



Briefing for NDAWG on habits surveys

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This briefing was produced for presentation to the November 2003 NDAWG on behalf of the Food Standards Agency, the Environment Agency and the Health and Safety Executive. It briefly explains how habits surveys are undertaken in England and Wales near nuclear sites and touches on how the information has been used in radiological assessments. Similar surveys are carried out in Scotland on behalf of SEPA.

It is hoped that the briefing will help the Group develop its policy and practice in guiding dose assessments in the UK.

The presentation takes the form of Power point slides and associated notes.

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Outline of presentation

- Purposes of surveys
- Past surveys
- Scope of current survey programme
- Methods used before and during fieldwork
- Classifying pathways and presenting results
- Strengths and weaknesses
- Application of data in dose assessments
- Availability of data and reports

Purposes of surveys

- Protect the public from the effects of radioactive waste discharges and nuclear site operations
- Provide data for dose assessments
- Identify relevant and/or unusual exposure pathways
- Target monitoring programmes
- Confidence building

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Purposes of surveys

Habits surveys provide information to help in protection of members of the public from the effects of radioactive waste discharges and site operations. Data on their eating habits, recreational pursuits, work etc which are relevant to their radiation exposure are gathered around specific nuclear sites and in other areas affected by waste discharges. Data are processed (for example, to define characteristics of critical groups) and used to assess radiation doses. The radiological protection system in the UK is based on dose limits which ICRP have recommended as relevant for critical groups.

Site specific surveys are carried out since these provide information which is unique and directly relevant to the habits of populations local to particular nuclear establishments.

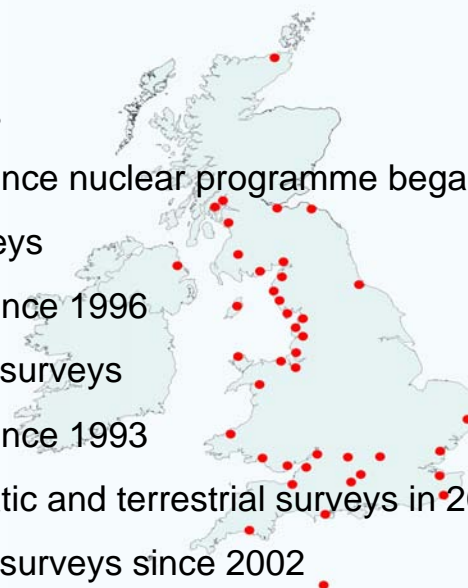
Surveys help identification of relevant exposure pathways. For liquid waste discharges, these would typically include consumption of locally-caught seafood, occupation of intertidal areas whilst angling, and handling sediment during bait digging or tending nets. For gaseous discharges, typical pathways include consumption of locally-grown fruit and vegetables and locally-produced meat, eggs and milk. For direct radiation, they include time spent in indoor and outdoor activities. Unusual pathways are also identified during surveys. Examples include consumption of uncommon seafoods (e.g. razor shells), or use of seaweed as a soil conditioner on vegetable plots.

The surveys provide information which are used to target monitoring programmes. For example, routine monitoring of cockles may be replaced by winkles if, because of availability or some other reason, this has become the preferred species for high rate consumers. Monitoring of honey may be adopted if local production and consumption was found to have started.

The surveys provide an important way of liaising directly with the public and demonstrating to them that their health and safety is being protected. Interviewees are often pleased to hear that this is happening and that it is independent of nuclear site operations.

Past surveys

- Aquatic surveys
 - site-specific since nuclear programme began
- Terrestrial surveys
 - site-specific since 1996
- Direct radiation surveys
 - site-specific since 1993
- Combined aquatic and terrestrial surveys in 2001
- Fully combined surveys since 2002



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Past surveys

The trend in the main programme of surveys has been towards providing data for integrated assessments across all relevant pathways.

Aquatic habits surveys relevant to liquid radioactive waste discharges date as far back as the early-1950s in relation to Sellafield. With the burgeoning nuclear power programme, surveys extended to all the major nuclear sites in the UK (e.g. Winfrith, 1958, Bradwell, Berkeley, Oldbury and Hinkley Point 'A', 1960). Surveys continued routinely around the main nuclear sites and included areas remote from, but affected by discharges (e.g. Cumbrian Coast, Northern Ireland, Channel Islands).

