UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
SOLID WASTE AND
EMERGENCY RESPONSE

**OSWER Directive 9200.1-120**

**MEMORANDUM**

**SUBJECT:** Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors

**FROM:** Dana Stalcup, Acting Director
Assessment and Remediation Division
Office of Superfund Remediation and Technology Innovation

**TO:** Superfund National Policy Managers, Regions 1 - 10

**Purpose**

The mission of the Superfund program is to protect human health and the environment consistent with the Comprehensive Environmental Response, Compensation and Liability Act, as amended, (CERCLA) and as implemented by the National Oil and Hazardous Substances Pollution Contingency Plan. The purpose of this directive is to update the Interim Final Standard Exposure Factors Guidance (1991), which is reflected in the attached table and is to be used:

- in the CERCLA remedial investigation and feasibility study process (e.g., assessing baseline health risks, developing preliminary remediation goals, evaluating risks of remedial alternatives),
- to evaluate health risks in the CERCLA removal program, and
- in the process of five-year reviews of selected remedies.

This guidance update supplements the *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A* (RAGS, Part A) that was issued October 13, 1989. This guidance supersedes and replaces certain portions of OSWER Directive 9285.6-03, issued March 25, 1991 and updates the *Risk Assessment Guidance for Superfund, Part E,* issued July 2004 (RAGS, Part E). Other cleanup programs in the Office of Solid Waste and Emergency Response (OSWER) are welcome and encouraged to adopt the recommended exposure factors, much as they have historically adopted other aspects of the *Risk Assessment Guidance for Superfund* (RAGS).

## Background

In September 2011, EPA's National Center for Environmental Assessment, Office of Research and Development (ORD/NCEA) issued a substantive update to its exposure assessment recommendations. *Exposure Factors Handbook – 2011 Edition*, referred to as EFH 2011 herein, provides information and recommendations on various physiological and behavioral factors commonly used in assessing exposure of adults and children to environmental chemicals. ORD/NCEA's recommended values for exposure factors are based on the results of studies deemed to be the most up-to-date and scientifically sound, based upon data available up to July 2011, and incorporates revisions made to the *Child-Specific Exposure Factors Handbook*, which was last updated and published in 2008. EFH 2011 is not a Superfund-specific document; rather, it provides a summary of the latest developments in exposure science and provides recommendations for a broad range of EPA programs.

Following the publication of EFH 2011, regional risk assessors received inquiries from other EPA program offices, states, the regulated community, and other interested parties regarding the applicability of the ORD/NCEA's recommendations for use in human health risk assessments. During the October 2011 to August 2012 period, the OSWER Human Health Regional Risk Assessors Forum (OHHRRAF) reviewed the recommendations in EFH 2011 in the context of the default exposure factors used in the Superfund program and to derive Regional screening levels. As a result of a consensus-driven process, the OHHRRAF identified several Superfund-specific default exposure factors that warranted updating, based upon recommendations from ORD/NCEA in EFH 2011. This guidance incorporates and adopts the updates recommended by the OHHRRAF.

## Objective

This guidance has been developed to reduce variability and uncertainty in the exposure assumptions used by Regional Superfund staff to characterize exposures to human populations for human health risk assessments.

## Implementation

This guidance supplements the *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual* (RAGS), Part A through E. Where numerical values differ from those presented in Part A or E, the factors presented in this guidance should be considered updates to the older values. As new data become available, this Directive may be modified accordingly.

This report can be found at www.epa.gov/oswer/riskassessment/superfund_hh_exposure.htm Please contact Richard Kapuscinski at (703) 305-7411 if you have questions or concerns.

Attachment

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# Attachment 1. Recommended Default Exposure Factors (2014)

