Pennsylvania Department of Environmental Protection

MEMO

TO Alexander Sandy
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FROM Henry F. Bonifacio HFB
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THROUGH Andrew W. Fleck AWF
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DATE December 22, 2025

RE Air Dispersion Modeling for Inhalation Risk Assessment
Shell Chemical Appalachia LLC
Application for Plan Approval 04-00740D
EMACT Project, WWTP Permanent Controls Project, and Plan
Approval Reconciliations
Shell Polymers Monaca Site
Center Township and Potter Township, Beaver County

MESSAGE:

The Pennsylvania Department of Environmental Protection's (DEP) Air Quality Modeling and Risk Assessment Section has completed its technical review of the air dispersion modeling for the inhalation risk assessment included in Shell Chemical Appalachia LLC's (Shell) application

for Plan Approval 04-00740D for several changes at Shell Polymers Monaca Site in Center Township and Potter Township, Beaver County. The changes included are the Ethylene Maximum Achievable Control Technology (EMACT) Project to comply with the revised 40 CFR 63 Subpart YY, the Wastewater Treatment Plant (WWTP) Permanent Controls Project to install permanent equipment to improve oil, grease, and volatile organic compounds removal from the wastewater, and the reconciliations of plan approval source descriptions and conditions as well as potential to emit calculations, referred to as "Plan Approval Reconciliations", based on Shell's latest review of its "as-built" equipment and operations.

During its technical review, the DEP made several revisions to Shell's air dispersion modeling for the inhalation risk assessment. The DEP's technical review concludes that Shell's air dispersion modeling, in conjunction with the revisions made, is consistent with the U.S. Environmental Protection Agency's (EPA) relevant air dispersion modeling policy and guidance. The DEP's summary of Shell's air dispersion modeling for the inhalation risk assessment, along with the DEP's revisions, is attached.

If you have any questions regarding Shell's air dispersion modeling for the inhalation risk assessment, you may contact me (hbonifacio@pa.gov, 717.772.5968) or Andrew Fleck (afleck@pa.gov, 717.783.9243).

Attachment

cc: Mark Gorog, SWRO/Air Quality
        Sheri Guerrieri, SWRO/Air Quality/New Source Review
        Nicholas Lazor, BAQ/Director
        Viren Trivedi, BAQ/Permits
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DEP Summary of Air Dispersion Modeling for Inhalation Risk Assessment
Shell Chemical Appalachia LLC
Application for Plan Approval 04-00740D
EMACT Project, WWTP Permanent Controls Project, and Plan Approval Reconciliations
Shell Polymers Monaca Site, Center Township and Potter Township, Beaver County
December 22, 2025

I. Background

The Pennsylvania Department of Environmental Protection (DEP) received a plan approval application on September 13, 2024, from Shell Chemical Appalachia LLC (Shell) for several changes at Shell Polymers Monaca Site in Center Township and Potter Township, Beaver County.[1] The changes included are the Ethylene Maximum Achievable Control Technology (EMACT) Project to comply with the revised 40 CFR 63 Subpart YY, the Wastewater Treatment Plant (WWTP) Permanent Controls Project to install permanent equipment to improve oil, grease, and volatile organic compounds removal from the wastewater, and the reconciliations of plan approval source descriptions and conditions as well as potential to emit calculations, referred to as "Plan Approval Reconciliations", based on Shell's latest review of its "as-built" equipment and operations. The plan approval application contained an inhalation risk assessment for chemicals of potential concern (COPC). In response to the DEP's December 20, 2024,[2] technical review comments, the DEP received a revision to the inhalation risk assessment from Shell on May 29, 2025.[3,4] In response to the DEP's July 7, 2025,[5] and July 14, 2025,[6] technical review comments, the DEP received a revision to the inhalation risk assessment from Shell on September 5, 2025.[7,8] The DEP received an additional revision to the inhalation risk assessment from Shell on October 14, 2025.[9]

The plan approval application and the included inhalation risk assessment were prepared by Landau Associates, on behalf of Shell.

