Safety Discussion with PRTs

A Review of Safety Issues on the Experimental Floor

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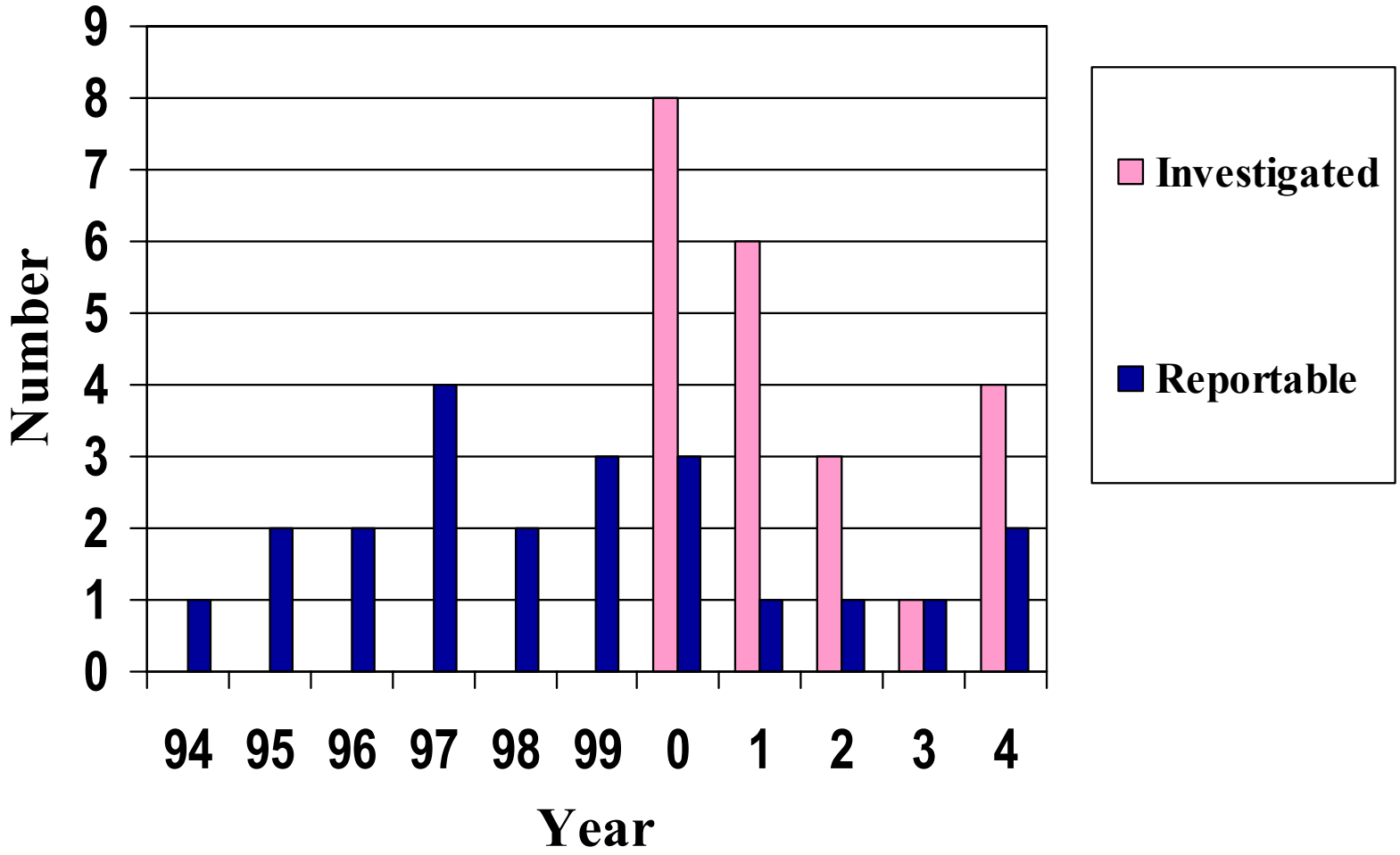
Safety Environment at BNL

- High expectations for safety performance by BNL and DOE management.
- DOE Office of Science has “Zero Tolerance” for work place incidents and wants to be “Best in Class” for safety performance.
- BNL has adopted a vision that “all accidents are preventable” and expects strict compliance with all ESH rules
- Any incident draws considerable reaction from Office of Science, particularly from Ray Ohrbach, and from BNL management.
- NSLS has had a number of incidents – therefore …

