

Occurrence Report

After 2003 Redesign

U1a Complex

(Name of Facility)

Balance of Plant - Infrastructure (Other Functions not specifically listed in this Category)

(Facility Function)

Nevada Test Site

Los Alamos National Lab. - Nevada

(Site)

(Contractor)

Name: Eugene W. Christensen**Title:** Barolo Test Director**Telephone No.:** (702) 295-4400

(Facility Manager/Designee)

Name: YAZZIE, ALVA M**Title:** OCCURRENCE INVESTIGATOR**Telephone No.:** (505) 664-0666

(Originator/Transmitter)

Name: Eugene Christensen**Date:** 11/18/2009

(Authorized Classifier (AC))

1. Occurrence Report Number: NA--NVSO-LANV-U1A-2009-0001

Barolo U1a Laser Incident

2. Report Type and Date: FINAL

	Date	Time
Notification:	08/31/2009	14:38 (ETZ)
Initial Update:	10/06/2009	11:06 (ETZ)
Latest Update:	11/18/2009	15:23 (ETZ)
Final:	11/18/2009	15:23 (ETZ)

3. Significance Category: 3**4. Division or Project:** Barolo Sub-Critical Experiment**5. Secretarial Office:** NA - National Nuclear Security Administration**6. System, Bldg., or Equipment:** Class 4 Laser

7. UCNI?: No

8. Plant Area: U1a.05 Complex

9. Date and Time Discovered: 08/24/2009 11:00 (PTZ)

10. Date and Time Categorized: 08/26/2009 08:45 (PTZ)

11. DOE HQ OC Notification:

Date	Time	Person Notified	Organization
NA	NA	NA	NA

12. Other Notifications:

Date	Time	Person Notified	Organization
08/25/2009	08:45 (PTZ)	Kevin Breen	NNSA NSO
10/05/2009	14:49 (PTZ)	Kevin Breen	NNSA NSO

13. Subject or Title of Occurrence:

Barolo U1a Laser Incident

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:

MANAGEMENT SYNOPSIS: On August 24, 2009, at 1100, while performing work at the Nevada Test Site, U1a Complex Zero Room, two Photonic Doppler Velocimetry (PDV) workers (W1 and W2) of the National Security Technologies, LLC (NSTec) were briefly exposed or flashed with a laser light emanating from a fiber optic cable. W1 and W2 were moving fiber cables when they observed a green light emitting from one of the fiber cable ends. Subsequent review found the fiber optic cable had been inadvertently left connected to the laser while NSTec operators were aligning the Velocity Interferometer System for Any Reflector (VISAR) laser. The output from the laser to the Zero Room was estimated to be less than 600 microwatts. Following discovery of the laser light, the VISAR laser system was de-energized. Incident reporting and subsequent medical evaluation were delayed due to late notification by the employees to NSTec management. On August 25, 2009, W1 and W2 were examined by NSTec Occupational Medicine personnel and referred to a local ophthalmologist. The medical evaluation concluded W1 and W2 did not sustain any eye injuries and were released back to work with no restrictions. The NSTec management paused all laser operations within the U1a Complex pending further review.

16. Is Subcontractor Involved? No

17. Operating Conditions of Facility at Time of Occurrence:

Laser Operations

18. Activity Category:

03 - Normal Operations (other than Activities specifically listed in this Category)

19. Immediate Actions Taken and Results:

1. On August 25, 2009, W1 and W2 were examined by NSTec Occupational Medicine personnel and referred to a local ophthalmologist. The medical evaluation concluded the employees did not sustain eye injuries and were released back to work with no restrictions.
 2. The NSTec management paused all laser operations within the U1a Complex pending further review. On August 27, 2009, after an operational laser review, NSTec management approved the re-start of VISAR laser operations at the U1a Barolo Project.
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20. ISM:

- 2) Analyze the Hazards
 - 3) Develop and Implement Hazard Controls
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21. Cause Code(s):

A3B1C03 - Human Performance Less Than Adequate (LTA); Skill Based Errors; Incorrect performance due to mental lapse
 -->couplet - A5B2C08 - Communications Less Than Adequate (LTA); Written Communication Content LTA;
 Incomplete / situation not covered
 A2B4C07 - Equipment/ material problem; Material control LTA; Marking/labeling LTA
 A1B2C05 - Design/Engineering Problem; Design output LTA; Design input not addressed in design output
 A4B1C01 - Management Problem; Management Methods Less Than Adequate (LTA); Management policy guidance / expectations not well-defined, understood or enforced
 A5B4C01 - Communications Less Than Adequate (LTA); Verbal Communications LTA; Communication between work groups LTA

22. Description of Cause:

ISM SUMMARY: Although no personnel incurred physical harm, the laser event resulted from the lack of an adequate hazard analysis and implementation of adequate administrative and engineering controls to prevent personnel exposure to the laser light. This event illustrated deficiencies of ISM Steps 2, Analyze the Hazards and 3, Develop and Implement Hazard Controls.

