# Working Group on Position-Sensitive Gamma-Ray Imaging Spectrometers in the Nuclear Power Industry

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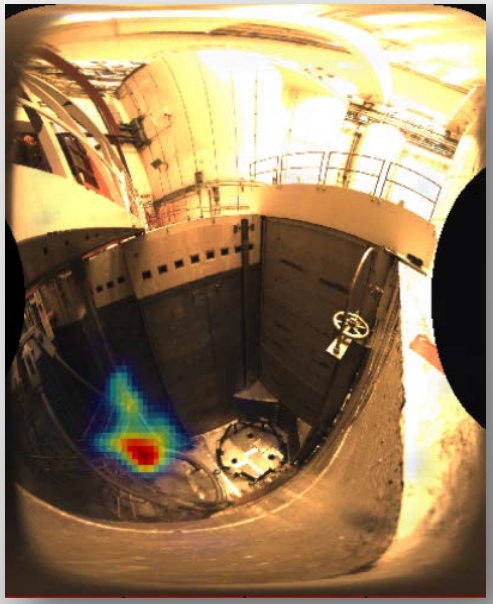
# Contents

I. Motivation for an inclusive working group
   i. Interface between industry representatives across utilities
   ii. Interface between technical experts and industry representatives
II. Group structure
III. Impact of image and data sharing
IV. Value of qualitative comparisons of gamma-ray images

# I. Motivation for an inclusive working group

A. Minimizing the initiation phase

DC Cook (Bridgman, MI, United States) was the initial user and beta tester of the early Polaris-H imaging spectrometer design dating back to 2012:



# I. Motivation for an inclusive working group

A. Minimizing the initiation phase

- Cook's initiation phase:
  - Health physicists required an initial period to gain an intuition of how the imaging spectrometer operated – the length of measurements required for sufficient image resolution, effects of temperature and count saturation, etc.
  - The increase of understanding and usage of the system necessitated advanced procedures for contamination and performance monitoring of the Polaris-H system.

# I. Motivation for an inclusive working group

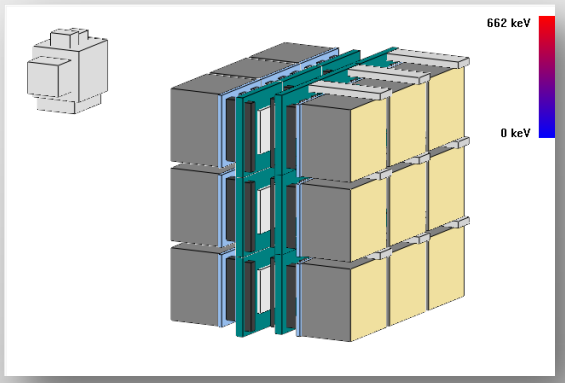
A. Minimizing the initiation phase

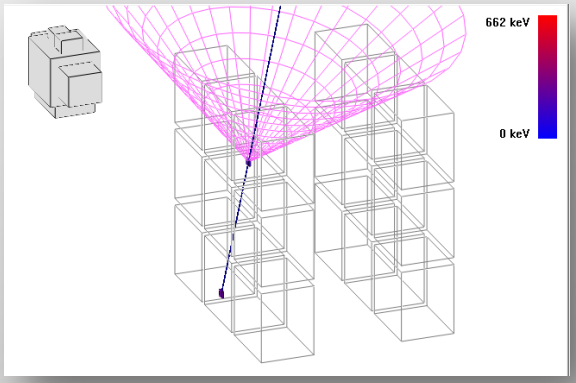
- As more plants started to engage this technology, each plant entered its own 'initiation phase' rather than accessing the operational experiences of health physicists accustomed to the technology.
- North American Technical Center's objective:
  - Minimize the initiation phase for plants with limited exposure to position-sensitive imaging spectrometers

# I. Motivation for an inclusive working group

B. Provide health physicists in the industry with support from technical experts

- While DC Cook and others have passed the 'initiation phase,' there is still an incomplete understanding among health physicists of the underlying physics and systems that make position-sensitivity and imaging possible