NSLS Occurrences 1994-2004



Types of Reportable Occurrences in Past 10 Years

- 2 working hot incidents (95, 97)
- 2 electric shock (02, 04)
- 2 spills (96, 97)
- 2 cryogenic (over pressurized dewars) (97, 99)
- 2 laser incidents (Non-exposure) (99, 01)
- 2 fires of electrical origin (97, 99)
- 3 personnel injuries (97, 00, 03)
- 1 procedural violation during beam line alignment using synchrotron radiation visible light (02)

Examples of Recent Incidents at NSLS

- 5/2002 – Local contact modifies electrical connections to address an operational issue with his sample and accidentally energizes BNC connector to 1000 V. d.c. Subsequently, he experiences electrical shock.

- 10/2002 – Beam stop and barriers for alignment at VUV beam line are removed prematurely and worker is exposed to low intensity light beam from ring.

- 3/2003 – Despite repeated warnings, a user enters the experimental floor on several occasions without radiation dosimetry.

Recent Incidents at NSLS (Cont.)

- 5/2004 – In an effort to change polarity, two users reverse electrical connections of cable at 1000 V. power supply and accidentally energize outer shell of SHV connectors. Unsafe condition exists for ~ 5 days and carries on to 2 subsequent experiments.

- 8/2004 – Local contact for beam line and NSLS tech remove front plate to a beam line component. Neither is aware of energized surfaces within box and tech subsequently suffers 300 V d.c. electrical shock.

The Dilemma

- For the most part, our safety program is judged very strong and has been very effective, except for incidents at the beam lines.
- Although none of these incidents has resulted in even minor injury, each represents serious departure from expected practice.
- The most recent incident provoked a letter from the DOE Site Office Manager expressing strong concern about "… the high frequency of safety related incidents at the NSLS …"

NSLS Follow-up

- Each of the previous incidents had resulted in a detailed critique of the circumstances and a corrective action plan established.
- To address DOE concerns about the last incident, we had to conduct an in-depth critique and 7 other assessments reviewing elements of the program.
- Critique identified 6 causal factors and resulted in 20 corrective actions.

The role of the PRT

- In the past, we have sought to improve NSLS training, increase NSLS oversight and provide frequent dialogue with PRT and general users about the importance of these issues in an effort to strengthen safety culture at the beam lines.

- In addition, we have sought to ensure understanding of the role of the PRTs and general users in assuring safe operations at each beam line.

PRTs are vital in the safety program

- PRTs
  - Operate and maintain the beam lines
  - Schedule activities
  - Train, support and provide oversight to users at their beam line

- Overall, PRT beam line staff have much more presence at their beam line than NSLS and should play the lead role in safety management at their beam line.

Responsibilities for the PRT

- Conduct pre-run briefing with each experimental group to ensure:
  - Approved SAF exists and that conditions imposed by the SAF are understood and addressed by experimental team
  - BLOSA training for all team members is current
  - Understanding by team members of essential facility and beam line safety requirements
  - Adequate and qualified staffing exists for safe and effective operation

Responsibilities for the PRT (cont.)

- Ensure configuration control of the beam line and associated equipment and report proposed changes to NSLS ESH Staff or Beam Line Safety Committee
- Provide adequate beam line support to experimental teams to ensure safe and effective running consistent with NSLS requirements
- Provide general oversight of experimental team to ensure compliance with ESH and other beam line requirements

Responsibilities for PRT Staff (cont.)

- Maintain same training requirements as NSLS beam line staff
- Follow work planning requirements for moderate and high hazard work
- Adhere to BNL safety requirements

Training Requirements

- We expect that the PRT provides experienced knowledgeable people that can conduct activities in a safe manner

- We expect you to know BNL requirements by completing:
  - General Employee Training
  - Emergency Planning/Resp
  - NSLS Safety Module for Scientific/Technical Staff
  - GERT
  - Lab Standard

Training Requirements (cont.)

