# Assessment of the possible risks of radiation induced health effects from contamination at the University of Manchester

## Summary of provisional report

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This study was carried out to estimate the risks from exposure to radioactive contamination in two buildings at the University of Manchester used by Professor Rutherford and his colleagues in early research work with radioactive materials. The study is an input into the inquiry being carried out by Professor David Coggon following concerns from staff about possible health effects from working in those buildings.

Radionuclides from each of the uranium-238, thorium-232 and uranium-235 decay chains were used by Professor Rutherford and his colleagues. The first stage in the assessment was to collect all relevant information on radioactive contamination at the affected locations at the University. This information was then used to derive representative levels of contamination at a generic location which were used to estimate radiation doses and risks of radiation induced health effects. The aim was to calculate doses to hypothetical individuals from exposure to radioactive contamination that could have occurred in the past and from current exposure levels, in each case assuming a working lifetime of 40 years. As measurements of radioactive contamination were not available before 1999, assumptions had to be made to determine levels in earlier years (1950 to 1989 were considered) and a cautious approach was adopted to try to ensure that the risks were not underestimated. Two source terms were used in the study, one representing the more likely amount of radioactivity (referred to as the 'base case') and the other representing an upper bound of the possible levels of contamination. Remediation of the buildings was carried out between 2000 and 2004. Measurements made after the remediation were used to estimate the contamination levels for the assessment of exposure for current and future occupants.

The possible radiation exposures of two groups of staff were considered. The first group represented office-based university staff, who were likely to have spent most time in the rooms where contamination had been found. The second group consisted of maintenance workers who would have spent less time in the relevant areas but who may have had raised exposures compared to the office-based workers in the short term owing to the nature of their work. For each group and time period considered, radiation doses were estimated and used to estimate the risks of radiation induced health effects.

The radiation doses calculated in this study were committed effective doses and the committed equivalent doses to bone surfaces, brain, liver, pancreas, red bone marrow and lungs. Radioactive material taken into the body is retained in organs and tissues until it is excreted while at the same time undergoing radioactive decay. The period over which a radionuclide delivers dose can vary from a few days to many decades depending on its chemical and physical decay characteristics. Committed dose takes account of the time radioactive material remains in the body by estimating the dose which will be delivered over a 50 year period following its intake. The doses estimated for the office-based university worker were higher than those for the maintenance worker because of the greater time spent in the area. The highest estimated committed effective dose, summed over the period from 1950 to 1989, was about 75 mSv for the office based worker assuming the upper bound source term. The dose estimate for the base case was slightly lower at 72 mSv.

The organs and tissues estimated to receive the highest doses are the lungs and bone surfaces. Estimated doses for the pancreas and the brain were about an order of magnitude lower.

The highest risk estimated was for the hypothetical office-based workers, assuming the upper bound contamination scenario from 1950 to 1989. The highest risk of cancer mortality in this hypothetical scenario would be from lung tumours, with a lifetime risk of exposure-induced death (REID) of 0.6%. In other words, this estimate means that approximately 60 in every 10,000 people exposed to this level of radiation would die from a radiation-induced lung cancer. This compares with a baseline risk of dying from lung cancer in the general population of about 7% (700 deaths per 10,000). The average years of life lost in an individual who died of lung cancer as a consequence of his exposure would be approximately 12.

The estimated risks of pancreatic and brain cancer were much lower with REIDs of 0.004% and 0.003% respectively (less than 1 in every 10,000 deaths), about a hundred times lower than the baseline risk of dying from these cancers.

Extensive remediation of both buildings was carried out between 2000 and 2004. Cautious estimates of current and future doses were obtained by using measurements that included the contribution from natural background. The estimated dose over 40 years was 48 mSv for the office-based worker and 7 mSv for the maintenance worker. These doses are lower than those estimated for past exposures and the associated risks are correspondingly low. Any residual contamination by radionuclides is not at a level that indicates a need for further decontamination or routine exposure monitoring in order to protect the health of people working in the buildings. However, before carrying out any future intrusive maintenance work that will significantly disturb floor or wall materials, a radiological risk assessment should be made to determine whether other additional measures are needed to protect those involved in the work.

Uranium-238, thorium-232 and uranium-235 and their decay products occur naturally in the earth's crust and everyone receives doses from exposure to these and other natural sources, including from cosmic radiation. In order to put the doses estimated in this assessment into context the exposure from natural background radiation is given for comparison. The exposure from natural background for the average member of the UK population is estimated as about 90 mSv in 40 years (2.2 mSv per year) (Watson et al, 2005). However, this value does vary considerably, with the lower end of the range being about 40 mSv and the upper end being about 4000 mSv over the 40 year period.

HPA would like to acknowledge valuable contributions from a number of individuals. This work would not have been possible in the available timescale without the large amount of research carried out by Neil Todd and John Churcher. Also, discussions have taken place throughout with Professor Coggon and this has also been extremely beneficial. An important aspect in this study was that the concerned staff from the University of Manchester and their families were kept informed and consulted about the work and were given the opportunity to question what was being done. All of these inputs have improved the study.