nuclear Facilities and Sites,” July 2003 (ADAMS Accession No. ML032470827).

NEI 07-07. “Industry Ground Water Protection Initiative – Final Guidance Document,” August 2007, (ADAMS Accession No. ML072600295).

TI 2515/173. Temporary Instruction 2515/173, “Review of the Implementation of the Industry Ground Water Protection Voluntary Initiative,” Revision 1 (ADAMS Accession No. ML082770349).

NEI 08-08. Nuclear Energy Institute NEI-08-08A, Rev. 0, “Guidance for Life Cycle Minimization of Contamination”, October 2009, (ADAMS Accession No. ML093480532).

SECY-07-0112, “Staff Evaluation and Proposed Revision to the Public Radiation Safety Significance Determination Process to Address Radioactive Liquid Spills and Leaks,” July 6, 2007 (http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2007/secy2007-0112/2007-0112scy.pdf).

IMC 0308. Inspection Manual Chapter 0308, Attachment 3, Appendix D, “Technical Basis for Public Radiation Safety Significance Determination Process,” June 25, 2004

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IMC 0609. Inspection Manual Chapter 00609, Appendix D, “Public Radiation Safety Significance Determination Process,” February 2, 2008 (ADAMS Accession No. ML072970802).

NUREG/CR-6948, Vol. 1 Integrated Ground-Water Monitoring Strategy for NRC-Licensed Facilities and Sites: Logic, Strategic Approach and Discussion, U.S. NRC, Washington, DC, November 2007. (http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6948/v1/index.html)

NUREG/CR-6948, Vol. 2 Integrated Ground-Water Monitoring Strategy for NRC-Licensed Facilities and Sites: Case Study Applications, U.S. NRC, Washington, DC, November 2007. (http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6948/v2/index.html)

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Appendix C

Regulatory Framework for Groundwater Incidents Involving NRC Licensees

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Appendix C

Regulatory Framework for Groundwater Incidents Involving NRC Licensees

C.1. Overview

The regulations found in 10 CFR Part 20 establish standards for protection against ionizing radiation resulting from activities of NRC licensees and are intended to control, amongst other things, the possession and use of licensed material such that that the total dose to an individual does not exceed radiation protection standards. These regulations are issued under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. Recognizing this, the Groundwater Task Force (GTF) reviewed the regulatory framework with regard to groundwater for operating reactors as well as those for other NRC-licensed facilities (NRC 1986). In addition, the GTF reviewed SECY-09-0042 (ADAMS Accession No. ML090500143), which proposes a final rule impacting, to some degree, NRC's regulation of subsurface contamination. The following sections summarize the key aspects of the operating reactor regulatory framework and identify important differences between that framework and those established for other licensing programs. Based upon this review, the GTF derived conclusions regarding regulatory framework issues.

C.2. Facts and Observations

The overarching requirements regulating radiological impacts for facility operations are in 10 CFR Part 20. The framework of regulations that address losses of licensed material confinement may be best understood by first reviewing what the regulations require to restore and release a site at decommissioning.

Under 10 CFR § 20.1003,

> "Residual radioactivity means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR Part 20."

Thus, radioactivity in groundwater is considered by, and regulated by, NRC. It does not matter if the material was licensed or unlicensed. Similarly, it does not matter if the release was accidental (e.g., a leak) or intentional (e.g., a planned discharge). It does not matter if the material is in a safety-related pipe or a non-safety related pipe, if it is associated with the licensee's activities; it is regulated by the NRC. It also makes no difference if the licensee is

a complex power plant or a single source material licensee; the same definition of residual radioactivity applies. The level of residual radioactivity is most relevant when a licensee decides to cease operations and must satisfy NRC's decommissioning requirements.

In addition to NRC requirements, NRC has entered into a Memorandum of Understanding[13] (MOU) with EPA on cleanup of radioactively contaminated sites. This MOU includes provisions for NRC and EPA consultation for certain sites including when, at the time of license termination, contamination exceeds EPA-permitted levels. Under 10 CFR § 20.1402, "Radiological criteria for unrestricted use," for a site to be restored and released by the NRC for unrestricted use, the residual radioactivity, including activity in groundwater, must meet the following:

> "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE[14] to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal."

Thus, there are two controlling requirements on subsurface radioactivity that determine if a site may be released: 1) a 25 mrem per year limit for all pathways, including from drinking water and/or groundwater, and 2) reducing the residual radioactivity, which includes activity in groundwater, to as low as reasonably achievable (ALARA). ALARA means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is 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. See 10 CFR § 20.1003.

Under 10 CFR § 20.1501, licensees are required, at all times including both operations and decommissioning, to conduct surveys to determine, among other things, concentrations or quantities of radioactive material, and potential radiological hazards. These surveys must be reasonable under the circumstances to evaluate groundwater radioactivity to the extent that it may be necessary for the licensee to comply with the regulations 10 CFR Part 20. Additionally, licensees are also required to maintain records for purposes of tracking spills and leaks.

At all times, licensees must practice ALARA with respect to doses to both the members of the public and with workers. See 10 CFR § 20.1101(b), § 20.1301, and § 20.1302. The

[13] http://www.nrc.gov/reading-rm/doc-collections/news/2002/mou2fin.pdf
[14] TEDE is the Total Effective Dose equivalent, as defined in 10 CFR Part 20.

methods used by the licensee to achieve ALARA are reviewed at least annually. See 10 CFR § 20.1101(c).

As previously discussed, ALARA principles apply to doses associated with groundwater contamination. See 10 CFR § 20.1402.

C.2.1. Operating Reactors

Licensing Bases. Today's operating reactors were licensed under a multi-step process under 10 CFR Part 50. In brief, a preliminary design in the form of a Preliminary Safety Analysis Report (PSAR) is submitted as part of a request for a construction permit, as discussed in 10 CFR § 50.34(a). The PSAR includes the principal design criteria (PDC) for a proposed facility. The PDC establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety; that is, structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. Thus, the PSAR addresses how licensees plan to control liquids, and provides that information to NRC staff to review in order to decide if it is appropriate to issue a construction permit.

Within 10 CFR Part 50, Appendix A, the General Design Criteria (GDC) is described, which establishes minimum requirements for the principal design criteria. Included among these criteria are several related to controlling effluents. For example, GDC 60, "Control of releases of radioactive materials to the environment," states that the facility's design shall include means to control suitably the release of radioactive materials in gaseous and liquid effluents, and requires consideration of any unfavorable site environmental conditions that can be expected to impose unusual operational limitations upon the release of such effluents to the environment. GDC 64, "Monitoring radioactivity releases," requires that a means shall be provided for monitoring, among other things, the facility environs for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents.

Subsequently, the applicant submits its Final Safety Analysis Report (FSAR) as part of the application for an operating license, as described in 10 CFR § 50.34(b). The FSAR updates the information in the PSAR, which includes information as to how the facility will meet its GDC or PDC. Under 10 CFR § 50.34(b)(3) the FSAR must include the kinds and quantities of radioactive materials expected to be produced in the operation. Further, under 10 CFR § 50.34(b)(3), the FSAR must include the means for controlling and limiting radioactive effluents and radiation exposures within the limits set forth in 10 CFR Part 20. Thus, controls and means to limit radioactive effluent are part of the application and part of the licensing basis of operating reactors.

The discussion above is by no means all-inclusive; and additional regulations have been added to the regulatory framework over the years was promulgated that affected later

applications. For example, the Commission promulgated 10 CFR § 50.34a, which includes a reference to Appendix I, requiring more specific information on the description of the equipment and procedures for the control of gaseous and liquid effluents and for the maintenance and use of equipment installed in radioactive waste systems.

The regulations are not as prescriptive in telling licensees how to maintain their licensing basis for systems that are not directly associated with protecting the reactor core. Thus, the maintenance of piping and tanks that contain radioactive fluid may not be directly addressed by any specific paragraph in 10 CFR Part 50.

License Renewal. The License Renewal Rule, 10 CFR Part 54, also targeted core protection and requires licensees to demonstrate that systems designed for core protection are maintained consistent with the current licensing basis during the period of extended operations.

C.2.2. Decommissioning Reactors

Release of all or part of the site, after decommissioning, makes it available to members of the public for use with or without restrictions. NRC has requirements for areas to be released from the license in 10 CFR §§ 50.82 and 50.83 (which incorporate §§ 20.1402 and 20.1403). In order to comply with these regulations, the licensee conducts sampling and monitoring to accurately define all radioactivity remaining on the site. Following remediation, as defined in the License Termination Plan (LTP), or request for partial site release, sampling of groundwater for residual radioactivity must be conducted according to an approved scheme, to demonstrate compliance with release criteria.

In addition to NRC requirements, as mentioned earlier, NRC has entered into a MOU with EPA on cleanup of radioactively contaminated sites. This MOU includes provisions for NRC and EPA consultation for certain sites including when, at the time of license termination, contamination exceeds EPA-permitted levels.

C.2.3. Proposed Final Rule on Decommissioning Planning (SECY-09-0042)

In SECY-09-0042, currently before the Commission, NRC staff recommended that a new clarifying rule be adopted that would require licensees to conduct their operations to minimize the introduction of residual radioactivity into the site, including subsurface soil and ground water (i.e., proposed 10 CFR § 20.1406(c)). Staff noted in 62 FR 39058 (July 21, 1997), the intent of § 20.1406 is to emphasize the importance, in an early stage of planning, for facilities to be designed and operated in a way that would minimize the amount of radioactive contamination generated at the site during its operating lifetime. More specifically, a new section (§ 20.1406(c)) would be added such that operating facilities, including reactors "shall, to the extent practical, conduct operations to minimize the introduction of residual radioactivity into the site, including the subsurface, in accordance with the existing radiation protection requirements…" The longer subsurface contamination

continues at a site, the larger the area contaminated with residual radioactivity may be. This may result in increased cleanup costs, longer periods of time to clean up and potentially more public concern.

