APPENDIX 6

DEVELOPMENT OF THE NONROAD MODEL RFP EMISSIONS INVENTORIES FOR THE HGB SIX-COUNTY, DFW NINE-COUNTY, AND BEXAR COUNTY OZONE NONATTAINMENT AREAS

Bexar County Moderate Area Reasonable Further Progress
State Implementation Plan Revision for the 2015 Eight-Hour Ozone National Ambient Air Quality Standard

Project Number 2022-024-SIP-NR
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Development of the Nonroad Model RFP Emissions Inventories for the HGB Six-County, DFW Nine-County, and Bexar County Ozone Nonattainment Areas

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1.0 Overview

This Report is Deliverable 6.2 for the project "Development of Texas Nonroad Model Mobile Source Air Emissions Reporting Requirements, Reasonable Further Progress, and Redesignation and Maintenance Emissions Inventories" (Contract Number 582-19-92744, Work Order 582-21-22147-003). The sections below describe the work performed under Task 6 to estimate emissions for a potential moderate reclassification state implementation plan (SIP) revision for the 2015 eight-hour ozone national ambient air quality standard (NAAQS).

2.0 Background

The Texas Commission on Environmental Quality (TCEQ) contracted with Eastern Research Group, Inc. (ERG) to develop Texas NONROAD (TexN) version 1 and subsequent version 2 (TexN2), which are utilities for estimating Texas-specific emissions from nonroad mobile sources, excluding commercial marine vessels, locomotives, drilling rigs, and aircraft. The TexN model used the United States Environmental Protection Agency's (EPA) standalone NONROAD model to calculate emissions, whereas TexN2 uses EPA's MOVES-Nonroad model. MOVES is required by the EPA for state development of nonroad emissions estimates for SIP revisions, national emissions inventories, and reasonable further progress (RFP) analyses. Since TexN was first developed, the TCEQ has frequently updated the Texas-specific data and enhanced the utility's functions. The EPA recently updated the MOVES model, releasing MOVES3[1] in November of 2020, and TCEQ contracted with ERG to update TexN2 for full compatibility with MOVES3[2]. States are required to use the most recent version of MOVES when developing and submitting emissions estimates from specific nonroad mobile sources to the EPA.

The purpose of Task 6 of this project is to provide RFP emissions inventories (EI) to support the TCEQ with a potential moderate reclassification SIP revision for the 2015 ozone NAAQS. The EIs include ozone season day (OSD) weekday estimates of volatile organic compounds (VOCs) and oxides of nitrogen (NO_X) for the base year 2017 and future years 2020, 2023, and 2024. The RFP EIs were generated using MOVES3 code version 3.0.1 with database version 'movesdb20210209' and TexN2 code version 2.2.0 with the TexN2 database last updated May 24, 2021.

[1] US EPA, 2020. "MOVES3: Latest Version of Motor Vehicle Emission Simulator." https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves. Accessed 17 February 2020.

[2] ERG, 2021. "TexN2.2 Utility Updates for Compatibility with the US EPA MOVES3 Model." Prepared for the Texas Commission on Environmental Quality, Air Quality Division, Austin, TX 78711-3087. April 23.

3.0 Emissions Inventory Development and Results

The geographic scope of the EIs includes the six-county Houston-Galveston-Brazoria (HGB) area (defined as Brazoria, Chambers, Fort Bend, Galveston, Harris, and Montgomery Counties), the nine-county Dallas-Fort Worth (DFW) area (defined as Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Tarrant, and Wise Counties) and Bexar County.

The temporal scope of the EIs is OSD weekday for the years 2017, 2020, 2023, and 2024. The period type "OSD weekday" represents weekday emissions averaged over the summer months June, July, and August. TexN2 allocates annual activity to these months with monthly and day type allocation factors contained in tables within the TexN2 utility database.

The meteorology data in the EIs was specific to the base year 2017, applied to all RFP analysis years 2017, 2020, 2023, and 2024. The fuel types in each analysis year are specific to 2011 for the base year and 2020 for the three later years. At the time of writing (June 2021), year 2020 is the latest available fuel survey data contained in the TexN2 database.

