Critique of Incident

"Work Planning Violation

At U5UA Beam Line on 10/4/2002"

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Critique of Work Planning Violation at U5UA Beam Line on 10/4/2002

I. Purpose The purpose of this critique is to review the sequence of events and to determine the causal factors leading up to the work planning violation that occurred at beam line U5UA at the National Synchrotron Light Source (NSLS) on 10/4/2002. This event had been previously critiqued and reported in an internal memo written by N. Gmur on 10/30/2002.

At the time of the incident, a NSLS manager serving as the on-duty BNL Occurrence Categorizer determined that the event was not reportable. In a memo dated 2/13/2004 from M. Holland to P. Chaudhari, the lab was requested to report this incident in the Occurrence Reporting System (ORPS) and to review the lack of formal reporting to DOE initially. This new critique was conducted to satisfy the requirements of the ORPs reporting system. In addition, an analysis of the reporting issue is also included in Appendix A.

The following persons participated in this critique: A. Ackerman (NSLS), M. Ali (DOE), M. Buckley (NSLS), R. Casey (NSLS), N. Gmur (NSLS), S. Hulbert (NSLS), E. Johnson (NSLS), E. Sierra (QMO), E. Vescovo (NSLS), C. Weilandics (SHS)

II. Background This incident took place at the NSLS at the U5UA beam line on the VUV experimental floor. At the time of the incident, changes in the beam line were in progress to replace the experimental end-station with a new one. The local contact[1] for the beam line had assigned a post-doc collaborator the task to determine the focal point of the visible light beam emerging through a glass window at the end of the U5UA beam line. This measurement was needed to establish the exact location of a new photoemission chamber. Based on his knowledge and experience with the beam line, the local contact knew that the visible light beam would be low power and that the post-doc could safely conduct this work. As required, the local contact submitted the work for safety review by the NSLS Safety Officer, but unknowingly had not successfully entered the work description into the Safety Approval Form (SAF)[2] database. As a result, the posted SAF for this work was inaccurate and incomplete at the time the activity was scheduled to begin; beamline personnel and operations personnel relied, instead, on verbal instructions from the Safety Officer.

III. Sequence of Events

10/2/2002

[1] Local Contact is the title used at the NSLS for the person responsible for the day-to-day activities of the beam line.

[2] The safety approval form (SAF) is the document completed by a user that describes the work to be done and the potential hazards associated with the job.

- The NSLS floor watch (Operations Coordinator[3]) receives a request to enable[4] beam line U5UA, but finds that the SAF for the work is not approved and does not properly describe the work that will be performed. The Safety Officer is contacted and he goes to the beam line and meets with the post-doc and a beam line technician to review the work and to determine the necessary controls. The Safety Officer provides verbal instructions that the beam path be defined and that barriers be established to prevent inadvertent exposure to the light beam. These requirements are standard for work of this nature at the NSLS, even with low power beam lines, as it is considered good practice to have open beam paths always controlled. The Safety Officer provides approval to enable the beam line subject to these requirements.

- The beam line technician installs a beam line barrier in accordance with the recommendation of the Safety Officer. The NSLS Operations Coordinator reviews the set up, confirms that proper barriers are in place, and enables the beam line. The work begins and is readily accomplished. The focal length measurement is completed.

10/3/02

- After first confirming with the post-doc that the measurement of the focal length was complete, the beam line technician removes the beam barriers in order to conduct his work on the beam line. During the day, in reviewing the work of the previous day, the Beamline Development & Support Group Section Head asks the post-doc to conduct a measurement of the angle of the visible light beam relative to the floor. Because this measurement requires additional equipment, an experienced NSLS staff member (a support Science Associate) is assigned to work with the post-doc. Later, the two begin the set-up of the optical equipment required to conduct the second measurement. The new configuration for the second measurement required a light path extending over several meters and would have been incompatible with the barrier and stop used in the previous measurement.

