ANALYSIS OF IMPACT OF THE PRIMARY HEAT TRANSPORT PURIFICATION SYSTEM ON OUTAGE RADIATION FIELDS

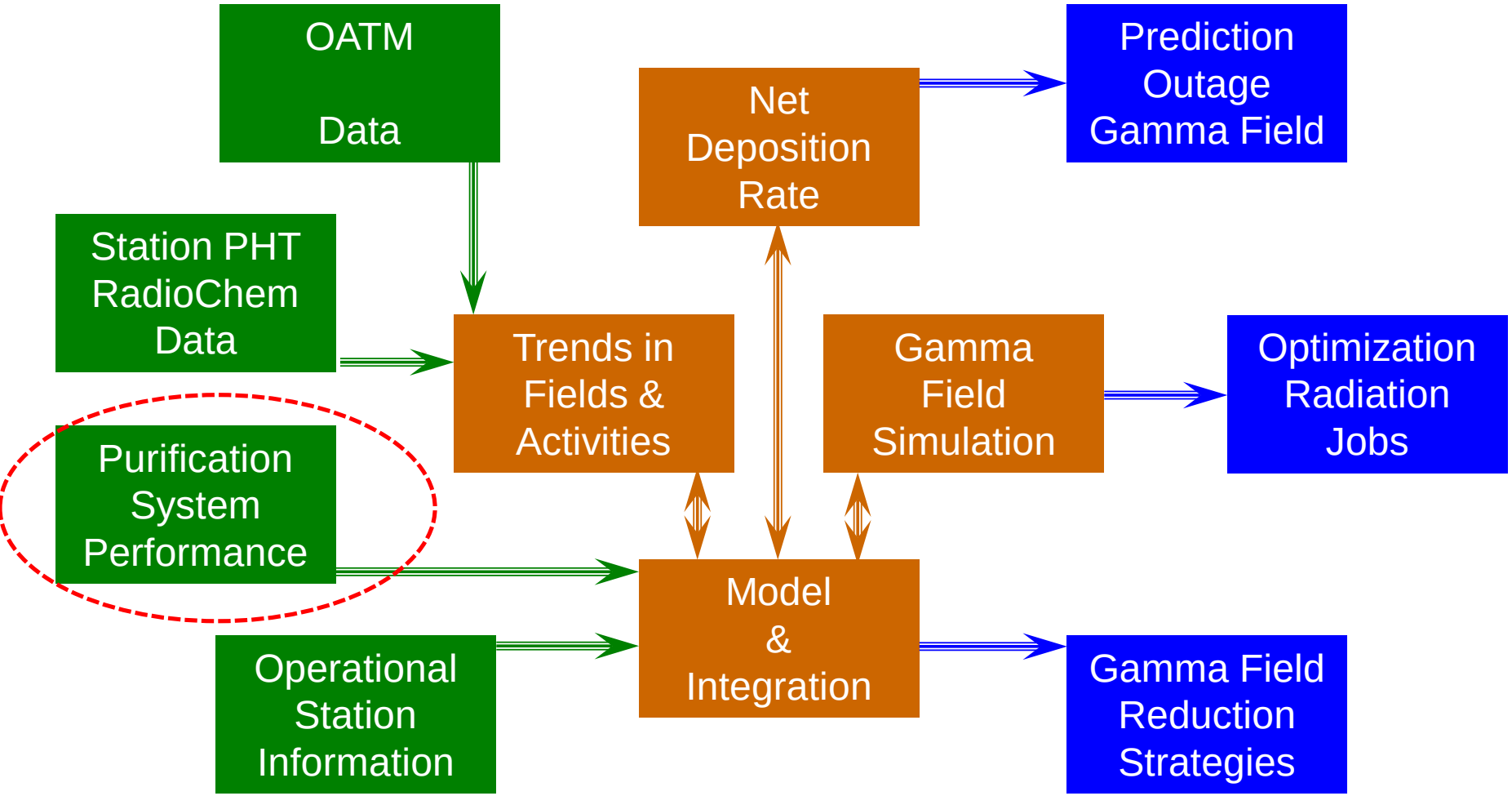
Y. Verzilov and Y. Kravtsova / KINECTRICS
A. Nedelcu, I. Popescu and V. Simionov / CNE Cernavoda

ISOE International Symposium on Occupational Exposure Management at Nuclear Facilities
Brussels • Belgium • June 1-3, 2016