The RFP EIs include VOC and NO_X emissions from ten separate runs that the TexN2 utility automatically initiates in sequence corresponding to the scenarios listed below. The first scenario represents a case without any emission controls. The second through tenth RFP scenarios add successive federal and state emissions controls. TexN2 sets up the MOVES runs for each scenario using alternate versions of the MOVES input table that describes technology fractions by equipment model year. TexN2 disables the inclusion of reformulated gasoline (RFG) in the HGB and DFW areas, until the final RFP scenario, *allRules_cntl*, representing the fully controlled scenario. RFG fuels, where they are in use, are implemented as the final control strategy in all six HGB counties and four of the nine DFW counties (Collin, Dallas, Denton, and Tarrant). Five of the DFW counties and Bexar County do not have RFG fuel, so these areas do not receive any emissions benefits from RFG. Similarly, the benefits of Texas Low Emission Diesel (TxLED) fuel are delayed until the final RFP scenario, where they are included as a post-processing adjustment to NO_X from diesel-fueled equipment. All 16 counties are part of the 110-county TxLED fuel control area.

RFP Scenario Name	Description
smallSprk1_uncntl	No controls
smallSprk1_cntl	Controls through Small nonroad spark ignition (SI) engines (Phase 1)
Tier1_cntl	Controls through Tier 1 nonroad diesel engines
Tier2_3_cntl	Controls through Tiers 2 and 3 nonroad diesel engines
smallSprk2_cntl	Controls through Small nonroad SI engines (Phase II)
largeSprk_cntl	Controls through Large nonroad SI engines
Tier4_cntl	Controls through Tier 4 nonroad diesel engines
recMarine_cntl	Controls through Diesel recreational marine engines
smallSI_cntl	Controls through SI marine engines
allRules_cntl	Controls through SI marine engines, includes RFG and TxLED fuel controls

Tables 1, 2, and 3 show results for each RFP scenario for the HGB area, DFW area, and Bexar County, respectively. They include separate line items showing RFG and TxLED benefits as control scenarios number 9 and 10. The final scenario (Fully Controlled) corresponds to the "allRules_cntl" RFP scenario. The Fully Controlled case contains the same values as the prior TxLED line item because TexN2 does not model any further emission controls after RFG and TxLED. It remains in the tables for clarity to indicate the cumulative effect of all controls.

Table 1. NO_X and VOC Emissions for the HGB Six-County Area (Tons/Day)

Emissions Control Scenario	2017		2020		2023		2024	
	NO_X	VOC	NO_X	VOC	NO_X	VOC	NO_X	VOC
Uncontrolled	124.08	170.42	147.59	184.44	154.40	194.82	156.68	198.39
1. smallSprk1_cntl	130.13	124.37	153.93	135.08	161.13	142.49	163.56	145.02
2. Tier1_cntl	129.34	119.65	153.22	130.06	160.79	137.35	163.29	139.85
3. Tier2_3_cntl	124.67	118.66	149.29	129.25	158.12	136.79	160.78	139.33
4. smallSprk2_cntl	120.34	75.12	144.74	82.72	153.29	87.68	155.86	89.33
5. largeSprk_cntl	81.90	62.48	100.45	67.95	102.36	70.79	102.71	71.74
6. Tier4_cntl	40.93	52.90	40.81	54.73	36.48	56.50	35.97	57.30
7. recMarine_cntl	40.91	52.90	40.79	54.73	36.45	56.50	35.95	57.30
8. smallSI_cntl	36.90	36.63	36.34	36.40	31.62	36.70	31.00	37.05
9. RFG	36.89	36.16	36.34	36.28	31.62	36.57	31.00	36.92
10. TxLED	35.66	36.16	35.11	36.28	30.66	36.57	30.08	36.92
Fully Controlled	35.66	36.16	35.11	36.28	30.66	36.57	30.08	36.92

The NO_X and VOC emissions generally decline from Uncontrolled to Fully Controlled except for small nonroad SI engines Phase 1 (smallSprk1_cntl), which increases NO_X by approximately 6 tons per day in 2017. The minor NO_X increase was allowed under the small SI rule, where some equipment have their standards defined in terms of combined hydrocarbons plus NO_X.

The pre-Tier 4 scenarios all show increased NO_X emissions over 2017 to 2024 within each scenario, whereas the Tier 4 and later controls scenarios show NO_X declines over the same period despite a gradual growth in equipment population. These trends are more apparent in Figures 1 through 3. Figure 1 shows that for NO_X in the HGB area, the two RFP scenarios *largeSprk_cntl* and *Tier4_cntl* are responsible for most of the reductions in all years. The VOC emissions reductions appear more evenly impacted by the successive controls.

