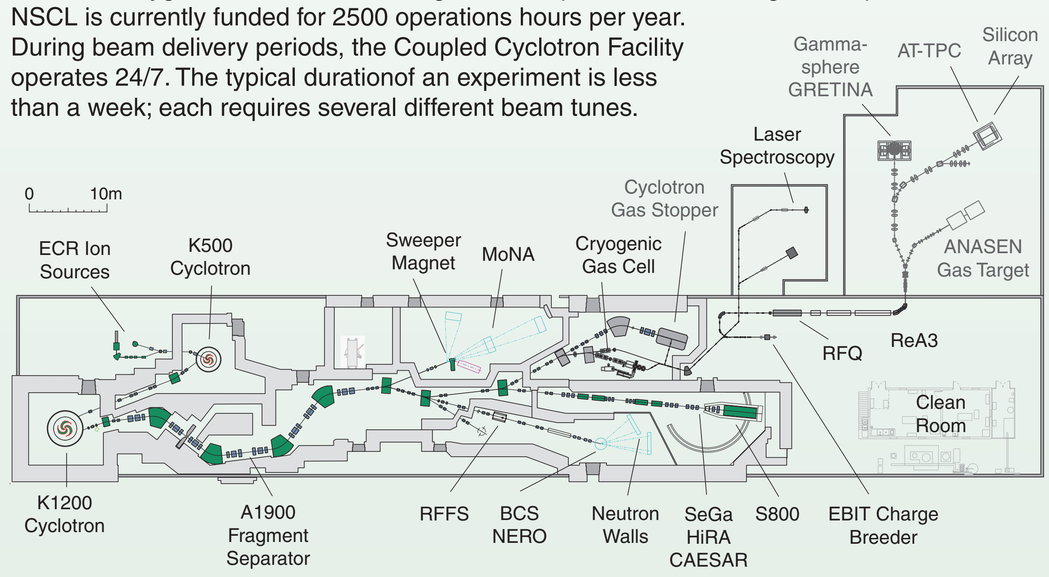
Standards-Based Operation of a Nuclear Physics User Facility

Summary — As the nation's largest university-based nuclear science user facility, the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University plays a leading role in rare isotope research and nuclear science education. NSCL produces word-class beams of rare isotopes using the in-flight separation technique and serves a user community of more than 700 scientists. NSCL established management systems for quality, environmental impacts, and occupational health and safety. These systems have been certified according to the international standards ISO 9001, ISO 14001, and ISO 18001 and cover all processes in support of delivery of beams to experimenters. Applying the experience of established industry standards in management of a nuclear physics research facility resulted in efficient, reliable, and safe facility operation and highly satisfied facility users.

The National Superconducting Cyclotron Laboratory provides accelerated beams of heavy ions from oxygen to uranium, including rare isotope beams, at energies of up to 170 MeV/u. NSCL is currently funded for 2500 operations hours per year. During beam delivery periods, the Coupled Cyclotron Facility operates 24/7. The typical durationof an experiment is less than a week; each requires several different beam tunes.



Standards-Based Integrated Management at NSCL

All processes that affect safety, environmental impact, and delivery of beams to experimenters are well defined and communicated to employees and to users of the facility.
Changes to processes or equipment, including experimental setups, require reviews that consider safety, environmental impact, and quality impact.
External audit provides annual review of business processes.
Service Level Descriptions define support levels that facility users can expect.
For every experiment, an Experiment Service Description will be compiled with details of provided services.

ISO 9001 – Quality Management System
Covers the delivery of rare isotope beams to users and all related processes.

ISO 14001 – Environmental Management System
Establishes significant aspects regarding environmental impact, leading to the development of appropriate mitigation plans.

ISO 18001 – Occupational Health and Safety Management System
Controls health and safety risks, establishes training requirements, and provides framework for performance enhancement.

Environmental, Safety, and Health (ESH) Management System

NSCL's Environmental, Safety and Health Management System assists management in ensuring that a safe and healthy workplace is provided to all employees and facility users while also protecting the environment.
Assessment of risks to ES&H for all work allows to identify appropriate preventative and protective measures in order to comply with any relevant statutory provisions, and to maintain health and safety of all persons.
Determination of a list of significant aspects (significant environmental, safety or health impact of operations conducted at NSCL) allows the development of mitigation plans.
Formalized safety policies and procedures are readily available to all employee.

