CP&L

Carolina Power & Light Company

APR 20 1984

SERIAL: NLS-84-178

Director of Nuclear Reactor Regulation
Attention: Mr. D. B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing
United States Nuclear Regulatory Commission
Wasnington, DC 20555

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 & 50-324/LICENSE NOS. DPR-71 & DPR-62
REQUEST FOR ADDITIONAL INFORMATION ON BURNING OF WASTE OIL

Dear Mr. Vassallo:

In a letter dated February 15, 1984, Carolina Power & Light Company (CP&L) was requested to provide some additional information concerning the combustion of waste oil at the Brunswick Steam Electric Plant (BSEP).

Please find enclosed our responses to the questions raised by your staff. Should you have further questions, please contact a member of our Licensing Staff.

Yours very truly,

S. R. Zimmerman
Manager
Nuclear Licensing Section

PPC/gvc (9865PPC)

Enclosures

cc: Mr. D. O. Myers (NRC-BSEP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. M. Grotenhuis (NRC)

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411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

RESPONSE TO A REQUEST FOR ADDITIONAL INFORMATION

BRUNSWICK STEAM ELECTRIC PLANT

DOCKET NOS. 50-324/325

EVALUATION OF BRUNSWICK REQUEST TO BURN CONTAMINATED OIL

CP&L is requesting permission to burn contaminated oil in both an auxiliary boiler and a clean trash incinerator. Questions related to solids retention, solids disposal, and occupational exposure are addressed for both of these options.

Question

Provide the quantities of radioactive materials that may be retained by dust collection systems, ash collection systems, and other portions of the combustion system and the means to be provided for disposal of these radioactive materials.

Response

The auxiliary boiler has no ash or dust collection systems because No. 2 fuel oil has < 0.01 percent ash (Table 9-11, Chemical Engineers Handbook, Perry and Chilton). A thin layer of soot is deposited in the fire tubes, smoke boxes, and stack. Routine periodic maintenance or the detection of measurable levels of radiation could present occasions for cleaning out this soot. All such maintenance procedures will follow applicable OSHA and NRC guidelines.

CP&L's request states that the total quantity of radioactivity which may be released from the site by combustion of waste oil shall be limited to 50 μCi per calendar year. As indicated in the appendix to our application of November 21, 1983, the only isotope routinely seen in cleaned waste oil is Co-60. If 50 μCi of Co-60 was deposited on the walls of the auxiliary boiler and was depleted only by radioactive decay, then the maximum total activity can be determined using the decay equation for secular equilibrium (Introduction to Health Physics, Herman Cember, 1st edition, p. 98). In secular equilibrium, an isotope is assumed to be formed (or in

this case, introduced to the boiler) at a constant rate and to decay exponentially at a rate governed by its decay constant, λ. Using this equation,

$$A_{Co-60} = \frac{K}{\lambda_{Co-60}} (1 - e^{-\lambda_{Co-60} t})$$

Where: A_{Co-60} = activity of Co-60 in μCi at time t

K = "formation" rate of Co-60 = 50 μCi/year

$(1 - e^{-\lambda_{Co-60} t})$ = exponential decay term

As $t \to \infty$, $A_{Co-60} = \frac{K}{\lambda_{Co-60}}$

A_{Co-60} = 379 μCi

This value, 379 μCi, is the equilibrium value (point at which rate of formation = rate of decay). This is the largest possible activity that could be present in the boiler. This value would be approached in 20-30 years.

The auxiliary boiler to be used is a Johnston fire tube boiler. The design of this boiler features a steel shell which encloses water-jacketed fire tubes. As mentioned, soot will deposit in these fire tubes, in smoke boxes, and in the stack. The activity in the fire tubes would be well shielded by the water and steel. The smoke boxes and stack are manufactured of 10-gauge steel which provides very little shielding. If all 379 μCi were deposited at a point on the smoke box, the 1-foot exposure rate would be approximately 6 mR/hr from a Co-60 source (from 6CEn approximation of a gamma point source). This rate could only be achieved if all the Co-60 introduced into the boiler collected at one point for a period of 30 years or more. In conclusion, the auxiliary boiler will produce no solid waste for disposal (other than a slight soot buildup) and will under all conditions contribute only negligible occupational exposures.

The alternat.ve disposal route is to use a clean trash incinerator. Such an incinerator will be required to have a heat release capacity of at least 7,000,000 Btu/hr. At this rate, approximately 7,000 lb/day of clean

trash could be incinerated on an 8-hour per day burn rate. To incinerate 12,000 gallons of waste oil per year containing 50 μCi of Co-60, a constant feed rate of 6 gph would be required. For conservatism, we can assume a waste oil feed rate as high as 20 gph. Twenty gallons has a Btu value of approximately 2,900,000. At this rate, the clean trash burn rate (based on the BSEP waste profile) would drop to ~ 4000 lb/day. If for conservatism a mass reduction of 20:1 is assumed, there there would be 200 lb of ash occupying 10 cubic feet generated per day (assume 20 lb/cu ft ash density). If the 50 μCi of Co-60 is contained in 12,000 gallons of waste oil, then a 20-gph burn rate would introduce 0.67 μCi of Co-60 in an 8-hour burn. If all the activity remained in the ash, there would be a Co-60 concentration of 2.37×10^{-6} μCi/cc in the ash. The concentration in the ash would therefore be greater than in the waste oil. The dose reading of a 55-gallon drum of ash (7.5 cu ft containing 5×10^{-7} Ci) can be estimated.

From Bowman and Swindle (Health Physics, November 1976, p. 445-450), the exposure rate to curie content conversion formula is given by:

Ci = R/hr x K x Energy conversion factor

K is a conversion factor based on the dimensions of a right circular cylinder and the density of the material in the cylindrical container. In this case, a 55-gallon drum of ash is considered with:

height = 85 cm
diameter = 57 cm
density of ash = 0.3 g/cm^3
K = 0.7

K is determined for an average gamma energy of 0.5 MeV. For Co-60, the average gamma energy is 1.25 MeV. The energy correction factor, which varies with energy and density, must be applied. In this case, the energy correction factor is given as 0.387.

Solving for R/hr,

Exposure rate = 5.0×10^{-7} Ci/(0.7) (0.387)

Exposure rate = 1.9 μR/hr

Question

Describe means for minimizing occupational exposures from radioactive material in the oil and from radioactive materials accumulated in the combustion system.

Response

The state of North Carolina currently allows containers to be buried in the on-site clean trash landfill with exposure readings up to 5 μR/hr. Since the assumptions made thus far are conservative, there should be no special concern for handling the clean trash incinerator ash.

The work crew at the clean trash incinerator will be trained in health physics practices and issued TLDs. Given that the cleaned waste oil and ash will have exposure rates that are ALARA, there should be no additional concerns for occupational exposure.