A COLLABORATIVE WEB SITE FOR FACILITATING ENVIRONMENTAL PARAMETER COMMUNICATIONS*

D.J. LePoire, B.M. Biwer, J.J. Arnish, S. Kamboj, S.Y. Chen
Argonne National Laboratory, Argonne, Ill.

A. Wolbarst
National Institutes of Health, Bethesda, Md.

S. Domotor
U.S. Department of Energy, Washington, D.C.

R. Cady
U.S. Nuclear Regulatory Commission, Rockville, Md.

ABSTRACT

A database-driven web site allows access to information culled from priority references concerning environmental parameters for radiological risk assessment models. Users working on various radiologically contaminated sites are able to access a common database of known citable reports and papers to analyze potential hazards. The web site, the ISCORS Parameter Catalog (http://web.ead.anl.gov/iscors/home.cfm), was constructed so that it could be easily expanded by collecting information from the community, checking the data, and then allowing access to the whole community. The project was initiated by the Interagency Steering Committee on Radiation Standards -Cleanup Subcommittee (ISCORS-CU) to facilitate better informed risk analysis. Agencies involved include the Department of Energy (DOE), Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), and the Department of Defense (DOD).

INTRODUCTION

Environmental transport models are often used to estimate risks and demonstrate regulatory compliance at many of the thousands of sites in the United States that are contaminated with radioactivity, affecting millions of cubic meters of soil and other materials and posing health risks to many [1]. Radioactive contamination has been of public and governmental concern, and over the past few decades, federal and state regulatory agencies have prepared guidance and regulations for the remediation of such sites, for example, U.S. Environmental Protection Agency (EPA) guidance for CERCLA (Superfund) sites [2]; U.S. Nuclear Regulatory Commission (NRC) guidance for licensed facilities under License Termination Rule of 10 CFR 20, Supplement E [3]; U.S. Department of Energy (DOE) guidance for the nuclear

weapons complex [4]; U.S. Department of Defense (DOD) guidance on its own environmental remediation [5]; and a variety of state programs [6].

These environmental risk assessment models rely on information concerning many site-specific parameters. Generally, direct measurement of all parameters is neither cost effective nor efficient. If the parameter might be affected by future events, a measured parameter value might not be sufficient. Partial information about site-specific parameters can be obtained from wider scope and context studies, e.g., regional precipitation, or based indirectly on observed parameters, e.g., soil structure. Often, partial information can be used to determine the relevance of a model parameter through sensitivity analysis.

If none of these techniques results in identifying a justifiable parameter value, uncertainty analysis can be performed; however, this requires an estimate of the probability distribution of the parameter. Often, partial quantitative and qualitative data can be combined to further refine the probability distribution, leading to better estimates of doses. For example, the distribution coefficient in soils for many radionuclides can vary over several orders of magnitude. To reduce the uncertainty, information concerning the site, including soil characteristics (type, pH) and chemical form, could be collected. This collected information could then be used in refining searches and in deriving better parameter estimates.

One common technique to identify parameter values and probability distributions is to search available public technical databases and search engines, such as Google, the DOE Information Bridge [7], the ISI Web of Knowledge [8], and bibliographic library database systems, however, these sources usually lack sufficient specificity and content to be of much use in environmental risk assessment.

APPROACH

Previous collaborative web sites, such as Argonne's NORM Technology Connection and TechCon sites, have been useful in providing detailed and semistructured communications on radiological waste management. The NORM Technology Connection site (http://www.iogcc.state.ok.us/norm/index.cfm) provides information concerning state and federal regulations and guidelines on the handling of naturally occurring radioactive material (NORM). The TechCon site collected and distributed various advanced techniques for tackling specific cleanup issues.

The sites are designed to support limited collaboration through use of a central database on a web server along with a web application script. Through the NORM Technology Connection web site, vendors can suggest services they can provide and the regions they cover. This information is forwarded electronically to the site manager, who reviews the information. If the information is approved, it is incorporated into the database for others to search.

The DOE Technology Connection (TechCon) was initiated to encourage the use of emerging and commercially available technologies for cleanup of contaminated sites. The TechCon site presents problem specifications and requirements for various sites. Potential vendors can submit, via the web site, case histories and proposed solutions for a contamination site. Again, the information is processed by the site manager and made available to stakeholders, including regulators and community leaders. After email and web-based communication, vendors and stakeholders meet face-to-face at a workshop.

The ISCORS Parameter Catalog web site uses this same type of interaction to support a growing resource for model parameters. Its growth depends on contributions, via the web site, of information concerning new parameter information, which is reviewed and approved by the site manager.

