SOUTHEAST TEXAS PHOTOCHEMICAL MODELING TECHNICAL COMMITTEE

Meeting Summary
August 18, 2010

H-GAC Offices
3555 Timmons Avenue
Houston, Texas

Members and Guests Present:

Bruce Benton, Erik Snyder, Michael Feldman, Elena Craft, Barry Lefer, Bernhard Rappenglueck, Dan Baker, Bruce Davis, Steven Hansen, Rohit Sharma, Daniel Cohan, Nathan Chenaux, Antara Digar, Liz Hendler, Graciela Lubertino, Mark Estes, Ron Thomas, Michael Ege, Dan Lutz, Ryan Perna, and Dick Karp, and Lola Brown, Angela Kissel, Tom Tesche, Jim Wilkinson, and Jim Smith, via telephone.

SIP Planning and Implementation Update – Lola Brown (TCEQ)

(Note: Lola's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html and contains specific links to the various items discussed below.)

Lola indicated the TCEQ Air Quality Planning Section staff is currently involved in the following activities:

- reviewing the proposed Clean Air Transport Rule (August 2, 2010, Federal Register) and has requested a 90-day extension of the public comment period, as well as additional public hearings to include a Texas location; and
- reviewing the information provided with the new standards for sulfur dioxide (SO_2) and nitrogen dioxide (NO_2), and preparing to develop designation recommendations.

Lola reported the TCEQ will be accepting written comment on potential ozone nonattainment area boundaries and classifications for the 2010 ozone NAAQS until September 3, 2010. (Note: subsequent to the meeting, EPA announced a delay in the 2010 ozone NAAQS, so the TCEQ has extended the comment period to November 8, 2010)

Lola also reported that the TCEQ executive director has approved a HGB RACT SIP revision to provide EPA with an updated RACT analysis which will include the CTGs not included in the March 2010 SIP revision. The RACT update SIP revision is tentatively scheduled for proposal in May 2011 with adoption in November 2011.

In addition, Lola reported the TCEQ has scheduled the following hearings on the proposed revisions to the VOC degassing rules:

- Austin on September 7, 2010,
- Houston on September 8, 2010, and
- Fort Worth on September 9, 2010.

The comment period on the rule revisions closes on September 13, 2010.

Also, Lola indicated that the TCEQ Emissions Banking and Trading Program has posted the final 2010 CAIR NO_X allowance allocations from the new unit set-aside trading budget at:
http://www.tceq.state.tx.us/implementation/air/banking/Air_Banking_CAIR.html.

For other questions or more information, please contact Lola at lbrown@tceq.state.tx.us.

Major Findings from the 2009 Sharp Field Campaign – Barry Lefer, Ph.D., U of H

(Note: Barry's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

The 2009 SHARP (Study of Houston Atmospheric Radical Precursors) field campaign occurred during the springtime from April 15 through June 2, 2009. Although historically the period from late July through early October is generally associated with the highest ozone concentrations and the most number of days with exceedances, the springtime is also associated with a notable number of exceedance days. One of the major objectives of this study was to determine the relative importance of the springtime ozone formation mechanism. With regard to the ozone formation mechanism, a particular focus of the study was determining the contribution of direct (primary) emissions of formaldehyde (HCHO) and nitrous acid(HONO), both of which produce hydroxide radical (OH*), which is the major oxidizing agent in the photochemistry of the troposphere. Other objectives of the study included the formation pathways (secondary) of HCHO (via oxidation of olefins) and HONO (e.g., nitric acid reactions on hydroxyl-aerosols) and measuring the ambient levels of nitrous chloride ($ClNO_2$). Similar to OH*, the chloride radical (Cl*) is also an oxidizing agent in the photochemistry of the troposphere. Another objective was determining the impact of soot on the atmospheric chemistry (including photochemistry) in Houston.

During the presentation, Barry responded to questions and comments regarding a slide that showed a time series graphic of the measured ozone production (ppb/hr), the measured ozone concentration (ppb) and the measured nitrogen oxide (NO) concentration (ppb) at the U of H Moody Tower for May 4, 2009, one of the days following a frontal passage on which eight-hour ozone exceeded 80 ppb. Barry explained that the increasing ozone production from 0600 to 1100 hours is reflected in the increase in the ozone concentrations up to approximately that time. However since the slope of the time series of the ozone concentration remains the same until approximately 1600 hours, during which time the ozone production, although still

positive, is generally decreasing, this suggests that a notable amount of ozone produced somewhere else must have been transported to the Moody Tower site in the early afternoon.

