Summary of RHIC Facility Characteristics

- 120 Buildings
- 7 Accelerators
- 3 Major Experimental Areas
- 6.2 Miles Of Vacuum Pipe
- 24 Miles Of Cable Tray
- 1000s Of Electro-magnets / Power Supplies
- 10s Of Compressors For Cryogenics Systems
- 62 Electrical Substations
- 1000s Of Electrical Distribution Circuits
- 15 Cooling Towers In Service
- 52 Cooling Systems In Service
- 1.2 Million Ft² Of Office And Laboratory Space
- 1000 Acres Of Land
- 1000 Users
- 320 FTE Direct Staff
- 20 FTE Allocated Staff
Summary of Environmental Aspects

- Regulated Industrial Waste
- Hazardous Waste
- Mixed Waste
- Radioactive Waste
- Atmospheric Discharges
- Liquid Discharges
- Storage / Use Of Chemicals Or Radioactive Material
- Soil Activation
- Power And Water Consumption
- Sensitive / Endangered Species And Sensitive Habitats
Summary of Radiological Hazards

- Low-level Contamination
- Residual-radiation Levels At Collimators and Beam Dumps
- Tritium Production In Helium Gas And Cooling Water
- Radioactive Waste
- Radioactive Atmospheric Discharges
- Radioactive Liquid Effluents
- Storage / Use Of Radioactive Material
- Soil Activation
- Residual-radiation From Activated Materials
- Very High In-beam Radiation Levels
- Sky-shine
Summary of OSH Hazards

- Non-ionizing Radiation (Lasers, RF, UV)
- Magnetic Fields
- Working With Hazardous Or Toxic Materials
- Exposure To Electrical Energy
- Oxygen Deficiency
- Confined Spaces
- Being Struck By An Object; Cranes; Lifting Devices
- Falls; Vacuum; Pressure
- Contact With Temperature Extremes
Applicable Safety Requirements

- DOE Orders and Federal Regulations
  - DOE Order 5480.19, Conduct of Operations
  - DOE Order 420.2B, Accelerator Safety
  - DOE Order 420.1A, Facility Safety, §§ 4.2 and 4.4
  - DOE Order 414.1C, Quality Assurance
  - 10CFR835, Radiation Worker Protection
  - 10CFR851, Occupational Worker Protection

- BNL SBMS Subject Areas
  - 98 Subject Areas Contain ESH Requirements That Apply To RHIC
    - Accelerator Safety
    - Work Planning And Control
    - Construction Safety
    -...

- Voluntary Management Systems
  - OSH Management System, OHSAS 18001
  - Environmental Management System, ISO 14001
  - Human Performance Initiative, INPO
Safety Model at RHIC

- 3 Root Factors
  - Management Commitment
  - Line Responsibility For Injuries
  - Worker Involvement
- 3 Driver Factors
  - Clear Rules
  - Competent Safety Specialists
  - Comprehensive Safety Systems
- 3 Outcomes
  - Safe Equipment And Facilities
  - Safe-aware People
  - Excellent Injury Record
## ESH Requirements and Safety Model

<table>
<thead>
<tr>
<th>Some ESH Requirement Sets</th>
<th>Some Safety Management Factors Addressed by ESH Requirements Set:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integrated Safety Management (ISM)</strong></td>
<td>Clear Rules (Driver Factor)</td>
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<tr>
<td><strong>Worker Safety and Health 10CFR851</strong></td>
<td>5 Core Functions</td>
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<tr>
<td><strong>Safety Management System</strong></td>
<td>National and Consensus Standards</td>
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<tr>
<td><strong>Environmental Management System</strong></td>
<td>OHSAS 18001</td>
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<tr>
<td><strong>Human Performance</strong></td>
<td>ISO 14001</td>
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<td>Fisher Improvement Technologies</td>
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</tbody>
</table>

*DOE Mandated Requirements  **Voluntary Requirements  ***Improves Operations and ESH Performance
## Performance, Backward-Looking Indicators

<table>
<thead>
<tr>
<th>Category</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>10-1-06 to 6-30-07</th>
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<tbody>
<tr>
<td>Collective Dose (person-rem)</td>
<td>5.3</td>
<td>1.4</td>
<td>0.95</td>
<td>0.55</td>
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<tr>
<td>Skin and Clothing Contaminations</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Internal Contaminations</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Hazardous Materials Overexposures</td>
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<tr>
<td>Annual DART Rate (# / 100 FTEs)</td>
<td>1.7</td>
<td>0.29</td>
<td>0.30</td>
<td>0.33</td>
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<tr>
<td>Number of Injury Cases</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Annual Recordable Rate (# / 100 FTEs)</td>
<td>2.9</td>
<td>1.2</td>
<td>1.5</td>
<td>1.0</td>
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<tr>
<td>Number of Injury Cases</td>
<td>12</td>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>First Aid Cases Excluding Athletic Injury</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Occurrences</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>1</td>
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</table>
Injury Performance - Long Term

