

Safety Evaluation Report

Proposed Quantitative ISA Standard for Dermal and Ocular Exposure for BWXT Nuclear Operations Group Inc. – Lynchburg, VA

TAC Number L33377

Requirement

10 CFR 70.65(b) requires the ISA Summary to contain a description of the proposed quantitative standards used to assess the consequences to an individual from acute chemical exposure to licensed material or chemicals produced from licensed materials that are on-site, or expected to be on-site as described in 10 CFR 70.61(b)(4) and (c)(4).

Staff Review

The guidance applicable to the NRC's review of an ISA Summary is contained in Chapter 3 of NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility". Section 3.4.3.2 of NUREG-1520 addresses the relevant criteria which a staff reviewer should look for in an acceptable submittal. The acceptance criteria in Section 3.4.3.2(7) require a satisfactory standard to be unambiguous and allow the licensee to distinguish between life-threatening, irreversible or long-lasting, and mild transient exposures.

The NRC staff also evaluated the proposed standard using the guidance provided in draft Interim Staff Guidance (ISG). The instructions provided in the ISG ask the staff to verify that the proposed standard is consistent with one of the suggested sources of useful data. Where the proposed standard is not a published standard, an alternative may be used, with supporting documentation.

In the June 8, 2015 letter (ML15180A163), B&W proposed a standard for use in their ISAs that would classify an acute dermal HF exposure of a worker to an HF solution of greater than 11 weight percent HF which covered greater than 10 percent of the body surface area (1,610 cm²) for greater than 30 minutes without medical treatment as a high consequence event.

This June 8, 2015 letter also proposed a standard that would classify an acute dermal HF exposure of a worker to an HF solution that is less than or equal to 11 weight percent HF but greater than 1 weight percent HF which covered greater than 10 percent of the worker's body surface area for greater than 30 minutes without medical treatment as an intermediate consequence event.

Finally, the June 8 letter proposed a standard for an intermediate ocular exposure event which was clarified in a July 27, 2015 letter. The proposed standard would classify an acute ocular HF exposure event to an HF solution of greater than 1 weight percent HF for greater than 30 minutes without medical treatment as an intermediate consequence event.

These proposed standards represent a relatively small change from the previously approved standard for B&W's dermal and ocular exposure events analyzed in their ISA. The previously approved standard was only for a high consequence event while the currently proposed standards are for both high and intermediate dermal and ocular exposure events. The differences between the previously approved standard and the currently proposed standards are summarized in Table 1.

Table 1- Comparison of previously approved and new HF standard for classifying dermal and ocular exposures.

| Event Severity | Previously approved standard | Currently proposed standard |
|--|--|---|
| High consequence | Exposure to an HF solution of less than 50 weight percent HF but greater than or equal to 2 weight percent over 805 cm ² of body surface area or any contact with the eye for more than 30 minutes without medical treatment. | Exposure to an HF solution of less than 50 weight percent HF but greater than 11 weight percent over 10 percent of the worker body surface area (1610 cm ²) for more than 30 minutes without medical treatment. |
| Intermediate consequence | No proposed standard | <p>Dermal exposure to an HF solution of 11 weight percent HF or less but greater than or equal to 1 weight percent over 10 percent of the worker body surface area (1610 cm²) for more than 30 minutes without medical treatment.</p> <p>Ocular exposure to HF solution of greater than 1 weight percent for more than 30 minutes without medical treatment.</p> |
| Low (less than intermediate) consequence | Exposure to HF solution of less than 2 weight percent HF | Exposure to HF solution of less than 1 weight percent HF |

The staff has reviewed available HF toxicity information and finds the proposed standard for classifying a dermal HF exposure as a high consequence to be acceptable for the following reasons.

