

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

Technical Annex for work to be carried out by the Radiation Protection Division of the Health Protection Agency (HPA-RPD)

Background

Concern has been raised by staff at the University of Manchester about possible health effects from radioactive and chemical contamination in certain locations on the campus. These locations were used by Rutherford in carrying out early work with radioactive material and residual radioactivity has been found. An Inquiry has been set up under the independent chairmanship of Professor David Coggon to examine this possibility and HPA-RPD has been asked to carry out a risk assessment in support of the Inquiry with regard to the radioactive contamination. This technical annex outlines the work that will be carried out on behalf of the university as input into the Inquiry. It relates to the assessment of risk from ionising radiation and any measurement programmes that may need to be carried out, although it is not possible to specify these in advance. HPA-RPD is also carrying out a completely separate piece of work for the Manchester Coroner related to the unfortunate death from cancer of the pancreas of one of the people who worked in the area of interest. If agreed with the coroner and appropriate, data obtained will also be used in this study.

An important factor in all of the work undertaken will be to ensure that the concerned staff and their families are kept informed about the work and have the opportunity to contribute by commenting on what is proposed, providing relevant information and questioning what will be and has been done. This will be done by holding a series of meetings with them as well other means of communication. The work will be divided into a number of tasks and sub-tasks as outlined below. Due to the nature of the work review points are included in the project so that the progress can be assessed and subsequent tasks and timescales changed if necessary.

Outline of work

Task 1 Collection of relevant information

1.1 *Prepare background material on the nature of the radioactive contamination at Manchester University and possible risks to health.*

Short papers will be prepared on the following topics to inform the Inquiry and other interested parties. Although technical in nature as far as possible these papers will be written for the non-specialist.

- 1.1.1 A summary of the possible radionuclides that might have been used in the Physics buildings at Manchester University including the members of the relevant uranium and thorium decay chains plus tritium. This will cover the characteristics of the radionuclides (including their radioactive half-lives and type of radiation emitted), their relative importance and which radionuclides have been found to be important in other situations. These radionuclides all occur naturally and so information will also be provided on levels found naturally in the UK.
- 1.1.2 There are a number of different ways in which radionuclides can lead to the exposure of people both from external irradiation and internal irradiation when taken into the body. The possible exposure routes will be described with information provided on their likely importance for different radionuclides. In addition the data required to assess the radiation exposures from each route will be outlined.
- 1.1.3 For the key radionuclides (uranium isotopes, thorium isotopes, radium-226, radon and daughters, lead-210 and polonium-210) information will also be provided on their behaviour when taken into the human body by inhalation or ingestion. This

will include information on the extent to which the radionuclide might irradiate different organs and tissues, particularly the brain and pancreas.

- 1.1.4 Exposure to ionising radioactivity can give rise to possible health effects including an increased risk of developing cancer. The possible long term health effects of exposure to radiation will be outlined; this will include a summary of the dose response relationships that will be used and their basis. Particular attention will be given to known health effects associated with the radionuclides of potential interest at Manchester University and also to any information on the possibility of radiation induced cancer of the pancreas and brain. Information will also be provided on the natural incidence of the cancers of interest.

The output from Task 1.1 will be a short report containing the four papers outlined above and presentations to the interested parties.

1.2 Collect relevant information on radioactive contamination of the relevant locations at Manchester University

Various surveys have been carried out at the university over the years to determine the levels of radioactive contamination in different locations. In addition it is known that remedial work was carried out around 1999 and that refurbishment of some locations has been carried out more recently. Information on levels of contamination will be collected from all relevant sources including if possible data from before the remediation in 1999. Manchester University may be arranging for furniture and other items removed from the relevant locations to be monitored for radioactive contamination. The University is also currently monitoring the locations of interest for levels of radon. The results of all such monitoring will also form an input into the risk assessment when available.

In addition Manchester University will be putting together information on the history of the relevant locations indicating what work was carried out when used by the Physics Department and who has occupied the relevant rooms over the years. This information will also form an input into the risk assessment.

1.3 Identification of important gaps in the information available.

Based on the information gathered under Task 1.2 and the background knowledge obtained under Task 1.1 gaps in the information available will be identified. This task will cover time periods and/or locations for which information is not available and will focus on omissions which will affect the subsequent risk assessment. Key radionuclides, locations and priorities for subsequent monitoring will be identified. If it is decided that further radioactive monitoring is required then this will be carried out as a separate study. Such monitoring might include passive detection for radon and active surveys for other radionuclides.

The output from Task 1.3 will be a short report identifying gaps in the available information; recommendations for further monitoring will be made if necessary. At this stage in the project there will be a review point to determine if there are sufficient data available to proceed and to review the future work and timescales.

