Revisions to the State Implementation Plan (SIP)
for the Control of Ozone Air Pollution

HOUSTON/GALVESTON/BRAZORIA OZONE NONATTAINMENT AREA

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
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Adopted
December 1, 2004

PROJECT NO. 2004-042-SIP-NR

SECTION V: LEGAL AUTHORITY

A. General

The TCEQ has the legal authority to implement, maintain and enforce the national ambient air quality standards.

The first air pollution control act, known as the Clean Air Act of Texas, was passed by the Texas Legislature in 1965. In 1967, the Clean Air Act of Texas was superceded by a more comprehensive statute, the Texas Clean Air Act (TCAA), found in Article 4477-5, Vernon's Texas Civil Statutes. The Legislature amended the TCAA in 1969, 1971, 1973, 1979, 1985, 1987, 1989, 1991, 1993, 1995, 1997 and 1999. In 1989, the TCAA was codified as Chapter 382 of the Texas Health & Safety Code.

Originally, the TCAA stated that the Texas Air Control Board (TACB) is the state air pollution control agency and is principal authority in the state on matters relating to the quality of air resources. In 1991, the Legislature abolished the TACB effective September 1, 1993, and its powers, duties, responsibilities and functions were transferred to the Texas Natural Resource Conservation Commission (TNRCC). With the creation of the TNRCC, the authority over air quality is found in both parts of the Texas Water Code and the TCAA. Specifically, the authority of the TNRCC is found in Chapters 5 and 7. Chapter 5, Subchapters A - F, and H - J and L, include the general provisions, organization and general powers and duties of the TNRCC, and the responsibilities and authority of the Executive Director. This Chapter also authorizes the TNRCC to implement action when emergency conditions arise, and to conduct hearings. Chapter 7 gives the TNRCC enforcement authority. In 2001, the 77th Texas Legislature continued the existence of the TNRCC until September 1, 2013, and changed the name of the TNRCC to the Texas Commission on Environmental Quality (TCEQ).

The TCAA specifically authorizes the TCEQ to establish the level of quality to be maintained in the state's air and to control the quality of the state's air by preparing and developing a general, comprehensive plan. The TCAA, Subchapters A - D, also authorize the TCEQ to collect information to enable the commission to develop an inventory of emissions; conduct research and investigations; enter property and examine records; to prescribe monitoring requirements; to institute enforcement proceedings; to enter into contracts and execute instruments; to formulate rules; to issue orders taking into consideration factors bearing upon health, welfare, social and economic factors, and practicability and reasonableness; to conduct hearings; to establish air quality control regions; to encourage cooperation with citizens' groups and other agencies and political subdivisions of the state as well as with industries and the Federal Government; and to establish and operate a system of permits for construction or modification of facilities.

Local government authority is found in Subchapter E of the TCAA. Local governments have the same power as the TCEQ to enter property and make inspections. They also may make recommendations to the Commission concerning any action of the TCEQ that affects their territorial jurisdiction, may bring enforcement actions, and may execute cooperative agreements with the TCEQ or other local governments. In addition, a city or town may enact and enforce ordinances for the control and abatement of air pollution not inconsistent with the provisions of the TCAA, the rules or orders of the Commission.

B. Applicable Law

The following statutes and rules provide necessary authority to adopt and implement the SIP. The rules listed below have previously been submitted as part of the SIP.

Statutes

TEXAS HEALTH & SAFETY CODE, Chapter 382	September 1, 2001
TEXAS WATER CODE	September 1, 2001

All sections of each subchapter are included, unless otherwise noted.

Chapter 5: Texas Natural Resource Conservation Commission
Subchapter A: General Provisions
Subchapter B: Organization of the Texas Natural Resource Conservation Commission
Subchapter C: Texas Natural Resource Conservation Commission
Subchapter D: General Powers and Duties of the Commission
Subchapter E: Administrative Provisions for Commission
Subchapter F: Executive Director (except §§ 5.225, 5.226, 5.227, 5.2275, 5.232, and 5.236)
Subchapter H: Delegation of Hearings
Subchapter I: Judicial Review
Subchapter J: Consolidated Permit Processing
Subchapter L: Emergency and Temporary Orders (§§ 5.514, 5.5145 and 5.515 only)

Chapter 7: Enforcement
Subchapter A: General Provisions (§§ 7.001, 7.002, 7.0025, 7.004, 7.005 only)
Subchapter B: Corrective Action and Injunctive Relief (§ 7.032 only)
Subchapter C: Administrative Penalties, §§ 7.051- 7.075
Subchapter E Criminal Offenses and Penalties: §§ 7.177, 7.179-7.181

Rules
All of the following rules are found in Title 30, Texas Administrative Code, as of the following effective dates:

Chapter 7, Memoranda of Understanding, §§ 7.110 and 7.119	May 2, 2002
Chapter 35, Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions	December 10, 1998
Chapter 39, Public Notice, §§ 39.201; 39.401; 39.403(a) and (b)(8)-(10); 39.405(f)(1) and (g);39.409; 39.411 (a), (b)(1)-(6) and (8)-(10) and ©)(1)-(6) and (d); 39.413(9), (11), (12) and (14); 39.418(a) and (b)(3) and (4); 39.419(a), (b),(d) and (e); 39.420(a), (b) and ©)(3) and (4); 39.423 (a) and (b); 39.601; 39.602; 39.603; 39.604; and 39.605	September 23, 1999
Chapter 55, Request for Contested Case Hearings; Public Comment, §§ 55.1; 55.21(a) - (d), (e)(2), (3) and (12), (f) and (g); 55.101(a), (b),©)(6) - (8); 55.103; 55.150; 55.152(a)(1), (2) and (6) and (b); 55.154; 55.156; 55.200; 55.201(a) - (h); 55.203; 55.205; 55.206; 55.209 and 55.211	October 20, 1999

Chapter 101: General Air Quality Rules	October 20, 2002
Chapter 106: Permits by Rule, Subchapters A and B	October 20, 2002
Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter (formerly known as Regulation I), except amendments effective September 16, 1996 and June 11, 2000	June 11,2000
Chapter 112: Control of Air Pollution from Sulfur Compounds (formerly known as Regulation II)	July 16, 1997
Chapter 113, §113.120, Subchapter A: Control of Air Pollution from Toxic Materials (formerly known as Regulation III)	July 9, 2000
Chapter 114: Control of Air Pollution from Motor Vehicles (formerly known as Regulation IV)	May 28, 2002
Chapter 115: Control of Air Pollution from Volatile Organic Compounds (formerly known as Regulation V)	May 16, 2002
Chapter 116: Permits for New Construction or Modification (formerly known as Regulation VI)	October 20, 2002
Chapter 117: Control of Air Pollution from Nitrogen Compounds (formerly known as Regulation VII)	April 4, 2002
Chapter 118: Control of Air Pollution Episodes (formerly known as Regulation VIII)	March 5, 2000
Chapter 122, § 122.122: Potential to Emit	September 20, 1993

SECTION VI. CONTROL STRATEGY

A. Ozone (Revised)

1. *Dallas/Fort Worth* (No change since August 2001 revision)
2. *Houston/Galveston/Brazoria* **(Revised)**
    - Chapter 1: Executive Summary
    - Chapter 2: General
    - Chapter 3: Photochemical Modeling
    - Chapter 4: Data Analysis
    - Chapter 5: Required Control Strategy Elements
    - Chapter 6: Future Attainment Plans
3. *Beaumont/Port Arthur* (No change since October 2004 Revision**)**
4. *El Paso* (No change since July 1996 revision)
5. *Regional Strategies* (No change since April 2000 revision)
6. *Northeast Texas* (No change since November 2004 revision)
7. *Austin Area* (No change since November 2004 revision)
8. *San Antonio Area* (No change since November 2004 revision)

C. Particulate Matter (No change)

D. Carbon Monoxide (No change)

E. Lead (No change)

F. Oxides of Nitrogen (No change)

G. Sulfur Dioxide (No change)

H. Conformity with the National Ambient Air Quality Standards (No change)

I. Site Specific (No change)

J. Mobile Sources Strategies (No change)

1. *Inspection/Maintenance* (no change since September 2004 revision)
2. *Transportation Control Measures* (No change since May 2000 revision)
3. *Vehicle Miles Traveled* (No change since May 2000 revision)
4. *Clean Gasoline* (No change since June 1999 revision)