- Electrical Safety 1
- LOTO-affected
- Cryogen Safety
- Compressed Gas Cylinder Safety
- Portable Ladder Safety
- Cyber Security
- Review of NSLS Lead Working Guidelines (PRM 6.2.0)

Permissible after additional training

- Generating hazardous and industrial waste
- Rigging, material handling and hydraulic lifts, designated as “ordinary lifts”
- Machine shop use
- Handling limited quantities of lead bricks (< 100 bricks)
- Work with sealed radioactive sources (for accountable sealed sources only)

Formal Work Plans are required
for the following situations

Radiological and Lasers

- Removal of beam line radiation shielding (Safety System Work Authorization Permit)
- Use of the synchrotron radiation beam for beam line configuration or experimental work[3]
- Work in posted radiation areas (radiation dose rate is ≥ 5 mRem/hr)
- Work with dispersible radioactive material
- Work with Class 2, 3a, 3b or 4 lasers

Chemicals and Toxic Materials

- Any beam line work that involves handling or clean-up of damaged beryllium windows
- Non-routine Laboratory wet chemistry work[3]
- Lead handling > 100 bricks

Hutch and Beam line Construction or Modification

- Construction of a hutch
- Any modification to a hutch, beam line or beam line support structure

Electrical Safety, Rigging and Working at Heights

- Trouble-shooting exposed energized electrical components > 50 volts less ≤ 220 volts (ac or dc)
- Rigging, material handling, or hydraulic lifts designated as “pre-engineered” or “critical lifts”
- Working on platforms or other surfaces where your feet are above 4 feet over grade (e.g. hutch roof)

Activities Requiring Impairment of Fire Protection Systems

- Soldering on pipes that are greater than 1 inch diameter or when impairment of the fire suppression system is required.
- Any processes that will develop excessive vibration, dusts, smoke, fumes or mists

Hazardous Equipment Inventory

- Identify equipment with energy sources that must be controlled during maintenance, trouble shooting, etc. to prevent injury.
- Equipment is normally made safe by securing the energy source prior to removal of protective enclosures or barriers.
- Work closely with Ackerman and Aloi for guidance and consistency in approach.

Managing beam lines is a challenge

- Many users are short-term and are not aware of the safety expectations at BNL
- Many users come from a different safety culture and bring a different commitment to safety requirements
- We need PRTs to operate their beam lines safely and in compliance with BNL requirements, and to provide consistent support and oversight of visitors and general users

Important Messages That You Should Understand and Practice During Your Daily Work

- We have very high expectations for performance
- Getting the job done safely is our highest priority
- Rules are not discretionary, but remember that good judgment is always needed
- Take a time out and reconsider if conditions aren't as expected
- If you have doubts, pull back and get help
- Everyone has a part to play – watch out for the other guy
- Life is too short to take unnecessary risks

X1 Photon Monitor Shock

- Six Causal Factors
- Lessons Learned
  - Management
  - Supervisors
  - Workers
  - Staff and Users

Causal Factor 1:

Tech assumes system in safe configuration to begin work

Apparent Cause #1

- There was no procedure that the LC or utilities group could refer to place the PBPM in a safe configuration prior to replacing the hose.

Apparent Cause #2

- The communication between the tech and the LC was incomplete.

Apparent Cause #3

- The instruction and briefing provided by the supervisor to the tech performing the work needed improvement.

Apparent Cause #4

- The use of Lockout/Tagout needed improvement.

Causal Factor 2:

The X1A1/A2 LC was not aware that the PBPM was biased at 300 VDC nor aware of location of power supply in the electronic rack at front end of the X1 beamline.

Apparent Cause #5 (same as #1)

- There was no procedure that the LC or utilities group could refer to place the PBPM in a safe configuration prior to replacing the hose.

Apparent Cause #6

- The instruction and training provided to the Local Contact needs improvement.

Apparent Cause #7

- The Local Contact was not qualified to assume responsibility for placing the PBPM in a safe state.

Causal Factor 3:

Caution sign found laying face down near box.

Apparent Cause #8

- The manner in which the warning sign was affixed did not adequately consider the radiation environment of the X-ray ring.

Apparent Cause #9

- The placement of the original warning sign was inadequate.

Causal Factor 4:

The requirement implemented previously to lock and tag out the power supply to the PBPM was not documented and resulted in a loss of historical information.

