Duke Energy Nuclear Programs Update for the South Carolina Governor's Nuclear Advisory Council

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For Information Purposes Only

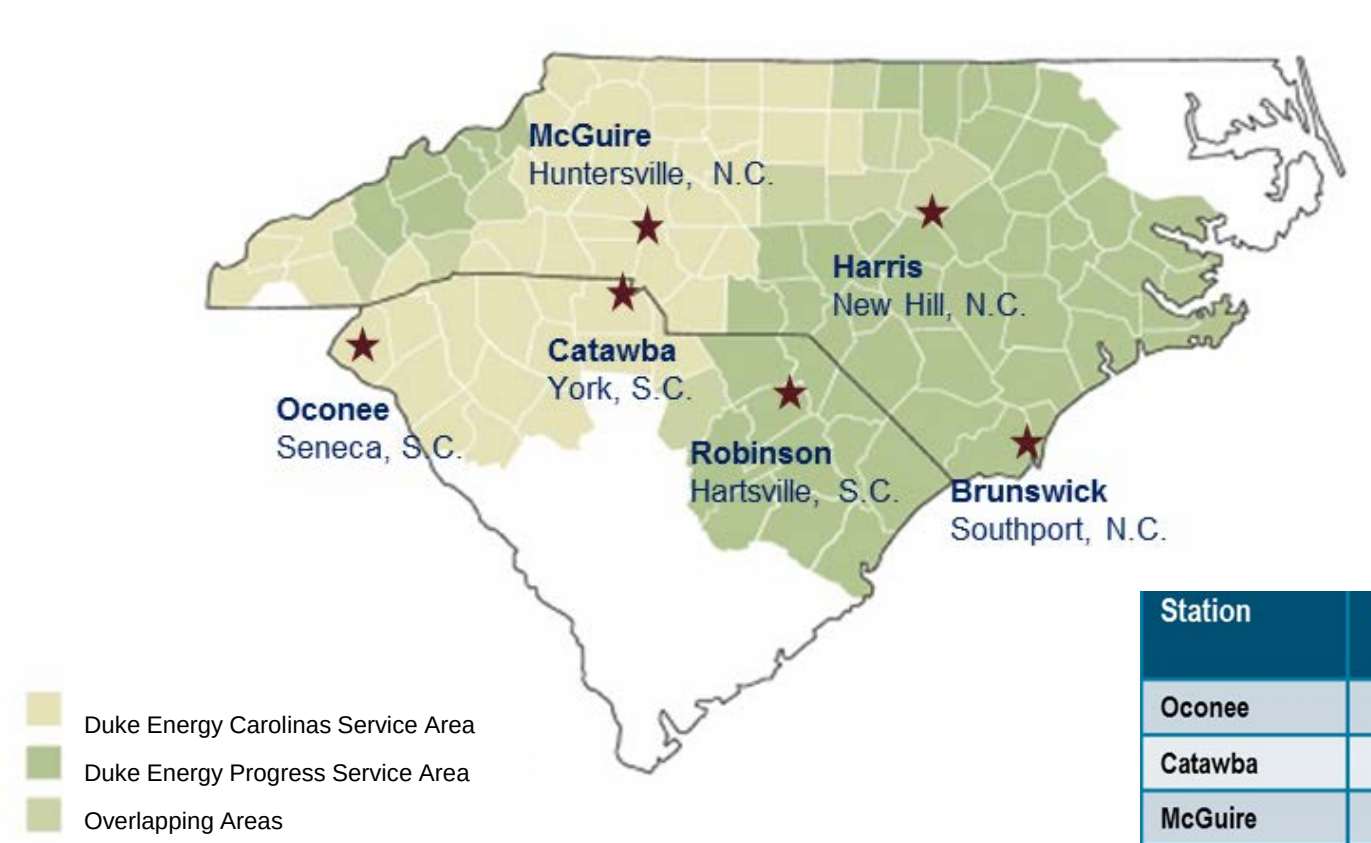
DUKE ENERGY.