LIST OF ACRONYMS

ACT - Alternative Control Techniques
AFV - Alternative Fuel Vehicle
AFS - Airs Facility Subsystem
AIRS - Aerometric Information Retrieval System
APA - Administrative Procedure Act
ARACT - Alternate Reasonably Available Control Technology
ARPDB - Acid Rain Program Data Base
ASC - Area Source Categories
ASE - Alliance to Save Energy
ASM - Acceleration Simulation Mode
ATA - Airline Transport Association
ATMET - Atmospheric, Meteorological, and Environmental Technologies
ATC - Air Traffic Control
Auto-GC - Automated Gas Chromatograph
BACT - Best Available Control Technology
BCCA-AG - Business Coalition for Clean Air
BEIS - Biogenic Emissions Inventory System
BEIS-2 - Biogenic Emissions Inventory System, version2
BELD - Biogenic Emissions Land Cover Database
BIF - Boilers and Industrial Furnaces
BIOME - Biogenic Model for Emissions
BPA - Beaumont/Port Arthur
Cal LEV - California Low Emission Vehicle
CAM - Compliance Assurance Monitoring
CAMS - Continuous Air Monitoring Station
CAMx - Comprehensive Air Model with Extensions
CARB - California Air Resources Board
CARE - Clean Air Responsibility Enterprise
CB-IV HC - Carbon Bond IV Hydrocarbon
CFR - Code of Federal Regulations
CEMS - Continuous Emissions Monitoring System
CMAQ - Congestion Mitigation and Air Quality
CMSA - Consolidated Metropolitan Statistical Area
CNG - Compressed Natural Gas
CO - Carbon Monoxide
CO_2 - Cardon Dioxide
COAST - Coastal Oxidant Assessment for Southeast Texas
CTG - Control Technique Guidelines
DART - Dallas Area Rapid Transit
DERC - Discrete Emission Reduction Credit
DFW - Dallas/Fort Worth
DFWN - Dallas/Fort Worth North
DFWRTM - Dallas/Fort Worth Regional Travel Model
DOE - Department of Energy
DOW - Day of Week
DPS - Department of Public Safety

DRI - Desert Research Institute
DV - Design Value
EDFW - Extended Dallas/Fort Worth
EGAS - Economic Growth Analysis System
EGF - Electric Generating Facilities
EGR - Exhaust Gas Recirculation
E-GRID - Emissions and Generation Resource Integrated Database
EGU - Electric Generating Unit
EI - Emissions Inventory
EIA - Energy Information Administration
EIP - Economic Incentive Program
EISM - Enhanced Industry Sponsored Monitoring
EIQ - Emissions Inventory Questionnaire
ELP - El Paso
EMRS - Environmental Monitoring Response System
EPA - U.S. Environmental Protection Agency
EPN - Emission Point Number
ERC - Emission Reduction Credit
ERCOT - Energy Reliability Council of Texas
ERG - Eastern Research Group
ESAD - Emission Specification for Attainment Demonstration
ETR - Employer Trip Reduction
ETS/CEM- Emissions Tracking System/Continuous Emissions Monitoring
FAA - Federal Aviation Administration
FACA - Federal Advisory Committee Act
FCAA - Federal Clean Air Act
FCIAC- Fuel Cell Initiative Advisory Committee
FERC- Federal Energy Regulatory Commission
FMVCP - Federal Motor Vehicle Control Program
FR - Federal Register
FTE - Full Time Equivalent Employee
FTP- Federal Test Procedures
FTP - File Transfer Protocol
g/hp-hr - Grams Per Horsepower-Hour
GIS - Geographic Information System
GloBEIS - Global Biogenic Emissions Inventory System
g/mi - Grams Per Mile
GMAQS - Gulf of Mexico Air Quality Study
GOES - Geostationary Operational Environmental Satellites
GPM-Gallons Per Minute
GSE - Ground Support Equipment
GVWR - Gross Vehicle Weight Rating
GWEI - Gulf-Wide Emission Inventory
HAP - Hazardous Air Pollutant
HARC - Houston Advanced Research Center
HAXL - Houston Air Excellence in Leadership
HB - House Bill
HC - Hydrocarbon

HDD - Heavy-duty Diesel
HDDV - Heavy-duty Diesel Vehicle
HDEWG - Heavy Duty Engine Working Group
HDV - Heavy-duty Vehicle
HG - Houston/Galveston
HGA - Houston/Galveston Area (former notation for HGB)
HGAC - Houston-Galveston Area Council
HGB - Houston/Galveston/Brazoria
HON - Hazardous Organic NESHAPS
HOV - High Occupancy Vehicle
hp - Horsepower
HPMS - Highway Performance Monitoring System
HRM - Houston Regional Monitoring
HRVOC- Highly-Reactive Volatile Organic Compound
ICI - Industrial, Commercial, and Institutional
IIG - Interim Implementation Guidance
IIP - Interim Implementation Plan
I/M - Inspection and Maintenance
INIT - Initial Condition Tracer
ITWS - Integrated Terminal Weather System
IWW - Industrial Wastewater
KG/HA - Kilograms/hectare
KM - Kilometer
kWh- kilowatt-hour
LBNL- Lawrence Berkeley National Laboratory
LDAR- Leak Detection And Repair
LDEQ - Louisiana Department of Environmental Quality
LDT - Light-Duty Truck
LED - Low Emission Diesel
LEV - Low Emission Vehicle
LIDAR - Light Detection and Ranging
LNG - Liquefied Natural Gas
LSG - Low Sulfur Gasoline
m - Meter
MACT - Maximum Achievable Control Technology
MCR - Mid-Course Review
MDERC - Mobile Discrete Emission Reduction Credit
MERC - Mobile Emission Reduction Credit
MECT - Mass Emission Cap and Trade
METT - Mass Emissions Transient Testing
MIR - Maximum Incremental Reactivity
MRF - Medium Range Forecast
MM5 - Mesoscale Meteorological Model [Version 5]
MMBtu - Million British Thermal Unit
MPA - Metropolitan Planning Area
MSFC - Marshall Space Flight Center
MVEB - Motor Vehicle Emissions Budget
MWh - Megawatt Per Hour

MY - Model Year
NAAQS - National Ambient Air Quality Standard
NCDC - National Climatic Data Center
NCEP - National Center for Atmospheric Prediction
NCTCOG - North Central Texas Council of Governments
NEGU - Non-electric Generating Units
NEI - National Emissions Inventory
NERC- North American Electric Reliability Council
NESHAPS - National Emission Standards for Hazardous Air Pollutants
NET- National Air Pollutant Emission Trends
NEVES - Non-road Engine and Vehicle Emission Study
NHSDA - National Highway System Designation Act
NLEV - National Low Emission Vehicle
NNSR - Nonattainment New Source Review
NOAA - National Oceanic and Atmospheric Administration
NOAH LSM - Land Surface Model prepared by National Center for Atmospheric Prediction (NCEP), Oregon State University (OSU), Air Force, and the Hydrologic Research Laboratory
NO_x - Nitrogen Oxides or Oxides of Nitrogen
NO_y - Nitrogen Species
NSR - New Source Review
NTRD-New Technology and Research Development
NWS - National Weather Service
O_3 - Ozone
OAQPS - Office of Air Quality Planning and Standards
OBD - On-Board Diagnostics
OSAT - Ozone Apportionment Technology
OSU - Oregon State University
OTAG - Ozone Transport Assessment Group
OTAQ - Office of Transportation and Air Quality
OVOC - Other Volatile Organic Compounds (does not include HRVOC)
PAMs - Photochemical Assessment Monitoring Sites
PBL - Planetary Boundary Layer
PCA- Power Control Area
PCV - Positive Crankcase Ventilation
PEI - Periodic Emissions Inventory
PEMS- Predictive Emissions Monitoring System
PiG - Plume in Grid
PM_{10} - Particulate Matter less than 10 microns
PFM - Positive Matrix Factorization
ppb - Parts Per Billion
ppm - Parts Per Million
ppmv - Parts Per Million by Volume
PSDB - Point Source Database
PSIA - Pounds per Square Inch Absolute
PSIG- Pounds per Square Inch Gauge
PUC- Public Utility Commission
QA/QC - Quality Assurance/Quality Control
RACM- Reasonably Available Control Measure

RACT - Reasonably Available Control Technology
RAQPC - Regional Air Quality Planning Committee
RAZ - Regional Analysis Zone
RCTSS - Regional Computerized Traffic Signal System
RFG - Reformulated Gasoline
REMI - Regional Economic Modeling, Inc.
RFO - Request for Offer
ROP - Rate-of-Progress
RPM - Revolutions Per Minute
RRTM - Rapid Radiative Transfer Model
RSD - Remote Sensing Device
RVP - Reid Vapor Pressure
SAE - Society of Automotive Engineers
SAI - Systems Applications International
SAIMM - Systems Applications International Meteorological Model
SAPRC - Statewide Air Pollution Research Center
SB - Senate Bill
SCAN - Soil Climate Analysis Network
SCAQMD - South Coast Air Quality Management District [Los Angeles area]
SCC - Source Classification Code
SCR- Selective Catalytic Reduction
SCRAM - Support Center for Regulatory Air Models
SECO- State Energy Conservation Office
SETRPC - Southeast Texas Regional Planning Commission
SIC - Standard Industrial Classification
SIP - State Implementation Plan
SITWC - Spark Ignition Three-Way Catalyst
SO_2 - Sulfur Dioxide
SO_x - Sulfur Compounds
SOCI - Sudden Ozone Concentration Increase
SOCMI - Synthetic Organic Chemical Manufacturing Industry
SOS - Southern Oxidants Study
SPP- Southwest Power Pool
STARS - State of Texas Air Reporting System
SULEV - Super-Ultra-Low Emission Vehicle
TAC - Texas Administrative Code
TACB - Texas Air Control Board
TAFF - Texas Alternative Fuel Fleet
TAMU - Texas A&M University
TCAA - Texas Clean Air Act
TCEQ- Texas Commission on Environmental Quality (commission; formerly TNRCC)
TCF - Texas Clean Fleet
TCM - Transportation Control Measure
TERC - Texas Environmental Research Consortium
TERP- Texas Emission Reduction Plan
TexAQS - Texas 2000 Air Quality Study
TexAQS II - 2005-6 Texas Air Quality Study
TFS - Texas Forest Service

