Safety

DOE-NP Annual S&T Review of RHIC

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Office of Nuclear Physics
Exploring Nuclear Matter - Quarks to Stars

BROOKHAVEN
NATIONAL LABORATORY
Brookhaven Science Associates

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 Ft^2 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

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- 3 Driver Factors
  - Clear Rules
  - Competent Safety Specialists
  - Comprehensive Safety Systems

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- 3 Outcomes
  - Safe Equipment And Facilities
  - Safe-aware People
  - Excellent Injury Record

ESH Requirements and Safety Model

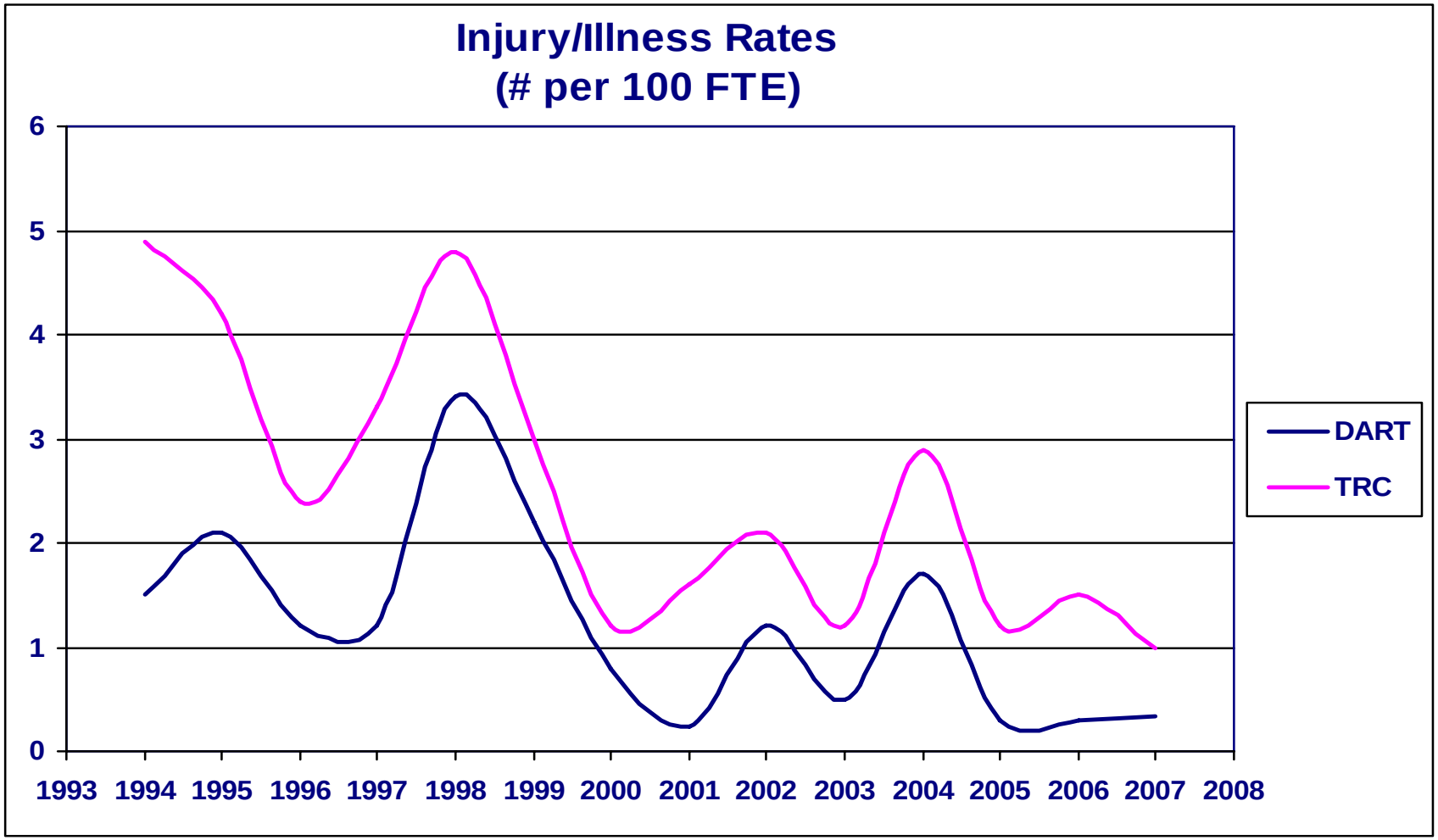
Some ESH Requirement Sets	Some Safety Management Factors Addressed by ESH Requirements Set:		
	Clear Rules (Driver Factor)	Worker Involvement (Root Factor)	Management Commitment (Root Factor)
Integrated Safety Management (ISM)*	5 Core Functions	▪ Perform Work Within Controls ▪ Feedback and Improvement	7 Guiding Principles
Worker Safety and Health 10CFR851*	National and Consensus Standards	Worker Rights and Responsibilities	Management Responsibilities
Safety Management System**	OHSAS 18001	Job Risk Assessments	Management Review
Environmental Management System**	ISO 14001	Process Assessments	Management Review
Human Performance** ***	Fisher Improvement Technologies	▪ Self-Check Tool ▪ Step-By-Step Tool ▪ Stop When Unsure Tool	▪ Work Observation Program ▪ SMART Model for Procedures ▪ Just Culture for Deviations

