
HPA Peer Review of SPRG web based calculator

Dr T W Charnock

ABSTRACT

As a foreign national I am not familiar with the US regulatory framework, and therefore I have not gone into depth on how appropriate the tool is with regard to that framework. Instead I have concentrated on the usability of the calculator and the underlying science and methodology.

I have tried to address each item in the Peer review Charge, although there is some overlap between the items. Charge questions are given in ***bold italics***.

This work was undertaken under the Environmental Assessment Department's Quality Management System, which has been approved by Lloyd's Register Quality Assurance to the Quality Management Standards ISO 9001:2000 and TickIT Guide Issue 5, certificate number 956546.

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As a foreign national I am not familiar with the US regulatory framework and therefore I have not gone into detail on how appropriate the tool is with regard to that framework. Instead I have concentrated on the usability of the calculator and the underlying science and methodology. I have tried to address each item in the Peer review Change, although there is some overlap between the items. Change questions are given in bold italics.

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The report from EPA Radiation Protection Division reflects understanding and evaluation of the current scientific evidence as presented and collected in the literature.

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A. Overall Website

A1 *Is the website clearly organised, described and generally 'user friendly'? If not what do you recommend?*

The site is reasonably clearly organised. The first page clearly explains the purpose of the site and how it meshes with the regulations and advice it is intended to support. For a newcomer to the site it is important that this first page is read thoroughly. A very minor complaint is that the site does not do enough to guide newcomers through the appropriate subsequent sequence of pages. Along the tabs at the top of the next page following the home page is the SPRG calculator itself (slightly confusingly called SPRG search), but it is more important for a new user to read the User's guide before using the calculator. A page especially designed for new users might help guide users through the website.

A few minor technical issues with the website were identified as follows in no particular order:

- a No matter how wide the screen is made, a small part of the contents is always cut off at the left or the right (see Figure 1).
- b Often the site loads very slowly and without formatting.

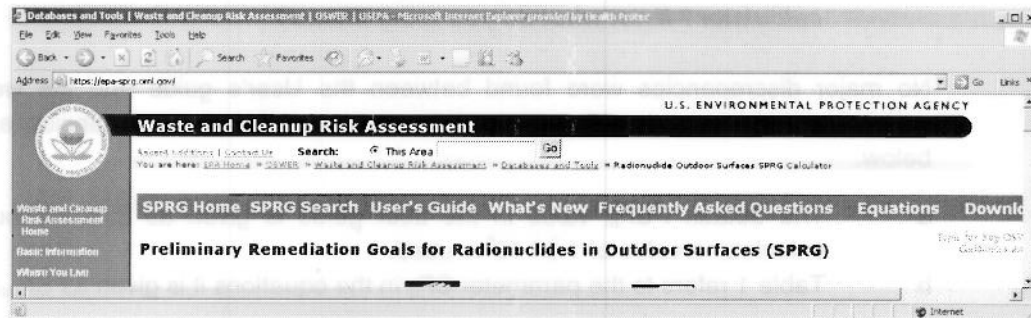


Figure 1 Screen shot of SPRG calculator home-page viewed with Microsoft Internet Explorer 6. The window is as wide a possible but the text still hangs off the edge.

A2 *Have the objectives of the SPRG calculator, as stated in the documentation, been realised? If not what do you recommend?*

The following objectives were identified in the User's guide and the website:

"This web calculator is intended to be a generic steady-state screening assessment tool".

"The calculator is flexible and may also be used to derive site specific risk assessments".

"The intent of this calculator is to address hard outside surfaces such as building slabs, outside building walls, sidewalks and roads."

"The purpose of this recommended SPRG calculation tool is to assist risk assessors, remedial project managers, and others involved with risk assessment and decision-making at sites with contaminated outdoor hard surfaces such as buildings, slabs, outside building walls, sidewalk and roads."

Generally these objectives have been met. However, there are some choices for wording, particularly in the User's guide, that suggest that the objective is to state policy and provide recommendations, rather than to be a tool that implements the policy and recommendations. For example, under "Disclaimer" in the User's Guide is the phrase "This guidance document sets forth recommended approaches based on EPA's best thinking..." Is it true that the objective is for the EPA to put forward its recommendations in this document or have the recommendations been made elsewhere? Could it be better worded as follows: "This guidance document is based on approaches recommended by EPA (citation)..."?