Task 2 Assessment of past risks from radioactive contamination

The aim of this task will be to assess the risk of radiation induced health effects from exposures during the period from around 1950 to around 2000 (exact dates to be agreed depending on the results of Tasks 1.2 and 1.3). This task will not assess the risk to any particular individual but will assess the possible risks to hypothetical individuals representing those who are likely to have received the highest exposures in the past. The approach will be to carry out a cautious risk assessment with simplifying assumptions adopted to determine the extent of any possible health risks. There is a review point in the project following the completion of the main part of this task to review whether a more detailed study could be required. The following sub-tasks will be carried out.

2.1 Agree locations for which the risk will be assessed.

In collaboration with the Leader of the Inquiry, Professor Coggon, and the interested parties agree the initial locations for which a risk assessment will be carried out. It is not feasible to consider all possible rooms and locations; so attention will be focussed on those rooms with significant occupancy known to have the highest levels of contamination.

2.2 Agree data for use in the risk assessment

The data required to assess risks from radioactive contamination include levels of different radionuclides as a function of time and the possible behaviour of people using the relevant locations (eg number of years and the number of hours per year spent at the location). A distinction will be made between normal occupancy of the agreed locations and periods when building work was being carried out that could have affected the radiation exposure. The data to be used will be based on the information collected under Task 1 and where possible will be agreed with the Inquiry leader and other interested parties. It should be recognised that there are likely to be significant uncertainties associated with these data, particularly for the early years of the study. Where necessary assumptions will be made to supplement the available data and these will be clearly described and justified. Uncertainties will be identified and if possible ranges given for key parameters.

2.3 Assess radiation exposures and risks for the period and locations of interest during normal use

Radiation exposures and risks will be estimated for hypothetical individuals who occupied the locations agreed under Task 2.1 using the data agreed under Task 2.2. The radiation exposures assessed will be the integrated equivalent dose to specific tissues (as defined in ICRP publication 60). For external radiation this will be over the periods of interest and for internal radiation it will be the committed exposure from intakes of radionuclides over the periods of interest. It is unlikely that sufficient data will be available to take account fully of variations in concentrations of radionuclides with time. The likely approach will be to estimate concentrations in key years and assume that they apply to the period on either side of them (eg 1968 may be used to represent the period from 1960 to 1975).

The tissues of interest are the brain and pancreas although these are not associated with a relatively high risk of radiation induced cancer and so are not among the organs/tissues for which specific risk factors for radiation induced cancer are normally calculated, although they are included in the overall estimate of the risk. However, data are available to estimate committed equivalent doses to pancreas and brain for use here. For the radionuclides that are likely to be of interest for this study the organs/tissues that would normally be considered are the lung, bone, liver and red bone marrow and therefore doses will also be estimated for these tissues for internal irradiation. For external irradiation the dose to all tissues will be taken to be the same as the whole body dose. The risks of radiation induced pancreas, brain, lung, bone and liver cancer plus leukaemia (based on the red bone marrow dose) will be estimated using standard basic dose/risk relationships. A cautious approach will be used with no account taken of the time dependence of the exposure and the risk.

These initial estimates will aim to scope the likelihood of anyone developing a radiation induced cancer from radiation at Manchester University and will rely on a number of assumptions and estimations. Where necessary a cautious approach will be adopted but any uncertainties will be discussed in a qualitative or quantitative way. It should be recognised that the uncertainties will be particularly great when estimating risks from exposures up to 40 years in the past. It should be noted that within the timescales of this project we do not intend to carry out a formal uncertainty analysis.

In radiation protection the quantity effective dose is used to combine and compare exposures from different types of radiation to different organs and tissues. It is used in the regulation of radiation exposures and is also useful for comparing different sources. Effective doses will also be estimated as part of this study to allow comparison with the doses that people would have received over the period from other sources, notably from natural background radiation.

2.4 Assess radiation doses and risks during building work

Over the period of interest work will have been carried out to refurbish the locations of interest. This might have included major structural changes to the rooms as well as routine decoration and maintenance. It is also thought that remedial work was carried out. All of these types of work could have led to increased exposure to any radioactive contamination. This possibility will be considered and depending on the amount of information available the additional exposure and risk associated with building work will be assessed.

Task 3 Assessment of current and future risks from radioactive contamination

The aim of this task will be to estimate radiation exposures and risks from the current levels of contamination found at relevant locations in Manchester University and to indicate how these might change in the future. As for Task 2 the estimated risk will not be to any identified individuals but to hypothetical individuals representing those who are likely to receive the highest exposures. The same cautious, simplified approach to estimating doses and risks will be adopted as outlined in Task 2. The following sub-tasks will be carried out.

3.1 Agree data for use in the risk assessment

As for Task 2 the aim will be to agree the locations and data to be used in the risk assessment with the Inquiry leader and other interested parties. It is likely that the same locations will be considered as identified in Task 2.1. However, the information gathered in Task 1.2 will be reviewed and different locations chosen if the pattern of contamination is different now than it was in the past.