| Symbol | Definition (units) | Previous Default Value | Currently Recommended Value | Source of current recommendation | Source of previous recommendation |
|---|---|---|---|---|---|
| **Ingestion and Dermal Contact Rates** | | | | | |
| $IRW_c$ | Resident Drinking Water Ingestion Rate - Child (L/day) | 1 | 0.78 | U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years) | U.S. EPA 1989 (Exhibit 6-11) |
| $IRW_a$ | Resident Drinking Water Ingestion Rate - Adult (L/day) | 2 | 2.5 | U.S. EPA 2011a, Table 3-33; 90th percentile of consumer-only ingestion of drinking water (≥ 21 years) | U.S. EPA 1989 (Exhibit 6-11) |
| $IRS_c$ | Resident Soil Ingestion Rate - Child (mg/day) | 200 | 200 | U.S. EPA 2011a (Table 5-1); "upper-bound values" accounting for both soil and dust ingestion | U.S. EPA 1991a (pg. 15) |
| $IRS_a$ | Resident Soil Ingestion Rate - Adult (mg/day) | 100 | 100 | U.S. EPA 1991a (pp. 6 and 15); EFH 2011 only provides a central tendency value | U.S. EPA 1991a (pg. 15) |
| $IR_{iw}$ | Indoor Worker Soil Ingestion Rate (mg/day) | 50 | 50 | U.S. EPA 1991a (pp. 9-10, 15); EFH 2011 values not provided | U.S. EPA 1991a (pg. 15) |
| $IR_{ow}$ | Outdoor Worker Soil Ingestion Rate (mg/day) | 100 | 100 | U.S. EPA 1991a (pg. 15), same as adult resident; EFH 2011 value not provided | U.S. EPA 1991a (pg. 15) |
| $SA_{sc}$ | Resident skin surface area - child ($cm^2$) | 2,800 | 2,373 | U.S. EPA 2011a, Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years)(forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere (per EPA 2011b)) | U.S. EPA 2002 (Exhibit 1-2) |
| $SA_{sa}$ | Resident skin surface area - adult ($cm^2$) | 5,700 | 6,032 | U.S. EPA 2011a, Tables 7-2 and 7-12; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+ years)(forearm and lower leg-specific data used for males and female lower leg; ratio of male forearm to arm applied to female arm data). | U.S. EPA 2002 (Exhibit 1-2) |
| $SA_{sow}$ | Worker skin surface area - adult ($cm^2$) | 3,300 | 3,527 | US EPA 2011a, Table 7-2; weighted average of mean values for head, hands, and forearms (male and female, 21+years) (similar assumptions for forearms as used in EPA 2011b) | U.S. EPA 2002 (Exhibit 1-2) |
| $SA_{wc}$ | Resident Water Surface area - child ($cm^2$) | 6,600 | 6,365 | U.S. EPA 2011a, Table 7.9; weighted average of mean values for male and female children <6 years. | U.S. EPA 2004 (Exhibit 3-2) |
| $SA_{wa}$ | Resident Water Surface area - adult ($cm^2$) | 18,000 | 19,652 | U.S. EPA 2011a, Table 7.9; weighted average of mean values for male and female adults, 21-78. | U.S. EPA 2004 (Exhibit 3-2) |
| $AF_c$ | Resident soil adherence factor - child ($mg/cm^2$) | 0.2 | 0.2 | U.S. EPA 2004 (Exhibit 3-5), RAGS Part E | U.S. EPA 2002 (Exhibit 1-2) |
| $AF_a$ | Resident soil adherence factor - adult ($mg/cm^2$) | 0.07 | 0.07 | U.S. EPA 2004 (Exhibit 3-5), RAGS Part E | U.S. EPA 2002 (Exhibit 1-2) |
| $AF_{ow}$ | Worker soil adherence factor - adult ($mg/cm^2$) | 0.2 | 0.12 | U.S. EPA 2011a, Table 7-20 and Section 7.2.2; arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities | U.S. EPA 2002 (Exhibit 1-2) |
| $BW_c$ | Resident Body Weight - child (kg) | 15 | 15 | U.S. EPA 2011a, Table 8-1; weighted average of mean body weights (birth to <6 years) | U.S. EPA 1991a (pg. 15) |
| $BW_a$ | Resident Body Weight - adult (kg) | 70 | 80 | U.S. EPA 2011a, Table 8-3; weighted mean values for adults 21 – 78 | U.S. EPA 1991a (pg. 15) |
| $BW_w$ | Worker Body Weight (kg) | 70 | 80 | U.S. EPA 2011a, Table 8-3; weighted mean values for adults 21 – 78 | U.S. EPA 1991a (pg. 15) |
| **Exposure Frequency, Exposure Duration, and Exposure Time Variables** | | | | | |