Similarly, also under "Disclaimer" in the User's guide, the sentence "The policies set out in the Radionuclide SPRG User's guide provide guidance to EPA staff" can be found. Again is it true that the policies are set out in the Guide or are they set out elsewhere?

A3 Does the documentation (User's guide) match the SPRG search calculator? If not what do you recommend?

No major discrepancies were found between the User's guide and the website in general and the search calculator tool in particular. Trivial discrepancies are listed below.

- a The default PEF_m value in the user guide is given as $3.05 \cdot 10^7$ but in the calculator a value of $1.34 \cdot 10^5$ is used.
- b Table 1 refers to the parameter SF_i , in the equations it is given as SF_{inh}

A4 Do you have any recommendations to improve the usability of the website?

In no particular order, my recommendations are listed below.

- a It would be useful if site specific parameters could be saved to a file and uploaded at a later date. This would reduce the time taken and the possibility of errors when typing and retyping in parameters (eg when exploring the sensitivity of parameters) and facilitate archiving and sharing work between organisations.
- b The site specific parameter web page displays the input fields in an arbitrary order, which is a little confusing. Perhaps they could be grouped by pathway or by adult and child inputs.

0.5	FTSS _s (fraction transferred surface to skin - hard surface) unitless	4	ET _{h,c} (exposure time - child hard surface) hours/day
0.5	SE (saliva extraction factor) unitless	30	ED _c (exposure duration - child resident) years
15	SA _c (surface area of fingers - child) cm ²	9.5	FQ _c (frequency of hand to mouth - child) events/hour
4	ET _{h,a} (exposure time - adult hard surface) hours/day	45	SA _a (surface area of fingers - adult) cm ²
0	ED _a (exposure duration - adult resident) years	20	HR _a (inhalation rate - adult) m ³ /day
1	FQ _a (frequency of hand to mouth - adult) events/hour	10	HR _c (inhalation rate - child) m ³ /day

- c There are two fields labelled “Q/C_{wind}” on the *site* specific input form. On the *State* specific input form there is one field labelled “Q/C_{wind}” which should probably be “Q/C_{mechanical}”.

B. User's guide

B1 Is the tool and the website clearly explained?

There are some editorial problems with the User's guide as discussed below. Generally it feels imbalanced as it is very thorough regarding the underlying models and assumptions but weaker on the practicalities of using the website and the process and pitfalls of developing a site conceptual model. Generally it lacks an overview that would be particularly useful to new users.

B1a Are the assumptions clear and reasonable? If not what do you recommend?

The User's guide describes the underlying models and methodology thoroughly and apart from one or two minor issues (discussed below) it is generally clear regarding the assumptions behind the models and the parameters, with adequate links and citations to the source material.

B1b Does it adequately describe its limitations?

Generally the user guide provides adequate explanation about the models and the underlying science and information about their limitations. The developers should consider bringing this material together within a single section.

B1c Is it well written and clearly organized? If not what do you recommend?

The User's guide contains a lot of useful information, particularly about the underlying models and the derivation of SPRGs, but it is not well structured and sections generally begin with in-depth methodological detail but do not give sufficient overview. For example, Section 2 “Understanding the SPRG website” does not explain the website but concentrates on slope factors and the derivation of SPRGs. Another example is that the option for calculating State specific SPRGs is never acknowledged or specifically explained (although it is referred to obliquely in Section 4.3.10). I recommend that the developers reconsider the structure of the User's guide and the titles of the sections and subsections. They should consider adding a section on navigating and using the website and on the use and options of the SPRG search tool. At various points the guide discusses the appropriate way to use the calculator and the SPRG. These considerations are very important and the developers should consider bringing all these together in a single section, possibly with a worked example of how to develop a conceptual site model and apply the calculator to it.

