INL/CON-23-74549-Revision-0

INL Alpha Background Radiation Study

January 2024

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Changing the World's Energy Future

Idaho National Laboratory

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U.S. Department of Energy's Office of Nuclear Energy

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The Problem – How Contaminated is the World Already?

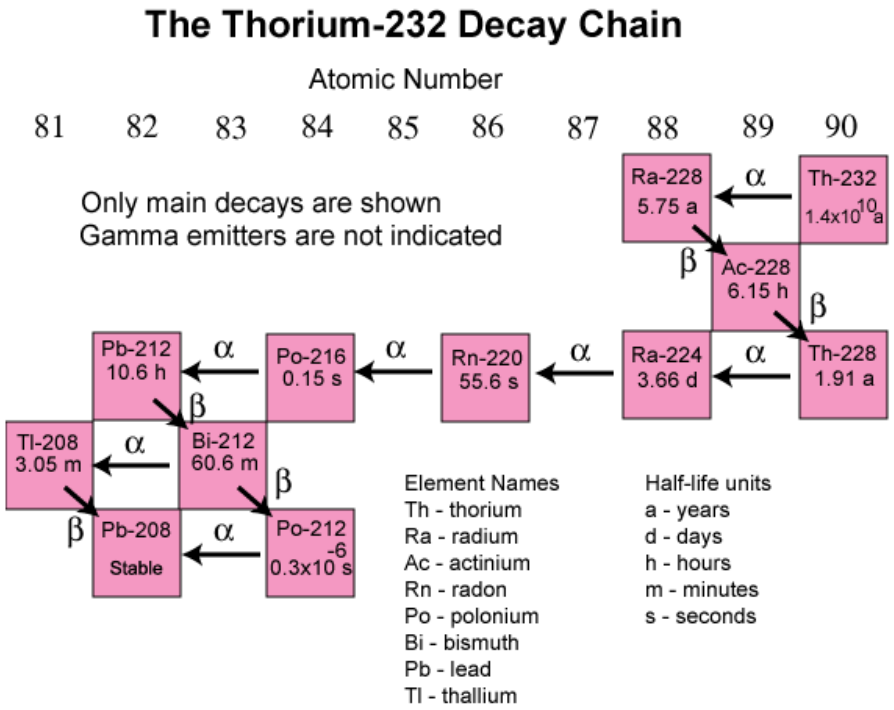
- During radiological emergencies, field monitoring teams are dispatched to determine the extent of any radioactive material release.
- A common measurement taken is a direct reading of the ground surface using count rate instruments to determine the amount of material that may have been deposited from the incident.
- Measurements may be taken for beta-gamma radiation and/or alpha radiation.
- To quantify the activity of material deposited on the ground, the nominal background emission rate must be subtracted from the measurement and then a correction for the detector efficiency can be applied.

