DERSE & SCHROEDER ASSOCIATES, LTD.
DEVELOPMENTAL SCIENCE

PHILIP H. DERSE
COLLIN H. SCHROEDER

979 JONATHON DRIVE
MADISON, WI 53713
(608) 273-2494

April 1, 1985

Mrs. B.J. Holt
Region III Licensing Section
Material Licensing Branch
Division of Fuel Cycle and Material Safety
Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Il 60137

Re: Control # 77774
Amendment of NRC license number 48-20213-01

Dear Mrs. Holt:

Thank you for the reprint of Part 20, "Standards for Protection Against Radiation" and the clarification of regulations concerning scintillation media disposal.

I tried to reach you by phone last week, but I understand you will be on vacation for a couple weeks. I wanted to discuss further the possibility of declaring part of our roof area as restricted for incineration purposes. Since you indicated that we should reply in writing to your memo of March 7, 1985 within 30 days, I am submitting our response to item 2, "Incineration Guidelines" (June 13, 1984) for your review. I believe it is a reasonable approach and trust it is well within NRC regulations.

Item 2

We wish to incinerate ^{14}C and ^{3}H in the form of assorted combustible waste materials. We request a daily limit of 1000 microcuries of ^{14}C or 1000 microcuries of ^{3}H when the isotopes are burned separately. We also request a daily limit of 500 microcuries each of ^{14}C and ^{3}H when they are incinerated together as a mixture. The maximum number of 1 hour burns will be: 1 per day, 5 per week, 260 per year.

We wish to declare the top 14 feet of our 26.5-foot incinerator stack as a restricted area. Access to this restricted area is controlled as follows:

1. By design, i.e., equipment such as a ladder, crane or other climbing device is necessary to occupy that area.

2. Radioisotopes are not present in the restricted area except during incinerator operation.

3. During incinerator operation, access to the area is controlled initially by the incinerator operator as directed by posted S.O.P.. Within 5 minutes after incinerator ignition, access to the restricted area is self-controlled by high stack temperature.

4. Occupancy of the restricted area for purposes of maintenance or repair will be controlled by Derse & Schroeder Associates.

The incinerator does not have scrubbers or condensors, therefore only gaseous effluents well within the limits of Table II, Appendix B, Column 1, 10CFR20 will be released into non-restricted areas.

Item 2, A.

Calculation of the Concentration of Radioactivity at the Boundary of the Restricted Area (Paragraph 20.106, d, 10CFR20)

All calculations of radioactivity concentrations in the air at the boundary of the restricted area were made based on Sutton's Model of Diffusion. The definitions, assumptions, and equations follow:

Definitions:

Q - recommended maximum quantity of each radionuclide to be incinerated per day; quantity in microcuries.

C - maximum concentration of a radionuclide in air for the time period given at the boundary of the restricted area which could result from the incineration of the quantity Q of that radionuclide on a given day; expressed in uCi/mL.

MPC - Maximum permissable concentration of a radionuclide in air for unrestricted areas as specified in Appendix B, Table II, Column 1, 10CFR20; expressed in uCi/mL.

%C/MPC - Percentage of MPC for the time period given which could result at the boundary of the restricted area from the incineration of the quantity Q of a radionuclide on any given day.

Assumptions for the Calculation of C:

1. 100% of the incinerated radionuclide is released to the atmosphere resulting in a volatile fraction of 1.

2. The windspeed is uniform with a mean of 3 mph.

3. There is no rising of effluent due to buoyancy.

4. The effluent particles do not fall out.

5. The effluent leaves the stack isotropically 14 feet (427 centimeters) from the restricted area boundary.

6. The concentration of airborne radioactivity of interest is the maximum concentration at the boundary of the restricted area.

