



# Technical Reachback Project

## Data Analytics

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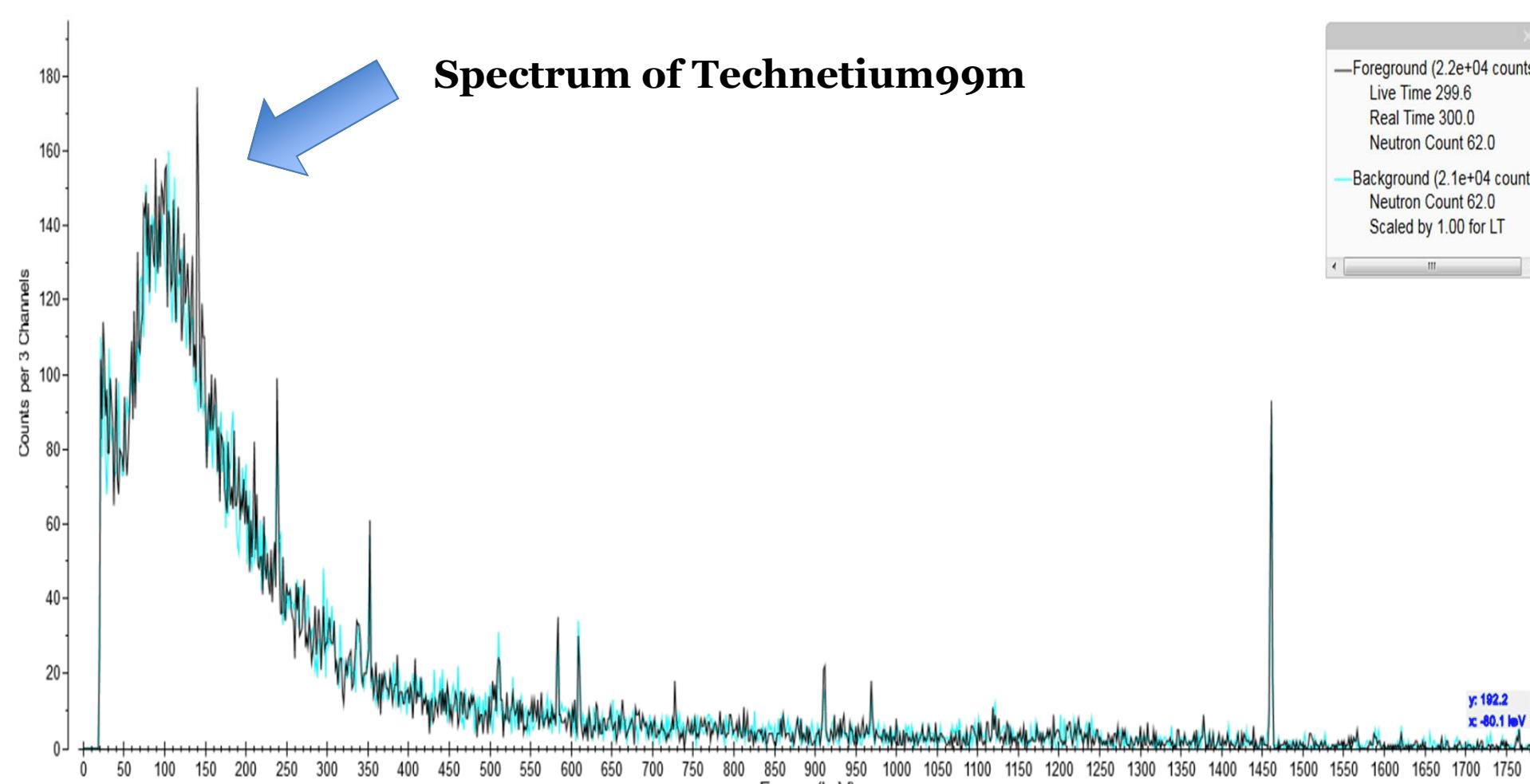
### Abstract

Technical Reachback (TRB) is a Department of Homeland Security program designed to provide assistance to Customs and Border Protection officials in assessing threats reported by radiation monitors at the United States borders. U.S. ports of entry have portal monitors that detect radiation from vehicles entering the country. The purpose of these monitors, and of TRB, is to detect nuclear material and prevent it from being smuggled into the country. As part of TRB, Sandia has developed software to investigate existing data from radiation monitors. In-depth analysis of this data is crucial to providing insight into whether a vehicle with an anomalous radiation profile is in fact a threat to our nation.

