

Brookhaven National Laboratory Environmental Management System

EMS Implementation Costs at a DOE National Laboratory

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Presented at ASQ -EED 2/16/00

Presentation Overview

Purpose:

Provide a case study of costs associated with EMS implementation

Topics:

- Where and what is Brookhaven National Laboratory?
- Background on EMS Project
- Cost Estimates
- Actual Expenditures
- Key Cost Centers
- Cost savings



Brookhaven National Laboratory

Mission: *Basic and applied research in a variety of scientific fields: Physics, Chemistry, Materials Science to Biology, Medicine and forefront technology*

EXPLORING EARTH'S MYSTERIES
...PROTECTING ITS FUTURE

Facts:

- Founded 1947 on former US Army's Camp Upton
- Operated by Brookhaven Sciences Associates (BSA) for DOE
- 3000 employees; 4,000 visiting scientists annually
- Located on eastern Long Island, NY
- 21.3 km² (5000+ acres; 1,600 acres developed)





BNL Facilities, Programs, Operations

■ BNL MACHINES

- Research Reactors
- Collider-Accelerators
- Synchrotron Light Source

■ FACILITY OPERATIONS

- Physical Plant Operations
 - Sewage Treatment Plant
 - Central Steam Facility
 - Major Petroleum Facility
- Waste Management Facility
- Environmental Restoration

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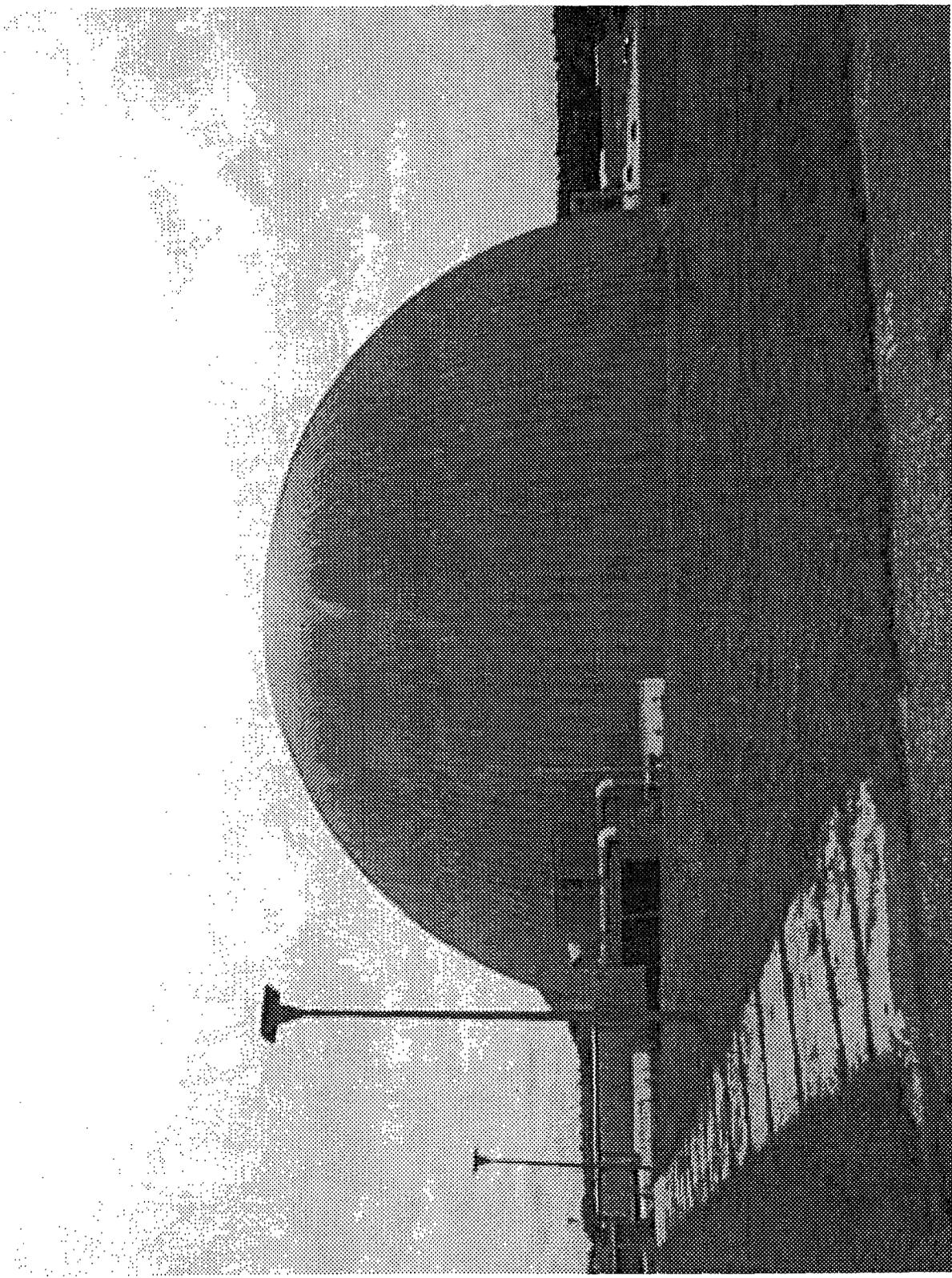
■ SCIENTIFIC ACTIVITIES

- Medical Research Operations
- Material Science Research
- Bench-top Experiments
- Terrestrial Research

■ SUPPORT PROCESSES

- Radiation Source Material Storage
- Machining Operations
- Photography
- Fleet Operations
- Bulk Chemical Distribution Operations