(continued, Item 2, A)

Equations:

Sutton's Diffusion Equation for an elevated source of airborne radioactivity gives the maximum concentration of a radionuclide in air, averaged over time t:

Equation 1. $$C = \frac{2 f Q}{e \pi u t h^2}$$

when f = volatile fraction
u = mean wind speed
t = time in hours
h = vertical distance between point of effluent discharge and boundary of the restricted area
e = constant, 2.718

Substituting values from the assumptions stated above into Equation 1 yields:

Equation 2.

$$C = \frac{(2)\ (1)\ (Q)}{2.718\ \pi\ (3\ \text{mph})(1.61 \times 10^5\ \text{cm/hr/mph})(t)(427\ \text{cm})^2}$$

Equation 2 gives the maximum concentration of a given radionuclide in air averaged over time at the boundary of the restricted area which could result from the incineration of the quantity Q (in microcuries) of that radionuclide in one given day. C is given in uCi/mL.

When the isotopes are burned as a mixture, the ratio of the concentration of each isotope in the mixture to the maximum permissable when not in a mixture (Appendix B, Table II, Column 1) is calculated. The sum of the ratios for all isotopes in the mixture may not exceed 1.

Equation 3.

$$\frac{C\ (\text{carbon-14})}{MPC\ (\text{carbon-14})} + \frac{C\ (\text{tritium})}{MPC\ (\text{tritium})} \leq 1$$

(continued, Item 2, A)

Maximum Radioactivity Concentration in Air
at the Boundary of the Restricted Area During Incineration
(Based on Sutton's Diffusion Model)

(Incineration of one isotope per burn, one burn per day)

Isotope	Q (uCi)	C (uCi/mL)	MPC (uCi/mL)	% C/MPC
^{14}C	1000	2.7×10^{-9}	1×10^{-7}	2.7
^{3}H	1000	2.7×10^{-9}	2×10^{-7}	1.4

(Incineration of mixed isotopes per burn, one burn per day)

Isotope	Q (uCi)	C (uCi/mL)	MPC (uCi/mL)	Ratio Sum
^{14}C	500	1.4×10^{-9}	1×10^{-7}	0.021
^{3}H	500	1.4×10^{-9}	2×10^{-7}	

$$C = \frac{(2)\ (1)\ (1000)}{2.718\ \pi\ (3\ \text{mph})(1.61\times10^{5}\ \text{cm/hr/mph})(1\ \text{hr})(427\ \text{cm})^{2}}$$

$$\frac{C\ (\text{carbon-14})}{MPC\ (\text{carbon-14})} + \frac{C\ (\text{tritium})}{MPC\ (\text{tritium})} = 0.021$$

Q = requested maximum quantity of radionuclide to be incinerated on any given day.

C = maximum concentration of radionuclide in air averaged over the given time period at the boundary of the restricted area resulting from the incineration of the quantity Q.

MPC = maximum permissable concentration of radionuclide in air for unrestricted areas as specified in Appendix B, Table II, Column 1, 10CFR20.

% C/MPC = Percentage of MPC averaged over the given time period which could result at the boundary of the restricted area from incineration of the quantity Q of a radionuclide on any given day.

(continued, Item 2, A)

Maximum Radioactivity Concentration in Air
at the Boundary of the Restricted Area Averaged Over 24 Hours
(Based on Sutton's Diffusion Model)

(Incineration of one isotope per burn, one burn per day)

Isotope	Q (uCi)	C (uCi/mL)	MPC (uCi/mL)	% C/MPC
^{14}C	1000	1.1×10^{-10}	1×10^{-7}	0.11
^{3}H	1000	1.1×10^{-10}	2×10^{-7}	0.06

(Incineration of mixed isotopes per burn, one burn per day)

Isotope	Q (uCi)	C (uCi/mL)	MPC (uCi/mL)	Ratio Sum
^{14}C	500	5.5×10^{-11}	1×10^{-7}	0.0008
^{3}H	500	5.5×10^{-11}	2×10^{-7}	

$$C = \frac{(2)\ (1)\ (1000)}{2.718\ \pi\ (3\ \text{mph})(1.61\text{x}10^{5}\ \text{cm/hr/mph})(24\ \text{hrs})(427\ \text{cm})^{2}}$$

$$\frac{C\ (\text{carbon-14})}{\text{MPC (carbon-14)}} + \frac{C\ (\text{tritium})}{\text{MPC (tritium)}} = 0.0008$$

Q = requested maximum quantity of radionuclide to be incinerated on any given day.