The ISCORS Parameter Catalog web site was designed to address questions such as:

- What information is available on groundwater transport parameters used in RESRAD?
- What information is available on distribution coefficients of uranium?
- Do the references support uncertainty analysis with a probability distribution?
- Were the measurement techniques discussed in the reference?
- What pathways use the "depth of roots" parameter in the RESRAD model?

Construction of the web site involved many steps: (1) designing the database structure; (2) implementing a Windows-based administrative application; (3) implementing an efficient web site structure supporting both structured and textual search strategies; (4) initiating the data collection; and (5) enabling the collaborative feature for user contributions. While the set of tasks might seem to be linear, explorations in each stage were conducted interactively as unforeseen needs were identified. More than 350 references have been added. The data, structure, and operation have been tested, and the web site is currently available to use in either search or collaborative submittal mode.

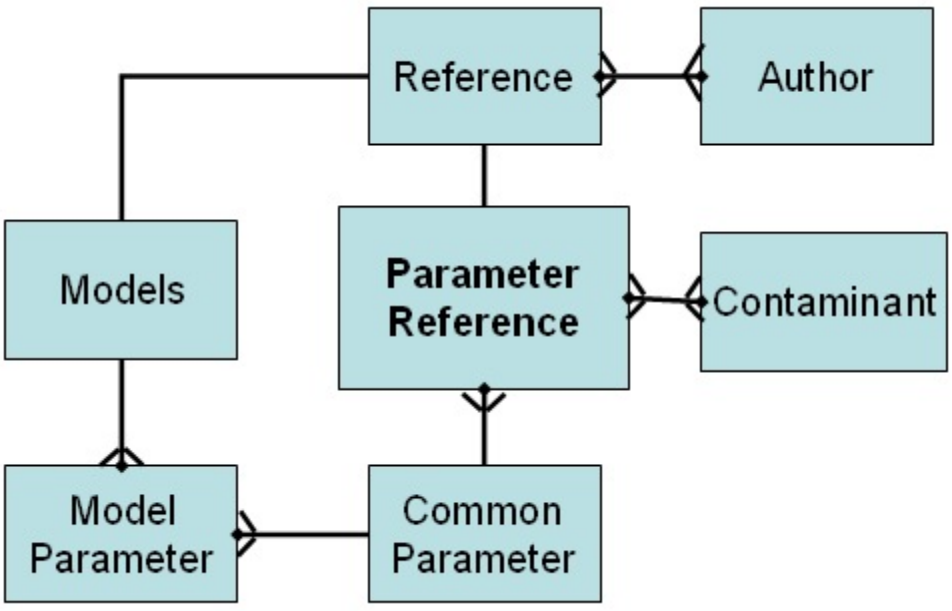

Fig. 1. Database structure for the web site.

The database structure was generalized for connecting common parameters, references, and models (Figure 1). Common parameters are defined and associated with specific uses in the various supported codes (RESRAD, DandD, EPA Radionuclide PRG calculator, and GENII2). These models contain more than five hundred model-specific parameters, but of these, only about one hundred are truly different, referred to as *common parameters*. Other models, RESRAD-BIOTA and RESRAD-OFFSITE, are in the process of being incorporated into the catalog. References such as a compendium might contain information about many parameters. The information collected might concern techniques, uncertainty discussion, and context evaluated (Figure 2). Where available, the reference's abstracts are displayed. The measured values or distributions are not directly accessible from the Web site; instead, biographical information or URLs for the primary publication are provided for the analysts to pursue. These models contain more than five hundred model-specific parameters, but of these, only about one hundred are truly different, referred to as *common parameters*.

