UNITED STATES
NUCLEAR REGULATORY COMMISSION
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LICENSEE: Combustion Engineering, Inc.
Hematite, Missouri

SUBJECT: SAFETY EVALUATION REPORT: APPLICATION DATED AUGUST 12, 1997, RELEASE OF HYDROFLUORIC ACID

BACKGROUND

By letter dated August 12, 1997, Combustion Engineering, Inc. (CE) requested an amendment to License No. SNM-33 to authorize the release of hydrofluoric acid for unrestricted commercial use. The acid will be generated from the treatment of process off-gas with a new wet absorber system, which will replace the present calcium carbonate scrubbing system.

At the CE-Hematite facility, the UF_5 is converted to UO_2F_2 using superheated steam and is then defluorinated to UO_2 using disassociated ammonia (hydrogen) and superheated steam. The off-gas from the process contains hydrogen fluoride, water vapor, and uranium particulate. This off-gas will be treated by passing it through two sets of sintered metal filters to remove uranium particulate and then to the wet absorber system, where the hydrogen fluoride is captured. The hydrofluoric acid (HF) generated from the absorber system will be held in a 35,000 liter tank prior to off-site release in batches of 20,000 liters.

In addition to an environmental safety review of the release of the HF for unrestricted use, the NRC staff also conducted a review of criticality and chemical safety associated with the new absorber system. The results of this review are described below.

DISCUSSION

Criticality Safety

As documented in NRC memorandum dated November 24, 1997, the NRC staff initially reviewed the licensee's criticality safety documentation for the new absorber system during a site visit on November 12-14, 1997. By telephone conversation on January 20, 1998, the NRC staff requested additional criticality safety information. This information was provided by letter on

January 30, 1998. (The letter was mistakenly dated January 30, 1997). In follow-up discussions, the licensee provided further information during telephone conversations with the NRC staff.

The NRC staff has reviewed the information provided by the licensee and has performed a technical assessment of the Nuclear Criticality Safety Program for use of the HF absorber system. This includes on-site collection of liquid HF into favorable geometry containers, transfer to and storage in an unfavorable geometry bulk storage tank, and transfer to an unfavorable geometry tanker truck. During telephone conversations during the week of February 2 and 23, 1998, the licensee indicated that the absorber system will be monitored by CE-Hematite's current criticality alarm system. The criticality safety controls used in the absorber system will be (1) favorable geometry in conjunction with interaction and (2) concentration control of uranium. The licensee has committed to providing the assurance that the controlled parameter, concentration control of uranium, is maintained within the defined limits for aqueous solution transfers from favorable to unfavorable geometry in the HF absorber system by at least two independent representative samples.

The NRC staff analyzed the bulk storage tank to determine if criticality safety would be maintained under normal operating conditions. The bulk storage tank will be subcritical under normal operating conditions because the maximum uranium concentration will be 0.2 g U/liter, which is below the license limit for concentration control of uranium safe units.

The NRC staff analyzed the rest of the absorber system to determine if criticality safety would be maintained under abnormal operating conditions. The neutron interaction analysis was performed by the NRC staff using KENO V.a calculations. The 44-group cross section library is conservative and was used to take advantage of the most recently available nuclear data. The polymeric lining of the vessels and tanks was modeled as polyethylene.

When nuclear criticality safety is based on computer code calculations, CE-Hematite is committed to using an effective multiplication factor for normal or abnormal credible operating conditions that is less than or equal to 0.95, including applicable biases and calculational uncertainties. The most reactive abnormal operating condition is 5 wt.% ^{235}U (aqueous solution of UO_2) which resulted in a calculation of 0.917, including all applicable bias and uncertainties, for CE-Hematite and a (k_{eff}+2sigma) calculation of 0.928 for the NRC. Since the most reactive (k_{eff}+2sigma) calculation is below the license limit of 0.95, including applicable biases and calculational uncertainties, the entire HF absorber system excluding the unfavorable geometry bulk storage tank is subcritical under both normal and credible abnormal operating conditions.

In conclusion, Part I of CE-Hematite's license requires assumed conditions of process variables to be at their credibly most reactive values. Examples of these process variables include: moderation, reflection, mass, concentration, density, enrichment, heterogeneity, geometry, and spacing. Based on the staff's review, the credibly most reactive conditions have been assumed in the licensee's analysis.