Initially assessment of gaseous discharges through terrestrial pathways relied on national food consumption data. In 1996, a programme of site-specific terrestrial surveys in England and Wales was begun to provide confidence that the system based on national survey data was robust. By 2000, this had covered 15 major nuclear sites.

Assessment of direct radiation is undertaken by site operators. In 1993 independent surveys began for HSE. By 2001, 17 sites had been surveyed.

In 2001, the FSA programmes of aquatic and terrestrial surveys were amalgamated, and combined surveys were carried out at Berkeley and Oldbury, Heysham and Sizewell. In 2002, the programme was further modified to include the direct radiation surveys for HSE and the non-food interests of the Environment Agency. The agreement resulted in combined surveys at Aldermaston and Burghfield, Drigg and Hartlepool in 2002, and Cardiff, Sellafield and Winfrith in 2003.

Surveys sponsored by government authorities are also undertaken in Scotland on behalf of SEPA and are also directed on occasion at specific pathways e.g. occupancy near the Chapelcross pipeline and turf cutting in coastal areas of the Irish Sea. Site operators occasionally sponsor habits surveys.

Scope of current survey programme

- Geographically defined areas around site
- Aquatic survey area – local areas affected by liquid discharges
- Terrestrial survey area – within 5 km of site centre
- Direct radiation survey area – within 1 km of site perimeter
- Members of the public only
- Sub-sets of population
- Variable frequency

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Scope of current surveys

Current surveys are based on 3 geographically-defined areas which reflect where liquid and gaseous discharges and direct radiation respectively may be considered to influence exposure pathways. The choice of survey area is a judgement taking into account cost and the likely extent of the effects of the source in question.

Marine surveys loosely cover the sea area encompassed by dispersion over one tidal cycle from the liquid discharge point. They target people fishing within the area or consuming fish from it, and people undertaking recreational activities (e.g. windsurfers). In addition, intertidal activities such as angling, shellfish collecting, wildfowling, or beach related pursuits are identified in the coast. Retail and wholesale outlets involved in seafoods obtained from the survey area are also contacted

Terrestrial surveys include the area within a circle of 5 km radius centred on the nuclear site centre. People within this area targeted for interview include farmers, allotment holders, wholesalers and beekeepers. Information on collection and consumption of wild/free foods, game and freshwater species is also gathered.

Direct radiation surveys are conducted within 1 km of the site perimeter. They include residences and any businesses not directly related to the operation of the nuclear site.

Although the surveys are carried out in these 3 distinct areas, each interviewee is asked about habits relevant to all 3 areas. Habits data generally exclude activities associated with site operations. The surveys do not attempt to interview every person within the areas. Instead, a subset are targeted who are potential critical group members.

The frequency at which surveys are repeated is variable and depends on resources, the radiological significance of the site and the requirements for formal assessments. Full surveys are not repeated more than every 3 years.

Methods used before fieldwork

- Establish site-specific requirements
- Use information from previous surveys and assessments
- Liaise with people/organisations with relevant local knowledge
- Send letters to farmers within 5 km and to residents within 1 km.

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Planning

There are 3 stages to a survey: planning, fieldwork and reporting. Planning takes account of information from previous surveys, what environmental monitoring is undertaken, the results of dose assessments and the specific requirements of the sponsors.

Contact is made with people in local organisations to obtain relevant information. They include the site operators, Defra and EA fisheries officers, Defra field officers, the local sea fisheries committee, the local councils, the local associations, allotment wardens, wildfowling organisations and the local tourist office.

Letters are sent to farmers within the 5 km terrestrial survey area and residents within the 1 km. The letters tell recipients about the survey and that they are likely to be visited.

Methods used during fieldwork

- Meet with site operators
- Interview individuals from pre-fieldwork preparations
- Interview individuals identified during course of fieldwork
- Visit areas where relevant recreational or commercial pastimes occur
- Skilled interviewing using a questionnaire as an aide-memoire
- QA and Health & Safety

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Fieldwork

At the start of the fieldwork, a meeting is held with the site operators to establish contact and find out relevant local information, including the potential for wildlife to transfer activity off-site. Contact is also made with individuals and organisations identified during the pre-fieldwork preparations.

