



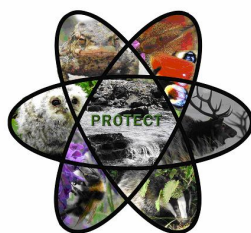
EUROPEAN
COMMISSION

Community Research

PROTECT

Protection of the Environment from Ionising
Radiation in a Regulatory Context

(Contract Number: **036425 (FI6R)**)



PERIODIC ACTIVITY (FINAL) REPORT

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Name	Number of copies	Comments
EC, Henning von Maravic	1	pdf
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PROTECT Partners	1	pdf
Workshop participants	1	pdf
PROTECT website	1	pdf on Outputs page

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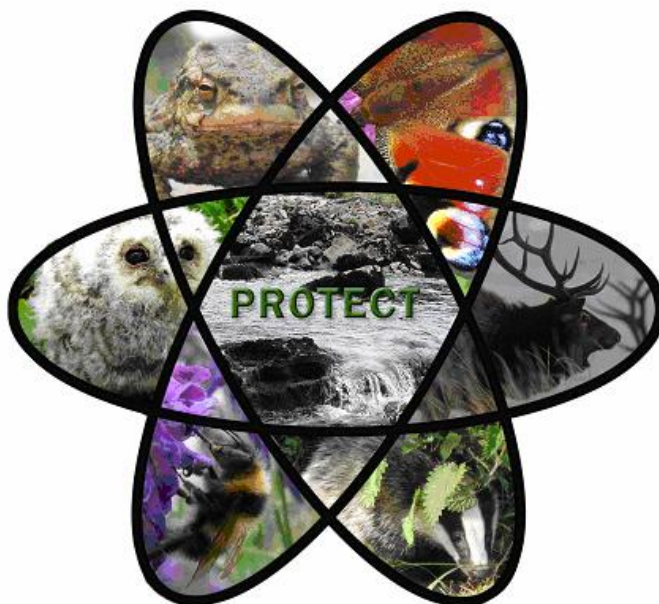
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The EU EURATOM funded **PROTECT** project (FI6R-036425) will evaluate the different approaches to protection of the environment from ionising radiation and will compare these with the approaches used for non-radioactive contaminants. This will provide a scientific justification on which to propose numerical targets or standards for protection of the environment from ionising radiation.



Project Co-ordinator: Natural Environment Research Council, Centre for Ecology & Hydrology

Contractors:

Natural Environment Research Council, Centre for Ecology & Hydrology (NERC-CEH)	
Swedish Radiation Safety Authority	(SSM)
Environment Agency	(EA)
Norwegian Radiation Protection Agency	(NRPA)
Institute for Radiological Protection and Nuclear Safety	(IRSN)

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1. Project objectives and major achievements

1.1 Milestone achieved

The PROTECT project has generally run to schedule with all milestones for WPs 2, 3 and 4 due in the last 12 months met. Deliverable 4 was delayed so that the maximum benefit could be gained from the Aix workshop and to incorporate analysis requested by the ICRP. The WP3 workshop was held one month later than planned and agreement on the minutes with some invited experts took longer than anticipated, partly due to holiday commitments. Input from PROTECT into FUTURAE was accomplished through close interaction between the coordinators including joint meetings with the EC, so a final PROTECT-Futuræ joint meeting was not needed although informal discussions took place at the Bergen conference in June 2007.

Table 1.1. PROTECT CA monitoring against project milestones and deliverables in year 2.

Month	Checkpoints	Delivery	Status
Month 14 ¹	WP4: Year 1 management and activity reports and financial cost statements WP1: Delivery of Deliverable 3 WP3: Decision on numerical targets WP2: Workshop to <i>discuss outcomes and implications of evaluation exercises</i> (associated management group meeting)	November 2007	On Schedule mid Dec 2007 Revised due date April 2008 Postponed to Jan 2008
Month 15	WP2: deliver minutes on Workshop to <i>discuss outcomes and implications of evaluation exercises</i> (and associated management group meeting)	December 2007	Workshop delayed to Jan 08; minutes delivered 1 month thereafter
Month 16:	WP3: Issue draft Deliverable 5 (Part B) for web consultation with experts.	January 2008	Revised due date April 2008
Month 18	WP3: Deliver agenda for Workshop to <i>consult with external experts and presentation of different approaches to wider audience</i> WP3: End period of web-consultation WP4: Interim Management Report	March 2008	Outline draft agenda available on web (Feb. 2008) Revised consultation process (see below) On Schedule
Month 19	WP2: Finalise evaluation of numerical benchmarks provided by WP3 WP3: Workshop to <i>consult with</i>	April 2008	Draft analysis completed for presentation in Aix workshop Meeting held in May 08