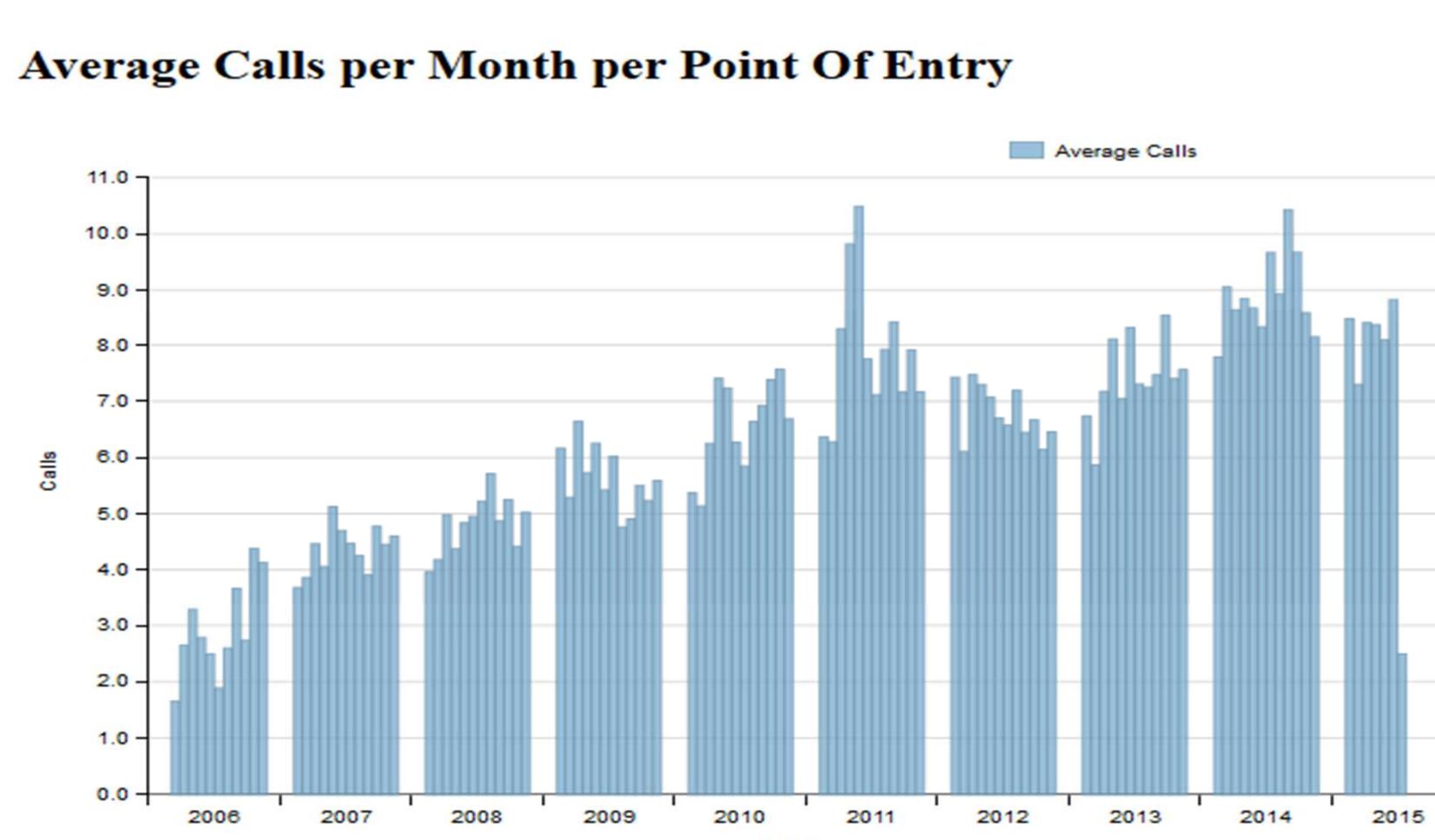
### Methods

Two major components of the data analytics for the TRB project are data exploration and data visualization. Data exploration involves understanding the data and identifying trends and anomalies. Data visualization focuses on clearly representing these trends and anomalies.