TIP - Transportation Improvement Program
TIPI - Texas Industrial Production Index
TMC - Texas Motorist's Choice
TMO - Transportation Management Organization
TNMOC - Total nonmethane organic compounds
TNRCC - Texas Natural Resource Conservation Commission (commission)
TPD - Tons Per Day
TPOD - Tons Per Ozone Day
TPY - Tons Per Year
TSP - Total Suspended Particulate
TTI - Texas Transportation Institute
TxDOT - Texas Department of Transportation
UAM - Urban Airshed Model
UAH - University of Alabama Huntsville
UHI - Urban Heat Island
UNC - University of North Carolina
USDA - United States Department of Agriculture
USGS - United States Geological Survey
UT - University of Texas
UTM - Universal Transverse Mercator
VAVR - Voluntary Accelerated Vehicle Retirement
VERP - Voluntary Emission Reduction Permit
VID - Vehicle Identification Database
VIN - Vehicle Identification Number
VIR - Vehicle Inspection Report
VMAS - Vehicle Mass Analysis System
VMEP - Voluntary Mobile Source Emissions Reduction Program
VMT - Vehicle Miles Traveled
VNR or VNRAT- VOC-NO_x ratios
VOC - Volatile Organic Compound
VRF - Vehicle Repair Form
WoE - Weight of Evidence
ZEV - Zero Emission Vehicle

HOUSTON/GALVESTON/BRAZORIA ATTAINMENT DEMONSTRATION
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CHAPTER 1: EXECUTIVE SUMMARY

1.1 INTRODUCTION

1.1.1 Purpose

The purpose of this document is to demonstrate that Texas has fulfilled its obligations under 42 USC §7410 of the Federal Clean Air Act (FCAA) for the Houston/Galveston/Brazoria (HGB) area defined by Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties. The Act requires a demonstration that revised state implementation plans (SIPs) are adequate to attain the 1-hour ozone National Ambient Air Quality Standard (NAAQS) and that such demonstration use photochemical grid modeling or any other analytical method determined by the Administrator of the United States Environmental Protection Agency (EPA) to be at least as effective. The HGB area, formerly denoted "HGA," ozone nonattainment area is classified as Severe-17 under the FCAA Amendments of 1990 (42 United States Code (USC) §§7401 et seq.), and therefore is required to attain the 1-hour ozone standard of 0.12 parts per million (ppm) by November 15, 2007.

1.1.2 Background

Ozone, a highly reactive gas, is present both in the Earth's upper atmosphere (the stratosphere) and at ground level (the troposphere). Tropospheric ozone is an air pollutant that is harmful to breathe and damages crops, trees and other vegetation. It is a main ingredient of urban smog. The troposphere generally extends to a level about 6 miles up from the Earth's crust, where it meets the second layer, the stratosphere. Ozone is formed naturally at high altitudes in the stratosphere where it acts beneficially to absorb potentially damaging ultraviolet solar radiation before it reaches the Earth's surface. Protection of stratospheric ozone is addressed under Title VI of the Clean Air Act.

Tropospheric ozone is usually not directly emitted to atmosphere but is instead produced at ground level by a series of chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of heat and sunlight. NO_x is produced primarily during the combustion of fossil fuels, such as gasoline, diesel, natural gas, and coal. Major sources of NO_x include motor vehicle exhaust, internal combustion engines such as those used in construction equipment, natural gas furnaces, and utility and industrial boilers. Anthropogenic emissions of VOC include gasoline vapors and industrial and commercial solvents. Additionally, vegetation emits significant amounts of biogenic VOC.

The Clean Air Act of 1963 and subsequent amendments in 1970, 1977, and 1990 mandated programs to define and address areas where ground level ozone concentration has reached unhealthy levels. The 1990 Amendments classified areas where monitored 1-hour ozone levels were exceeding the NAAQS of 0.12 ppm. The NAAQS is attained when, over a three-year period, the fourth highest value at a site (i.e., the design value) is less than 0.12 ppm. The term design value is used because air quality management strategies are designed to reduce this value to less than the level of the NAAQS. Nonattainment areas were classified as marginal, moderate, serious, severe, or extreme based on the design value in that area. The HGB area is classified as Severe-17, and therefore is required to attain the 1-hour ozone standard of 0.12 ppm by November 15, 2007.

"The History of the Texas State Implementation Plan (SIP), " a comprehensive overview of the SIP revisions submitted to EPA by the State of Texas is available at the following website: http://www.tnrcc.state.tx.us/oprd/sips/sipintro.html#History

For the HGB area, the TCEQ has developed an attainment demonstration in accordance with 42 USC

§7410. Recent HGB SIP revisions related to this SIP revision are the December 2000 1-hour ozone standard attainment demonstration, the September 2001 follow-up revision, and the December 2002 NO_x/highly reactive VOC (HRVOC) revision.

The development of a strategy for reducing ozone in HGB is complicated by the many factors contributing to ozone formation in this area. A hot sunny climate combined with large urban population and a highly concentrated industrial area provide the framework for ozone formation. Other challenges to modeling and controlling ozone in Houston include the significant biogenic emissions and complex meteorology including a land sea breeze that causes recirculation of air parcels.

In December 2000, the TCEQ adopted an HGB Attainment Demonstration Ozone SIP that included rules requiring a 90 percent average nitrogen oxides reduction strategy from industrial sources such as chemical plants, refineries, and power plants. In this SIP revision, the TCEQ committed to perform and submit a mid-course review (MCR). A follow-up HGB SIP was adopted in September 2001, incorporating some revisions to several control strategies.

The Business Coalition for Clean Air - Appeal Group (BCCA-AG), a group of Houston-area companies, challenged the December 2000 HGB SIP and some of the associated rules. Among other things, BCCA contended that the last 10 percent of the NO_x reductions were not cost effective and that the ozone plan would fail because the TCEQ did not account for volatile organic compound emissions associated with upset conditions. BCCA and the TCEQ settled the lawsuit in June 2001. Included in the settlement agreement was a commitment from the TCEQ to analyze rapidly forming ozone events and determine whether these events can be controlled with a strategy other than the 90 percent NO_x reduction strategy.

In compliance with the Consent Order, the commission conducted a scientific evaluation based in large part on aircraft data collected by the Texas 2000 Air Quality Study (TexAQS). The TexAQS, a comprehensive research project conducted in August and September 2000 involving more than 40 research organizations and over 200 scientists, studied ground-level ozone air pollution in the HGB and east Texas regions.

To address the findings from TexAQS and fulfill obligations in the consent order, the commission adopted a SIP revision in December 2002 focused on replacing the most stringent 10 percent industrial NO_x reductions with VOC controls. In light of the TexAQS study, the TCEQ conducted further modeling analysis of ambient VOC data. The photochemical grid modeling results and analysis indicated that the HGB area can achieve the same air quality benefits with industrial VOC emissions reductions, combined with 80 percent industrial NO_x emissions reductions, as would be realized with a 90 percent industrial NO_x emission reduction. An analysis of automated gas chromatograph data (TCEQ, 2002) revealed that four compounds were frequently responsible for high reactivity days: ethylene, propylene, 1,3-butadiene, and butenes, as such these compounds were selected as the best candidates for highly reactive VOC (HRVOC) emission controls.

The commission adopted revisions to the industrial source control requirements, one of the control strategies within the existing federally approved SIP. The December 2002 revision contains new rules that will better quantify and reduce HRVOC emissions from four key industrial sources: fugitives, flares, process vents, and cooling towers. The adopted rules target HRVOC emissions. Analysis showed that limiting emissions of ethylene, propylene, 1,3-butadiene, and butenes in conjunction with an 80 percent reduction in NO_x is equivalent or better in terms of air quality benefit to that resulting from a 90 percent point source NO_x reduction requirement alone.

1.2 APPROACH TO DEMONSTRATION OF FUTURE ATTAINMENT

1.2.1 Overview of EPA Modeling Guidance

The Clean Air Act requires that attainment demonstrations be based on photochemical grid modeling or any other analytical methods determined by the EPA to be at least as effective. EPA's "Guidance on the Use of Modeled Results to Demonstrate Attainment of the Ozone NAAQS," (EPA, 1996) improves on prior guidance by allowing greater consideration of an area's ozone design value and severity of meteorological conditions in the selection of episodes to model. Additionally, to more closely reflect the form of the NAAQS, the modeled attainment test permits occasional exceedances at any location. This guidance also acknowledges the uncertainty associated with using models to project ozone concentrations into future years.

This attainment demonstration uses the "Deterministic Approach" described in EPA's guidance consisting of an attainment test and an optional weight-of-evidence (WoE) determination. If the test is not passed, a weight of evidence determination may be performed. If the additional weight of evidence leads to the conclusion that attainment is likely, attainment is demonstrated. Because of the uncertainty of projecting air quality and emissions many years into the future, the guidance suggests that severe nonattainment areas provide for at least one MCR of air quality, emissions, and modeled data.