The staff has reviewed and simulated the system postulated by the licensee. Based on this review, the staff concludes that there is reasonable assurance that the licensee has examined all credible control failure sequences and that a nuclear criticality will not occur by assuring that no single failure will cause an inadvertent nuclear criticality. Based on this review, the staff has reasonable assurance that a sufficient margin of safety exists to prevent a nuclear criticality during both normal and abnormal operating conditions.

Chemical Safety

By letter dated November 25, 1997, the NRC staff requested information on the chemical safety of the new absorber system. By letter dated February 6, 1998, the licensee provided a response, which included an integrated safety analysis (ISA) for the process. The licensee also provided information during a meeting with NRC staff on January 15, 1998.

Based on this information, the staff has conducted a technical review of the chemical safety features associated with the licensee's HF absorber system. The absorber system includes three packed-column absorbers and associated piping, pumps, and tanks leading to and from the absorbers. The staff has determined that the materials of construction, controls, and preventive maintenance procedures associated with the HF absorber system provide adequate assurance of chemical safety.

The materials of construction for equipment in contact with HF appear to provide adequate protection against corrosion and thermal degradation. Each of the materials in Table 1 is HF-resistant and should not encounter temperatures above its temperature rating in normal or upset conditions. As is indicated below, temperature controls will shut down the process before this occurs.

Table 1. HF absorber construction materials.

Material	Use	Process Temperature (°F)	Temperature Rating (°F)
TEFLON®	Liner for piping leaving filters	400	500
KYNAR®	Absorber lining and packing	210 (maximum)	275
Polypropylene	Liner for storage tanks, vent piping	140	225
Polyethylene (cross linked)	Bulk storage tank	140 (maximum)	160
VITON®	All internal valves and pumps	400 (maximum)	450
Graphite	Heat exchanger	210	All temperatures

The three absorbers will be operated at temperatures ranging from 186°F to 210°F. The maximum temperature that can be attained in the absorbers, 248°F (the boiling point of the hydrogen fluoride solution), is within the design temperature of KYNAR®, the material of construction.

The engineered controls appear to adequately prevent or mitigate the consequences of accidents. These controls include the following:

- Sintered metal filters are used in each steam reactor to prevent particulates from entering the off-gas stream or the HF absorbers.
- Multiple interlocked steam flow and pressure indicators will prohibit unreacted UF_6 from reaching the absorbers.
- During transfer from the favorable geometry storage arrays to the bulk storage tank, two level indicators will terminate the transfer to avoid overfilling the tank.
- Concrete dike containment under the bulk storage tank is designed to hold 108% of the tank volume.
- A high level alarm in the tank truck will prevent overfilling.
- On-line monitoring of the process will occur and should any of the following be detected the process will undergo an interlocked shut down

  -high temperature,
  -abnormal pressure,

-conductivity irregularities,
-high liquid levels, and
-circulation pump failure.

The preventive maintenance procedures, if properly followed, appear to provide adequate assurance of continued safety. The maintenance procedures include the following:

- Startup testing, including leak checking and pressure testing.
- Piping and flexible joints at pumps will be periodically checked for leaks and deterioration.
- The concrete containment dike will be periodically checked for cracking and HF exposure.
- Bolt torques will be checked for correctness.
- Flexible hoses for tank truck transfer will be replaced periodically.
- Plant workers receive detailed training on the proper operating procedures and the hazards of HF exposure.

In conclusion, staff believes that the licensee has provided adequate assurance of chemical safety of the HF absorber system. The significant chemical hazards have been identified in the ISA and other submittals and the preventive measures appear to be adequate. Thus, assuming proper maintenance and surveillance, operation of the HF absorber system should not adversely affect public health and safety.

Environmental and Radiation Protection

The NRC staff requested additional information from the licensee on environmental and radiation protection associated with the release of HF by letter dated November 6, 1997. The licensee provided this information in a letter dated December 8, 1997.

The new wet absorber system consists of three absorbers in series and was designed to remove 99.5% of the HF from the exhaust gas. This is a significant improvement over the current system which is only 90% efficient and generates approximately 180,000 kg of solid calcium fluoride waste each year.

The new absorber system will also generate HF (35% by weight), which the licensee has proposed to sell off-site. The licensee has made a commitment to ensure that the uranium concentration of the HF released is below 3 pCi/ml. As it is produced, the solution will be collected in qualification tanks or day tanks, which will be sampled before transfer to a 35,000 L hold tank.

This hold tank will be double-walled and located on a diked pad capable of holding 38,000 liters. The concentration of uranium in the hold tank will be verified prior to release by taking and analyzing a representative sample of the tank.