Specific issues about the User's guide are listed below in no particular order

- a There is no table of contents.
- b Tables are labelled erratically; there are several items that look like tables and Table 1 is the fifth or sixth.
- c Abbreviations are used inconsistently. For example, some abbreviations are introduced before they are defined (PEF, RI), some are never defined (eg ADTV, HEAST, CERCLA, FS) and some are continually defined (COPC).
- d For each of the important parameters it would help to summarise what the effect of changing the parameter is on the SPRG (eg increasing SLF will tend to decrease both $SPRG_w$ and $SPRG_m$) and also to give a range of reasonable values if possible.
- e The developers should consider whether it is necessary to include separate external exposure equations for each depth; apart from different slope factors the equations are identical.
- f In Table 1, exposure time parameters are given under the "Ingestion rate variables" heading.

B1d Is the technical support documentation complete, well organized and easy to follow?

The technical support documentation is very complete, and contains many links to supporting information. It contains enough information for equations to be replicated independently. However, it is unstructured and the parameters could be grouped into more logical sections by pathway.

Specific issues about the technical support documentation in the user guide are listed below

- a Most subsections that describe parameters of the models include the parameter abbreviation; however Section 4.3.10 "Silt Loading Factor" and Section 4.3.11 "Area Correction Factor" do not.
- b It is not clear why slope factors are discussed in Section 2.2 and not in the technical support document.
- c It is not clear what the distinction is between Sections 4.4, "Supporting equations", and Section 4.5 "Equation details", or why Section 4.5 comes after the references.
- d In Table 1 a wind driven PEF_w is given for Minneapolis and a mechanical PEF_m is given for Phoenix. This is the first mention in the User's guide of these cities and there needs to be an explanation of their significance; presumably they are defaults. However the values of the PEF_m for Phoenix given in the User's guide ($3.05 \cdot 10^7$) is not the same as that used by the calculator ($1.34 \cdot 10^5$).
- e It is not explicit how the dose from the external exposure pathway calculated in Section 4.5.1 relates back to the risk and slope factors.
- f It is not clear what the difference between tr and EDR is. However the calculator ensures that they are the same.
- g It is not clear from the wording of external exposure equations whether the contamination is at 1, 5, 15 or 30 cm or infinite depth, or whether the material

is uniformly contaminated to depths of 1, 5, 15, 30 cm or infinite depth. Presumably the latter assumption is the correct one.

B2 Are the sources/citations appropriate and do they represent the current state of knowledge? If not what do you recommend?

This appears to be the case. The full Eckerman and Ryman 1993 citation is not given but it is a familiar work.

B3 Are the models comprehensive, accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations?

B3a Residential exposure

Yes.

B3b Worker exposure

Yes.

B3c Children's exposure

The calculator does not treat children separately from adults. This seems to be in accordance with the EPA advice and recommendations and therefore it is not a weakness of the calculator. The slope factors from the HEAST data are age averaged and cannot be changed in the calculator. A situation can be identified in which using age specific information could make a difference to the SPRG (see Section B8b below in this document), but this is an artificial situation and is probably not a typical application.

B3d Conceptual two and three-dimensional

Yes.

B4 Are the equations comprehensive, accurate and do they represent the current state of knowledge? Are they supported appropriately by citations or derivations? If not, what do you recommend?

B4a Residential exposure

Yes.

B4b Worker exposure

Yes.

B4c Conceptual two and three-dimensional

Yes.

B4d Are the equation variables adequately explained in terms of relative sensitivities?

Generally the relative sensitivities of parameters are not discussed in the User's guide. For parameters such as exposure time ET, fraction transferred from surface to skin (FTSS), frequency of hand to mouth (FQ) and saliva extraction factor (SE), it is probably unnecessary as it is fairly intuitive.

For the dissipation rate constant (k), the User's guide does give some discussion of sensitivity (see also Section B8e).