"One Team, One Fleet, One Company"

Agenda

- Nuclear Fleet Overview
  - Operating
  - New
  - Decommissioning
- 2013 Performance
- 2014 Initiatives
- Groundwater Protection

Current Nuclear Fleet



Station	Capacity (MW)	Units	Commercial Operation	License Renewal
Oconee	2,538	3 PWR	1973	2033, 2034
Catawba	2,258	2 PWR	1985	2043
McGuire	2,200	2 PWR	1981	2041, 2043
Brunswick	1,870	2 BWR	1975	2034, 2036
Harris	900	1 PWR	1987	2046
Robinson	724	1 PWR	1971	2030
Crystal River	Retirement announced on February 5, 2013			
Total	10,490	11		

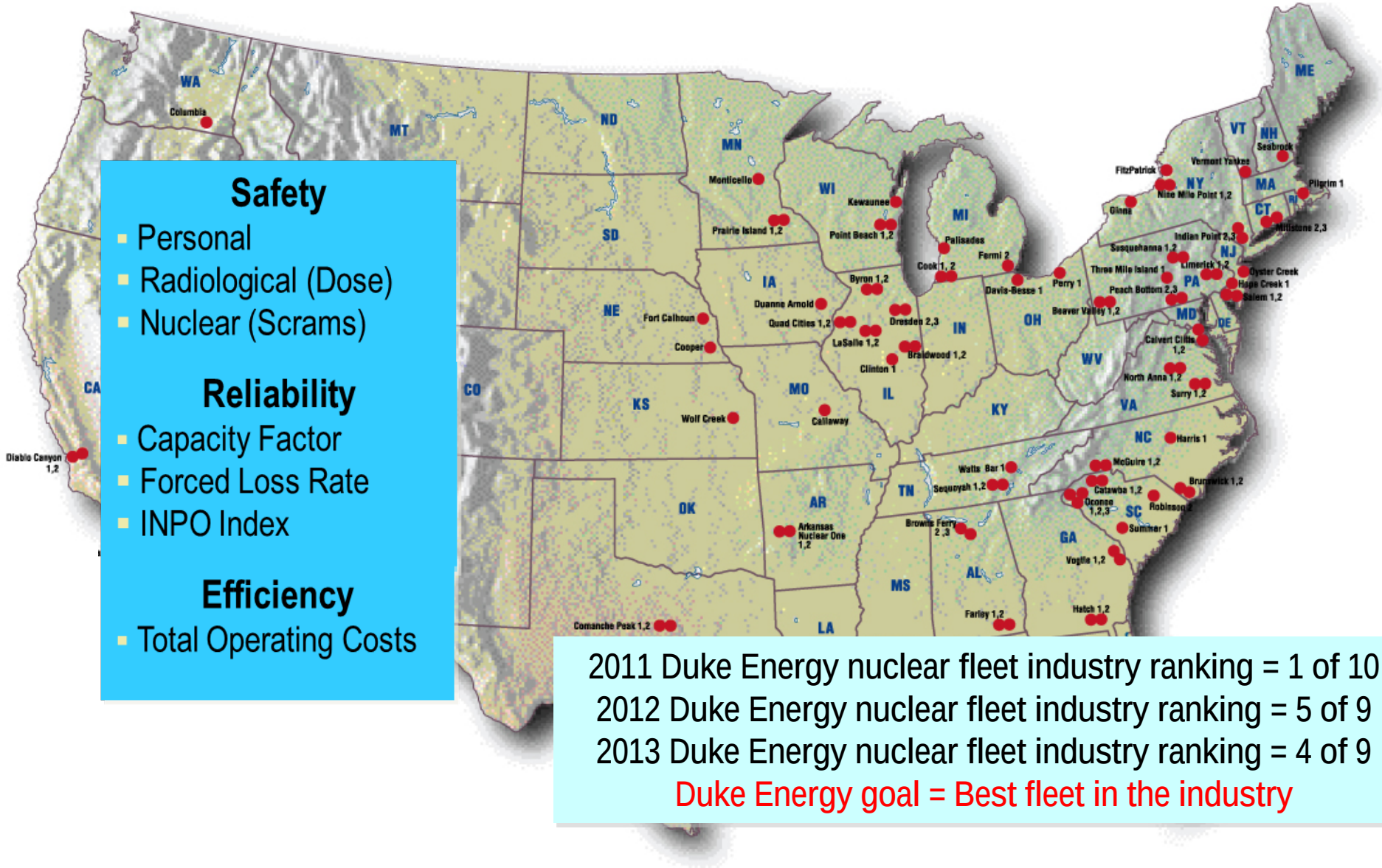
New Nuclear Plants

- Combined construction and operating license applications
  - Lee (two AP1000 units near Gaffney, South Carolina)
  - Levy (two AP1000 units in Levy County, Florida)
- Lee Nuclear Station licensing challenges
  - Waste Confidence
  - Central and Eastern United States seismic impacts
  - Condensate return

Crystal River Unit 3

- Containment shield building damage in 2009 during steam generator replacement activities
- Decision to retire unit rather than repair announced in February 2013
- Plant will be maintained in SAFSTOR until decommissioning
- Submittals to the Nuclear Regulatory Commission in December 2013
  - Post-Shutdown Decommissioning Activities Report (PDSAR)
  - Decommissioning Cost Estimate
  - Irradiated Fuel Management Program update

Nuclear Fleet – Key Performance Indicators



Safety
- Personal
- Radiological (Dose)
- Nuclear (Scrams)

Reliability
- Capacity Factor
- Forced Loss Rate
- INPO Index

Efficiency
- Total Operating Costs

2011 Duke Energy nuclear fleet industry ranking = 1 of 10
2012 Duke Energy nuclear fleet industry ranking = 5 of 9
2013 Duke Energy nuclear fleet industry ranking = 4 of 9
Duke Energy goal = Best fleet in the industry