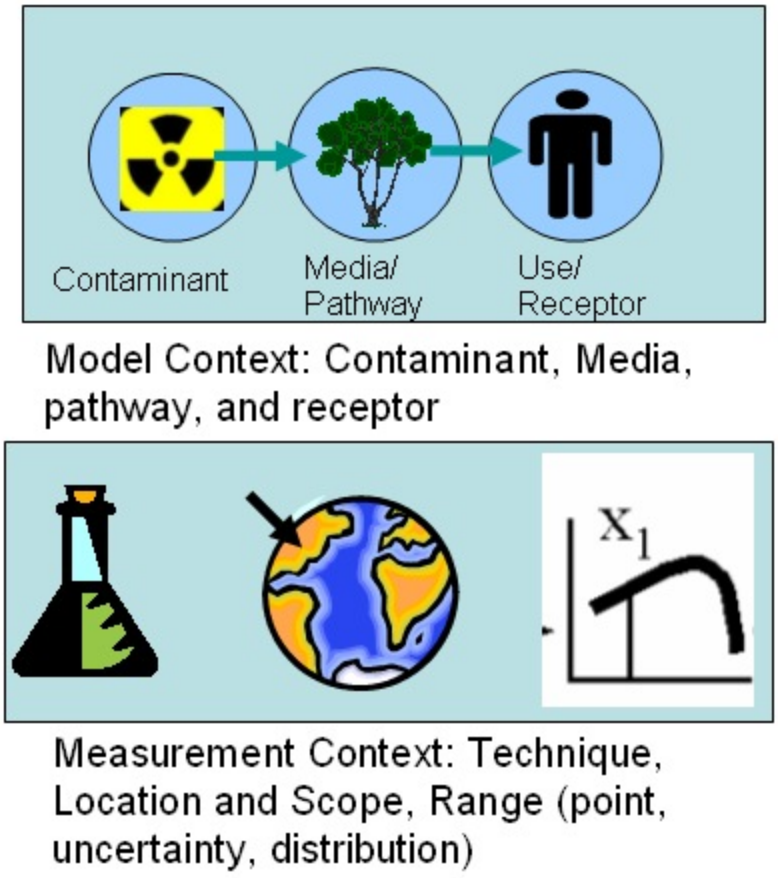

Fig. 2. Model and measurement contexts of the parameter information.

RESULTS

Data Collection

Data collection began with the identification, collection, and compilation of a representative sample of existing peer-reviewed papers, books, agency reports, and agency databases that present parameter values and distributions. While some of these are original publications in journals, others have been brought together in government and private/commercial sector compendia. These include public information sources from federal agencies, such as EPA's *Exposure Factors Handbook* [9], NRC's NUREG/CR-6697 [10], and DOE's DEPOT database [11].

It is intended that the database will grow, primarily through user submissions. Users can provide general bibliographic information to ISCORS about a reference for consideration by the web site managers, who will then enter the appropriate information into the *Catalog*. Or, users can submit proposed references to the web site managers via a mechanism that makes possible rapid entry of the complete reference information into the *Catalog* database, as discussed below. Following a QA check and approval, the submitted item is then automatically placed in the database and available to the user community.

Sample Search of the ISCORS Parameter Catalog

As an example that demonstrates the ease and simplicity of the search, Figure 3 displays the search process by either subject- or text- based criteria. Reference citations resulting from the search are displayed with author(s), title, and publication date. Choosing one of the reference citations displays the document information. Various interlinked data concerning the references, parameters, and models can then be accessed.