Apparent Cause #10

- The communication and documentation system for ensuring that established safety requirements associated with maintenance are documented and carried forward needs improvement.

Causal Factor 5:

Based on NSLS specific training LC believed BNC cables used for <50V.

Apparent Cause #11

- The "Sci/Tech Staff Safety Training Module" needs improvement.

Causal Factor 6:

*Equipment responsibility not adequately assigned for Photon Beam Position M*onitor

Apparent Cause #12

- The assignment of responsibility for the X1 PBPM was inadequate.

Lessons Learned:

Management:

- Ensure that all beamline and facility equipment with significant hazards has clear ownership and a responsible person.
- It is vital that all hazardous equipment has someone designated to maintain safe configuration, including appropriate warning signs, and to act as a contact for questions concerning hazards, operation, maintenance, and troubleshooting.

Lessons Learned:

Supervisors:

- Do not assign work as "skill of the worker" on equipment with electrical or other energy sources that you are unfamiliar with. "Skill of the worker" should be restricted to tasks for which the worker has been formally qualified by the supervisor, and it is known that the work is low hazard. Work permits should be expected for work with unfamiliar equipment that is potentially hazardous unless a designated responsible person has confirmed the equipment is in a safe state and has placed the first lock-out when required.

- When screening work to determine hazard level and work planning requirements, be particularly cautious with equipment that has no readily identifiable responsible person. "Legacy" equipment with unclear ownership may have hazards that have been long forgotten and work should not proceed on these systems until their function, hazards and operation are defined.

Lessons Learned:

Workers:

- All electrical equipment must be de-energized before work may begin on the system. You must assure that the power supply is de-energized, locked, and tagged out and in a confirmed safe state before work begins.

- Make no assumptions. If there is uncertainty, contact your supervisor and ask to initiate a formal work plan.

Lessons Learned:

Staff and Users:

- Do not alter the configuration of equipment or components unless you are authorized to make changes and are knowledgeable of the hazards associated with the equipment.

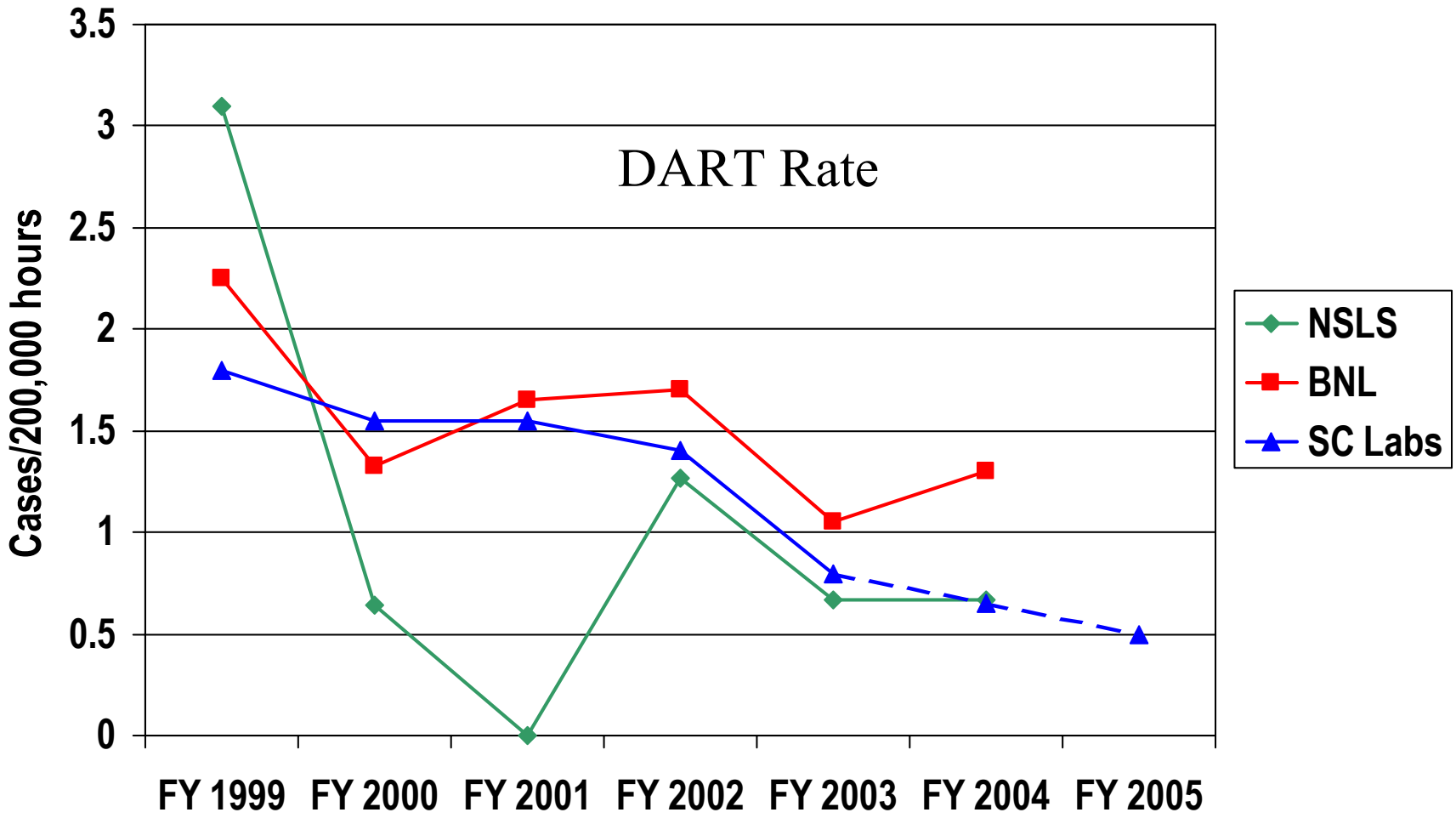
- Use inherently safe voltages (< 50 V a.c./d.c. or < 10 mA) whenever possible when designing and constructing equipment.