Hazard Identification Checklist

Hazards	Y	N
1) Chemicals		
2) Compressed Gases		
3) Pressure or Vacuum Vessels		
4) Cryogens		
5) Confined Spaces		
6) Electrical Systems		
7) Fire or Explosive Hazards		
8) Special Material Handling		
9) Oxygen Deficiency		
10) Human Exposure to Electric or Magnetic Fields		
11) Special LOTO procedures		
12) Ergonomic Issues		
13) Environmental Impact		
14) Non-ionizing Radiation (lasers, microwave, RF, etc.)		
15) Ionizing Radiation		
16) Adverse Conditions (height, noise, ventilation, lighting,...)		
17) Special Emergency Response Procedures.		
18) Qualified Operating Personal		
19) Non Standard Industrial or Commercial Issues		
20) Special Personnel Protective Equipment		
21) Equipment and Structural Integrity Issues		
22) Operational Effect on Other Systems		
23) Will new JSA(s) need to be generated to perform work?		
24) Other		

Elements of the ESH Management System

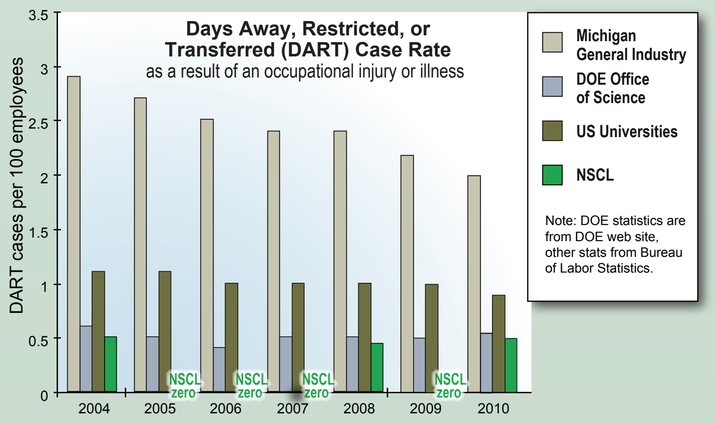
- Job Safety Analysis to provide a process for task hazard identification & documentation of control
- Tier I Inspections including reporting and tracking of findings
- Record of Decision to formally document safety related decisions
- Causal Analysis of all accidents to prevent recurrence
- Stop Work Authority empowers all NSCL workers to stop imminent hazards
- Operational Readiness Review to determine operational compliance & safety preparedness
- Safety Suggestion Program to promote employee involvement & ownership of safety

Safety Training

NSCL training database
- to record required and completed training,
- integrated to NSCL access control database

Communication of training requirements

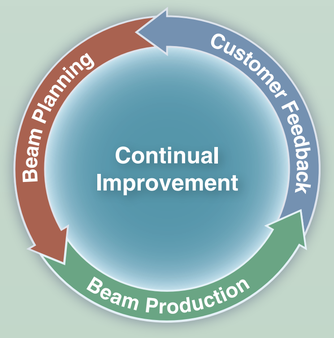
Provide all training courses online for immediate access



Continuous Improvement is a requirement of all three standards

NSCL has a Continuous Improvement Committee
- Review of all Trouble Reports (bi-weekly)
- Committee is stakeholder in all decisions affecting reliability

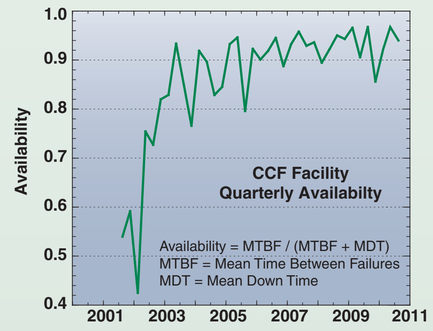
Input received from:
- Trouble Report System
- User Surveys
- Verbal communications through line management
- Annual internal and external audits



