Rhode Island Department of Environmental Management
Office of Air Resources

GUIDELINES FOR ASSESSING HEALTH RISKS FROM PROPOSED AIR POLLUTION SOURCES

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I. GENERAL INTRODUCTION AND APPLICABILITY

250-RICR-120-05-9 (Part 9), "Air Pollution Control Permits" requires applicants for permits to construct, install or modify an air pollution source to demonstrate that emissions from that source will not cause ground level off-property ambient impact pollutant concentrations that exceed the Acceptable Ambient Levels (AALs) listed in 250-RICR-120-05-22 (Part 22), "Air Toxics" and any "Calculated Acceptable Ambient Levels" (CAALs) derived for substances not listed in Part 22. AALs and CAALs are derived by the Rhode Island Department of Environmental Management (RI DEM) using procedures delineated in the "Rhode Island Air Toxics Guidelines."

AALs and CAALs are sufficiently stringent that, in most cases, air impacts that comply with those limitations are unlikely to be associated with public health effects. However, in some situations, further analysis is required to adequately evaluate the health risks associated with a source's air emissions. Specifically:

- Multiple Exposure Pathways AALs and CAALs are derived to assess health effects associated with inhalation exposures. Deposition of certain air pollutants may result in exposure by additional pathways, such as soil ingestion and food consumption. This issue is of particular concern for persistent bioaccumulative and toxic pollutants (PBT pollutants). The term "PBT pollutants" is defined by the United States Environmental Protection Agency (US EPA) as "chemicals that are toxic, persist in the environment and bioaccumulate in food chains and, thus, pose risks to human health and ecosystems."[1]

- Cumulative Effects on Organ Systems The cumulative effect of emissions of two or more air toxics that affect the same organ system may be unacceptable even if the AALS for the individual substances are not exceeded.

- Unusual Impact Locations Evaluation of impacts of emissions of pollutants associated with acute health effects within the facility's property line may be required if the property is routinely accessed by members of the public. Evaluation of impacts at elevated receptors may also be required in some situations.

To address these issues, Part 9 stipulates that applicants for permits to construct, install or modify an air pollution source (preconstruction permits) must conduct any additional health studies required by the RI DEM, as specified in this document, "Guidelines for Assessing Health Risks from Proposed Air Pollution Sources." Section II of this edition of the guidelines requires applicants to conduct risk assessments in conjunction with preconstruction permit applications for major stationary sources and major modifications, as defined in Part 9, and sets forth specifications for such assessments.

1 US EPA Webpage for the Persistent Bioaccumulative and Toxic (PBT) Chemical Program, http://www.epa.gov/pbt/pubs/aboutpbt.htm

II. RISK ASSESSMENT GUIDELINES FOR MAJOR STATIONARY SOURCES AND MAJOR MODIFICATIONS

A. General Information

Preconstruction permit applications for all proposed major stationary sources and major modifications, as defined in Part 9, must include a multi-pathway human health risk assessment. This section specifies minimum requirements for such assessments. It is the responsibility of an applicant to supply any additional information which may be required for a comprehensive assessment of the potential health impacts associated with the proposed facility.

The applicant must submit a risk assessment protocol to RI DEM for approval prior to preparation of the assessment. The protocol must include the following:

- A description of the proposed facility, including operations and emissions points;
- A schematic showing the site layout, as proposed;
- A map with an accompanying explanatory narrative showing land use; zoning classifications; the location of drinking water sources, fishing areas, farms and sensitive receptors (e.g. schools, parks and playgrounds, day care centers, nursing homes, hospitals, and residential dwelling units) in the vicinity of the proposed source; and any other geographical information pertinent to the assessment;
- Emissions rate estimates for pollutants that will be emitted from the proposed source by emissions point and the source of those emissions estimates;
- As discussed below, assessors must use the California Environmental Protection Agency's Risk Assessment Standalone Tool (RAST) to calculate environmental transport, human exposure and health impacts. That tool includes several user-selected options; the protocol must identify the options that will be selected and provide a justification for the selection of those options, particularly when RAST defaults are not used; and
- A detailed discussion of the exposure scenarios that will be evaluated, as discussed below, including the pathways, parameters and other assumptions that will be used to evaluate exposures at non-residential sensitive receptors and workplaces.