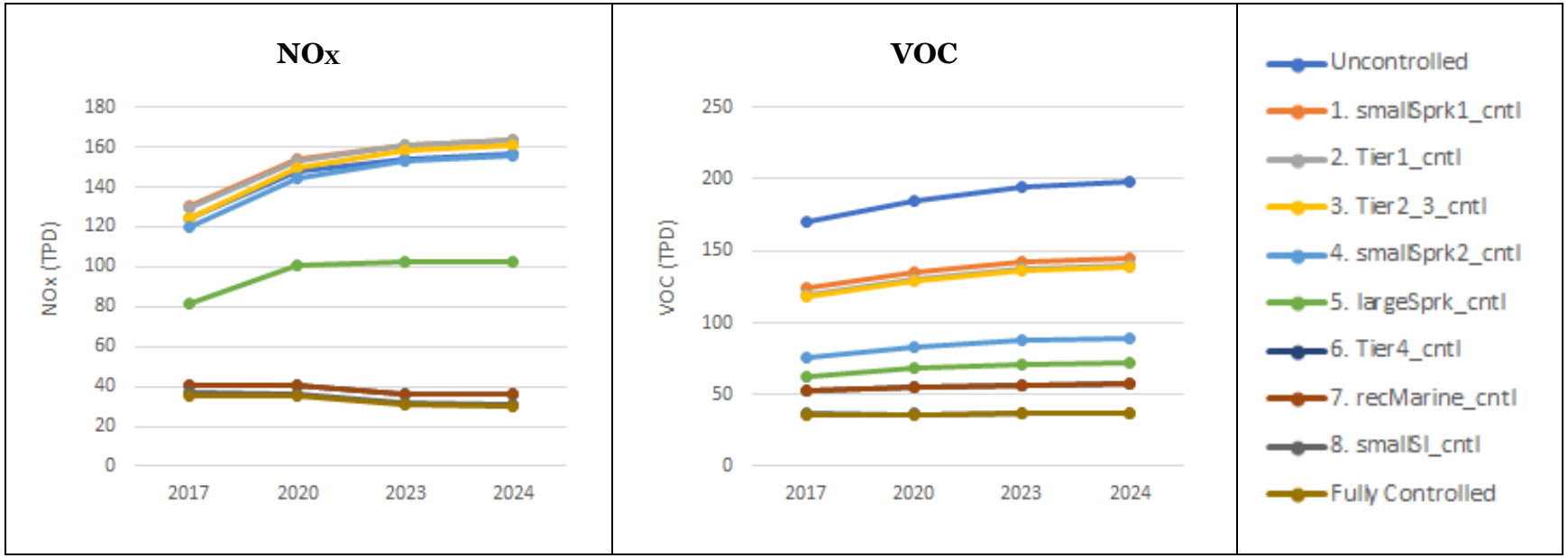

Figure 1. NO_X and VOC Emissions for the HGB Six-County Area (Tons/Day)

Table 2 and Figure 2 for the nine-county DFW area show similar trends to the HGB area. NOx emissions slightly increase with *smallSprk1_cntl*, then decline or stay the same for all other successive controls. Figure 2 trends look similar to Figure 1.

Table 2. NOx and VOC Emissions for the DFW Nine-County Area (Tons/Day)

Emissions Control Scenario	2017		2020		2023		2024	
	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC
Uncontrolled	131.61	188.84	152.31	204.28	161.11	216.42	163.99	220.57
1. smallSprk1_cntl	138.57	135.83	159.60	147.47	168.85	156.16	171.89	159.12
2. Tier1_cntl	137.29	132.75	158.35	144.19	168.00	152.86	171.13	155.82
3. Tier2_3_cntl	132.28	131.67	154.04	143.31	164.75	152.21	168.03	155.21
4. smallSprk2_cntl	127.31	81.45	148.81	89.65	159.21	95.56	162.37	97.51
5. largeSprk_cntl	88.99	68.51	104.76	74.59	108.62	78.41	109.59	79.67
6. Tier4_cntl	45.04	58.27	44.59	61.11	40.67	63.39	40.33	64.37
7. recMarine_cntl	45.04	58.27	44.59	61.11	40.66	63.39	40.32	64.37
8. smallSI_cntl	40.57	40.26	39.68	40.80	35.38	41.52	34.92	42.02
9. RFG	40.57	39.89	39.69	40.44	35.39	41.14	34.92	41.63
10. TxLED	39.17	39.89	38.31	40.44	34.26	41.14	33.84	41.63
Fully Controlled	39.17	39.89	38.31	40.44	34.26	41.14	33.84	41.63