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	<i>external experts and presentation of different approaches to wider audience</i> (in collaboration with WPs1 & 2)		
Month 20	WP3: Deliver minutes on Workshop to <i>consult with external experts and presentation of different approaches to wider audience</i>	May 2008	Draft Minutes delivered in July 08, comments integrated and agreed by August 08
Month 22	WP2: Publication of Deliverable 4 WP4: Deliver agenda for <i>joint PROTECT-FUTURAE workshop</i> WP1-4: Deliver agenda for <i>final consortium meeting</i>	July 08	Delayed to incorporate extra analysis requested by ICRP C4 and discussions from Bergen and Manchester meetings. Delivered early November Informal discussions held during FUTURAE meeting Delayed by 1 month as meeting postponed until Sep
Month 23	WP4: <i>Joint PROTECT-FUTURAE workshop</i> (with FUTURAE) WP1-4: <i>Final consortium meeting</i>	August 2008	Held in Month 21 Held in Month 24
Month 24	WP4: Deliver minutes on <i>joint PROTECT-FUTURAE workshop</i> WP1-4: Deliver minutes on <i>final consortium meeting</i> WP3: Publish Deliverable 5, Part A, Part B (revised) and Part C	September 2008	Informal input only Delivered 1 month after meeting Part A combined with Part B to form D5. Part C partially delivered (Month 23) as report to Aix meeting and further as a separate annex to D5. D5 and annex delivered mid November to allow time for comments from experts.
Month 26 ²	WP4: Final management and activity reports and financial cost statements WP4: Final Plan for using and disseminating knowledge Deliverable 7 WP4: Report on raising public participation and awareness Deliverable 8	November 2008	Draft prepared in late 2008 but a delay caused by auditing problems at SSM and EA. Delivered march 2009 Annex 1 of final Activity Report Within final Activity Report

¹This milestone was incorrectly timetabled as Month 12 in the DoW (revised date matches requirements of the EC).

²This milestone was incorrectly timetabled as Month 24 in the DoW (revised date matches requirements of the EC).

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1.2. Publications from the PROTECT CA

The following outputs have been produced, and are available on the PROTECT website (<http://www.ceh.ac.uk/protect/>).

Table 1.2 Outputs and other material on the PROTECT website.

Public Area	Consortium Protected Area
List of Consortium members Chester Workshop minutes and presentations Vienna Workshop minutes and presentations Oslo Workshop minutes and presentations Aix Workshop minutes and presentations Updated links to various environmental protection documents (radioactive, chemical and EC) PROTECT Glossary [updated November 2008] Tutorial and accompanying documentation on application of species sensitivity distributions Triggers vs standards – discussion document Deliverable 1- Project Presentation Deliverable 2 - Communication action plan Deliverable 3 - A review of approaches to protection of the environment from chemicals and ionising radiation - requirements and recommendations for a common framework. Deliverable 4- Evaluation of approaches for protecting the environment from ionising radiation in a regulatory context Deliverable 5 Numerical benchmarks for protecting biota from radiation in the environment: proposed levels, underlying reasoning and recommendations Deliverable 5 Annex: Numerical benchmarks for protecting biota from radiation in the environment: record of the consultation process and views of independent experts Deliverables from previous EC projects: ERICA, FASSET, EPIC available to download PROTECT Newsletters Papers in conference proceedings Links to various relevant websites and documents.	Technical Annex I – complete version (28-05-04) Consortium agreement Minutes from 1 st project meeting (Lancaster) and associated presentations Interim management report Power Point presentation template Consortium minutes Chester meeting March 2007 Consortium minutes Warrington meeting August 2007

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1.3. PROTECT Deliverables

Deliverables as specified in the DoW for this reporting period have been produced (see Table 1.3). Deliverable 4 and 5 were delayed so that the maximum benefit could be gained from the Aix workshop and to incorporate analysis requested by the ICRP. In addition to the person months connected to the deliverables, 1.6 person months were used in WP4 for management purposes.

Table 1.3. PROTECT deliverables.

Del. no.	Deliverable name	WP	Delivery date (project month)	Actual/forecast delivery date	Estimated person-months	Used person-months	Lead Participant
D1	Project presentation	4	1	4	0.25	0.2	CEH
D2	Communication Action Plan	4	6	7	0.25	0.2	CEH
D3	A review of approaches to protection of the environment from chemicals and ionising radiation - requirements and recommendations for a common framework	1	14	19	10.5	13.6	EA
D4	Evaluation of the practicability of different approaches for protecting the environment from ionising radiation in a regulatory context and their relative merits	2	22	23	10.3	9.2	CEH
D5	Aims, and associated secondary numerical targets, for protecting biota against radiation in the environment A: Recommendations for further actions B: Proposed levels and underlying reasoning C: Records of end users' views on feasibility of proposed targets	3	24	24	10	14.8	SSM
D6	Web site	4	3-24	2	1	1	CEH
D7	Final Plan for using and disseminating knowledge	4	24	30	0.5	0.25	CEH
D8	Report on raising public participation and awareness	4	24	30	0.5	0.25	CEH

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1.4. Publicising the PROTECT CA

The PROTECT CA produced a third newsletter distributed to interested parties (circulation list >160 email addresses) in April 2008 by email and a last newsletter will be produced after the period of the contract finishes. Recipients include regulators, NGO's, industry (and industry groups) and the research community.

Presentations on the PROTECT CA have been made at the following events (separated into first and second year so only the later are relevant for the activity report of year 2):

Year 1

IAEA EMRAS (November 2006): oral presentation (*PROTECT: Protection of the Environment from Ionising Radiation in a Regulatory Context*; Howard).

