

Occurrence Report

After 2003 Redesign

Advanced Photon Source

(Name of Facility)

Accelerators

(Facility Function)

Argonne National Laboratory East

Argonne National Laboratory - East

(Site)

(Contractor)

Name: BARKALOW, THOMAS W

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(Facility Manager/Designee)

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Name:

Date:

(Authorized Classifier (AC))

1. Occurrence Report Number: SC--ASO-ANLE-ANLEAPS-2008-0003

Management Concern User Report of Suspected Exposure to Diffuse Laser Light

2. Report Type and Date: FINAL

	Date	Time
Notification:	08/19/2008	11:58 (ETZ)
Initial Update:	09/29/2008	17:36 (ETZ)
Latest Update:	10/03/2008	17:26 (ETZ)
Final:	10/03/2008	17:26 (ETZ)

3. Significance Category: 3

4. Division or Project: X-Ray Science Division (XSD)

5. Secretarial Office: SC - Science

6. System, Bldg., or Equipment: Instrument Station 7-ID-C/Building 400

7. UCNI?: No

8. Plant Area: Experiment Hall

9. Date and Time Discovered: 08/13/2008 17:00 (CTZ)

10. Date and Time Categorized: 08/15/2008 16:15 (CTZ)

11. DOE HQ OC Notification:

Date	Time	Person Notified	Organization
NA	NA	NA	NA

12. Other Notifications:

Date	Time	Person Notified	Organization
08/15/2008	17:00 (CTZ)	P. Neeson	DOE-ASO
08/14/2008	15:30 (CTZ)	E. Turnquest	DOE-ASO

13. Subject or Title of Occurrence:

Management Concern User Report of Suspected Exposure to Diffuse Laser Light

14. Reporting Criteria:

10(2) - An event, condition, or series of events that does not meet any of the other reporting criteria, but is determined by the Facility Manager or line management to be of safety significance or of concern to other facilities or activities in the DOE complex. One of the four significance categories should be assigned to the occurrence, based on an evaluation of the potential risks and the corrective actions taken. (1 of 4 criteria - This is a SC 3 occurrence)

15. Description of Occurrence:

At 1800 on 08/13/2008, a visiting scientist reported to Sector 7 APS personnel that he suspected he was exposed to diffuse laser light while performing work on 08/09/2008 in Building 400, Instrument Station 7-ID-C. On 08/15/2008 the visiting scientist was examined by an ophthalmologist (no eye damage was detected by the examination) and subsequently was interviewed to obtain additional information. He returned to his home in Europe on 08/17/2008.

The visiting scientist reported that he had been engaged in setting up a new optical light path to utilize an ultrafast, multiple frequency Class IV laser as part of an experiment using the 7-ID beamline x-rays. The Class IV laser is in a separate enclosure with a previously reviewed and approved enclosed light path to bring the laser light into Instrument Station 7-ID-C. For the specific experiment that was being performed, the laser beam power level was attenuated such that the actual power present in the instrument station was within the range for a Class IIIb laser. An optical table inside the instrument station was used to construct a complex optical path over a period of about 1 week with the final configuration being settled upon, installed, and aligned on 08/09/2008. Following the final adjustment to align the laser beam on the x-ray target, the visiting scientist was leaning over the optical table when he suspects he may have been exposed to diffuse laser light. He reported seeing a brief flash of diffused light in his peripheral vision coming from below the laser protection spectacles he was wearing over his prescription spectacles, but did not notice any apparent adverse effects afterwards. A few days later while driving back from presenting a lecture at the University of Michigan, the visiting scientist noticed a persistent "spot" in his vision while facing the setting sun. This prompted him to report the

brief flash he had seen the previous weekend. On 08/14/2008 the visiting scientist presented a separate lecture to a university in the Chicago area and he returned to Argonne on 08/15/2008.

The ophthalmologic examination did not find any apparent eye damage though the visiting scientist reported seeing a "spot" when viewing bright light. The ophthalmologist recommended that the visiting scientist undergo another examination if the "spot" persisted over a month.

