NRC ASSESSMENT: INDIAN POINT CONTAMINATED GROUNDWATER

Agenda

- 6:30 Introductions
  - Marc Dapas, Deputy Regional Adminstrator
  - Marsha Gamberoni, Director of Reactor Safety
- 6:40 Meeting Ground Rules
  - Rich Barkley, Technical Communications
- 6:45 Entergy Presentation
  - Don Mayer, Director of Special Projects
- 7:10 NRC Presentation
  - John White, Branch Chief, Plant Support 2
- 7:50 Break
- 8:00 Questions and Answers

NRC Inspection and Assessment Team

Principal Inspection Contributors:

- NRC Region I
  - James Noggle, Senior Health Physicist
  - James Kottan, Senior Health Physicist
  - John White, Chief, Plant Support Branch 2
- NRC Office of Research
  - Thomas Nicholson, Senior Technical Advisor-Radionuclide Transport
- US Geological Survey
  - John Williams, Senior Hydrologist

Coordinating Government Agencies

Federal:

- US Environmental Protection Agency (EPA)
- US Geological Survey (USGS)

New York State:

- Department of Environmental Conservation (DEC)
- Department of Public Health (DPH)

Purpose

- Evaluate Entergy's performance and provide status of inspection findings associated with the following:
  - Cause of the groundwater contamination
  - Extent and migration of the groundwater releases
  - Radiological significance of these releases
- Ensure that public health and safety and protection of the environment were maintained

Purpose

- Ensure Entergy's groundwater transport model is correct and tested
- Research prior opportunities for leak discovery and evaluate Entergy's response
- Determine Entergy's conformance with regulatory requirements

Scope

- Assess Entergy's investigation of the Unit 2 spent fuel pool leak since August 2005
- Examine Entergy's investigation of previous Unit 1 and Unit 2 spent fuel pool leaks identified in 1992

Scope

- Independent Assessment Effort:
  - Collection and analysis of groundwater samples
  - Verification of licensee's hydrological conclusions
  - Verification of dose assessment to the public
  - Verification of water inventory losses from Unit 1 and Unit 2 spent fuel pools
  - Verification of no detectable environmental impact through the analysis of aquatic food samples from the Hudson River.

Scope

- Comprehensive assessment of groundwater transport pathways and contaminant plume behavior
- Historical conditions

NRC Assessment

- Independent analysis confirms offsite migration is limited to the Hudson River
- The groundwater transport model was based on well-developed data, measurements, and field observations

NRC Assessment

During site visits and teleconferences, questions posed:

- ➢ to evaluate the Conceptual Site Model assumptions, and
- ➢ to pro-actively engage Licensee's contractor in developing corroborating field data
- ➢ to understand ground-water plume sources, extent, and behavior

NRC Inspection Focus and Activities

- NRC Staff from Region I and Office of Nuclear Regulatory Research provided technical oversight of IPEC ground-water contamination studies
- U.S. Geological Survey scientist provided technical support to the technical oversight
- Initial ground-water contamination identified in leak from Unit 2 Spent Fuel Pool
- Site visits focused on technical questions concerning the contaminant sources, pathways, potential receptors, and monitoring to detect future leaks
- Field data from rock cores, monitoring wells, geophysical surveys, hydraulic tests and tracer tests independently reviewed

NRC Assessment Questions

- What are the source(s) of the ground-water contamination?
- Where do they intersect the accessible environment?
- Are there fast and preferential pathways?
- Do the contaminant plumes move under the Hudson River?
- Are local drinking water sources affected?
- Are the plumes captured by the Discharge Canal?
- What are the hydraulic controls on the plume(s)' behavior as reflected in the Conceptual Site Model?
- What remediation is appropriate?
- How can future leaks be detected?
- What surveillance is needed to confirm dose assessments remain below regulatory limits?