*DOE Mandated Requirements **Voluntary Requirements ***Improves Operations and ESH Performance

Performance, Backward-Looking Indicators

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

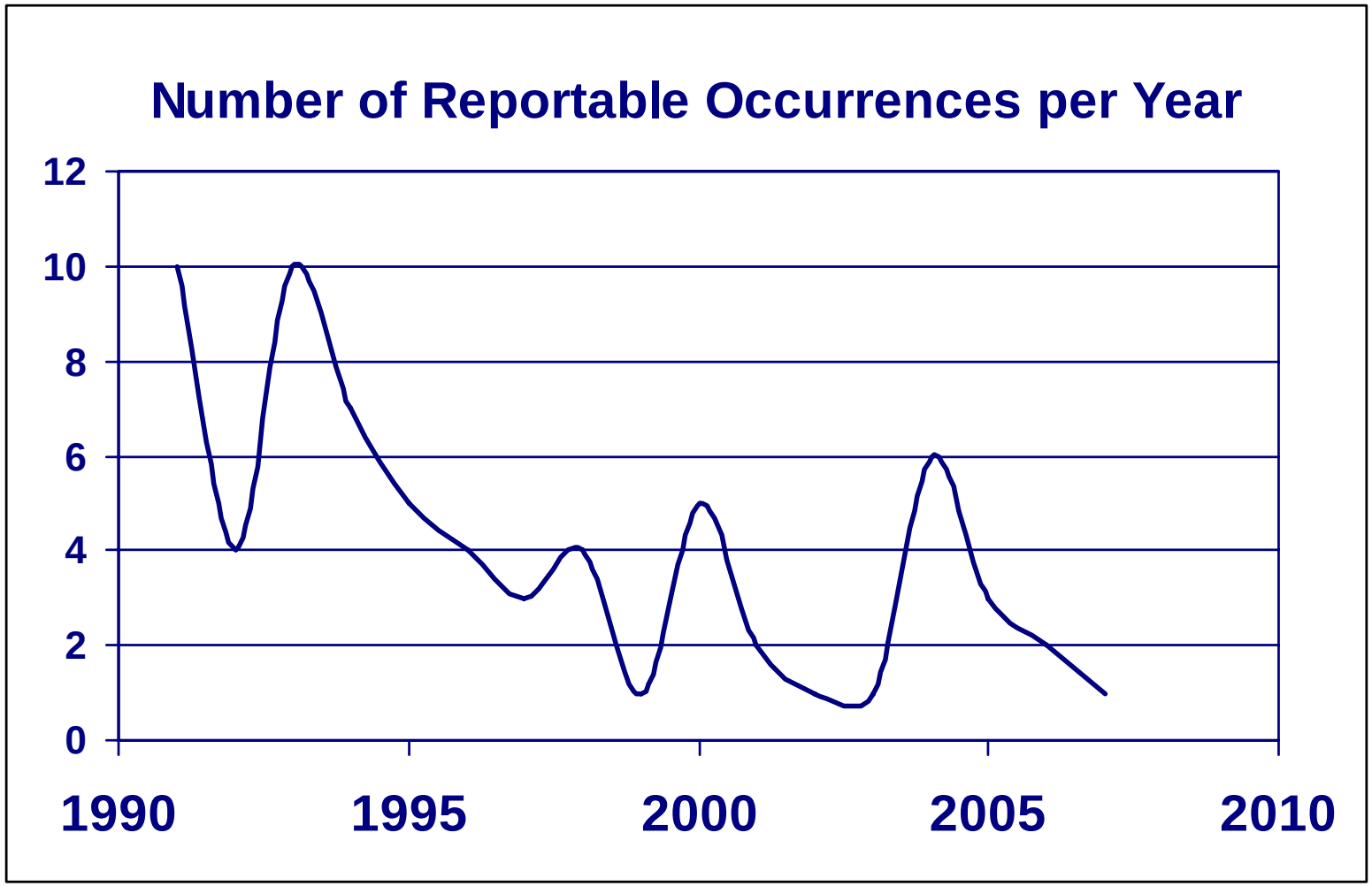
Injury Performance – Long Term



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

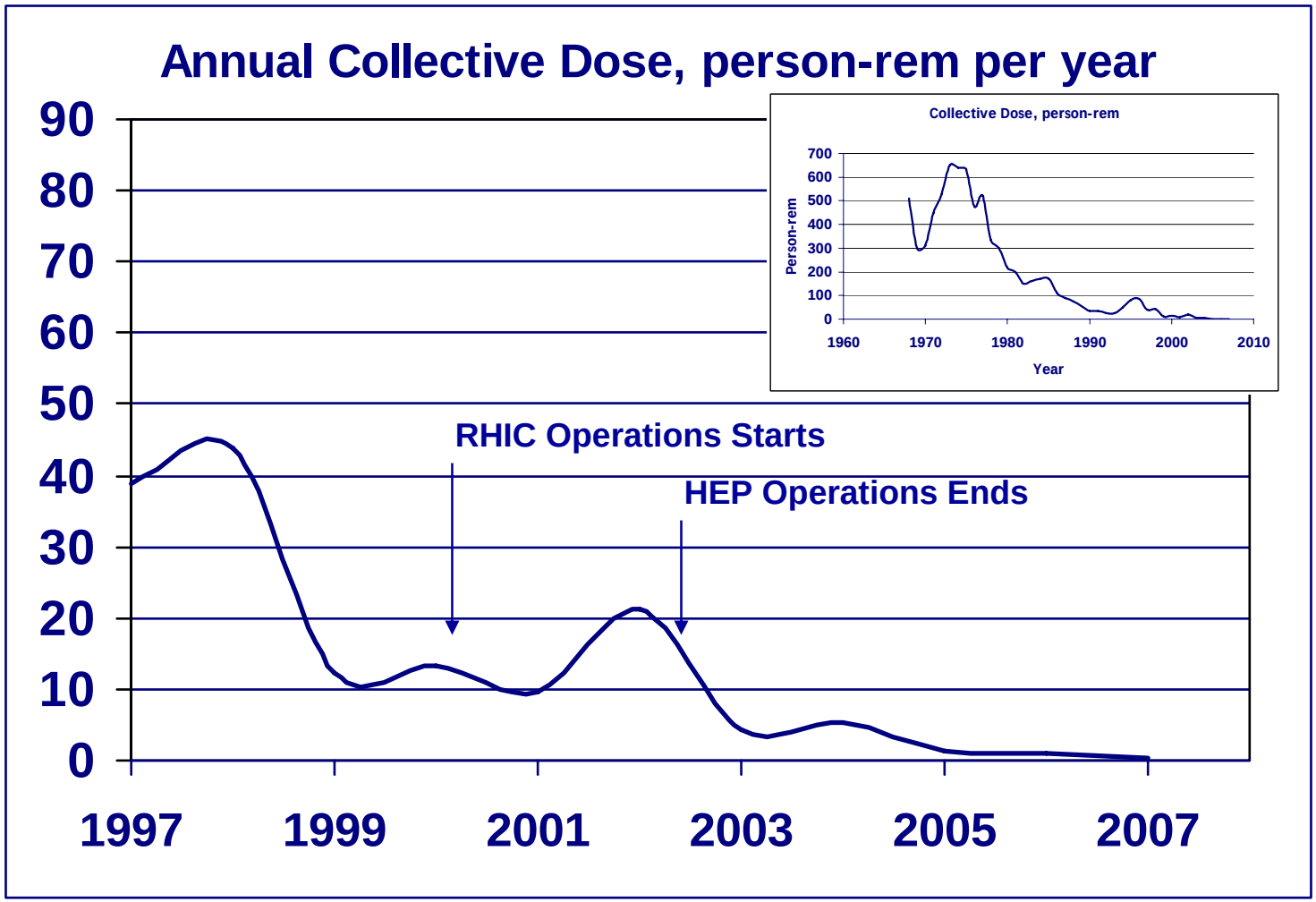
Occurrence Performance - Long Term