Types of Injuries

(Does not include injuries experienced by users)

- Slipped or tripped on floor and fell – 3
- Moving or lifting heavy loads – 2
- Slipped and fell on stair way – 2
- Cuts from sharp objects (e.g. bandsaw, razor knife, sheet metal) – 4
- Hernia from assuming awkward positions in difficult job – 1
- Fell while riding bicycle - 1
- Hurt back bending over - 1
- Stepped in pothole in parking lot and fell – 1
- Struck by car while crossing road – 1

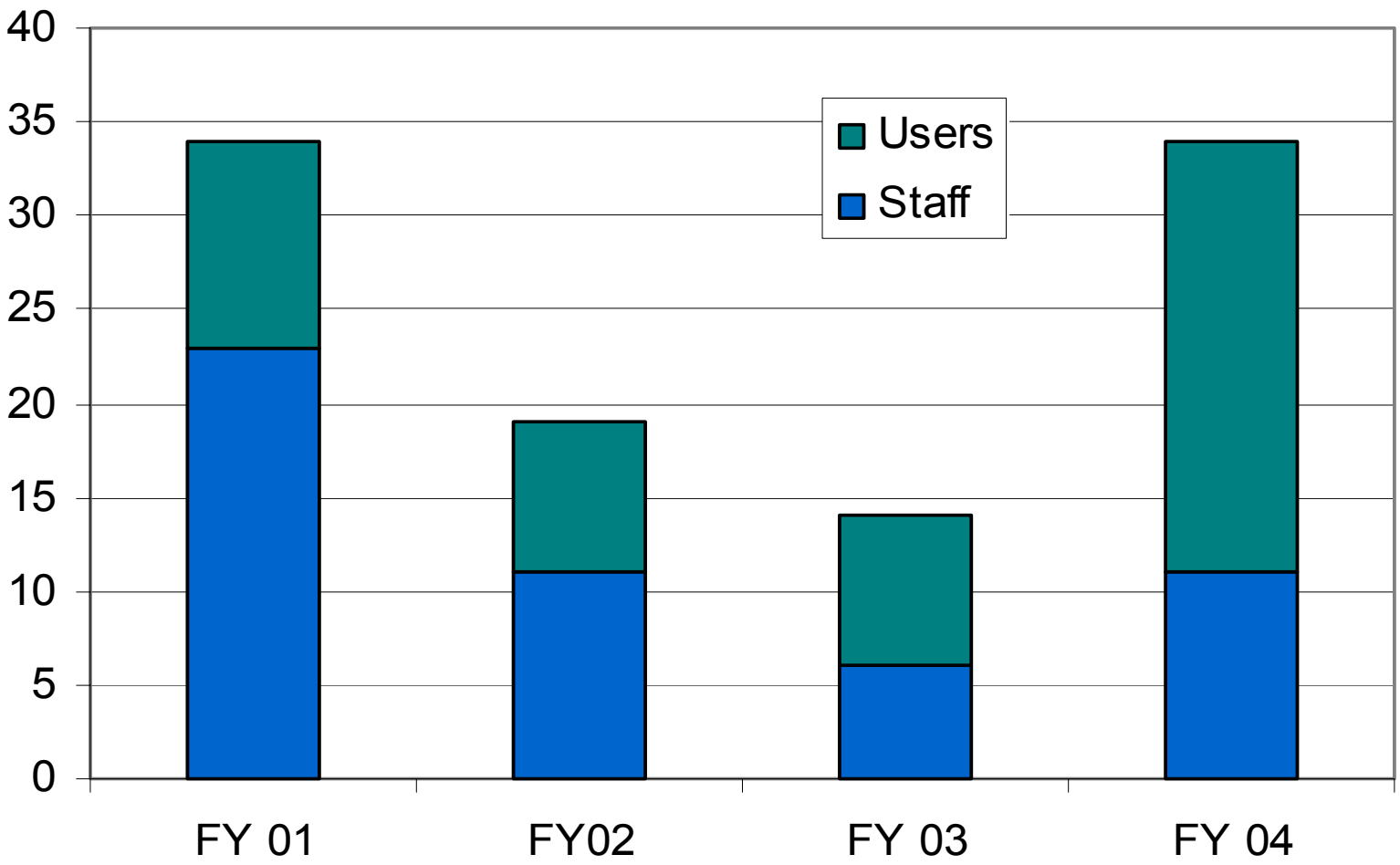
NSLS Compared to BNL & All SC Labs



Traffic Violations

- 18 tickets since new policy and traffic enforcement campaign started 4/1/04
  - 3 tickets received by NSLS personnel [1 student, 1 post-doc, 1 staff member (ticket successfully appealed)]
  - 3 tickets received by PRT beam line staff
  - 12 tickets received by General Users
- 18 tickets distributed as follows:
  - 3 parking
  - 1 speeding
  - 1 following too close (appealed)
  - 13 stop sign violations

Traffic Tickets per Fiscal Year



Work planning requirements for short-term users

Following completion of NSLS facility specific training and LS-RAD-FACILITY, a user has access to all areas of the building except for those posted as Radiation Areas.

Following completion of BLOSA training, the user is authorized to conduct the following type of activities without additional work planning and permits.

- Set-up of experimental apparatus and manipulation of beam line controls as authorized by beam line staff and approved on the experiment Safety Approval Form.

- Routine work associated with data collection and sample preparation