BIOPROTA workshop (January/February 2007): oral presentation (*EC Methodology development and potential application*; Howard). (Presentations updating PROTECT progress were requested and provided for a subsequent BIOPROTA workshop in May 2007).

United Kingdom COGER meeting (17-19th April 2007): poster presentation (*PROTECT: Protection of the Environment from Ionising Radiation in a Regulatory Context*; Howard, Beresford, Barnett, Copplestone, Hingston, Andersson, Brown & Garnier-Laplace).

Royal Society of Chemistry conference 'Future Energy: Chemical Solutions' (September 2007): poster presentation (*PROTECT: Protection of the environment from ionising radiation in a regulatory context*; Copplestone, Beresford, Brown, Garnier-Laplace, Andersson, Hingston, Howard, Barnett, & Whitehouse).

IUR Task Group on Waste workshop (October 2007) – attended by PROTECT co-ordinator.

Additional presentations were made to experts attending the PROTECT workshops in Chester (WP1), Vienna (WP2). One of the expert attendees at the Chester workshop subsequently presented a poster on PROTECT to the Italian Radiation Protection Society (S. Risica; Il Progetto PROTECT).

Year 2

Presentations have been made to experts attending the PROTECT workshops in Oslo (WP2 & 3) and Aix-en-Provence (WP3) and Manchester.

PROTECT's approach to deriving numerical benchmarks was discussed at a working group meeting of a project evaluating chemical risk assessment methodologies by P. Howe of CEH.

The PROTECT coordinator visited the IAEA in February 2008 to discuss actions arising from PROTECT activities that might fit into the IAEA action plan.

Andersson P., Garnier-Laplace J., Beresford N.A., Brown J., Copplestone D., Hingston J.L., Howard B.J., Howe P., Oughton D. and Whitehouse P. (2008) Setting Environmental Numerical Benchmark Values for Radiological Protection of the Environment. In: The Twenty-seventh Annual Meeting of the Co-ordinating Group on Environmental Radioactivity, 7-9 April, University of Nottingham (Paper).

Copplestone D., Beresford N.A., Brown J., Cailes C.R., Dysvik S., Garnier-Laplace J., Hingston J.L., Howard B.J., Andersson P. and Whitehouse P. Assessing environmental risks from radionuclides - what can we learn from chemical risk assessment? Poster presented at

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the Society of Environmental Toxicology and Chemistry (SETAC), UK annual general meeting, 9-10th September 2008, University of Reading.

Three talks on each of PROTECT WP's 1-3 were given at the International Conference on Radioecology and Environmental Radioactivity held in Bergen (June 2008). Extended abstracts for all three papers were published at the meeting. The WP3 talk has been submitted as a refereed paper in the Special Issue of Journal of Environmental Radioactivity associated with the Conference. The WP1 and 2 talks will be published in a Special Issue of Radioprotection.

The PROTECT Co-ordinator attended the annual IAEA Coordination Group on Radiation Protection of the Environment in Bergen, June 2008. She reported on the progress and outputs of the CA. The meeting provided a valuable opportunity to ensure that all the relevant international bodies were fully aware of the PROTECT work and its preliminary conclusions and had the opportunity to comment on them.

Over the period since the website was launched there has been an increasing trend in visits with time with peaks associated with expert meetings, newsletters and the release of deliverables for consultation (Figure 1.1).



Figure 1.1. Trend in visits to the PROTECT CA website (www.ceb.ac.uk/PROTECT/) (note the last bar represents an incomplete reporting period).

Finally, an issue of the Journal of Radiological Protection will include four refereed papers on the outcomes of PROTECT.

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2. Workpackage progress for the period

Workpackage 1 activities were completed within the first reporting year. Progress in each of workpackages 2-3 during the second year of the PROTECT CA is described below.

2.1 Workpackage 1 Environmental protection concepts

The deliverable (D3) was finalised and sent to the EC in December 2007. This work package was then completed and the outputs from this work have been taken forward into WP2 and WP3. An oral paper from WP1 was presented at the Bergen Radioecology conference.

2.2. Workpackage 2 Assessment approaches: practicality, relevance and merits

In response to international recommendations, and to address the requirements of existing national legislation in some countries, a number of approaches have been developed specifically to estimate the exposure of non-human biota to ionising radiation. Some of the approaches are currently being used within the national regulatory frameworks of some countries, including EC member states. This report describes activities conducted to: evaluate the practicability of existing and developing approaches; consider the acceptability and relevance of current approaches compared to the needs of industry and regulators and the different situations it may need to address; test available approaches against any relevant ICRP recommendations or outputs from PROTECT; and assess the availability, usability and transparency of available approaches to groups other than those involved in their development. The outputs of these activities are described in Deliverable 4 which is summarised below.

The three most comprehensive approaches which are freely available for use, and which are being used by organisations other than their developers, are RESRAD-BIOTA (implementing the USDoE 'graded approach'), EA R&D 128 (developed for use in England and Wales) and the ERICA Tool (developed under EURATOM funding). Consequently, some emphasis was placed on these three approaches.

