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ATTACHMENT 1

SAFETY DEMONSTRATION

USE OF CALCIUM FLUORIDE IN BRICK MANUFACTURING

SOURCE OF THE PRODUCT

From wet conversion operations, fluorides and ammonia are the major chemical components of the liquid waste stream from the Columbia Fuel Fabrication Facility. This waste stream is processed through the advanced waste-water treatment process, which first removes residual uranium to concentrations less than 0.3-parts-per-million. Then, slaked lime is added to precipitate calcium fluoride, and the resultant slurry is processed through a distillation column, where the ammonia is steam-stripped to ammonium hydroxide and re-cycled to the wet conversion process. The calcium fluoride is transferred to a holding lagoon, and/or other de-watering methods are employed, to increase the solids content to greater than 60-weight-percent. De-watered calcium fluoride can then be loaded for transport off-site, in closed transport containers and/or closed vehicles, to final disposition. This final disposition may be shipment to a licensed radioactive waste burial facility, shipment to an approved industrial waste burial facility, or licensed sale as a useful CaF_2 by-product. Typical end uses of the material may include use in the metallurgical foundry industry or the brick fabrication industry. Prior to unrestricted sale or other transfer of by-product CaF_2, a detailed plan for such sale or transfer must be submitted to NRC for review and approval. Elements of a typical plan, for sale of CaF_2 to Yadkin Brick Co., Inc. for mixing with other constituents such as clay for end-use in the manufacture of bricks, are presented in the successive paragraphs.

Yadkin Brick Co., Inc. is located at Route 2, Box 50, Stanly County, New London, North Carolina. Here, the facility fabricates a variety of bricks for end-use in residential buildings and industrial projects. Percentage quantities of calcium fluoride can be incorporated into the brick material and can assist in the firing process. The process flow is shown in Figure 1.

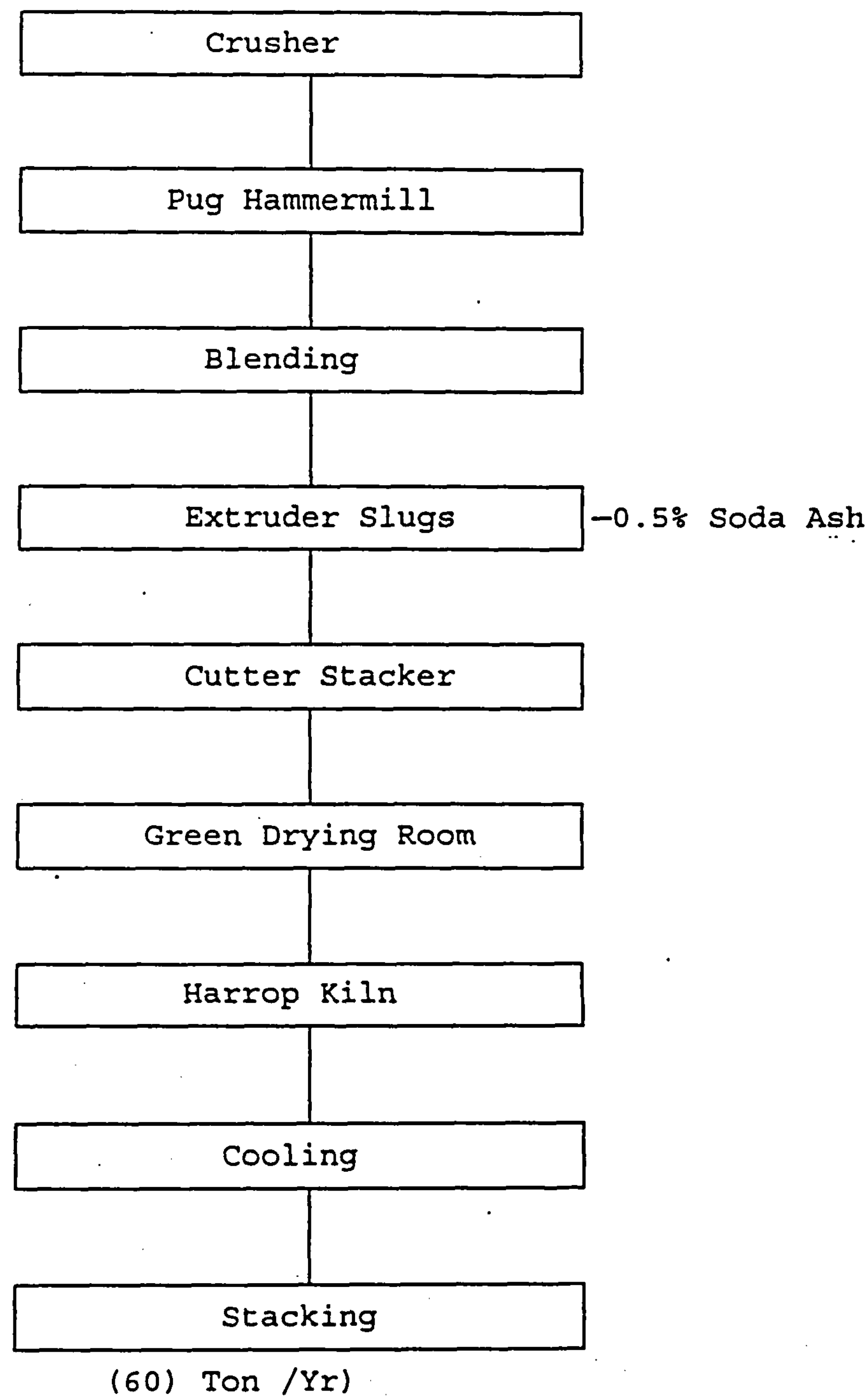
RADIOLOGICAL AND ENVIRONMENTAL PROTECTION CONTROLS