The TCEQ committed in 2000 to perform a MCR to ensure attainment of the 1-hour ozone standard. The MCR process provides the opportunity to update emissions inventory data, use current modeling tools, and enhance the photochemical grid modeling. The data gathered from the TexAQS continues to improve photochemical modeling of the HGB area. The collection of these technical improvements gives a more comprehensive understanding of the ozone challenge in Houston which is necessary for developing a plan to reach attainment. In early 2003, as the TCEQ was preparing to move forward with the MCR, EPA announced its plans to begin implementation of the 8-hour ozone standard. On June 2, 2003 the Federal Register published EPA's proposed Implementation Rule for the 8-Hour Ozone Standard. In the same timeframe, EPA also formalized its intentions to designate areas for the 8-hour ozone standard by April 15, 2004, meaning states would need to reassess their efforts and control strategies to address this new standard by 2007. Recognizing that existing 1-hour nonattainment areas would soon be subject to the 8-hour ozone standard, and in an effort to efficiently manage the state's limited resources, the TCEQ developed an approach that addresses the outstanding obligations under the 1-hour ozone standard while beginning to analyze 8-hour ozone issues.

The TCEQ's 1-hour ozone SIP commitments include:

- Completing a 1-hour ozone MCR
- Performing modeling
- Adopting measures sufficient to fill the NO_x shortfall
- Adopting measures sufficient to demonstrate attainment
- Revising the Motor Vehicle Emissions Budget (MVEB) using MOBILE6

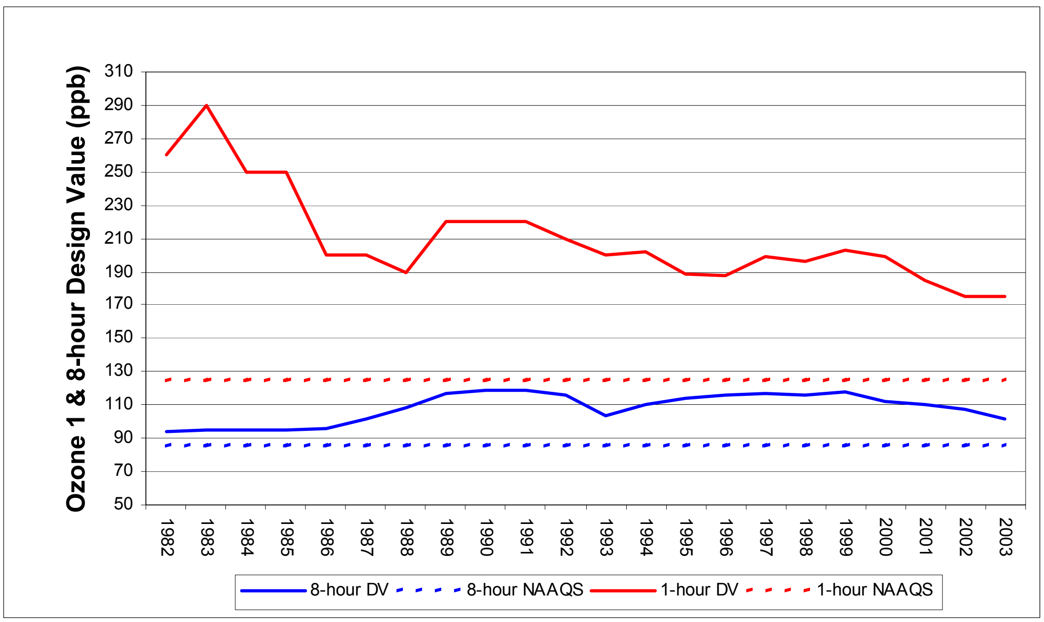
Because the December 2002 SIP revision involved the substitution of one control strategy for another, the FCAA requires that a demonstration be made that the substituted strategy will not interfere with any applicable requirement of the Act. The last 10 percent of the NO_x strategy is being replaced with the extensive HRVOC monitoring program and emission reductions.

1.2.2 Air Quality Analysis

HGB is classified as Severe-17 with a design value of 220 ppb. An examination of the 1-hour ozone design value since the early 1980's shows significant improvement, dropping from highs approaching 290 ppb to approximately 172 ppb in 2003. The design values are projected to continue this downward trend as additional emission reductions occur.

Even though the 1-hour ozone design value has seen marked improvement, the 8-hour ozone design value has remained fairly constant over the last 20 years. From 1999 to 2003, the 8-hour ozone design value also experienced a downward trend. Figure 1.2-1, *Ozone 1-Hour and 8-Hour Design Values for HGB (1982-2003),* illustrates the trends seen in the 1-hour ozone design value as well as trends in the 8-hour design value.

Figure 1.2-1 Ozone 1-Hour and 8-Hour Design Values for HGB (1982-2003)



1.3 CONTROL STRATEGY

The TexAQS results and recent photochemical modeling suggest that ozone formation in the HGB area stems from a combination of two different types of emissions. The first is the daily routine emissions of a large industrial base located in an urban core with onroad and nonroad emissions typical of a city of four million people. These emissions can be thought of as the base of emissions that could be expected at any given time in the HGB area.

The second type of emissions can be characterized as the fluctuations that occur daily, even hourly in the HGB area resulting from sudden sharp increases in short-term HRVOC releases from industrial sources. While these emission fluctuations can occur in any industrial area, the dense concentration of chemical and refinery sites and the overall reactivity in the airshed make this of particular concern in the HGB area.

Ozone forms rapidly when these variable emissions occur in the immediate presence of NO_x, under the right atmospheric conditions (Allen, 2004). The design value in the HGB area is driven by a combination of these two types of emissions. To address ozone formation in the HGB area, a dual strategy is needed to reduce the base of emissions existing continuously in the HGB area as well as restrictions on a short-term basis to address short-term variations. To address the "base" emissions, control strategies are needed that resemble those used by other metropolitan areas with a combination of a large urban population and a significant industrial base. These strategies include vehicle I/M, cleaner fuels, cleaner technology for construction equipment, industrial-based controls for routine emissions of NO_x and VOCs, and a long-term cap on HRVOCs. To address the short-term variable emissions, a restriction of the maximum hourly rate of HRVOCs is necessary. This restriction would apply to both unauthorized emissions as well as to permitted emissions that may fluctuate on an hourly basis.

To achieve the necessary HRVOC reductions, the TCEQ developed a dual approach: address variable short-term emissions through a 1200 lb/hour not-to-exceed emission limit and address steady-state and routine emissions through an annual cap. The annual HRVOC cap and fugitive emission rules will reduce the overall reactivity in the airshed by removing the compounds that are most prevalent and most likely to react rapidly enough to cause 1-hour ozone exceedances. The annual HRVOC cap in Harris County will be reduced from the existing HRVOC cap in order to support the attainment demonstration modeling. In addition, the cap was further reduced by 5 percent to account for daily variability in emissions and to address uncertainty in the geographic redistribution of emissions between the attainment demonstration model and how actual emissions may occur with trading in place. Sites also have the opportunity to convert VOC emission reduction credits to a yearly allocation of HRVOC allowances, based on a ratio of maximum incremental reactivity(MIR) for the speciated VOCs reduced and the MIR for an HRVOC. Sites located in the seven counties surrounding Harris County, must enforceably limit HRVOC emissions. Modeling studies have demonstrated that the proposed HRVOC limits on sites located in the seven counties surrounding Harris County are not necessary for the HGB area to attain the 1-hour ozone standard. Affected industries in the seven-county area have indicated to the commission that representations for HRVOC emissions within their respective air permits are well below the values likely to be put in place through the HRVOC annual cap.

The short-term HRVOC limit in Harris County will reduce both the frequency and magnitude of short-term HRVOC releases, thus decreasing the likelihood that these releases will occur at a time and place and be of sufficient magnitude to cause or contribute to a 1-hour ozone exceedance.

Traditional photochemical modeling can adequately replicate the first part of the control strategy since the assumption of a steady-state emission rate is consistent with typical modeling for 1-hour ozone nonattainment areas. The TCEQ's primary emphasis has been directed towards understanding and modeling a control strategy that addresses this contributor to ozone formation in the HGB area. The future case control runs demonstrate that an effective strategy has been developed for daily routine emissions.

1.4 PHOTOCHEMICAL GRID MODELING

In recent years, a significant amount of data has become available and has advanced the understanding of the formation, causes and movement of ozone in the HGB area. The knowledge base continues to expand as the TCEQ and other organizations complete additional research analysis. Many research efforts are underway to continue to improve all facets of ozone attainment modeling and control strategies. Three key areas are critical to a valid modeling demonstration: meteorology, emissions inventory, and chemistry.

1.4.1 Meteorology

Meteorological models provide critical inputs to photochemical models. In general, meteorological models use a set of measurements taken at limited times and at a limited number of sites, along with models of physical processes, to predict the physical behavior of the atmosphere. During the TexAQS, a wide range of regular and special meteorological measurements were collected from multiple observation platforms. The TCEQ used observations to evaluate and adjust the performance of the model and to improve the accuracy of the model. Data obtained from Geostationary Operational Environmental Satellites (GOES) have also improved the meteorological model. The GOES data has not been available for the entire episode and the TCEQ continues to seek GOES data for the September 2- 6 portion of the episode.