BNL HIGH FLUX BEAM REACTOR



RHIC Complex

Tandem
van de Graaff

Heavy Ion
Transfer Line

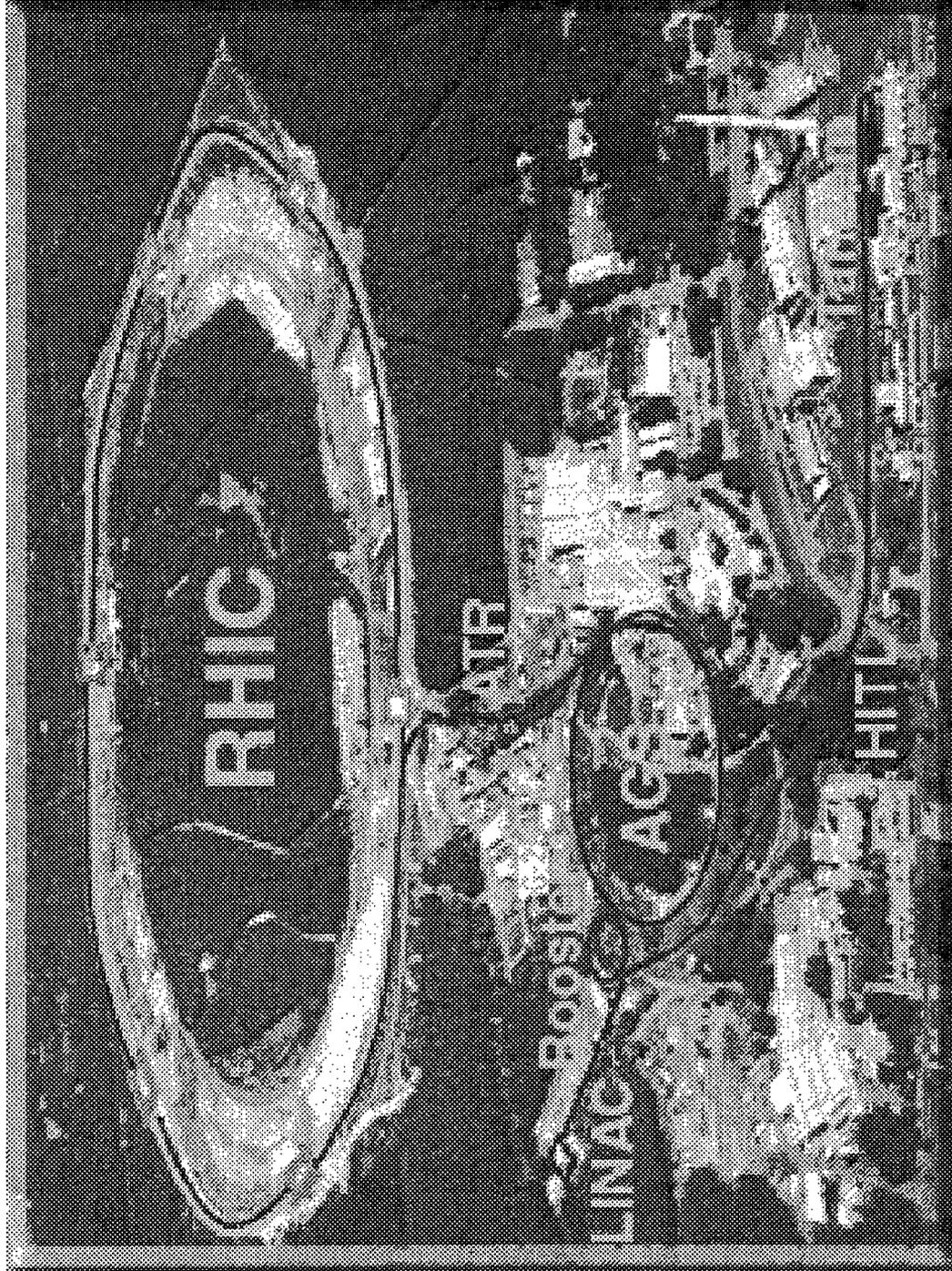
Booster

Linear
Accelerator
(LINAC)

