Insignificant Gaseous Effluent Release Points – Potential Impact on Groundwater

REEW Workshop

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Hope Creek Elevated Tritium Identified

Problem Statement: Identified tritium concentrations confirmed in excess of 10M pCi/L (in snow, ice, and water dripping from upper elevations of the Unit 2 Turbine Building (TB) exterior) during a routine walkdown related to groundwater well 'BY'. Investigate various TB penetrations as sources for the contamination.

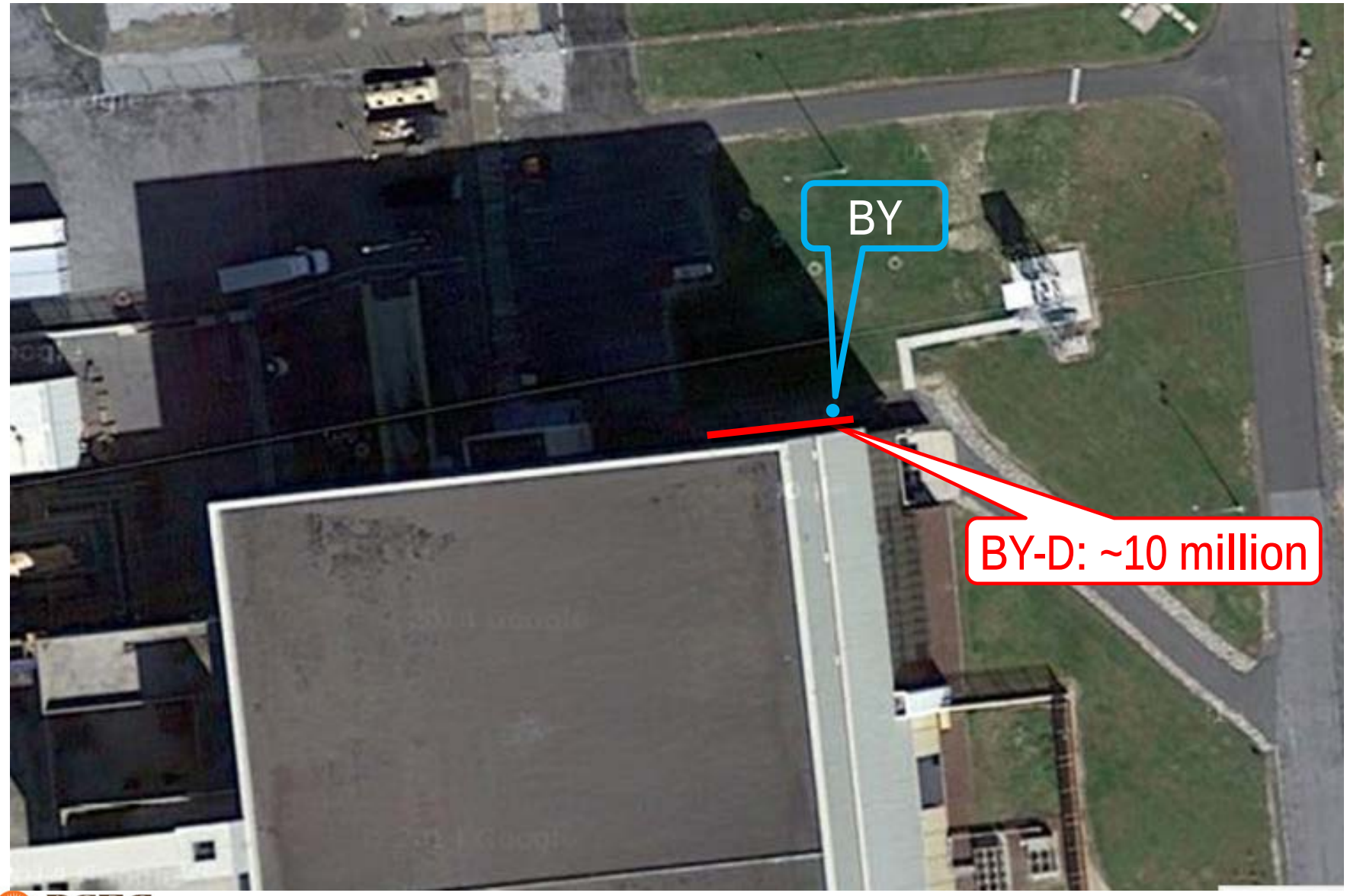
Event Data:

