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Project status review

1.0 **Purpose:**

To present an end-of-year project review.

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2.0 **Project Status:**

2.1 **Neutron spectroscopy.**

The major effort has been directed toward developing techniques, using activation analysis which will yield the spectral and spatial distribution of the patient neutron therapy beam in air, in vivo and in phantoms during steady-state reactor operation. These methods will also be applicable to pulsed neutron beams. The objectives of this program have been achieved. Eight isotopes are being used, and two more may be added in 26 geometries. Three counting techniques have been developed. Cadmium and boron shielding is used to obtain information in the resonance region. Results of this program indicate that, depending upon moderator, reflector and collimator geometry and pile-power level, a maximum thermal flux of 7.5×10^{10} may be attained accompanied by a very intense gamma beam. The gold resonance flux lying between 0.4 ev and 4.95 ev is two orders of magnitude less than the thermal flux. Neutron number flux falls off rapidly with energy vanishing at 2.9 MeV. An essentially uncollided neutron flux is present in the energy region of 1.5 to 2.9 MeV. The value of this value is approximately 9×10^2 n/cm^2-sec. Film emulsion techniques, very recently used, confirm foil measurement. Greater use of emulsions will be made in the future. If possible, a slow chopper will also be used.

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2.2 Gamma measurements.

The measurement of gamma rays in the presence of neutrons has always been difficult. If spectral and in-vivo information is required, almost all of the conventional techniques fail. One method holds fair promise of success and that is the use of radiophotoluminescent glass needles measuring 1 millimeter in O.D. and 6 millimeters high. Their relative neutron insensitivity has been proven by Kondo and Hurst at ORNL. I have been able to confirm this. When soft gamma rays are present, metallic shielding is needed to eliminate energy dependence. Due to their small size, in-vivo measurement is possible as well as area mapping. The methods of absorption spectrometry may also be applied. These needles have been gradually introduced and soon will replace r-meter measurements. A computer program is being developed to take advantage of absorption spectrometry. Dr. Bond has requested use of the needles.

2.3 Coincidence spectrometry.

Murray of ORNL has developed a technique using Li^6 I (Eu) and Li^7 I (Eu) crystals to determine the spectrum of low intensity, mixed neutron and gamma fields. This method is applicable to shield leakage studies and low power-level therapy beam measurements.

2.4 Instrumentation.

At 4π beta counter using a pair of thin window G-M tubes will soon be operable. A plastic scintillator type NE-102 will soon be used to check beta spectra. This "crystal" will also facilitate beta-gamma coincidence counting. A wire scanner is under construction. To date, gross counting coupled with half-life determination has been used when reading activated foils. Photopeak counting will be introduced as soon as possible.

2.5 Analysis.

A limited, hand-calculated, multi-group, multi-region shield review of the [redacted]RR is under way. Design of short-lived isotope loops is in progress. A N^{16} loop should be operable by early June. Particular attention is being given to the short-lived isotopes of As, Cu, I_2, P_1 and Co, and to pure beta and positron emitters. A conceptual design

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of an activation analysis loop modeled on the ORNL design may be begun. Consideration is also being given to mosaic scanners in cooperation with Dr. Fine in order to develop rapid scanning methods.

3.0 The majority of the indicated projects will not be completed before my scheduled departure at the end of June. A "cook-book" type of summary report will be prepared dealing with neutron activation analysis.

cc: Dr. J.S. Robertson
Mr. R.H. Powell