09/29/2008 Update: The description provided in the Notification Report has been revised to correct several minor errors. As a result of questions received regarding the laser installation, the following details are provided:

Three frequencies were in use for the experiment: 800 nm, 400 nm, & 266 nm. The experiment utilized an x-ray streak camera that required 150 milliwatts at 266 nm for fiducial timing and 150 milliwatts at 800 nm to "trigger" the streak camera. The target required 20-30 milliwatts at 400 nm to provide the desired photon induced electron excitation in the target material. The streak camera's timing had to be synchronized to the x-ray beam pulse rate for proper detection and data collection to occur. As a single source was being used, the laser beam was split into two separate beams, one beam containing two frequencies (266 & 800 nm) for the streak camera and the other beam containing a single frequency (400 nm) for the target. The two beam paths had to be identical in length for the timing to be synchronized. Both of these beams had to incorporate a vertical length as the x-ray beam axis is above the optical table. Optical periscopes were used to take the beam off the horizontal plane of the optical table beam path into the vertical and then back to the horizontal for use with the streak camera and target. The visiting scientist was standing over the target beam portion (20-30 milliwatts at 400 nm) when he thought he saw diffuse laser light. This was a first time and temporary optical beam path installation inside an interlocked instrument station. Specific interlocks and an opaque curtain at the station entrance were added for the laser optical beam path installation, but the optical beam path was not itself enclosed at the time of the incident.

16. Is Subcontractor Involved? No

17. Operating Conditions of Facility at Time of Occurrence:

Normal facility operations

18. Activity Category:

12 - Research

19. Immediate Actions Taken and Results:

The involved Class IV laser system was locked out of service pending additional review. Arrangements were made for the visiting scientist to receive an ophthalmologic examination. No apparent eye damage was detected. An ad hoc fact finding team was assembled to interview the visiting scientist before he returned to his home in Europe. The initial report was based upon the information obtained from this interview. A final decision regarding ORPS reporting was delayed pending results from the ophthalmologic examination and interview and this accounts for the delay between discovery and initial notification.

The laser protection spectacles worn by the visiting scientist were obtained prior to the interview and were held pending further investigation.

The initial fact finding indicated further review was necessary of the administration of the optical path set up and use. An investigation committee was formed to conduct this review with the results to be included in the causal analysis for this report.

09/29/2008 Update: Several minor errors were corrected in the immediate actions described in the Notification Report. The investigation committee was formed on 08/21/2008. The charge to the committee was to investigate the circumstances surrounding the reported incident, to evaluate the administrative practices followed in establishing the optical beam path inside the 7 ID-C instrument station, and to identify any significant issues or organizational weaknesses which contributed to the incident. The committee held several meetings between 08/25/2008 and 09/05/2008 which included interviews, document review, and committee discussions. There were several iterations of a draft investigation report with the final report being issued on 09/22/2008. The results are incorporated into this update report.

20. ISM:

- 3) Develop and Implement Hazard Controls
 - 4) Perform Work Within Controls
-

21. Cause Code(s):

A4B1C01 - Management Problem; Management Methods Less Than Adequate (LTA); Management policy guidance / expectations not well-defined, understood or enforced

A1B4C03 - Design/Engineering Problem; Design Verification / Installation Verification LTA; Independent inspection of design/installation LTA

22. Description of Cause:

The Argonne laser safety program requires a reviewed and approved standard operating procedure (SOP) and an issued laser operating permit (LOP) before a Class IIIb or IV laser can be operated. The program also relies on a designated laser control area supervisor (LCAS) to prepare and maintain the standard operating procedure, perform interlock testing, inspect eye personal protective equipment (PPE), provide hands on training for laser alignment activities, and to monitor laser user activities to ensure safety requirements are being followed. Class IIIb and IV laser installations also are required have enclosed or well shielded vertical beam paths. In addition the Argonne laser safety officer (LSO) is required to be contacted for review and approval of each new laser installation or significant modification to an existing installation.

The investigation committee concluded there were two immediate causes for the incident: the visiting scientist did not properly wear the eye laser PPE and the optical beam path was not adequately shielded. Several contributing factors existed for each immediate cause. The following addresses the two immediate causes separately.