Alternating
Gradient
Synchrotron

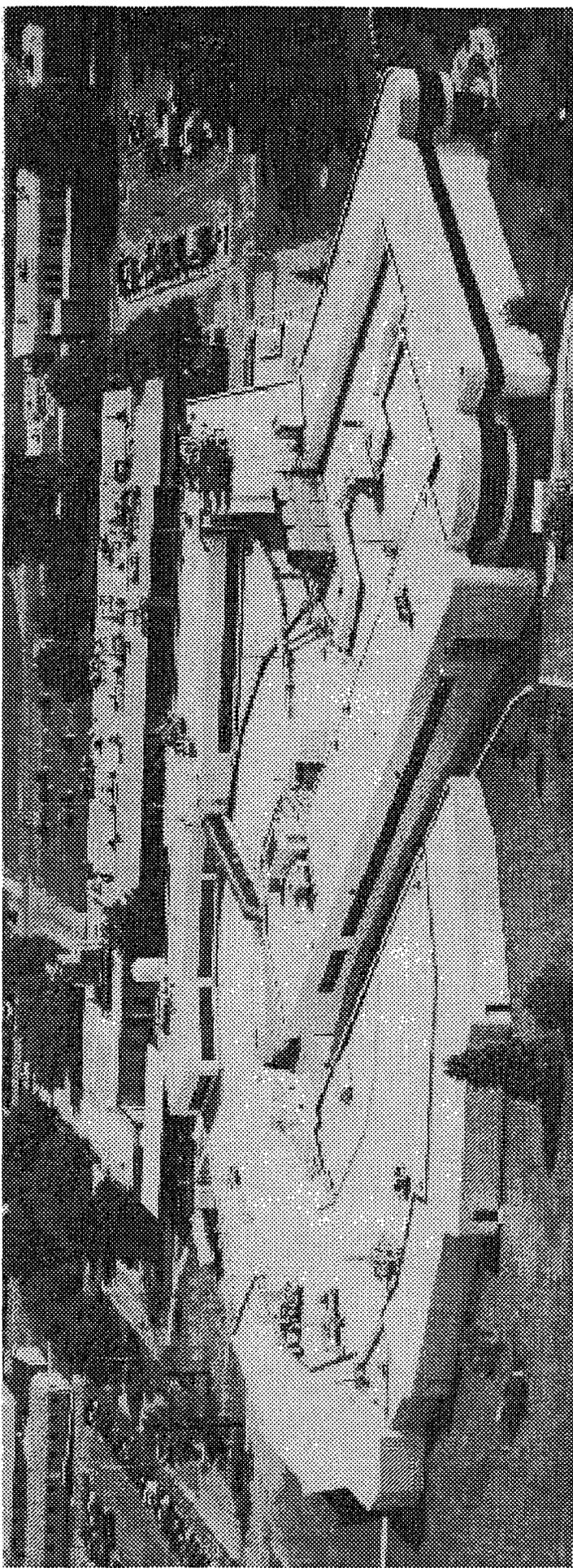
AGS-to-RHIC
Transfer Line

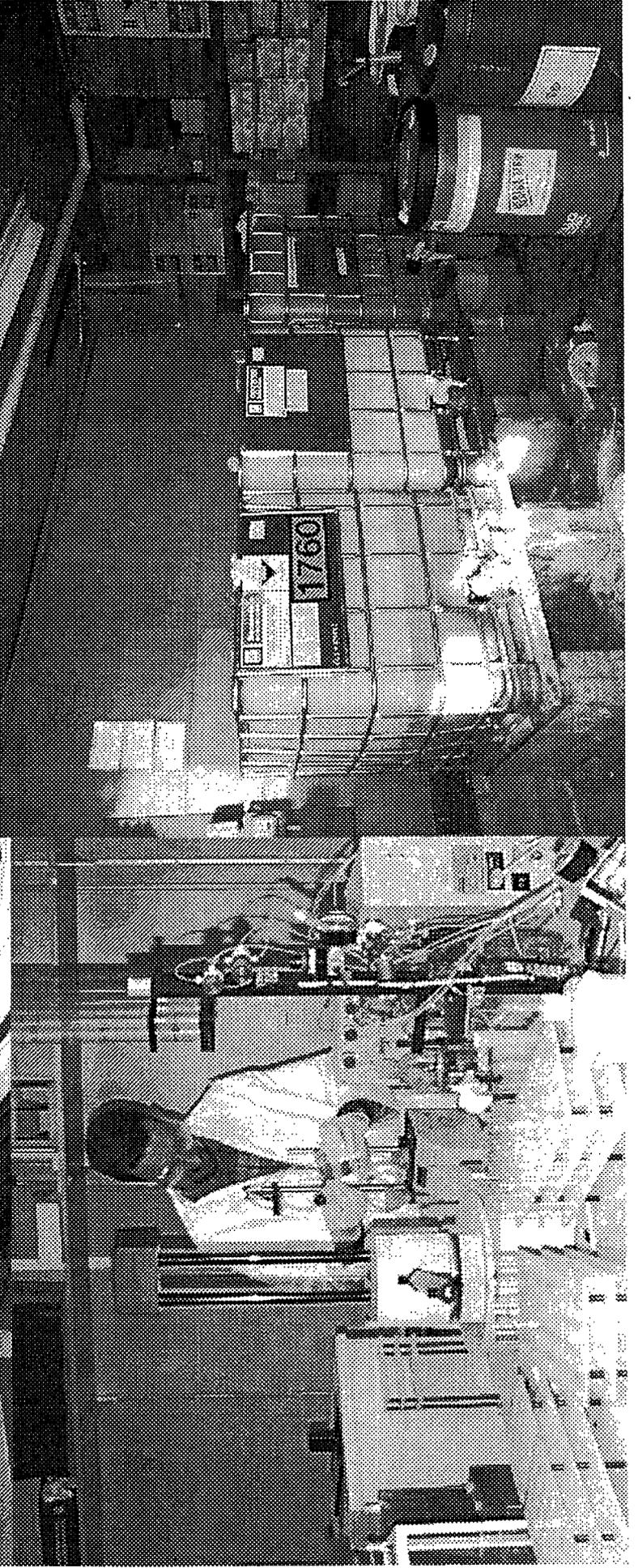
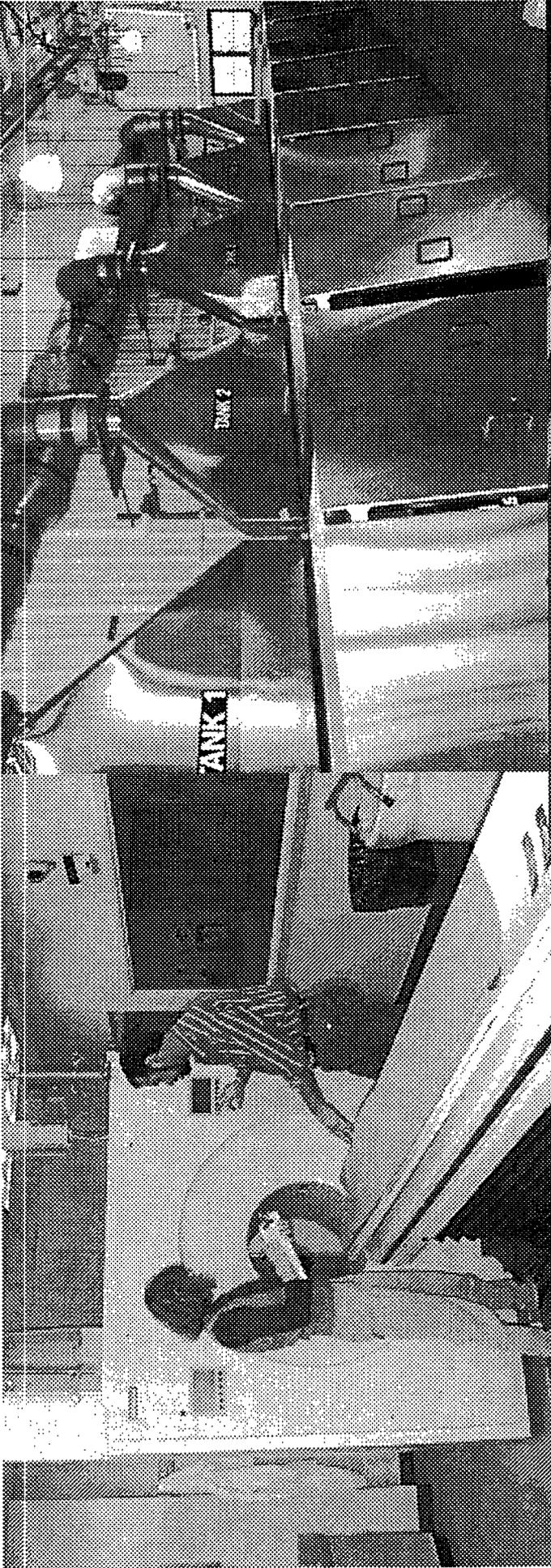
RHIC ring