A comprehensive sampling and analysis program is maintained to assure that uranium concentrations in the calcium fluoride meet conditions specified by the Regulatory Component. If the material is taken directly from the distillation column system, representative samples are obtained from either the still feed-tank or the de-watering discharge; the samples are then analyzed to assure the mean uranium concentration is less than 30-picocuries per gram of dried material. If the material is taken from the holding lagoons, representative samples are obtained from either the de-watering discharge or the lagoon itself; the samples are then analyzed to assure the mean uranium concentration is less than 30-picocuries per gram of dried material. The material is subsequently transported to the receiver in closed containers and/or vehicles, to protect against suspension in air.

FIGURE 1

BRICK PROCESSING FLOW DIAGRAM

YADKIN BRICK COMPANY



A uranium concentration of 30-picocuries per gram is equivalent to approximately 13-parts-per-million, for 5.0 w/o U-235 enrichment; to date, nominal levels of the Westinghouse material have ranged from 1.4 to 4.0 ppm. This is in the same range as uranium concentrations in natural fluorspar; which, have ranged from 2.5 to 14 ppm. Thus, the environmental impact of the Westinghouse material will not differ from that of similar material from natural sources.

A calculation has been performed to estimate the maximum dose to the nearest off-site resident, located approximately 180-meters to the northwest of the Yadkin site. This calculation utilizes the following equation, to determine ground-level concentration, taken from Smith, Maynard; RECOMMENDED GUIDE FOR THE PREDICTION OF THE DISPERSION OF AIRBORNE EFFLUENTS; American Society of Engineer's Committee on Air Pollution Controls; May 1968, and modified to assume a conservative ground-level, point-source, release:

$$X = \frac{Q}{(\pi \sigma_y \sigma_z)\bar{\mu}}$$

Where:
Q, the activity release rate in microcuries per second, is the product of: the emission rate of a 10 percent mixture of calcium fluoride in brick -- 0.037-pounds per hour, or 4.67E-03-grams per second; the uranium concentration in the calcium fluoride -- 13-parts-per-million, or 13E-06 grams per gram of calcium fluoride; and the specific activity of the uranium -- 2.385-microcuries per gram. Thus, Q = 1.4E-07 microcuries per second.

π is a constant -- 3.14.

σ_y is the Class D stability cross-wind plume standard deviation for the maximum concentration 180-meters down-wind -- 12-meters.

σ_z is the Class D stability vertical plume standard deviation for the maximum concentration 180-meters down-wind -- 8-meters.