- No gamma emitters identified
- Extremely cold January and February

Initial Actions Taken:

- Installation of catch containments
- Sampling of external and internal potential sources
- Dose impact assessment - Minimal dose impact
- Turbine Building roof penetrations evaluated
- Visual inspections of turbine building roof and wall system

Hope Creek Elevated Tritium Issue



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Source of Tritium: Initial Thoughts

Steam Leak?

- Tritium Activity detected ~10 million pCi/L
- Condensate Demineralizer Effluent (CDE) Tritium Activity was about 25 million pCi/L

However:

- No Identified Steam Leaks
- No Infrastructure to carry Tritium
- No gamma emitters identified
- Turbine Bldg. Roof Leaking during Rain Event
  - Activity was ~ 12 million pCi/L
- Tritium Identified in Roof Material (Perlite Insulation)

Source of Tritium: Initial Thoughts

Source of Tritium coming from the Turbine Building Roof

But Where?

- Recapture from SPV
- Unmonitored Gaseous Vents

History of Tritium Recapture at Site

- Air Conditioner Condensate
- Low Volume Oily Waste 2014

Hope Creek Elevated Tritium Issue

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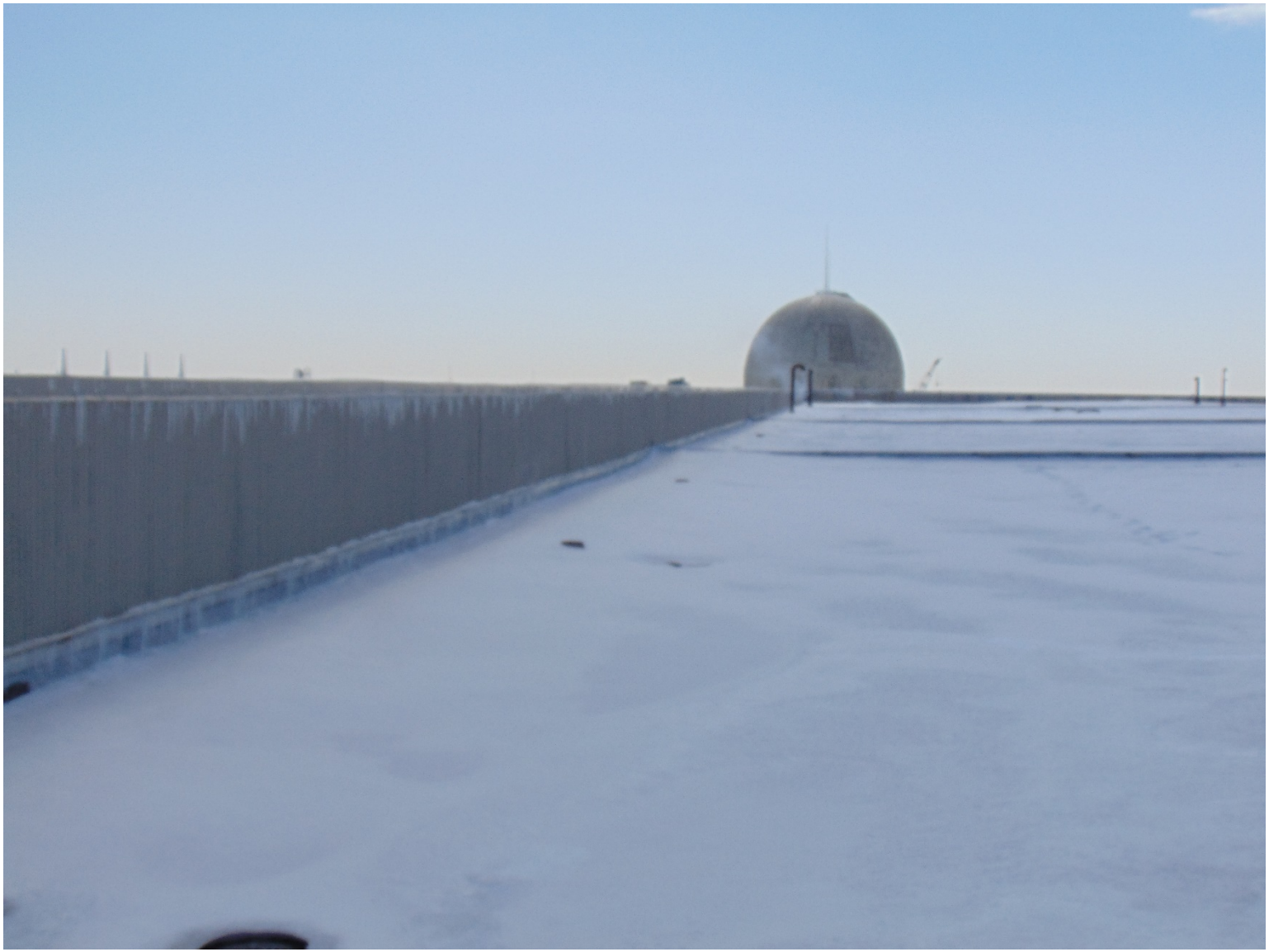