10/4/02

- On the 3rd day, the second measurement (i.e. beam angle) began. Based on their knowledge that the light intensity was very weak, the involved personnel (i.e. post-doc and science associate) did not seek to re-establish compatible barriers with the exposed light beam. Use of the beam without the required controls for the second measurement was not reviewed with the Local Contact, Safety Officer or an Operations Coordinator. The beam line technician continued with the work begun on the previous day with no knowledge of the plans for the second

[3] Operations Coordinator is the title used at the NSLS for the persons responsible to permit turn on of beam lines following the determination that all requirements are satisfied.
[4] At the NSLS, the shutter permitting light to enter a beam line cannot be opened until "enabled" by an Operations Coordinator.

measurement. At one point after stepping away for a discussion at another beam line, the technician returned to his work without realizing that the visible light beam was now exposed and unprotected. As he crossed the beam path, he felt the light strike his eye. He looked up and was briefly struck by the light beam again (exposure time is assumed to be the blink reflex time of an average person, ~0.25 second). The two staff members conducting the measurement were also present at the beam line, but neither observed the technician return to the beam line.

- The incident was immediately reported to the technician's supervisor and NSLS Safety Staff, and the area was secured. Although the beam line staff and local contact reported that the light beam was not dangerous, the power level of the light beam was evaluated by independent NSLS beam line staff and the BNL Laser Safety Officer, a member of the Safety and Health Services Division at BNL. It was determined that the beam power was indeed very low (~5 x 10^{-5} watts) and that there was no potential for harm to the employee who was exposed to the light beam. (For a comparison, the power in a typical laser pointer is 1 – 2 x 10^{-3} watts, or 20 – 40 times more intense than the light output coming through the view port of this beam line.) It should also be noted that there was no exposure to ionizing radiation because of the nature of the beam.

- There was a critique of the incident with all involved persons later in the afternoon to determine the sequence of events. The BNL Occurrence Categorizer evaluated the event and determined that it was non-reportable within the ORPS system.

Later Events

- Discussions were held with the technician who had been exposed to the light beam to ensure that he had no concerns about his eye exposure. He was advised that he should consult with medical doctors if he had any reservations about the exposure.

- A disciplinary meeting with the department chair and involved personnel was held on 10/8/02.

- A formal report of the incident was prepared and distributed on 10/30/02 to NSLS management and ESH staff, as well as other persons involved in the incident.

- The categorization of the event as non-reportable was discussed at the BNL Occurrence Categorizers Workshop on 12/18/02.

IV. Causal Factor Analysis

A brainstorming session was conducted on 2/23/04 with the participation of all meeting attendees to determine the causal factors associated with this incident. The following issues were evaluated:

1. Beam line staff did not comply with the established safety requirements

The safety controls for the work with the exposed light beam had been established by the Safety Officer and were implemented by the technician and the post-doc at the beginning of the activity. When the scope of the work was expanded to include the second measurement, the same or similar controls would have been required for the configuration of the second activity. The post-doc and science associate's knowledge that the beam was non-hazardous resulted in their lack of concern in proceeding with the work without the required barriers specified during the initial review of the Safety Officer. When realizing that there were no barriers along the beam path, they should not have proceeded without re-establishing the barriers or obtaining the approval of the Safety Officer to work without them.

The Committee concluded that the lack of adherence to the established safety requirements was a causal factor.

2. Difficulties with the initial SAF submission created an on-the-floor assessment of issues at the time the work was scheduled to begin

The current SAF database system[5] for submitting proposals for safety review can be error prone for users and staff. The Safety Officer often encounters incomplete submissions created by users who have not correctly entered their information into the system. When it was realized that the SAF entry for this work was not correct or complete, the Safety Officer proceeded to the beam line and verbally established the job requirements directly with the post-doc responsible for the work on this project. After meeting at the beam line and establishing the required controls, the SAF as submitted was posted at the beam line and the work was authorized to begin. Although the manner of this safety review is not customary, the review was adequate to establish the appropriate requirements. This type of beam line work is not uncommon and beam barriers and posted warnings have always been required for such work at the NSLS.

The Committee concluded that the difficulty with the SAF system in the initial submission of the work plan was not a causal factor in the incident.