The focus of the risk assessment is the impact to the theoretical "most exposed individual" (MEI). For the purpose of this guideline, RI DEM is defining the MEI as a person who lives for

thirty years, including childhood, at the location of the facility's maximally impacted residential receptor and whose diet includes homegrown produce and food and water from impacted sources, if applicable (e.g. local farms that produce milk, meat or produce; drinking water sources; and fishing areas). Note that RI DEM classifies all receptors as residential unless the applicant demonstrates that a receptor is located in an area where residential development is precluded by zoning or other land use limitations.

The applicant may also include an evaluation of a more realistic exposure scenario, and should explain clearly why assumptions included in that scenario may be more appropriate than the assumptions cited above. Impacts at nearby non-residential sensitive receptors and maximally impacted workplaces should also be evaluated.

The Air Resources Board of the California Environmental Protection Agency has developed the Hotspots and Reporting Program (HARP), a free software suite used for the evaluation of risks associated with air pollutant emissions. RI DEM is requiring that risk assessments developed in conjunction with Rhode Island major source or major modification preconstruction permits use the most current version of the Risk Assessment Standalone Tool (RAST) portion of the HARP suite for calculating environmental transport and fate, exposure and health impacts. The RAST tool can be used to calculate risks associated with exposures to pollutants via multiple pathways and the cumulative health impact of exposures to multiple pollutants that affect the same target organ system.[2]

[2] As of the date of publication of this document, the most current version of RAST (HARP Version 2), is available for download at http://www.arb.ca.gov/toxics/harp/harp.htm The user manual for that program (California Environmental Protection Agency Air Resources Board, "User Manual For the Hotspots Analysis and Reporting Program Health Risk Assessment Standalone Tool Version 2", March 17, 2015, is available at http://www.arb.ca.gov/toxics/harp/docs2/harp2rastuserguide.pdf . That agency's "Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments", which provides the rationale for the assumptions in the RAST tool, is available at http://oehha.ca.gov/air/hot_spots/hotspots2015.html

B. Exposure Assessment

1. Pollutant Selection

Risk assessments must include all pollutants evaluated by the RAST that will be emitted from the proposed facility for which emissions estimates are available, including pollutants that are emitted in quantities lower than the Minimum Quantities listed in Appendix A of RIAPCR No. 9. As discussed above, PBT pollutants are of particular interest in multi-pathway risk assessments. Therefore, the applicant should make every attempt to quantify potential emissions of any PBT pollutant that may be released from the proposed source or modification. PBT pollutants commonly emitted by combustion sources include mercury, benzo(a)pyrene and other polycyclic aromatic hydrocarbons, and dioxins/furans.

2. Dispersion Modeling

RAST requires users to input maximum hourly and annual average ground level concentrations of emitted pollutants, either by direct entry of those concentrations or by importing those values from a CSV file. Rhode Island assessments must use ambient air impact concentrations associated with emissions from the source, as predicted by dispersion modeling analyses conducted as specified in the "Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources."[3] Submission of a modeling protocol, separate from the risk assessment protocol, is required prior to conducting the modeling analysis. Risk assessment input requirements should be considered when designing the modeling analysis, including:

- **Pollutant selection** – As discussed above, the risk assessment does not exclude pollutants for which emissions are below Part 9 Minimum Quantities thresholds. Therefore, the air quality modeling analysis should include all pollutants evaluated by RAST that will be emitted by the proposed new or modified facility for which air emissions estimates are available.

  Note that RAST allows concentrations of chlorobenzenes, chlorophenols, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins and dibenzofurans to be entered either as individual speciated substances or as the total concentration of the family of substances. Concentrations of pollutants in those families should be entered as individual substances if speciated emissions data are available. If speciated data are not available for some or all of the emissions, impacts of those emissions should be entered under the family classification.

[3] At the time of preparation of this document, the most current version of the "Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources," the March 2013 Revision, is available at: http://www.dem.ri.gov/pubs/regs/regs/air/airtoxmd.pdf

- **Receptor locations –** Receptor locations should be sufficient to identify ground level pollutant impacts at the off-site point of maximum impact and at the point of maximum impact for which residential use is not precluded by zoning or other land use restrictions. Receptors should also be located at nearby sensitive receptors (e.g. schools, day care centers, parks, playgrounds and health care facilities). Note that, if residences or other sensitive receptors are located on the source's property, those receptor locations should be modeled. Elevated receptors must also be included where applicable. In addition, since RAST allows the user to input ground level air concentrations at the maximally impacted pasture, drinking water source and fishing area, the modeler should site receptors at those locations, if applicable.