There is likely to be a significant future requirement for such tools as a consequence of revised ICRP Recommendations and EC and International Safety Standards. The existence of currently available assessment tools considered here will reduce the cost to any further industry users/regulators who may need to demonstrate protection of the environment in response to international guidelines and resultant national legislation. However, currently none of the available approaches is comprehensive and, as a consequence, parts of different approaches are often being combined for use in some assessments.

Evaluations by PROTECT support the conclusions of the IAEA EMRAS BWG and others, that the transfer components of the assessment tools add most to the overall uncertainty in predictions.

Of the three most developed approaches freely available to any user, EA R&D128 could be described as the most basic and the developers state an intention to adopt parameters from the ERICA Tool. However, it is the only one of the three approaches to consider radioisotopes of noble gases which can constitute an important component of airborne releases from nuclear power plants. The RESRAD-BIOTA package is designed as a

screening tool with, in effect, a requirement for site specific data at anything above the initial screening levels. However, the tool does contain allometric models enabling the user to define transfer to terrestrial/riparian mammal and bird species of interest (including the creation of simple foodchains). The ERICA Tool has the most developed CR-based transfer databases for a wide range of reference organisms arguably giving it a better basis to conduct prospective (when site specific data will not be available) assessments. It also considers the largest number of radionuclides having the ability to estimate dose conversion coefficients values for most radionuclides included within ICRP Publication 38. The ERICA Tool may also provide the most appropriate platform to implement the ICRP framework when it becomes available (the ERICA Tool already includes all of the adult life stages of the ICRP proposed Reference Animals and Plants and the ICRP have adopted the same dosimetric methodology as used in the ERICA Tool). However, the ERICA Tool lacks the functionality of RESRAD-BIOTA provided by its allometric models and ability to consider contaminated water intake by terrestrial animals. If organisms are to be assessed at the level of species (e.g. as in the Canadian ‘valued ecosystem component’ approach) then robust generic approaches to deriving transfer need to be further developed (e.g. allometric models for animals or phylogenetic approaches for plants).

Both RESRAD-BIOTA and the ERICA Tool continue to be maintained and developed; in the case of the ERICA Tool this is currently being conducted by a number of the original developing organisations without additional funding. Given the more comprehensive nature of the ERICA Tool we recommend its use for chronic exposure assessment within EC member states. However, it may be necessary to use it in conjunction with other models including the allometric modelling functionality of RESRAD-BIOTA. Our recommendation is only valid with the assumption that there is continued development and maintenance of the ERICA Tool and its databases.

There may be requirements to conduct temporal and/or spatial assessments, capabilities which the three models considered in most detail in this report do not have. Some dynamic models have been developed. For spatial assessments, the USEPA SADA model enables screening tier assessments to be conducted spatially (utilising parameters from RESRAD-BIOTA), and parameters from both the FASSET and ERICA Tool have been implemented in geographical information systems. Similarly, if packages such as RESRAD-BIOTA and the ERICA Tool do not have the required flexibility in the dosimetric assessment components there are other bespoke dosimetry tools available which may have the required flexibility, although these may not have been as independently assessed to date as the more generic tools.

Perhaps the most important criteria for the assessment tools, such as RESRAD-BIOTA or the ERICA Tool, is that they can be used with confidence in screening tier assessments. However, the comparison of screening tier predictions presented in this report does not promote the level of confidence required with large differences in output between the three approaches evaluated. If these models are to be (increasingly) used for regulatory assessment the reasons for such large variation in basic screening tier outputs needs to be more fully understood and any deficiencies addressed. This emphasises the importance of continuing the work of groups such as the IAEA EMRAS BWG and further funding for this still developing area of radiological protection.

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All the major international organisations (i.e. ICRP, EC, IAEA and UNSCEAR) have draft documents in progress on this area. As these become available the requirements for assessment tools and their development may further evolve.

Deliverable 4 was made available on the PROTECT website for consultation. Comments received and PROTECTs responses to these can be found on: http://www.ceh.ac.uk/protect/outputs/documents/PROTECTD4comments-responsessummary_000.pdf.

Additional Workpackage 2 activities included supporting Workpackage 3 by evaluating potential numeric benchmark values at sites of interest (reported in Deliverable 5 and at the May 2008 Aix workshop).

Workpackage 2 has also maintained an active link with the IAEA EMRAS Biota Working Group and presented an oral paper at the Bergen Radioecology conference (June 2008).

2.3. Workpackage 3 Requirements for protection of the environment from ionising radiation

The derivation of benchmark values, together with the underpinning scientific assumptions and transparent justification is the focus of Workpackage 3 activities. The work thus included suggestion of protection goal, matching endpoints, methodology to derive the benchmark, intended meaning and use of the benchmark. This has been documented in Deliverable 5 which is summarised below.

Following consultation, PROTECT suggested the following general protection goal:

‘To protect the sustainability of populations of the vast majority of all species and thus ensure ecosystem function now and in the future. Special attention should be given to keystone, foundation, rare, protected or culturally significant species’

The need for a system able to demonstrate that the environment is adequately protected from the effects of radioactive substances has been recognised by international organisations, a number of regulators and many scientists. As a consequence, a number of approaches/tools to estimate dose rates to non-human biota have been developed and some of these are now being used in a regulatory context. Estimated dose rates need to be compared with some form of criteria to judge the level of risk. There is, therefore, a need for predefined dose rate values, or benchmarks, to be proposed and agreed. The transparent derivation of benchmark values, together with the underpinning scientific assumptions was the focus of the WP3 deliverable.

