Project #7: Nuclear Fuel

Lydia Breitenstein  
Yi Yan Heng  
Ryan Howard  
Eric Leyda  
Matthew Lim  

Elena Miyasato  
Andrew Reinhart  
Matt Schmenk  
Elizabeth Wilks  
Austin Williams
Nuclear Fuel Processing

- Mining ore
- Leaching
- Enrichment
- Fuel Pellets

Photo sources:
http://www.earthtimes.org/energy/uranium-mining-power-weapons/1873/
http://energy.gov/ne/advanced-modeling-simulation/nuclear-fuels
http://lasttechage.wordpress.com/2011/05/08/nuclear-decisions-3-%E2%80%93-spent-fuel/
Nuclear Reactors


Benefits and Costs

http://www.1reservoir.com/awow-1166
http://www.glogster.com/littlepinkprincess/katie-rapp-glog/g-6mfvo2opg147hibgo3dla0
Policy

- Safety
  - NRC
  - ICRP
  - IAEA

Incentives

- DOE Loans
- Production tax credit
- Insurance

25 rem = 1% cancer

The bottom line:
“Apart from Chernobyl, no nuclear workers or members of the public have ever died as a result of exposure to radiation due to a commercial nuclear reactor incident.”
Policy
Source for all three pictures: NRC

- Disposal
  - Transportation
  - Yucca Mountain
  - Reprocessing
Lab Background Information

- α, β, γ radiation
- Damage cells, increased risk of cancer

Sources
http://www.nrc.gov/reactors/pwrs.html
http://www.chemteam.info/Radioactivity/Writing-Alpha-Beta.html
http://www.chemteam.info/Radioactivity/Beta-Example1.GIF
The Lab: Radiation Is Everywhere.

- Measured radiation with geiger counters
- High-purity germanium detector for gamma ray energy spectroscopy
- Collected gamma energy spectra from samples, identified which radioactive isotopes were present in the samples
### Background Radiation

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>Peak</td>
<td>KeV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>Cesium - 137</td>
<td>1113.69</td>
<td>279.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>Manganese-54</td>
<td>23.59</td>
<td>6.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>Sodium-22</td>
<td>3006.22</td>
<td>752.48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Cobalt-60</td>
<td>1976.14</td>
<td>494.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Low Enriched Uranium Fuel

![Energy Spectrum of Germanium](image)

\[ y = 0.2501x + 0.619 \]