1.4.2 Emission Inventory

Data collected and analyzed from the TexAQS provided valuable insight regarding the ambient concentrations of ozone precursors in the HGB area. One conclusion of the study was that ambient concentrations of NO_x and certain VOCs (terminal olefins) were not consistent with the industrial emissions estimates. Specifically, the ratio of terminal olefins to NO_x did not correlate to the ambient ratio of these VOCs to NO_x.

Because of the greater certainty associated with the NO_x emissions estimates, the TCEQ concluded that industrial emissions of terminal olefins were likely understated in earlier emissions inventories. This conclusion has been reviewed and documented in numerous scientific journals (Berkowitz et al., 2004; Jiang et al., 2004; Lei et al., 2004; Ryerson et al., 2003; Wert et al., 2003). The question of whether emissions estimates of other VOCs should be adjusted has arisen. Adjustments to the emission inventory are only warranted when strong evidence and substantial analysis and review indicates that an adjustment would be necessary. Because this type of support is not available to warrant an inventory adjustment beyond the terminal olefin adjustment, "other" VOCs (those not described as "highly reactive") are not adjusted as a part of this revision. The TCEQ continues to investigate whether other VOCs should be adjusted. To date, few in-depth analyses of aircraft observations have been conducted comparing other VOC concentrations with those expected based on the reported emissions (although several projects are expected to be completed within the next year).

Recently-available data from the Enhanced Industry Sponsored Monitoring (EISM) provides a very comprehensive set of hydrocarbon measurements in and around the Houston Ship Channel and near several smaller industrial clusters in the HGB area. These data are currently being analyzed by the Pacific Northwest National Laboratories and will be compared with reported emissions inventories. Analyses will be performed for both HRVOCs and other VOCs. The EISM data provide a significant data set for a number of additional analyses in the near future.

Ambient monitoring shows that other less-reactive VOCs can sometimes contribute an equivalent amount of reactivity to the airshed as HRVOCs. However, the reactivity measure does not indicate the speed at which a VOC component helps create ozone. HRVOCs react quickly to form ozone, thus making them the most important VOCs with regard to the 1-hour ozone standard. The scientific evidence shows that additional reductions in other less-reactive VOCs are not necessary in order to attain the 1-hour ozone standard. However, the TCEQ intends to continue to aggressively research the role of other VOCs in ozone formation with respect to the 8-hour ozone standard and will address emissions of those compounds if additional VOC controls are necessary to achieve the 8-hour ozone standard.

Through the research conducted as a part of the TexAQS and subsequent studies, HRVOC emissions have been acknowledged as a priority area needing both improved emission controls and better emission quantification. The enhanced monitoring requirements that have been established as part of the HRVOC rules will improve emission quantification. The HRVOC emissions in future models will be based on measured HRVOC emissions rather than on estimated emissions based on ambient ratios.

The following subsections list a few of the measures that TCEQ is taking to address the emissions of less-reactive VOCs.

1.4.2.1 Emission Inventory Data Collection

The TCEQ is pursuing improvements to the emissions inventory data collection process to provide more accurate and specific information regarding VOC emissions.

The enhanced HRVOC monitoring requirements of Chapter 115 will provide the TCEQ additional information regarding the emissions of less-reactive VOCs in two different ways. First, the point source HRVOC monitors will collect information on other VOCs as well. The TCEQ is evaluating changes to the emission inventory data collection process to ensure that companies include this information with their emissions inventory. Second, the HRVOC monitoring will provide information on which types of sources (i.e., flares, cooling towers, vents) are contributing most to the emission under-estimation problem. This information will be used to focus any subsequent efforts on the sources that will provide the biggest air quality benefit.

The emissions inventory process is undergoing several changes that have been outlined in this document. The TCEQ also plans to initiate a stakeholder process in January 2005 and end the process in July 2005. The stakeholder group will assist with determining the best path forward to develop an industrial sector emissions inventory that is not dependent on an adjustment factor, but is based on the best science available.

1.4.2.2 2005-6 Texas Air Quality Study

The TCEQ is continuing its aggressive program to develop a more complete, accurate characterization of ozone formation in the HGB area, as well as in the remainder of Texas. Foremost is the 2005-6 Texas Air Quality Study, TexAQS II. This study will continue to examine the unique features of the Texas Gulf Coast and will collect data designed to address questions not completely answered during the original TexAQS. The TexAQS II will expand upon the geographical scope of the TexAQS 2000 and will focus on essentially all of eastern Texas, including DFW, BPA, Austin, San Antonio, and Tyler/Longview/Marshall. A number of studies will be conducted in each of the following areas:

- Transport of pollutants into and out of Texas
- Emissions inventories
- Meteorological issues
- Atmospheric chemistry

1.4.2.3 Enhanced Ambient Monitoring

Since 2003 the TCEQ and the regulated community have significantly expanded the real-time ambient monitoring network of specific VOCs. This network is discussed in more detail in Section 1.6.1 below. These monitors collect data on ambient concentrations of several VOCs including HRVOCs. The TCEQ will use the information being collected by these monitors to determine which other VOCs may need to be controlled for the HGB area to attain the 8-hour ozone standard. In addition, the information is being analyzed to identify specific areas where ambient monitoring data is not consistent with VOC emission inventory estimates. Other VOCs may be added to the Environmental Monitoring Response System to encourage voluntary emission reductions of VOCs that are determined to play a significant role in the

HGB area's 8-hour problem.

1.4.2.4 Improved New Source Review Permitting

The TCEQ has developed revised permitting language to address VOC leaks in cooling towers. New and amended permits will include a short-term emission limitation based on a maximum allowed VOC concentration the cooling tower water. An on-going leak will result in a violation of the long term (annual) emissions authorized. The larger the leak and the cooling tower, the sooner the leak will cause the owner or operator to be in violation of their permit. The TCEQ has revised cooling tower language to clarify that the emission rates represented in the Maximum Allowable Emission Rate Table are enforceable.

1.4.2.5 Project H-13

A collaborative effort (known as project H-13) of the Houston Advanced Research Center (HARC), the TCEQ, the University of Texas (UT), and the University of North Carolina (UNC) studied the second type of emission contribution to ozone formation. Discrete short-term HRVOC releases like those that occur in the HGB area were added to the TCEQ's future-case photochemical model at sites determined to have the greatest impact on the modeled peak ozone concentrations. The model can replicate the observed monitoring data with greater accuracy by confining the short-term releases to a relatively small area near the industrial sources. Project H-13 used computationally-efficient sub-domain modeling as an alternative to full three-dimensional modeling to ease the computational burden and to confine the short-term emission releases. Sub-domain modeling provided a screening tool for identifying emission times and locations that would most affect the peak ozone concentrations in a full three-dimensional model.

Multiple 3-D photochemical (CAMx) runs were completed to confirm the conclusions based on the subdomain modeling exercise. These two analytical efforts, availability of additional monitoring data to support the analysis and the increased understanding of HGB ozone formation, allow the TCEQ to better address the 1- hour ozone standard in Houston.

1.4.2.6 Other Research Projects

Two research projects in progress now are investigating elements related to the photochemical modeling supporting this SIP revision. The first is a HARC project and the second project is funded by the TCEQ and EPA through a Performance Partnership Grant.

In July of 2004 HARC, UT, and UNC initiated a project, labeled H12.2004.8HRB, *Role of Modeling Assumptions in the Houston-Mid-Course Review*, to examine elements of this MCR. Assumptions that are being considered in this project are: land cover characterizations, uncontrollable emissions components such as biogenic emission estimates, emission inventory estimates of non-EGU VOCs, including HRVOCs and other VOCs, grid resolution and chemical mechanism details.

A currently on-going study being conducted by Pacific Northwest Laboratory is also examining source attribution and emissions adjustments. This work has two objectives. The first is to use various tools and techniques to determine source speciations, origins, and transport pathways of the emissions of selected VOCs and related trace gases. The participants plan to identify times and source regions that appear to be associated with emission events that are inadequately depicted by emission inventories. The second objective seeks to discuss and illustrate problems involved with comparing observation from an airborne platform with results from photochemical grid models and then to identify methodologies to effectively use aircraft data in model performance evaluation.

1.4.3 Chemistry

The TCEQ and other research organizations have evaluated the chemistry of ozone formation to determine if the commission should use more sophisticated or updated chemical modules with the photochemical model. Current photochemical grid modeling uses CAMx 4.03 with the Carbon Bond IV (CBIV) mechanism. Alternative chemical mechanisms use different groupings of reactive compounds and different set of equations to determine changes in ozone concentration. As part of its efforts to employ the most current, most scientifically sound modeling methodologies, the TCEQ continues to investigate the use of advanced modeling methods. The TCEQ is currently evaluating the Statewide Air Pollution Research Center (SAPRC) chemical mechanism and the Community Multiscale Air Quality (CMAQ) Modeling System for possible use in future SIP work.