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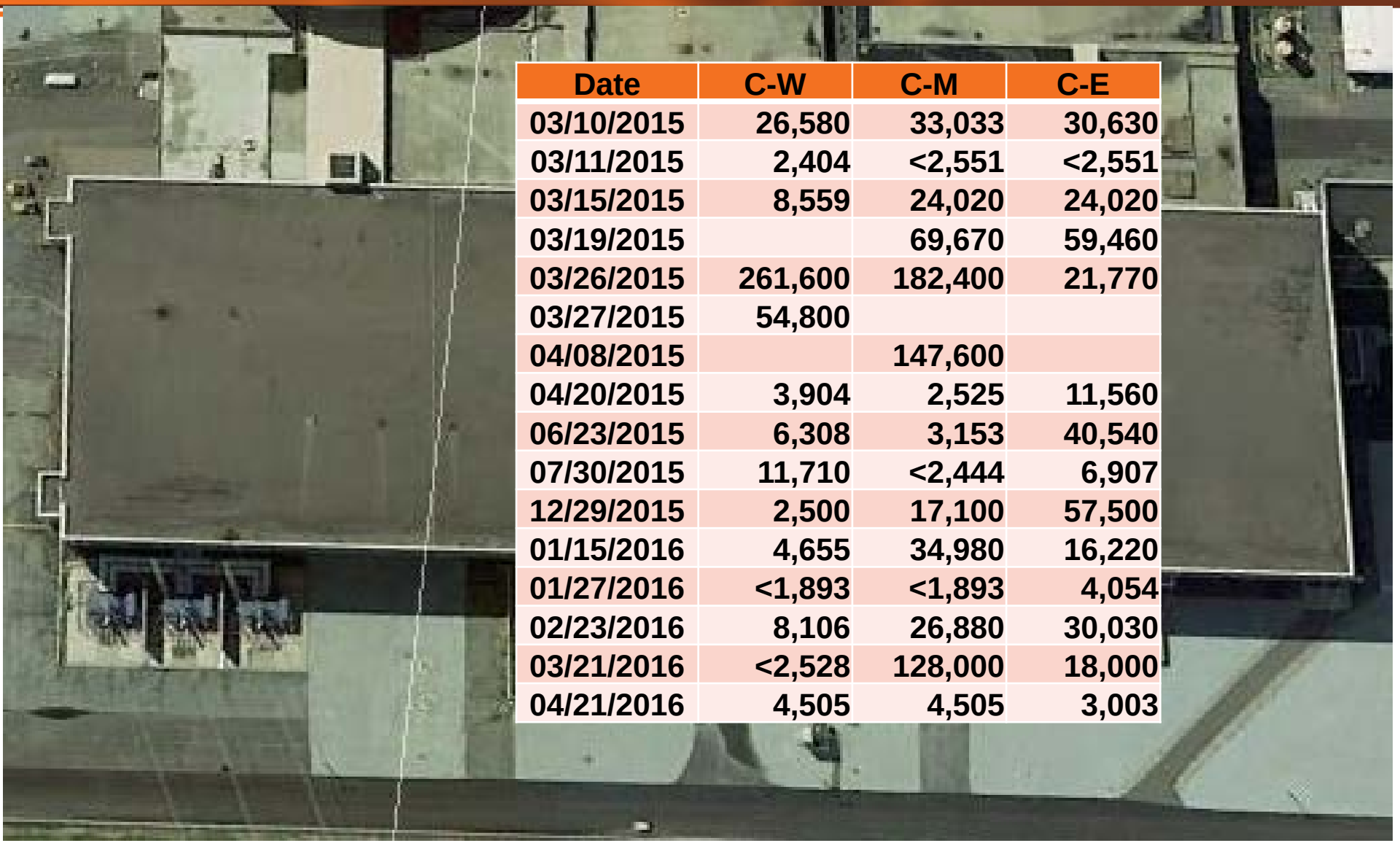