In SECY-09-0042, NRC staff concluded that new or amended regulations for this final rule either clarify existing requirements, require the collection of information using existing equipment and procedures, or are administrative matters outside the scope of the backfitting rule (i.e., 10 CFR § 50.109). Actions undertaken by licensees during facility operations to comply with these new and amended requirements are expected to establish a technical basis for licensees and the NRC to understand the effects of significant residual radioactivity on decommissioning costs, and will help to determine whether existing financial assurance provided for site specific decommissioning is adequate. This rule would require licensees to identify and evaluate subsurface contamination, maintain records of contamination, and account for the cost of remediation of residual contamination for site-specific decommissioning cost estimates. This rule is directed at decommissioning planning and would not alter the regulatory framework for confinement of licensed material, incorporate the voluntary industry initiative or require early remediation. However, in response to the Staff Requirements Memorandum (SRM) for SECY-07-0177, staff is separately pursuing further improvements to the decommissioning planning process with the objective of avoiding complex decommissioning challenges that can lead to legacy sites. The GTF determined that the staff is developing a technical basis to address the need for immediate remediation of spills at NRC-licensed facilities. This technical basis, in conjunction with stakeholder engagement and development of dose limits and criteria, may lead to a decision on the need for a rulemaking.

At its 183rd Meeting, in 2007, the Advisory Committee on Nuclear Waste and Materials[15] (ACNW&M) received a presentation from the NRC staff on the proposed rulemaking approach to prevent legacy sites. The ACNW&M offered the Commission the following recommendations on early remediation:

- The Committee believes that legacy sites can be prevented through: (1) prevention of unplanned releases; (2) unplanned release detection; and (3) prompt remediation of unplanned releases rather than delaying remediation until final decommissioning. The Committee recommends that the NRC require licensees to promptly assess and remediate unplanned releases. The staff should develop criteria specifying the assessments and actions a licensee should take to characterize and mitigate the impacts of unplanned releases. These criteria should preclude most licensees from deferring action until eventual decommissioning. These criteria should also emphasize the application of the ALARA principle to fully account for the impacts of contamination if remediation is deferred.

[15] In 2007, the ACNW&M was a separate Committee from the Advisory Committee on Reactor Safeguards. Currently the Committees are merged as one, titled the Advisory Committee on Reactor Safeguards.

- The Committee recommends that the Commission consider gathering additional stakeholder input regarding prevention of legacy sites from a broad range of stakeholders including licensees, advisory or community groups, and State and local governments that participate in decommissioning.

C.2.4. New Reactors

New applicants are required to comply with § 20.1406, which states:

> (a) Applicants for licenses, other than early site permits and manufacturing licenses under Part 52 of this chapter and renewals, whose applications are submitted after August 20, 1997, shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.
>
> (b) Applicants for standard design certifications, standard design approvals, and manufacturing licenses under Part 52 of this chapter, whose applications are submitted after August 20, 1997, shall describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

DC/COL-ISG-06 "The Evaluation and Acceptance Criteria for 10 CFR § 20.1406 to Support Design Certification and Combined License Applications" (ISG-06)[16] provides guidance to the staff for review of the design features and operation of system, structures, or components (SSCs) that contain or handle radioactive material, but does not provide the level of detail contained in other SRP sections. Regulatory Guide (RG) 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," provides guidance on an acceptable method of demonstrating compliance with § 20.1406.[17] Both documents contain examples of non-safety related components, including radioactive waste tanks and piping, condensate storage tanks and piping, buildings sumps, seams and joints.

In November 2009, the Nuclear Energy Institute (NEI) notified NRC that industry had adopted the NEI Buried Piping Industry Initiative (BPII) and the supporting Electric Power Research Institute (EPRI) technical basis document related to the minimization of leakage from buried piping.

[16] http://www.nrc.gov/reading-rm/doc-collections/isg/digital-instrumentation-ctrl.html

[17] http://nrc-stp.ornl.gov/special/reg_guide4-21.pdf

C.2.5. Research and Test Reactors

The Office of Nuclear Reactor Regulation (NRR) staff provided the GTF with a brief overview of Research and Test Reactor (RTR) operations related to groundwater contamination. RTRs share the same regulatory framework discussed in Section C.2.1, with the exception of requirements outlined in 10 CFR Part 50, Appendices A and B. GDC requirements to control and monitor liquid releases to the environment and quality assurance program requirements do not apply to RTRs. Historically, RTRs have promptly informed the NRC whenever a leak has been detected. RTRs are also required to provide annual reports to the NRC that summarize the nature and amount of radioactive effluents released to the environment, including primary coolant leakage. RTR pool leaks are identified primarily through pool water inventory balance calculations with the radionuclides being released (primarily tritium and sodium-24) identified by means of periodic pool water sample analysis. During normal operation, maximum concentrations of radionuclides in the primary coolant remain relatively constant and in some cases, these facilities use primary coolant radiation monitors to detect any sudden increase in radionuclide concentration of the reactor pool water. There are no requirements for groundwater samples of the environment surrounding RTR facilities. As part of the RTR license renewal process, NRC staff does request that these facilities analyze the radiological impact of any primary coolant leakage to the environment, if applicable.

C.2.6. Uranium In-Situ Recovery and Conventional Milling Program

The uranium recovery program is unique in both the extent to which groundwater is regulated and the fact that in certain cases, NRC's requirements for groundwater restoration are more stringent than some individual States. It is also unique because the NRC regulatory program regulates hazardous constituents; both radiological and non-radiological constituents (e.g. methylated keytones). NRC's regulatory authority over groundwater contamination related to uranium in-situ recovery or conventional milling is primarily described in 10 CFR Part 40, Appendix A. NRC regulations are based on the standards established for uranium mill facilities by EPA regulations (40 CFR Part 192) for protecting the groundwater at uranium recovery operations. While the requirements of 10 CFR Part 40, Appendix A apply principally to conventional mills, they have been applied to in-situ uranium recovery facilities via license conditions.

NRC regulations are based on parallel EPA regulations (40 CFR Part 192, subparts D & E) for protecting the groundwater at uranium recovery operations. Compliance with 10 CFR Part 40, Appendix A does not depend on a dose analysis, but on the concentrations of specified hazardous constituents in the groundwater. 10 CFR Part 40, Appendix A requires a point of compliance beyond which the groundwater quality in the aquifer will not be significantly degraded. To determine the point of compliance, a three-dimensional hydrologic analysis of groundwater flow at the site is commonly used. Regulatory criteria at

the point of compliance are specified in terms of contaminant concentrations to determine if performance thresholds are exceeded, which would require corrective action.

These regulations also require pre-operational, operational, and post-operational groundwater quality monitoring. Close-in monitoring of regulated activities are used to prevent contamination of groundwater resources at greater distances. NRC's regulatory authority over groundwater contamination related to uranium in-situ recovery or conventional milling is primarily described in 10 CFR Part 40, Appendix A. Licensees are required to maintain documentation of unplanned releases and spills and evaluate the consequences of and report those releases/spills as appropriate. Environmental monitoring of groundwater similar to that described for operating reactors is also performed for the plant operations.

The inspection criterion for "In-Situ Leach Facilities," (IP 89001)[18] provides additional focus for all areas of groundwater protection. Much of the guidance in IP 89001 is in place to ensure that NRC recognizes areas of vulnerability if a leak were to occur, while "Radioactive Gases and Liquid Effluent Treatment," (IP 71124.06)[19] identifies actions to be taken after a leak is identified. For example, the procedure requires inspection to verify that pipelines have been appropriately monitored for breakage and that appropriate corrective actions and regulatory notification occurred. Furthermore, IP 71124.06 requires inspections to verify that any ongoing excursions (solutions moving beyond the well field) are being monitored and cleaned up, that NRC is being appropriately informed, and that the licensee is following its cleanup plan.

C.2.7. Fuel Cycle Facilities

Similar to reactor facilities, operating fuel cycle facilities are regulated under 10 CFR Parts 70 and 20. Within 60 days after January 1 and July 1 of each year, Part 70 licensees are required to submit a report to NRC specifying the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents during the previous six months of operation (per 10 CFR §70.59). Part 70 licensees are subject to various reporting and notification requirements including §§ 70.50 and 70.52.

With respect to monitoring for on-site contamination:

- A pre-operational program that documents background levels of radioactivity may not be required. Additionally, specific off-site environmental pathways may not be routinely sampled at the site boundary.
- For spills, licensees are required (per 10 CFR § 20.1406) to keep records of information important to the safe and effective decommissioning of the facility.

[18] Inspection Procedures can be found at: http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/

[19] Ibid.

With respect to performance requirements for facilities for which Subpart H applies of Part 70 (10 CFR § 70.61):

- Protection of the environment only involving human interaction is considered.
- A dose assessment will be conducted, should a spill occur and if a viable pathway to members of public is identified, in order to:
  - Provide data on quantities of radioactive material released in liquid and gaseous effluents,
  - Provide data on measurable levels of radiation and radioactive materials in the environment, and
  - Identify needed changes in the use of unrestricted areas (e.g., for agricultural purposes) to permit modifications in monitoring programs for evaluating doses to individuals from the principal pathways of exposure.

Also, just as with reactors, and other operations that are a part of the nuclear fuel cycle, pursuant to § 20.2203(a)(4), fuel cycle licensees are subject to the provisions of EPA's generally applicable standards in 40 CFR Part 190, and are required to submit a report for levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

C.2.8. NRC's Mission and Environmental Protection

Comments from stakeholders. Throughout the GTF review, the issue of environmental protection was raised by stakeholders from many different backgrounds. Some external stakeholders were concerned with NRC's regulation of radioactive contamination in groundwater, while others at public meetings indicated that since the releases to the environment were far below regulatory limits, that no increased regulatory actions were necessary.

Because of these opposing views, the regulation of groundwater is challenging. Although many of the leaks seen to date have not posed a hazard to human health, they have posed significant issues with respect to public confidence in NRC's interest in environmental protection by some stakeholders. The stimulus for this GTF has been the pressure from various stakeholders for explicit demonstrations of protection of the environment, separate from demonstrations of protection of individuals.

Challenges to the portion of the NRC's mission statement addressing protection of the environment exist with respect to the interplay between State and Federal regulation. Other Federal agencies are regulating the licensees in new areas. Several Federal agencies such as Federal Aviation Administration, Occupational Safety and Health Administration, Environmental Protection Agency, Federal Bureau of Investigation, Department of Homeland Security, Federal Energy Regulatory Commission, and others, are increasingly more active in pursuing their statutory authority over NRC-licensed material. Some, but not

all of this activity, is due to increased security concerns. However, questions continue to be raised about NRC's ability to adequately protect the environment within the boundaries of NRC's statutory authority. However, over the years questions have been raised, and continue to be raised, about NRC's ability to adequately protect the environment within the boundaries of NRC's statutory authority. Recently, States have become more active in their desire to enforce their regulations on NRC licensees. This became most evident in the 2005 Braidwood groundwater event where the State of Illinois pursued enforcement for "degradation" of a natural resource. The GTF heard comments from State and local legislators who were frustrated with NRC's "change of regulatory positions" (i.e. why the Braidwood finding had regulatory significance and now other findings are minor) and questioned why NRC would not step aside in areas where it is unclear if NRC has statutory authority over environmental protection of groundwater, especially when the State has been delegated authority for groundwater protection from EPA to impose standards on NRC licensees.

