forward in that employees "bank," and can be reserved for a future need But the RPG (radiation protection guide) limits its use to a maximum of 3 rem in any 13 consecutive week period In practice, the exposure rate (roentgens/hour) would be measured with an instrument Direct reading dosimeters are available, as are those that emit sound (a chirp) at a preset exposure rate

Detecting and measuring external radiation

Instruments for monitoring and survey work to detect external radiation are available from many commercial sources Instruments must be checked frequently for operation and calibration, and a dependable source of maintenance service must be available, especially for portable instruments

Instruments may be used to detect or locate sources of radiation or to measure radiation Selection from the variety of choices of type and manufacture is based not only upon the kinds of radiation to be encountered but also upon the reliability, operating characteristics, and vendor's service capabilities

Some instruments are designed to detect only one type and level of radiation, such as low-level alpha radiation Others will detect several types and levels of radiation

Several air samplers are available These may be purchased complete, or the fans (vacuum pumps) may be ordered separately and then equipped with a specially constructed filter paper holder and an air-flow indicator The filter media must then be counted for alpha and beta-gamma

Gas flow proportional counters are available, which allow simultaneous determination of alpha and beta-gamma The probe has two sections one for alpha, the other for beta-gamma Two scaling units are used to record the alpha and beta-gamma counts separately Systems which employ a separate probe and scaling unit for each component may be used In this case, the filter paper must be counted separately in each unit to obtain the activities

There are many types of specialized instrumentation available Detection of radiation has been accomplished by devices using the ionization method, scintillation method, chemical processes, optical effects in solid-state devices, and the activation process Ionization chambers, proportional counters, and scintillation counters are commonly used for alpha radiation Geiger counters and ionization chambers, are often used for beta-gamma Proportional counters and activation devices have been used successfully for neutrons

Fixed monitors, such as area monitors, stack monitors, or personal monitoring stations, range in complexity of design depending upon their application Many of these devices start out as home-made designs and evolve into commercially available units

Since there are many instrument designs and types, the novice can be easily confused Thus, if one does not have prior experience in the selection of instrumentation, he should let an experienced person help him

For further information see *Health Physics Instrumentation*, J S Handloser (Pergamon Press, 1959), *Safe Handling of Radioisotopes—Health Physics Addendum*—Safety Series No 2, International Atomic Energy Agency (Vienna, 1960), especially pp 34-46, *Radiological Monitoring Methods and Instruments*, NBS Handbook 51 (1952), pp 7-18, and *Nuclear Instruments and Their Uses*, A H Snell (ed) (John Wiley, 1962), pp 425-442

Monitoring, surveying, and personnel monitoring The external and type of monitoring for detection of external radiation are determined largely by experience and the nature of the source of radiation

- For example, if the radiation field is limited by the nature of the source of the radiation film badges or dosimeters worn by the exposed employees may be completely adequate

- Some operations emit radiation at levels which would be excessive for 40-hr exposure On these operations, fixed monitoring equipment of the recording and alarm type may be installed

- For high levels of radiation, on-the-spot measurements are essential to keep exposures within acceptable limits as the work is progressing This work requires frequent review of the exposure records of particular employees and preventive measures to minimize unnecessary exposure