1.4.4 Adequacy of episode

The TCEQ, in conjunction with the Photochemical Modeling Technical Committee, analyzed potential August -September episodes from the 1998-2000 design value analysis period. (See Chapter 3, Section 3.2 for a complete description of the episode selection process.) The TCEQ selected the August 19 through September 6, 2000 period for the following reasons:

- The design values for most HGB area monitors are established during August or September.
- The episode occurred during the TexAQS 2000, which provided a larger and substantially-improved database, including special surface and airborne meteorological and air quality measurements of NO_x VOC, and other compounds, and extensive scientific analysis.
- The episode represents typical HGB area ozone conditions and included 13 1-hour exceedances and 14 8-hour ozone exceedances.
- The episode includes three days with multiple exceedances at 9 to 12 surface monitors, and other days with high ozone occurring at from 1 to 7 surface monitors.
- The episode also included exceedances in the BPA area.
- The multi-day episode allows the modeling of both long-range transport and the accumulation of local emissions.
- The episode covered a wide range of meteorological conditions typically associated with high ozone formation in the HGB area, including stagnation, flow reversals, persistent sea breezes, and persistent land breezes.

The HGB area design value is driven by a combination of the two types of emissions being addressed by the dual control strategy. Traditional photochemical modeling can adequately replicate only the daily routine emissions of a large industrial base located in the urban core of a large city. Therefore, the adequacy of the modeling episode should be judged only against the portion of the design value that is driven by these daily routine emissions.

In Chapter 3, Section 3.9.5, the TCEQ describes a method for generating an alternative design value by removing the influence of sudden ozone concentration increases (SOCI)[1] from the modeling episode design value period (calendar years 1999 through 2001). This alternate design value is 144 ppb. The base case modeling run includes seven days with modeled peak ozone greater than 144 ppb, so the modeled peaks represent the (non-SOCI) design value very well. If SOCIs result primarily from emission

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[1]These sudden ozone increases have been referred to in previously literature as Transient High Ozone Events (THOEs), but this label is somewhat misleading since some of the events persist for several hours, hence are not "transient." A SOCI is defined by a hour-to-hour difference in ozone of 40 ppb at a single monitor. These sharp increases in ozone are believed to be attributable to a sudden sharp increase in HRVOC emissions.

events[2], then it follows that the model is over-predicting the "routine" part of the ozone on these days, so the future concentrations would actually be lower than reported for the future controlled case (CS-08).

1.4.5 Modeling Results

The photochemical modeling of the August-September 2000 episode demonstrates attainment of the 1-hour ozone standard when coupled with a weight-of-evidence argument. As noted in Table 1.4-1, of the ten days in the episode, six days are clearly modeled below the 125 ppb NAAQS. Of the remaining four days, two days had maximum predicted concentrations of 125.1-125.2 ppb and one day had a predicted maximum concentration of 128.6 ppb. The last day, August 31 had a predicted modeled maximum concentration of 147.6 ppb. A detailed analysis provided in Section 3.9 discusses the reason this day does not appear responsive to the control strategy employed.

Table 1.4-1 Modeled Peak Ozone Concentration

Episode Day	Modeled Peak Ozone Concentration (parts/billion)
August 25	121.6
August 26	113.6
August 29	113.6
August 30	122.5
August 31	147.6
September 1	119.5
September 2	128.6
September 3	115.0
September 4	125.2
September 6	125.1

1.5 MOTOR VEHICLE EMISSIONS BUDGET (MVEB)

The MVEB refers to the maximum allowable emissions from onroad mobile sources, and are determined for each applicable criteria pollutant or precursor as defined in the SIP. These budgets must be used in transportation conformity analyses. In order to pass the budget test, areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB(s).

The attainment budgets represent the mobile source emissions that have been modeled for the attainment demonstration, and reflect all the onroad control measures used in that demonstration. Attainment MVEBs are shown in Table 1.5-1, *2007 Attainment Demonstration Motor Vehicle Emissions Budget for HGB*. These figures have been calculated by subtracting all onroad mobile source reductions from the

[2]Sudden ozone increases have been observed in many cases to result from identified emission events, although there may be cases where rapid ozone rise is triggered by meteorological phenomena.

projected, uncontrolled onroad mobile source emissions forecast for the attainment year of 2007. For additional detail, see Table 3.5-48.

Table 1.5-1: 2007 Attainment Demonstration Motor Vehicle Emissions Budget for HGB

Year	NO_x (tpd)	VOC (tpd)
2007	186.13	89.99

1.6 WEIGHT OF EVIDENCE (WoE)

EPA's guidance allows other weight of evidence arguments to be used in conjunction with the modeled attainment demonstration when considering the approvability of the SIP. In this attainment demonstration, the weight of evidence discussion can be divided into two areas: a general discussion that is applicable to all days and a specific discussion centered on the ozone predictions for August 31.

1.6.1 August 31

The August 25 - September 6, 2000, ozone episode was modeled in support of the SIP revision. August 31 is the only day during the August 25 - September 6 episode that is not reasonably responsive to the control strategies for the following reasons.

- Temperature effects on biogenic emission inside HGB area: Additional biogenic emissions in HGB resulted from high temperatures during the August 30 - September 5, 2000 time period. The record high temperatures allowed modeled biogenic emissions to increase 30 to 45 percent above average levels.
- Temperature effects on biogenic emissions outside of HGB area: High temperatures through the region led to higher than normal biogenic emissions that were available for transport into HGB. The ozone source apportionment technology (OSAT) tool in the CAMx model estimates that over 38 ppb of the August 31 ozone was formed from biogenic emissions outside of the HGB area, a four-fold increase over other days in the episode.
- Greater transport of biogenic emissions from outside of HGB: Modeled ozone on August 31 is more strongly affected by non-HGB biogenic emissions than any other episode day. The strong contribution from non-HGB biogenics results in background ozone on August 31 being approximately 20 ppb higher than on August 30.

In summary, the TCEQ photochemical model sensitivity analyses show that the modeled ozone is sensitive to changes in temperature and temperature-dependent emissions. Results are consistent with those found by Aw and Kleeman (2003). Modeled ozone on August 31 is not reasonably responsive to controls largely because of the high contribution of biogenic emissions to peak ozone, including biogenic emissions that originate outside of the HGB area. The large contribution from biogenics is due to the record high temperatures observed during this time, and strong westerly morning winds that transported ozone and precursors from outside the HGB area. The sensitivity analysis suggests that the peak ozone on August 31 would have responded more fully to the controls if the temperatures had not been at record levels. Similar temperatures have occurred only twice in the past 57 years. Therefore, the conditions that led to the resistance of August 31 to ozone control strategies are infrequent, and are unlikely to occur once per year.

1.6.2 Additional Reductions

1.6.2.1 Collateral VOC Reductions
Additional and less predictable emission reductions are also expected to occur as industries improve their monitoring capabilities and become more knowledgeable about their own HRVOC emissions. Collateral reductions of other VOCs that are present in HRVOC streams will also occur when the HRVOC streams are controlled. For example, a cooling tower that handles an HRVOC stream that has other VOC present will have extensive monitoring of the water to determine when a leak is present. When the leak is fixed, not only are HRVOC emissions controlled, but the VOC emissions are as well. While qualitatively these emission reductions can be expected, the nature of the cap program, which allows the owner/operator to determine the best control method to stay under the cap, inherently prevents the TCEQ from explicitly knowing in advance how those reductions would be achieved. Thus, predicting and accounting for these reductions is difficult. In order to preserve these reductions as a part of the SIP strategy, the TCEQ has added language to the rule preventing a company from taking “credit” for these reductions resulting from the HRVOC program. This prohibition prevents the banking of a reduction for use as offsets, thus preventing that reduction from offsetting an increase and returning those emissions to the airshed.

The TCEQ rules require owner/operators of flares in HRVOC service to install flow meters and comply with maximum tip velocity and minimum heat content requirements to ensure proper combustion by the flare. The tip velocity and heat content requirements apply at all times, not only when the flare is combusting HRVOC streams. Because many of these flares are also used for non-HRVOC streams, the regulations will result in better combustion of other VOC streams as well. This improved combustion will reduce emissions of less-reactive VOCs.

1.6.2.2 Potential Reductions Resulting From EISM/EMRS
Since 2003 the TCEQ and the HRVOC regulated community have significantly expanded the real-time ambient monitoring network of specific VOCs. Evaluation of data collected since the installation of these monitors in the summer of 2003 has increased the confidence in the direction of this SIP strategy. Likewise, there is an indication that HRVOC concentrations are trending downward in advance of the HRVOC rule requirements. This downward trend is expected since, as with the experience of the Toxic Release Inventory, the awareness by industry of ambient concentrations often results in reductions of emissions well in excess of any mandatory regulatory program.

To increase the potential for success of this SIP strategy, a program to help industry respond rapidly to increases in ambient HRVOC concentrations detected by these monitors is under development. The Environmental Monitoring Response System (EMRS) is a cooperative monitoring venture between Houston Regional Monitoring Network, HGB area Industry and the TCEQ which is designed to measure Photochemical Assessment Monitoring Sites (PAMS) VOC species close to point source clusters.

A primary goal of EMRS is to prevent HRVOC emissions from creating situations that may lead to high levels of ozone. This goal will be accomplished by the near real time monitoring and rapid response built into the program.