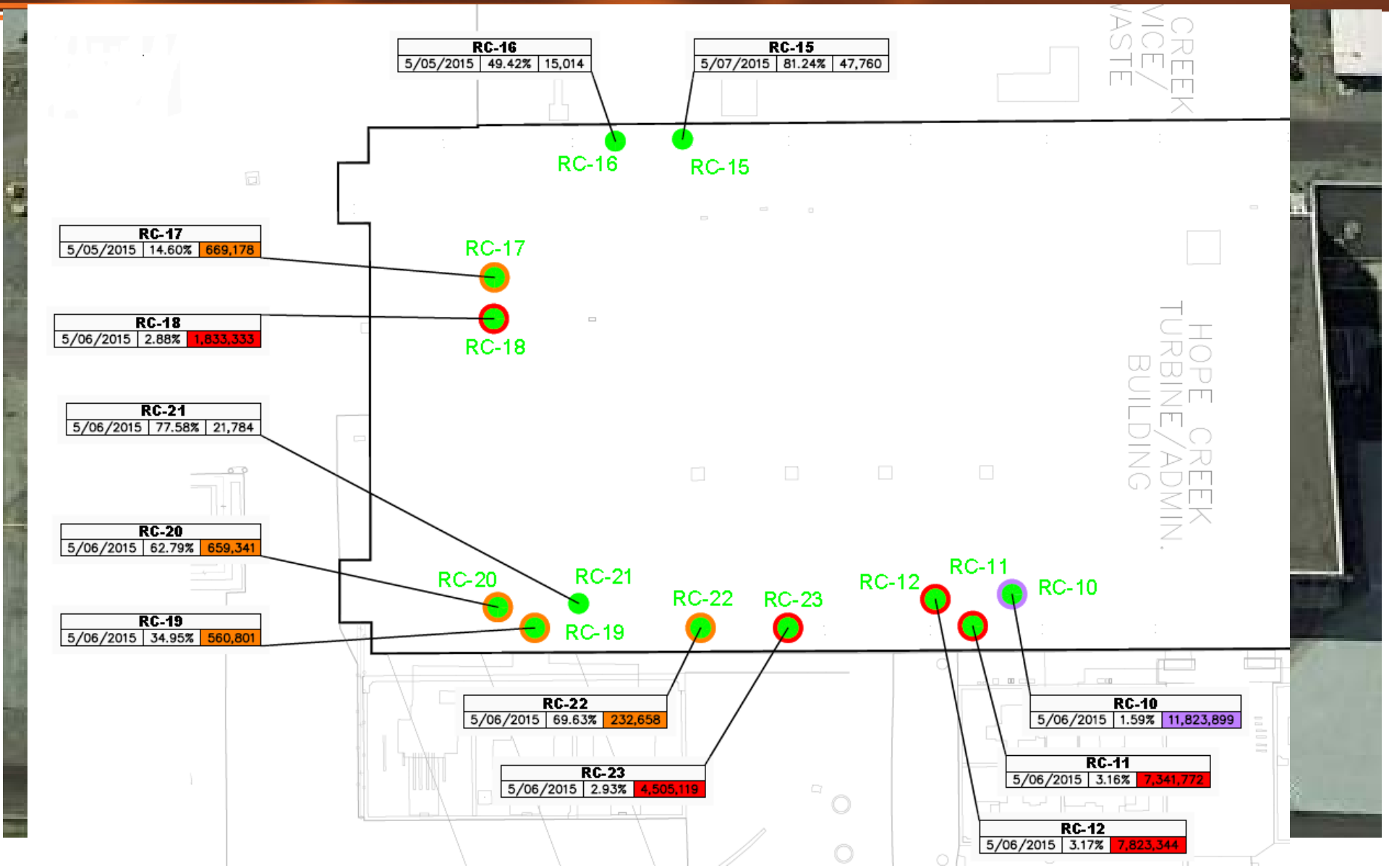
Hope Creek North Wall Containment Tritium Results



