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June 10, 1981

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety & Safeguards
Division of Fuel Cycle & Material Safety
Washington, D.C. 20555

Attention: Mr. R. G. Page, Chief
Uranium Fuel Licensing Branch

Gentlemen:

SUBJECT: Application for Amendment to License SNM-1107, Docket 70-1151

The Westinghouse Electric Corporation hereby transmits an application for an amendment to License No. SNM-1107 for our Columbia, SC Plant. The purpose of this application is to revise the description of the use of Borosilicate - glass raschig rings as a secondary method for nuclear criticality control.

Enclosed is a check in the amount of $1,400 in payment of the fee requirement specified in 10 CFR 170.31.

If you have any questions regarding this matter, please write me at the above address or telephone me at (412) 373-4652.

A Joseph Nardi

A. J. Nardi, Manager
NES License Administration

AJN/dr

Enclosures

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NMSS
MAIL SECTION
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Applicant.....
Check No. 23810
Amount/Fee Category 1400-1B
Type of Fee. Amend Fee
Date Check Rec'd 7/1/81
Received By.....

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REVISION RECORD

Revision No.	Date of Revision	Pages Revised	Revision Reason
11	6/24/80	102g	Reprint Section 1.9.1.10 entitled "Solution Storage" previously printed on page 102.
11	6/24/80	154	Add the types of waste treatment conducted at the Columbia Plant.
12	6/10/81	60, 60a, 60b, 60c. 61	Describe use and testing of raschig rings. Provide test results on analysis of raschig rings.
12	6/10/81	101	Revise solution conditions.
12	6/10/81	220	Specify minimum operating conditions for use of raschig rings.

Page 10 intentionally left blank.

1.8.1.2 (Continued)

minimum of one foot edge-to-edge separation with no interaction considerations.

Dry UO_2 in closed containers -- Calculations for UF_6 reported in K-1663 indicate that K_∞ for U(5.0) F_6 with an $H/^{235}U \leq 10$ is less than 1.0. Based on the nuclear similarity of oxygen and fluorine, and on the shape of the curve in Figure 3 of K-1663, this value is considered to apply to oxides of uranium enriched $\leq$ 4.15 w/o in the isotope ^{235}U, provided that $H/U \leq 0.5$ and the moderator is uniformly distributed in the fissile material. Therefore such subcrits require no interaction considerations. However, individual containers must be closed or sealed and must meet one of the subcrit maximum permissible values established in subparagragh 1.8.1.1. An array must provide a minimum of one foot edge-to-edge spacing between subcrits. These requirements assure nuclear criticality safety if a subcrit or the array were to be accidentally moderated. The same requirements apply to the oxides of uranium enriched between 4.15 w/o and 5 w/o in the isotope ^{235}U, except that the H/U ratio is limited to ≤ 0.3.

1.8.1.3 Nuclear Poisons

Borosilicate glass Raschig rings, when used as the primary control for nuclear criticality safety, are used only in accordance with Regulatory Guide 3.1 "Use of Borosilicate - Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material." Raschig rings may also be used as a secondary control to provide additional nuclear criticality safety assurance in vessels of

1.8.1.3 (Continued)

uncontrolled geometry where normally uranium concentrations are maintained less than the maximum permissible solution concentrations (5.0 g ^{235}U/liter for aqueous solutions) as the primary nuclear criticality safety control. Typical of such uses would be the addition of Raschig rings into the process quarantine tanks, which are sampled prior to release to the Waste Treatment Facility, and effluent scrubber system reservoirs.

The solutions used in these tanks have a pH < 11.0 and a fluoride concentration of approximately 4% as NH_4F. Ten years of operating experience at the Columbia Plant has shown that corrosion of the rings is negligible as shown by the data given in table 1.8.1.1.

1.8.1.3 (continued)

The following tests are performed annually to determine the various parameters of the Raschig Rings. Test results are reported to the Radiation Protection Component for review and evaluation:

Settling

The levels of rings in the tanks are determined by visual and physical measurements in accordance with written procedure. Rings are added when the required cumulative addition will become equal to 10% of the original loading. Since 1971, settling of the rings has been negligible.

Physical Properties

The volume occupied by the rings is determined by calculating the arithmetic difference between the actual tank volume and the liquid capacity of the tank with the rings. The glass content volume of the tanks is approximately 39%.

Boron Content

Boron content is determined in accordance with Appendix A of ANSI/ANS-8.5-1979. Rings have been sampled and analyzed since 1971, with no significant boron leaching detected. The average boron content of the rings is approximately 12.5 weight percent B_2O_3.

