SAFETY AND ENVIRONMENTAL PROTECTION DIVISION

BNL LABORATORY HOODS--
RATIONALIZATION FOR EXEMPTION FROM MONITORING
AND REPORTING REQUIREMENTS

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REPORT

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During an ERDA safety and health inspection, Brookhaven National Laboratory was cited for failure to monitor and report the amount of airborne contaminants released to the environment via laboratory hoods. However, an analysis of potential environmental releases of radiological and nonradiological contaminants from these hoods illustrate that even under "worst case" situations, emissions of these contaminants would not endanger the community air quality. Brookhaven is therefore requesting an exemption from the ERDA requirement. Rationalization supporting this request is presented in this report.

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Of approximately 500 laboratory hoods at BNL, 98 are equipped with HEPA filters or scrubbers which limit the amount of airborne contaminants released to the environment.⁽¹⁾ Effluent monitors and/or periodic sampling techniques are utilized at five facilities where a potential for releasing environmentally significant quantities of radioactive contaminants exists. An environmental monitoring program provides a means of checking the efficiency and accuracy of these techniques. To date, no detectable BNL effluent radio-nuclides have been found in air particulate samples collected at the BNL site boundary.⁽²⁾ The emission rates from these systems are reported in the Safety and Environmental Protection Division's (formerly the Health Physics and Safety Division) Effluent Monitoring Report.

Average environmental concentration obtained in monthly composite air samples are at least 630 times below the applicable radiation concentration guide as shown in Table I (1974 data). The utilization of monitoring and sampling procedures is not required for those laboratory hoods which employ such low material usage that their emission levels are even farther below appropriate air quality standards. The emission quantity of a given nuclide necessary to reach the Radiation Concentration Guide⁽³⁾ under extremes of meteorological conditions^(4,5) may be compared to the annual acquisition of

*Research carried out at Brookhaven National Laboratory under contract with the U.S. Energy Research and Development Administration.

this nuclide by the laboratory. For 1975, if all of the incoming nuclides were released to the environment during a one-week period, only two nuclides (^{131}I , half life 8.06 days, and ^{241}Am , half life 458 days) were used in sufficient quantities to exceed the guides (Table II). In both cases, the comparison is unrealistic since ^{131}I is short lived and all of the ^{241}Am was contained as sealed sources, except 5 μCi of calibration solutions.

Detailed characterization of hoods for nonradiological contaminants has only been performed for areas where potential airborne releases of carcinogenic chemicals and biohazards have been identified. All hoods in these areas are equipped with high efficiency (HEPA) filters. They are currently not monitored primarily because specific on-line monitoring technology is not available. Detailed characterization of other nonradiological emissions is in progress, but will not be completed for several years. However, it can be shown that a complete characterization of potential releases from each laboratory hood is unnecessary to assess whether these systems have a significant adverse effect on the community air quality.

Utilizing meteorological equations, material use data and applicable air quality and workplace standards, it can be shown that if all the hazardous material withdrawn from Supply & Materiel annually were released directly to the atmosphere, no violation of present federal or state air quality standards would occur. The Environmental Protection Agency's National Emission Standards⁽⁶⁾ permit 2,300 g of mercury/24 hr. period, 10 g of beryllium/24 hr. period and no visible emission of asbestos. These standards apply to industrial sources such as mills, foundries, plants, incinerators, etc.