NRC Assessment

Fundamental Understanding for the Conceptual Site Model

- Nature of the leaks and initial pathways through backfills and fractured rock at or above the local water table.
- Role of fractures and possibility of solutioning & connectivity
- Interaction of ground-water flow with the Hudson River
- Location and relationships to local drinking water sources
- Ground-water flow gradients, vertical and horizontal flow directions related to the sources, Discharge Canal, and River
- Movement of H-3, Sr-90, Cs-137 and Ni-63 to the River
- Benefits of a long-term ground-water monitoring program

NRC Assessment Conclusions

- Unit 1 and 2 are the source(s) of the ground-water contamination
- Plumes move west, intersect the Hudson River but not under to Rockland County
- Backfills and connected fractures are the preferential pathways
- No local drinking water sources are affected
- Discharge Canal captures some but not all of the plume
- Ground-water gradient and flow direction controlled by local hydrology
- Monitored natural attenuation is the appropriate remediation approach
- Future leaks can be detected by monitoring wells near Units 1 and 2
- Long-term monitoring is needed to confirm dose assessments remain bel regulatory limits during plant operations

NRC Assessment

- Entergy implemented timely actions to investigate source, and determine dose impact
- Entergy conformed to regulatory survey requirements with 1 minor violation of quality control of sample analyses
- Groundwater contamination resulted only from leakage attributed to Unit 1 and Unit 2
- Entergy's site characterization was based on state-of-the-practice monitoring wells, tests, and analysis methods

NRC Assessment

- Exposure pathway to man is aquatic food from Hudson River (fish, invertebrates)
- Calculated exposure to maximum exposed individual is 0.002 mrem/yr total body and 0.01 mrem/yr maximum organ
- Calculated exposures are less than 0.1% of NRC regulatory limit

Radiation Dose Perspective

- Background (est.) 360 mrem/year (NCRP 94)
- Public Dose Limits 100 mrem/year (10CFR20.1301)
  25 mrem/year (40CFR190)
- Liquid Effluent Limit 3 mrem/year, total body
  10 mrem/year, organ (10CFR50, App. I)
- Estimated Dose Rate 0.002 mrem/year, total body
  0.01 mrem/year, bone
- EPA drinking water limits (40 CFR 141.16)
  Tritium (H-3) 20,000 pCi/L
  Strontium (Sr– 90) 8 pCi/L

(EPA maximum contaminant level based on 4 mrems per year)

NRC Assessment-Regulatory Requirements

- Entergy is monitoring and reporting the groundwater effluent release condition in accordance with NRC regulations
- Relative to Unit 1, there was no condition in which the licensee failed to meet a regulatory requirement or standard that was reasonably within its ability to detect or correct

NRC Assessment

- Removal of Unit 1 fuel and drainage of the pools will eliminate the source of Sr-90, Ni-63, Cs-137
- Entergy has initiated a long-term monitoring process to:
  - Report groundwater liquid releases
  - Measure the effectiveness of remediation and natural attenuation
  - Detect new or changing groundwater contamination conditions

NRC Lessons-Learned

NRC Lessons Learned Task Force Identified:

- No regulatory guidance for detecting, evaluating, and monitoring releases via unmonitored pathways
- No regulatory requirement / guidance for remediation of groundwater conditions
- No requirement to assure leaks and spills will be detected before migration off-site

Actions have been initiated to address these and other identified issues.

Planned and Continuing NRC Inspection and Assessment

- Assessment of Long-Term Groundwater Monitoring Plan
- Inspection oversight of Unit 1 fuel removal and pool draining activities
- Baseline inspection now includes aspects of groundwater protection and assessment
- Inspection initiative to confirm licensee implementation of Industry Groundwater Protection Initiative

Additional Information

- NRC Homepage
  - www.nrc.gov
- Indian Point 2 Current Performance Summary
  - www.nrc.gov/NRR/OVERSIGHT/ASSESS/IP2/ip2_chart.html
- Indian Point 3 Current Performance Summary
  - www.nrc.gov/NRR/OVERSIGHT/ASSESS/IP2/ip3_chart.html
- Indian Point "Specific Plant of Interest" Page
  - www.nrc.gov/reactors/plant-specific-items/indian-point-issues.html
- Indian Point License Renewal Review Status
  - www.nrc.gov/reactors/operating/licensing/renewal/applications/indian-point.html
- USGS Open-File Report on Flow-Log Analysis
  - http://pubs.usgs.gov/of/2008/1123/