Date	C-W	C-M	C-E
03/10/2015	26,580	33,033	30,630
03/11/2015	2,404	<2,551	<2,551
03/15/2015	8,559	24,020	24,020
03/19/2015		69,670	59,460
03/26/2015	261,600	182,400	21,770
03/27/2015	54,800		
04/08/2015		147,600	
04/20/2015	3,904	2,525	11,560
06/23/2015	6,308	3,153	40,540
07/30/2015	11,710	<2,444	6,907
12/29/2015	2,500	17,100	57,500
01/15/2016	4,655	34,980	16,220
01/27/2016	<1,893	<1,893	4,054
02/23/2016	8,106	26,880	30,030
03/21/2016	<2,528	128,000	18,000
04/21/2016	4,505	4,505	3,003

Hope Creek Roof Core Samples - Tritium Results



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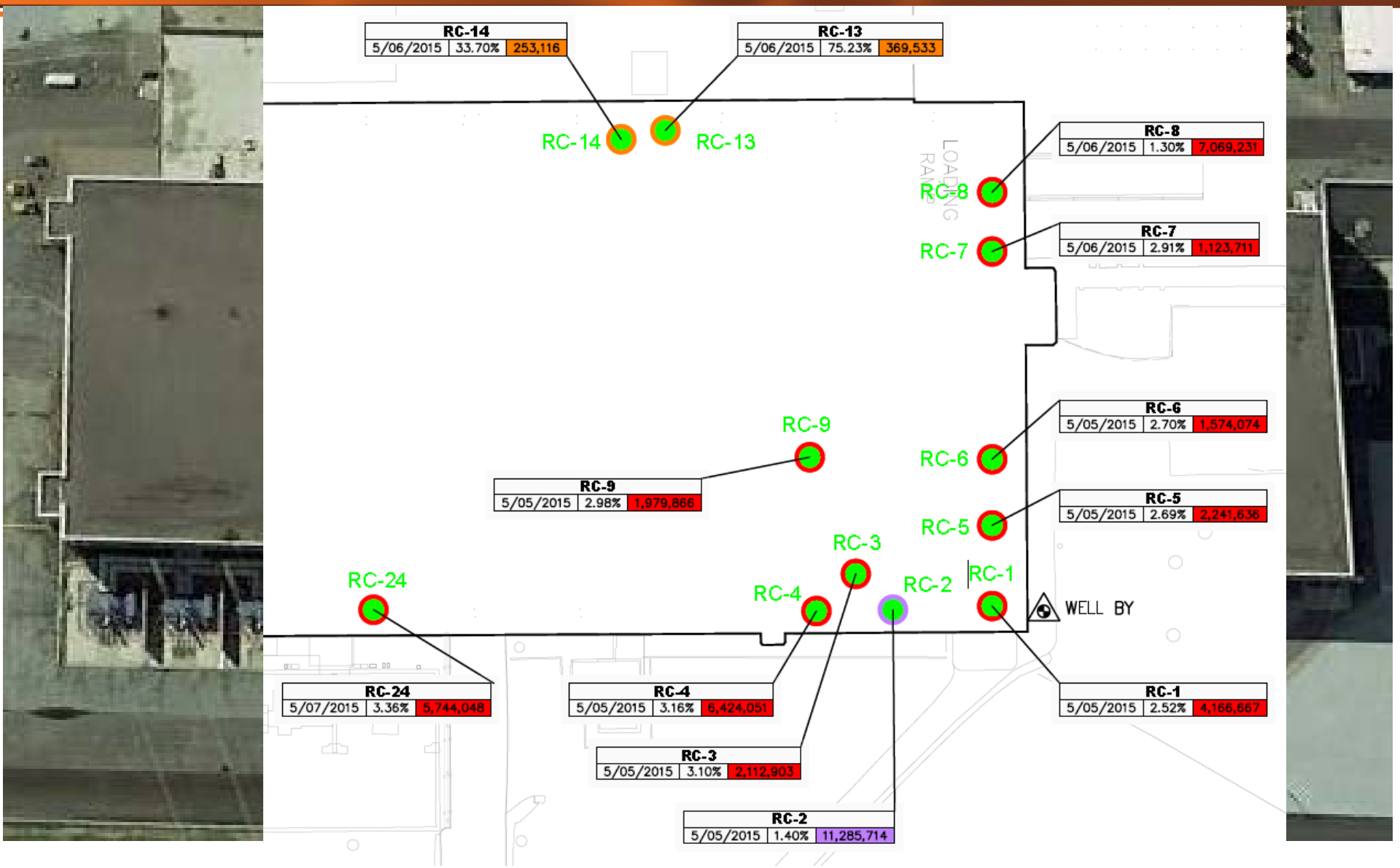
Hope Creek Roof Core Samples - Tritium Results