INVESTIGATION METHODOLOGY

The NSTec management conducted an apparent causal analysis of this incident. Excerpts from the "NTS, U1a, Barolo VISAR Laser Near Miss Apparent Cause Analysis Report" were taken and incorporated into this report. Apparent causal analysis and the DOE Causal Analysis Tree as described in the DOE Occurrence Reporting Causal Analysis Guide (DOE

G 231.1-2) were used to identify the causes for this event. Apparent causes are identified as the most probable causes of an event or condition that management has the control to fix and for which effective recommendations for corrective actions can be generated. The apparent causes identified for this event, which capture the deficiencies described below are (A3B1C03) Human Performance Less Than Adequate, Incorrect Performance Due to Mental Lapse; (A5B2C08) Written Communication Content Less Than Adequate, Incomplete/Situation Not Covered; (A2B4C07) Equipment Material Problem, Marking/Labeling Less Than Adequate; (A1B2C05) Design/Engineering Problem, Design Input Not Addressed in Design Output; (A4B1C01) Management Policy Guidance/Expectations Not Well-Defined, Understood or Enforced; and (A5B4C01) Communications Less Than Adequate, Communication Between Work Groups Less Than Adequate.

BACKGROUND

The laser operations were being performed in support of the Los Alamos National Laboratory (LANL) Barolo Sub-Critical Experiment (SCE). The Barolo Test Director and NSTec diagnostic personnel had reviewed and approved the Barolo Screen Room 4 Laser Safety and the Barolo VISAR checklists prior to the start of work.

EVENT SEQUENCE

On August 24, 2009, two laser operations were being performed simultaneously in the U1a Complex. W1 and W2 were in the Zero Room attempting to connect the fiber optics to the patch panel. VISAR laser personnel were in Screen Room 4 aligning the interferometer using the attenuated VISAR laser beam.

At 1100, as W1 pulled down on a fiber-optic bundle to move the fiber optics closer to the patch panel, he inadvertently viewed a bright green light emanating from the cut-off end of a fiber optic. Realizing he was viewing the laser light, W1 moved the fiber optic away from his direction and pointed it downward. During this motion, the illuminated fiber optic crossed the line of sight of W2, accidentally exposing W2 to the laser light.

While W1 secured the illuminated fiber optic, W2 went to Screen Room 4 (VISAR laser system) to inquire if the VISAR laser system was transmitting laser light to the zero room. The initial response from VISAR laser personnel was no, but upon inspection of their system (with the VISAR laser off) laser personnel discovered they had accidentally left an input fiber optic open to the attenuated VISAR laser beam they were using to align their interferometer at the time. The input fiber optic provided a pathway to the cut-off VISAR probe line. Upon discovery, the primary VISAR laser operator removed the input fiber optic connection from the laser beam path.

On August 25, 2009, the workers reported to the NSTec medical facility for eye examinations to determine if there was any harmful laser exposure to their eyes. Incident reporting and subsequent medical evaluation were delayed due to late notification by the involved workers. W1 and W2 were examined by NSTec occupational medicine personnel and then referred to a local ophthalmologist. The medical evaluation concluded the workers did not sustain any eye injuries. W1 and W2 were released back to work with no restrictions.

Following the event, NSTec management paused all laser operations within the U1a Complex pending further review. On August 27, 2009, upon completion of an operational laser review, NSTec management approved the re-start of the VISAR laser operations on the U1a Barolo Project.

Since the VISAR laser system was configured for alignment of their interferometer, a neutral density (ND) filter was installed in the beam path of the Coherent Verdi, Nd:YVO4 laser used in the VISAR system. The ND filter, along with the attenuating factors of other optics within the laser system, reduced the input laser light injected into the fiber optic that connected to the zero room down to approximately 600 micro-watts (Class 2). The Class 2, 532 nm, continuous wave (CW) laser light, exiting the cut-off end of the fiber optic was of a low enough intensity to prevent damage to the eyes of the two PDV workers. The fiber-optic cable provided additional safety even if the end was perfectly cleaved, the laser light would exit in a diverging cone angle governed by the numerical aperture of the fiber.