Depending on when this part of the study is carried out additional information may be available on levels of contamination in the locations of interest or on furniture and other items removed from the site. This additional information will be used in the assessment of current and future risks as appropriate.

In considering possible future risks account will be taken of whether additional radioactive contamination could be exposed during building works or through different uses for the relevant locations.

3.2 Assess current and future radiation exposures and risks for the locations of interest during normal use.

Radiation exposures and risks will be estimated for hypothetical individuals using the chosen locations. Annual doses will be estimated based on the current levels of contamination taking into account external exposure during the year and internal exposure from intakes by inhalation and ingestion over a year. Likely future doses will also be estimated taking into account changes in levels of radionuclides due to radioactive decay and the ingrowth of radioactive progeny. The current and future doses will be integrated to provide an estimate of the possible future risk of radiation induced cancer. The period of integration will be agreed with the Inquiry leader and interested parties but is likely to be 20 or 30 years to allow for the same people occupying the location.

The doses and risks assessed will be as for the past exposures, i.e. for pancreas, brain, lung, bone, liver and red bone marrow. Again cautious assumptions will be made as appropriate and the assumptions and major uncertainties will be identified.

3.3 Possible future radiation exposures and risks during major building works.

It is possible that future work to refurbish or alter the buildings of interest could lead to additional exposures to radioactive contamination. This possibility will be considered and if sufficient information is available, exposures and risks will be assessed. The need to take additional precautions during future building work will also be addressed.

Task 4 Preparation of an interim report on the risk assessment

An interim report will be prepared following the completion of tasks 2.2 and 3.2 which will outline the results obtained and the progress with Tasks 2.3 and 3.3. This will give the data and assumptions used in the assessment of risks and the results obtained. The interim report will review the results and indicate what further work is required to complete the study. A review meeting will then be held to decide on whether the study can be finalised as outlined below or whether further work is required to refine the risk assessment, consider different locations etc.

Task 5 Preparation of the final report on the risk assessment

If it is agreed in the review of the interim report that the study can be finalised then a final report will be prepared. This will contain the information provided in the reports produced under Task 1 and the interim report. In addition, the major sources of uncertainty will be identified and discussed. The estimated radiation exposures will be compared with exposures from other sources and the estimated risks will be placed in context by considering the natural incidence of the different types of cancer.

A final draft report will be presented to and discussed with the Inquiry leader and other interested parties. The aim would then be to finalise the report taking into account any comments received.

Deliverables

The following deliverables are envisaged from this study:

- 1) A report containing a series of papers written for the non-specialist on the nature of the radioactive contamination at Manchester University and the possible risks to health. (Task 1.1) Draft report for 28.2.09
- 2) A short report identifying gaps in the available information on levels of contamination in the locations of interest at Manchester University and recommendations on future monitoring requirements. (Task 1.3) Draft report for 28.2.09
- 3) An interim report giving the results of the risk assessment for past, current and future exposures under normal conditions at relevant locations in Manchester University. Draft interim report for 29.5.09
- 3) A final report on the risk assessment for past, current and future exposures to radioactive contamination at relevant locations in Manchester University. Draft final report 31.8.09 depending on outcome of review in June 2009.

Timescales and milestones

The following assumes that the contract with the University is agreed and in place such that work can start by the beginning of December 2008. The Gantt chart attached shows the timescales for the project and the various review points. It should be noted that timely inputs are required from Manchester University of all monitoring results that are available plus their report on the history of the relevant buildings.

The review points are:

- Early March 2009 following completion of Task 1.
- Early June 2009 following completion of Task 4.

External meetings

An early meeting preferably in December 2008 should be held at Manchester University involving all interested parties. The aim would be to present the outline of the proposed study, to obtain views on what is planned and to discuss the kind of information that we would welcome from those attending. Further contact with interested parties would then be by e-mail with additional meetings held at the end of Task 1 and Tasks 2.2 and 3.2, when the project is reviewed in June 2009 and when the draft report is available in September 2009.

Regular progress meetings could be held by teleconference with Professor Coggon and/or the University of Manchester to report on progress and exchange information. Formal project review meetings are planned for early March 2009 and early June 2009.

A final meeting should be held at the University to report the findings of the study and to discuss them and their implications. Provided that the work is carried out as planned this should be held in September 2009 once the draft final report is available.

HPA Staff involved in the study and Estimates of effort

The overall project manager will be Jane Simmonds from the Environmental Assessment Department (EAD), with the work overseen by Dr John Cooper, Deputy Director.