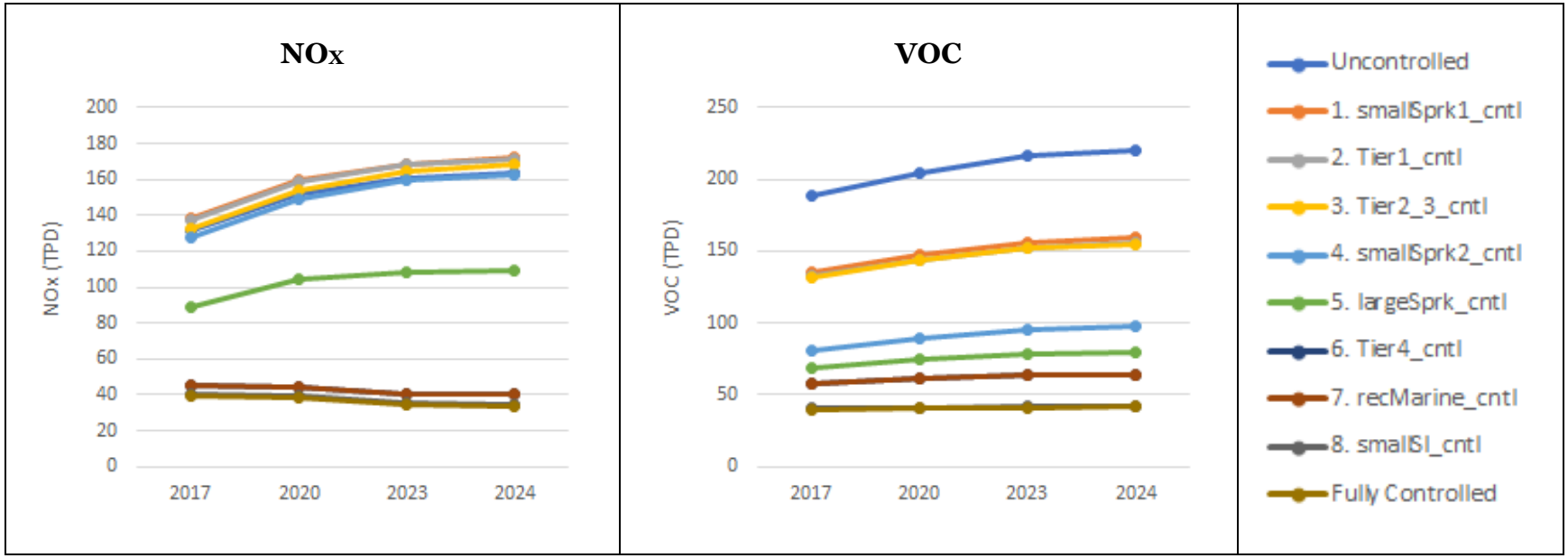

Figure 2. NO_X and VOC Emissions for the DFW Nine-County Area (Tons/Day)

It was somewhat unexpected that Bexar County (Table 3) would have higher VOC emissions than NO_X. In the prior 2017 AERR, the OSD NO_X and VOC were 7.30 and 6.58 TPD[3], respectively. The VOC increase to 11.22 TPD in Table 3 (Fully Controlled) represents a 70 percent increase from the prior estimate, caused by larger gasoline equipment populations in TexN2.2, mostly in the Lawn and Garden category.

Table 3. NO_X and VOC Emissions for Bexar County (Tons/Day)

Emissions Control Scenario	2017		2020		2023		2024	
	NO_X	VOC	NO_X	VOC	NO_X	VOC	NO_X	VOC
Uncontrolled	23.13	50.79	28.13	54.78	28.49	57.67	28.66	58.67
1. smallSprk1_cntl	25.00	35.80	30.10	38.78	30.57	40.77	30.77	41.46
2. Tier1_cntl	24.73	35.61	29.81	38.59	30.37	40.59	30.59	41.28
3. Tier2_3_cntl	23.77	35.40	28.94	38.41	29.74	40.46	30.00	41.16
4. smallSprk2_cntl	22.41	20.29	27.53	22.33	28.24	23.52	28.48	23.92
5. largeSprk_cntl	17.96	18.24	22.53	19.98	22.63	20.91	22.65	21.22
6. Tier4_cntl	9.21	16.02	9.56	16.92	8.72	17.63	8.65	17.92
7. recMarine_cntl	9.21	16.02	9.56	16.92	8.72	17.63	8.65	17.92
8. smallSI_cntl	7.98	11.22	8.23	11.56	7.30	11.90	7.20	12.07
9. RFG	7.98	11.22	8.23	11.56	7.30	11.90	7.20	12.07
10. TxLED	7.70	11.22	7.94	11.56	7.07	11.90	6.98	12.07
Fully Controlled	7.70	11.22	7.94	11.56	7.07	11.90	6.98	12.07

[3] 2017 AERR. Available online (as of 6/30/2021) https://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5821881185013-20181026-erg-texas_statewide_emissions_inventory_nonroad_model_mobile_sources.pdf