Introduction

- Kinectrics Routinely Conducts the Source Term Monitoring at CANDU Fleet. Main Activities include:
  - **O**utage **A**ctivity **T**ransport **M**onitoring Surveys (OATM)
  - Data Integration and Interpretation
  - Radiation Field Trend and Impact Analysis
  - Outage Radiation Field Mapping & Predictions

Data Integration & Interpretation



PHT Purification System

- System is Designed to:
  - Minimize the Levels of Soluble and Insoluble Impurities
  - Remove Potential Corrosive and Deposit Forming Constituents (such as chlorides, silicates and carbonates)
  - Maintain the Required Heavy Water Chemistry
- System Consists of:
  - 2 Parallel Filters (FR) connected in Series with
  - 4/2 Parallel Ion Exchangers (IX)

Outage Radiation Field at CANDU Unit

Main Contributors:

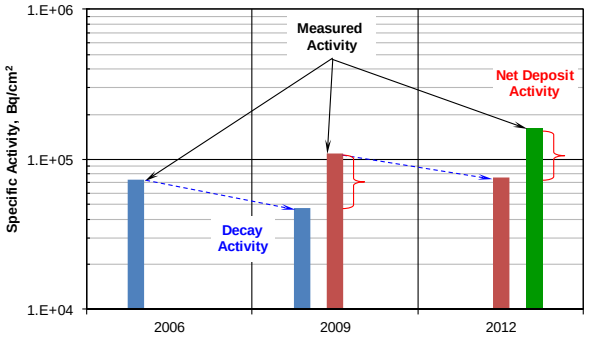
Co-60 (40-80%), Zr/Nb-95 (10-40%), Sb-124 (2-20%) and F.P. (1-10%)

Soluble & Insoluble Contaminants

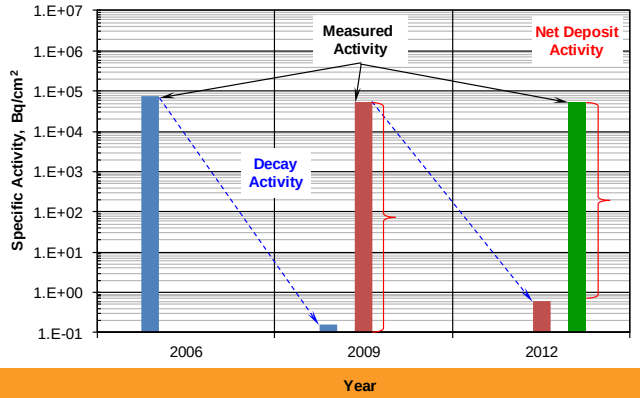
$$RF(r,t) = \sum_i \{f_i(r) \times w_i(t) \times A_i(r,t)\}$$

RF -	outage radiation field;
r -	distance from the gamma source;
t –	time of a particular outage;
i -	radionuclide index;
f_i -	activity to dose conversion factor;
w_i -	impact factor for *i* – radionuclide;
A_i -	activity of radionuclide;

Long-lived Radionuclide



Short-lived Radionuclide



Impact of the System on Radiation Field

Radiation Field

Design Data: S, cm^2

OATM Data
Surface Activity:
As, Bq/cm^2
Factor per Year:
k
Net Activity per Year:
$A = S \times As \times k$, Bq

Net Deposited Activity

Purification System

Design Data: V, cm^3

Spent IX Resin Scan
Volume Activity:
Av, Bq/cm^3
Total Activity per Year:
$A_{IX} = Av \times V$, Bq