- Running experimental cables, including low voltage, high voltage and signal cables. Cables must be placed in the appropriate cable tray. (Work is not permitted on exposed energized components > 50 V and no work is permitted on building AC power distribution systems.)

Continuation of slide 18

- Access to hutches, and search and resetting of hutch security systems. Operation of shutters to bring the synchrotron beam into the hutch or end station.
- Work on “User” equipment interlocks as authorized by the beam line staff. Work on NSLS personnel interlocks is strictly forbidden.
- Experimental system plumbing (e.g. water, etc.) as authorized by the beam line staff.
- Limited transfer of cryogenic liquids consistent with BLOSA instructions.
- Limited handling of compressed gas systems consistent with BLOSA instructions.
- Use of portable ladders

Following completion of the training program for personnel assigned to a beam line (and approval of the local contact), the individual is authorized to conduct the following type of activities without additional work planning.

- All of the work identified in the previous section
- Set-up, exchange, and operation of compressed gas cylinders and systems.
- Experimental system plumbing (e.g. water, compressed gas, etc.) Any connection to NSLS house systems must be pre-approved by the NSLS utilities group.
- Handling helium and nitrogen cryogenics.
- Beam line diagnostics, setup and alignment without beam.
- Work on beam line vacuum systems in accordance with the vacuum procedures for each beam line.