Barry also responded to a question about the potential primary emissions of HCHO and HONO from mobile sources and indicated that measurements indicate that these emissions are primarily associated with diesel exhaust.

Barry was also asked to which hour the eight-hour average ozone concentrations were assigned, as the TCEQ assigns the eight-hour average ozone concentrations to the first hour of the period. For example, the eight-hour average ozone concentration assigned to 1200 hours (noon) is the eight-hour average ozone concentration for the hours from 1200 through 1700. Barry indicated they had not assigned the eight-hour average ozone concentrations in that manner, but instead had used the end hour.

Overview of Meteorology and Chemistry During SHARP – Bernhard Rappenglueck, Ph.D., U of H

(Note: Bernhard's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Bernhard's presentation focused on comparing and contrasting aerometric measurements taken during the SHARP field campaign at the Clinton Drive monitoring site (CD) and Moody Tower (MT). The CD site, at an elevation of approximately 6 meters (above sea level) and in a generally industrial setting, is approximately 8 kilometers east-north-east (bearing approximately 73 degrees) from MT at an approximately 70 meter elevation and in a generally urban setting.

In response to a question about large hour to hour wind direction shifts being associated with low wind speeds and the averaging time used, Bernhard responded that typically low wind speeds are associated with large shifts in wind direction. However, for this analysis stagnant winds (i.e., less than 3 mph) were not used. As Bernhard and Barry recalled, they used a 15 minute averaging time and agreed that a larger averaging time, say one hour, might smooth out the data, although in general, the wind data showed good agreement between the two sites. As Bernhard pointed out, for winds out of the north (e.g., from 350 to 10 degrees), the graphical display (from 0 to 360 degrees) can give an impression of poor agreement, when in fact there is good agreement.

During the discussion comparing PAN and PPN at the two sites, PPN being more attributable to industrial emissions, a question was raised about the meaning of the acronyms. Bernhard responded that PAN stands specifically for peroxyacetyl nitrate ($CH_3CO_3NO_2$) and is formed when the peroxyacetyl radical (CH_3CO_3) reacts with NO_2. While precursors for PAN may include a wide variety of hydrocarbons with C numbers greater than 2, precursors for, PPN (peroxypropionyl nitrate; C3H2CO3NO2) tend to be longer chained hydrocarbons. This is why PPNs are even more closely associated with anthropogenic emissions, whereas PAN can be derived from both industrial and biogenic (i.e., isoprene) emissions, and also why generally, PAN is greater than PPN.

Bernhard was asked about the time series graphics of benzene and toluene for May 19-20, 2009, and May 29-30, 2009. The time series show these two aromatics increasing sharply as carbon monoxide (CO) is decreasing from the morning (rush hour) traffic, suggesting the possibility of emissions from other than mobile sources. In particular, the question was whether vehicle "hot-soak" emissions, i.e., evaporative emissions from vehicles after they have just been turned off, could account for a temporal lag in the aromatic measurements as compared to the CO measurements. Bernhard responded that since for both May 19-20, 2009, and May 29-30, 2009, the winds were generally blowing from the Houston Ship Channel (HSC) to the CD and MT monitoring sites, it seemed to him more likely that the HSC sources accounted for the aromatic measured concentrations. In addition, the benzene levels were unusually high compared with typical rush hour traffic values.

In closing, Bernhard indicated that U of H was currently conducting a follow on field campaign at the MT and CD sites funded by the TCEQ, which began on August 15 and is scheduled to run through October 15, 2010. In regards to this monitoring project, Bernhard and Barry asked about partnering with industry to provide hourly emission data for the August 15 through October 15, 2010, period. It was discussed that the 2010 point source emissions inventory was due to the TCEQ on March 31, 2011, but the temporal resolution is annual, although some sources are required to provide ozone-season-day emissions estimates. However, sources required to have continuous emissions monitoring systems (CEMS) would have hourly emissions data. The TCEQ staff indicated they would follow up on the request.

