5 November 2001
Session 3, 1:30 p.m.

Bioassay Software Workshop

Workshop on *IMBA Expert USDOE-Edition* and Related Developments

In July, 2001 the U.S. Department of Energy, Office of Worker Protection Policy and Programs (EH-52) let a contract with ACJ & Associates, Inc., Richland, WA to co-develop with the UK's National Radiological Protection Board (NRPB) a comprehensive software package for internal dosimetry, to replace the current CINDY package. *IMBA Expert USDOE-Edition* will enable DOE facilities and Internal Dosimetry Programs to carry out bioassay analyses and internal dose assessments by standardized, quality assured methods that will implement all of the International Commission on Radiological Protection's (ICRP's) current biokinetic and dosimetry models. The software package is being developed in Visual Basic® 6, to incorporate the NRPB's proprietary *Integrated Modules for Bioassay Analysis* (IMBA). The project will be carried out in two phases. The 'Alpha' version of the Phase I software is due to be distributed to EH-52 and six DOE sites by September 30th, for user testing. This workshop will start with a presentation by Miss Frances A. Fry, Director of Research Division, NRPB, and Chair of ICRP Committee II's Bioassay Task Group, who will give an overview of ICRP's current activities and developments in internal dosimetry. This will be followed by a presentation from the software developers on the design concepts and capabilities of *IMBA Expert USDOE-Edition* (Phases I and II), and how these implement the new ICRP methodologies. The workshop will then provide an informal scientific forum for the software's test-users, and any other interested parties, to present their observations and comments on the Phase I software's performance and usability. Technical information on the *IMBA Expert USDOE-Edition* project, and related software developments, is available online at www.acj-associates.com.

Contact: Anthony C. James (888-723-9234 or 509-375-7718; imba@acj-associates.com)

The work of ICRP Committee 2 on
Dose coefficients for intakes of radionuclides
and bioassay data interpretation

F A Fry
National Radiological Protection Board

The International Commission on Radiological Protection (ICRP) is an independent registered charity established to advance for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation. ICRP

consists of the Main Commission and four Committees. Committee 2 (Doses from Radiation Exposures) is concerned with the development of dose coefficients for the assessment of internal and external radiation exposure, development of reference biokinetic and dosimetric models and reference data for workers and members of the public.

For some years, Committee 2 has had a substantial programme of developing dose coefficients (dose per unit intake of a radionuclide by inhalation or ingestion) for workers and for members of the public. ICRP Publication 30 giving relevant information for workers was developed over a number of years (publications spanned 1979 to 1982). This publication used a model for the respiratory system based on a model proposed by a Task Group on Lung Dynamics in 1966; a simple model of the gastrointestinal system based on publications in the literature, also in 1966; relatively simple biokinetic models for each element, based on information available in the literature at that time. The Publication presented its results as Annual Limits on Intake for intake both by ingestion and inhalation and Derived Air Concentrations (DAC) for intake by inhalation; where appropriate, DAC were also given for submersion in a radioactive cloud.

Since that Publication was completed, there have been many developments in models and the increasing power of computers has meant that it has been possible to implement very complex models. Unfortunately, this complexity has made the models difficult to use except in situations where the default parameter values were appropriate for the case considered.

Increasing concern about public exposure to radioactive materials and perhaps particularly the consequences of the accident at the Chernobyl nuclear power plant led to the need to develop age-specific dose coefficients for infants, children and young persons as well as adults. Also, default parameter values considered appropriate for the workplace were not necessarily applicable to environmental exposures. There is now a completely revised kinetic and dosimetric model of the human respiratory tract, which is age-specific (Publication 66, 1995) and revised biokinetic models of a number of elements considered to be of importance for public exposure (Publication 56, 1990, Publication 67, 1993, Publication 69, 1995, Publication 71, 1996). These models were used to provide dose coefficients for members of the public at ages 3 months, 1 year, 5 years, 10 years, 15 years and adult; these values were compiled in Publication 72, 1996.

With the dosimetric changes recommended in Publication 60, it also became necessary to reconsider doses to workers and dose coefficients for intakes by inhalation and ingestion were given in Publication 68 in 1994. These values were based on the new model of the respiratory tract and updated biokinetic models where available (from Publications 57, 67 and 69). Some guidance on individual monitoring of workers and bioassay interpretation was given in Publication 78, 1997.

Other recent developments which are relevant to both occupational and public exposure are : doses to embryo/foetus from intakes by the mother; transfer of radionuclides to breast milk and doses to the infant; a new model of the alimentary tract; new reference values for basic anatomical and physiological data (i.e. an update of Reference Man).

The Commission is working towards a re-statement or update on its basic recommendations for about four to five years time. It is of course far too early to know whether there will be significant changes that affect dosimetry – new organs identified at risk, new risk factors, new values for radiation weighting factors and tissue weighting factors, changes in dosimetric concepts. Nevertheless, Committee 2 has a substantial programme of work in hand so that it will be in a position to produce a new document on occupational exposures by around 2005/6. This includes:

revision of nuclear decay data
development of new phantoms
review of biokinetic and bioassay data
development of biokinetic models and model validation
guidance on bioassay interpretation

Recent international comparisons of bioassay data interpretation have revealed a wide (unacceptably wide) spread in results. This may be due to a number of factors including: simple mistakes; lack of experience in the particular problem; different assumptions made about time, pattern, route of intake, differences in data handling and fitting routines; differences in choice of models and parameter values; availability in computer tools; differences in regulatory approaches. When we have conducted such intercomparisons between experienced laboratories in the UK (Approved Dosimetry Services and NRPB) we have generally found reasonable agreement when the problem is sufficiently well defined. For a well understood situation, differences mainly arise because of different decisions about particle size and absorption parameters. When the situation is not well defined and there is uncertainty about time or route of intake, differences in results can be much larger. But that, of course, is the real world in most situations.

Committee 2 has therefore realised that it needs to give more guidance on how its models and data are used to interpret bioassay data and a Working Party has been set up to consider the matter. The Working Party will make a proposal to Committee 2 and, if accepted, it will work on this task for the next few years so that guidance on interpretation will be available at the same time as new dose coefficients. The Working Party proposes that it should give guidance on:

- what assumptions to make if the timing/pattern of intake is not known
- when, and how, to use material specific values rather than default values
- advice on data handling
- advice on data fitting routines
- how to deal with more than one exposure route
- how to handle more than one type of bioassay data
- use of tracers
- use of decay products
- when, and how, to use individual specific data
- wounds
- effects of treatment
- elements of a good computer program
- quality assurance

The guidance will be tailored to various levels of user; clearly it will not be necessary to consider all the above items if workplace monitoring demonstrates that intakes are trivial. The Working Party proposes that a written report should be accompanied by a CD which includes dose, excretion and retention coefficients for use in interpretation of bioassay measurements. For the expert user, the coefficients for inhalation intakes will be presented in a manner that enables the user to obtain values appropriate for specified AMAD by presenting the coefficients as a linear combination of deposition in the regions of the respiratory tract.

Current ICRP policy is that it does not produce computer codes. All ICRP CD-ROMS produced to-date have been look-up tables. The proposed CD-ROM for the expert user is therefore a slight departure from current policy.

In many cases, e.g. trivial levels of intake, use of default parameter values will be satisfactory. Where deviation from default values are most likely to be required, this will involve changes to values of parameters within the Respiratory Tract Model. For these situations, the Working Party will draw substantially on the Technical Document in use of the Human Respiratory Tract Model, which is shortly to be published.

The Working Party intends to provide worked examples.