Other goals of EMRS include the ability to measure the effectiveness of HRVOC rules, to correlate HRVOC levels with ozone, to determine which other VOCs should also be considered HRVOCs, to provide high resolution data that will allow Emissions Inventory improvements, and to provide a reasonable alternative to costly fence line monitoring.

1.6.2.3 Emission Event Database with Lower Reportable Quantities
Another tool also expected to result in additional reductions is the web-based access to an emission event database incorporating lower reportable quantities of VOCs beyond just the HRVOCs of most concern.

As public awareness of the number and amount of these releases increases, industry is expected to respond in a manner similar to their approach for the Toxics Release Inventory program. Awareness and documentation of these events should prompt industry to begin to evaluate not just the causes of these events but also the causes of near events and institute an enhanced program to ensure that even the potential of an event is significantly minimized. In fact, the East Harris County Manufactures Association has a significant initiative underway to evaluate and communicate among themselves which best management practices are most effective.

1.6.2.4 Shutdown/Mothballing of Electric Utilities
As the Texas utilities continue their transition to a fully deregulated market, the existing less efficient plants will continue to be shut down and replaced as newer, more cost effective plants come online. Predicting the market forces that will drive these shutdowns as well as the timing of retiring the older plants would be difficult. However, it is reasonable to assume that additional reductions currently unaccounted for will result from this process. Since, at this time, the modeling only excludes units that been formally indicated an intent to cease operation (by withdrawing an air permit or by including the unit in the Public Utility Commission of Texas Project Cancellation list) or will be retired/reduced under agreed orders, the current future case modeling inventory undoubtedly includes sources that will in fact be mothballed or retired in (and/or prior to) 2007.

1.6.2.5 Non-EGU Permitted Prior to January 2, 2001
A correction was applied to electric generating units (EGUs) to account for the expected electricity demand in 2007 (see Chapter 3, Section 3.5.1.2). This correction assumed that only 75 percent of allowances assigned to newly permitted EGUs would be used, i.e., emissions from these units would be 75 percent of the allowances that are currently available for use for these units.

No correction was made to non-EGUs (NEGUs) since a comparable relationship is not available that would provide enough confidence for direct inclusion into the model. However, an examination of years 2002 and 2003 indicate that only 33 to 39 percent of the allowable allowances for permitted facilities were used. NEGUs permitted prior to the initiation of the MECT program, but not in operation for sufficient time to establish a baseline are allowed to operate at their allowable levels until a baseline has been established. Typically these facilities are not operating at their allowable rates, but significantly below those values. As these newly permitted facilities establish baselines from which to grant "actual" allowances, the amount of cap in the HGB will decrease overall. This decrease has not been accounted for in the modeling.

1.6.3 Comprehensive Ozone Metrics and Ambient Trends
Section 3.9 provides figures showing the benefits from CS-06a compared to the uncontrolled base case and to CS-03. These figures graphically depict the reductions being made as a part of the control strategies contained within this SIP revision. Additionally, the 1-hour ozone design values for the HGB area have decreased significantly from 260 ppb in 1982 to 175 ppb in 2003. Using all this data to estimate a trend leads to the conclusion that attainment of the 1-hour standard would be reached sometime after 2020 (see Figure 3.9-28, *Estimated Ozone Attainment Date Based on Ambient Data*). Examination of the figure shows that the area's design value dropped significantly during the 1980s, then flattened out during the 1990s, hovering around 200 ppb. Starting in the late 1990s, however, an encouraging trend appears to be emerging. Recently, design values have again resumed their downward trend and are at the lowest values seen in at least the last twenty years. The current trend may be partly due to meteorological conditions in recent years, but is almost certainly accelerated by emission reductions made since the 2000 SIP revision. If the design value continues to drop at a rate comparable to that seen in the most recent five-year period, then attainment may occur sometime around 2010. But the amount of emissions

reductions is expected to increase each year until 2007 as a result of rules adopted in the 2000 SIP revision and in this SIP revision. Consequently, the design values are expected to decrease more rapidly as 2007 approaches. While this simplistic analysis by no means proves the area will attain the standard by 2007, the recent design value trends are consistent with reaching attainment sometime around 2007.

1.6.4 Alternative Design Value and Addressing Short-Term Excursions

Unlike the base case, the future case modeling includes only limited variation in point source emissions (primarily temperature-driven variability in electric generation). Base case variation rising from a special inventory collected during the TexAQS (see Chapter 3, Section 3.5.1.1) is not applied in future case modeling. There is certain to be some level of variability in the future emissions, and to address this issue the commission is instituting a short-term cap on point source HRVOC emissions.

Traditional modeling does not replicate ozone produced by the sudden sharp increases in HRVOC emissions that occur in the HGB area. This technical deficiency provides an explanation for why the model's peak simulated ozone concentrations were all below the HGB area's design value in 2000. The actual design value calculated for the years 1999-2001 was 182 ppb, while Base 5b simulated peak ozone concentrations below 160 ppb on every day but August 31. The influence from short-term releases must be removed from the area's design value to determine whether the model is adequately simulating the routine urban ozone formation in the base case. The model would perform adequately if the simulated ozone peak concentrations were consistent with this "alternate" design value.

The TCEQ approximated removing the influence of short-term releases using a method developed by Blanchard (2001). The Blanchard method calculates a design value that excludes the effects of sudden large increases in observed ozone concentrations. Blanchard used a threshold of a 40 ppb rise in ozone concentration in one hour to distinguish sudden rises from the more typical case where ozone increases more gradually.

To apply Blanchard's technique to the year 2000, the TCEQ used 1-hour average ozone data for the Houston region from EPA's Aerometric Information Retrieval System (AIRS) from years of 1999 through 2001. The hour-to-hour difference was calculated for each of the 16 ozone monitors in Houston. If the difference for any monitor for a given day was greater than 40 ppb, the day was determined to be characterized by a sudden ozone concentration increase.

Once a day has been identified to contain a SOCI, that day was removed from the calculation of the design value. The "alternate" (non-SOCI) design value was determined by removing all days with identified SOCIs and recalculating the design value. The alternate design value so calculated is 144 ppb. Base 5b includes seven days with modeled peak ozone greater than 144 ppb, so the modeled peaks in fact represent very well the (non-SOCI) design value. If SOCIs result primarily from emission events, then it follows that the model is over-predicting the "routine" part of the ozone on these days, so the future concentrations would actually be lower than reported for CS-08.

1.6.5 Wildfires

Significant effort has been made to appropriately characterize and model wildfires present during the modeling episode. However, 2000 had an unusually large amount of wildfire activity in Southeast Texas due to drought conditions and extreme temperatures in the August-September time frame. Because the number and scope of fires modeled in the base model would not be reasonably expected in future years, they were removed from the future control strategy evaluation runs. However, to identify the impact of similar wildfire activity in the future, Table 1.6-1, *Modeled Peak Ozone Concentration including Wildfires* provides the future case modeling including the wildfires.

Table 1.6-1 Modeled Peak Ozone Concentration including Wildfires

Episode Day	Modeled Peak Ozone Concentration (parts/billion)	Modeled Peak Ozone Concentration with Wildfires (parts/billion)
August 25	121.6	121.6
August 26	113.6	113.6
August 29	113.6	113.6
August 30	122.5	122.5
August 31	147.6	147.7
September 1	119.5	119.6
September 2	128.6	128.7
September 3	115.0	115.1
September 4	125.2	126.3
September 6	125.1	126.8

1.7 8-HOUR OZONE NON-INTERFERENCE DEMONSTRATION

Because this SIP revision includes elements that modify certain previously-adopted rules, EPA requires a demonstration showing that the current strategy will not interfere with attainment of the 8-hour ozone standard. This non-interference demonstration is an independent requirement in § 110(l) of the Federal Clean Air Act, which requires that any plan revision must not interfere with any applicable requirement concerning attainment and reasonable further progress or any other applicable requirement of the Act 42 U.S. C. § 7410(l). To determine whether this SIP revision would interfere with any applicable requirement, the commission conducted non-interference modeling, specifically to determine whether this revision would interfere with attainment of the 8-hour ozone national ambient air quality standard. The modeling shows that the current strategy is equivalent or superior to the strategy in the federally approved December 2000 and September 2001 SIP revisions.

1.8 SUMMARY

The HGB SIP no longer relies primarily on new reductions from NO_x-based strategies. A combination of point source HRVOC controls and NO_x reductions are the most effective means of reducing ozone in the HGB area. Under this revision, the HGB SIP no longer has a NO_x shortfall. This document follows EPA guidance on the use of modeled results to demonstrate attainment. Although the results do not indicate that attainment will be achieved in all grid cells for all hours in the attainment year 2007, other significant improvements demonstrate that the SIP will result in attainment in 2007.

Through this revision, the TCEQ is fulfilling its outstanding 1-hour ozone SIP obligations and beginning to plan for the 8-hour ozone standard. This revision demonstrates attainment of the 1-hour ozone standard in HGB in 2007 and provides a preliminary analysis of the HGB area in terms of the 8-hour ozone standard in 2007. In April 2004, EPA finalized Phase I of the 8-Hour Ozone Implementation Rule. However, Phase II of the 8-Hour Ozone Implementation rules is not expected until sometime next year.