H-GAC Air Quality Issues – Graciela Lubertino, Ph.D. (H-GAC)

(Note: Graciela's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Graciela presented the draft results of the MOVES versus MOBILE6 on-road mobile source emission estimate for the eight-county HGB area. The calculations were done by TTI for the TCEQ, using the years 2006 and 2018 since these are the baseline and attainment years, respectively, for the SIP revision submitted to EPA in April 2010. For the 2006 baseline, MOVES generates 42% more NO_X than MOBILE6, while the MOVES' CO emission estimate is a little less (approximately 9%) and the MOVES' VOC emission estimate is a somewhat larger (approximately 19%). For the 2018 future base, MOVES generates 110% more NO_X than MOBILE6, while the MOVES' CO emission estimate is somewhat less (approximately 16%) and the MOVES' VOC emission estimate is only a little larger (approximately 4%). Graciela explained that the main difference in NOx emissions is due to the estimation of the emission factors, since it has been shown that the emission credits taken by the use of the I/M and ATP programs should not be as large as MOBILE6 estimated. Also, Graciela indicated that the substantial change in the estimated NO_X emissions is problematic, because there appears to be a scheduling conflict between the time MOVES must be used for conformity analyses and the adoption of a new motor vehicle emissions budget (MVEB) based on MOVES.

As Graciela explained, the HGB SIP submitted to EPA in April 2010 has a MVEB based upon the lower NO_X emissions generated with MOBILE6 and once adopted, that MVEB

will become the target for conformity analyses until a new MVEB based upon MOVES is adopted. EPA regulation will require using MOVES generated emission estimates for conformity purposes in April 2012, however, the anticipated date for the next SIP revision, which would include a new MVEB based on MOVES, is December 2013, with potential adoption sometime in 2014. This means there could be at least a two year period (2012 to 2014) during which conformity analyses would be required to use MOVES, which generates larger NO_X emissions, with a MVEB based upon the lower MOBILE6 emission estimate, and with such a substantial difference, it is quite likely H-GAC will not be able to show conformity. As discussed the HGB area is not the only area which is facing this issue and the consensus appeared to be that EPA needs to work on resolving this problem.

During the discussion Graciela was asked which of the two models (MOVES or MOBILE6) is more correct and responded that the MOVES estimates are supposed to be more correct since they are based on newer tests and calculations of emission factors.

Graciela was also asked about the difference in CO_2 emission estimates between MOVES and MOBILE6, and indicated that both models estimate CO_2 emissions but for MOBILE6 the estimation is independent of vehicle speed, while for MOVES the CO_2 emissions are speed dependent. Currently H-GAC does not have to address CO_2 in their conformity analyses, so she did not include it in this presentation.

It was noted that MOVES and MOBILE6 emissions factor models are formulated somewhat differently, in particular, with regard to the on-road mobile source activity data used to estimate emissions. And the question was asked if these formulation differences accounted for the difference in the estimated NO_X emissions. Dick indicated that his understanding was that the MOVES emission estimates developed by the Texas Transportation Institute (TTI) used the same travel demand model (TDM) output of on-road mobile source activity data (e.g., VMT, speeds), as used with MOBILE6, so the major difference is the emissions factors. (Note: subsequent to the meeting Dick check with Chris Kite, and TTI did use the same TDM processed output with MOVES)

EPA Update – Erik Snyder (EPA)

(Note: Erik's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Erik's presentation included updates to the 2010 revised ozone NAAQS, the interstate transport rule, and the new SO_2 NAAQS. Erik indicated that the publication of the 2010 revised ozone NAAQS may be delayed as the package still needs to be sent to OMB. (note: subsequent to the meeting EPA announced a delay in the publication of 2010 revised ozone NAAQS until the end of October 2010)

As Erik explained, the proposed interstate transport rule is intended to replace the Clean Air Interstate Rule (CAIR), which was remanded by the court. During Erik's presentation he was asked about the use of the 1997 ozone NAAQS (85 ppb) as the basis for the proposed rule, since the March 2008 NAAQS (75 ppb) and the proposed 2010 revised NAAQS (60 – 70 ppb) are notably lower. Erik responded that EPA needed to get

the replacement for CAIR proposed and the 2010 revised NAAQS has not been finalized, so they used the 1997 NAAQS. So while Texas would be required to reduce NO_X emission during the ozone season due to its modeled impact on east Baton Rouge at an 85 ppb NAAQS, it is not clear whether at a much lower NAAQS, Texas would impact other states.

Erik also indicated that permit modeling issues for both the new NO_2 and SO_2 NAAQS in forth coming guidance is expected to include interim significant impact levels (SILs).

Barge (in transit) Emission Estimates – Michael Ege, TCEQ

(Note: Michael's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Michael presented a status of the Barge Emissions project conducted by Eastern Research Group (ERG). The project focuses on estimating 2008 evaporative emissions of volatile organic compounds (VOCs), in particular, hazardous air pollutants (HAPs), toxics and highly reactive VOC (HRVOC), from barges while in transit, similar to "breathing losses" from storage tanks. The project focused on barge traffic in the HGB, BPA and Corpus Christi industrial waterways.