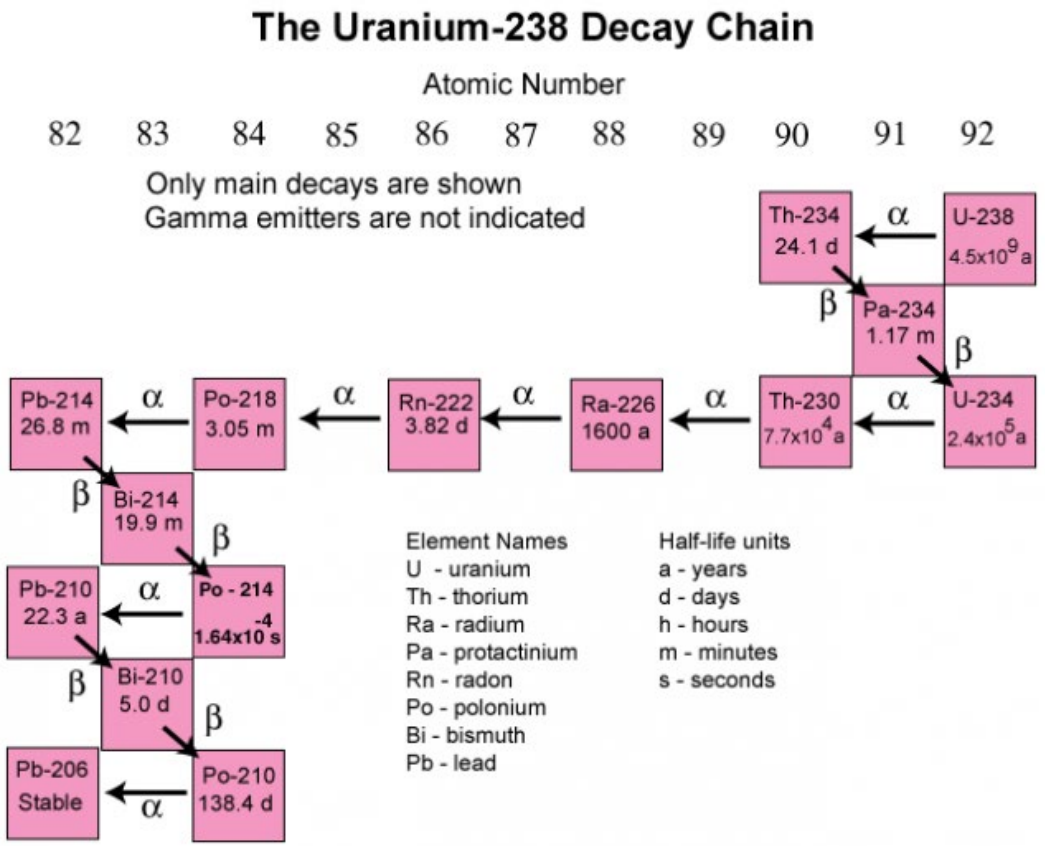
Fukushima Daichi - 2011

Nuclear Facility Experience – Alpha Background

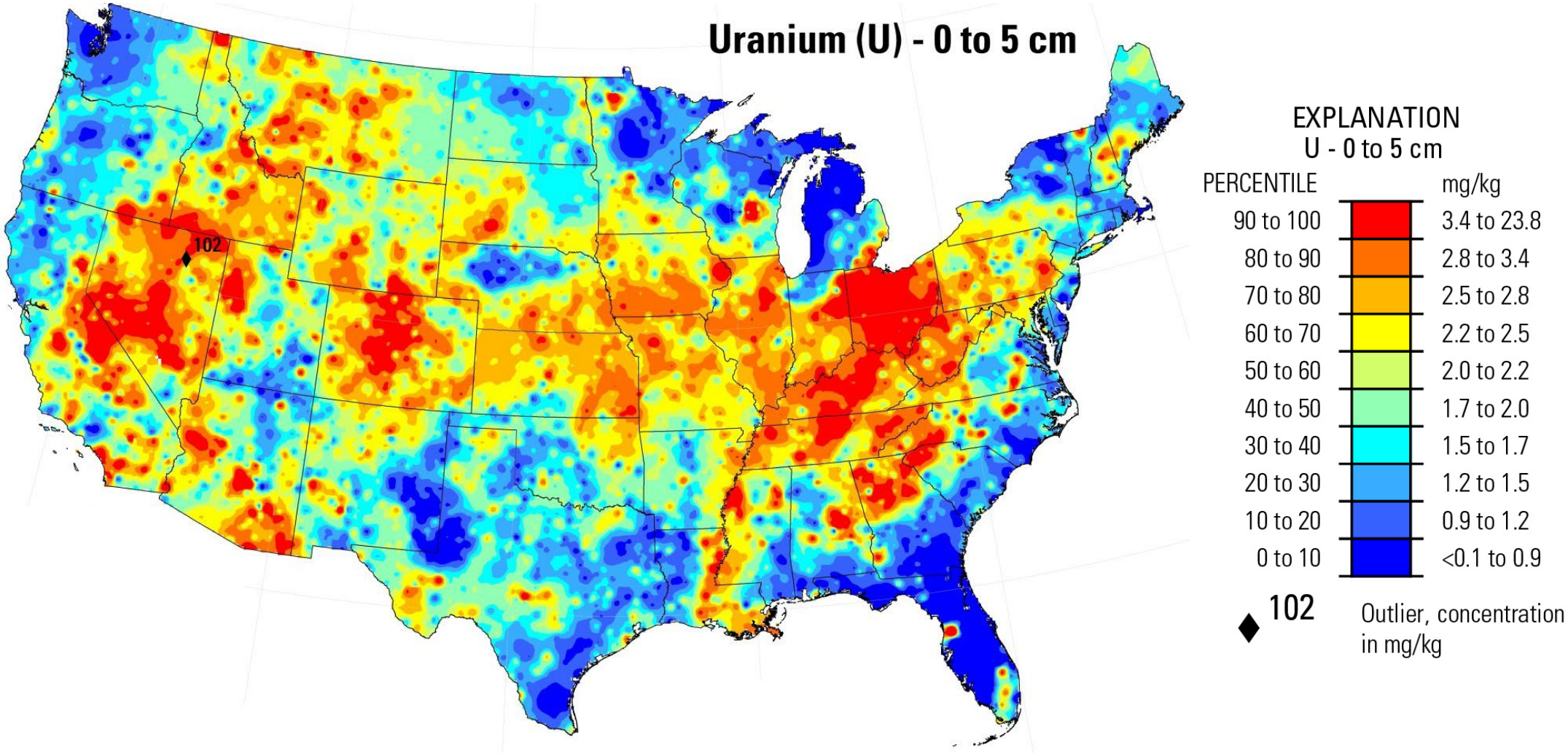
- Many radiological protection professionals have experience with the background radiation levels found in nuclear, radiological and medical facilities.
- Surfaces of materials that contain naturally occurring radioactive materials (NORM) like concrete, cinder block, brick and stone are sealed or painted to aid in cleaning or decontamination.
- This results in industrial surfaces in facilities that get routinely monitored for alpha radiation to exhibit very low backgrounds of zero to a couple counts per minute.
- Surfaces with higher alpha background rates are problematic to radiation protection programs as it is difficult to differentiate low levels of NORM from low levels of radionuclides of concern in a facility.
- Many facilities take positive actions to reduce or eliminate any NORM background on surfaces or in the air (radon and thoron interference).