- **Averaging time –** RAST inputs include maximum (one-hour average) and average (annual average) ground-level concentrations for all pollutants, so impacts corresponding to those averaging times must be generated for all pollutants evaluated. Note that the predicted maximum one-hour and maximum annual average concentrations may not occur at the same location.

- **Isopleth maps –** Isopleth maps showing gradients in maximum 1-hour and annual average pollutant concentrations for the five year period modeled should be constructed such that they can be adjusted to include information pertinent to the risk assessment, including zoning classifications and the location of farms, drinking water sources, fishing areas, and sensitive receptors.

3. Exposure Scenarios

The risk assessment will focus on the theoretical MEI resident, but may also evaluate more realistic residential exposure scenarios. For instance, although RI DEM classifies receptors in all areas where residential development is not precluded by zoning or other land use restrictions as residential receptors for the MEI exposure evaluation, the assessor may also want to evaluate exposures in areas where residences are located or planned at the time of the assessment. In addition, exposures at other nearby sensitive receptors (e.g. schools, parks and playgrounds, day care center and health care facilities) and at the maximally impacted workplace should also be evaluated. The following is a discussion of the requirements for evaluating residential exposures and exposures at other pertinent locations.

(1) Residential Exposure

All multi-pathway risk assessments must focus on the MEI, a theoretical person who lives for thirty years, including childhood, at the facility's residential (or potentially residential) point of maximum impact and whose diet includes homegrown produce and food and water from sources maximally impacted by emissions from the source, if applicable (e.g. local farms producing milk, meat, and produce; drinking water reservoirs; and fishing areas).

As discussed above, receptors in all areas that are currently residential or where future residential development is not precluded by zoning or other land use restrictions should be included when selecting maximum one-hour and annual average impact concentrations. Note that the maximum concentrations predicted by the dispersion model for the one-hour and annual averaging times may not occur at the same location.

The modeled maximum one-hour and annual average residential impact concentration are input into the RAST tool as maximum and average concentrations, respectively. Exposures via the following pathways, which are mandatory pathways for Rhode Island residential risk evaluations, are based on those maximum residential concentrations:

- Inhalation;
- Soil ingestion;
- Dermal exposure;
- Ingestion of mother's milk (polycyclic aromatic hydrocarbons (PAHs), creosotes, lead, dioxins, furans and polychlorinated biphenyls (PCBs) only); and
- Ingestion of homegrown produce

In addition, the RAST assessment must assume that the MEI is exposed via the following pathways, as applicable:

- Ingestion of drinking water from the maximally impacted drinking water source;
- Ingestion of fish from the maximally impacted fishing area; and
- Ingestion of produce, beef and dairy, and pigs, chicken and eggs from the maximally impacted farm.

Note that the RAST tool allows users to input the predicted ground level concentrations at the maximally impacted pasture, drinking water source and fishing area.

As discussed above, RAST users are allowed to select some of the parameters used in exposure calculations. In the risk assessment protocol, the applicant should identify the options that will be selected and justify those selections, particularly if parameters that are different from the RAST defaults are selected.

As discussed above, the assessment may also include an evaluation of impacts at current or planned residences or another residential scenario that the applicant considers to be a more realistic representation of the risk associated with the proposed source. Such analyses should identify all assumptions utilized and provide an explanation of why those assumptions are more realistic than those used in the MEI evaluation.

(2) Exposures at Sensitive Receptors and Occupational Locations

An assessment of exposures at nearby non-residential sensitive receptors and at the maximally impacted workplace also must be conducted. Selection of exposure pathways and parameters for such evaluations must be tailored to match the receptor type and site-specific details. In general, such analyses will evaluate fewer exposure pathways than those included in the residential evaluation; however, differences in certain parameters (e.g. an assumed increased breathing rate at work places) may increase exposures at those locations.

C. Risk Characterization and Acceptability Criteria

1. Analysis Type

The RAST tool can be used to evaluate cancer risk, chronic non-cancer risk, acute non-cancer risk and 8-hour/day non-cancer risk for individual residents, populations and workers. RI DEM does not require an evaluation of population risk MEI and other residential assessments must include analyses of cancer risks and chronic, acute and 8-hour non-cancer risks to individual residents. Workplace impacts should be evaluated for 8-hour chronic non-cancer risks to workers. Risk analysis types for non-residential sensitive receptors should be tailored to those receptors. The analysis type that will be applied to each exposure scenario should be identified in the risk assessment protocol.