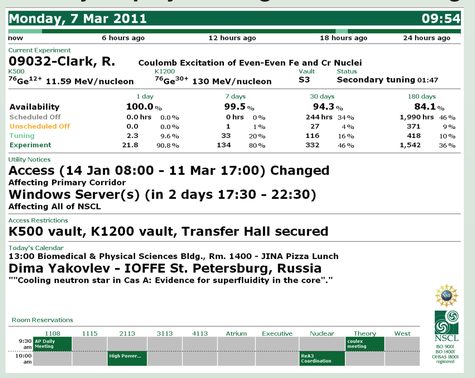
Quality Management System (QMS) covers the delivery of beams

The objectives of the QMS are measurable performance indicators relevant for facility operation:
- Rare Isotope Beams will be delivered with 90% availability
- Rare Isotope Beams will be delivered within 24 hours of the scheduled time

High availability results in dependable schedule which leads to high user satisfaction



Hallway displays throughout the building



Every system or process failure triggers a **"Trouble Report"**
- Root cause analysis, corrective and preventive action
- Risk-based graded response to address failures (for all 3 systems)

Labwide **Preventive Maintenance Database**
- Scheduled maintenance with reminder emails
- Maintenance records to document maintenance history

Experimenter Feedback Survey to analyze "Customer Satisfaction"

One common risk management matrix for all management systems

Corrective and preventive action process for all three management systems
- Suggestions for improvements, safety and environmental near-misses, safety/environmental findings, and audit findings
- Risk Management Matrix determines risk based on Severity (impact on facility downtime, equipment loss, environmental, safety/health, project management) and probability of occurrence
- Graded response based on risk

Risk	Negligible	Marginal	Significant	Critical	Crisis
Frequent	Medium	Medium	High	High	High
Probable	Medium	Medium	Medium	High	High
Occasional	Low	Medium	Medium	Medium	High
Remote	Low	Low	Medium	Medium	Medium
Improbable	Low	Low	Low	Medium	Medium

Severity	Project management	safety/health	environmental	equipment loss	facility downtime
Crisis	Project stopped. Catastrophic threat to mission need.	Death, permanent total disability	Irreversible severe environmental damage that violates law or regulation	Loss exceeding $1M	Downtime exceeding 285 hours
Critical	Goals and objectives are not achievable. Additional funding or time may be required	Permanent partial disability, injuries or occupational illness that may result in hospitalization of at least three personnel	Recoverable serious environmental damage causing a violation of law or regulation	Loss exceeding $210K but less than $1M	Downtime exceeding 60 hours but less than 285 hours
Significant	Significant degradation objectives, significantly increased cost or significant impact on schedule.	Injury or occupational illness resulting in more than one lost work day	Correctable moderate environmental damage, possibly causing a violation of law or regulation	Loss exceeding $42K but less than $210K	Downtime exceeding 12 hours but less than 60 hours
Marginal	Minor degradation of objectives. Marginal increase of cost, marginal impact on schedule.	Injury or occupational illness resulting in one lost work days	Mitigatible environmental damage without violation of law or regulation	loss exceeding $3.5k but less than $42k	Downtime exceeding 1 hour but less than 12 hours
Negligible	Minimal or no consequence on performance. No impact on project cost or schedule.	Injury or illness not resulting in a lost work day	Minimal environmental damage not violating law or regulation	loss less than $3.5k	Less than 1 hour downtime

High user satisfaction as a result

Are you in general satisfied with your experience performing this experiment at NSCL?	true	100%
	false	0%
Did the Coupled Cyclotron Facility provide the beams you requested?	true	100%
	false	0%
Was the communication between your experimental team and NSCL staff efficient and effective?	true	100%
	false	0%
Did you understand how decisions affecting your experiment were made?	true	100%
	false	0%
Please rate your overall experience as an experimenter at the NSCL?	excellent	71%
	very good	27%
	good	2%
	fair	0%
	poor	0%

Analysis of User Feedback Data (2009-04-01 – 2012-04-01)

All experimenters are asked to complete a survey at the end of their experiment:

Survey results reflect highly satisfied experimenters.

Comments provided by experimenters in the survey help to improve the beam delivery process.

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