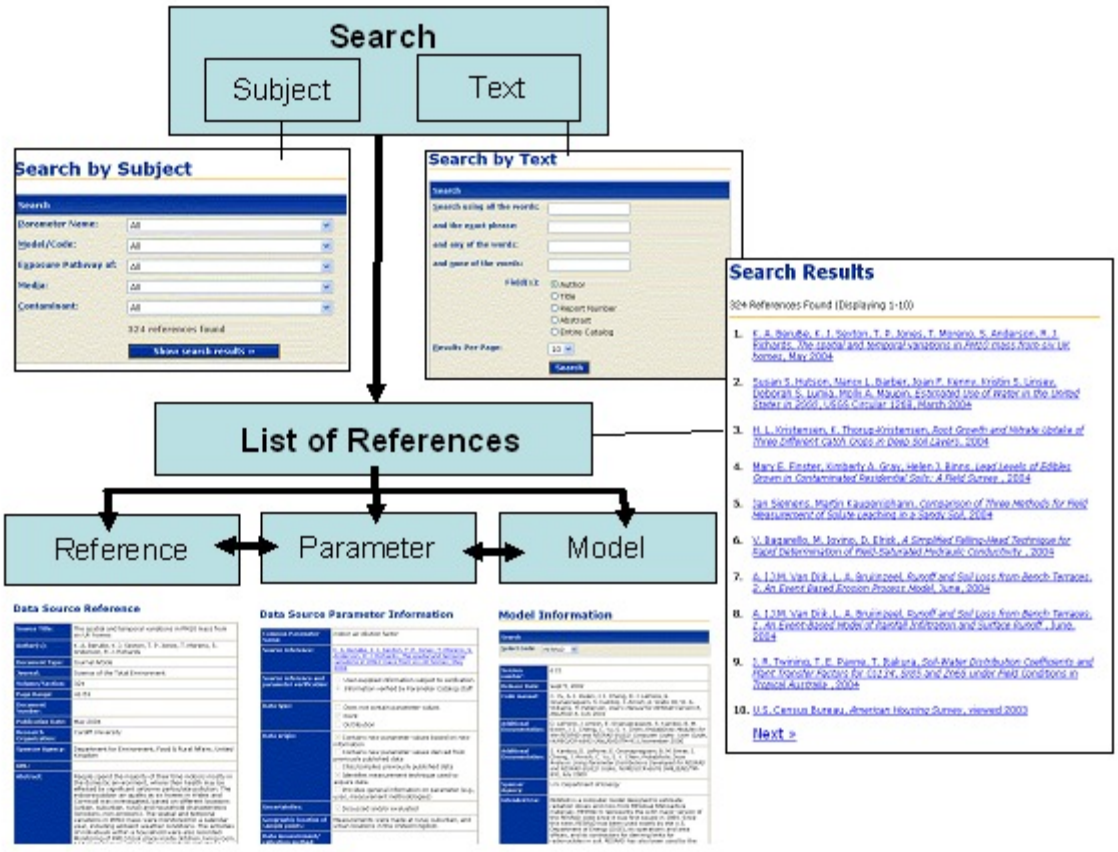

Fig. 3. Web site use from search, result list, and information details.

Input of Data on Source References by Users

When data sources are suggested by users, information is requested for each new reference submission (Figure 4) including pertinent bibliographic information. An alternate submission process (not shown) also allows for specification of parameter-relevant information within the new reference.

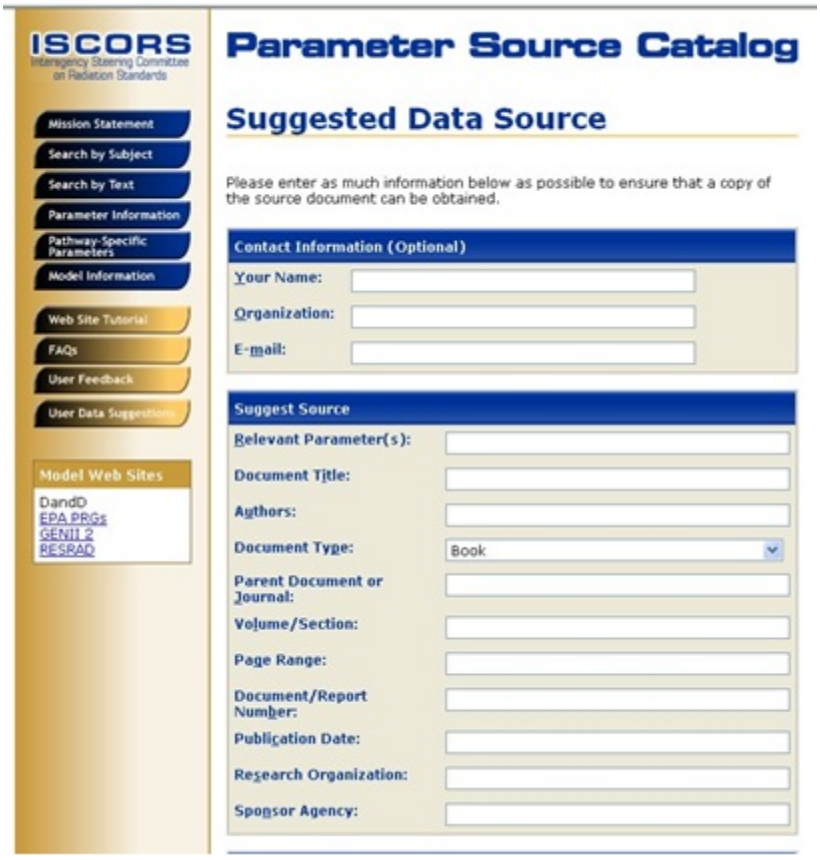

Fig. 4. Web site for members of the community to suggest new references.

Every reference suggested or submitted directly on-line to the database by a user is checked by the web-site managers to confirm the correctness of the citation information, before acceptance. Acceptance criteria include publication in a peer-reviewed technical journal, appearance in a formally-issued federal or state agency report, etc.

FURTHER CONSIDERATIONS

While the web site facilitates gathering parameter information, there are many issues still to be addressed by the environmental analyst such as parameter correlation, data aggregation, and uncertainty analysis not associated with parameters.

