national accelerator laboratory

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NAL SITE: MONITORING OF UNCONTROLLED RADIATION AREAS

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A. INTRODUCTION

Present plans to monitor the radiation levels in off-site and on-site uncontrolled areas are described. These plans have been formulated on the basis of either U. S. Government standards[1] for personnel protection, or the more stringent limits set by R. R. Wilson, NAL Director[2].

1. Integrated Doses to People

The limits described below refer to incremental radiation dose equivalents produced by the NAL accelerators and which people may absorb above that due to natural environmental radiation.

1.1 Off-Site

10 (ten) millirem/year.

1.2 On-Site

170 (one hundred seventy) millirem/year.

The off-site dose is that given in a directive from R. R. Wilson, NAL Director[2]. It is ten per cent of the nominal environmental background.

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The present applicable radiation protection standards (AEC Manual, Chapter 0524) specify,

any one person : not more than 500 millirem/year
a suitable population sample: not more than 170 millirem/year.

2. Exposure Times

To calculate the permissible radiation dose rates, it is necessary to have in addition to the allowable integral doses, the time of occupancy for the areas in question.

2.1 Off-Site Exposure Time: 8760 hours/year.

2.2 On-Site Exposure Time: estimated less than 100 hours/year.

3. Hourly Dose Rates

3.1 Off-Site

10 mrem/8769 hours = 1.1 microrem/hour.

3.2 On-Site

Outside fences: less than 10 millirem/hour.

4. Radiation Monitoring

4.1 Off-Site

The off-site doses will be estimated from surveys made and monitors placed on the site and near the boundary. The survey radiation detectors will be mounted on a mobile laboratory. This laboratory will have about 100 square feet of space. It will be heated and air-conditioned for year-round operations.

It will have four wheel drive to permit travel through open country where no roads exist. It will have 2.5 kW of 110 V, AC, for instrument operation.

The instrumentation may consist of all or some of the items listed below.

a) A precision, reproducible long counter as designed by dePangher[3].

b) A subset of Bonner spheres[4] such as bare, 2 in, 5 in, 12 in, and 18 inch.

c) A sixteen liter tissue-equivalent chamber.

d) A twenty liter aluminum chamber filled with argon.

e) A three inch by three inch NaI(Tl) crystal.

f) One or more muon telescopes.

g) A Ne-213 detector plus a pulse shape discriminator for detection of neutrons in the 10 to 100 MeV region.

All supporting electronics, oscilloscopes, PHA, etc., will also be carried on board.

This laboratory will roam the site boundaries and the site roads as needed to assure compliance with the limits given in section 1.

Some radiation monitoring, mostly muons near the site boundary and downstream from the experimental areas, will be done with 55 gallon ionization chambers which derive all their power from storage batteries (sensitivity ~ 1 microrad/hour). These detectors are easily portable and sit in little enclosures to protect them from the weather.

4.2 On-Site

A network of detectors connected to a central hardware programmed computer (made using two pulse height analyzers) will monitor in real time the dose rates at some twenty to thirty locations. Some of these detectors may be ten inch pseudospheres with silver wrapped, thin wall Geiger-Mueller counters[5] (sensitivity ~ 0.2 mrem/hour). Others may be tissue-equivalent ionization chambers with or without gas gain. They will be located at critical locations along the external particle beams, near roads, etc. A set of twenty of these detectors has already been in operation at the accelerator complex (Linac, Booster and Main Ring) for nearly one year without malfunctions.

These real time radiation monitors may be complemented with an array of activation detectors and self-powered active detectors.

An environmental radiation monitoring station has been in operation at the "Village" for nearly one year. It is equipped with an extended set of Bonner spheres (18 inch as well as part of the boron coated set of Burrus's[6]), two large volume ionization chambers (tissue-equivalent and Al-Ar), a long counter à la dePangher[3], and a gamma-ray dosimeter using a 3 inch by 3 inch NaI(Tl).

REFERENCES

1. AEC Manual, Chapter 0524.
2. R. R. Wilson, directive to M. Awschalom (June 15, 1971).
3. J. dePangher and L. L. Nichols, "A Precision Long Counter for Measuring Neutron Flux Density", Report-BNWL-260 (June, 1966).
4. R. L. Bramblett, et al., "A New Type of Neutron Spectrometer", Nucl Instr & Meth 9, 1 (1960).
5. M. Awschalom, et al., "A Study of Spherical.....D.E. Rate-Meter", NAL-TM-291 (July 12, 1971).
6. S. K. Metha, "A New Method for the Evaluation of Neutron Emission...", ORNL-TM-1171 (July, 1965).
7. H. A. Wollenberg, et al., "Natural & Fallout Radioactivity...", UCRL-18460 (September, 1968).