Two forms of eye laser PPE were available for the visiting scientist's use: spectacles (which resembled wrap around sunglasses) and goggles. The available laser eye protective goggles could have been worn over the scientist's prescription spectacles while still providing all round protection. The scientist did not use the available goggles due to his past experience with such goggles fogging. So the scientist chose to use the laser eye protective spectacles over his prescription spectacles. The scientist was not aware that wearing the spectacle PPE over his prescription spectacles did not provide adequate protection as several gaps in coverage of his peripheral vision resulted. In addition no one noted that gaps in protective coverage existed and did not correct the visiting scientist's improper use of eye PPE. The committee determined this was due to several factors with the most significant one being a lack of guidance as to how to properly wear laser protection eyewear (spectacles or goggles). Another factor in why the visiting scientist's improper wearing of eye laser PPE was not corrected involved a long term LCAS for 7 ID having left Argonne employment a few weeks previous to the incident and a full time replacement LCAS not being available to start until a month after the incident. A temporary LCAS with laser operational and safety experience was appointed to cover this gap. The temporary LCAS was to be assisted by a post-doctoral appointee who had a greater technical experience with ultrafast lasers, but had limited laser safety experience. A split in LCAS responsibilities during the experiment resulted from the arrangement as the temporary LCAS handled only the "paperwork" LCAS duties while the post-doctoral appointee (who had less laser safety

experience) handled the hands on alignment training and laser user activity monitoring. The temporary LCAS did not monitor the laser activities and could not have noted the improper wearing of the laser eye spectacles over the prescription spectacles and the post-doctoral appointee did not know this was improper. This immediate cause and contributing factors are best represented by Causal Code A4B1C01 - Management policy guidance/expectations not well-defined, understood or enforced.

Two corrective actions have been developed to address this application of Causal Code A4B1C01. A new SOP is being prepared by Sector 7 staff in order to obtain authorization to resume laser operations on the 7 ID beam line. The new SOP will explicitly direct that goggles providing all around eye laser protection must be used during alignment activities using Class IIIb and IV laser beam power levels. The target date for issuing the approved SOP is 10/31/2008. In addition the Argonne LSO is reviewing the current laser safety training for possible revisions regarding currently addressed LCAS responsibilities and proper methods for wearing eye laser PPE. The target date for completing this review is 10/31/2008.

The installed temporary beam path included limited shielding. The investigation committee noted during examination of the optical beam path components that the only shielding present on the vertical beam paths were small shields on the back of the reflecting optical component mounts. These apparently were meant to block any laser light transmitted through the reflecting optic component. There was no shielding provided to block misaligned beam or specular or diffuse reflections. The committee concluded the installed optical path did not meet the laser safety program requirements for shielding/enclosure of vertical beam paths. The committee also concluded this failure did not result from deliberate disregard of requirements. Instead the personnel involved felt the limited shielding provided was adequate and this was due to not having a good understanding of the actual requirements and the bases for the requirements. Again this is best represented by Causal Code A4B1C01 - Management policy guidance/expectations not well-defined, understood or enforced.

One of the two previously mentioned corrective actions also addresses this application of Causal Code A4B1C01. A new SOP is being prepared by Sector 7 staff in order to obtain authorization to resume laser operations on the 7 ID beam line. The new SOP will explicitly direct that optical beam paths will be shielded for alignment activities. The target date for issuing the approved SOP is 10/31/2008.

An independent review of the path involved in the incident may have resulted in better shielding. The Argonne laser safety program requires that the laser safety officer (LSO) be contacted for review and approval of each new laser installation or significant modification to an existing installation which was not done for the new 7 ID-C optical path prior to the incident. This was largely due to the 7 ID laser installation SOP being written in a manner that clearly included the intent to install and remove temporary optical beam paths inside the 7 ID-C instrument station as needed to support the experimental activities. In addition the SOP did not define any standard beam paths for such use and did not specify whether or not each temporary installation required LSO review and approval. The SOP was interpreted by the beam line staff as already approving the establishment of temporary optical paths within the 7 ID-C instrument station and that LSO review and approval of these temporary optical beam paths was not required. Failure to contact the LSO is enveloped by Causal Code A4B1C01 - Management policy guidance/expectations not well-defined, understood or enforced, but also is appropriately addressed by Causal Code A1B4C03 – Independent inspection of design/installation LTA.

Two corrective actions have been developed to address this application of Causal Code A1B4C03. As noted previously a new SOP is being prepared by Sector 7 staff in order to obtain authorization to resume laser operations on the 7 ID beam line. The new SOP will explicitly direct that the LSO be contacted regarding all new optical paths prior to their alignment or operation. The target date for issuing the approved SOP is 10/31/2008. To address the broader issue of Causal Code A4B1C01 as well as this application of Causal Code A1B4C03, the LSO committed to determining by 09/26/2008 whether or not issuing multiple laser operating permits would provide for better execution of the Argonne laser safety program for configurations involving a single laser source with multiple endpoints in different locations where each location may have a separate beam path. The LSO completed that determination on 09/25/2008 and is in the process of issuing multiple laser operating permits for these configurations. Each endpoint and optical path will now be covered by a separate laser operating permit. This permits more specific evaluations before issuing each such permit and allows for location/path specific directions on the specific laser operating permits.