The correlation between pairs of parameters might be important when conducting probabilistic analysis. For example, in RESRAD, the distribution coefficients in multiple subsurface unsaturated layers are assumed to be independent. This condition might be true in some situations; however, in others, a different controlling variable, e.g., chemical form or soil type, might introduce some correlations between them. Since the distribution coefficient is often important and has a wide distribution, this potential correlation can make quite a difference.

While data can be gleaned from references, they do not specify how the user should construct a useful parameter value or probability distribution. The user might have multiple sets of

information, both quantitative and qualitative, that must be aggregated to form the basis for parameter selection.

While this web site might facilitate sharing and standardization of model parameter information for contamination specification, release, environmental transport, and potential exposure, there are many aspects of the risk process that are not addressed, such as the uncertainties in the end user scenario specification, dose from contaminants, health effects from dose, and potential medical intervention.

CONCLUSIONS

The success of the ISCORS Parameter Catalog web site depends on the user-community's participation in utilizing and expanding the reference base. The web site can also be extended in a number of ways. Other models could be added, including chemical risk models. Longer range extensions might include context-sensitive integrated accessibility through the software models to the parameter database. Further integration might include the ability to maintain the metadata (e.g., reference citation) from the database in the construction of the model's application documentation.

REFERENCES

[1] A.B. WOLBARST; P.F. BLOM; D. CHAN; R.N. CHERRY, JR; M. DOEHNERT; D. FAUVER; H.B. HULL; J.A. MACKINNEY; A.C.B. RICHARDSON; L. ZARAGOZA. "Sites in the United States Contaminated with Radioactivity," Health *Phys* **77**:247-260 (1999).

[2] U.S. Environmental Protection Agency. *U.S. Code of Federal Regulations, Title 40: Protection of Environment, Part 300,* "National Oil and Hazardous Substances Pollution Contingency Plan" (2003).

[3] U.S. Nuclear Regulatory Commission. *U.S. Code of Federal Regulations, Title 10: Energy, Part 20,* "Standards for Protection Against Radiation, Subpart E – Radiological Criteria for License Termination" (2004).

[4] U.S. Department of Energy. *Radiation Protection of the Public and the Environment*. DOE Order 5400.5 (1990/19930.

[5] U.S. Department of Defense. DOD Instruction 4715.7. *Environmental Restoration Program* April (1996).

[6] Conference of Radiation Control Directors, Inc. (CRCPD). *Suggested State Regulations for Control of Regulation, Vols. I & II.* CRCPD, 205 Capital Avenue, Frankfort, Kentucky, April (2004). (http://www.crcpd.org/publications.asp#ssrcr)

[7] U.S. Department of Energy. *Information Bridge. Office of Science and Technical Information*, Office of Science, U.S. DOE, Oak Ridge, Tennessee (2004). (http://www.osti.gov/bridge/)

[8] Thompson Scientific. *ISI Web of Knowledge*, Thompson Scientific, 3501 Market St., Philadelphia, Pennsylvania (2004). (http://isi3.isiknowledge.com/portal.cgi)

[9] U.S. Environmental Protection Agency. *Exposure Factors Handbook; Volume I – General Factors*, Washington, D.C.: U.S. EPA, Office of Research and Development, National Center for Environmental Assessment: Report EPA/600-P-95-002Fa (1997). (http://www.epa.gov/ncea/pdfs/efh/front.pdf)

[10] U.S. Nuclear Regulatory Commission. Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes (Attachment C, *Parameter Distributions for Use in RESRAD and RESRAD-BUILD Computer Codes*). Yu, C.; LePoire, D., Gnanapragasam, E.; Arnish, J.; Kamboj, S.; Biwer, B.M.; Cheng, J-J.; Zielen, A.; Chen, S.Y. Washington, D.C.: U.S. NRC: NUREG/CR-6697, ANL/EAD/TM-98; (2000).

[11] U.S. Department of Energy. *A Database of Environmental Parameters, Organizations, and Tools for Probabilistic Risk Assessment*. Gruebel, M.; Carson, S.; Garcia, L.; Malczynski, L.; Pohl, P.; Reeder, R.; Kalinina, E.; Reynolds, W.; Brokaw, J.; Ma, M.; McNeely, J.; Old Coyote, A. Proceedings of the International Association for Probabilistic Safety Assessment and Management – PSAM 6, June 23 – 28, 2002: San Juan, Puerto Rico (2002).

FOOTNOTE

* Argonne work supported by the U.S. Environmental Protection Agency under interagency agreement, through U.S. Department of Energy Contract No. W-31-109-ENG-38, and by the U.S. Department of Energy under Contract No. W-31-109-ENG-38.