Activity Removed by IX Resin

Design Data: S, cm^2

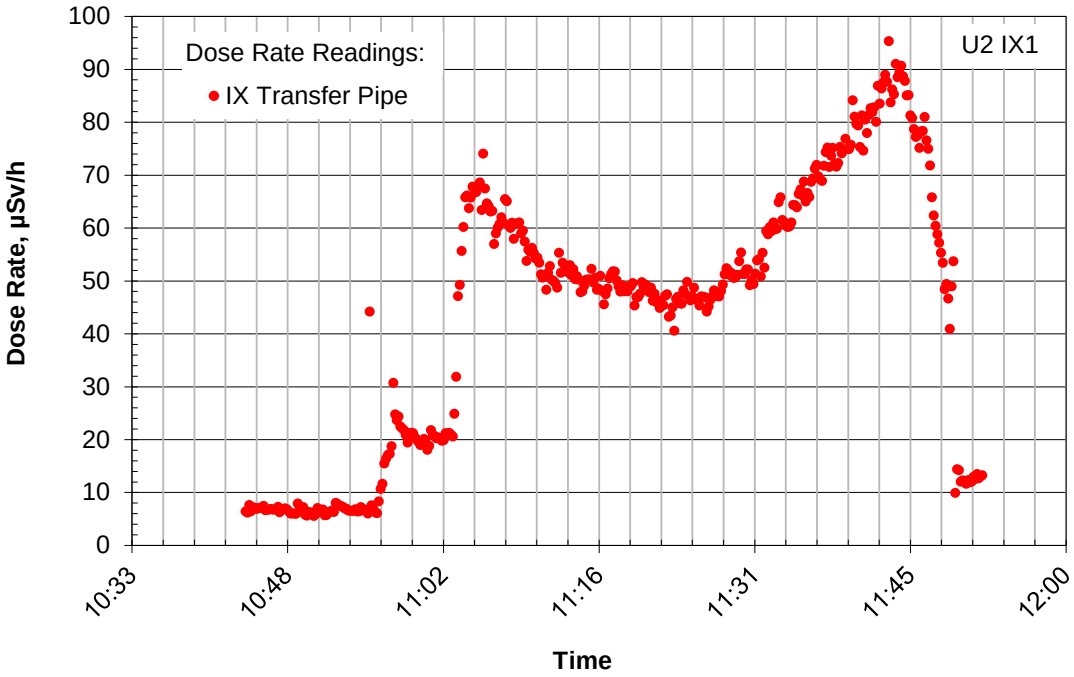
Spent FR Filter Scan
Surface Activity:
Av, Bq/cm^2
Total Activity per Year:
$A_{FR} = A_S \times S$, Bq