# Attachment 1. Recommended Default Exposure Factors (2014)

| Symbol | Definition (units) | Previous Default Value | Currently Recommended Value | Source of current recommendation | Source of previous recommendation |
|---|---|---|---|---|---|
| $EF_r$ | Resident Exposure Frequency (days/yr) | 350 | 350 | U.S. EPA 1991a (pg. 15); value not provided in EFH 2011 | U.S. EPA 1991a (pg. 15) |
| $EF_w$ | Worker Exposure Frequency (days/yr) | 250 | 250 | U.S. EPA 1991a (pg. 15); value not provided in EFH 2011 | U.S. EPA 1991a (pg. 15) |
| $EF_{iw}$ | Indoor Worker Exposure Frequency (days/yr) | 250 | 250 | U.S. EPA 1991a (pg. 15); value not provided in EFH 2011 | U.S. EPA 1991a (pg. 15) |
| $EF_{ow}$ | Outdoor Worker Exposure Frequency (days/yr) | 225 | 225 | U.S. EPA 2002; value not provided in EFH 2011 | U.S. EPA 1991a (pg. 15) |
| $ED_r$ | Resident Exposure Duration (yr) | 30 | 26 | EPA 2011a, Table 16-108; 90th percentile for current residence time. | U.S. EPA 1991a (pg. 15) |
| $ED_c$ | Resident Exposure Duration - child (yr) | 6 | 6 | U.S. EPA 1991a, Pages 6 and 15 | U.S. EPA 1991a (pg. 15) |
| $ED_a$ | Resident Exposure Duration - adult (yr) | 24 | 20 | EDr (26 years) - EDc (6 years) | U.S. EPA 1991a (pg. 15) |
| $ED_w$ | Worker Exposure Duration - (yr) | 25 | 25 | U.S. EPA 1991a (pg. 15); EFH 2011 only provides a central tendency value | U.S. EPA 1991a (pg. 15) |
| $ED_{iw}$ | Indoor Worker Exposure Duration - (yr) | 25 | 25 | U.S. EPA 1991a (pg. 15); EFH 2011 only provides a central tendency value | U.S. EPA 1991a (pg. 15) |
| $ED_{ow}$ | Outdoor Worker Exposure Duration (yr) | 25 | 25 | U.S. EPA 1991a (pg. 15); EFH 2011 only provides a central tendency value | U.S. EPA 1991a (pg. 15) |
| $ET_{ra}$ | Resident Air Exposure Time (hours/day) | 24 | 24 | The whole day | The whole day |
| $ET_{rs}$ | Resident Soil Exposure Time (hours/day) | 24 | 24 | The whole day | The whole day |
| $ET_w$ | Worker Air Exposure Time (hr/hr) | 8 | 8 | The work day | The work day |
| $ET_{ws}$ | Worker Soil Exposure Time (hours/day) | 8 | 8 | The work day | The work day |
| $ET_{rw}$ | Resident Water Exposure Time (hours/day) | 24 | 24 | The whole day | The whole day |
| $ET_{rwc}$ | Resident Water Exposure Time - child (hours/event) | 1 | 0.54 | U.S. EPA 2011a, Table 16-28; weighted average of 90th percentile time spent bathing (birth to <6 years) | U.S. EPA 2004 |
| $ET_{rwa}$ | Resident Water Exposure Time - adult (hours/event) | 0.58 | 0.71 | U.S. EPA 2011a, Tables 16-30 and 16-31; weighted average of adult (21 to 78) 90th percentile of time spent bathing/ showering in a day, divided by mean number of baths/showers taken in a day. | U.S. EPA 2004 |
| **Miscellaneous Variables; values not provided in EFH 2011** | | | | | |
| $AT_r$ | Averaging time - resident (days/year) | 365 | 365 | U.S. EPA 1989 (pg. 6-23) | U.S. EPA 1989 (pg. 6-23) |
| $AT_w$ | Averaging time - composite worker (days/year) | 365 | 365 | U.S. EPA 1989 (pg. 6-23) | U.S. EPA 1989 (pg. 6-23) |
| $AT_{iw}$ | Averaging time - indoor worker (days/year) | 365 | 365 | U.S. EPA 1989 (pg. 6-23) | U.S. EPA 1989 (pg. 6-23) |
| $AT_{ow}$ | Averaging time - outdoor worker (days/year) | 365 | 365 | U.S. EPA 1989 (pg. 6-23) | U.S. EPA 1989 (pg. 6-23) |

# Attachment 1. Recommended Default Exposure Factors (2014)

| Symbol | Definition (units) | Previous Default Value | Currently Recommended Value | Source of current recommendation | Source of previous recommendation |
|---|---|---|---|---|---|
| LT | Lifetime (years) | 70 | 70 | U.S. EPA 1989 (pg. 6-22), pending additional input from NCEA | U.S. EPA 1989 (pg. 6-22) |
| $IR_{fish}$ | Fish Ingestion Rate (mg/day) | $5.4 \times 10^4$ | ** | Recommend using site-specific values | U.S. EPA 1991a (pg. 15) |
| $IR_{produce}$ | Consumption of homegrown produce (g/day) | 42 (fruit); 80 (veg) | ** | Recommend using site-specific values | U.S. EPA 1990 |

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*Footnote:* Users are directed to the *Exposure Factors Handbook* (2011) as a source for specific age-group exposure factors as described in EPA, 2005.