The GTF heard from several State representatives, local officials and the public regarding their disagreement and concern with NRC's dose-based approach to regulating groundwater issues. However, NRC does not generally have authority under the AEA to promulgate regulations based solely on environmental protection without a public health and safety basis (there are limited exceptions such as regulations regarding uranium mill tailings (commonly referred to as 11(e)(2) material)).

For many years, the EPA and NRC disagreed about the proper approach to setting radiation protection standards. Much of the disagreement was attributable to specific restrictions placed on each agency by different statutory requirements. On March 16, 1992, NRC and EPA signed an MOU to foster cooperation between the two agencies to provide a framework to resolve issues, avoid duplication, and focus priorities (57 FR 54127; November 16, 1992). The MOU established that the agencies will actively explore ways to harmonize risk goals and will cooperate in developing a mutually agreeable approach to risk assessment methodologies for radionuclides.

The Charter requested the GTF review NRC's relationship with the Department of Homeland Security (DHS). We believe it is premature to review this relationship at this time. After NRC determines any changes to policies or procedures, then a review of this relationship would be beneficial.

C.3. Conclusions

C.3.1. Conclusion

The regulations are not prescriptive for maintaining the licensing basis for non-safety related systems. Thus, the maintenance of piping and tanks that contain radioactive fluid may not be directly addressed by any specific paragraph in 10 CFR Part 50. Because NRC regulations in this area are not prescriptive, confusion may be created over enforcement of

the requirement for operations to be consistent with design and licensing basis and broad requirements of 10 CFR Part 20. NRC could consider and explore the potential to enforce compliance with licensing bases when leaks occur. As an alternative, NRC could consider conducting rulemaking to clarify existing requirements of 10 CFR Part 50. Additionally, NRC could consider issuing a generic communication reminding licensees to maintain their operations and designs consistent with their licenses.

C.3.2. Conclusion

NRC's regulatory framework with respect to radiological impacts of facility operations vary for different licensed facilities (e.g., power and research reactors, fuel cycle, in-situ recovery). NRC has been regulating groundwater quality using projected dose calculations for some licensees and by measurements of groundwater concentration for other licensees. Furthermore, some programs have regulated both radiological and non-radiological constituents. Some programs require groundwater characterization and ongoing close-in monitoring while some do not. Variation in NRC's regulatory frameworks among licensed facilities can be a source of both internal and external stakeholder confusion. NRC should consider ensuring that offices responsible for regulating facilities with these issues coordinate and communicate to strive for consistency in NRC response.

C.3.3. Conclusion

The final decommissioning rule now before the Commission (SECY-09-0042) is not intended to, and would not require immediate remediation, if there exists a potential for contamination to migrate to potable aquifers and/or subsurface-water bodies. NRC staff is developing a technical basis to address the need for immediate remediation of spills at NRC-licensed facilities. This technical basis, in conjunction with stakeholder engagement and development of dose limits and criteria, may lead to a decision on the need for a rulemaking.

C.4. References

Generic Aging Lessons Learned (GALL) report (NUREG 1801), http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1801/.

Inspection Procedure 89001, "In-Situ Leach Facilities," http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/.

Inspection Procedure 71124.06, "Radioactive Gaseous and Liquid Effluent Treatment," http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/.

SECY-09-0042, “Proposed Final Rule on Decommissioning Planning” (ADAMS Accession No. ML090500143)

NUREG 0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/.

NEI 07-07. Nuclear Energy Institute, “Industry Ground-Water Protection Initiative – Final Guidance Document,” Washington, DC, August 2007 (ADAMS Accession No. ML072600295).

NRC 1986. “Groundwater Protection Activities of the Nuclear Regulatory Commission,” NUREG-1243, 1986. (ADAMS Accession No. ML 101550111).

ANSI/ANS-2.17-20xx, “Evaluation of Subsurface Radionuclide Transport at Commercial Nuclear Power Production Facilities,” Draft Rev. 11 (ADAMS Accession No. ML101310455).

Electric Power Research Institute (EPRI), “Ground-Water Protection Guidelines for Nuclear Power Plants,” EPRI Report No. 1016099, Palo Alto, CA, January 2008. (ADAMS Accession No. ML080450056).

Advisory Committee on Nuclear Waste and Materials, ACNWMR-0272, November 20, 2007, SUBJECT: Proposed Rulemaking to Prevent Legacy Sites1. (ADAMS Accession No. ML. 073170715).

Appendix D

Communications on Groundwater Incidents

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Appendix D

Communications on Groundwater Incidents

D.1. Overview

The issue of groundwater contamination at operating nuclear power plants has generated considerable attention in the public, States, the media, and Congress. Recognizing this, and consistent with its charter, the Groundwater Task Force (GTF) has reviewed the results of two recent public meetings, additional public comment, media reports, Congressional correspondence issued between 2006 and 2010, and the content of the U.S. Nuclear Regulatory Commission (NRC) public website. This appendix summarizes this review and provides the GTF's observations. It should be noted that the GTF sought specific and focused input from only a limited range of stakeholders. Broad surveys of stakeholder opinion were not conducted across the licensed community.

D.2. Facts and Observations

D.2.1. Public Meetings

On April 19 and 20, 2010, NRC held two public meetings on particular aspects of groundwater contamination and loss of licensed material confinement issues. NRC's summary of the two meetings was issued on May 12, 2010 (ADAMS Accession No. ML101320047).

The first meeting, held in Brattleboro, Vermont, was an open house meeting to discuss groundwater contamination at Vermont Yankee, NRC's perspective on potential public health and safety impact, regulatory requirements related to tritium, and how the NRC fulfills its mission. Key points made by public participants included the following:

- Consider or revisit NRC's policy on conducting independent split samples in response to ongoing tritium leaks.
- Conduct another public meeting when the results of the GTF are complete.
- NRC appears to not be responsive to issues raised by the public at these meetings.
- The NEI Initiative is too weak. There should be a better way of detecting leaks rather than waiting for the water to make its way to a monitoring well. There need to be more wells, more frequent sampling, and the samples need to be processed more quickly.
- The reactor oversight process (ROP) is flawed. It didn't anticipate leaks at Vermont Yankee, despite years of "low risk," high profile events at the plant because it doesn't trend issues over a longer period of time. The ROP is not predictive and does not look at long-term trends.
- NRC relies too much on self-reporting in lieu of direct observation/inspection.

- NRC oversight of tritium released to groundwater is inadequate since this is a public health issue.
- NRC regulations don't require preventing leaks/accidental discharges and NRC doesn't enforce the regulations it has.
- NRC should not allow natural attenuation as a remediation alternative.
- NRC should have better requirements for detecting or preventing leaks…. better than detecting the leak in wells after they've occurred.
- Less than detectable amounts of tritium in the Connecticut River do not mean that the release is safe. NRC should understand the exact amount of radioisotopes going into the river.
- NRC knew about the underground pipes and did nothing. This is a trust and confidence issue.
- There is a lack of transparency with NRC and there is no trust in NRC or its regulations.
- Information [specifically licensee Radiological Control Areas] regarding health and safety are withheld from the public.
- Trust has been broken. We can't believe you [NRC] when you tell us there's no risk from the tritium since you didn't correct the information about underground piping. NRC doesn't believe the research that shows all radiation is bad.
- NRC is too closely tied to the nuclear industry.
- Profits trump over safety and as a mature industry, the nuclear industry should be better run and regulated.
- The Vermont State legislature cannot make informed and irreversible decisions because Federal preemption[20] allows the rules to be changed after the legislature has made their decisions. Examples include:
    - The legislature was told that high level waste would only be stored onsite for 20 years, but license extension for the Independent Spent Fuel Storage Installation appears likely.
    - The legislature was told that the plant site would be returned to a greenfield after cessation of operations, but it appears that the plant can be entombed for 60 years in SAFESTOR.

The April 20 meeting, held at NRC's headquarters, was intended to obtain the perspectives of external stakeholders regarding NRC's regulatory framework (i.e., regulations, guidance, inspection, and enforcement) and planned activities involving groundwater contamination at nuclear power plants. Key points made by public participants included the following:

- Reporting of contamination incidents needs to be required, timely, and public.
- Tritium is mildly radioactive; the consequences of additional regulation may be counterproductive.
- NRC's regulatory framework should focus more on environmental protection, rather than just public health.

[20] Preemption is a judicial principle asserting the supremacy of Federal legislation over State legislation on a particular issue.

- Monitoring should be more extensive (e.g., more wells), better planned (using hydrogeological modeling) and closer to the potential sources of contamination.
- Remediation should occur as contamination occurs, not at the end of the facility's use.
- NRC needs to enforce its regulations.
- Voluntary industry initiatives should not be used as a substitute for NRC regulations.

D.2.2. Public Comment

The GTF solicited public comment via an NRC Press Release,[21] "NRC Seeks Additional Public Input on Groundwater Contamination Issue," issued on May 6, 2010. The public comments received (ADAMS Accession No. ML101320375) are similar to the public comments discussed during the two public meetings.

D.2.3. Media Coverage

Between 2006 and 2010, there has been considerable press coverage of groundwater contamination issues at operating nuclear power plants. This coverage, includes a number of key messages. Recent reports of tritium leaks at commercial nuclear power plants and a research reactor have garnered lots of media attention and present the NRC with an ongoing communications challenge.

These messages included:

- NRC's inspection process isn't working to ensure prevention or early detection of such leaks.
- Current monitoring isn't sufficient (e.g., more wells are needed).
- NRC's license renewal process is flawed, since it doesn't account for aging equipment that has caused leaks.
- Independent verification of groundwater contamination levels is needed.
- NRC needs to be more transparent and timely in providing information on leaks.
- When leaks are found, they need to be stopped and cleanup undertaken promptly.