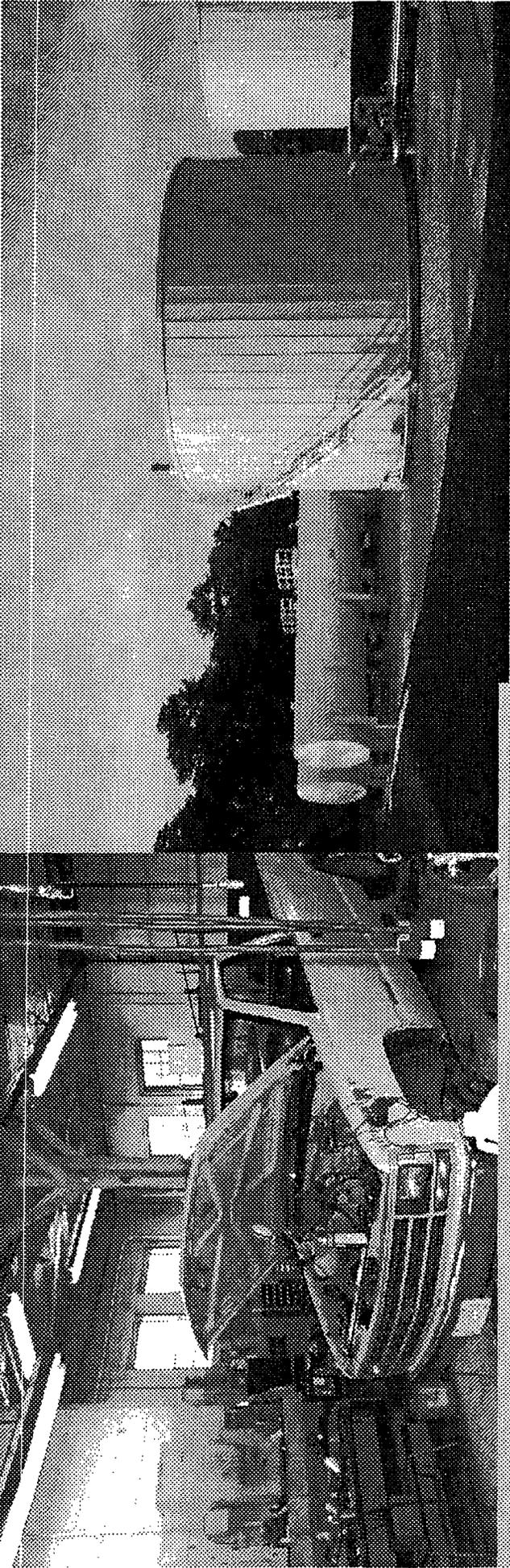
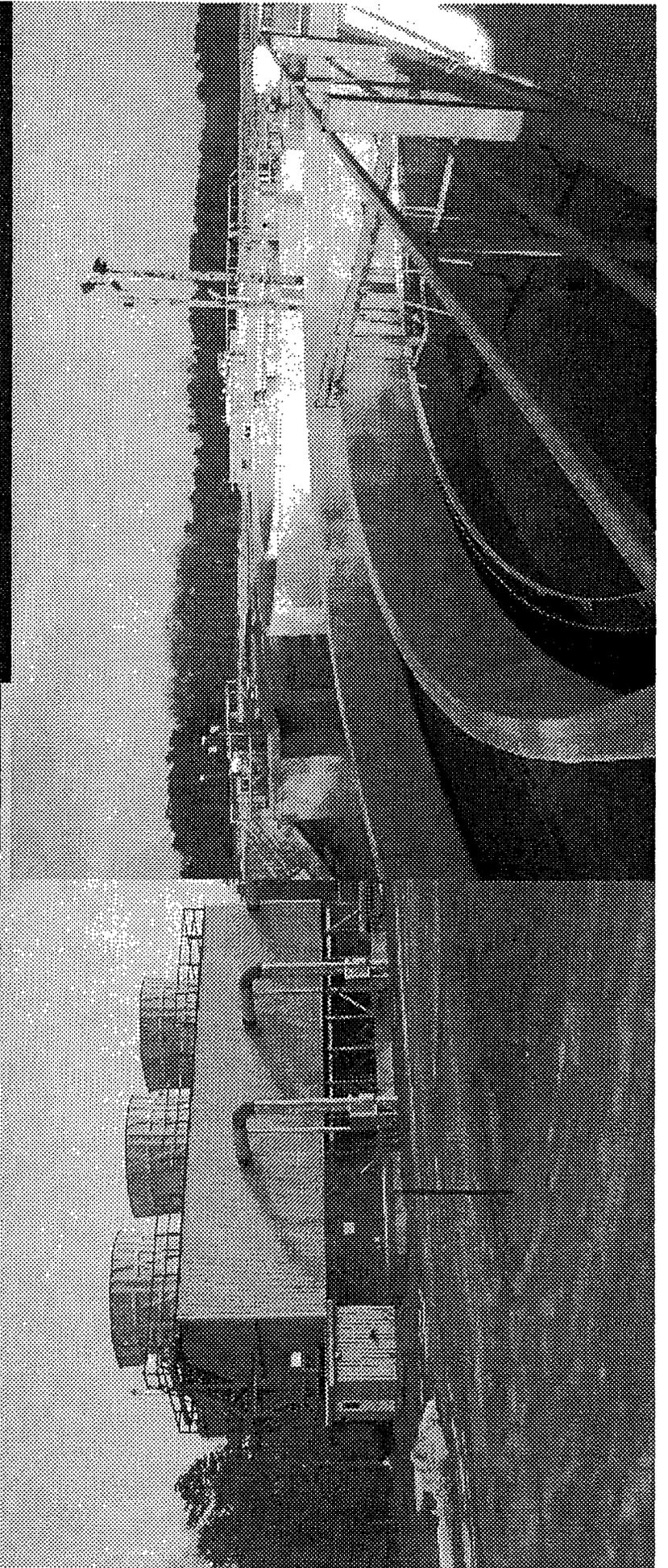


Click the picture or the index to learn more about the many Brookhaven physics facilities that make up the RHIC complex.