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Hope Creek Elevated Tritium Issue

Regulatory Issues:

1. Determining the occupational and public dose consequences for the identified tritium concentrations
2. Assessment of discharges to surface water or groundwater
3. Evaluation of potential unmonitored release path(s) from the Turbine Building that have contributed to the identified tritium concentrations

Assessments of Unmonitored Gaseous Release Paths

USNRC Reg. Guide 1.21, Rev 2 Defines “Significant Release Point” as any location, from which radioactive material is released, that contributes greater than 1 percent of the activity discharged from all the release points for a particular type of effluent considered.

Team Approach was to evaluate several unmonitored systems for potential radioactive releases against this criteria.

Unmonitored Gaseous Release Paths

16 Turbine Bldg. Vent Penetrations Identified

3 Systems Identified as Potential Significant Sources of Tritium :

1. Reactor Feedwater Pump Turbine (RFPT) Lube Oil Vent (3 vent lines)
2. Generator Hydrogen Seal Oil Vent
   - 3” line
   - 10” line
3. Main Turbine Lube Oil (MTLO) Vapor Extractor Vent

Gaseous Release Paths - Potential Tritium Sources

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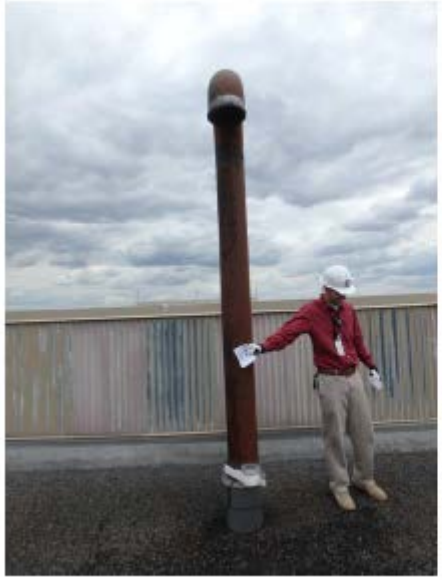
Gaseous Release Vents - Potential Tritium Sources

Clockwise from Top Left:

Reactor Feedwater Pump Turbine Lube Oil System

Generator Hydrogen Seal Oil System

Main Turbine Lube Oil System



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Issues with Monitoring Potential Gaseous Release Paths

Sampling and Interpretation of Vent Releases

1. What to use to take a representative sample?
   - Bubbler, Cold finger, Silica Gel
2. Where to take the sample?
3. Flow Measurement?
4. Is it only a Cold Weather Phenomenon?
5. What is the Impact from SPV?
   - 7 Ci per week
6. Tritium content in a volume of air vs. tritium content in the water in the air

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Assessments of Unmonitored Gaseous Release Paths

- Assessment of the Three Systems for Releases of Tritium to the Environment was a Theoretical Assessment.
- Assumptions used for Analysis:
  1. RCS water - tritium concentration 0.035 uCi/ml
  2. 2014 SPV tritium released 362 Ci
  3. Percent of RCS water in Gland Seal Steam Condensate 46.9%
  4. 100% Humidity at 120F

Assessments of Unmonitored Gaseous Release Paths

- Assumptions used for Analysis:

5. Tritium in Turbine Building Condensate 2,000 pCi/L (MDA)
6. Maximum Calculated Condensate Flow Rate
   - 3 inch RFPT Vent Line 0.089 gpm (1.76E+08 ml/yr)
   - 3 inch GHSO Vent Line 0.012 gpm (2.35E+07 ml/yr)
   - 10 inch GHSO Vent Line 0.104 gpm (2.06E+08 ml/yr)
   - 8 inch MTLO Vent Line 0.031 gmp (6.16E+07 ml/yr)

Assessments of Unmonitored Gaseous Release Paths

Vent	Maximum Condensate Flow Rate, ml/year	Gland Seal Steam Condensate Water Percentage	Tritium Concentration of Gland Seal Steam Condensate, uCi/ml	Annual Release of Tritium, uCi/year	Annual Release of Tritium, Ci/year
3 inch RFPT Vent Line	1.76E+08	46.9%	0.035	2.89E+06	2.89
3 inch GHSO Vent Line	2.35E+07			3.86E+05	0.39
10 inch GHSO Vent Line	2.06E+08			3.38E+06	3.38
8 inch MTLO vent Line	6.16E+07			1.01E+06	1.01

Assessments of Unmonitored Gaseous Release Paths

Vent	Annual Release of Tritium, uCi/year	Annual Release of Tritium, Ci/year	Total Annual Release of tritium, Ci	Percentage of Activity relative to total release at SPV
3 inch RFPT Vent Line	2.89E+06	2.89	369.7	0.78%
3 inch GHSO Vent Line	3.86E+05	0.39		0.10%
10 inch GHSO Vent Line	3.38E+06	3.38		0.92%
8 inch MTLO vent Line	1.01E+06	1.01		0.27%
Total	7.67E+06	7.67		2.08%

Assessments of Unmonitored Gaseous Release Paths

Also Calculated Potential Noble Gas

- 1% of One Main Steam Line Loss = 80 gpm water loss
- Noble Gas Activities from UFSAR Table 11.2-3
- Source term from ANSI N237 used for Setpoints
- 10% Loss as the oil/water mixture degases
- 4.4:1 Reduction in Gas Concentration

Noble Gas Releases about 0.8% Total

Particulates and Iodines about 0.01%

- Particulates and Iodines are in the water exiting the vents

Summary

1. Source of Tritium in Icicle
   - No Steam Leaks
   - Roof of Turbine Building
2. Tritium Identified from Ice, Snow and Water Samples on Roof and Ground
   - Tritium continuously identified in catch containments suggesting recapture
   - Not Just a Cold Weather Phenomenon
3. Unmonitored Release Points Do Not Require Monitoring
   - < 1% of Total HC Gaseous Releases of Tritium

Summary

4. Source of Tritium to the Roof
   - Multiple Turbine Building Release Points 7.7 Ci Calculated
   - SPV – 362 Ci Released in 2014
   - Ground Level Release Plant
   - History of Tritium Recapture at the Site

Questions??

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