ERG used data available from the U.S. Army Corps of Engineers, the U.S. Coast Guard, the American Waterways Operators and the Texas Waterways Operators Association to develop emission factors for various barges taking into account:

- 3 geographic areas,
- 3 barge sizes,
- 3 barge pressure settings, and
- 16 chemical categories.

During Michael's presentation, he was asked why the Victoria industrial waterway was not included as one of the geographical areas, and responded that he was not sure but it may be due to the level of activity being much less than the other areas.

Michael was also asked about the apparent lack of HRVOCs transported by barge, since at least anecdotally in the past (1990s) there were reports of possible emission events arising from releases from barges. For example, in the 2000 HGB AD SIP revision, there is a discussion of such an event, although it only refers to a "plant upwind of the monitor" and not specifically to a barge. Michael and other TCEQ staff (Ron Thomas) responded that most if not all HRVOCs are most likely transported via pipelines.

CAMx Alternative Plume Rise Algorithm – Ron Thomas, TCEQ

(Note: Ron's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Ron presented the results of a CAMx model enhancement project conducted by Environ. The project involved the development of an alternative plume rise algorithm, which would distribute emissions vertically into multiple layers (note: the current plume rise

algorithm in CAMx places all emissions in the vertical layer corresponding to the height of the stack plus the plume rise).

In conducting the project, Environ reviewed the plume rise algorithm used in the SMOKE/CMAQ emissions modeling system as a possible candidate. However, Environ noted some issues with the SMOKE/CMAQ algorithm, including an upward bias in plume rise for short stacks (10 meters), an arbitrary assumption that the plume depth equals plume rise and a uniform distribution of emissions to multiple layers. Therefore, Environ decided to upgrade the current CAMx algorithm by:

- Determining the plume depth at final plume rise using the same diffusion equations used in the Plume-in-Grid sub-model and vertically distributing the emissions in a gaussian distribution,
- Improving the capping inversion to allow for partial penetration into layers at and above the capping inversion, and
- Applying a lower limit of ambient wind speed (1.0 m/s) to eliminate unrealistically large plume rise estimates under neutral/unstable light wind conditions.

Ron showed the NO_X and ozone modeling results of comparing CAMx with the alternative plume rise (CAMx_v5.2pr) to the original CAMx (CAMx_v5.2) for the 2006 episodes. Generally, the domain-wide peak NO_X differences (CAMx_v5.2pr minus CAMx_v5.2) were small and negative (approximately -1 to -2 ppb), with the largest differences associated with the largest NO_X sources (e.g., large power plants). And as expected, the domain-wide peak ozone differences were generally positive, located at the largest NO_X sources (i.e., less titration).

During the presentation, Ron was asked about comparing CAMx_v5.2pr with the SMOKE/CMAQ system, and responded that he did not think there was much to be gained. Ron was also asked about the impact on the fourth highest eight-hour ozone concentration, and responded that he did not think this analysis could address a change in the modeled fourth highest eight-hour ozone concentration. In addition, Ron was asked about comparing vertical profiles of CAMx_v5.2pr and CAMx_v5.2 modeled NO_X and ozone with aircraft spirals and ozone sondes, which Ron indicated was a good idea, although Ron felt the most benefit of the alternative plume rise would be from a regional effect.

Proposed New Modeling Domains – Dick Karp, TCEQ

(Note: Dick's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Dick explained that the 2010 ozone NAAQS will require new modeling domains for the new nonattainment areas within Texas (e.g., Austin, San Antonio) and this provided an opportunity for the TCEQ to review and evaluate features of the modeling domains, including the geographical mapping projection and the geographical extent of fine, intermediate and coarse grids. In particular, the TCEQ weighed the advantages and disadvantages of adopting the national (RPO) mapping projection used by most other states, as well as EPA for national ozone modeling. The TCEQ feels the major advantage

of direct compatibility of modeling files between the TCEQ and other modeling efforts outweighs the disadvantages and is moving forward to develop the needed files to model the new projection for work conducted in support of 2010 ozone standard SIPs.

As Dick showed, a 36 km coarse grid domain (one each for the meteorological modeling with WRF and the photochemical modeling with CAMx), and a 12 km nested intermediate grid domain (again, one each for WRF and CAMx) will be used with one 4 km nested fine grid domain for WRF, 0ne for EI and nonattainment area specific 4 km nested fine grid domains for CAMx. Dick mentioned a couple of exceptions to this modeling domain configuration, those being for the HGB nonattainment area, which is expected to need a higher resolution fine grid of 1 km and El Paso, for which no 4 km fine grid may be needed due to the influence of international emissions.