II. Regulatory Applicability

Shell's inhalation risk assessment was conducted in support of the application for Plan Approval 04-00740D at the request of the DEP in accordance with 25 Pa. Code § 127.12(a)(2).

[1] Letter with enclosure (Plan Approval Application for Shell Polymers Monaca) from James Howell, Shell to Mark Gorog, DEP/SWRO/Air Quality. September 13, 2024.
[2] Letter with enclosure from Henry F. Bonifacio and Stephen J. Steirer, DEP/BAQ/Permits/Air Quality Modeling and Risk Assessment to Kimberly Kaal, Shell. December 20, 2024.
[3] Letter with enclosures from Kimberly Kaal, Shell to Alexander Sandy, DEP/SWRO/Air Quality/New Source Review. May 29, 2025.
[4] Email with link to files associated with the inhalation risk assessment from Michael Carbon, Landau Associates. May 29, 2025.
[5] Email with attachment from Henry Bonifacio, DEP/BAQ/Permits/Air Quality Modeling and Risk Assessment to Michael Carbon, Landau Associates. July 7, 2025.
[6] Email with attachment from Stephen Steirer, DEP/BAQ/Permits/Air Quality Modeling and Risk Assessment to Michael Carbon, Landau Associates. July 14, 2025.
[7] Letter with enclosures from Kimberly Kaal, Shell to Mark Gorog, DEP/SWRO/Air Quality. September 5, 2025.
[8] Email with link to files associated with the inhalation risk assessment from Michael Carbon, Landau Associates. September 5, 2025.
[9] Email with link to files associated with the inhalation risk assessment from Todd Higginbotham, Landau Associates to Mark Gorog, DEP/SWRO/Air Quality. October 14, 2025.

III. Air Dispersion Modeling

As part of the inhalation risk assessment, Shell conducted two air dispersion modeling runs to calculate short- and long-term average air concentrations for subsequently characterizing acute and chronic risks, respectively, due to its emissions of COPCs. Shell provided a detailed description of the air dispersion modeling methodology for the inhalation risk assessment in section 4.0 (Model Selection and Model Input) of Appendix D-3B (Dispersion Modeling Analysis for the Inhalation Risk Assessment for Shell Polymers Monaca) of the plan approval application.

A. Model Selection

Shell's air dispersion modeling for the inhalation risk assessment utilized the American Meteorological Society (AMS) / U.S. Environmental Protection Agency (EPA) Regulatory Model (AERMOD) v24142. AERMOD is the EPA's required near-field air dispersion model for a wide range of regulatory applications in all types of terrain and for aerodynamic building downwash.[10]

B. Model Input

1. Control Pathway

AERMOD was executed with regulatory default options. AERMOD was executed with rural dispersion, by default, based on the EPA's recommended Land Use Procedure.[11,12] The land cover within three (3) kilometers of Shell Polymers Monaca Site is predominantly rural.

For characterizing acute risk, the option to calculate 1-hour average concentrations was selected in AERMOD. For characterizing chronic risk, the option to calculate concentrations averaged over the entire meteorological data period, i.e., five (5) years, was selected in AERMOD.

2. Source Pathway

a. Source Characterization

Shell modeled its COPC-emitting sources as either point sources or volume sources. Sources whose emissions are emitted to the atmosphere via typical unobstructed vertical stacks were characterized in AERMOD as point sources and included the following:

- seven (7) ethane cracking furnaces,
- three (3) combustion turbines with duct burners,
- two (2) totally enclosed ground flares,

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[10] *Code of Federal Regulations*. 40 CFR Part 51, Appendix W (Guideline on Air Quality Models). Subsection 4.2.2.1(a).
[11] *Code of Federal Regulations*. 40 CFR Part 51, Appendix W (Guideline on Air Quality Models). Subsection 7.2.1.1(b)(i).
[12] AERMOD Implementation Guide (EPA-454/B-24-009, November 2024). Subsection 5.1.