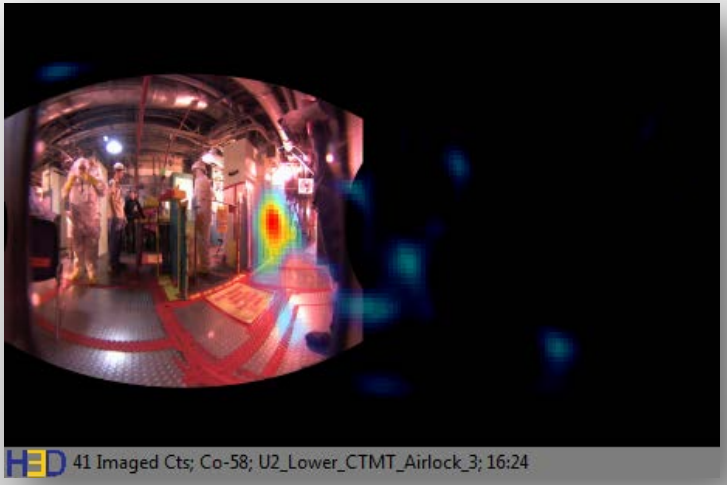


# I. Motivation for an inclusive working group

B. Provide health physicists in the industry with support from technical experts

- Technical experts are required to communicate these low-level system responses to health physicists. For example:
  - $^{10}B$ and $^{113}Cd$ activation gamma-ray contamination in energy spectra measured around thermal neutron fields
  - Improper event sequence reconstruction



# II. Group structure and provisions

- To ensure that these objectives are met without interference from conflicting interests, guidelines were established:

1. Images and data as measured by imaging devices are property of the nuclear power plant utility. These may be released to the open forum of health physicists given that the plant Radiation Protection Manager has authorized the data exchange.
   - Data and images have limited distribution to the group for the ultimate purpose of reducing radiation exposure and developing As Low As Reasonably Achievable culture

# II. Group structure and provisions

2. While H3D – developer and distributor of the Polaris-H systems – is represented to provide technical and analytical support, the forum is not to be used to promote new products and business opportunities, including products from other vendors. Product discussion and evaluation are to be conducted openly.

- Attempts to promote business interests undermine the focus of the group – to engage in imaging technology for dose reduction strategies.

# II. Group structure and provisions

3. Performance issues with instrumentation are to be discussed with the suppliers before disclosing information within the group.

- The technical performance of instrumentation is a matter that should be resolved between the supplier and the end-user, and these discussions tend to fall outside the scope of practical use in the nuclear power industry.

# III. Impact of image and data sharing

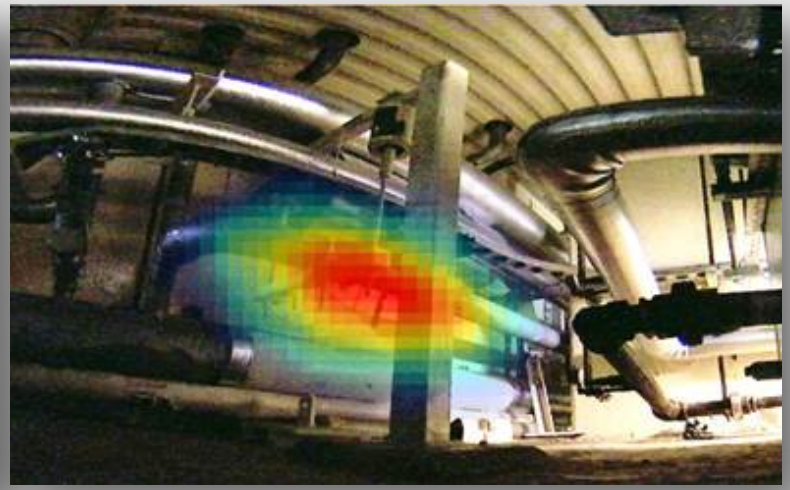
- Success criteria:

1. New users are equipped to make informed decisions based on the information provided by imaging spectrometers
2. Experienced users are using the imaging technology within its limitations to advance occupational health physics applications and support plant activities

# III. Impact of image and data sharing

1. New users are equipped to make informed decisions based on the information provided by imaging spectrometers

- From Oconee Nuclear Station, Seneca, United States:
  - Polaris-H imaging helped health physicists at Oconee to locate a section of piping used for transporting resin that emitted 50 mSv/h. Based on this information, the line was drained, and the dose rate was reduced by a factor of 200 before radiation workers fulfilled their work order