During the presentation Dick was asked about source apportionment modeling using the 4 km EI domain. Dick responded that he felt that source apportionment modeling was most useful when modeling the future base to see what sources from what regions have notable impacts and possibly when that time arrives there may be some consideration given to modeling the 4 km EI domain. The typical approach has been to apply the source apportionment modeling to the nest grid configuration with some source regions being in multiple domains.

Subsequent to the meeting, Dick was asked whether the 4 km fine grid domains that encompass more than one nonattainment area, such as HGB and BPA, implied the TCEQ was planning to combine nonattainment areas. Dick responded that currently it is only for modeling purposes that nonattainment areas, such as HGB and BPA, are combined.

Air Quality Research Program (AQRP) Update – Mark Estes

(Note: Mark's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Mark presented an overview of the AQRP projects that were recently awarded, plus two contingency projects. In his overview he discussed the AQRP projects in groups, those involving data collection and analysis, those involving enhancing emission estimates and those involving photochemical modeling.

Mark was questioned about the projects involving estimating emissions from flares, in particular, the addition of more flare test days to the TCEQ Comprehensive Flare Study. Industry representatives indicated that if the scope of the TCEQ Comprehensive Flare Study was being changed, they wanted an opportunity to comment. They suggested this could be accomplished via an addendum to the QAPP. Subsequent to the meeting Mark checked with other TCEQ staff knowledgeable of the QAPP for the TCEQ Comprehensive Flare Study and determined that the current QAPP allows for the addition of more sampling days. Therefore this AQRP project does not constitute a change in scope. Mark communicated this to industry representatives.

8-Hour Coalition Update – Tom Tesche, Ph.D., CARA

(Note: Tom's presentation is available on the SETPMTC Web site, http://www.tceq.state.tx.us/implementation/air/airmod/committee/pmtc_set.html.)

Tom briefly went over the modeling project being conducted for the 8-Hour Coalition to be submitted to the TCEQ as a weight-of-evidence (WOE) approach for the next HGB eight-hour ozone SIP revision. One particular feature of the modeling project is the categorization of ozone exceedance days into those days that can be adequately replicated with current state-of-the-science models (category I) and those days that cannot be adequately replicated (category II). The presumption appears to be that if the fourth highest eight hour ozone concentrations at one or more monitors are made up of category II days, the current modeling attainment test is not appropriate. Further, if the category II days are primarily due to emission events not included in the models, then the current modeling attainment test would result in requiring emissions reductions from all sources, rather than focusing on those sources responsible for the emissions events. To address this situation, the 8-Hour Coalition modeling approach is to:

1. Conduct multi-scale ensemble modeling simulations of the category I days for three consecutive future years consisting of seven-month long ozone seasons and calculate the future design value directly;
2. Conduct emissions control effectiveness modeling for monitors with future year fourth highest eight-hour ozone associated with category II days; and
3. Merge the results from the above steps for the pertinent monitors to calculate a future design value.

During the presentation, Tom was asked what if the category II days are primarily a meteorology problem (e.g., wind speed, wind direction) and not due to an emission event. Tom responded that the case-by-case analyses conducted on the category II days will indicate whether the problem is due to meteorology or emissions. Tom also indicated that the category II days could be divided into those for which the case-by-case analysis identifies the problem (i.e., provides an explanation) and those days that cannot be explained. The TCEQ staff commented that based on the recent field studies (TexAQS II, TRAMP, SHARP), the current emissions inventory under-represents the routine (i.e., typical) ozone precursors being emitted, which will bias case-by-case analyses of category II days. Staff also noted that categorizing and analyzing exceedance days might lead to insights as to why the model has difficulty replicating the observed concentrations under certain conditions. Delineating these insights could potentially point the way to improving the models. The reason that improving the models is of fundamental importance is that they provide the only practical means for assessing the effects of emission changes (future growth and controls) on air quality. However, Tom indicated that his scope of work did not extend beyond categorizing and analyzing the days.

Agenda Items for October 14, 2010 Meeting

Dick indicated that the next SETPMTC meeting is scheduled for October 14, 2010, and that a meeting has also been scheduled for December 16, 2010.

Dick also indicated that the HRVOC pipeline air quality emissions project is scheduled to be presented at the October, 14, 2010, meeting.