2013 Generation Highlights

- Fleet capacity factor of 92.81 percent
  - 15th year of fleet capacity factor greater than 90 percent (excluding Crystal River 3 in 2010-2012)
  - Exceeded U.S. industry average for past 21 years
- June-July-August fleet capacity factor 99.73%
- Robinson had a 531-day continuous run (unit best)
- Oconee 2 had a 552-day continuous run (unit best)
- Oconee 3 had a 504-day continuous run (unit best)
- Oconee station had 315-day continuous run of all three units (site best)
- Oconee station had a capacity factor of 94.55% (site best)

2014 Fleet Initiatives

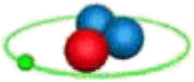
- Equipment Reliability
- Workforce Sustainability
- Outage Execution
- Financial Stewardship (Excellence in Cost Management)

Duke Energy Groundwater Protection Program – Discussion Outline

- Background on Tritium
- Nuclear Industry Groundwater Protection Initiative (GPI): NEI 07-07
- Nuclear Industry Underground Piping and Tanks Integrity Initiative (UPTI): NEI 09-14
- May 2014 Oconee Event
- Overview of Catawba, Robinson and Oconee Groundwater Programs
- Summary
- Questions

Tritium Background

- Tritium is a radioactive variation of the chemical element hydrogen (radioactive hydrogen-3 or ^{3}H) and has a half-life of about 12.5 years.
  - Half-life: Time period for a radioactive atom to naturally lose half of its radioactivity.



Tritium Atom

- The tritium nucleus is made up of one proton and two neutrons.

- Tritium is naturally occurring (cosmic rays in the upper atmosphere can convert a minor fraction of hydrogen into deuterium and tritium).

- Tritium is present at background levels in the environment, predominantly due to atmospheric testing of nuclear weapons in the 1960s.