2. Risk Calculation and Presentation

Applicants must submit a comprehensive risk assessment report to RI DEM that includes a description of the analyses conducted, including an identification and justification of the assumptions used and parameters chosen for each exposure scenario. RAST inputs and outputs for all scenarios evaluated must be attached to the report. RAST output spreadsheets include the following information:

- Cancer risk tables, which include the risk associated with each applicable exposure pathway and the total risk for all pathways for each carcinogenic substance evaluated;

- Chronic non-cancer tables, which include the chronic hazard quotient, calculated as the exposure dose divide by the California chronic health benchmark by substance for each target health effect (12 organ systems plus odor and general toxicity), as well as the dose associated with each exposure route;

- Acute non-cancer tables, which include the acute hazard quotient (exposure dose/California acute health benchmark) for each substance for each target health effect. RAST includes only inhalation exposures in acute dose calculations; and

- 8-hour non-cancer risk tables for residential and worker exposures are also based solely on inhalation exposures; the RAST 8-hour output displays the 8-hour chronic hazard quotient (8-hour exposure dose/California 8-hour health benchmark) for each applicable substance for each target health effect.

The report must include maps and explanatory text that clearly identify the locations of: the MEI residential receptor; any other residential receptor evaluated; the maximally impacted farm, drinking water source and fishing area used in that analysis; non-residential sensitive receptors; and the maximally impacted workplace.

For the MEI and any other residential analysis, the report must include the following information, as extracted from the RAST output:

1. A table showing the cancer risk associated with each carcinogenic substance and the total of those risks;

2. A table and stacked column chart that shows the contribution of each exposure route to the cancer risk calculated for each carcinogen;

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3. A stacked column chart that shows the contribution of each carcinogen and the contribution of each exposure route to the total cancer risk calculated for the project;

4. A table showing the total and pollutant-specific chronic hazard quotients for each target health effect, including general toxicity and odor;

5. A stacked column chart that shows the contribution of each substance to the total chronic hazard quotient for each target health effect, including general toxicity and odor;

6. Tables showing the total and pollutant-specific acute hazard quotients and 8-hour hazard quotients for each target health effect, including general toxicity and odor; and

7. Stacked column charts that show the contribution of each substance to the total acute hazard quotient and total 8-hour hazard quotient for each target health effect, including general toxicity and odor.

Risk summaries for non-residential sensitive receptor and workplace exposure scenarios must include all of the above information that is applicable to that exposure scenario.

3. Acceptability Criteria

The risk posed by a proposed facility will be considered acceptable if the assessment is conducted according to the conditions delineated in this Guideline and in a risk assessment protocol approved by RI DEM and the following criteria are satisfied:

1. The maximum off-site ground level ambient air impacts predicted by an approved air dispersion modeling study for all evaluated pollutants are less than or equal to the corresponding AALs listed in Part 22 and any CAALs developed by RI DEM for substances not listed in Part 22, considering appropriate averaging times. Note that § 22.8(D) allows RI DEM to modify modeling requirements by:

    a. Allowing the applicant to exclude impacts in an area that is not accessible to the public, provided that the applicant demonstrates that public access to that area is precluded;

    b. Allowing the applicant to use an adjusted annual or 24-hour average AAL to determine the acceptability of impacts in an area, provided that the applicant demonstrates that land use or other factors limit the potential duration of public exposure to the contaminant in that area; or

    c. Requiring the applicant to evaluate one-hour and 24-hour average impacts in areas of the facility's property to which members of the public have unrestricted access.

2. The total cancer risks associated with the impact of facility emissions for the MEI and other residential receptors, non-residential sensitive receptors and the maximally impacted workplace, evaluated according to the specifications of this document for all applicable exposure routes, do not exceed 1/10,000 (10^{-4}).

3. The total chronic hazard quotient, total acute hazard quotient and total 8-hour hazard quotient for each target health effect, including general toxicity and odor, associated with the impact of facility emissions at residential receptors and, as applicable, non-residential sensitive receptors and the maximally impacted workplace, evaluated according to the specifications of this document for all applicable exposure routes, does not exceed one.