In an article published in the March 2010 issue of Psychology Today magazine, a risk communications specialist at the Harvard School of Public Health, said that when it comes to nuclear power and risk "It's not about the facts; it's our feelings that count."

From a GTF perspective, it might be useful for NRC to supplement its risk communications strategy, one designed to instill greater trust among those who are concerned. In addition to using a risk communications model, it might be helpful to incorporate a public health discussion and turn to the medical community for assistance with communication.

[21] http://www.nrc.gov/reading-rm/doc-collections/news/2010/10-083.html

D.2.4. Congressional Correspondence

Between 2006 and 2010, NRC also received a number of letters from members of Congress on the groundwater contamination issue. This correspondence (compiled in ADAMS Accession No. ML101310326) provided a number of important perspectives. These perspectives included the following:

- NRC needs to enforce its regulations more strongly on energy companies. (Weller '06, Olver '10)
- When there is a problem, both Congress and the public should be warned of any possible implications to health, environment. (Feinstein '06)
- [NRC needs to] ensure that the public is fully aware of both the nature of the problem, and the steps that are being taken to resolve it. (Weller '06, Markey '06, Hall/Hinchey/Lowey/Engel '09)
- NRC should be insisting upon access to buried pipes. (Markey/Hall '06, Adler '09)
- Current inspection processes must be inadequate if licensees can miss the development of such large problems. (Markey/Hall '06, Adler '09)
- One failure may indicate a systemic failure of the licensee to guarantee public health and safety. (Markey/Hall '06, Leahy/Sanders/Welch '10)
- NRC should perform independent audits or additional inspections wherever problems have been discovered. If the licensees can't catch the problems before they manifest, then they can't be trusted to adequately inspect their properties. (Weller '06, Leahy/Sanders/Welch '10, Olver '10)
- In the light of these issues, NRC should review license renewal applications to ensure they do not contain falsified information. (Olver '10)
- NRC should provide Congress with detailed descriptions of all laws and regulations applicable in each problem situation. (Markey '06)
- NRC needs to assure Congress and the public that disciplinary actions it assigns will be reasonable and effective punishment. (Olver '10)

D.2.5. NRC's Public Website

NRC's public website contains prominent links to information related to groundwater contamination. High-level "fact sheets," more detailed "backgrounders," lists of key documents and correspondence, and "frequently asked questions" are provided. The GTF notes that NRC's public website should be an important mechanism for communicating key facts and NRC's perspectives on groundwater contamination. The website contains considerable information on groundwater contamination. However, some of the linked pages are also several years old and contain outdated information.

D.2.6. Key Messages

The GTF did not attempt to obtain comprehensive stakeholder opinion. The two public meetings held on April 19-20, 2010, were largely attended by stakeholders with concerns regarding recent groundwater incidents. In addition to these two public meetings, the GTF reviewed media reports, public comments and Congressional correspondence communications. This input included the following key messages to NRC:

- Stakeholders viewed NRC's current regulatory framework and its reliance on the voluntary industry initiative as inadequate.
- Stakeholders valued independent information on contamination incidents.
- Stakeholders indicated that NRC's licensees should be held appropriately accountable for groundwater contamination incidents.
- Stakeholders indicated the importance of finding leaks early, ensuring that the source of the leaks is quickly identified, and performing prompt cleanup.
- Stakeholders indicated that NRC needs to provide prompt information on the nature of groundwater contamination incidents and what NRC is doing in response.
- The low risk associated with tritium contamination needs to be placed in the proper context and communicated effectively with stakeholders.

D.3. Conclusions

D.3.1. Conclusion

Further consideration should be given by staff to more effectively communicate information on incidents involving a loss of confinement. As an example, information obtained in OpE reviews could be provided on a near-real-time basis to the public via NRC's website. The importance of particular incidents could be conveyed by including information such as the amount of material introduced into the environment, the type and quantity of radioactive material involved the safety significance of the release, and the proximity to the site boundary. In addition, staff could consider posting the Radiation Exposure Information and Reporting System[22] NRC public website page devoted to radiation exposure information for workers webpage.

D.3.2. Conclusion

At present, the public website information is fragmented and, in some cases, out of date. It focuses on tritium and buried pipe, but in general, does not give a clear general message of how we protect public health and safety as well as protect the environment.

[22] http://www.reirs.com/

D.3.3. Conclusion

As gleaned from stakeholder input, dissatisfaction by some stakeholders with NRC's regulatory approach and incident response has appeared to result in a lack of trust. Sometimes NRC communication methods are not timely in relaying information about the staff's assessment of groundwater incidents. Consideration should be given to using third-party validation methods following NRC assessment of groundwater incidents. This could include development of a standard protocol for when split samples should be taken and cooperative strategic alliances with public health officials and international counterparts.

D.4. References

"Summary Notes of the NRR Public Meetings on Groundwater Contamination at Nuclear Power Plants, April 19 and 20, 2010," (ADAMS Accession No. ML101320047).

NRC Press Release, "NRC Seeks Additional Public Input on Groundwater Contamination Issue," http://www.nrc.gov/reading-rm/doc-collections/news/2010/10-083.html.

Public Input on Groundwater Contamination Issues (ADAMS Accession No. ML101320375).

David Ropeik, "Nuclear Power and Risk; It's Not About the Facts. It's Our Feelings" March 29, 2010; http://www.psychologytoday.com/blog/how-risky-is-it-really/201003/nuclear-power-and-risk-it-s-not-about-the-facts-it-s-our-feelings

Groundwater Contamination Congressional Letters (ADAMS Accession No. ML101310326).

Appendix E

Summary of International Input on Groundwater Incidents

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Appendix E

Summary of International Input on Groundwater Incidents

E.1. Overview

In order to obtain information from the international community as to how other Regulatory Authorities have responded to groundwater contamination incidents or leaks of underground piping (both below and within regulatory limits), the Groundwater Task Force (GTF) contacted 13 international representatives to the International Atomic Energy Agency's (IAEA's) International Nuclear and Radiological Event Scale (INES) Advisory Committee to request their assistance. Specifically, these country contacts were asked to briefly summarize how their regulatory authority and/or licensees (operators) respond to such incidents, or if they have experienced such incidents at nuclear power plants in their country, how the level of contamination and safety significance was communicated. In addition, observations from a visit to a nuclear power plant in Canada which had experienced tritium issues have also been added to the country summaries.

In response to this request, nine organizations responded with an overview of their experience on the issues. The following section provides a more detailed overview of the responses from the following countries: Belgium, Bulgaria, Canada, France, Luxembourg (European Commission), Netherlands, South Africa, Spain, United Kingdom (Sellafield).

E.2. Facts and Observations: Detailed Country Summaries

E.2.1. Belgium Federal Agency for Nuclear Control (FANC)

The Belgium Federal Agency for Nuclear Control (FANC) has not developed an official policy for regulatory response to events involving releases of radioactivity that are measured below the regulatory limits, because they are extremely rare in practice. However, FANC staff provided several examples of where radiological monitoring results are effectively communicated annually as required by the 1957 EURATOM Directive.[23] FANC produces a yearly report that is published on their website [an English version of this report has also been published (FANC 2008)]. Part of the data that is included in these reports comes from the nuclear power plant operators, since they are required to maintain a radiological survey program of the site and its surroundings. FANC's environmental monitoring program includes background dosimetry, impact to people and the environment of releases of radioactive material (airborne and liquid), as well as regular sampling and measuring of drinking water, milk, and food crops.

[23] The 1957 European Atomic Energy Community (EURATOM) Directive brings together knowledge, infrastructure and funding of nuclear energy. It ensures the security of atomic energy supply within the framework of a centralised monitoring system for a specialist market for nuclear power.

In addition, FANC also issues short communications on its website, in a NEWS section, on sources or suspicious objects that are found outside nuclear facilities. In one case last year, FANC had an event involving trace quantities of uranium in a water well that was used for the sanitary installations of a nearby college. FANC investigated this thoroughly (and prohibited the use of this water until the environmental report was issued). After a series of tests and monitoring, FANC concluded that the uranium was of natural origin with activities that were in accordance with the regulations and that these were levels that could be expected in that particular water. After the report was final, FANC informed the public extensively on the results of their investigation and finding through its website and press-releases.

In Belgium, the IAEA International Nuclear and Radiological Event Scale[24] (INES) has been used for the past 20 years for events involving major nuclear facilities such as nuclear power plants, fuel fabrication, and research reactors. The use of the scale is done in coordination with the operators and the regulatory authority. Most recently, in April 2010, FANC has extended the use of this INES convention to other facilities such as accelerators for medical isotope production, research and development facilities and large irradiators. FANC anticipates that they will use INES to communicate the safety significance of events in the future to the public for all events related to ionizing sources (except medical applications). FANC also stated that when INES is used for future non-reactor events, it will be used in the same way as is currently used now, in close collaboration with the concerned stakeholders in order to have an open process of communication of the issues before publishing event-related information through INES.

E.2.2. Bulgarian Nuclear Regulatory Agency (BNRA)

The BNRA staff stated that they have not observed any incidents concerning groundwater contamination at their nuclear power plants. Releases or leaks are monitored and are well below the regulatory limits. Any observations of this type have been several orders of magnitude below the regulatory limits and are not reportable. No events of this type have been reported via IAEA's INES, due to the low safety significance of these types of events.

E.2.3. Canada: Pickering Nuclear Station (PNS)

The Pickering Nuclear Station (PNS) has eight CANDU (CANada Deuterium Uranium) reactors which uses heavy water (deuterium oxide) for moderator and coolant, and natural uranium for fuel. Although heavy water is relatively immune to neutron capture, a small amount of the deuterium turns into tritium via this process. Tritium is extracted from some CANDU plants in operation in Canada, primarily to improve safety in case of heavy-water leakage. At PNS, there has been a groundwater monitoring program in place since 1998.

A site-specific risk-based generic screening criterion for tritium in groundwater that is not used as drinking water has been developed by Ontario Power Generation (OPG) and

[24] *See* http://www-pub.iaea.org/MTCD/publications/PubDetails.asp?pubId=8120

approved by the Canadian Nuclear Safety Commission (CNSC) and Ontario Ministry of the Environment. The generic screening criterion is 3×10^6 Bq/L (8.1×10^7 pCi/L). Groundwater behavior is routinely monitored and water samples are obtained. This is part of a site-wide monitoring and modeling program to determine if there are any abnormally high values that need to be investigated. The licensee program results are reported in an annual report which is submitted for review by the CNSC.