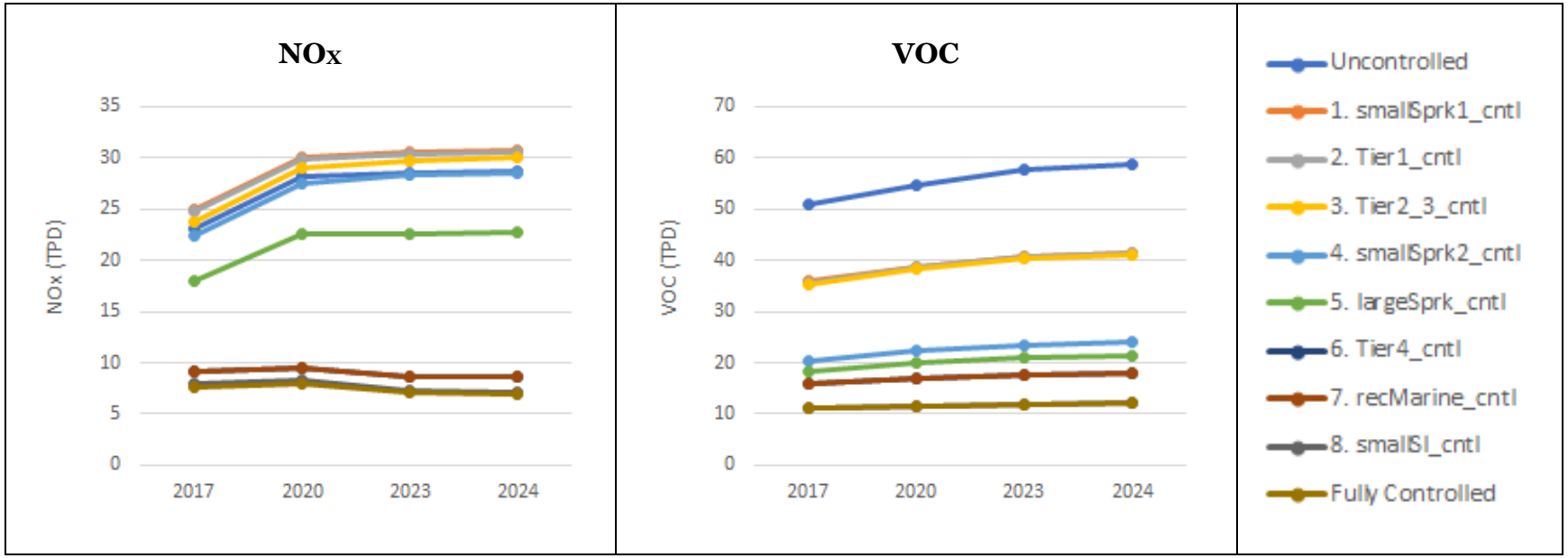

Figure 3. NO_X and VOC Emissions for Bexar County (Tons/Day)

4.0 Quality Assurance

The TexN2 "Automated RFP" function prevents much of the potential for human error by automating the creation of MOVES county databases with alternative nonroad equipment engine technologies by model year, while keeping all other modeling inputs constant.

TexN2 Automated RFP runs were performed in a cloud computing environment using Amazon Web Services (AWS). The use of AWS allowed runs to progress much faster by running 16 instances in parallel (corresponding to the 16 counties). ERG performed a subset of the Task 6 runs on both a local PC and on AWS to compare output emissions reports, ensuring that TexN2.2 with MOVES3 generated identical results between computing environments.

ERG retrieved the TexN2 utility logfiles from the cloud and used a script to scan them for error messages associated with the runs. Finally, ERG generated a large PDF containing plots to examine unit-level emissions factors, emissions, and population by county and emissions scenario. ERG reviewed the plots for outliers and did not find any.

To ensure consistency of Task 6 results with other tasks of the project, ERG also compared the fully controlled scenario (allRules_cntl) to the EIs for EPA's Air Emissions Reporting Requirements and separate RFP EIs associated with a potential SIP revision associated with the 2008 eight-hour ozone NAAQS. The emissions trends of pooled results across this project are consistent, steadily declining with advancing calendar years and the small differences in overlapping or neighboring years make sense considering the minor differences in EI inputs, such as the meteorological data year.

Further information on the comparisons between EIs and quality assurance of the TexN2.2 utility in general can be found in Section 5.0 of the final project report, "Development of Texas Nonroad Model Mobile Source Air Emissions Reporting Requirements, Reasonable Further Progress, and Redesignation and Maintenance Emissions Inventories."