As the field work progresses, other potential interviewees are identified and contacted, thus gradually building up a picture of the area, relevant pathways and the habits of the people engaged in them.

Areas are visited where relevant recreational and commercial pastimes occur. They include harbours, beaches, angling shops, allotments, wholesalers, food shops and farms.

Interviews are conducted by experienced scientific staff. The work requires good interpersonal skills and the ability to elicit the required data about people. Full training for new staff is provided. The success of the interview approach is assisted if a survey has been undertaken in the area previously. Sometimes a questionnaire is used, but more as an aide memoire than a 'tick-box' form.

The fieldwork is undertaken by several surveyors, and regular contact and networking is carried out in order to maintain quality assurance of data gathering and comprehensiveness of the survey.

Potentially, interviewing is a dangerous occupation, so interviewers are trained in identifying 'tricky' situations and locations, as well as diffusing awkward confrontations. Some staff are not prepared to undertake fieldwork because of the perceived risks. In the vast majority of cases, co-operation by interviewees is excellent.

Classifying pathways and presenting results (1)

- Numerically-defined pathways (e.g. kg y^{-1} , h y^{-1})
 - adults, 15, 10, 5 & 1 year, & 3 month age groups
 - 5 aquatic food groups
 - 16 terrestrial food groups
 - intertidal occupancy (by sediment type)
 - handling gear/sediments
 - occupancy in/on water
 - occupancy in/out doors
- Each of these sub-divided where relevant

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Results 1

Information obtained during surveys is essentially of 2 types – numerically defined pathways and qualitatively defined pathways. For the former, the interview data are processed into annual rates (e.g. consumption in kg y^{-1} , occupancy in h y^{-1}) and categorised into age and pathway groups.

The age groups are from 0 to 1.0 y of age (called 3 months); more than 1.0 y to 2.0 y (called 1 year old); more than 2.0 y to 7.0 y (called 5 year old); more than 7.0 y to 12.0 y (called 10 year old); more than 12.0 y to 17.0 y (called 15 year old); more than 17.0 y (called adults).

Pathways represent groups of activities with similar attributes. They include consumption of aquatic foods (fish, crustaceans, molluscs, marine plants and wildfowl) and terrestrial foods (milk, green vegetables, other vegetables, root vegetables, potatoes, domestic fruit, cattle meat, pig meat, sheep meat, poultry, eggs, wild/free foods, honey, fungi, rabbits/hare and venison). Freshwater aquatic foods in the terrestrial survey area are also included. Data are included which further sub-divided these activities by species or food type (e.g. crab, cabbage, plum).

External exposure pathways cover occupancies and handling. Intertidal occupancies are grouped according to sediment type (e.g. sand, mud), and handling is grouped into sediment and fishing gear. Occupancies in water and on water are grouped separately, as are occupancies indoors and outdoors which are relevant to direct radiation. For the latter, the data are further grouped by distance from the site perimeter (0 – 0.25 km, 0.25 – 0.5 km and 0.5 – 1 km).

Classifying pathways and presenting results (2)

- Qualitatively-described pathways
 - sewage workers; livestock on beaches etc
- Interview data are presented as annual rates
 - annex with all observations per individual
 - tables with all observations per pathway
- Data are analysed to give rates typical for those people most exposed
 - 97.5 percentile rates
 - ‘cut-off’/divide by 3/ critical group rates

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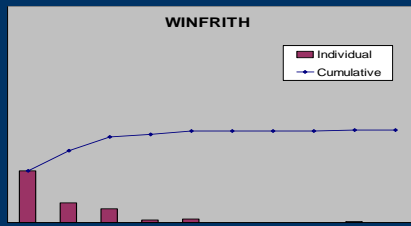
Results 2

Qualitatively described pathways are also investigated during the surveys. They include pathways where quantitative data may be needed subsequently, or unusual pathways which have been identified during a survey. Examples include activities at sewage treatment works through which discharged liquid effluents from a site may pass, and cattle grazing on foreshores affected by discharges.