The benchmark values derived within PROTECT are screening values. The use of such values (which would typically be used within a tiered assessment framework) is to screen out situations of no regulatory concern. For consistency with chemical risk assessment, PROTECT has adopted the assessment factor and statistical extrapolation techniques as recommended by the EC (2003) (i.e. the technical guidance document (TGD)). PROTECT has, wherever possible, decided to use the statistical extrapolation techniques (Species Sensitivity Distribution, SSD) to derive our benchmarks. Within the WP3 deliverable, we have derived both generic and organism group specific screening values as a basis for further development of the protection of the environment. The FREDERICA database was used to identify references of suitable quality from which EDR₁₀ values (i.e. the dose rate giving rise to a 10% effect in the exposed group in comparison to the control group) could be estimated.

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For the estimation of the generic screening value, data for all organism types were used within an SSD. A number of different data treatments were considered, but all of the options we investigated gave a reasonably similar result (giving some confidence in the numbers generated). The methodology thus seems robust when applied to the available data to generate a generic screening value. Although some of the EDR₁₀ values have large statistical errors in themselves the derived HDR₅ value did not change substantially if values with lower associated uncertainty were used or if data were weighted for uncertainty when fitting the distribution. Consequently, we have used the TGD methodology, with simple rules for data selection and without arbitrary weighting, and have some confidence in robustness of the derived HDR₅ value. As the TGD does not give guidance (other than specifying a range of 1-5) on the assessment factor to be applied to the derived HDR₅ value in order to estimate a PNEDR value, we used our own selection criteria. However, we acknowledge that there is considerable statistical uncertainty associated with the estimated HDR₅ value, and that the derived PNEDR should therefore be considered an indicative guidance value rather than an exact estimate.

The resultant proposed generic screening value is 10 $\mu\text{Gy h}^{-1}$.

In many cases the most exposed organism type may not necessarily be the most sensitive. Because a generic screening value is applied to all species, its use may result in either: (i) overly conservative assessments which lead to more detailed site-specific assessments which may not be scientifically justified; or (ii) assessments which do not identify the need for more detailed consideration of the more radiosensitive organism groups. Organism group specific screening values may, therefore, be more appropriate than a single generic value. Ultimately, it would be desirable to have screening values for as many relevant groups as justifiable (probably taxonomically at the family or class level), however, currently we do not have enough data to achieve this. Consideration was therefore given to deriving values for three broad groups, namely plants, vertebrates and invertebrates recognising that these groupings each contain organisms which are likely to have a range of radiosensitivities. Whilst it would be preferable to derive these using the same SSD methodology as applied for the generic screening assessment, the lack of data led us to also consider alternative approaches. The estimated screening values were: (i) vertebrates 2 $\mu\text{Gy h}^{-1}$; (ii) plants 70 $\mu\text{Gy h}^{-1}$; (iii) invertebrates 200 $\mu\text{Gy h}^{-1}$. The vertebrate and invertebrate values were generated using the SSD methodology whereas, because of the fewer available data, the plant value was generated using the assessment factor approach. Taking into account the limited data and uncertainty associated with these estimates, they should be considered as illustrative and indicative of the order of magnitude of values only. However, the organism group values are broadly compatible with the lower end of the derived consideration level (DCL) band for comparable organisms as proposed in the draft ICRP report. Whilst the ICRP values were derived by expert judgement, it is encouraging for both works that similar values have been derived using different approaches.

The conceptual difference between the types of screening value is that the generic value should *protect 95 % of all species* whereas the organism specific values should *protect 95 % of species within each organism group*. Application of a generic screening value may therefore not protect all groups to a 95% level.

An advantage of the SSD methodology is that it can be easily refined as more data become available, and targeted studies could be designed to provide data to enable SSDs to be constructed for organism groupings.

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Whilst using a screening value is helpful in identifying when further work is required (or not), an assessor can face a problem when a refined exposure assessment has been completed but the calculated dose rates remain above the screening value. In these circumstances, an assessor cannot easily state with confidence that there will be negligible, or no, impact on biota. Currently there is limited advice on what an assessor should do if the screening value is exceeded. A possible solution is a second, higher, benchmark which identifies, for example, when the risk of impact is 'significant' or 'severe'. This could aid decision making by highlighting where, on the scale of no effect to significant effect, the calculated dose rate is. During the PROTECT consultation it was not possible to reach consensus on the need for this second benchmark with arguments both supporting and objecting to this proposal. The PROTECT consortium recognises that further discussion about the need for this second higher level would be useful. However, it is outside of the scope of the PROTECT project to define such a level as this introduces value judgements and is predominantly a social and ethical decision. The PROTECT consortium suggests that there is a need for a wider discussion on the potential usefulness and application of a second higher benchmark value and the WP3 deliverable provided PROTECT's contribution to this debate. We also explored potential approaches which could be used to provide the scientific input to help determine such a level.