For the silt loading factor (SLF), the sensitivity is not discussed but it is fairly clear that a higher SLF will lead to lower SPRGs. However a line in the User's Guide: "the default of 0.015 (g/m²) was chosen, with California interstate ADTV, for this calculator as a conservative value suitable for producing default SPRGs" is counter-intuitive because 0.015 (g/m²) is the lowest value in Table 2 and therefore not conservative. The statement is correct for mechanical resuspension because it is the corresponding Californian ADTV data (with high traffic volumes) that make the resultant SPRG conservative. It is not correct for wind driven resuspension which does not use traffic information; in this case the SLF for a country road with a higher SLF would give a more conservative SPRG.

Particle emission factor wind (PEF_w) and Particle emission factor mechanical (PEF_m) are fairly complex parameters and generally I found the explanation confusing (Section 4.4.2 of the User's guide). The section does not give a discussion about the relative sensitivity of the parameters. The developers should consider whether an in-depth discussion of PEF is appropriate or whether it is sufficient to cite the relevant material. Discussion of sensitivity should concentrate on the input parameters such as silt loading factor (SLF) and traffic factors that can be easily understood by the user (eg a heavier traffic regime is likely to lead to a lower SPRG when considering mechanically driven resuspension).

B4e Are the equation constants adequately explained and sourced?

Generally yes; deficiencies are as discussed in Section B4d above because I haven't distinguished between constants and variables.

B5 Are the toxicological and exposure data comprehensive, appropriate, accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? Are they appropriate for residential and worker exposures?

Toxicological data are taken from the HEAST which appears comprehensive and appropriate and adequately explained. It is beyond my capability to comprehensively test individual values.

B6 Are the assumptions and data for children's exposure reasonable and supportable?

The assumptions and parameters for children appear reasonable and are well supported by citations. There is of course a lot of variability and uncertainty in these parameters (particularly those concerned with ingestion; SA, FQ, SE, and FTSS; and with exposure time ET and EF) and presumably they are chosen to be conservative. The User's guide should discuss this uncertainty and caution against excessive tinkering with these values without a very good reason.

B7 Are the exposure parameters and default values appropriate and based on supportable reasoning?

Exposure parameters and default values seem appropriate and all have citations that can be followed up, most citations are EPA documents that appear current. I was unable to see how the default values for the parameters ET_{or} (1.752 hr/day) and ET_{ir} (16.4 hr/day) were derived from the source material which gives mean values of 154.03 min/day (2.57 hr/day) and 1001.39 min/day (16.68 hr/day) respectively.

A few questions that could be addressed in the User's guide are listed below.

- a Why are the adult and child inhalation rates taken from one document and the worker inhalation rates from another?
- b The citation given for the worker breathing rate recommends 1.3 m³/hr, but the value chosen for the calculator default is 2.5m³/hr, the heavy work value. The justification needs to be included in the User's guide, presumably it was chosen as it is the most conservative?

B8 SPRG for settled dust

B8a Were appropriate exposure input parameters selected and logically supported to developed risk-based criteria?

See Section B7 above. Also note that the citation for EPA 1999b is not included in the reference list.

B8b Are children adequately protected by the risk based criteria as developed?

Generally children are protected by the approach. However, the use of slope factors that are not age specific may be of concern for short-lived radionuclides which, because of the rapid decay, have a relatively short exposure period. In these situations it could be argued that an age specific SF might be more appropriate. For example, for radionuclide ²¹⁰Po, the difference in dose coefficients (Sv/Bq) for adults and children for both inhalation and ingestion is about a factor of 4 (see ICRP publication 72). However a short-lived radionuclide that is not in equilibrium with the parent is a situation that users are not likely to encounter when dealing with historic sites.

Similarly, it is possible that inhalation or ingestion rates averaged over age groups may be inappropriate for a short lived radionuclide, where the exposure is over a relatively

short time. In these cases it may be more appropriate to use the more extreme behaviour of a single age group (eg the mouthing rate of a baby or the inhalation rate of an adult) than an averaged behaviour. By suitable adjustment of the inputs the calculator is able to account for this so it merely requires noting in the User's guide as an issue for the user to consider. As an example, I did a site specific calculation and adjusted the inputs to make the ingestion pathway dominant (by assuming an interstate silt loading factor, a rural local road level of traffic and a climate zone based on Minneapolis). In this calculation, if I used the default exposures times of 24 years as an adult and 6 years as a child (30 years in total), I calculated a $SPRG_w$ of $6.19 \cdot 10^{-2}$ pCi/cm² and a $SPRG_m$ of $1.95 \cdot 10^{-2}$ pCi/cm². When I assumed 6 years of child exposure the calculator gives a lower $SPRG_w$ of $3.95 \cdot 10^{-2}$ pCi/cm² and $SPRG_m$ of $7.13 \cdot 10^{-3}$ pCi/cm². The difference of about a factor of two is due to the higher mouthing rate of the infant. Again this is a situation unlikely to be encountered at historic sites.

