

Medical Consultant Report
(To be completed by medical consultant)

Medical Consultant Name: Ronald E. Goans, PhD, MD, MPH
Report Date: 7/30/2008

Signature Ronald E. Goans 5/13/2008

Licensee Name:

BWX Technologies, Inc.
Nuclear Products Division
PO Box 785
Lynchburg, VA 24505
(434) 522-6000

License No. SNM-42
Docket No. 70-27

Incident Date: 4/28/2008

Date of Notification: 4/28/2008

Individuals Contacted During Investigation:

Donald G. Branson, MD
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Lynchburg, VA 24501
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(434) 522-5006

David Ward
Manager Environment, Safety, Health, & Safeguards
BWX Technologies NOG-L
Lynchburg, VA 24501
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Henry HC Tseng, MD
Duke Eye Center
Duke University Medical Center
2351 Erwin Rd
Durham, NC 27705

Patient Physicians

Donald G. Branson, MD
2137 Lakeside Dr # 100
Lynchburg, VA 24501
(434) 385-4184
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Saxton T. Moss, MD
Piedmont Eye Center
2402 Atherholt Rd.
Lynchburg, VA
(434) 947-3984

Records Reviewed: (General Description)

1. Preliminary description of the incident
2. Licensee Event Report
3. Patient consent form for release of medical records.
4. Medical Report of Duke Eye Center
5. BWXT Medical and Nursing Intervention Guide for Eye and Skin Burns
6. Medical Records of Piedmont Eye Center, Inc., 2402 Atherholt Road
Lynchburg, VA 24501
7. Medical records of [REDACTED] by permission (Dr. Branson)

Estimated Dose to Unintended Anatomic Region: N/A

Probable Error Associated with Estimation: N/A.

Prescribed Dose (Medical Misadministration Only): N/A

Method Used to Calculate Dose: N/A

Description of Incident:

On April 28, 2008 at approximately 10:15 pm, a Recovery Operator (subject A) noted a liquid leak of HF from an HF tank drain valve. As a safety response, subject A attempted to neutralize the HF spill using what he believed was soda ash, but which was actually sodium hydroxide. An exothermic reaction thereby ensued and the liquid erupted, resulting in a HF splash to subject A's face, eyes, and arms. A colleague, operator B, responded to provide medical assistance, subject A was taken to an eye wash station and the eyes were flushed for approximately 15 minutes.

Both operators and a radiation technician were transported to Lynchburg General Hospital for evaluation and treatment. Prior to transport to Lynchburg General Hospital, the BWXT emergency team treated operator A and the radiation technician with a calcium gluconate solution. For HF burns, the BWXT emergency team is taught to use the Honeywell protocol for HF injuries, including copious irrigation of the affected area and repeated application of a 2.5% calcium gluconate gel.

The prompt action of the BWXT emergency team and that of nearby colleagues in employing the Honeywell HF protocol undoubtedly significantly mitigated the extent of this injury.

Clinical Details of the Pathology of HF injury

Hydrofluoric (HF) acid is one of the strongest inorganic acids. HF acid burns are a unique clinical entity. Dilute solutions deeply penetrate before dissociating, thus causing delayed injury and symptoms. Severe burns occur after exposure of concentrated (i.e., 50% or stronger solution) HF

acid to 1% or more body surface area (BSA), exposure to HF acid of any concentration to 5% or more BSA, or inhalation of HF acid fumes from a 60% or stronger solution. The two mechanisms that cause tissue damage are corrosive burns from the free hydrogen ions and chemical burns from tissue penetration of the fluoride ions.

Fluoride ions penetrate and form insoluble salts with calcium and magnesium. Soluble salts also are formed with other cations but dissociate rapidly. Consequently, fluoride ions release, and further tissue destruction occurs. Local effects include tissue destruction and necrosis. Burns may involve underlying bone. Systemic fluoride ion poisoning from severe burns may be associated with hypocalcemia, hyperkalemia, hypomagnesemia, and sudden death. Deaths have been reported from concentrated acid burns to as little as 2.5% BSA.

Pre-hospital treatment for HF acid burns includes basic life support and appropriate decontamination, followed by neutralization of the acid by liberal use of topical calcium gluconate. The patient should be transported immediately to the nearest appropriate medical facility.