The concepts of the screening value proposed by PROTECT and the potential second higher benchmark value (if adopted in the future) can be seen to be broadly consistent with the framework for protection of humans. These concepts could be used within a framework for the protection of the environment which could be applied in parallel to that existing for human protection.

In summary WP3 recommends the following:

- The use of SSD methodology to derive, or inform the derivation of, numeric benchmarks values where sufficient data are available and that the derivation of any such numbers is clearly documented.
- The scientific community should perform targeted studies to enable SSD to be generated for required organism groups.
- The application of a generic screening value of $10 \mu\text{Gy h}^{-1}$ until sufficiently robust organism group values can be generated.
- The screening value should be applied to total incremental exposure (i.e. it is not a single source benchmark).
- That the concept, use and meaning of a potential second higher level benchmark value is discussed further by the wider community.
- There is a need for co-ordination of the studies required to further develop this area.

Outputs of the Workpackage were discussed with experts (including representatives of regulatory bodies, key international organisation, conservation agencies, industry and scientists, including ecotoxicologists, at the Oslo, Aix and Manchester workshops. Drafts of Deliverable 5 were made available for wider consultation in May, September and October 2008. Responses to comments received on the September draft were made available along with the October draft. The consultation process, comments received and responses of the PROTECT consortium have been documented in a separate annex to

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deliverable 5 (*Numerical benchmarks for protecting biota from radiation in the environment: record of the consultation process and views of independent experts*).

3. Consortium Management

This section includes activities relating to WP4. There have been no significant management problems; slight delays in some activities (as detailed elsewhere) had no negative impact on the production of deliverables and were rescheduled to allow time for additional consultation and more considered preparation.

Table 3.1 presents a revised project Gantt chart. The changes to those planned in the DoW are:

- Extension of WP1 information gathering to maximise questionnaire responses
- Extension of WP2 activity ‘Comparison of approaches for regulatory purposes’ to Month 24 as the Oslo workshop and the final meeting with international groups both gave valuable input into the final deliverable.
- Extension of tasks within WP3 to more logically fit to the due date of Deliverable 5.
- Changes in delivery dates of Deliverables 1, 4, 5 and 6 as discussed above.
- Revisions to workshop and meeting dates (see below).

Costs associated with the Co-ordinated action were slightly higher than anticipated for labour, largely as a result of the additional effort that the partners put in to following up the input from experts at the workshops. The meeting budget was slightly lower than anticipated even though more meetings were held than originally envisaged. The contribution of each partner to the management of the CA has been as followed:

CEH – project initiation, management and activity reports, website, newsletters, communication action plan, workshop organisation, interaction with international organisation and other relevant projects.

SSM – project initiation, contribution to management and activity reports.

EA – project initiation, contribution to management and activity reports, organise Chester and Manchester workshops.

NRPA – project initiation, contribution to management and activity reports, organise Oslo workshop.

IRSN – project initiation, contribution to management and activity reports, organise workshop in Aix.

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Table 3.1 Revised Gantt chart.

	Year 1												Year 2											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP 1 Environmental Protection Concepts																								
Gather information on regulatory approaches for chemicals and radioactive substances						W																		
Determine endpoints of protection, differences and similarities in approaches																								
Preparation of Deliverable 3													D3											
WP2 Assessment Approaches, Practicality, Relevance and Merits																								
Comparison of approaches for regulatory purposes									W															
Evaluation of numerical benchmarks																W								
Preparation of Deliverable 4																							D4	
WP3 Requirements for Protection of the Environment from Ionising Radiation																								
Interaction with WP1 to reach consensus on 'appropriate' protection level																								
Interaction with WP 2 on setting numerical benchmarks																								
Prepare draft Deliverable 5 Part B																								
Expert consultation																			W					W
Finalisation of Deliverable 5																							D5	
WP4 Management group																								
Preparation of annual & interim reports																								M
Produce deliverables required by reporting procedures				D1		D2																		D7/8
Monitor and manage project progress	M										M				M									W
Develop & maintain web site		D6																						

M = project management meetings; W – Workshops (expert consultation or joint with FUTURAE (month 23))
Changes to original scheduling are highlighted by red text and yellow cells (darker yellow for year 2).

3.1 Meeting and workshops

The planned meeting in January to discuss issue relating to WP2 was expanded to also allow initial discussions of suggested numerical benchmarks from WP3. This took place in Oslo on 28-30th January 2008 and was preceded and followed by a meeting of partners to discuss consortium issues. An expert workshop took place in Aix and was well attended by a range of different experts and international organisations (UNSCEAR, NEA, IAEA, DG TREN). Both meetings resulted in complimentary comments from participants. A final additional meeting took place in Manchester with ICRP, IAEA, EC DGTREN to Finalise D5 and to discuss final reporting. In addition to these scheduled meetings:

- EA and CEH had several bilateral meetings to discuss progress in WP2 and 3
- We collaborated with the IAEA Biota Working Group in evaluation of models in WP2
- CEH, SSI, EA and IRSN held a series of ‘telecom’ and video conferences to discuss derivation of predicted no effects dose rates (WP3)

Minutes from workshops and consortium meetings are in the public and consortium areas of the PROTECT website respectively.