- one (1) elevated, steam-assisted flare,
- one (1) multi-point ground flare that consists of 38 flare heads,
- one (1) continuous vent thermal oxidizer,
- one (1) spent caustic thermal oxidizer,
- two (2) diesel-fired fire water pumps engines,
- two (2) diesel-fired emergency generator engines,
- two (2) natural gas-fired emergency generator engines,
- one (1) process cooling tower with 26 cells, and
- three (3) polyethylene manufacturing lines.[13]

Sources characterized in AERMOD as volume sources included the following:

- one (1) liquid loadout for C3+, butene, isopentane, isobutane, and C3 ref,
- one (1) liquid loadout for recovered oil,
- twelve (12) ethylene manufacturing equipment components,
- one (1) polyethylene manufacturing line fugitive,
- fourteen (14) OSBL equipment components,[14] and
- two (2) WWTP bioaeration tanks.[15]

The two WWTP bioaeration tanks were modeled by Shell as one volume source. In the DEP's confirmation run, the two WWTP bioaeration tanks were modeled as two volume sources.

b. Emission Data

Shell entered a unitized emission rate of 1 lb/hr in AERMOD to calculate the maximum 1-hour average unitized concentration and the 5-year average unitized concentration for each source at each receptor defined in AERMOD.[16] For the process cooling tower, whose cells were modeled as separate point sources, Shell assigned the 1-lb/hr unitized emission rate for each pair of cells (i.e., 13 pairs of cells), entering 0.5 lb/hr in AERMOD for each cell.

The locations, stack parameters, i.e., release height, inside diameter, exit temperature, and exit velocity, for COPC-emitting sources modeled as point sources by Shell, and volume source parameters, i.e., release height, initial lateral dimension of the volume, and initial vertical dimension of the volume, for COPC-emitting sources modeled as volume sources are consistent with those provided in Appendix D-3B of Shell's plan approval application.

In the DEP's confirmation run, each cell of the process cooling tower was modeled with a unitized emission rate of 1 lb/hr. The DEP also made the following revisions in the volume

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[13] Two (2) manufacturing lines' emission points are two (2) shared catalyst filter vents. The last manufacturing line's emission points are two (2) catalyst activator filter vents.

[14] OSBL stands for "outside the boundary limits." OSBL equipment components include valves, connectors/flanges, relief valves, pumps, and compressor seals at various sources.

[15] Shell used the two bioaeration tanks to represent COPC emissions from WWTP.

[16] To be conservative in the acute risk calculations, the maximum 1-hour unitized concentration from each source was used regardless of whether these maximum 1-hour unitized concentrations from all sources occur during the same hour or not.

source parameters for the two WWTP bioaeration tanks, which, as stated above, were modeled by the DEP as two volume sources:

- the release height was based on the approximated headspace above the liquid in the bioaeration tank, i.e., the release height is the height of the center of the approximated headspace from the ground,
- the initial lateral dimension was based on the side of a volume source (i.e., with equal sides) that has an area equivalent to that of the bioaeration tank, and
- the initial vertical dimension was based on the approximated height of the liquid in the bioaeration tank.

c. Good Engineering Practice Stack Height and Downwash

Stack heights of sources modeled as point sources were fully creditable for entry in AERMOD since none exceeded their corresponding Good Engineering Practice (GEP) stack height,[17], i.e., the greater of 65 meters or the GEP formula stack height. Additionally, direction-specific building downwash parameters were entered in AERMOD for each point source. The GEP formula stack height and direction-specific building downwash parameters were calculated using the EPA's Building Profile Input Program for the Plume Rise Model Enhancements algorithm (BPIPPRM) v04274.

In the DEP's confirmation run, building downwash parameters for three (3) sources (i.e., identified in Shell's dispersion modeling by AERMOD Source ID GEN1, COI, COLTW7a) were corrected.[18]

d. Source Groups

To generate the maximum 1-hour average unitized concentrations and the 5-year average unitized concentrations for each source, Shell defined a source group for each source. For the process cooling tower, Shell assigned a source group for each pair of cells.