BNL NATIONAL SYNCHROTRON LIGHT SOURCE







Background: *Where BNL has come from...*

1/97: Tritium leak in Reactor discovered

4/97: External audits show significant safety management concerns

3/98: New BNL management company - BSA

3/98: EPA/DOE Memorandum of Agreement signed

- Evaluations of all industrial & experimental processes
- Regulatory Compliance Training
- Environmental Management System
- Annual Audits

5/98: EMS Project Initiated

8/99: RHIC Project Registered to ISO 14001



11/99: Reactor permanently closed

7/00: Expected completion date for EMS implementation lab-wide

Significant Environmental Aspects

Laboratory Aspects

- Waste Generation
 - regulated industrial
 - hazardous
 - radioactive
 - mixed
 - medical waste
- Atmospheric Emissions
 - radioactive
 - non-radioactive
- Liquid Effluents
 - chemical
 - radioactive
- Storage/Use Chemicals or Radioactive Materials
- Natural Resource Usage
 - power or water

**significance criteria beyond regulatory requirements*

Facility Specific Aspects

- Noise
- Sensitive wildlife habitats
- Use of buried ductwork in contaminated processes
- Soil Activation
- PCB storage or use
- Legacy Issues

Project Management Approach

EMS managed as an integrated project

- Project Management Plan establishes scope, schedule, cost, technical tasks, project controls and tracking systems
- Conceptual Approach:
 - Build on existing Laboratory Systems
 - Integrate EMS with new BSA Management System Initiatives
 - Enhance ISO requirements with EPA MOA Criteria
 - Compliance Assurance, Pollution Prevention, and Community Outreach
- Deploy at three levels: *Institutional, Facility, Project*

New BSA Management System Initiatives

**Integrated
Planning**

**Standards Based
Management**

**Strategic
Communications**

*Set and communicate institutional
requirements for staff*

**Integrated Safety
Management**

**Performance Based
Management**

**Training and
Qualification**

**Quality
Management**

*Set institutional objectives and
deploy them through organization*

**Human
Resources**

**Emergency
Response**

**Integrated
Assessment**

**Records
Management**

Evaluate performance and drive improvement

ISO 14001 Integration with BSA Initiatives

Environmental Management Program

-EMS Documentation
-Legal & Other Requirements

Communications

Identify & communicate environmental requirements to staff

-Aspects
Monitoring/Measurement
-Operational Control

Objectives & Targets

Training, Awareness & Competence

-Document Control
-Nonconformance CA/PA

Set environmental objectives at relevant levels of organization

Structure & Responsibilities

Emergency Response

-EMS Audits
-Management Review
-Compliance Status

Records

Evaluate environmental performance and continually improve

Project Implementation Strategy

- **Initiate & Plan Project Design**
- **Define Institutional Level EMS Program Requirements**
- **Test Implementation at Pilot Facilities**
- **Develop & Implement Training Programs**
- **Communicate, communicate, communicate**
- **Deploy EMS Program**
- **Assess & Improve Program**
- **Manage and track progress**

EMS Project Status

STATUS	TASK DESCRIPTION	START	FINISH	% COMPLETE
	BNL EMS PROJECT	May-98	Jan-02	67%
✓	Project Initiation	May-98	Dec-98	100%
✓	Institutional Program Requirements	Jul-98	Apr-99	100%
✓	Pilot Facilities	Jul-98	Sep-99	100%
✓	Communication Initiative	May-98	Dec-00	72%
✓	Training Initiative	Jul-98	Dec-99	100%
	Assessment Initiative	Jul-98	Jan-02	66%
	Laboratory Deployment	Jul-98	Jan-01	47%
	Laboratory-wide programs	Jul-98	Jan-01	77%
	Balance of Facilities	Jul-99	Sep-00	45%
	Improvement Initiative	Mar-99	Nov-00	49%

BNL EMS Resource Estimates

<u>Total Project Estimate:</u>	\$2.74 M
■ Contributed Resources-	\$2.13 M
• Line Departments	1.75 M
• Overhead Departments	0.38 M
■ Direct Project Costs	\$0.61 M

In perspective...

BNL Annual Research & Operations Budget: **\$400M**

ESH&Q : **\$16M**

Waste Management & Restoration: **\$20M**

Basis for Resource Estimate

Project and Support Organization Estimates

- Task-based estimates
- Review program status
- Build on existing programs
- Integrate with new initiatives
- Facilitated team process to develop procedures
 - staff involvement

Line Department Resource Model

- Baseline Tasks
 - review program status
 - develop, revise existing systems
 - Technical versus Administrative organizations
- Facility Specific Variables
 - # Employees (training, drills, communications)
 - # Work Processes with significant aspects (job specific training, operational controls, monitoring)

EMS Resource Breakdown

TASK DESCRIPTION	ESTIMATE	%TOTAL	ACTUAL
BNL EMS PROJECT	\$2,743,355	100%	\$1,988,830
EMS Project Initiation	\$31,250	1%	\$59,160
Establish Institutional EMS Program	\$209,100	8%	\$187,520
Develop Facility EMS Pilot Program	\$389,330	14%	\$255,289
Deploy EMS Communication Program	\$70,800	3%	\$68,563
EMS Training Development	\$45,400	2%	\$83,686
Assess Laboratory EMS Program	\$132,900	5%	\$71,592
Deploy Institutional EMS	\$1,373,950	50%	\$307,490
Improve Program	\$31,100	1%	\$26,000
Transition/Closeout Project	\$11,800	0%	\$0
Project Support	\$447,725	16%	\$259,680

Grey font: Ongoing task

Assumes hourly rate of \$50 (\$100K annual salary, burdened)

Under reporting of facility implementation hours

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Institutional EMS Program Highlights

- **Developed *comprehensive, up-to-date* set of environmental requirements**
 - 26 regulatory compliance and EMS supporting procedures
 - *Centralized, searchable, Web-based* information
 - *Staff involved* in development

- **Assessed program conformance and completeness**
 - Provided forum for review and input by BNL regulators
 - Independent evaluation by ISO expert