CAUSAL ANALYSIS

The triggering event was the VISAR laser operator inadvertently left the cut-off fiber optic connected to the laser beam. The unmarked and unsecured laser light pathway via the cut-off fiber optic was provided directly to the VISAR laser room. The only control to keep the laser light out of this pathway was administrative (a checklist) which relied on the laser operator to disconnect or block the laser light from the input fiber; however, the checklist had no step to ensure the operator disconnected or blocked the laser light. The investigation revealed the SNL shot checklist, which contained safety steps for the VISAR interferometer alignment, was not a configuration managed checklist. It did not appear to have been reviewed or approved by a laser safety officer (LSO) or management. The checklist had no revision number or date nor did it contain steps to ensure the shot-fiber optic inputs leading to the zero room were disconnected or blocked from receiving laser light while performing the interferometer alignment. The apparent causal factor which best describes this scenario is (A3B1C03) Human Performance Less Than Adequate, Incorrect Performance Due to Mental Lapse and coupled with (A5B2C08) Written Communication Content Less Than Adequate, Incomplete/Situation Not Covered. Corrective Action 1 addresses these apparent causal factors.

Organizational Weaknesses and Latent Conditions

The investigation found there was no labeling of the fiber optic cables, patch panel connections or junction boxes as required by ANSI Z136.1, American National Standard for Safe Use of Lasers. The labeling of these items would have identified any potential hazardous laser light paths. The apparent causal factor which best describes this scenario is (A2B4C07) Equipment Material Problem, Marking/Labeling Less Than Adequate. Corrective Action 2 addresses this apparent causal factor.

The VISAR laser enclosure lid had no safety interlocks as required by ANSI Z136.1, American National Standard for Safe Use of Lasers, Section 4.3.2. The enclosure lid for this laser was not a service access panel as it is removed to perform operations such as reconfiguration for the interferometer alignment and not restricted as an access panel to perform maintenance and/or repairs. The apparent causal factor which best describes this scenario is (A1B2C05) Design/Engineering Problem, Design Input Not Addressed in Design Output. Corrective Action 3 addresses this apparent causal factor.

Neither the PDV workers nor the VISAR laser operators had control of either laser system keys during their work activities. The PDV workers did not have laser key control while installing the PDV probes into the patch panel nor did the VISAR laser operators during interferometer alignment. The apparent causal factor which best describes this scenario is (A4B1C01) Management Problem, Management Policy Guidance/Expectations Not Well-Defined, Understood or Enforced. Corrective Action 1 addresses this apparent causal factor.

The PDV workers were unaware of laser operations in the VISAR laser room. The investigation found there was no communication of either laser operation to personnel in the affected area. In hindsight, if laser operations detailing who was performing laser operations, the class level, and location were communicated, it may have heightened personnel awareness in the area and eliminated any fear and/or anxiety to affected workers. The apparent causal factor which best describes this scenario is (A5B4C01) Communications Less Than Adequate, Communication Between Work Groups Less Than Adequate. Corrective Action 4 addresses this apparent causal factor.

The laser operations were performed in support of the LANL Barolo SCE Project. The investigation revealed the Barolo Test Director and the NSTec diagnostic personnel had reviewed and approved the Barolo Screen Room 4 Laser Safety and the Barolo VISAR checklists prior to the start of work. A NSTec LSO had reviewed the checklists; however, no supporting documentation was found to support this review. And further, neither the JNPO-LANL LSO nor any other JNPO-LANL safety professional had reviewed the checklists or the work documentation prior to the start of work. The apparent causal factor which best describes this scenario is (A4B1C01) Management Policy Guidance/Expectations Not Well-Defined, Understood or Enforced. Corrective Action 5 addresses this apparent causal factor.

Although not causal to the event, incident reporting and subsequent medical evaluation were delayed due to late notification by the involved workers to NSTec management. Corrective Action 6 addresses this issue.

23. Evaluation (by Facility Manager/Designee):

The checklists were revised to include steps to improve key control and ND filter inspection as well as entered into the formal change control process. It is recommended the key control checklist be made more specific to address how keys are controlled for multiple systems. The PDV workers did not have control of both PDV laser key and the VISAR keys when installing their PDV probes. It is recommended there be an announcement of laser operations describing who is performing laser operations, what class, and where operations are taking place. It is also highly recommended that JNPO checklists signed by the Test Director and NSTec laser preparers be reviewed by both NSTec and JNPO LSOs. Further, any pen and ink changes to JNPO checklists should be re-issued as revisions to provide for clarity in comprehension.