C = maximum concentration of radionuclide in air averaged over the given time period at the boundary of the restricted area resulting from the incineration of the quantity Q.

MPC = maximum permissable concentration of radionuclide in air for unrestricted areas as specified in Appendix B, Table II, Column 1, 10CFR20.

% C/MPC = Percentage of MPC averaged over the given time period which could result at the boundary of the restricted area from incineration of the quantity Q of a radionuclide on any given day.

Item 2, B.

Calculation of the Concentration of Radioactivity at the Boundary of the Restricted Area Averaged Over 1 Year

(Incineration of one isotope per burn, one burn per day)

Isotope	Q (uCi) *	C (uCi/mL)	MPC (uCi/mL)	% C/MPC
^{14}C	2.6×10^{5}	7.9×10^{-11}	1×10^{-7}	0.08
^{3}H	2.6×10^{5}	7.9×10^{-11}	2×10^{-7}	0.04

(Incineration of mixed isotopes per burn, one burn per day)

Isotope	Q (uCi) **	C (uCi/mL)	MPC (uCi/mL)	Ratio Sum
^{14}C	1.3×10^{5}	3.9×10^{-11}	1×10^{-7}	0.0006
^{3}H	1.3×10^{5}	3.9×10^{-11}	2×10^{-7}	

$$C = \frac{(2)\ (1)\ (1.3 \times 10^{5})}{2.718\ \pi\ (3\ \text{mph})(1.61 \times 10^{5}\ \text{cm/hr/mph})(8760\ \text{hrs})(427\ \text{cm})^{2}}$$

$$\frac{C\ (\text{carbon-14})}{\text{MPC (carbon-14)}} + \frac{C\ (\text{tritium})}{\text{MPC (tritium)}} = 0.0006$$

Q = requested maximum quantity of radionuclide to be incinerated on any given day.

C = maximum concentration of radionuclide in air averaged over the given time period at the boundary of the restricted area resulting from the incineration of the quantity Q.

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* 260 incinerations maximum per year x maximum quantity of radionuclide incinerated on any given day (1000 uCi ^{14}C or 1000 uCi ^{3}H).

** 260 incinerations maximum per year x maximum quantity of radionuclide incinerated on any given day (500 uCi ^{14}C plus 500 uCi ^{3}H).

(continued, Item 2, B)

MPC = maximum permissable concentration of radionuclide in air for unrestricted areas as specified in Appendix B, Table II, Column 1, 10C FR20.

% C/MPC = Percentage of MPC averaged over the given time period which could result at the boundary of the restricted area from incineration of the quantity Q of a radionuclide on any given day.

I'll try to phone you in a couple weeks to see if you have any further questions.

Sincerely,

Richard Lechnir

Richard Lechnir

CONVERSATION RECORD

TIME 3/7/85 DATE 4:00 pm

TYPE
☐ VISIT ☐ CONFERENCE ☑ TELEPHONE
☐ INCOMING ☑ OUTGOING

Location of Visit/Conference:

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU	ORGANIZATION (Office, dept., bureau, etc.)	TELEPHONE NO.
Richard Fechner	Reese & Schneider	(608) 273-2494

ROUTING

NAME/SYMBOL	INT

SUBJECT

Amendment Request
Control No. 77774

SUMMARY

I informed Richard that he would have to submit calculations in support of Item #2 on the Incineration Guidelines dated June 13, 1984.

I also asked him to reply to Item 3 if liquid effluents will be released from scrubbers, condensers, etc.

ACTION REQUIRED

30 day response

NAME OF PERSON DOCUMENTING CONVERSATION	SIGNATURE	DATE
	B J Holt	3/7/85

ACTION TAKEN

SIGNATURE	TITLE	DATE