The groundwater investigations at PNS began in 1998 when a higher than normal tritium level was detected in the sanitary sewer effluent discharged to the local municipal sewage treatment facility (PNS has 8 CANDU reactors, 6 of which are presently operating). The tritium source was traced back to a damaged sewer pipe that inadvertently served as a conduit for elevated tritium concentration [2.6×10^8 Bq/L (7×10^9 pCi/L)] under Units 1 and 2. Based on a series of exploration well drilling activities in which boreholes were drilled through the concrete floor of the auxiliary turbine building, the center of the tritium plume was determined to be in the reactor auxiliary bay corridor. Permanent groundwater wells of 25 to 30 foot depths adjacent to sumps in the reactor auxiliary bay were installed and are routinely sampled. During the 10 years of sampling, trends indicate a decrease of tritium concentration. PNS states that there are no indications of adverse, off-site migration of tritium at the perimeter of the site in the shallow groundwater flow system.

Since the discovery of the abnormal tritium releases, over 300 wells have been installed in the shallow backfill and glacial till deposits surrounding the reactor buildings as well as up- and down-gradient of the station. PNS installed many of these monitoring wells to serve as early detectors for offsite migration and evaluation of any remediation activities following analysis of groundwater/surface-water site behavior. Following the detection of high concentrations of tritium, a remediation program was developed. In addition, these wells serve to evaluate the efficacy of remediation activities following analysis of groundwater and surface-water site behavior. Remediation consists of: (1) pumping eight deep foundation drain sumps below the turbine auxiliary building to re-direct tritiated water; and (2) extensive monitoring of the contaminant plume that is naturally attenuating due to very slow ground-water movement in the shallow backfill and glacial till units enabling significant time for radioactive decay. Tritiated water from the foundation drain sumps is mixed with plant cooling water discharge, monitored and released to Lake Ontario at levels far below regulatory limits. The remediation and monitoring program have been ongoing since 2000.

In 2009, NRC staff met with hydrogeologists from OPG to discuss their Radiological Environmental Monitoring Program (REMP) in the vicinity of the PNS. In particular, the groundwater monitoring program was reviewed to understand the detection and distribution of abnormal tritium releases to the subsurface and monitoring trends. Staffs also discussed their environmental monitoring and modeling program to better understand how the normal and abnormal releases are assessed for potential impacts to public health and the environment. Technical discussions focused on the ground-water monitoring program of background tritium levels, tritium releases and migration to the accessible environment. Information and insights were obtained from the OPG hydrogeologists concerning discovery

and identification of multiple abnormal release sources, formulation of a Conceptual Site Model and development and implementation of a long-term ground-water monitoring program. Details on their ongoing ground-water monitoring program which includes a network of shallow and deep wells to measure hydraulic gradients, sample tritium concentrations and assess seasonal trends were also discussed.

The CNSC has published a series of research reports on tritium releases in Canada to expand the body of knowledge on the subject and to further enhance regulatory oversight of tritium-related activities. The CNSC references at the end of this Appendix provide information on standards and guidelines for tritium in drinking water, tritium releases from CANDU reactors and other nuclear and chemical facilities, characterization of public exposure to tritium in garden produce, and information on health effects (including dose consequences), dosimetry and radiological protection of tritium.

E.2.4. France: Autorité de Sûreté Nucléaire (ASN)

Information obtained from the staff of the French regulator, ASN, stated that radiological contamination of groundwater has been observed at some nuclear power plant sites in France. These incidents are not as a result of the normal discharge operations in the environment. The tritium found in groundwater in some locations is due to occasional incidents of operation leading to spillage of radioactive liquid into the soil, followed by a transfer in the ground. Such contamination incidents have been limited to the perimeter of the plant and the operator is responsible for reducing and limiting the spread of contamination. For example, water accumulated in this space can be regularly pumped out by licensees to maintain an efficient hydraulic gradient to ensure the radionuclide retention within a limited volume. Furthermore, French nuclear power plants have “geotechnical containments,” which are engineered and designed construction areas built at the same time as the reactors, which contributes to limiting the spread of groundwater contamination.

ASN Regulatory Requirements for Groundwater Issues. To prevent accidental releases resulting from NPP operation, ASN has specific legal and regulatory requirements. For example, the French Transparency and Nuclear Security Act (TSN Act) No. 2006-686, June 13, 2006, identifies three distinct categories of installations present within the perimeter of a NPP, according to their use and the nature and scale of the risks they create:

- The NPP itself, according to the definition given in Article 28 of the act;
- The equipment and installations required for its operation;
- The other installations entered on one of the lists specified in Articles L. 214-2 (water) and L. 511-2 of the Environment Code.

The installations in the first two categories are required to meet specific rules covering public health and safety as well as protection of nature and the environment. The general technical regulations that apply to them are defined by orders from the ministers responsible for nuclear safety, clarified by ASN general decisions (ministerial Order of December 31, 1999). Each installation is also subject to individual requirements defined by ASN. The

third category of installations remains subject to the provisions implementing the Environment Code. ASN is responsible for individual decisions and for regulation as specified in these provisions.

This requirement of the TSN Act enables the specific characteristics of nuclear activities to be taken into account. The December 31, 1999, Order sets measures designed to prevent or, in the event of an accident, to minimize direct or indirect release of toxic, radioactive, flammable, corrosive or explosive liquids into the natural environment and the sewers. It led to:

- Review of the design of storage, loading and unloading zones, with effective leak collection areas being required;
- Implementing an organization able to deal with accidental liquid spills before they can migrate into the natural environment;
- Installation of containment tanks in particular for collecting and treating fire-fighting water.

Application of these measures by the licensees led to significant progress in preventing accidental releases of contaminated effluents. Pipeline routes and conditions were checked, as was the condition of retention areas.

SOCATRI Event, INES Level 1. On July 7, 2008, ASN had an event that occurred in the uranium effluent treatment plant (STEU) in the SOCATRI nuclear installation that led to a leak of about 20 m^3 of uranium effluent outside the storage and leak tanks (see two Areva press releases at the end of this section). Some of this effluent flowed into the rainwater network and then into the la Gaffière river, while some infiltrated the soil of the area undergoing construction work.

Following notification of the ASN on 8 July 2008, immediate precautionary measures were taken by the licensee, jointly with ASN, to protect the population by the préfets of the Drôme, Ardèche and Vaucluse départements. The incident was rated Level 1 on the INES scale.

Following an ASN inspection on 10 July 2008, two decisions were issued requiring that emergency measures be taken for securing the installation and surveillance of the environment (described in Decision 2008-DC-0104 of 11 July 2008 and Decision 2008-DC-0105 of 11 July 2008). Compliance with the requirements of these decisions was subsequently checked by an ASN inspection on 12 July 2008.

Extensive environmental surveillance around the site of the incident was taken by the licensee and by the French l'Institut de Radioprotection et de Sûreté Nucléaire (IRSN) (French Institute for Radiological Protection and Nuclear Safety), which provided an analyses of the surface water, ground water and sediments, enabling the regulatory authority to take action, if needed. In the light of the results of these analyses, which were presented to the High Committee for Nuclear Transparency and Security, this incident had no consequences for the health of the workers and populations. ASN also had an additional

series of samples taken by the BRGM (an organization for the establishment of reference for resources and risks of soil and subsoil and measurements) on water, sediments and aquatic plants by the SUBATECH laboratory of Nantes. The additional samples taken to date show no significant degradation of the environment as a result of this event.

After examining a safety analysis report (SAR) transmitted by SOCATRI, ASN authorized restart of the new STEU. During the first operating phase, priority was given to draining the old storage tanks which caused the incident. In December 2008, the old storage tanks were drained and testing of the new effluent treatment plant commenced and is currently ongoing. The purpose of the steps currently being taken by the licensee is to mobilize the personnel with regard to the necessary conformity of the installation with the order of 31 December 1999 and the requirements of the discharge license. Finally, the available data concerning the causes of this incident led ASN on 31 July 2008 to ask the various BNI licensees for initial operating feedback concerning this incident with regard to their own installations, in particular the condition of the piping.

Two of the press releases related to this event are shown below. In both cases, the use of an INES rating (Level 1) was used to describe the safety significance of the event to the public. Per the INES User's Manual, ASN has been using this scale to communicate the safety significance of events that also attract public interest, including those that may be rated at INES Level 0 or 1.

PRESS RELEASE ON THE SOCATRI INCIDENT

ACCESSED AT HTTP://WWW.AREVA.COM/EN/NEWS-771/UPDATE-ON-SOCATRI-INCIDENT.HTML

Press release

July 11, 2008

- **Confirmation of Level 1 classification**
- **Unscheduled halt in the use of old storage tanks**

SOCATRI has acted on the decisions made by the French Nuclear Safety Authority (ASN), and will pursue its recovery operations undertaken since the incident occurred.

In accordance with the ASN's request, it has halted the use of former industrial waste effluent tanks, which, as part of a €13 million modernization plan launched in 2005, will be definitively shut down over the coming weeks. SOCATRI is now performing its activity on new installations.

The incident was partly due to the modernization work being carried out on the industrial effluent treatment station, which should soon be complete.

The most recent series of environmental measurements has confirmed the situation is returning to normal.

SOCATRI invited a number of associations to participate in the sampling taken as part of the reinforced environmental monitoring.

SOCATRI once more offers its apologies for the inconvenience that the incident and its media consequences have caused.

PRESS RELEASE 2: TRICASTIN: SOCATRI REPLIES TO CRIIRAD'S ALLEGATIONS

ACCESSED AT HTTP://WWW.AREVA.COM/EN/NEWS-6664/TRICASTIN-SOCATRI-REPLIES-TO-CRIIRAD-S-ALLEGATIONS.HTML

Press release

July 16, 2008

The incident that occurred on July 8 at a SOCATRI treatment station has been the subject of numerous communications made public by stakeholders from industry, elected and public authorities, and action groups. All of which are legitimate.

SOCATRI, for its part, kept the authorities and media fully abreast of developments throughout last week. The time taken on the morning of July 8 between discovering the incident, to understanding the situation and informing the authorities, is currently being audited internally. The aim is to establish whether this time was justified, given the time taken to complete the analyses and mobilize the teams. Furthermore, SOCATRI invited those experts and associations wishing to do so to take part in the sampling and analysis processes carried out as part of the stepped-up environmental surveillance on its site.