Thorium and Uranium are Alpha Emitting NORM





Uranium in the Top 5 cm of Soil in United States



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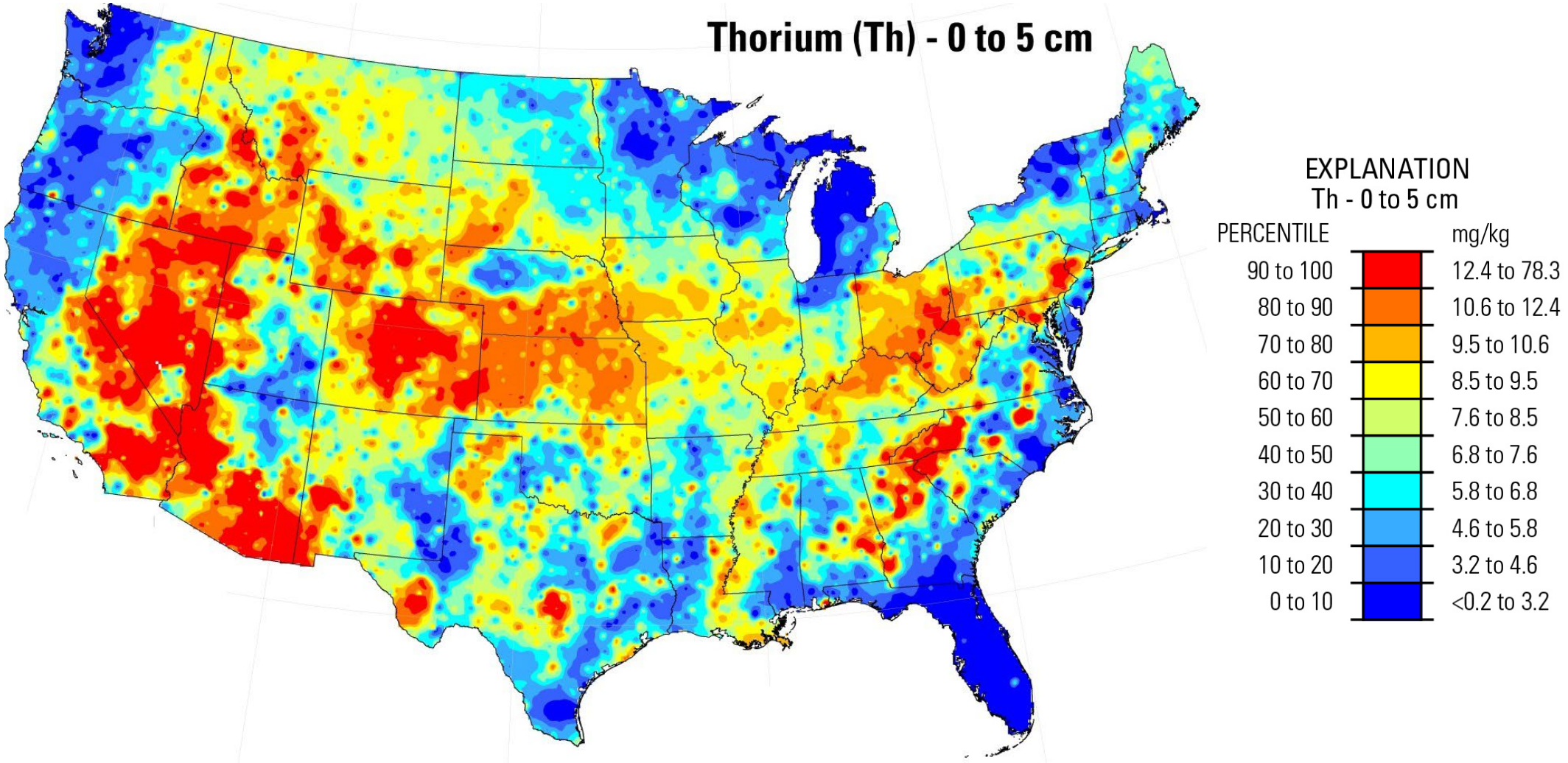