- **Recognized and celebrated contribution of all, 7/1/99**



Institutional EMS Program Requirements Costs

TASK DESCRIPTION	ESTIMATE	ACTUAL
ESTABLISH INSTITUTIONAL EMS	\$179,500	\$187,520
Policy	\$400	\$2,200
Aspects/Impacts	\$7,800	\$10,000
Legal & Other Requirements	\$83,000	\$24,160
Environmental & Waste Subject Areas		\$68,310
Objectives/Targets	\$8,400	\$4,000
EM Program	\$2,500	\$5,200
EMS Structure & Responsibility	\$500	\$4,000
Training, Awareness and Competency	\$8,700	\$6,000
Communications	\$900	\$7,350
EMS Documentation	\$400	\$4,000
Document Control	\$8,700	\$7,150
Operational Controls	\$10,000	\$2,000
Emergency Preparedness & Response	\$5,900	\$8,000
Monitoring & Measurement	\$30,600	\$14,450
Nonconformance & Corrective/Preventive Action	\$5,600	\$4,950
Records	\$900	\$8,550
Environmental Auditing	\$2,500	\$6,000
Management Review Process	\$2,700	\$1,200

Pilot Process

- Implementation tested in 3 facilities:
 - Relativistic Heavy Ion Collider Project
 - Waste Management Division
 - Reactor Operations
- Estimated tasks and level of effort for model
 - validated in a scientific department
- Process Evaluations provide technical basis for EMS
- Field test new procedures & provide feedback
- Developed tools & prototypes
- Registration process piloted

Overview of Pilot Facilities Costs

TASK DESCRIPTION	THEORETICAL FACILITY		PILOT FACILITIES		
	ESTIMATE (\$)*	% TOTAL	ESTIMATE (\$)	ACTUAL (\$)	% TOTAL
TOTAL	\$105,975	100%	\$369,000	\$243,539	
Plan Project	\$7,250	7%	\$25,830	\$14,142	6%
Implement Program	\$33,625	32%	\$118,080	\$94,015	39%
Policy	\$200	2%			
EMS Planning	\$9,400	9%			
Implement & Operation	\$14,825	15%			
Checking & Corrective					
Action	\$6,200	6%			
Management Review	\$3,000	3%			
Train Employees	\$19,550	18%	\$66,420	\$41,937	17%
Communicate EMS Initiative	\$7,550	7%	\$25,830	\$13,097	5%
Assess Readiness**	\$24,000	23%	\$84,870	\$45,319	19%
Project Support	\$14,000	13%	\$47,970	\$20,328	8%

EMS Communications Initiative

■ Internal EMS communications

- Lab Director communiques on Environmental Stewardship
- **Employee EMS Brochure**
- Laboratory newspaper articles
- Awards, celebrations

■ External EMS communications

- **Routine EPA Briefings**
- Brookhaven Executive Roundtable
- Attorney General Office
- DOE
- Publications (International Environmental Systems Update; US EPA Fed Facts; DOE This Month)

■ Networking with EMS Professional Organizations

- EPA Multi-State Working Group
- US TAG on ISO 14000
- ASQ Energy & Environmental Division

■ Outreach activities

- BNL Festival Science and Environment
- Univ Stony Brook WISE Program,
- Project XL (Excellence in Leadership)

■ EMS Communications Plan

Communication Costs

TASK DESCRIPTION	COSTS
TOTAL	\$115,600
EMS PROJECT COMMUNICATIONS	\$68,600
Develop EMS Communications Plan	\$4,000
Provide EMS Information	\$800
Develop and Distribute EMS Media*	\$23,400
Provide EMS Briefings, Updates and Presentations*	\$27,200
Participate in Professional EMS Organizations	\$13,200
Facility Communications*	\$47,000

**ongoing activities*

Media: brochures, posters, website

Presentations to senior management, DOE, regulators, elected officials, business community

EMS Training Initiatives

Course Description	Target Audience	Training Hours	# Attendees	% Complete
General Environmental Protection Training	All staff & visiting scientists	0.5	2828	86%
EMS Management Training				90%
Overview of EMS	Managers, EMS & ESH	2	655	
Department Specific EMS	Staff	1	157	
Specialized Support Training				100%
Gap Analysis	EMS mplementation	8	55	
EMS Implementation Training	Teams	16	69	
ISO 14000 Internal Auditor	Assessors, EMS Project	24	41	
ISO 14000 Lead Auditor	Personnel	35	13	
Regulatory Compliance Training	Line and Support ESH personnel; select line personnel	4 24 15	48 38 150	100%
BNL Job Specific EMS Training	Staff whose work can impact the environment	1	383	
	TOTAL TRAINING HOURS:	9601		

Does not include Contractor/Vendor Orientation

Training Costs

■ Development	\$ 45,270
■ Contractors	
• Management Training	\$ 3,000
• Implementation Training	\$ 18,980
• Auditor Training	\$ 26,506
■ Contributed (staff time)	\$ 92,000 +
■ TOTAL	\$ 185,756
• <i>7% of budget</i>	

Facility Training Costs & Status

FACILITY	# Employee	% Complete	Costs (\$)
TOTAL	3,008	92	\$91,776
RHIC Project	369	100	\$16,250
Waste Management Division	31	100	\$5,300
Reactor Division	107	100	\$16,613
Environmental Restoration Division	42	98	\$6,540
Facility & Operations	537	72	\$3,617
Basic Energy Sciences: NSLS, Chemistr	260	80	\$4,745
Accelerator Complex	211	84	\$6,373
Life Sciences: Medical, Biology	152	98	\$3,506
Applied Science & Technology	292	90	\$3,608
Environment, Safety, Health & Quality	199	89	\$12,358
Directors Office & Public Affairs	200	97	\$4,681
Finance & Administration	274	98	\$2,303
High Energy Nuclear Physics: Physics, Instrumentation	334	91	\$5,883

EMS Assessment Initiatives

■ Perform Gap Analysis

- Facility programs
- Institutional Program & New BSA Initiatives

■ Conduct Self-Assessments

- EMS Project
- Select support organizations
- Facilities
- Regulatory Compliance Assessments

■ Track Performance Measures

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■ Coordinate Internal Independent Assessments

- Peer review of environmental programs
- Compliance Subject Areas review by BNL regulators
- Technical review by ISO expert
- Special studies by BNL I/O Office
- Self Assessment by team of BNL and non-BNL staff