The New York State Ambient Air Quality Standards⁽⁷⁾ permit emissions such that the ambient air concentrations do not exceed the following levels:

Sulfur dioxide	80 $\mu\text{g}/\text{m}^3$	annual average
Carbon monoxide	10 mg/m^3	any 8 hr. period
Hydrocarbons	160 $\mu\text{g}/\text{m}^3$ as CH	from 6 a.m. to 9 a.m.
Beryllium	0.01 $\mu\text{g}^4/\text{m}^3$	monthly average
Hydrogen sulfide	14 $\mu\text{g}/\text{m}^3$	hourly average
Nitrogen dioxide	100 $\mu\text{g}/\text{m}^3$	annual average
Fluorides	0.8 $\mu\text{g}/\text{m}^3$	monthly average

In Table III, atmospheric dispersion equations were used to determine the emission rate of several potential air contaminants used at BNL which would produce environmental concentrations in excess of federal or state air quality standards. Both unstable atmospheric conditions (Class A) and the most stable atmospheric conditions (Class F) were evaluated. Most laboratory hood exhaust heights are lower than 20 meters. The maximum ground level concentration from these systems occurs within the laboratory boundary. Thus, a comparison between the total laboratory usage in 1975 and the quantity which would produce environmental concentrations in excess of the Threshold Limit Value⁽⁸⁾ during a 40-hour work week is appropriate to illustrate the insignificant impact such hood releases would have on any laboratory personnel who might be working at the downwind location of maximum ground level concentration. These values are grossly conservative, in that they assume that the entire annual use resulted in total release within a period of one work week. Only mercury, which is normally contained in closed systems, could have exceeded the exposure limit under these conditions.

When the same type of comparison is made, using applicable New York State Air Quality Standards, the impact of laboratory hood releases would have an even smaller impact within the site boundary. It is obvious that the

impact beyond site boundary will be even considerably smaller.

This analysis is set forth to support a request that all BNL laboratory hoods be exempted from monitoring and reporting procedures, in that these systems meet the exemption criteria described in the AECM 0513-05.

The Laboratory will continue its surveillance of hood activities, utilizing inspections, labeling, ventilation surveys and workplace standards to insure compliance with all appropriate standards.

References

1. Draft, Environmental Impact Statement, Brookhaven National Laboratory, ERDA-1540, U.S. Energy Research and Development Administration, Washington, D. C., 1975.
2. Hull, A. P. et al., "1974 Environmental Monitoring Report", BNL 19977, Brookhaven National Laboratory, Upton, N. Y., 1975.
3. Standards for Radiation Protection, ERDA Manual, Chapter 0524, Appendix A, Table II, Guide for Uncontrolled Area, 1968.
4. Henri, J. M., Final Safety Analysis Report on the Brookhaven High Flux Beam Research Reactor, BNL 7661, Vols, I and II, Brookhaven National Laboratory, Upton, N. Y., 1964.
5. Turner, D. B., Workbook of Atmospheric Dispersion Estimates, PHS Publ. No. 999-AN-26, U.S. Department of Health, Education and Welfare, Washington, D. C., 1969.
6. National Emission Standards for Hazardous Air Pollutants, Federal Register, 38, no. 66, 4/6/73.
7. New York Ambient Air Quality Standards, Parts 256 and 257, New York State Department of Environmental Conservation, 1972.
8. Threshold Limit Values for 1975, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1975.

TABLE I

Average Concentration of Nuclides in Monthly Composite Air Samples

(pCi/m³ or 10⁻¹² μ Ci/ml)

	<u>Average Gross beta</u>	<u>⁷Be</u>	<u>⁶⁵Zn</u>	<u>⁹⁵Zr-Nb</u>	<u>¹⁰⁶Ru</u>	<u>¹³¹I</u>	<u>¹³⁷Cs</u>	<u>¹⁴⁴Ce</u>
Average	0.161	0.143	0.143	0.035	0.014	<0.0002	<0.001	0.023
Radiation concentration guide	100	4x10 ⁴	2x10 ³	1x10 ³	200	100	500	200