Field Monitoring Team Instruments (INL and DOE-RAP)

Ludlum Model 2224 and Model 3002 with Model 43-93 - 100 cm^2 Alpha-Beta Scintillation Probes

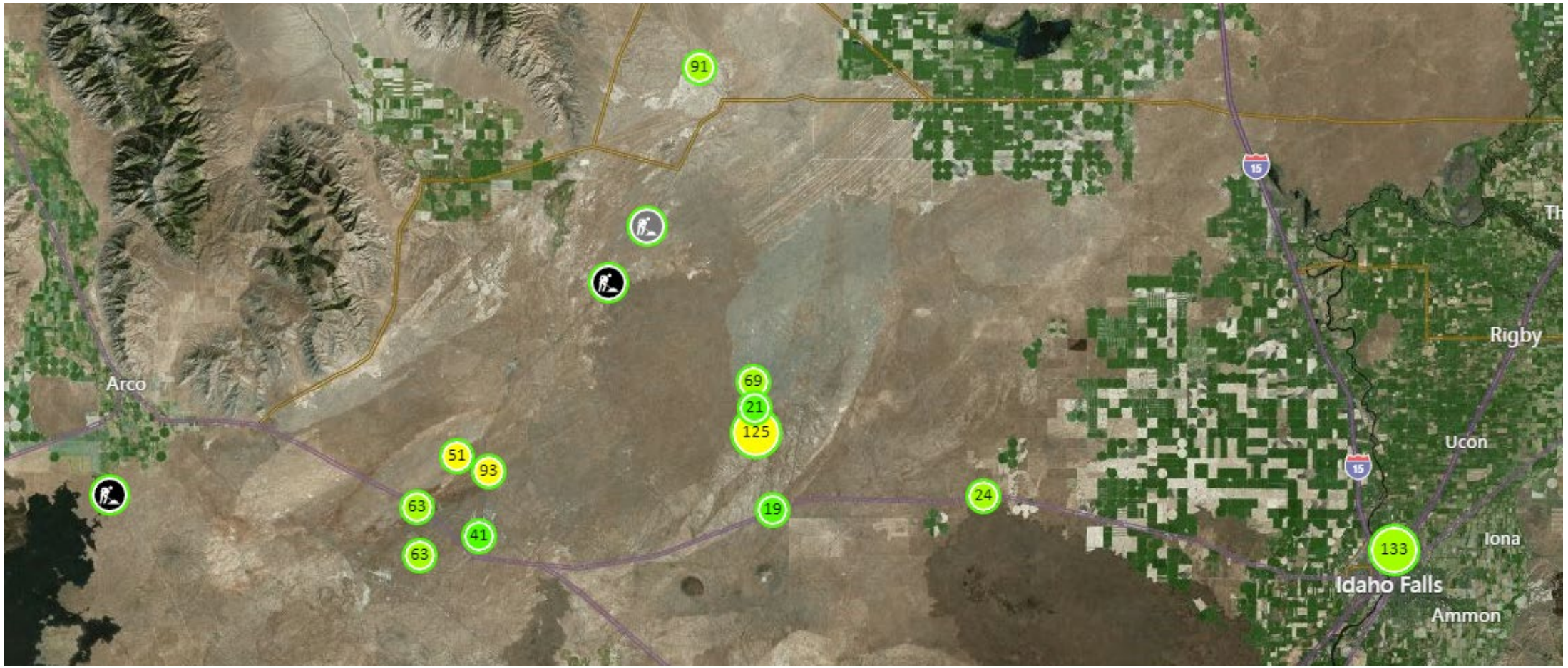