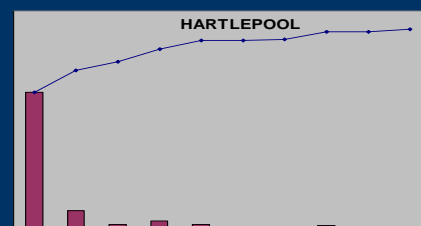
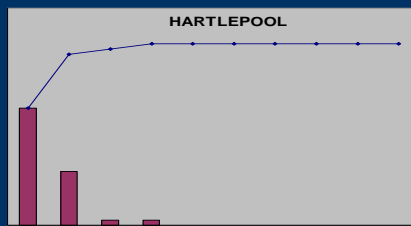
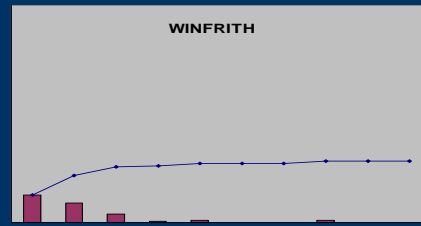
Quantitatively defined data are presented as annual rates in report tables. A summary annex lists all rates per pathway and age group for each individual. Summary tables are also provided.

The habits data are analysed to give rates typical for those people most exposed. Two methods are used. The first one analyses all the data for a given age and pathway group to give the 97.5 percentile rate. This approach is consistent with that adopted by FSA for the derivation of food consumption rates based on national statistics. The second method averages all the values from the highest to one third of the third highest. This approach is called the ‘cut-off’ method and has been related to the uncertainties in dosimetric factors.

Potatoes



Crustaceans



Y axis – no. of consumers

X axis – consumption rate

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Results 3

There are many features that can be derived from the data collected to date. As an example, in this slide observed rates (in this case, for consumption of potatoes and crustaceans from Winfrith and Hartlepool) are grouped into ranges and plotted against the number of consumers eating within that range. Unsurprisingly, a large proportion of individuals are found to eat at low rates and a few at high rates (despite the surveys targeting high-rate consumers). The high rate consumers can be easily missed by untargetted surveys. In these cases more people were found consuming crustaceans and potatoes at Hartlepool than at Winfrith. It is generally true that significant differences can be found from site to site.

Strengths and weaknesses

- Data on exposure pathways and habits rates are site specific
- Data are relevant to the survey year
- Observations depend on the individual and the interviewer
- The public and local organisations see independent health protection in action
- Habits surveys cost money
- Habit surveys help radioactivity monitoring programmes

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Strengths and weaknesses

In this slide some examples of aspects of habits surveys are listed which demonstrate strengths and weaknesses of the approach used.

Data on exposure pathways and habits rates are site specific which suggests that assessed doses are likely to be more realistic. Habits surveys can result in higher doses because national statistics may miss pathways or higher rates. However the converse can also be true. Integrated site-specific surveys enable pathway combinations for real individuals to be assessed.

Habits survey data are relevant to the survey year. This may be appropriate for a dose assessment for the survey year, but not for prospective assessments for future dose. This problem can be overcome by appropriate averaging or by prioritising frequency of surveys according to the radiological significance of sites.

Our experience suggests that the relationship between the individual and the interviewer is crucial. Assurance of quality can be achieved by training, by verifying unusual results with repeat interviews and by checking using logging surveys.

The public and local organisations see independent health protection in action. This is an important benefit, with interviewees often commenting that they welcome our independence from site operators.

Habits surveys cost money and the risks are relatively low.

Habit surveys help radioactivity monitoring programmes, making them more relevant to the local area and more cost effective.

Application of data in dose assessments

- RIFE – retrospective
- Discharge authorisations – prospective
- Integrated assessments (JRP paper) - retrospective
- Probabilistic assessments (Utrecht paper)

Availability of data and reports

- Need to respect individuals' confidentiality
- Reports for recent years are available
- Earlier reports available on a case-by-case basis
- Summary data in RIFE and scientific papers

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Dose assessments

Habits survey data are used in a number of different ways in dose assessments.