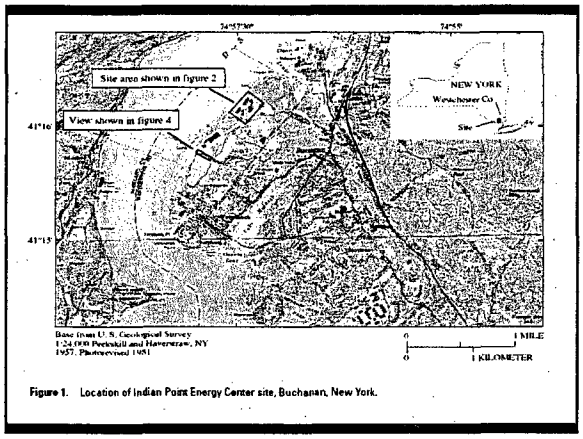
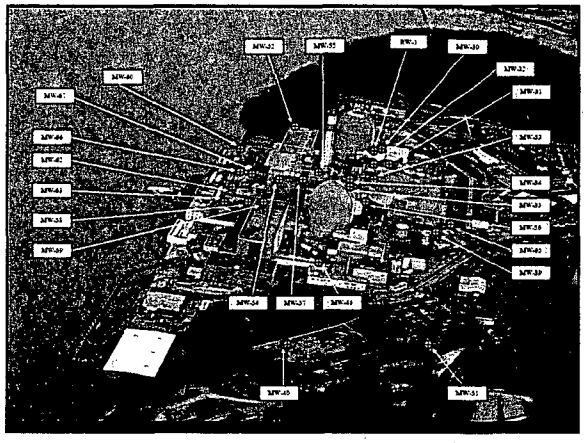
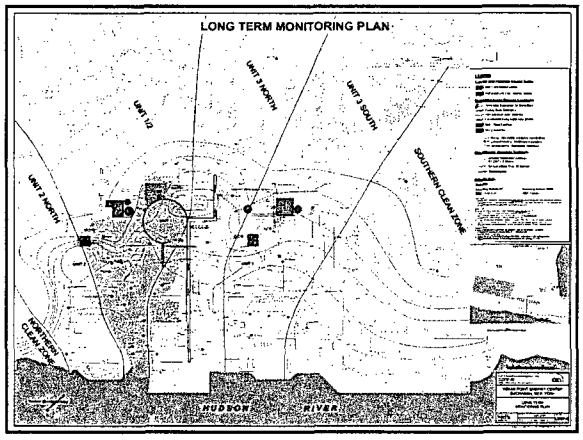
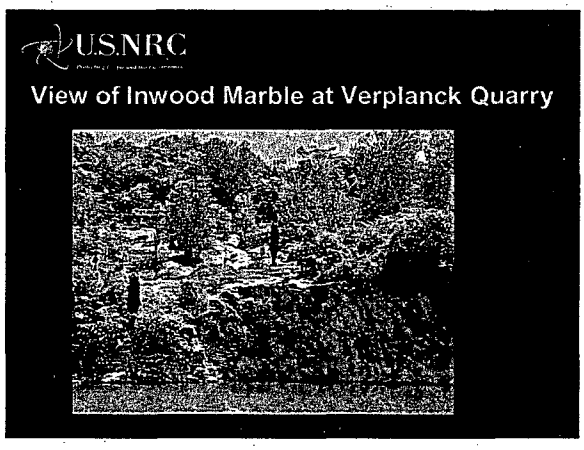
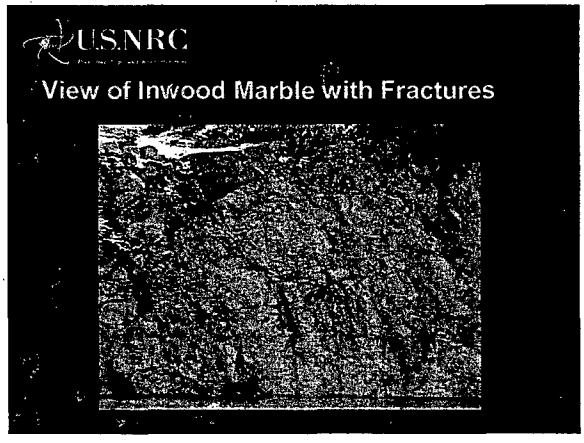