B8c Is the use of the external ground plane slope factor appropriate?

The use of external ground plane slope factors is appropriate for this kind of tool.

B8d Is the use of mechanical resuspension approach appropriate?

It is very appropriate to represent mechanical as well as wind driven resuspension. The approach was not one I am familiar with. However the use of a model apparently derived for unpaved roads is probably conservative, although the User's guide could include more justification for the use of this particular model.

B8e Is the use of the dissipation rate appropriate? Including a default input parameter of 0?

The ability to have a dissipation rate in the equation is important to allow the calculator to be applicable for situations where dissipation is significant. Assuming no dissipation is the most conservative option and therefore it is appropriate to set the default as zero. Establishing an appropriate dissipation rate would be difficult. Even direct measurement would be difficult as different hard surfaces may dissipate at different rates, because of traffic exposure, weather exposure, material etc. Andersson et al (2002)¹ give retention half-lives for various surfaces between 120 days for roads and up to 50 years for roofs.

The User's guide rightly cautions the user to be careful in setting an appropriate dissipation rate. But it should also note that the dissipation rate following clean-up could be less than before because the clean-up operations may remove the more readily removed material. Researchers frequently represent retention on half surfaces as double exponentials representing a more easily and less easily removed fractions of the contamination and therefore measured rates should also be treated with caution.

B8f Is the settled dust portion of the SPRG calculator reasonably consistent with other relevant EPA superfund guidance? Are there aspects of other superfund guidance which should have been used or incorporated into the calculator?

This appears to be the case, but my experience is limited in this area.

¹ Andersson KG, Roed J and Fogh CL (2002). Weathering of radiocaesium contamination on urban streets, walls and roofs. *J Environ Radioact*, **62**, 49-60

B9 SPRGs for 3-D external exposure**B9a Were appropriate exposure input parameters selected and logically supported to develop risk-based criteria?**

See Section B7.

B9b Are children adequately protected by the risk-based criteria as developed?

Children appear adequately protected by the default parameters chosen. It could be argued that children are likely to spend more time outdoors than adults. However, given that the default indoor location factor does not reduce the exposure by much, this is not an issue (see Section B9c below).

B9c Is the adjusted rate in(side?) for using the external slope factor on a contaminated urban street appropriate?

The calculator uses a factor of 0.4 to adjust dose rates to account for the shielding when indoors. As a default I would use a value of 0.1. However UK houses are generally of brick construction and so a value of 0.4 might be more appropriate for houses constructed with more lightweight material. The COSYMA code (CEC 1991)² uses a value of 0.5 for lightly constructed houses.

B9d Is the use of various (eg, ground plane, 1cm 5 cm and 15 cm) external slope factors appropriate)?

It is appropriate to use different slope factors to allow the user to consider different situations and I consider the range of options provided to be sufficient. The User's guide could perhaps give some example situations and state which SF would be appropriate.

It was not clear to me how the SF contamination at depth had been derived. The reference FGR 13 is not given in the reference list.

B9e Is the 3-D external portion of the SPRG calculator reasonably consistent with other relevant EPA superfund guidance? Are there aspects of other superfund guidance which should have been used or incorporated into the calculator?

This portion appears consistent; however I am not familiar with the EPA superfund guidance.

B10 SPRGs for 2-D external**B10a Were appropriate exposure input parameters selected and logically supported to develop risk-based criteria?**

See Section B7.

B10b Are children adequately protected by the risk-based criteria as developed?

See Section B9b above.