The staff reviewed the information on fatalities due to HF exposure that are documented in the OSHA accident database. The database described 13 events occurring between August 1984 and October 2002. All of the fatalities appear to involve HF in concentrations of greater than 50 percent (generally 70 percent HF) and body surface exposures in the range of about 10 to 40 percent. These fatalities involved conditions more severe than the proposed conditions for separating high and intermediate severity events (11 percent HF and 10 percent body surface area).

The staff also reviewed an article which documented the results of exposure to dilute HF (concentrations of less than 11 weight percent).¹ This article reported that 237 consecutive cases of dermal exposure to dilute hydrofluoric acid (6-11 percent HF) did not result in any

¹ M.S. el Saadi, et. al., "Hydrofluoric Acid Dermal Exposure", *Veterinary and Human Toxicology*, July 1989.

fatalities. The article also reported similar observations from 555 cases of exposure to dilute HF reported by the American Association of Poison Control Centers.

The staff also developed independent estimates of the potential HF intake for the proposed intermediate standard (11 percent HF over 1610 cm²). Assuming a film thickness of 1 mm, absorption of all the HF in an 11 percent solution, and an ICRP reference man bodyweight (70 kg), the total dose would be 235 mg/kg which is less than the estimated LD50 of 400 to 800 mg/kg reported in the NIOSH skin notation for HF.² A calculation using 10 % body surface area of the ICRP reference man (1.9 m²) results in a dose of 278 mg/kg which is also less than the estimated LD50 range.

This independent analysis supports B&W's proposed standard for classifying an acute dermal exposure to HF acid concentrations of greater than 11 weight percent HF over 10 percent of the worker's body surface area without medical treatment will for 30 minutes as high consequence (i.e., could endanger the life of the worker which is the definition of high consequences in 70.61(b)(4)(i)).

The staff also reviewed available HF toxicity information and also finds the proposed quantitative standards for classifying dermal and ocular HF exposure as intermediate consequence to be acceptable for the following reasons.

The staff reviewed a GHS database³ for HF which has the hazard statement H314 "causes severe skin burns and eye damage" for exposures to HF with a concentration between 1 and 0.1 percent HF with no limits on body surface area exposure.

This information supports the position that dermal and ocular exposure to HF acid concentrations less than 1 weight percent HF regardless of amount the worker's body surface area that is exposed is not expected to result in consequences that could lead to irreversible or other long-lasting health effect to a worker which is the definition of intermediate consequences in 70.61(c)(4)(i).

Conclusion

The NRC staff has conducted an independent review of the proposed standards consistent with the guidance in draft Interim Staff Guidance on Acute Chemical Exposures and Quantitative Standards (ML15051A29). The staff has determined that the proposed standard is consistent with available HF toxicity information and its use in ISA would support acceptable classification of postulated accident severity. In addition, its inclusion in ISA Summaries would be acceptable for meeting the requirement of 10 CFR 70.65(b)(7).

Principal Reviewers

² NIOSH Skin Notation Profile; Hydrogen Fluoride/Hydrofluoric Acid (HF), April 2011.

³ ([http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates\\$fn=default.htm\\$3.0](http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates$fn=default.htm$3.0))

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References:

M.S. el Saadi, et. al., "Hydrofluoric Acid Dermal Exposure", *Veterinary and Human Toxicology*, July 1989.

Draft Interim Staff Guidance: Guidance for the Evaluation of Acute Chemical Exposures and Quantitative Standards; Division of Fuel Cycle, Safety and Safeguards and Environmental Review. March 4, 2015. ML15051A29.

U. S. Occupational Safety & Health Administration. Fatality and Catastrophe Investigation Summaries, Integrated Management Information Systems (IMIS).
<https://www.osha.gov/pls/imis/accidentsearch.html>.

NIOSH Skin Notation Profile; Hydrogen Fluoride/Hydrofluoric Acid (HF), April 2011.

United Nations, Globally Harmonized System of Classification and Labelling of Chemicals (GHS), 2011, 4th ed. ([http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates\\$fn=default.htm\\$3.0](http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates$fn=default.htm$3.0))