For the annual RIFE report (now jointly sponsored by FSA, SEPA, EA and EHS), retrospective assessments for the year of the report are carried out. For aquatic pathways, assessments at each site are for one or more groups which have appropriate combinations of pathways based on the habits information. The habits rates for these pathways are the rates produced by the 'cut-off' method described earlier. More recently for Sellafield assessments, results of 5-year-averaged habits have also been included. For terrestrial pathways, generic rates derived from national statistics are used. This assessment uses a 'top-two' method whereby all terrestrial pathways are included, with the two giving the highest dose being at 97.5 percentile rates, and the rest at average rates. The difference in approach can be justified on the basis that aquatic pathways are found to be more variable from site to site. Alternative methods for use in RIFE are being developed.

Prospective assessments by FSA are based on data from the habits surveys. Outputs from models of predicted concentrations in a food group are combined with consumption rates of individual adults. Separate groups are considered for the effects of gaseous and aquatic discharges. Where possible a survey for the site being assessed is used. Where data for that site is not available, a surrogate dataset created by combining results from other surveys is used. Data for children are generated by scaling adult values using generic ratios because site-specific surveys do not generally provide sufficient child data for assessments to be robust. Within each age group, the critical group dose is determined by calculating the dose for each individual, summing contributions across all relevant food groups, and selecting the summed dose at the 97.5 percentile.

Other uses of habits survey data have been discussed in the following references:

Camplin, W.C., Brownless, G.P., Round, G.D., Winpenny, K. and Hunt, G.J., 2002. Radioactivity in Food and the Environment: calculations of UK radiation doses using integrated assessment methods. *J. Rad. Prot.* (22) 371-388.

Grzechnik, M., 2003. Representation of Habits Survey Data for Probabilistic Dose Assessments', Proceedings of Radiation Protection Symposium of the North West European RP Societies, Utrecht, The Netherlands. 2-5 June 2003.

Availability of data and reports

When making results of habits surveys available, there is a need to respect individuals' confidentiality. Recent reports have been produced taking this into account and are available from FSA, namely:

2001 Berkeley and Oldbury, Heysham and Sizewell

(also Hunterston and Torness from SEPA)

2002 Aldermaston and Burghfield, Drigg and Hartlepool

(also S W Scotland from SEPA)

Availability of earlier data and reports will be considered on a case-by-case basis.

Published summaries of aquatic habits data have been routinely included in RIFE reports since they were first published (RIFE 1 covered 1995). In addition, scientific papers have addressed specific issues e.g.:

Hunt, G.J., Hewitt, C.J., and Shepherd, J.G., 1982. The identification of critical groups and its application to fish and shellfish consumers in the coastal area of the north-east Irish Sea. *Health Physics* **43 (6)** 875-889.

Leonard, D.R.P., Hunt, G.J. and Jones, P.G.W., 1982. Investigation of individual radiation exposures from disposals to the aquatic environment: techniques used in habits surveys. In: Proceedings of the 4th International Symposium on Radiological Protection, Inverness." Society of Radiological Protection. 512-517.

Smith, D.L., Winpenny, K., Eaton T. and Naylor, G.P.L., 1999. The role of site specific habits surveys in radiological assessments. In: Proceedings of the 6th International Symposium on Achievements and Challenges: Advancing Radiation Protection into the 21st Century. Southport, UK, 14-18 June 1999. 359-362.

Reprints and a full list of relevant papers are available from w.c.camplin@cefas.co.uk

NDAWG November 2003



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Changes from one survey to next (Hartlepool)

	1998	2002	Change
	kg y ⁻¹	kg y ⁻¹	
Fish	59	32	-46%
Crustaceans	35	15	-57%
Molluscs	9.4	12	28%
Milk	nil	nil	nil
Green vegetable	57	33	-42%
Other vegetables	28	36	29%
Root vegetables	65	44	-32%
Potatoes	26	36	38%
Domestic fruit	26	12	-54%
Pig meat	68	nil	∞
Sheep meat	17	5	-71%
Cattle meat	nil	nil	nil
Poultry	92	9	-90%
Eggs	20	14	-30%
Wild/free foods	0.57	4.5	689%
Rabbits/hares	2.8	1.4	-50%
Honey	nil	6.8	∞
Wild fungi	2.3	4.2	83%
Venison	nil	nil	nil
	h y ⁻¹	h y ⁻¹	Change
Occupancy over sand	520	1600	208%
Handling gear	1800	1600	-11%
Handling sediment	520	1400	169%

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Optional slide parked because of time restrictions