The debate over the past few days on communications should not overlook the essential fact that the incident has been classified INES level 1 out of a maximum 7, and that – according to the institute for radiation protection and nuclear safety – the consequences for the people living nearby are negligible. Moreover, WHO standards for drinking water are now fully complied with.

SOCATRI regrets that CRIIRAD has decided to mix in other phenomena and deliberately play on people's concerns. The accusations levied at the group on its managing of "Tricastin hill" are unjustified; this issue, which has nothing to do with SOCATRI, has been known for several decades and has been the topic of a recent presentation to a local information committee:

- From 1964 to 1976, items from diffusion barriers used in the uranium enrichment process were stored to the north-east of the site.

- The storage location, a small hill some several meters high, was built on a layer of clay that isolated the stored material from the water table.

- Since the 1980s, annual pumping operations have been performed systematically to drain and monitor this water table. In 1998, these observations were supplemented by an examination by engineering firm Dames & Moore, which concluded that the storage hill in no way represented a risk to people's health.

- This matter was made public in a presentation to a local information committee in 1990, compiled in the first ANDRA inventory in 1993, and presented to the Committee for information on major energy equipment (CIGEET) on July 4, 2008.

- In 2006, the CEA agreed to give AREVA ownership of this hill, which also contains military waste that the group did not generate.

- Results have been presented in various reports (Guillaumont, Dames & Moore).

- The installation is monitored using piezometers and is inspected by the French defense security authorities.

Results indicate an average uranium concentration that is half the level recommended by the WHO (15 µg/L).

- A study in 1998 revealed that the hill was stable and caused no environmental impacts; the recommendation was to leave it as is[1].

- The French defense security authorities declared to local authorities on July 4 that (on July 10, during an on-site visit): "this matter is controlled by the operator and perfectly known by the authorities."

The communications issued by CRIIRAD lack the very clarity they claim to demand. With its exaggerated emotional tone, CRIIRAD is once more diverting people's attention to its anti-nuclear agenda. Ultimately, public information and the necessary debate on energy are what suffer from this method.

[1] The "Guillaumont" public report recommended an impact study be made.
A study by Dames & Moore in 1998 showed there to be no health risk, but recommended piezometric monitoring.

E.2.5. European Commission (EC), Luxembourg, Radiation Protection Section/ Environmental Radioactivity

In the European Union there is no specific legislation on nuclear installation groundwater issues and, in particular, none on groundwater contamination caused by leaking pipes. However, a potential impact by groundwater contamination is covered in the procedures of Article 37 of the EURATOM Treaty, an article dealing with plans for installations both in normal operation and in foreseeable accidental situations (by determining the possible radiation exposure of members of the population in the most effected Member State(s)). For these cases, each Member State (country) of the European Union is required to provide the EC with such general data relating to any plan for the disposal of radioactive waste to determine whether implementing such a plan may result in the radioactive contamination of the water, soil or airspace of another Member State. An update of a Recommendation defining general data to be supplied to the EC in this context is currently being drafted.

Member States, via specific authorizations to a licensee, may set up a specific monitoring program and may require specific actions if deemed needed or useful.

In addition, Article 35 of the EURATOM Treaty stipulates that each Member State shall require that their facilities carry out continuous monitoring of radioactivity in the air, water and soil to ensure compliance with the basic standards. The EC shall have the right of access to such facilities and may also verify their operation and efficiency.

The EC staff also stated that in their view, a leaking pipe could certainly be seen as an uncontrolled release, and the groundwater flow could probably reach beyond the boundary of the nuclear installation. Thus, within Article 35 verification missions, the EC may (and does, if applicable) verifies that facilities (including the sampling and measuring laboratories) are conducting monitoring of radioactivity in the air, water and soil. This could include looking at specific studies with regard to groundwater flow.

Article 35 verifications usually comprise the discharge monitoring (gaseous and liquid) from nuclear installations (on-site and off-site, by the plant operator and the control of discharges

by, or on behalf of, the regulating authority), as well as parts of the country's nationwide monitoring network for environmental radioactivity.

E.2.6. Netherlands Regulator, KFD MINVROM

In the Netherlands, staff of the Nuclear Safety Department, within the Ministry for Housing Spatial Planning and the Environment (Kernfysische Dienst, Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, or KVD) responded to our inquiry by stating that they have no formal policy on "below regulatory limits" for groundwater contamination, although they noted that several incidents in the Netherlands have attracted media attention. The most notable groundwater contamination incidents were: (1) increased tritium levels; (2) cesium contamination along the shores of the river Waal downstream of the now closed Dodewaard BWR; (3) higher uranium ground water contamination levels near a waste dump / scrap yard; and (4) a heavy and radioactive metals contamination area near a former tin and lead smelter. In this latter case, contaminated soil has been removed and is still being stored at the COVRA (Centrale Organisatie Voor Radioactief Afval) Dutch nuclear waste processing and storage facility for radioactive waste treatment and storage. In all the above cases, INES was not used to rate the irregularity, however KVD has used INES to rate incidents below Level 2 if they attract public or media interest.

KVD recommended that it might be worthwhile to hold an expert meeting on this topic to get some international consensus and related experience on the issues.

E.2.7. South African National Nuclear Regulator (NNR)

Dose Assessment and Environmental Monitoring Program. In accordance with NNR regulatory requirements, the operator (licensee) has instituted an Annual Authorised Discharge Quantity (AADQ) system whereby the maximum release limits from the nuclear power plants (NPPs) are derived in order to control effluent discharges (gaseous and liquid) to the environment. This ensures that the applicable regulatory public dose constraint and dose limits per the NNR regulations are not exceeded.

The mentioned AADQ system makes provisions for deriving and determining the maximum discharge activities in becquerel (Bq) on a nuclide-specific basis based on the activity migration of radioactivity in the actual plant originating from the fuel (source) to the point of effluent discharge. The Activity Migration "Model" makes provisions for *As Low As Reasonably Achievable* (ALARA) (plant design and operation) and subsequently provides a basis for optimized discharge activities.

In conjunction with the Activity Migration Model, Dose Conversion Factors (DCFs) are derived using appropriate computer software modeling (i.e., dilution, pathways, activity transport) to determine the Public Dose to the "critical group" prospectively due to the derived AADQ`s. Both the above mentioned applications are a prospective assessment and control of dose to the critical group. A complementary Environmental Surveillance /

Monitoring program is required to be implemented by the NPP to provide verification and confirmation that the activity discharges and subsequent doses as per the AADQ Model, are met and are ALARA. An Environmental Surveillance Report is issued by the operator on a quarterly basis for scrutiny by the Regulator. The report also includes trending analyses.

Before the start-up of the South African nuclear power plants, a baseline monitoring program was instituted and implemented in order to determine the radioactivity in the environment (soil, vegetables, feed crop, surface water, borehole water, etc). This radioactivity monitoring also included naturally occurring radioactive materials (NORM).

Groundwater (Boreholes) Monitoring for Radioactivity. NNR has no formal policy or specific requirements related to groundwater or borehole contamination. The NNR approves the licensing standards of the operator, in this case the Radiation Protection Environmental Surveillance Standard (Standard), which, for groundwater, specifically provides for pre-operational baseline monitoring as well as routine operational borehole sampling and frequencies on-site and off-site, together with reporting. With regards to off-site sampling, the regulatory requirements in the Standard focus on those groundwater and boreholes samples where the source is tapped for drinking water or irrigation purposes in area where the hydraulic gradient or recharge properties are suitable for contamination.

In South Africa, the operator has installed a number of boreholes on site to form part of, *inter alia*, the Baseline Monitoring Program as mentioned above. The intent of sinking boreholes is to determine the chemical/corrosion impact and attack on NPP systems, structures and components (SSCs) regarding equipment failure. The operator has a permanent contract with one of the national universities which is capable of measuring very low levels of radionuclides (e.g. tritium). Samples are collected routinely and analyzed for contamination/radioactivity and compared to expected southern hemisphere values. The results are then compared with pre-operational ground monitoring values.

The off-site boreholes are used to determine the migration of radioactivity to the public domain affecting public dose. Monitoring of radioactivity in groundwater (via boreholes) off-site essentially aims to verify the levels of fission products such as ^{137}Cs, corrosion products such as ^{60}Co and tritium of which the latter is perceived to be the most important indicator of radioactivity/contamination migration in groundwater. All nuclide specific activities detected as part of the environmental program are included in quarterly reports. This includes all pathways and media including groundwater. The frequency of off-site groundwater monitoring is linked to the land use census, and observations of specific locations and levels can be formally requested from the operator.

For the intended new power plant construction at the present nuclear power plant site, a borehole study has been performed to identify locations for new borehole positions at and around the proposed site. In addition to the 6 existing boreholes at the NPP Site, the borehole study recommended an additional 8 new boreholes, some of which will be placed between the two plants.

The new borehole positions will serve for both baseline and operational environmental monitoring similar to the present NPP monitoring strategy. The intent of sinking boreholes is to determine the chemical/corrosion impact and attack on NPP SSCs (equipment failure) and the migration of radioactivity to the public domain effecting public dose. The eight additional boreholes should provide a more comprehensive picture of groundwater in terms of radioactivity migration as well as ground water chemistry.

The new groundwater monitoring strategy will supplement the current groundwater monitoring and will serve as a baseline for any additional NPPs that may be built in the future at the present site. The current Environmental Surveillance Program will be altered accordingly and more emphasis will be placed on the monitoring and detection of ^{14}C.

NNR Position and Response. The NPP operator has a formal system of internal reporting for occurrences which provides for reporting in the event of elevated contamination levels (and trends) in the environment, including in the groundwater. On-site groundwater is not used for drinking or irrigation purposes. This report includes documented data contained in the Environmental Surveillance Reports, together with a retrospective dose assessment. Detected quantities of radionuclides in groundwater (low levels) are being compared to expected and derived reporting levels and ALARA dose targets. In case of elevated levels of radioactivity in boreholes on- and off-site, NNR would require the operator to perform an investigation in accordance with approved procedures. The origin, impact and recommended corrective actions are then submitted to the regulator. Results of all environmental analyses, deviations from trends, and doses to the public are reported in both operator and regulatory reports. NNR's annual report is a public document and is also presented in Parliament. Presently observed quantities of radioactivity in groundwater are not reported to the international forums.