Table 3.2 Places and revised timing of PROTECT consortium meetings.

Venue	Host	Month	Expert groups	Objective
Lancaster	CEH	Oct. 2006	No	Kick-off meeting
Chester	EA	March 2007	Regulators: nuclear & non-nuclear	WP1: Discuss regulatory approaches and requirements
Vienna	CEH	June 2007	Tool developers & users (including industry and regulators)	WP2: Define approaches available & agree evaluation exercises
Warrington	EA	August 2007	No	WP1 & WP3: Plan WP3 activities taking into account WP1 outputs
Oslo	NRPA	Jan. 2008	Tool developers & users (including industry and regulators)	WP2 (+WP3): Discuss outcomes & implications of evaluation exercises and initial ideas from WP3
Aix	IRSN	May 2008	Regulators, industry, NGOs, scientific experts, tool developers	WP3 (+WP2): Consultation with external experts & presentation of different approaches to wider audience
Bergen	NRPA	June 2008	n/a	Joint meeting with FUTURAE – was a short discussion rather than a formal meeting
Birmingham	EA	June 2008	No	WP3 meeting to finalise data selection for input into the calculations for the screening value(s).
Manchester	CEH	Sep. 2008	ICRP, IAEA & EC DGTREN	Finalise D5 and final reports. Discuss further actions with ICRP, IAEA, EC DGTREN

3.2 Co-operation with other programmes

The PROTECT project has been represented at IAEA EMRAS Biota Working Group workshops, the BIOPROTA project (<http://www.bioprotta.com/>) and the IAEA Co-ordinating Group on Radiation Protection of the Environment. In addition, representatives of the IAEA and the ICRP (Committee 5 or 4) attended the expert workshops; OECD-NEA attended one of the workshops. The workshops have also enabled significant interaction with groups in Europe, North America and Australia who are developing environmental radiation protection frameworks. Consultations (questionnaire and workshops) have included industry.

ICRP Committee 4 (C4) approached the IAEA EMRAS Biota Working Group (BWG) and the PROTECT consortium in November 2007 with a view to collaborating in the appraisal of the forthcoming report (*Environmental Protection: the Concept and Use of Reference Animals and Plants*) by ICRP Committee 5 (C5) which would contribute to the ICRPs intended framework for assessing the impact of ionising radiation on non-human species. As PROTECT project WP2 had an objective to assess the practicability of existing and developing approaches to radiological environmental assessment including any outputs of the ICRP it was agreed that PROTECT WP2 would try to assist ICRP C4. It was decided to take this forward further at the PROTECT Oslo workshop, which would be attended by a number of members of the BWG, organised for January 2008 at which stage the ICRP C5 draft report would be available. PROTECT produced a draft submission to ICRP C4 for their meeting in late summer 2008 and the final version (Coppelstone D., Brown J.E. and Beresford N.A. *Input by PROTECT to ICRP Committee 4 – Application of Draft 4a of the ICRP report on Environmental Protection: the Concept and Use of Reference Animals and Plants*) was produced in November 2008 as an Appendix to Deliverable 4. The outcome of the collaboration has been well received by the Main Commission of the ICRP and the PROTECT appendix will be included in the working party report to Committee 4.

PROTECT has maintained an interaction with the FUTURAE project and have input into the forthcoming FUTURAE deliverable 3 (*Rationalising radioecological capacity with requirements*).

The final expert consultation meeting with the ICRP, IAEA, EC DGTREN was invaluable in allowing time for detailed discussions of the outputs of WP3 and 2 and the resulting deliverables were substantially amended and improved. The meeting allowed the participants to consider the usefulness of PROTECT outputs for each international organisation and ensured that they had ample opportunity to provide comments on the final drafts and also that they were fully aware of the conclusions of the CA.

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Annex 1. Plan for using and disseminating knowledge

A.1 Promoting PROTECT

The PROTECT project will rely on a number of activities to promote the progress and disseminate its outputs. These are summarised in Table A.1.

Table A1.1 Overview of the PROTECT Projects communication activities

Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible	Partners involved	Description
Nov.2006 (launch)	Website	Public; Research; Industry;	All	n/a	CEH	All	<i>Website with project description, all project outputs, draft discussion documents & tutorials, workshop reports and presentations and links to other relevant websites(radiological and chemical)</i>
Nov. 2006	Leaflet	Research; Industry; NGO's	All	>200	EA&CEH	All	<i>PROTECT project overview</i>
As appropriate	E-newsletter	All interested parties	All	>160 (email list) & placed on website	CEH	All	<i>Updates on the PROTECT project, notification of consultations etc.</i>
As appropriate	Questionnaire	Industry; stakeholders; NGO's	EU member states, USA, Canada, Australia, Russia, Norway, Switzerland	c.100	EA	All	<i>Questionnaire to elicit views on protection of the environment</i>
March 2007 - May 2008	Workshops (n=4)	Industry; Regulators; NGO's;	Most EU member states, Norway, Russia, USA,	c. 80	All partners	All	<i>Consultations during the course of PROTECT as specified in the DoW</i>