3. Lack of communication between beam line staff prior to the incident resulted in a misunderstanding of the work in progress

[5] It should be noted that a new web-based system is under design and construction to replace the current system and is expected to be put into service during 2004.

There were 3 NSLS staff members actively involved in work at the beam line prior to and at the time of the incident – two (the Science Associate and the post-doc) were involved in the second set of measurements being made with the beam and one (the technician) was involved in the mechanical installation of a vacuum chamber.

The modification of the scope of work to include a second measurement and the need for an extended light path were not communicated to the beam line technician or to other personnel involved in the initial review. As a result, after removing the barriers required for the first measurement, the technician proceeded with his work at the beam line without knowledge or warning that a second beam measurement was to be made.

The Committee concluded that the lack of communication among the beam line staff was a causal factor in the incident.

4. The scope of work and the configuration of the beam line changed after the initial review.

Beam line operation for this set of measurements took place intermittently over a several day period and included a different set of measurements, a different beam line configuration than initially described in the only safety review, and different personnel. The change in scope of work coupled with the removal of the barriers should have been reported to the operations coordinators, who would have disabled further operations of the beam line. Work on the second measurement would then have required Op Co involvement to re-enable the beam line which would include confirmation of required controls. The post-doc, as the person responsible for the conduct of this work, should have reported this change in scope and removal of barriers to the on-duty operations coordinator.

The Science Associate who was asked to help with the second set of measurements was not present when the beam line was first enabled and the required controls were reviewed with the Operations Coordinator. He began the second set of measurements without knowledge of the original set up. However, as an experienced staff member familiar with this work, he should have questioned the lack of barriers. The post-doc had been present at the start of the measurements, but did not re-establish appropriate barriers when the set up was altered and did not inform the Science Associate of the required controls.

The Committee concluded that the change in scope of work and beam line configuration was a causal factor in the incident.

5. The need for strict adherence to the established requirements was not comprehended or accepted by the involved beam line staff

When the work on the second set of measurements began, the two staff members knew that the appropriate barriers were not in place. Their knowledge that the beam was not hazardous provided a personal rationale on their part that the work could proceed without the barriers or further review and discussion with the Safety Officer. The post-doc had

received specific instructions about the work the previous day. The Science Associate was an experienced NSLS beam line person who had performed this type of work on prior occasions and would be aware that beam line barriers were expected. Both were willing to perform the work without the required safeguards.

The Committee concluded that the willingness to work without the required safeguards was a causal factor in the incident.

V. Causes of Incident

Direct Cause – Two beam line staff members initiated work without adhering to the safety requirements established for the activity.

Contributing Causes

1. A change in the scope of work was done without additional safety review and resulted in a different beam line configuration and an unprotected light beam.
2. There was a lack of communication between the responsible person and support personnel of the change in scope of work and the need for protective barriers.

Root Cause – Two staff members perceived that it was acceptable to continue an evolving activity without the safeguards initially required for the work.

VI. Corrective Actions

1. NSLS Management will meet with the individuals who failed to follow the requirements initially established for the measurements of the visible light and reinforce the need for strict compliance while performing the work.

2. A procedure for the alignment of beam line components using synchrotron radiation shall be formally developed. These procedures shall address:
    i. Submission and posting of the SAF
    ii. Barriers and postings
    iii. Communication of changes in scope or requirements
    iv. Completion of alignment and unattended operations

3. The lesson-learned from this incident shall be distributed and discussed with NSLS staff and users. The conclusions contained in the report of the BNL Task force reviewing selected incidents in 2003 shall be considered and factored into the lessons learned. In the meeting reviewing this lesson learned, individual responsibilities for ESH shall be discussed, as well as consequences for failure to follow safety requirements.

VII. Lessons learned

Although the consequences of this incident in terms of harm to an individual were negligible, an inadvertent exposure to a light beam occurred. This incident was directly attributable to staff members who disregarded safety requirements previously established by the NSLS Safety Officer. Although the individuals were correct in their assessment of the hazard level of the beam, a fundamental principal of work planning is that established controls are not to be removed or altered without additional review and approval. It is important to emphasize with all staff and users that controls established during formal work planning or experimental safety reviews must be adhered to at all times unless formally altered by the person who established the initial safety requirement. Individuals who violate these requirements will be subject to disciplinary action.