E.2.8. Spanish Regulator, CSN (Consejo de Seguridad Nuclear)

CSN requires that their NPPs establish a radiological control program in which NPPs must identify radioactive materials in both the liquid and gaseous effluent streams. NPPs are also required to provide information about actual releases on a monthly basis to the CSN and to establish a sample environmental monitoring program. The aim of this program, amongst others, is to verify the adequacy of effluent monitoring and models of transfer of radionuclides in the environment so that any inadvertent leaks can be detected. The monitoring program for environmental radiation is defined in the Technical Specifications and the operation of the program is discussed in detail in the Manual of Dose Calculations.

CSN also manages an independent national environmental monitoring network called REVIRA (Environmental Radiation Monitoring Network) which covers all of Spain and provides surveillance of the radiological quantity of the environment in accordance with the requirements of 2000/473/EURATOM the European Commission. It consists of a network of sampling stations as well as an automated station network for the continuous measurement

of effluents. The network provides REVIRA radiological information on the radioactivity in air, soil, water (drinking water and marine) and foodstuffs.

Additionally, each NPP has implemented a new surveillance program for monitoring and control of surface water, groundwater and drinking water, and the results are collected and analyzed in the annual reports to the CSN. The specific objectives of the groundwater and surface water surveillance program are:

- Radiochemical water quality (chemical and radiological) of water surface and groundwater, in anticipation of potential accidental releases of radioactive wastes, including tritium;
- Detection of abnormal levels and possible radioactive contamination in the water to serve as an early indicator or degradation of structures, systems or components and the need for possible mitigative actions (repairs, cleaning, etc.)
- Detailed knowledge of the hydro-geological behavior of each NPP site and the possible conditions of groundwater to building structures of the plant.

As for the discharge criteria, NPPs are required to meet the operational dose limits of 100 µSv (10 millirem) per year due to releases during operation. This criterion takes into account all type of discharges (gaseous and liquid) and all the possible different types of radionuclides, but there are no specific regulatory discharge limits for tritium. There is however, a notification criterion for activity concentration in environmental samples, which is discussed in the Dose Calculation Manual. This criterion is based on the estimated dose (dose constraint) if one person ingested that concentration of water for one full year. If this criterion is exceeded, CSN requires the NPP to submit a report including the corrective actions to be implemented in order to avoid a potential dose in excess of dose limits to a member of the public.

The results obtained from these programs have allowed the CSN to conclude that the quality of the environment is acceptable from a radiological point of view and that there is no risk for the members of the public around NPPs due to the discharges during operation.

Although the REVIRA program results have shown an increase of tritium levels downstream from NPPs, CSN staff stated that these values are not significant and do not represent a risk. Regarding communication of these results to the public, the CSN submits an annual regulatory report (which includes a summary of environmental releases) to the Spanish Parliament, which is also available on their website.

The official CSN event communication policy is to review and issue an INES rating for all reported events from licensees to communicate the safety significance of the event to the public. Nationally, events are reviewed and given an INES rating, regardless of the Level (0-7). CSN staff stated that for Level 0 events, they may also include a short event description of the event on their public website, and for Level 1 events and above, an official press release. In summary, CSN uses INES mainly as a domestic (national) tool for rating

all events. In addition, for those events rated at Level 2 or above, CSN also transmits the event information internationally to the IAEA, who posts it electronically via its NEWS web server.

E.2.9. United Kingdom: Sellafield Groundwater Monitoring[25]

Nuclear licensed sites in the United Kingdom (UK) are regulated by the Nuclear Installations Inspectorate (NII) which is part of the Health and Safety Executive (HSE)[26] and the Environment Agency (EA)[27]. Under the Nuclear Installations Act 1965 (NIA 1965), NII is responsible for regulating operations on a nuclear licensed site. NII does this by granting licenses to the operators of the sites and is able to attach conditions to the licenses which it considers necessary or desirable in the interests of safety. In addition NII may attach such conditions as it sees fit for handling and treatment and disposal of nuclear matter. NII regards radioactively contaminated land and emplaced radioactive substances on nuclear licensed sites as accumulations of nuclear matter, unless they are, or arise from, authorized disposals, which requires licensees to manage it as such. The license conditions require that licensees control or contain nuclear matter, to record the amount of radioactive material and its location, and justify and demonstrate the arrangements to maintain safety by means of a safety case.

Safety Assessment Principles (SAPs) for managing radioactively contaminated land on nuclear facilities are published on the HSE Nuclear Website and have requirements for strategy, characterization, control and remediation, record keeping, safety cases and redevelopment. They define "radioactively contaminated land" as "land containing radioactive contamination that would preclude HSE giving notice in writing that in its opinion there ceases/has ceased to be any danger from ionizing radiations on the site, or part of the site". The criterion for delicensing (decommissioning) is that the risk of death to an individual should not be more than one in a million per year (10^{-6}). The overarching requirements of the Health and Safety at Work Act which, in part, reduces risks to "as low as reasonably practicable" (ALARP) also apply, but if risks are below one in a million per year, licensees are only expected to show that there are no other, inexpensive clean-up activities that could be carried out.

With regards to the use of INES, both the Sellafield operator and regulator use this scale to communicate the safety significance of events that are reported to the regulator or may attract public interest, including those that may be rated at INES Level 0 or 1.

EA Position Statement and Key Objectives on Contaminated Land and Groundwater. In January 2004, the UK's EA issued a position statement on contaminated land and

[25] *See http://www.sellafieldsites.com/land/pages/groundwater_monitoring.html*

[26] http://www.hse.gov.uk/nuclear/

[27] http://www.environment-agency.gov.uk/business/sectors/32517.aspx

groundwater at Sellafield. This document concluded with listing the EA's ten key regulatory objectives with respect to contaminated land and groundwater at Sellafield:

1. A Site policy with the goal of early cleanup of ground contamination and groundwater, avoiding and minimizing future ground and groundwater contamination spread.
2. The Site should develop groundwater protection principles and a groundwater protection strategy consistent with over-arching environmental protection principles and a Site integrated waste strategy.
3. Remediation options appraisals for each significant source (carried out according to a prioritized program) that includes consideration of the actual and potential risks. Risks here include those of significant dose to man, environmental harm, contamination of groundwater, or migration of contamination, which would make future remediation more difficult or costly. The Agency considers that options should include interim hydraulic isolation or groundwater treatment consistent with the site's integrated waste management strategy and plan.
4. Development of Site targets to: a) reduce the sources and b) to reduce the level of groundwater contamination.
5. A validated and verified conceptual model that includes a geological/hydro-geological and contaminant model with detailed development of source term understanding.
6. A mature quality assured groundwater monitoring program underpinned by clear monitoring strategy objectives.
7. A detailed radiological and environmental risk assessment of the individual and combined actual and potential source terms for current and future generations.
8. A detailed knowledge of the rate of leakage of radioactive waste to environmental receptors (to groundwater, to the atmosphere by aerial re-suspension and to rivers and the sea via groundwater discharge) from individual source terms and hence the rate of generation of secondary radioactive waste.
9. A developed communication strategy and plan, which facilitates early, open and transparent operator dialogue with appropriate stakeholders regarding these contaminated land and groundwater legacies. Recognition of the hazard and environmental risk of this legacy within a prioritized site restoration program to implement the recognized best options.
10. A public annual report to stakeholders detailing progress with the above.

Objectives of Groundwater Monitoring at Sellafield. The primary objective of the groundwater monitoring network at Sellafield is to monitor the groundwater quality and the hydrogeological features and processes that control it. There are a number of key components of the site that influence the design of the network, including the site boundaries, sources of contamination, migration pathways and potential receptors, i.e. the River Calder, the River Ehen and the Irish Sea. The groundwater monitoring program provides time series data which not only provide early warning of the movement of contaminants off-site, but provide data to validate the codes modeling contaminant transport.

The groundwater monitoring regime was significantly revised in 2006 following the findings and recommendations of a 2005 review (050268_02 First Issue)[28] by Westlake Scientific Consulting. The Sellafield Ltd. groundwater monitoring program was changed to adopt an integrated approach across the whole of the Sellafield site, rather than being restricted to the Site perimeter. This resulted in the total number of boreholes included in the site monitoring program being increased to more than 150, with many of these boreholes containing multi-level monitoring installations. The objectives of the Sellafield Ltd. groundwater monitoring program are:

1. To provide data to enable current impact on humans and non-human species from contaminants in groundwater to be determined.
2. Monitor changes in the groundwater quality between the points that groundwater enters the Sellafield site to the points it leaves the site.
    - Determine the nature, scale and location of activity and other contaminants in the groundwater entering the Sellafield site
    - Determine the nature, scale and location of activity and other contaminants in the groundwater leaving the Sellafield site and/or available to human and non-human species.
3. Provide details of the groundwater quality across the Sellafield site.
    - Determine the nature, scale and extent of contamination in the groundwater beneath the Sellafield site.
4. Facilitate planning and prioritization of remedial action.
    - Provide data to assess the direction and rate of migration of contamination entering the groundwater from contaminated land and other sources.
    - Provide data (contaminant concentrations, groundwater flows and directions) with which to assess the impact of contaminants in groundwater on actual or potential receptors including the sea or adjacent water courses (River Ehen and river Calder).
    - Provide data to assess the rate of discharge to groundwater from contaminated land.
    - Provide data to assess the rate of generation of waste.
5. Provide information to improve the conceptual hydrogeological model of the Sellafield site.
    - Monitor groundwater heads and hydraulic gradients across the site and provide information with which to improve the groundwater conceptual model.
    - Provide data to contribute to any routine water balance calculations for the site.

In addition to the above objectives, the program has also been expanded to:

6. Provide information to identify the role of colloids, particles and dissolved salts in the migration of contaminants within groundwater.

The sampling methodologies and the analytical limits of detection have also been changed following the reviews. These changes have resulted in a number of boreholes now having detectable concentrations of radionuclides within the groundwater.

[28] http://www.sellafieldsites.com/land/documents/050268_02%20First%20Issue.pdf

An example of this is from the analysis of total alpha in groundwater which had a reduction in the limit of detection from 200 Bq/m^3 to 30 Bq/m^3 (5400 pCi/m^3 to 810 pCi/m^3). This reduction has resulted in a number of locations where activity has been detected between the old and current detection limits. To further investigate the sources of the elevated Alpha activity changes have been made to the frequency of sampling and the analytical suite.

