ORNL
INSTRUMENT EVALUATION SUMMARY

Far West Technology REM 500
Neutron Survey Meter

Description: The REM 500 is an auto ranging neutron survey instrument that utilizes a propane-filled tissue-equivalent proportional detector/multi-channel analyzer system to measure dose-equivalent rates. Additional information can be found in the instrument's technical manual.

Ranges Tested: Digital Rate Meter

Report Date: February 29, 1996

General Comments:

1. Due to the extremely erratic nature of the REM 500 at low dose-equivalent rates, conclusive test results were not obtained. Most tests were performed using a 30 second time constant. At low dose-equivalent rates (10 to 30 mrem/hr) coefficient of variation rates were above the 12% limit (generally 16 to 60%). In an attempt to obtain greater statistical significance, re-tests for environmental factors were performed. Initially, the time constant was increased to 60 seconds using the same dose-equivalent rates. No significant decrease in variability was observed. This required that both the dose rate, and time constant would have to be increased. The second run was performed at approximately 40 mrem/hr using a 60 second time constant. Variability rates were lower, generally from 8 to 24%.

RADIATION RESPONSE

Probe Surface Sensitivity: N/A

Neutron Energy Dependence: The manufacturer's stated neutron energy response range is 70 KeV to 20 MeV. Tests were performed using D_2O-moderated ^{252}Cf with a cadmium shell, D_2O-moderated ^{252}Cf without a cadmium shell, and bare ^{252}Cf. Delivered dose-equivalent rates were 447.6, 447.6, and 780.8 mrem/hr, respectively. Calculated response ratios were 0.9, 1.05, and 1.0 based on an average response obtained with the instrument set to update using a 30 second time constant at each source configuration.

ELECTRONIC and MECHANICAL REQUIREMENTS and TESTS

Line Noise: N/A

Coefficient of Variation: A series of tests were performed on two REM 500s to evaluate variability. Each instrument was placed in three different dose-equivalent fields. Dose-equivalent rates were approximately 5, 15, and 60 mrem/hr. Readings were taken using four different time constants; 10, 30, and 60 seconds, and 2 minutes, with 21, 12, 10 and 5 data points taken respectively at each time interval. The maximum coefficient of variation values were as follows:
5 mrem/hr - 84.9%, 49.8%, 29.6%, 15.1% (10, 30, and 60 sec, and 2 min time constants), 15 mrem/hr - 51.7%, 29.1%, 17.6%, 15.1%, and 60 mrem/hr - 26.6%, 15.3%, 12.2%, 7.9%.

INTERFERING RESPONSES TEST RESULTS

Radio Frequency Fields: Average readings obtained from each set of data taken indicated that although erratic, three of the four REM 500s tested were acceptable when exposed to the 0.3 MHz to 35 MHz scan and 140 MHz at 50 volts/meter. The remaining instrument went to 0 when exposed to 140 MHz and out-of-tolerance low at 31.5 MHz. This same instrument went out-of-tolerance high when exposed to 915 MHz during the microwave field test. Coefficient of variation values were from 12% to 20% with each instrument set to a 30 second time constant.

Microwave Fields: Average readings obtained from each set of data taken indicated that although erratic, each instrument was acceptable when exposed to the 2.45 GHz field at 2.0 Watts/meter^2. Three instruments were acceptable when exposed to 915 MHz at 0.4 Watts/meter^2. The remaining instrument was out-of-tolerance high. Coefficient of variation values were from 12% to 24% with each instrument set to a 30 second time constant.

Electric Fields: Average readings obtained from each set of data taken indicated that although erratic, each instrument was acceptable when exposed to the electrostatic (5000 volts/meter) field and the 60 and 400 Hz electric fields at 100 volts/meter. Coefficient of variation values were from 9.1% to 25.3% with each instrument set to a 30 second time constant.

Magnetic Fields: Average readings obtained from each set of data taken indicated that although erratic, each instrument was acceptable when exposed to the 10 Gauss (DC) and the 60 Hz AC (1.26 Gauss) magnetic fields. Coefficient of variation values were from 13.5% to 28.7% with each instrument set to a 30 second time constant.

Interfering Ionizing Radiations: Not performed.

ENVIRONMENTAL FACTORS

Temperature: Two of the instruments tested on the first (low dose) run had acceptable mean responses at each temperature test point. One REM 500 was slightly low at 0 °C. The remaining instrument was high at 0 and -10 °C (+32 and +14 °F). On the second (high dose) run, one instrument was acceptable at all test points, the other was slightly high at 0 °C and -10 °C.

Temperature Shock: On the first run, one REM 500 was acceptable throughout the test except for one slightly low mean response 60 minutes after being shocked from 22 to 50 °C. Of the remaining three REM 500s, out-of-tolerance responses were obtained at different times throughout the test with a majority occurring after being shocked from 22 to -10 °C. On the second (high dose) run, one instrument was acceptable throughout the test, the other REM 500 went slightly high 30 minutes after being shocked from 22 to -10 °C and remained high until the 60 minute data collection interval.

Humidity: All instruments tested on the first (low dose) run had acceptable mean responses at each test point. On the second (high dose) run, one instrument was acceptable at all test points, the other was slightly high at the second 40% humidity test point.

Vibration: All three REM 500s had acceptable results when tested to 15 and 25 Hz fields at 2 Gs when positioned vertically and horizontally (display parallel to table). One REM 500 was also acceptable when positioned horizontally with the display perpendicular to the vibration table. Of the remaining two REM 500s, one went out-of-tolerance high after the 15 Hz test in the horizontal position with the display perpendicular to the table. The other went out-of-tolerance high after both the 15 and 25 Hz tests in that same position. Erratic results were obtained throughout the test.