Task 1

Task 1.1 will involve staff from a number of Departments in RPD as follows:

Task 1.1.1 Kelly Jones and Wayne Oatway, EAD

Task 1.1.2 Kelly Jones, Wayne Oatway and Sheila Holmes, EAD

Task 1.1.3 John Harrison and George Etherington of the Dose Assessments Department

Task 1.1.4 Colin Muirhead and Richard Haylock of the Epidemiology Section

Estimated total effort for task 1.1: 50 h

Tasks 1.2 and 1.3 will be managed by Kelly Jones of EAD with input from Sheila Holmes of EAD and from other people in RPD as required.

Estimated total effort for task 1.2: 55 h

Estimated total effort for task 1.3: 35 h

Tasks 2 and 3

These tasks will be managed by Jane Simmonds with support from Kelly Jones, Sheila Holmes and other staff as required.

Estimated total effort for task 2: 180 h

Estimated total effort for task 3: 120 h

Tasks 4 and 5

These tasks will be carried out by Jane Simmonds and Kelly Jones with input from others as required. The estimates of effort assume that no significant additional work is agreed at the review points.

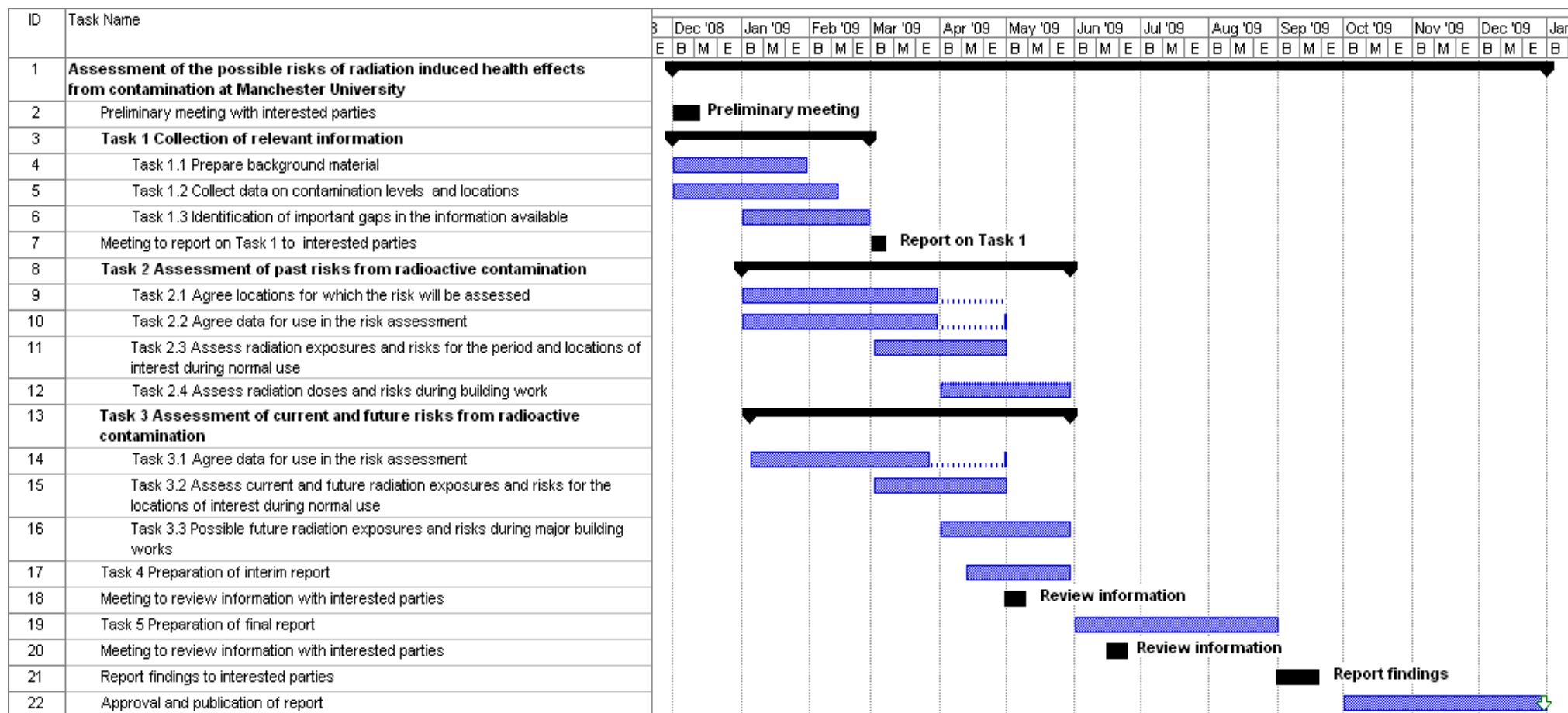
Estimated total effort for Task 4: 70 h

Estimated total effort for Task 5: 50 h

Estimated effort for Project management, attendance at meetings etc: 150 h

Jane Simmonds
14.01.2009

Gantt chart showing project tasks and timescales and review meetings



Note: The timescales given above may be subject to change following discussions at the review meetings.