

**NATURAL BACKGROUND RADIATION IN THE  
KINTA DISTRICT, PERAK, MALAYSIA**

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requirements for the award of the degree of  
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To my dear mother, my late father, brothers, sister, my wife and sons.

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## ABSTRACT

Measurement of natural background radiation levels in the Kinta District was carried out between 2003 and 2005. Gamma dose rates were measured from 1007 locations using a portable gamma-ray survey meter, Model 19 Micro R meter manufactured by Ludlum. The measured dose rates ranged from 39 to 1039 nGy h<sup>-1</sup> and have a mean dose rate of  $222 \pm 191$  nGy h<sup>-1</sup> (1.36 mSv y<sup>-1</sup>). Two small areas of hot spots around Kampung Sungai Durian with dose rates of 1039 nGy h<sup>-1</sup> were found. This is the highest dose rate recorded in Perak to date. A total of 128 soil samples collected were analyzed for the activities of the naturally occurring radionuclides, gross alpha and gross beta activities. The activity concentrations of <sup>238</sup>U, <sup>232</sup>Th and <sup>40</sup>K were analyzed by using a HPGe detector. The ranges are 12 – 426 Bq kg<sup>-1</sup> for <sup>238</sup>U, 19 – 1377 Bq kg<sup>-1</sup> for <sup>232</sup>Th and from less than 19 – 2204 Bq kg<sup>-1</sup> for <sup>40</sup>K. Based on the radioactivity levels determined, the gamma absorbed dose rates in air at 1 meter above the ground were calculated using the procedure applied by UNSCEAR 2000. The total calculated dose rates and measured dose rates have shown good correlation coefficient of 0.94. The calculated Radium Equivalent Activity (Ra<sub>eq</sub>) range from 0.14 to 6.01 mSv y<sup>-1</sup>. The gross alpha activity of the soil samples range from 15 to 9634 Bq kg<sup>-1</sup> with a mean value of  $1558 \pm 121$  Bq kg<sup>-1</sup>. The gross beta activity range from 142 to 6173 Bq kg<sup>-1</sup> with a mean value of  $1112 \pm 32$  Bq kg<sup>-1</sup>. The mean population weighted dose rate for the Kinta district is 1.2 mSv y<sup>-1</sup>. Gamma isodose map for the Kinta District was plotted. The isodose map is the most recent and can be used as a reference.

## ABSTRAK

Pengukuran bagi aras sinaran latar belakang semulajadi di daerah Kinta telah dijalankan antara tahun 2003 hingga 2005. Kadar dos telah diukur di 1007 lokasi dengan menggunakan meter survei sinaran gama, *Model 19 Micro R Meter* buatan syarikat Ludlum. Julat bagi kadar dos yang diukur ialah 39 hingga 1039 nGy h<sup>-1</sup> dan nilai min kadar dos ialah  $222 \pm 191$  nGy h<sup>-1</sup> (1.36 mSv y<sup>-1</sup>). Sekitar Kampung Sungai Durian terdapat dua kawasan kecil mempunyai kadar dos yang tinggi iaitu 1039 nGy h<sup>-1</sup>. Sehingga kini, kadar dos ini merupakan yang tertinggi di negeri Perak. Sebanyak 128 sampel tanah telah diambil dan dianalisis untuk menentukan keaktifan radionuklid semulajadi, keaktifan alfa dan beta. Kepekatan <sup>238</sup>U, <sup>232</sup>Th dan <sup>40</sup>K telah dianalisis dengan menggunakan alat pengesan HPGe. Julat bagi <sup>238</sup>U ialah 12 – 426 Bq kg<sup>-1</sup>, 19 – 1377 Bq kg<sup>-1</sup> bagi <sup>232</sup>Th dan kurang daripada 19 – 2204 Bq kg<sup>-1</sup> bagi <sup>40</sup>K. Berdasarkan kepada aras keaktifan yang dikira, kadar dos terserap sinaran gama di udara pada jarak 1 m dari atas tanah telah ditentukan menggunakan prosedur UNSCEAR 2000. Jumlah kadar dos yang dikira dan kadar dos yang diukur menunjukkan pekali korelasi yang baik iaitu 0.94. Aktiviti setara radium (Ra<sub>eq</sub>) yang dikira berada dalam julat 0.14 hingga 6.01 mSv setahun. Keaktifan alfa bagi sampel tanah didapati berada dalam julat 15 hingga 9634 Bq kg<sup>-1</sup> dan min dosnya ialah  $1558 \pm 121$  Bq kg<sup>-1</sup>. Keaktifan beta berada dalam julat 142 hingga 6173 Bq kg<sup>-1</sup> dan min dosnya ialah  $1112 \pm 32$  Bq kg<sup>-1</sup>. Min kadar dos pemberat populasi bagi daerah Kinta ialah 1.2 mSv setahun. Peta isodos sinar gama bagi daerah Kinta telah diplotkan. Peta isodos ini adalah yang terkini dan boleh digunakan sebagai rujukan.