If a process upset causes the uranium concentration in the qualification tanks or day tanks to be high, the solution will be diverted for later blending with lower concentration batches or neutralized. Neutralization may create a solid waste that will either be processed for uranium recovery or disposed of at an off-site licensed low-level waste disposal facility. Any resulting liquid effluents will be processed by the licensee's wastewater treatment facility.

The licensee plans to sell the HF to a chemical manufacturer or distributor and indicates that the most likely use of the material will be for metal pickling, which is used in the aerospace and automotive industries. After use in metal processing, the metals in the HF, including the uranium, will most likely be precipitated and disposed of in a landfill. The HF would not be used in any industry directly contacting the food chain because the Food and Drug Administration currently prohibits the usage of any hydrofluoric acid in food processing, allowing its usage only as a bonding agent for adhesives in food packaging.

The licensee provided an assessment to consider the radiological dose for a worker at a non-licensed facility handling HF. The licensee assumed that the worker is immersed in HF vapors at a concentration of 30 ppm, which is 10 times higher than the Occupational Safety and Health Administration (OSHA) short-term exposure limit. This is a conservative assumption because the injuries resulting from the chemical hazards of the HF would preclude HF use in this manner.

The worker was assumed to breathe the vapors containing 3 pCi/ml of uranium for 2000 hours per year. In addition, although the licensee expects that the majority of the uranium will be in the chemical form of UO_2F_2 (Class D), for assessment purposes the licensee assumed half of the uranium would be UO_2F_2 and half would be UF_4 (Class W). This calculation resulted in a total effective dose equivalent (TEDE) of approximately 2 mrem/yr. The contribution to the dose from ingestion and external exposure were orders of magnitude less than the inhalation dose.

The licensee also considered the occupational dose to a worker contacting wastes from HF processing. The HF was assumed to be precipitated using sodium hydroxide and subsequently dried for disposal. The worker was assumed to breathe the dust at the OSHA permissible exposure level for 2000 hours per year. As with the scenario described above, inhalation is the primary exposure pathway, and the assessment results in a TEDE of approximately 3 mrem/yr.

As a conservative assessment for the potential uses of the material, the licensee also considered a situation where the HF is released to a metal processor, the HF does not meet the processor's specifications and is subsequently sold to produce sodium fluoride to be used in drinking water fluoridation. A dose assessment was then performed for a member of the public who drinks two liters of this water per day. The drinking water fluoride concentration was assumed to be 1 ppm, resulting in a uranium concentration in water of 7×10^{-12} μCi/ml.

This calculation results in a TEDE of approximately 0.001 mrem/yr. The cumulative radiation exposure under this scenario is considered by the staff to be insignificant because it is highly unlikely that the industrial grade HF would be used in drinking water fluoridation and because it is highly unlikely that all of the water consumed by the individuals would be fluoridated with HF from the licensee.

The NRC staff conducted an independent assessment and concurs that the scenarios analyzed by the licensee are sufficiently conservative. In addition, the staff analyzed these situations using more conservative parameters, such as the most conservative chemical form of the uranium which may be present, and determined that the doses to a maximally exposed individual are not expected to exceed 5 mrem/yr. This is only 5% of the dose limit for members of the public specified in 10 CFR 20.1301. Conservative analyses were performed because, once the material is released from the licensee's control, the NRC can no longer place restrictions on its future use.

Hydrofluoric acid released for off-site commercial use is not considered by the staff to represent a significant change in the types or amounts of effluents released off-site because this material is not released in an uncontrolled manner into the environment. Instead, the HF is a product used in other industrial applications. Furthermore, there is not expected to be any significant impact to public health and safety or the environment from the uranium released in this material.

ENVIRONMENTAL REVIEW

The staff has determined that the following conditions have been met:

1. There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

2. There is no significant increase in individual or cumulative occupational radiation exposure.

3. There is no significant construction impact.

4. There is no significant increase in potential for, or consequences from, radiological accidents.

Accordingly, pursuant to 10 CFR 51.22(c)(11), neither an environmental assessment nor an environmental impact statement is warranted for this action.

CONCLUSION

The staff has determined that the new absorber system does not pose any significant criticality, chemical, or environmental safety concerns. In addition, the staff has determined that release of hydrofluoric acid which contains less than 3 pCi/ml, will not result in any adverse effect on public health and safety or the environment. However, the staff expects that the licensee will update the facility emergency plan to reflect the inventory of HF, which is a hazardous substance.

The Region III project inspector has no objection to the proposed action.

Michael F. Weber
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