Tritium Background

- Of the three primary types of radiation, alpha, beta and gamma, tritium emits only a very low energy beta radiation (approximately 18.6 kiloelectron volt or KeV).
  - Due to this low beta energy, tritium must be taken into the body to deliver radiation dose.
- The U.S. EPA's drinking water standard for tritium is 20,000 picocuries per liter (pCi/L). A picocurie is one millionth of a millionth of a curie (10^{-12} Ci).
  - The drinking water limit for tritium would produce a dose of 4 mrem in a year for a person drinking 2 liters of water at the concentration limit per day over a period of one year.
- The U.S. NRC's limit for tritium release without restrictions on use is 1 million pCi/L (permitted effluent releases).

Tritium Production in Reactors

Pressurized water reactors (PWRs)

- Tritium is produced primarily from neutron capture by boron-10 (B-10).
  - 90% of the total tritium in PWR reactor coolant is produced by reactions with soluble boron.

    e.g., ${}^{10}_{5}B + {}^{1}_{0}n \rightarrow {}^{11}_{5}B \rightarrow {}^{3}_{1}H + 2({}^{4}_{2}He)$
  - The remaining 10% is produced by ternary fission, neutron capture in other B-10, lithium-6 neutron capture, and deuterium activation.

Boiling water reactors (BWRs)

- Do not use soluble boron
- Tritium production much lower, but still must be addressed

Nuclear Energy Institute (NEI) 07-07

- Nuclear Industry Groundwater Protection Initiative: NEI 07-07
  - Voluntary program – industry Chief Nuclear Officer commitment
- Groundwater monitoring
  - Install additional monitoring wells
  - Voluntary stakeholder communications if > 20,000 pCi/L (^{3}H)
- Manage/prevent leaks and spills
  - Programs to prevent leaks and spills (enhancing systems and work practices)
  - Voluntary stakeholder communications for leaks or spills > 100 gallons with any detectable radioactivity with the potential to reach groundwater

NEI 09-14

- Nuclear Industry Underground Piping and Tanks Integrity Initiative: NEI 09-14
- Underground Piping and Tanks Integrity Initiative **goal** – to provide reasonable assurance of structural and leakage integrity of in-scope underground piping and tanks, with special emphasis on piping and tanks that contain licensed [radioactive] materials.
- The Underground Piping and Tanks Integrity Initiative will:
  - Drive proactive assessment and management of the condition of piping and tanks that fall within the Initiative scope.
  - Ensure sharing of industry experience.
  - Drive technology development to improve available techniques for inspecting and analyzing underground piping and tanks.
  - Improve regulatory and public confidence in the industry's management of the material condition of its underground tanks and piping systems.