■ Undergo External Audits

- Corporate Assessment
- DOE/EPA MOA Annual Audit
- DOE ISM Evaluation
- Regulatory Audits
- Registration Audit

Assessment Costs

■ Gap Analysis Costs: \$67K

- 1 day/facility; 5 persons
- Consultant - \$3K / facility
- 13 Facilities/Programs analyzed
- Training opportunity
- Used DOE P2 grant
 - BNL paid only \$30K

■ Internal Assessments: \$73K

- Consultant - \$22K
- EMS & Teams - \$51K
- *does not include other audited staff*

■ External Assessments: \$37K

- EMS Audits only
- *does not include other audited staff or any regulatory audits*

RHIC Registration

RHIC Project successfully obtains ISO 14001 Registration

- BNL's new, premiere facility
- Commissioned during period of public scrutiny
- Strong, proactive community outreach program addressed concerns
- ISO registration lauded by public officials
- First LI-based organization
- First Office of Science facility

NSF International Strategic Registrations, Ltd.

A Subsidiary of NSF International
2100 Chambersville Rd., Suite 200, Chambersville, PA 17021
(800) NSF-3834



Certificate of Registration

This certifies that the Environmental Management System of

BROOKHAVEN NATIONAL LABORATORY

Corporate Address:

Building 605, P.O. Box 500
Upton, NY 11973-5000
Phone: 616-444-3000
Fax: 616-442-7913
Contact: Ms. Susan L. Page

Site Address:

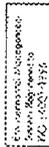
Rebecca Henry Ice Cully
Building 087, P.O. Box 3869
Upton, NY 11973-5000

has been assessed by NSF-ISR and found to be compliant to the following standard(s):

ISO 14001:1996

Scope of Registration:

The scope of registration includes the Environmental Management System for the Relativistic Heavy Ion Collider (RHIC) Project for all of BNL's operations. Science Associates and contractors and subcontractors of the Collider and Experiment. Also included are related activities encompassing superconducting magnet research, development, production of Collider magnets, and superconducting magnets for the Large Hadron Collider and other major hadron projects. Research operations of the project are included in the scope of this registration.



Incidental Classification:
SGS Code: 894

Randy A. Dougherty
Randy A. Dougherty, President, NSF-ISR

Certificate Number: 8931-1-1
Certificate Issue Date: 08/23/99
Date of Initial Registration: 08/23/99

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Registration Cost Estimates

- Registration Strategy:
 - Facility registration in a phased approach
 - Site wide registration in year 3
- Preparations
 - Evaluation of facilities \$ 10 K
 - Bid Proposal Preparation & Procurement \$ 24 K
 - Consultant \$ 11 K
- Range of Registrar bids: \$91 - 121 K
 - includes surveillance audits and re-registration audit
 - includes evaluation of EPA criteria in MOA
- Consultant during registration audit: \$ 6K

Registration Cost Estimates

TASK	FEES	DAYS	EXPENSES	SUBTOTAL	ACTUALS
RHIC Registration	\$13,200	10	\$2,500	\$15,700	\$13,100
EM Registration	\$6,600	4.5	\$1,125	\$7,725	
CAD Registration	\$6,600	4.5	\$1,125	\$7,725	
RD Registration	\$10,800	9	\$2,250	\$13,050	
BNL Registration	\$34,800	28	\$7,000	\$41,800	
SUBTOTAL	\$72,000	56	\$14,000	\$86,000	
Surveillance Audits (3 yrs)	\$16,200	12	\$3,000	\$19,200	
MOA Evaluation	\$0	0	\$0	\$0	
Recertification Audit	\$5,400	4	\$1,000	\$6,400	
SUBTOTAL	\$21,600	16	\$18,000	\$39,600	
TOTAL	\$93,600	79	\$32,000	\$125,600	

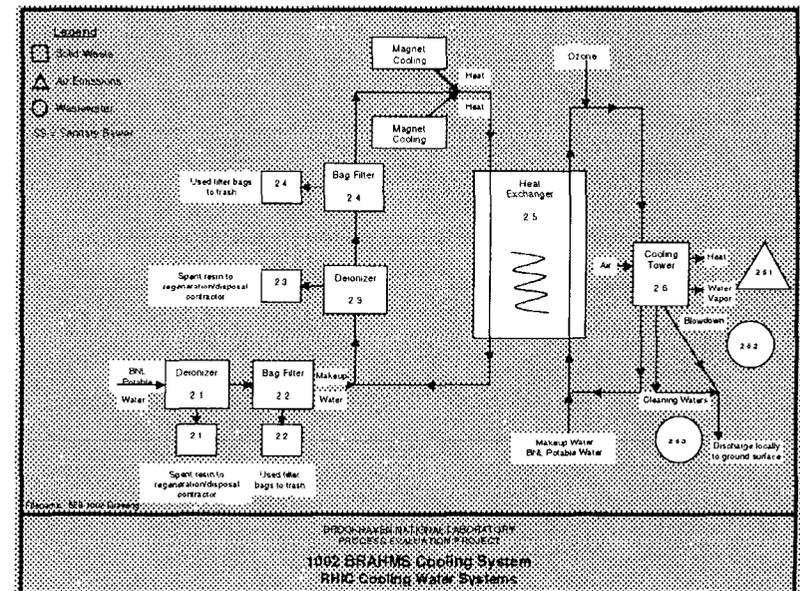
Expenses estimated at \$250/person-day

Laboratory Deployment

- Costs vary based on
 - status of existing infrastructure
 - aspects of work processes/facilities
 - level of formality
 - culture; staff acceptance
- Costs of enhancing existing programs, not development
 - Process Evaluation Process \$1.4 M, P2 Program \$150K/yr
 - Waste Management, Environmental Restoration Programs
 - Community Outreach
 - Site Environmental Report \$150 K/yr
- Incremental System Maintenance Costs: \$400 K/yr