24. Is Further Evaluation Required?: No

25. Corrective Actions

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

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|----|---|-------------------------------------|-----------------------------|
| 1. | Title: Revised Laser Checklists The JNPO management revised the Barolo Screen Room 4 Laser Safety and the Barolo VISAR Checklists to include steps for key control and ND filter inspection. Responsible Organization: JNPO Deliverable: Copies of the revised laser safety and VISAR checklists. | Target Completion Date: 08/27/2009 | Completion Date: 08/27/2009 |
| 2. | Title: Labeled Cables, Patch Panel Connection and Junction Boxes The NSTec Experimentation Support Department management had the fiber optic cables, patch panel connections, and junction boxes labeled to show the potential hazardous laser light paths. Responsible Organization: NSTec Deliverable: Documentation showing the cables, patch panel connections, and junction boxes were labeled. | Target Completion Date: 08/27/2009 | Completion Date: 08/27/2009 |
| 3. | Title: Implemented an Alternate Control Measure Permit The NSTec Experimentation Support Department management implemented an Alternate Control Measure Permit to complete work on the current experiment until modification can be made to the laser enclosure interlocks. Responsible Organization: NSTec Deliverable: A copy of the Alternate Control Measure Permit. | Target Completion Date: 08/27/2009 | Completion Date: 08/27/2009 |
| 4. | Title: Appointed a Laser Operations Point of Contact The NSTec Experimentation Support Department management appointed a point of contact to coordinate and control all laser operations which includes the communication of laser activities to the affected personnel. Responsible Organization: NSTec Deliverable: Documentation showing a laser operations point of contact was appointed. | Target Completion Date: 09/15/2009 | Completion Date: 09/15/2009 |
| 5. | Title: Review Laser Checklists The JNPO and NSTec management will ensure laser checklists are reviewed and approved by the Barolo NSTec local laser safety officer and the NSTec industrial hygiene manager (ESH&Q) per the requirements of NSTec CD-P280.013, Laser Safety. Responsible Organization: JNPO Deliverable: A copy of a laser safety officer approved Barolo laser checklist. | Target Completion Date: *03/18/2010 | Completion Date: |
| 6. | Title: Re-Emphasized Timeliness of Incident Reporting Requirements with Management Team The NSTec Experimentation Support Department management re-emphasized the timeliness of incident reporting and reporting requirements to the NSTec diagnostic management team. Responsible Organization: NSTec Deliverable: Documentation showing the timeliness of incident reporting was re-emphasized with the NSTec diagnostic management team. | Target Completion Date: 08/27/2009 | Completion Date: 08/27/2009 |

26. Lessons Learned:

Checklists are integral to the successful completion of projects. Barolo document control allows for contractor personnel to be the owner, preparer, and/or reviewer of checklists as was the case in this event. All checklists, as in the case of the added SNL checklist, must be made part of configuration management. All Barolo documents including checklists were approved by the Test Director who ensured the documents had a USQ review and training designation. Checklist users are responsible for validating their checklists with their LSO to ensure correct operations and safety; however checklists should not replace existing safety procedures and requirements, but incorporate and/or reference the procedures/requirements in the checklists.

27. Similar Occurrence Report Numbers:

NA--LSO-LLNL-LLNL-2008-0015

NA--LSO-LLNL-LLNL-2008-0067

28. User-defined Field #1:

amy

29. User-defined Field #2:**30. HQ Keyword(s):**

01A--Inadequate Conduct of Operations - Inadequate Conduct of Operations (miscellaneous)
 01B--Inadequate Conduct of Operations - Loss of Configuration Management/Control
 01G--Inadequate Conduct of Operations - Inadequate Procedure
 01N--Inadequate Conduct of Operations - Inadequate Job Planning (Other)
 01P--Inadequate Conduct of Operations - Inadequate Oral Communication
 01Q--Inadequate Conduct of Operations - Personnel error
 01R--Inadequate Conduct of Operations - Management issues
 08C--OSHA Reportable/Industrial Hygiene - Industrial Hygiene Exposure
 08H--OSHA Reportable/Industrial Hygiene - Safety Noncompliance
 11F--Other - Inadequate Design
 12J--EH Categories - OS/IH
 14C--Quality Assurance - Quality Improvement Deficiency
 14D--Quality Assurance - Documents and Records Deficiency
 14E--Quality Assurance - Work Process Deficiency
 14F--Quality Assurance - Design Deficiency

31. HQ Summary:

On August 24, 2009, while performing work at the Nevada Test Site, two employees of the National Security Technologies, LLC (NSTec) were briefly exposed or flashed with a laser light emanating from a fiber optic cable. The employees were moving fiber cables when they observed a green light emitting from one of the fiber cable ends. On August 25, 2009, the workers reported to the NSTec medical facility for eye examinations, examined by NSTec Occupational Medicine personnel, and then referred to a local ophthalmologist. The medical evaluation concluded the employees did not sustain eye injuries and were released back to work with no restrictions. Subsequent review found the fiber optic cable had been inadvertently left connected to the laser while NSTec operators were aligning the laser because the checklist used for the laser operations did not include a step to verify the fiber cable was disconnected prior to laser alignment. The output from the laser to the Clean Room was estimated to be 590 microwatts. The NSTec management

paused all laser operations within the U1a Complex pending further review.

32. DOE Facility Representative Input:

33. DOE Program Manager Input:

34. Approvals:

Approved by: Eugene W. Christensen, Facility Manager/Designee

Date: 11/18/2009

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