² CEC (1991). COSYMA: A New Programme Package for Accident Consequence Assessment. EUR 13028 EN. CEC, Brussels

B10c *is the adjusted rate in(side?) for using the external slope factor on a contaminated slab?*

See Section B9c above.

B10d *Is the use of various (eg, ground plane, 1cm 5 cm and 15 cm) external slope factors appropriate)?*

See Section B9d above.

B11 *Are the standard recommended default factors adequately explained, sourced and recommended?*

See Section B9d above.

B12 *Are the radionuclides appropriate?*

See Section C5.

B13 *Is there anything else you recommend for the User's guide to improve its stated purpose?*

No.

C. Calculator

C1 *Are the results clearly explained and presented?*

The results 'page' is adequately clear given that a large amount of information is being presented.

C2 *Are the results appropriately described and qualified?*

On its own the results 'page' does not provide the guidance needed to ensure that the users interpret and use the results correctly. However, there is sufficient information in the User's guide (once the editorial issues identified in Section B are addressed). Perhaps the results 'page' should refer the user to the User's guide.

C3 Do the results provide a defensible explanation of how they were derived or are they the result of a black box?

The results page lists all the inputs to the models and provides links to the equations; it is therefore not a black box. I performed a hand calculation on the residential dust model and was able to replicate the results.

C4 is the 2-D external portion of the SPRG calculator reasonably consistent with other Superfund guidance? Are there aspects of the other superfund guidance which should have been used or incorporated into the calculator?

This portion appears consistent; however I am not familiar with the EPA superfund guidance.

C5 Are the radionuclides appropriate and do the results adequately explain the variability among radionuclides?

Yes, the calculator provides a very comprehensive list of radionuclides with and without contributions from significant daughters.

D. Anything else

D1 Is there anything else you would recommend to improve SPRG's utility, accuracy, or supportability?

No.

E. Summary

Generally the website SPRG calculator is fit for use. A number of minor points were identified in Section A but none that would prevent its immediate use.

The User's guide needs editorial work (see Section B). The developers need to consider the structure and provide more guidance to the user on using the calculator and developing a site specific model. A worked example might facilitate this.

Curriculum Vitae

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I joined the National Radiological Protection Board (NRPB; now the Radiological Protection Division of Health Protection Agency) in 1997 from University.

Currently I am a Senior Scientific Officer in the Recovery Group of the Environmental Assessments Departments of the Radiological Protection Division of the Health Protection Agency (HPA). I develop models and advice particularly focusing on the remediation phase following a radiological incident.

I am a member of the Urban Remediation Working Group of the International Atomic Energy Agency (IAEA) Environmental Models for Radiation Safety (EMRAS) programme and of the UK Home Office Tolerability of Residual Radiological Hazards Working Group. I am also a collaborator in the European Community 6th Framework EURANOS consortium project.

Qualifications:

PhD; GIS linked environmental process models, Aston University 1997.

MSc; Information technology (Environmental Information Systems) Distinction, Keele University 1993.

BSc; 2.1 Hons, Environmental Sciences, Southampton University 1991.

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Peer Reviewer Conflict of Interest Certification

Peer Review: Preliminary Remediation Goals for Radionuclides in Outdoor Surfaces (SPRG)

A conflict of interest or lack of impartiality exists when the proposed peer reviewer personally (or the peer reviewer's immediate family), or his or her employer, has financial interests that may be affected by the results of the peer review; or may provide an unfair competitive advantage to the peer reviewer (or employer); or if the peer reviewer's objectivity in performing the peer review may be impaired due to other factors. When the Peer Reviewer knows that a reasonable person with knowledge of the facts may question the peer reviewer's impartiality or financial involvement, an apparent lack of impartiality or conflict of interest exists.

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Tom Charnock
Signature Date

THOMAS WILLIAM CHARNOCK
Printed Name

HEALTH PROTECTION AGENCY
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Check here if any explanation is attached

* 'TOPIC' & 'ISSUE' are taken to refer to 'Preliminary remediation goals for radionuclides in outdoor surfaces (SPRG) Electronic Calculator' and not urban contamination in general.