With a 1-lb/hr unitized emission rate setting in the DEP's confirmation run, each cell of the process cooling tower was assigned its own source group.

3. Receptor Pathway

a. Receptors

Two receptor grids were used in the inhalation risk assessment. For characterizing acute risk, receptors entered in AERMOD were the locations defined to be ambient air[19,20] within a

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[17] *Code of Federal Regulations*. 40 CFR § 51.100(ii). Definition of "good engineering practice stack height."
[18] In its confirmation run using the EPA's BPIPPRM, the DEP did not make any revisions to building parameters (dimensions, locations, elevations) and source parameters (stack heights, locations, elevations) as provided by Shell.
[19] *Code of Federal Regulations*. 40 CFR § 50.1(e). Definition of "ambient air."
[20] Revised Policy on Exclusions from "Ambient Air." EPA memorandum from Andrew R. Wheeler, Administrator to Regional Administrators. December 2, 2019.

Cartesian grid, approximately 13.0 by 12.5 km, centered on Shell Polymers Monaca Site. For characterizing chronic risk, the receptor grid was similar to that for the acute risk assessment but excluded receptors located on the Ohio River, facility property adjacent to the river, the Highway 376 bridge, and the railroad that transects the facility. Receptor density decreased with distance from Shell Polymers Monaca Site. These receptor grids, based on their extent and receptor density, were adequate to determine the locations and magnitudes of the maximum acute and maximum chronic risks.

b. Terrain Preprocessing

Receptor elevations and hill height scales were calculated by the AERMOD terrain preprocessor (AERMAP) v24142 utilizing the U.S. Geological Survey's (USGS) 3D Elevation Program (3DEP) data with a one-third arc-second resolution.

4. Meteorology Pathway

Shell's air dispersion modeling utilized a 5-year meteorological dataset consisting of hourly records from January 1, 2018, through December 31, 2022, derived from primary surface data from the Beaver Valley Nuclear Generating Station[21] and secondary surface data and upper air data from Pittsburgh International Airport (KPIT).

The meteorological dataset was processed by the DEP with the AERMOD meteorological preprocessor (AERMET) v24142 and its associated AERSURFACE v24142 tool. The fully processed meteorological dataset satisfies the EPA's recommendations for use in AERMOD,[22] and was appropriate for AERMOD to construct realistic boundary layer profiles to adequately represent plume transport and dispersion under both convective and stable conditions within the modeling domain. Additionally, the fully processed meteorological dataset satisfies the DEP's data completeness recommendation for use in air dispersion modeling.

5. Output Pathway

For characterizing acute risk, AERMOD was executed to summarize all model receptors and their corresponding maximum 1-hour average unitized concentrations in one tabular output file for each source group. Similarly, for characterizing chronic risk, AERMOD was executed to summarize all model receptors and their corresponding 5-year average unitized concentrations in another tabular output file for each source group.

C. Confirmation of Air Dispersion Modeling

The DEP confirmed Shell's air dispersion modeling for the inhalation risk assessment by executing AERMOD, upon reviewing the appropriateness of all model inputs, i.e., model control options, source emission data, building downwash data, terrain data, meteorological data, and

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[21] Surface meteorological data from the Beaver Valley Nuclear Generating Station was shared by a representative of the power station on August 15, 2023.
[22] *Code of Federal Regulations*. 40 CFR Part 51, Appendix W (Guideline on Air Quality Models). Subsections 8.4.3.2 and A.1(b)(2).

output options, to generate the maximum 1-hour unitized concentrations and 5-year unitized concentrations that were used in the DEP's confirmation of Shell's inhalation risk assessment.

IV. Conclusions

The DEP's technical review concludes that Shell's air dispersion modeling for the inhalation risk assessment, in conjunction with the revisions made by the DEP, is consistent with the EPA's relevant air dispersion modeling policy and guidance.

All input, output, and data files associated with Shell's air dispersion modeling for the inhalation risk assessment and the DEP's technical review thereof are available upon request.