Environmental Surfaces Surveyed

Soil

Concrete

Asphalt

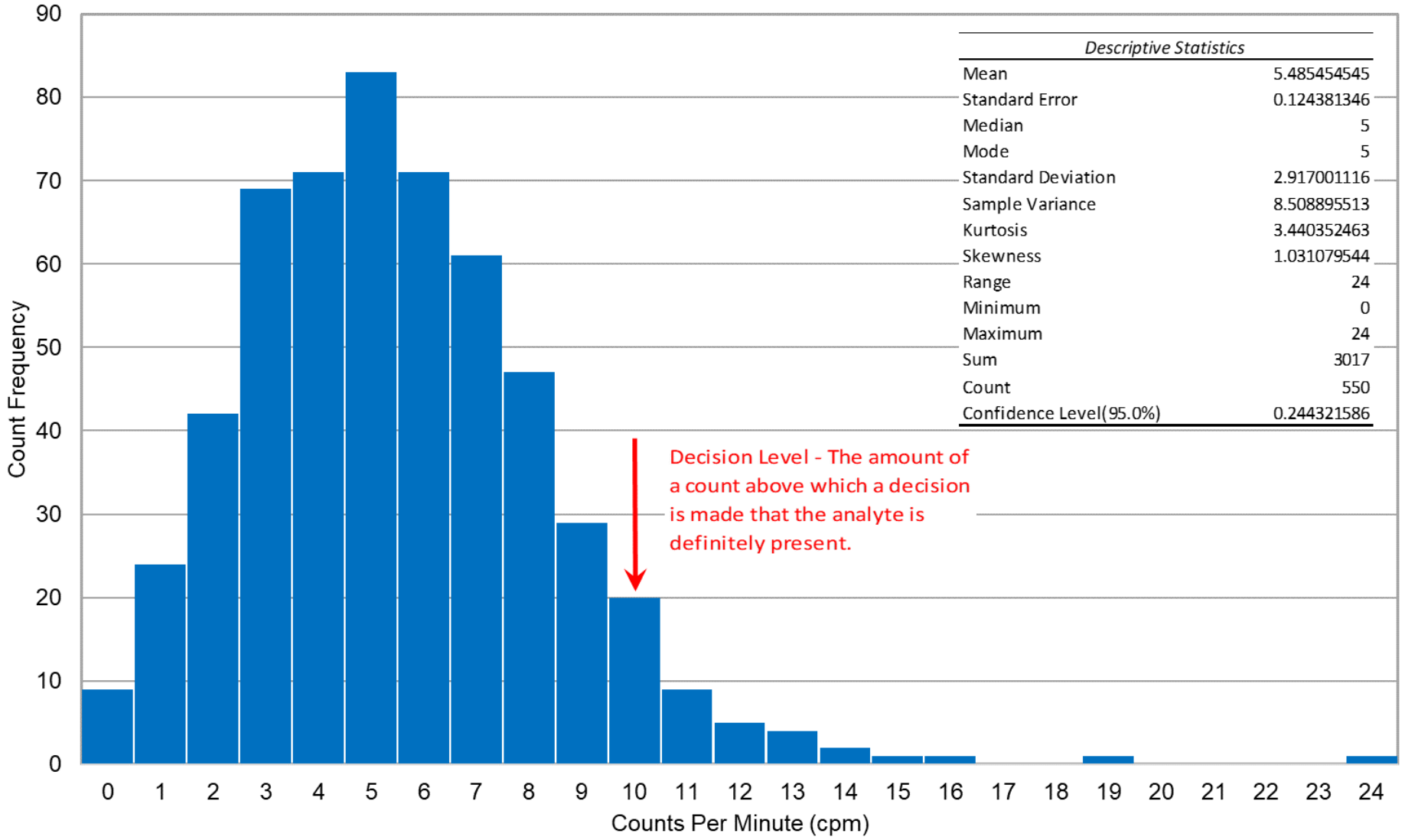
Sampling Locations



Obtained 784 total background counts – 550 were normal dry counts and 234 were rain enhanced

