pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

MEMO

TO Craig A. Evans, P.E.
Environmental Group Manager
Air Toxics and Risk Assessment Section
Division of Permits

FROM Andrew W. Fleck AWF
Environmental Group Manager
Air Quality Modeling Section
Division of Air Resource Management

DATE September 21, 2020

RE Summary of Revised Air Dispersion Modeling for Inhalation Risk Assessment
Shell Chemical Appalachia LLC
Plan Approval Application 04-00740C
Shell Polymers Monaca Site
Center Township and Potter Township, Beaver County

Background

The Pennsylvania Department of Environmental Protection (DEP) received a Plan Approval Application[1,2] on February 14, 2020, and February 26, 2020, from Shell Chemical Appalachia LLC (Shell) which incorporates "as-built" changes in design and construction associated with the Shell Polymers Monaca Site, henceforth Shell Facility, in Center and Potter townships, Beaver County. The Plan Approval Application was prepared by RTP Environmental Associates, Inc., on behalf of Shell. On March 4, 2020, the DEP Southwest Regional Office's (SWRO) Air Quality Program notified Shell that the Plan Approval Application was administratively complete.[3] Subsequently, the DEP received additional information associated with Shell's Plan Approval Application on April 24, 2020,[4] May 21, 2020,[5] May 28, 2020,[6] and September 3, 2020.[7]

[1] Air Quality Plan Approval Application. Shell Polymers Monaca Design Updates. Shell Chemical Appalachia LLC. Beaver County, Pennsylvania. Prepared by: RTP Environmental Associates, Inc., Raleigh, NC. February 2020.
[2] E-mail with attachments from H. James Sewell, Shell to Alexander Sandy, SWRO New Source Review Section. February 26, 2020.
[3] Letter from Alexander Sandy, SWRO New Source Review Section to H. James Sewell, Shell. March 4, 2020.
[4] Letter with enclosures from H. James Sewell, Shell to Alex Sandy, SWRO New Source Review Section. April 24, 2020.
[5] Letter with enclosures from H. James Sewell, Shell to Melissa Jativa, SWRO New Source Review Section. May 21, 2020.
[6] Letter with enclosures from H. James Sewell, Shell to Melissa Jativa, SWRO New Source Review Section. May 28, 2020.
[7] Letter with enclosures from H. James Sewell, Shell to Melissa L. Jativa, SWRO New Source Review Section. September 3, 2020.

The DEP issued Plan Approval 04-00740A on June 18, 2015, authorizing construction and temporary operation of the Shell Facility. The "as-built" changes in design and construction associated with the Shell Facility necessitated revisions to the air dispersion modeling for the inhalation risk assessment associated with Shell's application for Plan Approval 04-00740A.

Regulatory Applicability

In accordance with 25 *Pa. Code* 127.12(a)(2), Shell's Plan Approval Application included an inhalation risk assessment for the Shell Facility's estimated emissions of 53 compounds of potential concern (COPC). To this end, Shell conducted air dispersion modeling to calculate short- and long-term average concentrations for estimating acute and chronic risk, respectively, to human health.

Model Selection and Options

Shell's air dispersion modeling for the inhalation risk assessment utilized the American Meteorological Society (AMS) / U.S. Environmental Protection Agency's (EPA) Regulatory Model (AERMOD) v19191. 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.[8]

AERMOD was executed with regulatory default options. In the air dispersion modeling for estimating acute risk, the option to calculate concentrations for a 1-hour averaging time was selected in AERMOD. In the air dispersion modeling for estimating chronic risk, the option to calculate concentrations averaged over the meteorological data period was selected in AERMOD. Additionally, the flagpole receptor height option was selected in AERMOD with a default height of 0.0 meters.

Source Data Input

The Shell Facility's COPC emissions would be emitted to the atmosphere via a combination of typical unobstructed vertical stacks, flares, and as fugitives. The Shell Facility would consist of the following COPC emission sources:

- 7 ethane cracking furnaces' stacks;
- 3 combustion turbines' stacks;
- 2 ground flares;
- 1 high pressure elevated flare;
- 1 multipoint ground flare;
- 1 low pressure incinerator stack;
- 1 caustic oxidizer stack;
- 26 process cooling tower cells' stacks;
- 2 emergency fire water pumps' stacks;
- 5 emergency generators' stacks;
- 2 catalyst heaters' stacks;
- 2 catalyst activator filters' stacks;
- 11 ethane cracking fugitives;
- 4 outside boundary limit fugitives; and
- wastewater treatment plant fugitives.

[8] *Code of Federal Regulations*. 40 CFR Part 51, Appendix W (Guideline on Air Quality Models). Subsection 4.2.2.1.

All stacks were characterized in AERMOD as point sources. Flares, except the multipoint ground flare, were also characterized in AERMOD as point sources. The multipoint ground flare and all fugitive emissions were characterized in AERMOD as volume sources.

The emission rates and associated parameters entered in AERMOD for each source are consistent with those provided in Shell's Plan Approval Application and associated additional information.