As appropriate	Journals	Research community Research; Regulators; NGO's	Canada, Australia, international bodies n/a	n/a	All partners	All	<i>To publish the outputs of PROTECT in the peer reviewed literature. Two papers in press in Radioprotection; 1 invited paper submitted to J. Environ Radioact.; 4 papers to be submitted to J. Radiological Protection. UK COGER (April 2007 /2008); Royal Society of Chemistry meeting on Future Energy (Sept. 2007); SETAC, UK annual general (Sept. 2008)</i>
As appropriate	Conferences & Posters	Research; Regulators; NGO's	n/a	n/a	All partners	All	<i>WPs 1,2,& 3 have each presented oral papers at the 2008 International Conference on Radioecology and Environmental Radioactivity IAEA EMRAS Biota Working Group – presentation and updates of PROTECT & participation of PROTECT in BWG activities IAEA Co-ordinating Group on Radiation Protection of the Environment – PROTECT co-ordinator participates BIOPROTA – Industry supported group considering issues on waste repositories</i>
As appropriate	Interaction with other programmes	Industry; Regulators; NGO's; Research community	All	c. 100	CEH	All	

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Sept 2008	Meeting to discuss Deliverable 5	Major international relevant groups:	IAEA, ICRP, EC DG TREN	3	All partners	All	<i>ICRP Committee 5 – members of C5 attend PROTECT workshops</i> <i>FUTURAE project –provide input with regard to future radioecological priorities</i> <i>IUR Task Group on Waste</i> <i>Discuss conclusions and how to take the outputs forward in the international domain</i>
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Dissemination level: PU

Date of issue of this report: 1/03/09

A.2 Publishable results

Beresford, N.A., Beaugelin-Seiller, K., Brown, J.E., Copplestone, D., Hosseini, A., Andersson, P., Howard, B.J. Protection of the environment from ionising radiation in a regulatory context (PROTECT): assessment approaches - practicality, relevance and merits. *Radioprotection*; In press.

Copplestone, D., Andersson, P., Beresford, N.A., Brown, J.E., Dysvik, S., Garnier-Laplace, J.L., Hingston, J., Howard, B. J., Oughton, D., Whitehouse, P. Protection of the environment from ionising radiation in a regulatory context (PROTECT): Review of current regulatory approaches to both chemicals and radioactive substances. *Radioprotection*; In press.

Copplestone D., Brown J.E., Beresford N.A. 2008. Input by PROTECT to ICRP Committee 4 - Application of Draft 4a of the ICRP report on Environmental Protection: the Concept and Use of Reference Animals and Plants. Submitted to International Commission on Radiological Protections Committee 4 (November 2008) (also included in PROTECT D4 as appendix).

Andersson, P., Garnier-Laplace, J., Beresford, N.A., Brown, J.E., Copplestone, D., Hingston, J.L., Howard, B.J. Howe, P., Oughton, D., Whitehouse, P. submitted. Protection of the environment from ionising radiation in a regulatory context (protect): proposed numerical benchmark values. *J. Environ. Radioact.*

Beresford, N.A., Beauglin-Seiller, K., Brown, J.E., Copplestone, D., Hosseini, A., Howard, B.J. 2008. Protection of the environment from ionising radiation in a regulatory context (PROTECT): assessment approaches – practicality, relevance and merits. In proceedings: International conference on Radioecology & environmental radioactivity. Oral & oral poster presentations. Part 2 (Eds. Strand, P., Brown J.E., Jølle, T.) 20-23.

Anderson P., Garnier-Laplace, J., Beresford, N.A., Brown, J.E., Copplestone D., Hingston, J.L., Howard, B.J., Howe, P., Oughton, D., Whitehouse, P. 2008. Protection of the environment from ionising radiation in a regulatory context (PROTECT): proposed numeric benchmark values. In proceedings: International conference on Radioecology & environmental radioactivity. Oral & oral poster presentations. Part 2 (Eds. Strand, P. Brown J.E., Jølle, T.) 24-27.

Copplestone, D. Beresford, N.A., Brown, J.E, Garnier-Laplace, J., Hingston, J.L., Howard, B.J., Anderson P., Whitehouse, P. 2008. Protection of the environment from ionising radiation in a regulatory context (PROTECT): review of current regulatory approaches to both chemicals and radioactive substances. In proceedings: International conference on Radioecology & environmental radioactivity. Oral & oral poster presentations. Part 2 (Eds. Strand, P. Brown J.E. Jølle, T.) 469-472.

Howard, B.J., Beresford, N.A., Barnett, C.L., Copplestone, D., Hingston, J., Andersson, P., Brown, J.E., Garnier-Laplace, J. 2007. PROTECT: Protection of the Environment from Ionising Radiation in a Regulatory Context Poster presented at Co-ordinating group on Environmental radioactivity (COGER) 26th Open meeting, 17th-19th April. Loughborough University.

Andersson P., Garnier-Laplace J., Beresford N.A., Brown J.E., Copplestone D., Hingston J.L., Howard B.J., Howe P., Oughton D., Whitehouse P. 2008. Setting environmental numerical benchmark values for radiological protection of the environment. Paper presented at Co-ordinating group on Environmental radioactivity (COGER) 27th Open meeting. 7-9 April 2008. University of Nottingham.