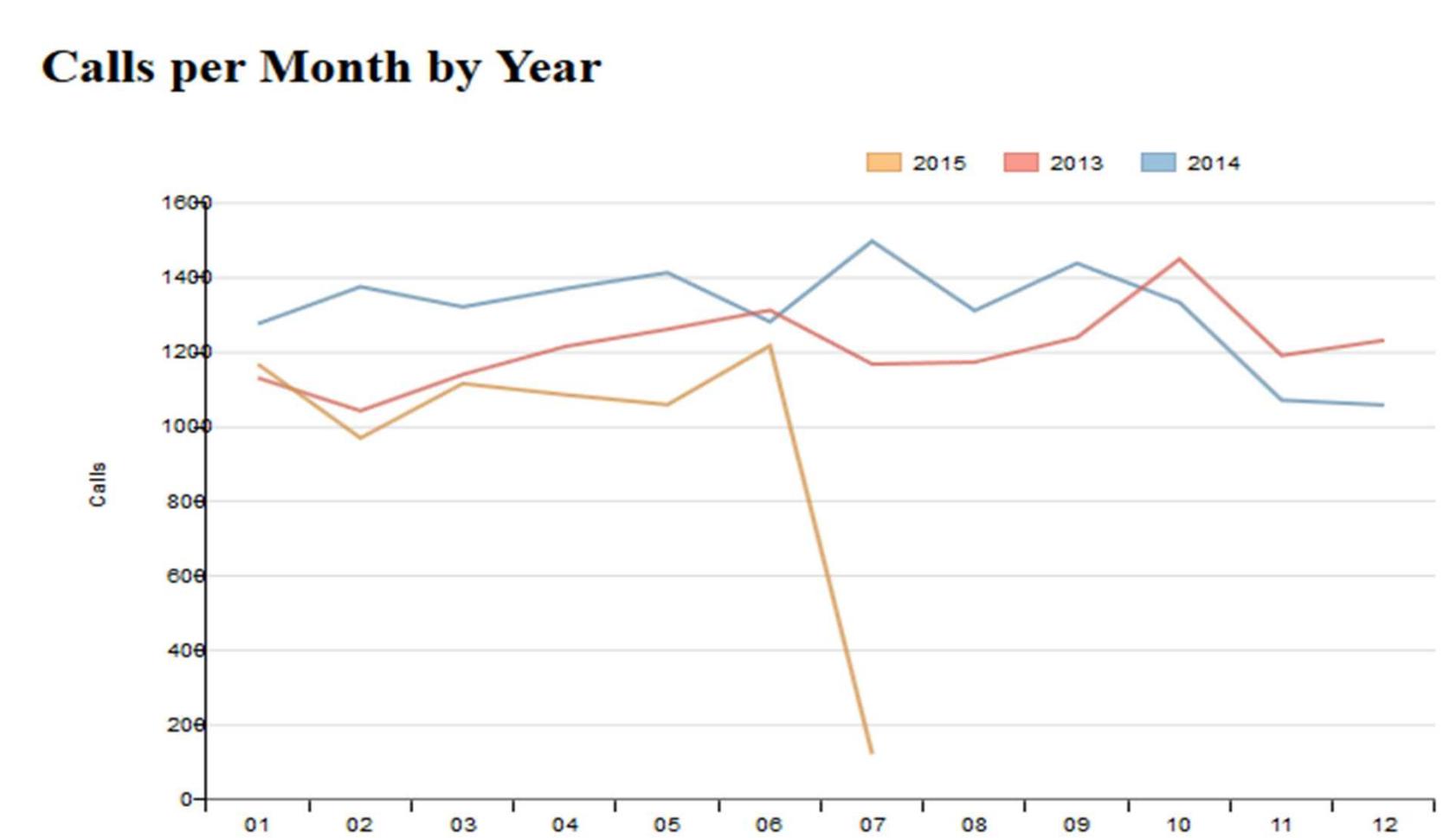
- i. **Data Exploration:** Data analysis was conducted to detect trends and patterns in the datasets that would be later modeled. Software tools, such as Tableau, were utilized to explore the data and determine what trends and patterns to visualize.
- ii. **Data Visualization:** The data visualization was primarily done using D3.js, a data driven JavaScript library. Other repositories built on top of D3, such as Dimple.js and C3.js, were used to enhance the look of the visualizations. Retrieving the data from the LSS calls log database was just as critical. This involved knowledge of SQL and PHP to convert results sets from SQL into JSON files that D3 and its libraries could easily read.



Emission spectrum of 1 microCurie of technetium 99m with a background in Livermore. Note the peak at 141 keV.



The bars symbolize the average number of radiation incidents reported by US border personnel per Port of Entry for each Month.



Comparison of the number of calls made each year regarding radiation incidents by US border officials.

### Results

#### i. LSS Calls Log Data Dashboard

We updated a dashboard that was created to consolidate and visualize important monthly trends and anomalies that were received from ports of entry around the United States. Call information, such as location, isotope, and location type, was measured and visualized by frequency. Also, a method of anomaly detection was developed to elucidate potentially concerning trends on a month-by-month basis. Studying these patterns and anomalies is very important to identifying alarming trends that could be threats to our nation.

#### i. Medical Radioisotope Modeling

We created visualizations of the decay of radioactive isotopes that are commonly used in medical diagnostics by using models of humans treated with these radioactive drugs. These visualizations would assist border control personnel by showing them how long a medical patient would be radioactive after a drug is administered. This would help in determining whether a detection of radioactivity in a patient is alarming.