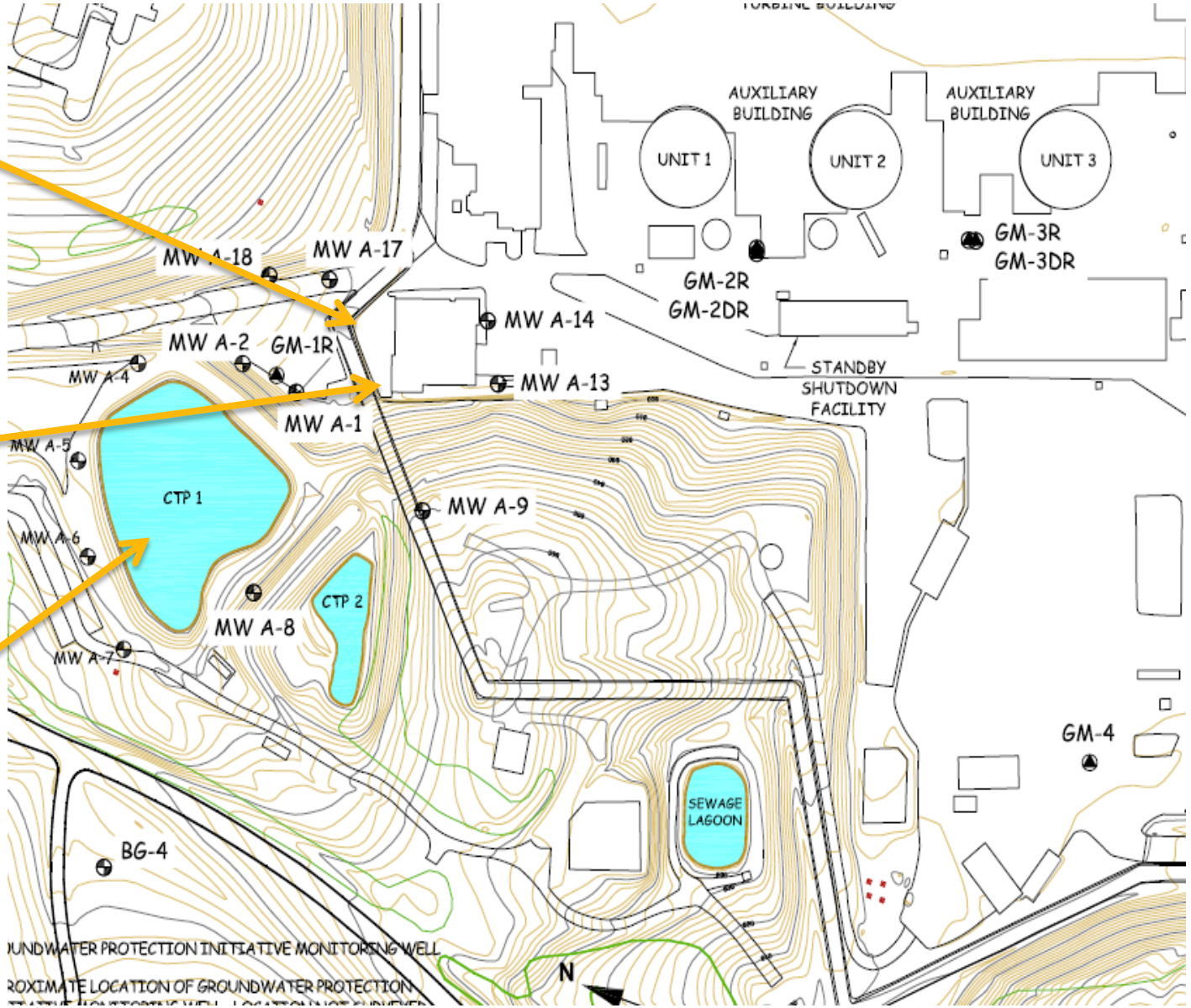
Oconee May 2014

Seepage Location

Discharge Pipe Transfer Path

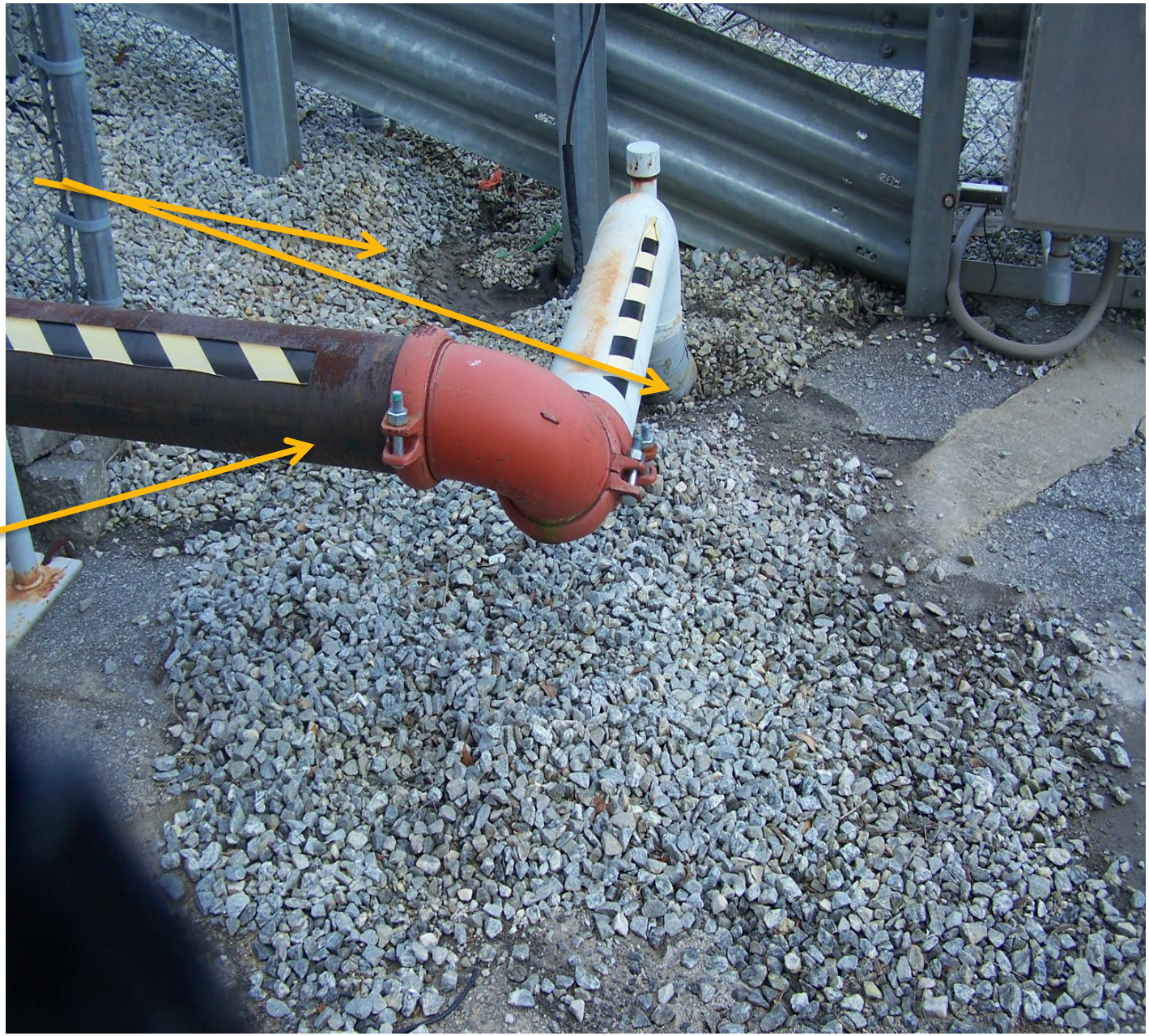
Location of Seepage

Chemical Treatment Pond 1



Visible Seepage

Pipe is Not Source



Location of Seepage

Path of Surface Flow to Discharge Pipe

Second Segment Of Discharge Pipe Transfer Path

Identification and Follow-up Actions

- Seepage identified at 4:45 p.m. on 5/6/2014
- Occurred during water transfer from Chemical Treatment Pond 1
- Water seepage from the ground subsided after termination of transfer
- Volume assumed to exceed 100 gallons
- Tritium activity of 3,150 pCi/L (16% of EPA drinking water limits)
- Action taken to prevent additional transfers from Chemical Treatment Pond 1
- Initiated NEI 07-07 stakeholder communications
- No Impact to public or employee health and safety
- Repair plan developed and completed

Plant Overview

Catawba

- ~ 40 monitoring wells
- Two NEI 07-07 communications in 2013

Robinson

- ~30 monitoring wells
- No NEI 07-07 communications since program began

Oconee

- ~60 monitoring wells
- No NEI 07-07 communications in 2013

Summary

- Tritium is a naturally-occurring radioactive isotope with relatively low biological impact. It is generated during nuclear power plant operations, particularly at PWRs.
- Industry instituted voluntary programs to prevent radioactive leaks and spills, identify them if they occur, mitigate any consequences and inform stakeholders.
- Programs are in place at all Duke Energy nuclear plants including Catawba, Oconee and Robinson in South Carolina.
- An event occurred at Oconee in May 2014 resulting in stakeholder notification. There were no public health and safety impacts.

Questions ?