Phase II Process Evaluation Project

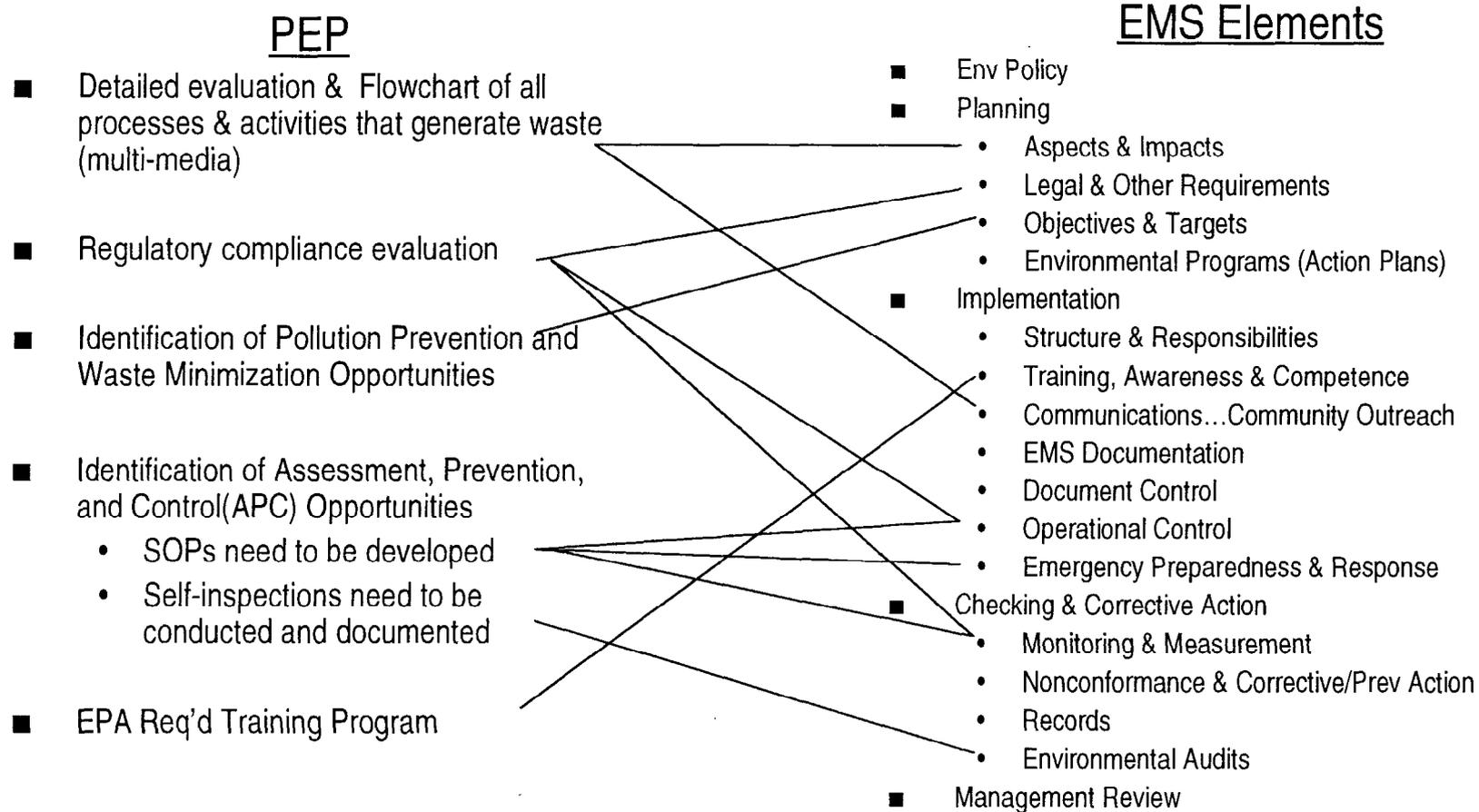
- Field Deployed Environmental Expertise - *ECR's*
- Process maps- industrial and experimental activities
 - 165 industrial processes
 - 1800 experiments
 - 450 maps
- Identifies material flow, waste streams, disposal practices
- Multimedia (air, water, solid)
- Link Aspects and Impacts to work
- Evaluates:
 - compliance status
 - operational controls
 - monitoring and measurement
 - pollution prevention opportunities



Provides technical basis for the EMS

EPA Phase II: Process Evaluation Project (PEP)

PEP Correlation with EMS Elements



Facility Deployment Costs

FACILITY	ESTIMATE (\$)	% Complete	ACTUAL (\$)
SUMMARY	1,826,310	45	\$533,839
RHIC Project	141000	100	\$89,850
Waste Management Division	64260	100	\$59,799
Reactor Division	165000	100	\$93,890
Environmental Restoration Division	112300	49	\$35,400
Facility & Operations	227000	39	\$19,600
Basic Energy Sciences: NSLS, Chemistr	149000	40	\$25,700
Accelerator Complex	168050	52	\$34,500
Life Sciences: Medical, Biology	126000	47	\$19,000
Applied Science & Technology	185600	48	\$19,500
Environment, Safety, Health & Quality	107000	43	\$67,000
Directors Office & Public Affairs	105250	42	\$25,300
Finance & Administration	123000	41	\$12,500
High Energy Nuclear Physics: Physics, Instrumentation	152850	52	\$31,800

Improvement Initiatives

- Implementation strategy improved based on lessons learned by pilots
- Tools, models, procedures developed by pilots available to Laboratory
- Significant Aspects criteria updated
- Assistance by Experts on EMS Audit process
- Management Review Process improved

Benefits Realized, To-Date

- Improved awareness of environmental issues
 - training, communications, aspects/impacts analysis
- Improved compliance status
 - reengineering regulatory requirements out of processes
- Systematically implementing P2 opportunities
 - Manager & Staff have formal objectives/targets
 - Reducing/eliminating waste streams
- Accessible Environmental professionals & information
- Commitment to Community concerns critical to operations
- Gained understanding of new BSA management systems
- Ongoing independent verification of conformance

Cost Saving Strategies

- Build on **existing systems** and infrastructure
- Centralized systems
- **Systems Thinkers** on Team
- **Assessments**
 - Minimize costs by minimizing findings
 - Integration theoretical; execution is still independent
- **Pilot Process Successful**
 - minimized costs of false starts and delays
 - test programs & provide feedback
 - created *momentum* for others
- **Web Based Systems**
 - procedures
 - training
- **Design for Successes**