Alpha Background Radiation Study Histogram

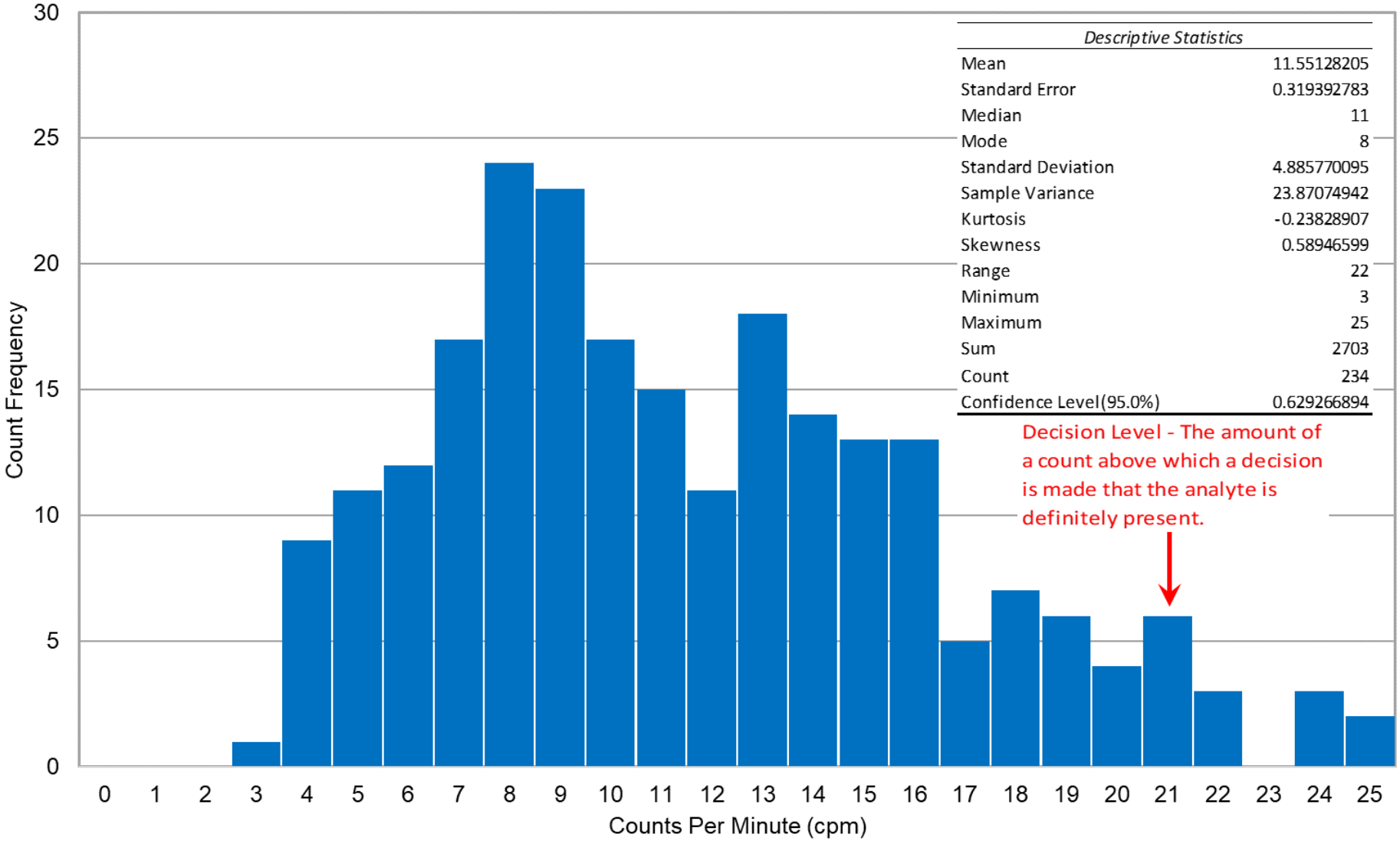
All Surfaces Data - Dry



Descriptive Statistics	
Mean	5.485454545
Standard Error	0.124381346
Median	5
Mode	5
Standard Deviation	2.917001116
Sample Variance	8.508895513
Kurtosis	3.440352463
Skewness	1.031079544
Range	24
Minimum	0
Maximum	24
Sum	3017
Count	550
Confidence Level(95.0%)	0.244321586

Alpha Background Radiation Study Histogram

All Surfaces Data - Rain Enhanced



Summary

- Environmental surfaces at the INL emit alpha particles at an average rate of 5 counts per minute (cpm).
- A decision level has been established at 10 cpm. 95% of the normal alpha background is less than 10 cpm. Reading of 10 cpm or higher are considered positive results.
- Rain and snow can have major impacts to the alpha background rate from environmental surfaces. It is expected that the exact impact is dependent on the environmental conditions, radon/thoron atmospheric levels, and the amounts of precipitation. Therefore, a decision level for surfaces that are wet or have been rained on in the last 24 hours has not been determined.

Questions?

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