In the air dispersion modeling for estimating acute risk, AERMOD was executed separately for each COPC. The maximum 1-hour emission rate for each source associated with each COPC was entered in AERMOD to calculate a maximum 1-hour concentration for each COPC. In the air dispersion modeling for estimating chronic risk, a "unit" emission rate equivalent to 1 pound per hour was entered in AERMOD for each source to calculate a 5-year average "unit" concentration for each source at each receptor entered in AERMOD.

The stack height entered in AERMOD for each Shell Facility point source does not exceed Good Engineering Practice (GEP) stack height.[9] Direction-specific downwash parameters, calculated by the EPA's Building Profile Input Program for the Plume Rise Model Enhancements algorithm (BPIPPRM) v04274, were entered in AERMOD for each Shell Facility point source.

Receptor Data Input

In the air dispersion modeling for estimating acute risk, receptors were entered in AERMOD at locations defined to be ambient air,[10,11] including receptors along the Vanport bridge with flagpole heights representing the bridge's deck height above water. In the air dispersion modeling for estimating chronic risk, receptors were excluded in areas were chronic exposure would not occur, i.e., portions of the Ohio River, Shell's property adjacent to the Ohio River, along the railroad transecting Shell's property, and along the Vanport bridge. The extent and density of AERMOD's receptor domains were adequate to determine the location and magnitude of the maximum concentrations.

Receptor elevations and hill height scales were calculated by the AERMOD terrain preprocessor (AERMAP) v18081 using the U.S. Geological Survey's (USGS) 3D Elevation Program (3DEP) data.

Meteorological Data Input

AERMOD utilized a 5-year meteorological dataset consisting of hourly records from January 1, 2006, through December 31, 2010. This dataset was derived from primary surface data from FirstEnergy's Beaver Valley Nuclear Power Station meteorological monitoring site and secondary surface data and upper air data from Pittsburgh International Airport (KPIT).

[9] "Good Engineering Practice stack height" defined in 40 CFR § 51.100(ii).
[10] "Ambient air" defined in 40 CFR § 50(e)(1).
[11] Revised Policy on Exclusions from "Ambient Air." EPA memorandum from Andrew R. Wheeler, Administrator to Regional Administrators. December 2, 2019.

The meteorological dataset was processed by the DEP with the AERMOD meteorological preprocessor (AERMET) v19191 and its associated tool, AERSURFACE v13016. In AERMET, the surface friction velocity adjustment (ADJ_U*) option was used in regulatory default mode. This option is intended to address concerns regarding AERMOD's performance, i.e., overprediction of concentrations during stable low wind speed meteorological conditions, by adjusting the surface friction velocity based on Qian and Venkatram (2011).[12]

The fully processed dataset 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.

Confirmation of Air Dispersion Modeling Results

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

The DEP's and Shell's air dispersion model results were compared. Differences in the DEP's resulting concentrations are due to the following differences in the DEP's model input:

- For estimating both acute and chronic risk, the DEP's rounding of emission rates and emission parameters in AERMOD's source pathway;

- For estimating both acute and chronic risk, the DEP's inclusion of COPC emissions associated with Emergency Generator #6, which Shell no longer proposes to install;

- For estimating acute risk for barium, chromium, copper, molybdenum, pentane, propane, and vanadium, the DEP's inclusion of emissions from the two ground flares, high pressure elevated flare, multipoint ground flare, low pressure incinerator stack, and caustic oxidizer, consistent with the emission information provided in Attachment A of Appendix D of Shell's Plan Approval Application;

- For estimating acute risk for benzene, styrene, and xylenes, the DEP's inclusion of additional outside boundary limit fugitive emissions, consistent with the emission information provided in Attachment A of Appendix D of Shell's Plan Approval Application; and

- For estimating acute risk for polycyclic aromatic hydrocarbons, the DEP's inclusion of emissions from the two emergency fire water pumps, consistent with the emission information provided in Attachment A of Appendix D of Shell's Plan Approval Application.

[12] Qian, W., and A. Venkatram, 2011. Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions. *Boundary Layer Meteorology*, 138, 475-491.

Conclusions

The DEP's technical review concludes that Shell's revised air dispersion modeling for the inhalation risk assessment is consistent with the EPA's relevant air dispersion modeling policy and guidance. Additionally, Shell's revised air dispersion modeling is consistent with the methods and procedures described in the modeling portion of its inhalation risk assessment protocol.[13]

If you have any questions regarding Shell's revised air dispersion modeling for the inhalation risk assessment, you may contact me by e-mail at afleck@pa.gov or by telephone at 717.783.9243.

cc: Viren Trivedi, BAQ Permits
Brian Morgan, BAQ Air Toxics and Risk Assessment
Mark Gorog, SWRO Air Quality
Edward Orris, SWRO New Source Review
Melissa Jativa, SWRO New Source Review
Kirit Dalal, BAQ Air Resource Management
AQ Modeling Correspondence File

[13] Protocol for the Inhalation Risk Assessment. Petrochemicals Complex. Shell Chemical Appalachia LLC. Beaver County, Pennsylvania. Prepared by: RTP Environmental Associates, Raleigh, NC. January 2015.