Emergency department care includes irrigation of the site with copious amounts of water and assessment and management of life-threatening conditions. Comprehensive patient monitoring is necessary for significant exposures. With any evidence of hypocalcemia, one should immediately administer 10% calcium gluconate IV. For topical management of the burn, it is prudent to apply 2.5% calcium gluconate gel to the affected area. If pain persists for more than 30 minutes after application of calcium gluconate gel, further treatment is required.

Subcutaneous infiltration of calcium gluconate is recommended at a dose of 0.5 mL of a 10% solution per square centimeter of surface burn extending 0.5 cm beyond the margin of involved tissue. A Bier block is useful for pain control. Continuous ECG and clinical monitoring are essential during the initial, possibly unstable phase.

Assessment of Probable Deterministic Effects of the Radiation Exposure on the Individual:

N/A

Briefly describe the current medical condition of the exposed individual:

The patient is currently doing well. [REDACTED] was initially evaluated by Dr. Donald Branson with a slit lamp exam and was found to have no overt eye pathology. The patient stated that he had some persistent photophobia and blurred vision, the right eye (OD) > than the left eye (OS). However, Dr. Branson found a primary visual acuity of 20/20 OD and 20/20 OS, full movement of the eyes in all directions and healing conjunctiva. The retinal exam was within normal limits. The patient was also evaluated repeatedly at the Piedmont Eye Center in Lynchburg, VA. With multiple normal exams, the patient was advised that he could return to work on May 5, 2008.

[REDACTED] was additionally evaluated by Dr. David HC Tseng at the Duke Eye Center, affiliated with Duke University Medical School. At this exam, the patient was found to have nearly perfect visual acuity: OD 20/20-2, OS 20/20. Further eye motility and visual fields were normal and a dilated fundoscopic exam was also within normal limits. Dr. Tseng's evaluation was a very mild burn, completely healed with no epithelial defect or iritis. He was advised to follow up with his primary ophthalmologist in Lynchburg and that he was able to return to work.

References

Hatzifotis, M., Williams, A., Muller, M., and Pegg, S. Hydrofluoric acid burns. *Burns* 30(2): 156-159, 2004.

Takase, I., Kono, K., Tamura, A., Nishio, H., Dote, T., and Suzuki, K. Fatality due to acute fluoride poisoning in the workplace. *Leg Med (Tokyo)* 6(3):197-200, 2004.

Wilkes, G. Hydrofluoric acid burns. *eMedicine*, accessed May 2, 2007.
<http://www.emedicine.com/emerg/topic804.htm>

Was individual or individual's physician informed of DOE Long-term Medical Study Program?

No; not relevant in this case.

If yes, would the individual like to be included in the program?

No; not relevant in this case.

COMPLETE FOR MEDICAL MISADMINISTRATION (To be completed by Medical Consultant)

I. Based on your review of the incident, do you agree with the licensee's written report that was submitted to the NRC pursuant to 32 Ill. Adm. Code 335.1080 in the following areas:

- a. Why the event occurred – Yes. This was an industrial accident involving spillage of HF on skin and in the eyes. There is not a root cause analysis of the accident at this time.
- b. Effect on the patient – Yes.

My independent assessment of the accident generally agrees with that provided by BWXT. The prompt action of co-workers and of the BWXT emergency team probably was instrumental in preventing vision loss in this incident. They are to be commended.

- c. Licensee's immediate actions upon discovery – There was prompt reporting of the incident to the NRC.

- d. Improvements needed to prevent recurrence – The BWXT emergency protocol is well designed and generally follows the standard Honeywell protocol. It would be helpful to have routine HF drills with Lynchburg General Hospital. Many emergency physicians are not familiar with the consequence of a severe HF burn and this situation can be improved with additional community drills.

This is a human factors issue, correctable by education and improved procedures. The initial hospital emergency department response to this potentially serious HF burn was too slow and this needs to be rectified.

I would suggest training exercises between BWXT and the Lynchburg General Hospital ED on common, serious industrial accidents.

2. In areas where you do not agree with the licensee's evaluation report, provide the basis for your opinion: N/A

3. Did the licensee notify the referring physician of the misadministration? Yes

Did the licensee notify the patient's or the patient's responsible relative or guardian?
Yes.

If the patient or responsible relative or guardian was not notified of the incident, did the licensee provide a reason for not providing notification? N/A

4. Provide an opinion of the licensee's plan for patient follow-up. If available.

The emergency response of the BWXT team in this serious HF burn was prompt and appropriate. It is also consistent with their emergency response plan.