Appendix A

Analysis of Non-Reporting of Work Planning Violation at U5UA

I. Introduction

The incident discussed in this critique was judged to be non-reportable under ORPS at the time of the occurrence. Following an anonymous letter to DOE on this incident in January 2004, the Brookhaven DOE Office conducted a review and issued a report on 2/3/04 entitled "NSLS October 4, 2002 Incident Involving Exposure to Visible Light Beam at the U5UA beam line". One purpose of this surveillance was to review the reportability of this incident under ORPS criteria. The DOE reviewer determined that "the incident should have been considered appropriate for reporting on ORPS because of the intentional violation of a critical procedure resulted in unwanted exposure to a potential hazard." ORPs Criterion Group 1 (F) Off-normal (2) in effect at the time of this incident was cited by the reviewer as applicable in this case. The report also noted that the incident could have been reported at the discretion of the Facility Manager using ORPs criterion Group 10 C. off-normal (2), particularly recognizing that the additional rigor required for investigating a reportable occurrence may have assisted in identifying the root and contributing causes of this event.

The purpose of the analysis in this appendix is to review the decision-making at the time of the incident and determine causes for the contrary decision.

II. Description of the Decision Making Process

A detailed description of the incident that took place on October 4, 2002 is contained in the main body of this report. The incident was evaluated against the DOE reporting criteria on Friday evening, October 4, 2002. By coincidence, the on-duty BNL Occurrence Categorizer that evening was the NSLS manager who had conducted the critique following the incident. He evaluated the reportabililty against several criteria:

Group 1 – Facility Condition

1F Violation/Inadequate Procedures

Off-normal (2) Use of inadequate procedures or deviations from written procedures that result in adverse effects on performance, safety, or reliability.

The categorizer judged that the deviation from the requirements identified in the safety review did not have an adverse effect on safety in that there were no exposures above

limits and no potential for harm to the exposed individual. The event was judged to not require reporting under this criterion.[6]

Group 3 – Personnel Safety

Off- normal (3) Personnel exposure in a single event to a hazardous substance in excess of limits …

It was judged by the categorizer that there was no exposure in excess of limits; and therefore the event was not reportable under this criterion.

Group 10 C. Potential Concerns/Issues

Off-normal (2) Identification of potential concerns or issues that are deemed worthy of reporting by the department chair/division manager.

This event sparked an immediate reaction within department management since it involved a deviation from requirements established in the experimental safety review conducted by the NSLS Safety Officer. Although there was no potential for harm in this event, disregard of safety requirements by the involved individuals was clearly an unacceptable action and was immediately addressed by the department management. Since the cause was viewed as poor judgment by the involved personnel, the incident was judged not to meet the requirements for reporting under this criterion by the facility manager; primarily because there were no programmatic or ESH lessons-learned seen as worthy of reporting to the greater community.

Based on these analyses, the event was judged non-reportable under the ORPs criteria. No discussion of the incident took place with the DOE facility representative.[7] A description of the event and reporting decision was entered into the ORPs Categorizer logbook. The event and reporting decision was discussed at the next BNL Occurrence Categorizer's Workshop with the Occurrence Reporting Program Manager and other categorizers on December 18, 2002. (See attachment A). Although these meetings are not intended as a validation of a previous categorizer decision, they provide a useful forum for discussion of events and the interpretation of the applicability of reporting criteria relative to a variety of incidents. During the discussion of this event, there was no disagreement expressed with the initial determination that it was non-reportable.

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[6] In 2003 DOE rewrote this criterion as follows: A facility operational event caused by deviating from a written procedure or using an inadequate procedure resulting in an adverse effect on safety, such as: an inadvertent facility or operations shutdown (i.e., a change of operational mode or curtailment of work or processes), facility or operations shutdown due to alarm response procedures, inadvertent process liquid transfer, or inadvertent release of hazardous material from its engineered containment. With this expanded information, it is agreed that the incident would not be reportable under this criterion.