Activity Removed by Filter

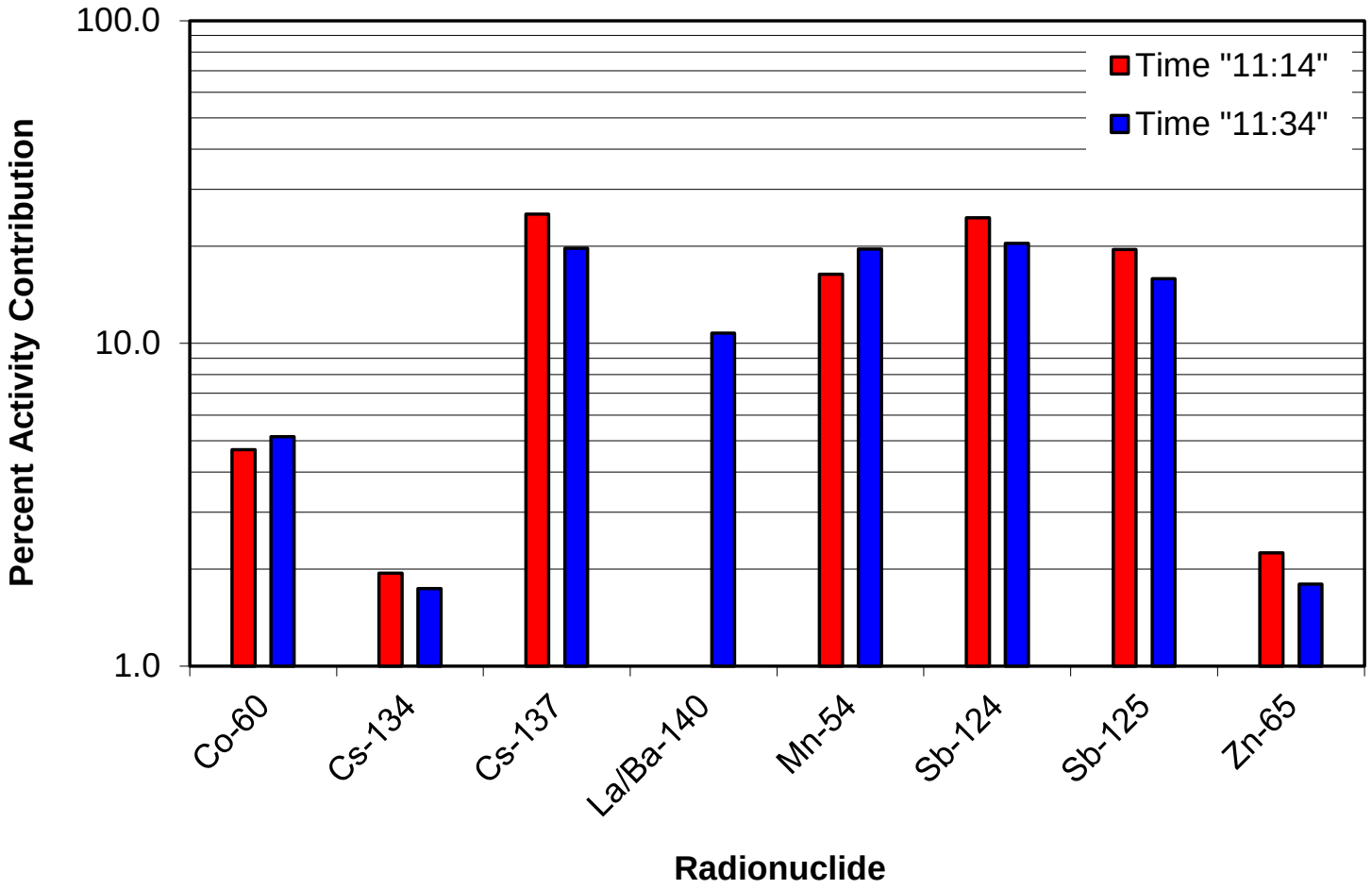
In-Situ Spectrometry of Spent IX Resin

Survey during Spent Resin Slurry from the System to the Waste Tank

I/S Duration – 21 months, V_{IX} =1000 L



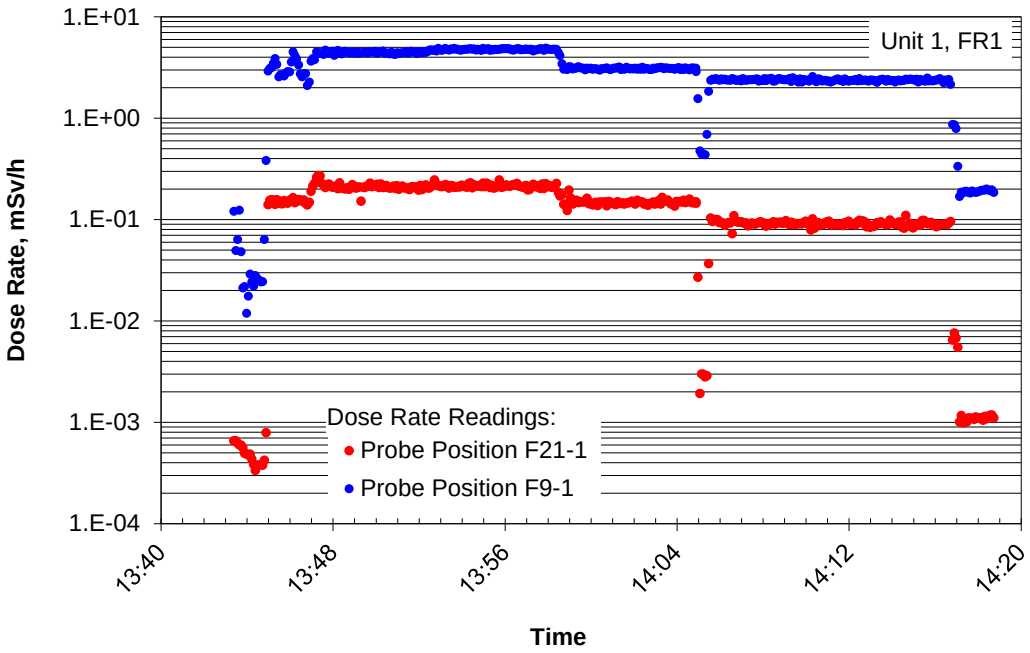
Radionuclides in Spent IX Resin



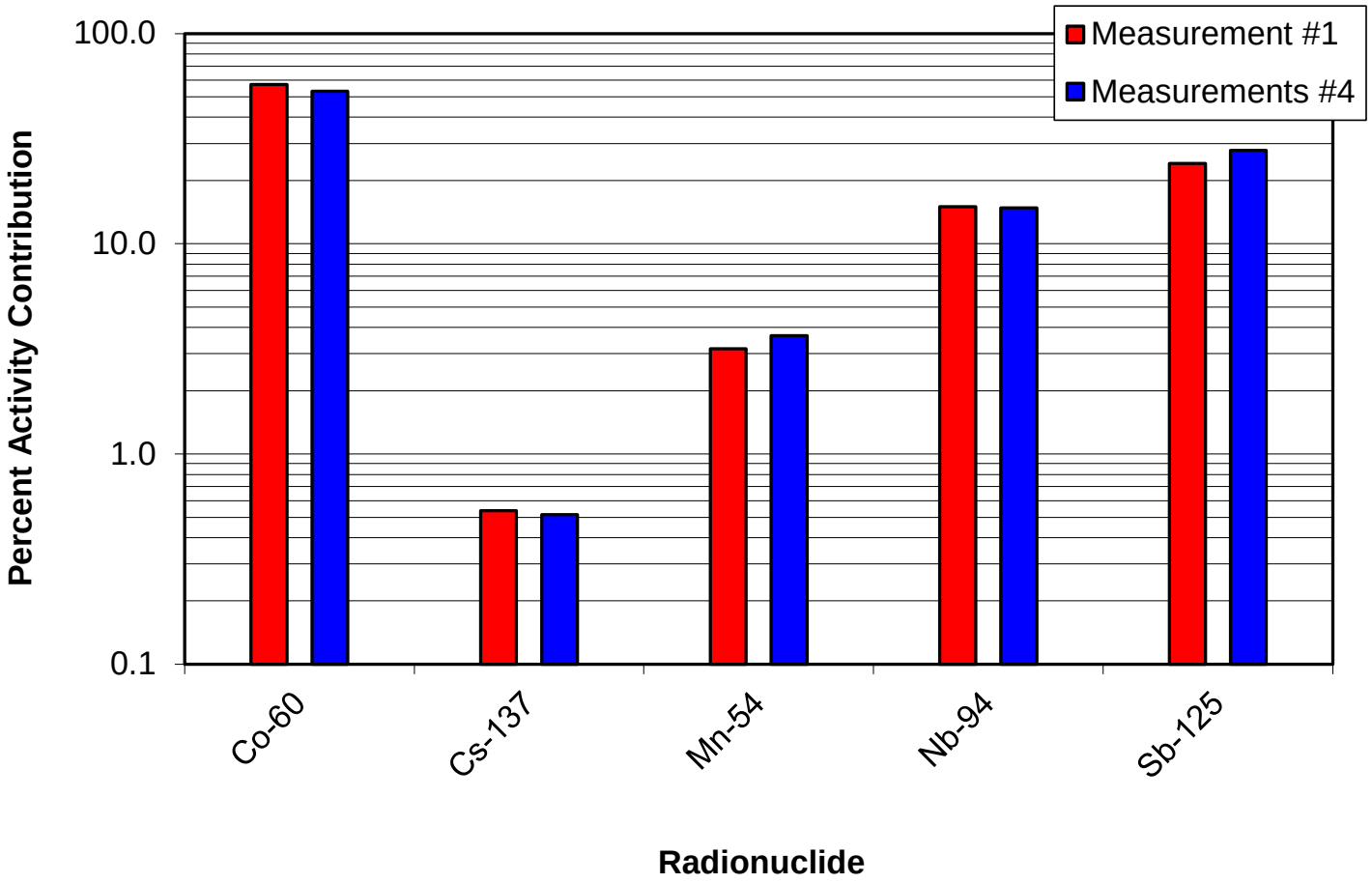
Surveys were completed 27 days after O/S

In-Situ Spectrometry of Spent Filter

Survey during Spent Filter Handling in the Transfer Room



Radionuclides in Spent Mechanical Filter



Surveys were completed 2 years after O/S

Conclusions

- Convenient Approach for Performance Analysis of Purification System
- Database of the Radionuclide Distributions and Inventory for IX & FR will allow:
  - Analyze the Effect of Mechanical Filter Parameters (pore size, media) based on the Actual Station Data
  - Directly Correlate the Activity Data to the Unit Service Conditions
  - Compare the Performance of Various IX Resin Types
  - Analyze the Radionuclide Distributions between IX Resin and Filter Media
- Waste Characterization