Figure 1. Location of Indian Point Energy Center site, Buchanan, New York.









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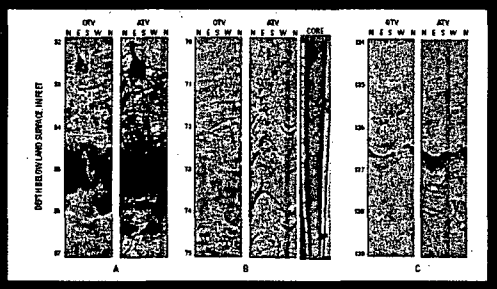
Optical and acoustic-televiewer logs and core from MW-00 showing conjugate and bedding fractures (Williams, 2006)



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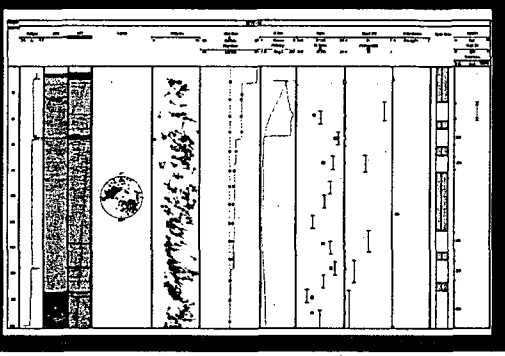
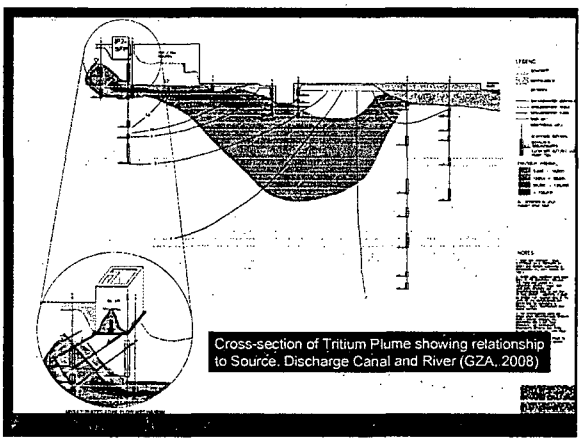
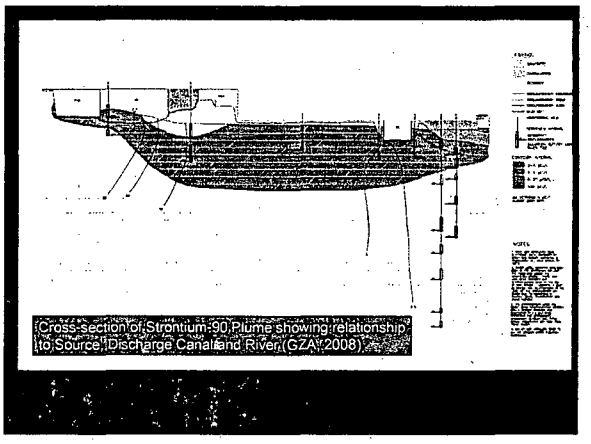
Composites of Geophysical Logs, Transmissivity and Hydraulic-Head Difference Estimates and Measurements, And Tracer-Test Results for Test Wells (Williams, 2006)





Cross-section of Tritium Plume showing relationship to Source, Discharge Canal and River (GZA, 2008)



Cross-section of Strontium-90 Plume showing relationship to Source, Discharge Canal and River (GZA, 2008)