Injury/Illness Rates
(# per 100 FTE)


DART
TRC
Injuries In FY 2007

- **Recordable Cases**
  - Bookshelf fell, caused laceration of forehead, DART
  - Cut hand on sharp edge of waste can, antibiotics given
  - Dirt from air conditioner floated into eye, antibiotics given

- **First Aid**
  - Bruise from walking into stanchion
  - Stood up and hit head on metal tank
  - Cut finger on metal shelf
  - Cut finger on tie wrap
Occurrence Performance - Long Term

Number of Reportable Occurrences per Year

Occurrences In FY 2007

- 2007
  - Coffee-Room Microwave Oven Fire Causes Building Evacuation
Backward-Looking Indicators

- C-AD Injury Performance Indicators Are In The Noise
- C-AD Technical Performance Indicators Are Declining:
  - OSHA Deficiencies
  - Occurrences and Environmental Non-Compliances
  - Radiation Exposure
- Backward-Looking Indicators Do Not Measure:
  - Organizational Deficiencies
  - Failure To Maintain And Modernize Critical Equipment
  - Operations Pressures
  - Cost-cutting In Maintenance, Training, Personnel
  - Management Commitment
  - Worker Involvement
  - Line Accountability For Injuries
Performance, Forward-Looking Indicators

Growth In ESSH Practices

EXAMPLE PRACTICES:
• Safety Meetings
• WOSH Committee
• Disciplinary Rules
• Work Planning
• Safety Surveys/Feedback
• Self-Assessment
• Manager Work Observations
• Management Review
• 3rd Party Registrations
• Security Committee
• Annual Objectives and Targets
• Human Performance Training
• Error-Prevention Tools
• User Training
• Guest Agreements
• ...
### RHIC ESSHQ Staff and Cost

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Staffing (FTEs)</strong></td>
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<tr>
<td>Physicists</td>
<td>1.1</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.8</td>
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<td>Engineers</td>
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<td>3.1</td>
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<tr>
<td>Technicians</td>
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<td>1.7</td>
<td>1.3</td>
<td>1.3</td>
<td>0.8</td>
<td>1.0</td>
<td>0.3</td>
<td>0.4</td>
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<tr>
<td><strong>Admin</strong></td>
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<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.6</td>
<td>1.8</td>
<td>1.6</td>
<td>2.0</td>
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<tr>
<td><strong>Cost ($k): Labor</strong></td>
<td>917</td>
<td>758</td>
<td>751</td>
<td>750</td>
<td>791</td>
<td>873</td>
<td>760</td>
<td>868</td>
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<tr>
<td>DTS</td>
<td>495</td>
<td>514</td>
<td>517</td>
<td>567</td>
<td>856</td>
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<td>811</td>
<td>870</td>
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<td>MSTC</td>
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<td>66</td>
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<td>51</td>
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<td>ODC</td>
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<td>243</td>
<td>265</td>
<td>287</td>
<td>241</td>
<td>237</td>
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<tr>
<td>G&amp;A</td>
<td>650</td>
<td>546</td>
<td>524</td>
<td>550</td>
<td>740</td>
<td>802</td>
<td>711</td>
<td>767</td>
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<tr>
<td><strong>Total Cost</strong></td>
<td>2,365</td>
<td>2,075</td>
<td>2,069</td>
<td>2,180</td>
<td>2,691</td>
<td>2,903</td>
<td>2,575</td>
<td>2,765</td>
</tr>
</tbody>
</table>
Summary

- RHIC Has Large Facilities With Complex Hazards
  - Potential For Organizational Accidents With Multiple Causes

- ESSH Performance Is Approaching Excellence
  - Safety Systems Are Comprehensive (Rules, Training, Safety Experts)
  - Users / Workers Perform Work To The Same Safety Standards
  - Workers / Managers Involved In Safety Program Development
  - Line Held Accountable For Performance
  - Managers And Supervisors Are Committed To Excellence In ESSH
  - The Number Of ESSH Practices Is Increasing
    - Organizations Rated World Class In Safety Have 25 To 40 Practices
  - Injury / Illness Rates Declining Toward Zero
  - Reportable Occurrences Declining Toward Zero
  - Non-compliances Declining Toward Zero