23. Evaluation (by Facility Manager/Designee):

The investigation committee concluded there is no evidence the visiting scientist was exposed to laser light. The investigation committee was conducted on the basis that an injurious exposure could have occurred.

The investigation committee focused on casual factors that could be addressed by the APS director. The corrective action requiring issuance of a new SOP reflects this. The Argonne laser safety officer has performed an evaluation of the incident and has reviewed the investigation report. The two corrective actions committed to by the LSO address the Argonne site laser safety program.

The incident occurred in an uncommon laser controlled area configuration (single source with multiple endpoint locations and optical paths). All Argonne laser SOPs are modeled after what would be normally followed for the most common LCA configuration (single source with a single endpoint location and optical path). The investigation committee did not reach any final conclusions regarding whether or not this was a contributing factor to the differing interpretations of the Argonne laser safety program requirements held by the LSO versus the Sector 7 staff. However, the use of multiple laser operating permits will mitigate this if it was a contributing factor.

Consideration is being given to defining a limited number of established optical beam paths to be used for experimental activities in the 7-ID-B and -C instrument stations. It is being considered to construct these using standardized optical path segments that could be installed at premeasured and aligned locations on the optical tables. Use of standardized segments also could permit better shielding/enclosures of each segment. As no final decision has been made in this regard, this was not included as a corrective action.

24. Is Further Evaluation Required?: No**25. Corrective Actions**

(* = Date added/revised since final report was approved.)

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|----|---|------------------------------------|-----------------------------|
| 1. | Argonne laser safety officer determines the feasibility of issuing multiple for laser installations having a single laser source, but with multiple end points in different locations where each may have a separate optical beam path. | Target Completion Date: 09/26/2008 | Completion Date: 09/25/2008 |
| 2. | Issue a new SOP for the Sector 7 laser installation and laser use in Instrument Stations 7-ID-C and 7-ID-D. | Target Completion Date: 10/31/2008 | Completion Date: 10/30/2008 |
| 3. | Argonne laser safety officer determines if laser safety training enhancements are needed as a result of evaluating the investigation report. | Target Completion Date: 10/31/2008 | Completion Date: 10/14/2008 |

26. Lessons Learned:

Guidance regarding eye laser PPE usually stresses selecting PPE with the proper optical density for the laser frequencies being used. Guidance also needs to be provided on the importance of selecting properly fitting PPE, when different types of PPE are appropriate to use, and which type of PPE can be worn over prescription spectacles.

In addition it is important to ensure that laser users and personnel monitoring laser user activities fully understand laser safety requirements including the proper way to use eye PPE for lasers.

27. Similar Occurrence Report Numbers:

SC-CH-AA-ANLE-ANLEAPS-2004-0003

SC-CH-AA-ANLE-ANLEAPS-1999-0002

28. User-defined Field #1:**29. User-defined Field #2:**

30. HQ Keyword(s):

01A--Inadequate Conduct of Operations - Inadequate Conduct of Operations (miscellaneous)

01G--Inadequate Conduct of Operations - Inadequate Procedure

01R--Inadequate Conduct of Operations - Management issues

08C--OSHA Reportable/Industrial Hygiene - Industrial Hygiene Exposure

08H--OSHA Reportable/Industrial Hygiene - Safety Noncompliance

11I--Other - Visiting Scientist/Researcher or Student Employee

12J--EH Categories - OS/IH

14D--Quality Assurance - Documents and Records Deficiency

14E--Quality Assurance - Work Process Deficiency

14H--Quality Assurance - Inspection and Acceptance Testing Deficiency

31. HQ Summary:

On August 13, 2008, a visiting scientist reported via telephone to Advanced Photon Source (APS) personnel that he suspected he was exposed to diffuse laser light from a Class IIIb laser while performing work on August 9 in Building 400. The visiting scientist returned to APS on August 15, was examined by an ophthalmologist (no eye damage was detected by the examination), subsequently was interviewed to obtain additional information, and then left to return to his home in Europe. The involved Class IIIb laser system was locked out of service pending additional review.

32. DOE Facility Representative Input:

33. DOE Program Manager Input:

34. Approvals:

Approved by: BARKALOW, THOMAS W, Facility Manager/Designee

Date: 10/03/2008

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