$\bar{\mu}$ is the wind-speed -- 3-meters per second.

Thus, X = 1.5E-10 microcuries per cubic meter, or 1.5E-16 microcuries per milliliter.

The annual dose is then calculated as the product of:

X = 1.5E-16 microcuries per milliliter;

The volume of air breathed -- 1.05E10 milliliters per year;

The dose conversion factor -- 1.25E05 millirem per microcurie inhaled; and,

An 80-percent occupancy factor -- 0.8.

Thus, the annual dose to the nearest resident is some 0.16 millirem per year, or some 0.6-percent of the 40CFR190 limit of 25-millirem per year and less than 0.2 percent of the 10CFR20 limit for individual members of the public.

Likewise, a calculation has been performed to estimate the maximum dose to a Yadkin employee involved in the calcium fluoride bricking operation. The annual dose is calculated as the product of:

The maximum permissible concentration for a nuisance dust in air -- 1E-02 grams of calcium fluoride per cubic meter;

The activity of the dust -- 30-picocuries per gram, or 3E-11 curies per gram of calcium fluoride;

The volume of air breathed -- 2.4E09 milliliters per year; and,

The dose conversion factor -- 1.25E05 millirem per microcurie inhaled.

A 10 percent occupancy factor -- 0.1.

Thus, the maximum annual dose to the worker is some 9 millirem per year, or some 36-percent of the 40CFR190 limit of 25-millirem per year and less than 10 percent of the 10CFR20 limit for individual members of the public. (Actual doses would be expected to be much less, because of the conservative assumptions used in the calculations.)

After the calcium fluoride is encapsulated in the bricks, it is transported to distributors for residential or industrial building materials.

Westinghouse calcium fluoride will be incorporated into the bricks. Approximately 10% of the brick material is Westinghouse calcium fluoride. Once encapsulated into the brick, the only environmental effect, if any, would be external radiation from the uranium in the calcium fluoride. To determine this impact, bricks containing Westinghouse calcium fluoride were compared with "natural" bricks using an Eberline PRM-7 micro R meter. To make the measurements , a group of five bricks were placed on their side (banded together) on a table in the low background Columbia Plant invivo counting chamber. The micro R meter was then placed on contact with the bricks. The following exposure rates were measured:

Type of Brick	Exp. Rate (μr/hr)
Natural (0% CaF_2)	2.5 $\pm$1
5% CaF_2	1.5 $\pm$1
10% CaF_2	1.5 $\pm$1

*Instrument Background = 0.5 μr/hr $\pm$ 1μr/hr

To determine the integrated dose, Eberine LIF thermoluminescent dosimeters (TLD's) were placed on contact with the bricks for a period of eleven days. The reported doses were zero for the natural (0% CaF_2) 5% CaF_2 and 10 CaF_2 bricks. The minimum detectable dose is 10 mREM.

One last qualitative test involved placing the group of five bricks, in the same geometry as described above, in the Columbia Plant low background invivo counting chamber, lowering the sodium iodide detector to within 2 inches of the surface of the bricks, and collecting the accumulated counts over the entire gamma spectrum. The results are given below:

Type of Brick	Accumulated Counts per minute
Natural (0% CaF_2)	48
5% CaF_2	38
10% CaF_2	38

Results of the above tests show that gamma emissions from the bricks containing up to 10% calcium fluoride are statistically less than from the "natural" (0% CaF_2) bricks. This may be attributed to the fact that the Westinghouse calcium fluoride is replacing natural raw materials such as clay and shale which contain higher natural concentrations of gamma-emitting radioisotopes.

Removable contamination surveys were also performed for all three sets of bricks. Results are given below:

	dpm/100 cm^2	
Type of Brick	Alpha	Beta-Gamma
Natural (0% CaF_2)	3	8
5% CaF_2	6	11
10% CaF_2	6	11

Therefore, it is concluded that there is no net exposure to the public from the use of bricks containing Westinghouse calcium fluoride as compared with "natural" (0% CaF_2) bricks.

OCCUPATIONAL SAFETY AND HEALTH CONTROLS

Activities supporting the calcium fluoride disposal operation require only routine industrial safety and hygiene practices.