[7] It should be noted that another occurrence took place at the NSLS on Sunday October 6, 2002 involving five users who entered the Controlled Area at the NSLS without wearing proper dosimetry. This event which was reported to BNL and DOE management on October 7, 2002 received much higher priority than the U5UA incident and dominated management attention in the ensuing weeks.

III. Analysis of Decision Making

DOE has established an exhaustive set of criteria for evaluating the reportability of incidents. Some of the criteria are quite easy to apply because very little interpretation is required; e.g. "any occupational injury resulting in hospitalization." Others require considerable interpretation and different categorizers could readily come to different conclusions regarding reportability of the same event. The Manager of the BNL Categorizers Program has sought to minimize this variability in categorizing by an extensive training and mentoring program for all new categorizers and the quarterly review program of previous events that was referenced above. Through this process a common understanding and application of the criteria among the categorizers is sought. In addition, a procedure has been established for the BNL Occurrence Categorization Program in an effort to ensure consistency within the program.

Despite these efforts, differences in judgments regarding reportability are possible, even for categorizers within the program and particularly for personnel who have not participated in the internal BNL program or for personnel trained at other DOE sites. This issue is recognized within DOE and a number of efforts at the DOE wide level are underway to improve consistency of reporting, including the recently revised ORPs criteria.

IV. Causal Analysis of why the incident was not reported under ORPS

Direct Cause – The BNL Occurrence Categorizer evaluated the incident against several criteria and decided that the event was not reportable.

Contributing Cause – Although the Occurrence Categorizer entered the event and his decision into the categorizer's logbook (which resulted in a subsequent discussion with a number of personnel), there was no discussion at the time of the incident with DOE, the ORPs Program Manager or other categorizers. Additional discussion with other personnel at the time of the incident may have resulted in a different decision[8].

Root Cause – The reporting criteria are subject to interpretation and different persons may examine an incident and come to different conclusions.

V. Corrective Actions

1. Distribute a lesson learned regarding this incident to BNL facility managers and occurrence categorizers to ensure knowledge of reporting issues associated with this event.

   Responsibility: R. Casey

[8] It should be noted that currently all events that are evaluated by a Categorizer are entered into a database and are forwarded to the Occurrence Reporting Manager at the time of the incident.

Due: June 1, 2004

Status: Open

2. Further written clarification will be provided regarding interpretation of occurrence reporting criteria, particularly for the more subjective criterion contained in DOE Order 231.1-2 and DOE Manual 231.1-2.

   Responsibility: E. Sierra

   Due: August 13, 2004

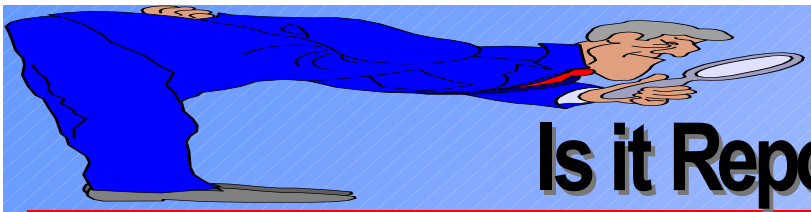
   Status: Open

VI. Lessons Learned

In some cases, the ORPs reporting criteria are subjective and require interpretation by the facility manager and the Occurrence Categorizer. Because of the potential variation in interpretation of these criteria, it is important that discussion take place between facility managers, categorizers and the local DOE office when incidents occur that require subtle interpretations of the criteria. Inadequate communication among critical stakeholders of these potentially sensitive issues can result in unneeded misunderstanding and extra effort after the fact that could have been eliminated with prompt discussion at the time of the incident.

Attachment A

Overhead from BNL Occurrence Categorizer Meeting of 12/18/02



Is it Reportable?

Scenario 1

Visible light beam physicists (NSLS) relax work controls (without safety input) such that beam extends across work area without proper definition. Sometime later worker walking across area feels beam strike his eye.

- What questions do you ask?
- Applicable Categories?
- Key factors?
- Reportable?

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