Phase I provides flexibility to the states in transitioning from the 1-hour to the 8-hour ozone standard, and the steps taken in this revision and the technical work performed to date will be invaluable through the transition period.

1.9 FUTURE ACTIONS

With the completion of the this 1-hour Mid-Course Review SIP revision, the commission can focus on future plans regarding the 8-hour ozone standard adopted by EPA on April 15, 2004. The commission will continue to review the measures contained in the current proposal to ensure that they are needed in this form in order to demonstrate non-interference. Additional analysis of the impact of the proposed rules on attainment of the 8-hour standard may indicate a need for new or more stringent control measures. The attainment demonstration may require adjustments in the level of VOC, HRVOC and/or NO_x reductions necessary to ensure attainment of the 8-hour ozone standard.

1.10 BIBLIOGRAPHY

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CHAPTER 2: BACKGROUND

2.1 GENERAL

"The History of the Texas State Implementation Plan (SIP), " a comprehensive overview of the SIP revisions submitted to EPA by the State of Texas is available at the following website: http://www.tnrcc.state.tx.us/oprd/sips/sipintro.html#History

The HGB, formerly denoted "HGA", ozone nonattainment area is classified as Severe-17 under the FCAA Amendments of 1990 (42 United States Code (USC) §§7401 et seq.), and therefore is required to attain the 1-hour ozone standard of 0.12 ppm by November 15, 2007. For the HGB area, defined by Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, the TCEQ has developed a demonstration of attainment in accordance with 42 USC §7410. The most relevant HGB SIP revisions to date are the December 2000 1-hour ozone standard attainment demonstration, the September 2001 follow -up revision, and the December 2002 NO_x/highly reactive VOC (HRVOC) revision.

The development of a strategy for reducing ozone in HGB is complicated by the many factors contributing to ozone formation in this area. A hot sunny climate combined with large urban population and a highly concentrated industrial area provide the framework for ozone formation. Other challenges to modeling and controlling ozone in Houston include the significant biogenic emissions and complex meteorology including a land sea breeze recirculation of air parcels.

This process has proven to be extremely challenging due to the concentration of industry in the HGB area and the magnitude of reductions needed for attainment. The emission reduction requirements included as part of the December 2000 SIP revision represent substantial, intensive efforts on the part of stakeholder coalitions in the HGB area to address ozone. These coalitions, which include local governmental entities, elected officials, environmental groups, industry, consultants, and the public, as well as EPA and the commission, worked diligently to identify and quantify control strategy measures for the HGB attainment demonstration.

2.1.1 December 2000

The December 2000 SIP revision contains rules and photochemical modeling analyses in support of the HGB ozone attainment demonstration. The majority of the emission reductions identified in this revision were from a 90 percent reduction in point source NO_x. The modeling analysis also indicated a shortfall in necessary NO_x emissions, such that an additional 91 tpd of NO_x reductions were necessary for an approvable attainment demonstration. In addition, the revision contained post-1999 ROP plans for the milestone years 2002 and 2005, and for the attainment year 2007, and transportation conformity MVEBs for NO_x and VOC. The SIP also contained enforceable commitments to implement further measures in support of the HGB attainment demonstration, as well as a commitment to perform and submit to EPA a MCR.

2.1.2 September 2001

The September 2001 SIP revision for the HGB ozone nonattainment area included the following elements: 1) corrections to the ROP table/budget for the years 2002, 2005, and 2007 due to a mathematical error; 2) incorporation of a change to the idling restriction control strategy clarifying that the operator of a rented or leased vehicle is responsible for compliance with the requirements in situations where the operator of a leased or rented vehicle is not employed by the owner of the vehicle (the commission committed to making this change when the rule was adopted in December 2000); 3) incorporation of revisions to the clean diesel fuel rules to provide greater flexibility in complying with the requirements of the rule while preserving the emission reductions necessary to demonstrate attainment in the HGB area; 4) incorporation of a stationary diesel engine rule that was developed as a result of the state's analysis of EPA's reasonably available control measures; 5) incorporation of revisions to the point source NO_x rules; 6) incorporation of revisions to the emissions cap and trade rules; 7) the removal of the construction equipment operating restriction and the accelerated purchase requirement for Tier 2/3 heavy duty equipment; 8) the replacement of the Tier 2/3 rules with the Texas Emission Reduction Plan (TERP); 9) the layout of the MCR process which details how the state will fulfill the commitment to obtain the additional emission reductions necessary to demonstrate attainment of the 1-hour ozone standard in the HGB area; and 10) replacement of 2007 Rate of Progress MVEBs to be consistent with the attainment MVEBs.

As was discussed in the December 2000 revision, the modeling resulted in a 141 ppb peak ozone level correlating to a shortfall calculation of 91 tpd NO_x equivalent. An additional five tpd was added to the shortfall because the state could not take credit for the NO_x reductions associated with the diesel pull-ahead strategy. The gap control measures adopted in December 2000, along with the stationary diesel engine rules included in the September revision, resulted in NO_x reductions of 40 tpd, which left a total remaining shortfall of 56 tpd. The state committed to address this shortfall through the MCR process. In the November 14, 2001 issue of the Federal Register EPA approved the December 2000 and September 2001 submittal.

2.1.3 December 2002

In January 2001, the Business Coalition for Clean Air - Appeal Group (BCCA-AG) and several regulated companies challenged the December 2000 HGB SIP and some of the associated rules. Among other things, BCCA contended that the last 10 percent of the NO_x reductions were not cost effective and that the ozone plan would fail because the TCEQ did not account for volatile organic compound (VOC) emissions associated with upset conditions. In May 2001, the parties agreed to a stay in the case, and Judge Margaret Cooper, Travis County District Court, signed a Consent Order, effective June 8, 2001, requiring the commission to perform an independent, thorough analysis of the causes of rapid ozone formation events and identify potential mitigating measures not yet identified in the HGB attainment demonstration, according to the milestones and procedures in Exhibit C (Scientific Evaluation) of the Order.

In compliance with the Consent Order, the commission conducted a scientific evaluation based in large part on aircraft data collected by the Texas 2000 Air Quality Study (TexAQS). The TexAQS, a comprehensive research project conducted in August and September 2000 involving more than 40 research organizations and over 200 scientists, studied ground-level ozone air pollution in the HGB and east Texas regions.

To address the findings from TexAQS, find the most cost-effective means of achieving ozone reductions, and fulfill obligations in the consent order, the commission adopted a SIP revision in December 2002, focused on replacing the most stringent 10 percent industrial NO_x reductions with VOC controls. In light of the TexAQS study, the TCEQ conducted further modeling analysis of ambient VOC data. The results of photochemical grid modeling and analysis indicated that it is possible to achieve the same or better level of air quality benefits with reductions in industrial VOC emissions, combined with an overall 80 percent reduction in NO_x emissions from industrial sources, as would be realized with a 90 percent reduction in industrial NO_x emissions. Studies have suggested that HGB's high ozone events can be attributed to the presence of significant reactivity in the airshed. An analysis of automated gas chromatograph data (Estes, 2002) revealed that four compounds were frequently responsible for high reactivity days: ethylene, propylene, 1,3-butadiene, and butenes. As such, these compounds were selected as the best candidates for highly reactive VOC (HRVOC) emission controls.

The commission adopted revisions to the industrial source control requirements, one of the control strategies within the existing federally approved SIP. The December 2002 revision contained new rules that better quantify and reduce emissions of HRVOCs from four key industrial sources: fugitives, flares, process vents, and cooling towers. The HRVOC rules are performance-based, emphasizing monitoring, recordkeeping, reporting, and enforcement rather than establishing individual unit emission rates.

Analysis showed that limiting emissions of ethylene, propylene, 1,3-butadiene, and butenes in conjunction with an 80 percent reduction in NO_x is equivalent or better in terms of air quality benefit to that resulting from a 90 percent point source NO_x reduction requirement alone.

The technical support documentation accompanying the December 2002 SIP revision describes modeling and ambient data analyses which demonstrate that reductions in emissions of HRVOCs can replace the last 10 percent of industrial NO_x controls.

Given the information available, the 2002 SIP revision exchanging the two strategies is approvable under 110(l) of the Federal Clean Air Act, which allows revision of the SIP where that revision would not interfere with reasonable further progress.

2.2 PUBLIC HEARING INFORMATION

Table 2.2: Public Hearing Information

The commission held public hearings at the following times and locations:

CITY	DATE	TIME	LOCATION
Houston	August 2, 2004	1:30 p.m. 5:30 p.m.	City Hall Council Chambers 901 Bagby
Beaumont	August 3, 2004	10:30 a.m.	John Gray Institute 855 East Florida Avenue
Austin	August 5, 2004	9:30 a.m.	Texas Commission on Environmental Quality 12100 Park 35 Circle Building F, Room 2210

Written comments were also accepted via mail, fax, or e-mail. The public comment period closed on August 9, 2004.

2.3 SOCIAL AND ECONOMIC CONSIDERATIONS

For a detailed explanation of the social and economic issues involved with any of the strategies, please refer to the preambles that precede each proposed rule package accompanying this SIP.

2.4 FISCAL AND MANPOWER RESOURCES

The state has determined that its fiscal and manpower resources are adequate and will not be adversely affected through the implementation of this plan.