Each year the schedule for groundwater monitoring is developed in conjunction with the Environment Agency. Part of this process includes the review of the previous year data and the development of the program in line with the monitoring objectives. This annual review is submitted to the Environment Agency at the end of September.[29]

Leak Detection Program. The Contaminated Land Project Leak Management and Detection Program was issued in 2006 and updated in 2008. The program is designed to minimize the impact of ongoing operations and structures on the subsurface environment and characterize and minimize further additions to the contaminated land store.

The program includes the following actions:

- Prioritize plants with respect to potential risk of leaks to land in order to focus Contaminated Land Project attention and resources upon the most important plants.
- Establish interfaces, regular communications, information transfer, and agreement of responsibilities with the prioritized plants.
- Recognize the importance of leaking drains with respect to transmitting subsurface contamination; establish interfaces, regular communications, information transfer, and agreement of responsibilities with the Plant Services Utilities – Civil Group and with the Low Active Effluent Management Group.
- Use a continuing program of audits and surveillances on plants and drain systems to assess compliance with relevant regulations pertaining to leaks to land, adequacy of leak to land management systems, and plant and drainage system vulnerabilities with respect to potential risks of leaks to land.
- Integrate the applicable portions of the Sellafield Contaminated Land and Groundwater Management Project (SCL&GMP) into the leak management and detection program.
- Transmit results of leak detection technology identification to plants and drain groups.
- Consult with plants on the placement and rehabilitation of boreholes in the Separation Area relative to optimizing locations with respect to possible future leaks.
- Use the results from the trench investigation as a model for processes for handling future leaks from plants or drains.
- Establish the Contaminated Land Project in a key role as an integrator in the exchange and dissemination of information and knowledge relative to leaks to ground so that all involved parties are operating from a common knowledge basis.
- Perform routine modeling and visualization of leaks to assess impact on the existing subsurface inventory.

[29] http://www.sellafieldsites.com/land/documents/TECH000221-Rev-2-Annual-Report-09.pdf

The contaminated land team currently manages an annual audit program to monitor the leak detection measure in high risk plants. By the end of 2009, this program had run for five years and the plan is to continue running it in the future.

External Stakeholders. As the focus of Sellafield's activities switches from an operating site to greater emphasis on the decommissioning and clean-up of the site, the possible end-uses and end-state of the site will come under greater scrutiny. Sellafield believes that their stakeholders need to have the necessary information on the merits and constraints of the various strategic and technical options available and they are able to provide informed views on the long term remediation of the site. Accordingly, a stakeholder plan has been prepared and will be updated as required to reflect any changes in stakeholder needs.

Sellafield Ltd. believes it is important to ensure that stakeholders have information on current contaminated ground and groundwater management and input into future decisions on the management and remediation of the site. A stakeholder plan has been formulated taking into account company guidance and policy as well as SAFEGROUNDS[30] guidance.

E.2.10. International Developments in Protection of the Environment

The international community has for some years been working to develop and benchmark modeling and assessment approaches for protection of the environment. These have centered upon developing and understanding radionuclide transport through environmental pathways, and calculations of doses to various receptor animals and plants in the environment. The stimulus for these efforts has been the pressure from various stakeholders for explicit demonstrations of protection of the environment, separate from demonstrations of protection for humans.

There are three key issues that continue to be examined internationally. First, is the question of what will be considered significant impacts in an animal or plant species. Unlike with protection of humans, protection of animals and plants in the environment is not necessarily the protection of each individual plant or animal, but rather considerations of populations, reproductive viability, and continued viability of the species. The second question is the levels of dose that are necessary to cause the effect of interest. There are significant differences between the radiosensitivity of different animals and plants. The third issue then becomes the modeling and dosimetry necessary to take the calculation of a radionuclide in a particular environment, and particular plant or animal, and calculate the dose from the presence of that radionuclide.

In addition to the work of ICRP, work continues at the International Atomic Energy Agency (IAEA), updating safety guidance on environmental assessment, and considering for the first time, in the draft Basic Safety Standards, explicit requirements for the conduct and use of environmental assessments. Similar work is being performed by the European Commission which is considering specific requirements for environmental protection, and for reference

[30] http://www.safegrounds.com/

animals and plants, in a revision of the European Directive. Finally, a number of coordinated efforts have been undertaken to benchmark various computer codes for assessment of the movement of radionuclides and projected doses.

E.3. Conclusions

E.3.1. Conclusion

International regulatory authorities effectively communicate radiological monitoring results annually in a public report to their parliament or Congress. While the majority of the countries contacted did not have an official policy for responding to events involving reports for releases of radioactivity below the regulatory limits for members of the public, all countries did have licensee (operator) reporting requirements for periodic environmental effluent monitoring as well as a more formal process for the regulatory authority to effectively communicate radiological monitoring results annually in a report to their parliament or Congress (and also made available to the public on their website). The GTF notes that NRC previously issued annual NUREG environmental reports between 1972 and 1993. However, in recent discussions with staff, it appears that as a result of Commission SRM for SECY-06-0212, a new type of annual environmental report is currently under development, which is anticipated to be published by staff in late 2010. In light of the increased public and Congressional interest on tritium issues, as well as to complete the response to the SRM for SECY-06-0212, NRC could consider re-issuing an annual environmental effluent report that is voluntarily transmitted to Congress and made available to the public on the NRC website.

E.3.2. Conclusion

The GTF notes that more than 65 countries (including the U.S.) use IAEA's International Nuclear and Radiological Event Scale (INES) to explain the safety significance of events associated with various sources of radiation. Since 1993 NRC has participated in INES by transmitting event information for events rated at Level 2 and above to IAEA (SECY-01-0071; RIS 2002-01; IN 2009-27). The IAEA's INES User Manual states that "all countries are strongly encouraged to communicate events (within 24 hours if possible) for events rated at Level 2 or above, or events attracting international[31] public interest" (IAEA 2008). Because of the high level of public interest in events involving the discovery of radioactive materials in areas not expected by design, NRC staff could consider the use of INES for communicating the non-safety significance of events (at Level 0 or 1) that attract domestic or international public interest. Helping the public better understand the safety significance of events that attract significant public interest aids in independent validation of the regulatory authority's assessment and helps to strengthen public trust.

[31] The INES Advisory Committee will make a determination at its next meeting in June 2010 if the term "international" in the 2008 Users Manual should also clarified to state: "national or international public interest," which would recommend communicating events below Level 2 if they attract significant public interest.

E.3.3. Conclusion

Timely exchange of information and cooperative efforts on NPP operational events would be of great value in assisting regulatory authorities worldwide to deal with emergent issues, such as the recent buried piping tritium leaks that are far below regulatory limits. Several international regulators commented on the need to cooperatively investigate corrosion or other incidents that have caused leaks in buried pipes and related systems at NPPs. NRC should consider initiating dialogue with international regulators to discuss, via an international expert meeting, collaborative approaches for effective resolution of these situations. This would assist in strengthening NRC's independent validation of the safety significance of such incidents and proactively work towards international consensus in this area. NRC could work through the OECD's Nuclear Energy Agency (NEA) and the IAEA's International Nuclear Safety Group (INSAG) in order to collect advice and generate guidance to address nuclear safety issues concerning buried piping and develop a collective strategy to communicate their safety significance.

E.3.4. Conclusion

The international community has been working to develop and benchmark modeling and assessment approaches for protection of the environment. NRC should consider conducting cooperative efforts with international regulators to focus on developing and understanding radionuclide transport through environmental pathways.

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Appendix F

Acronyms

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Appendix F

Acronyms

AADQ	Annual Authorised Discharge Quantity
ADAMS	Agency-Wide Documents Access and Management System
AFW	Auxiliary Feedwater
AIT	Augmented Inspection Team
ALARA	As Low As Reasonably Achievable
ALARP	As Low As Reasonably Practicable
AMPs	Aging Management Programs
ANS	American National Standard
AOG	Advanced Off Gas System
ASME	American Society of Mechanical Engineers
ASN	Autorité de Sûreté Nucléaire (French Regulator)
BNRA	Bulgarian Nuclear Regulatory Agency
BPII	Buried Piping Industry Initiative
CAP	Corrective Action Program
CNSC	Canadian Nuclear Safety Commission
COVRA	Centrale Organisatie Voor Radioactief Afval (Dutch Reprocessing Facilty)
CSN	Consejo de Seguridad Nuclear (Spanish Nuclear Regulator)
CST	Condensate Storage Tank
DCF	Dose Conversion Factors
EA	Environment Agency (United Kingdom)
EC	European Commission
FANC	Federal Agency for Nuclear Control (Belgium)
GALL	Generic Aging Lessons Learned
GPI	Groundwater Protection Initiative
GTF	Groundwater Task Force
HP	Health Physics
IAEA	International Atomic Energy Agency
IIT	Incident Investigation Team
IMC	Inspection Manual Chapter
INES	International Nuclear and Radiological Event Scale
IP	Indian Point
IRSN	l'Institut de Radioprotection et de Sûreté Nucléaire (France)
ISR	In-Situ Recovery
KVD	Kernfysische Dienst, Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, (Department of Nuclear Safety, Security, Safeguards and Radiation Protection, Netherlands)

LRRLLTF	Liquid Radioactive Release Lessons Learned Task Force
LTMP	Long Term Monitoring Program
LTP	License Termination Plan
MD	Management Directive
NEI	Nuclear Energy Institute
NII	Nuclear Installations Inspectorate
NNR	National Nuclear Regulator (South Africa)
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OCA	Office of Congressional Affairs
OEDO	Office of the Executive Director of Operations
OPA	Office of Public Affairs
OPG	Ontario Power Generation
PI	Performance Indicator
PNS	Pickering Nuclear Station (Canada)
REMPS	Radiological Environmental Monitoring Programs
REVIRA	Environmental Radiation Monitoring Network
RG	Regulatory Guide
ROP	Reactor Oversight Process
SAP	Safety Assessment Principles
SAR	Safety Analysis Report
SCL&GMP	Sellafield Contaminated Land and Groundwater Management Project
SDP	Significance Determination Process
SDSP	Storm Drain Stabilization Pond
SFP	Spent Fuel Pool
SIT	Special Inspection Term
SRP	Standard Review Plan
SSCs	Systems, Structures and Components
STEU	SOCATRI Uranium Effluent Treatment plant (France)
TS	Technical Specifications
TSN Act	French Transparency and Nuclear Security Act
VY	Vermont Yankee