TABLE II

Releases Required to Exceed Radiation Concentration Guides

Isotope	Half life	Radiation concentration guide (Ci/m ³)	Meteorological conditions, emission rates to exceed RCGs (Ci/sec)		Total release to exceed RCGs in 1 week--total Ci		Total received in 1975 (Ci)
			Stability Class A	Stability Class F	Class A	Class F	
²⁴¹ Am	458y	2x10 ⁻¹³	6.25x10 ⁻¹⁰	8x10 ⁻¹⁰	3.78x10 ⁻⁴	4.84x10 ⁻⁴	0.106
¹²⁵ I	60.2d	8x10 ⁻¹¹	2.49x10 ⁻⁷	3.2x10 ⁻⁷	1.50x10 ⁻¹	1.94x10 ⁻¹	2.2x10 ⁻²
⁷ Be	53.6d	4x10 ⁻⁸	1.25 x 10 ⁻⁴	1.6x10 ⁻⁴	75.6	96.8	3.5x10 ⁻⁴
²² Na	2.62y	3x10 ⁻¹⁰	9.375x10 ⁻⁷	1.2x10 ⁻⁶	5.67x10 ⁻¹	7.26x10 ⁻¹	1.6x10 ⁻³
¹³¹ I	8.06d	1x10 ⁻¹⁰	3.125x10 ⁻⁷	4x10 ⁻⁷	0.189	0.242	0.678
⁶⁵ Zn	245d	2x10 ⁻⁹	6.25x10 ⁻⁶	8x10 ⁻⁶	3.78	4.84	none
⁵⁴ Mn	303d	1x10 ⁻⁹	3.125x10 ⁻⁶	4x10 ⁻⁶	1.89	2.42	none
⁹⁰ Sr	27.7y	3x10 ⁻¹¹	9.375x10 ⁻⁸	1.2x10 ⁻⁷	5.67x10 ⁻²	7.26x10 ⁻²	5x10 ⁻³
²⁰¹ Tl	20.0s	3x10 ⁻⁸	9.375x10 ⁻⁵	1.2x10 ⁻⁴	56.7	72.6	0.156
⁹⁹ Tc		2x10 ⁻⁹	6.25x10 ⁻⁶	8x10 ⁻⁶	3.78	4.84	0.200

TABLE II.

Releases Required to Exceed Workplace and Air Quality Standards

Substance	TLV (g/m ³)	New York State Air Quality Standards	Total stock withdrawal in 1975 (kg)	Total release required to exceed TLV in 40 hr period		Yearly release necessary to exceed N.Y.S. standard class (kg)
				Class A (kg)	Class B (kg)	
Sulfur dioxide	13×10^{-3}	$80 \mu\text{g}/\text{m}^3$, annual avg.	1.82	5.8×10^3	7.5×10^3	7.9×10^3
Osmium tetroxide	0.002×10^{-3}	N.A.	none	0.9	1.2	N.A.
Beryllium	$.002 \times 10^{-3}$	$0.01 \mu\text{g}/\text{m}^3$, monthly avg.	none	0.9	1.2	1.0
Methanol	260×10^{-3}	$160 \mu\text{g}/\text{m}^3$, 3 hr limit	8.5×10^2	1.2×10^5	1.5×10^5	1.6×10^4
2-butanone	590×10^{-3}	$160 \mu\text{g}/\text{m}^3$, 3 hr limit	2.1×10^2	2.7×10^5	3.4×10^5	1.6×10^4
Carbon tetrachloride	65×10^{-3}	$160 \mu\text{g}/\text{m}^3$, 3 hr limit	1.4×10^2	2.9×10^5	3.7×10^5	1.6×10^4
Lead	0.15×10^{-3}	N.A.	3.2	67.5	86.4	N.A.
Mercury(except alkyl)	0.05×10^{-3}	N.A.	72.6	22.5	29.0	N.A.
Formaldehyde	3×10^{-3}	N.A.	3.79×10^2	1.35×10^3	1.74×10^3	N.A.
Toluene	375×10^{-3}	$160 \mu\text{g}/\text{m}^3$, 3 hr limit	1.34×10^2	1.6×10^2	2.2×10^2	1.6×10^4
Carbon monoxide	55×10^{-3}	$10 \text{mg}/\text{m}^3$, 8 hr limit	0.345	2.5×10^4	3.2×10^4	9.9×10^5