A publication by N. Ketzlach entitled "Proposed Extension of Raschig Ring Standard to Low Enriched Uranium Fuels," concludes that a 24 volume % borosilicate glass Raschig Ring poisoned mixture (<5% U-235 enriched) cannot be made critical independent of uranium concentration when B_2O_3 in the glass is 12.8%. Reducing the B_2O_3 content in the glass to 11.8% with 5.4g U/ml in the matrix solution resulted in an increase of $\sim$ 3.3% in the calculated K_∞ compared to the K_∞ for 12.8 B_2O_3. The average B_2O_3 content of rings in the tanks is approximately 12.5%. Consequently, the mixture is safe ($K_\infty < 0.8$). Actually, the margin of safety is much greater since the concentration of 5.4 g U/ml

TABLE 1.8.1.1

RASCHIG RING ANALYSIS FOR QUARANTINE TANKS

Weight Percent B_2O_3

	3/1/71	2/15/72	11/15/72	1/23/75	7/1/75	12/29/75	7/15/76	1/5/77	6/21/77	3/3/78	6/5/78	11/1/78	11/13/79	5/20/80	Avg. 3/1/71 5/20/80
V-216A	12.9		11.45	12.34	12.27	12.80	12.67	13.00	13.02	12.66	12.0	12.5	12.0	12.7	12.5
[illegible]	11.3			12.04	12.37	12.79	12.93	13.17	13.06	13.21	12.3	12.3	12.2	12.8	12.5
[illegible]	10.2		12.90	12.90	12.22	12.62	12.76	12.67	12.11	12.94	12.1	12.1	11.9	12.7	12.3
[illegible]	12.4	12.5	12.49	12.99	12.37	12.62	12.44	12.80	12.73	13.22	12.1	12.6	12.1	12.6	12.6
V-216B	13.2	12.7		12.80	12.22	12.80	12.72	12.79	12.59	12.88	12.1	12.0	11.9	12.7	12.6
V-216C	11.4	12.6	11.53	12.52	12.46	13.34	12.46	12.77	13.26	12.96	12.1	12.6	12.2	12.5	12.5
Unused Ring	10.8	13.4		12.99							12.4				12.0
Unused Ring	10.6														

1.8.1.3 (Continued)

is greater than the solubility limit for uranium in solutions. In addition, the average volume occupied by the rings in the existing tanks is approximately 39 volume %.

The use of any other nuclear poisons or any use of poisons for primary criticality control requires a specific license amendment.

1.8.1.4 Nuclear Interaction Evaluations

All subcrits must meet the MPV's and must have a separation of at least one foot edge-to-edge between any two subcrits.

Interaction between subcrits which are not isolated (¶ 2.1.1) is evaluated using the surface density method. This method requires that each subcrit be limited to the nuclear equivalent of a sphere having ≤ 0.4 times the volume of an unreflected critical sphere of the same material (≤ 0.4 "fraction critical"). Values are established for each control using equal buckling conversions as follows:

$$\left(\frac{\pi}{R_s + \lambda_s}\right)^2 = \left(\frac{\pi}{T+2\lambda t}\right)^2 + \left(\frac{\pi}{L+2\lambda t}\right)^2 + \left(\frac{\pi}{W+2\lambda t}\right)^2$$ for a slab with finite dimensions, or

2.3.2.2 (continued)

e. Subcrits which are safe by concentration control and which are part of a continuous processing line will be filed with a glass volume fraction of at least 30% Borosilicate glass Raschig Rings. The Raschig Rings shall be purchased in accordance with the specifications listed in ANSI/ANS-8.5-1979. During operation the glass Raschig Rings will be exposed to a basic solution (NH_4OH) which will have a pH less than 11.0, temperature of 60°C or less, and a fluoride concentration of ~4%. The Raschig Rings shall be acid washed on a routine basis with a weak acid solution containing ~15 - 30% nitric acid. The Raschig Rings shall be inspected at least once per year for (1) settling, (2) physical properties and (3) boron content in accordance with ANSI/ANS-8.5-1979, "Use of Borosilicate-Glass Raschig Rings as A Neutron Absorber in Solutions of Fissile Material."

f. Subcrits composed of fuel assemblies will be limited by reactivity. The computed keff, including allowanced for computational error, will not exceed 0.95. These computations will be performed by the NFD, Nuclear Design Department using procedures such as MUFT, SOFOCAT, LEOPARD, and/or PDQ-03. The results of these computations will be independently reviewed within the department and approved by the department manager before being transmitted to the NFD Manufacturing Department.

g. Maximum permissible values for subcrits containing plutonium will be those established in Figure 2.3.2.5. Subcrits containing plutonium will be restricted to encapsulated components containing PuO_2 mixed with natural or depleted UO_2.

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V-116A	12.9		11.45	12.34	12.27	12.80	12.67	13.00	13.02	12.66	12.0	12.5	12.0	12.7	12.5
V-116B	11.3			12.04	12.37	12.79	12.93	13.17	13.06	13.21	12.3	12.3	12.2	12.8	12.5
V-116C	10.2		12.90	12.90	12.22	12.62	12.76	12.67	12.11	12.94	12.1	12.1	11.9	12.7	12.3
V-216A	12.4	12.5	12.49	12.99	12.37	12.62	12.44	12.80	12.73	13.22	12.1	12.6	12.1	12.6	12.6
V-216B	13.2	12.7		12.80	12.22	12.80	12.72	12.79	12.59	12.88	12.1	12.0	11.9	12.7	12.6
V-216C	11.4	12.6	11.53	12.52	12.46	13.34	12.46	12.77	13.26	12.96	12.1	12.6	12.2	12.5	12.5
Unused Ring	10.8	13.4		12.99							12.4				12.0
Unused Ring	10.6														