Occurrences In FY 2007

- **2007**
  - **Coffee-Room Microwave Oven Fire Causes Building Evacuation**

Radiological Performance – Long Term

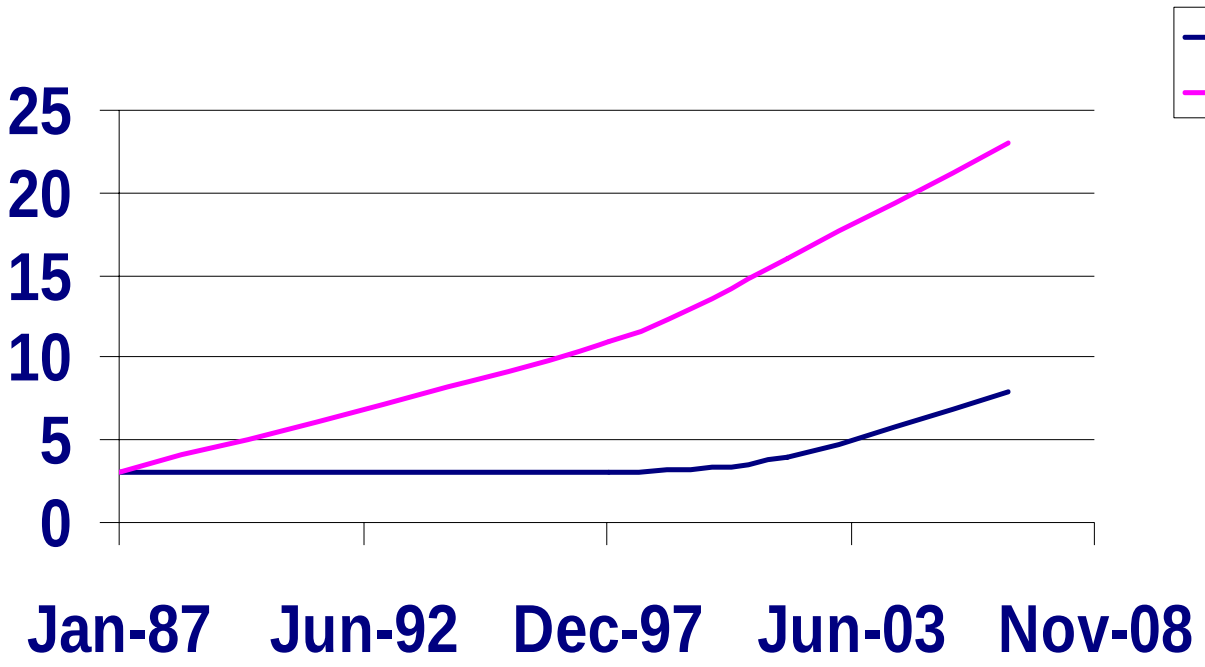


Backward-Looking Indicators

- 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

RHIC Operations	2000	2001	2002	2003	2004	2005	2006	2007
Staffing (FTEs)	9.5	7.2	6.9	6.9	7.0	7.0	7.0	7.3
Physicists	1.1	0.7	0.7	0.7	0.8	0.9	0.9	0.8
Engineers	3.8	3.1	3.2	3.2	3.8	3.4	4.2	4.1
Technicians	2.6	1.7	1.3	1.3	0.8	1.0	0.3	0.4
Admin	2.0	1.7	1.7	1.7	1.6	1.8	1.6	2.0
Cost ($k): Labor	917	758	751	750	791	873	760	868
DTS	495	514	517	567	856	909	811	870
MSTC	88	66	66	65	38	31	51	24
ODC	215	191	211	243	265	287	241	237
G&A	650	546	524	550	740	802	711	767
Total Cost	2,365	2,075	2,069	2,180	2,691	2,903	2,575	2,765

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