# III. Impact of image and data sharing

2. Experienced users are using the imaging technology within its limitations to advance occupational health physics applications and support plant activities

- From Bruce Nuclear Generating Station, Ontario, Canada:

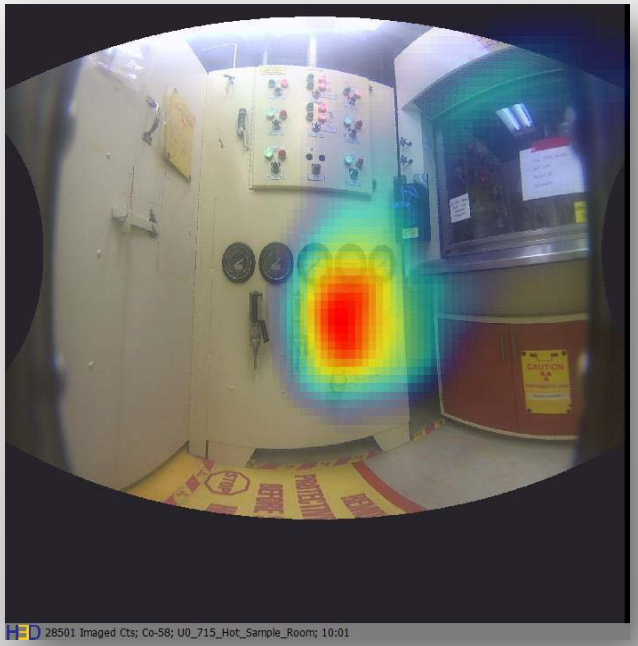
  - A shipment of $CO_2$ pressure tubes for the CANDU reactor erroneously contained inert argon gas. Bruce health physicists competently used the neutron-irradiated pressure tubes to locate and identify activated $^{41}Ar$ in place of the required $CO_2$.

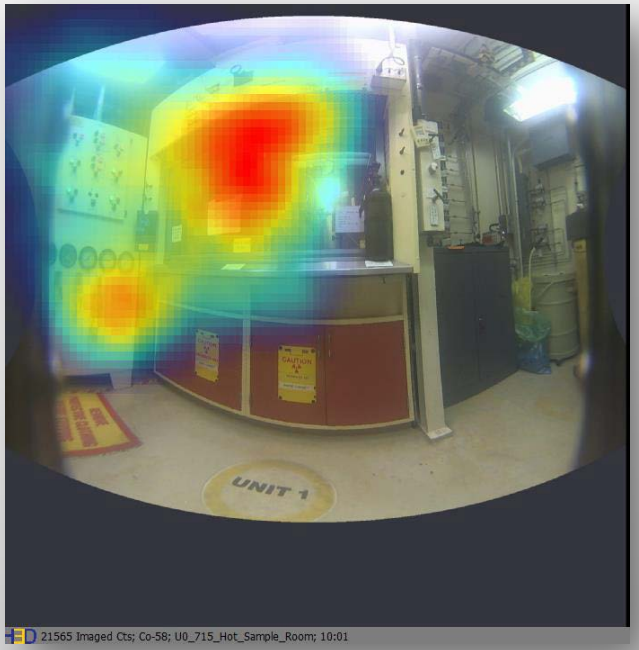
# IV. Value of qualitative comparisons of gamma-ray images

- Is the practice of sharing not only measurement data, but also images useful to health physicists at different plants with different designs?
  - There is no merit in comparing inherently different reactor designs based on gamma-ray images alone.
  - The value resides in components that are common to every plant, and ultimately in root cause analyses and finding aberrant behavior
  - Consider the following example from Prairie Island Nuclear Generating Plant

# IV. Value of qualitative comparisons of gamma-ray images

- During Prairie Island's Unit 1 outage in the fall of 2014, a chemical technician noticed elevated dose rates in the hot chemical sample room. The radiation protection department was notified, and they responded by investigating the area with their Polaris-H. Four components were imaged in an effort to determine the main contributor's the elevated dose rates.



# Questions?