Uinta Basin

Inventory Preparation Plan

US EPA Region 8

Introduction

The Uinta Basin (Basin) is a rural area in northeastern Utah. In recent years the Basin has experienced a large amount of growth in oil and gas energy production. Ozone concentrations measured by non-regulatory monitors in the Basin have exceeded the current ozone National Ambient Air Quality Standards (NAAQS) during the winter. Fine particulate matter ($PM_{2.5}$) concentrations have also remained high over a number of winters. In addition, the 8-hour ozone standard is currently being reconsidered and may be set at a lower concentration as a result. If so, future air quality monitoring will likely identify additional exceedances.

The potential for future exceedances in the Basin makes it imperative to obtain comprehensive emissions data for the area. Some work has been done to date in developing an emissions inventory for the area, but there remain data gaps. A high quality emissions inventory will be an invaluable tool for use in planning and attainment modeling. The inventory preparation plan describes how a high quality inventory will be prepared to describe emissions in the Basin.

Objective

A detailed emissions inventory of ozone precursors, $PM_{2.5}$, and pollutants known to affect the atmospheric chemistry process that produces ozone will help accomplish a number of objectives. It will help to establish permit programs in Indian country within the Uintah and Ouray Reservation and will strengthen the state of Utah's permit program applicable outside of Indian country. If the area does fail to maintain its unclassifiable/attainment air quality status, the state and the Ute Indian Tribe or EPA will use the emissions data for developing a state, tribal, or federal implementation plan (SIP and TIP or FIP) to bring the nonattainment area (NAA) back into attainment. In addition, the oil and gas industry will have the opportunity to use the emissions inventory to assess its operations and determine where work practices can be improved to minimize emissions.

A base year inventory must be established to provide a current and comprehensive data source for emissions contributing to the air quality problem addressed by a future SIP and TIP or FIP. In the case of ozone, the inventory's primary purpose will be to assess the effectiveness of control strategies in bringing the area into attainment. A second purpose is that it will become

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part of the statewide inventory for Utah's permit program.

The nonattainment plan inventory provisions in the Clean Air Act (CAA) section 172(c)(3) explain that base year inventories should include a "comprehensive, accurate, current inventory of actual emissions from all sources" in the applicable area. Details associated with preparing the base year inventory for the Basin are provided in Appendix B, with a discussion of the pollutants, the approach for developing emissions, data codes, and quality assurance.

The base year inventory will be the starting point from which the other future SIP, TIP, or FIP related inventories are derived. Should the Basin become nonattainment for ozone, additional inventories used for the Rate of Progress (ROP) and Reasonable Further Progress (RFP) baselines, modeling, emissions projections, and other inventories will be developed. These inventories may not necessarily be identical to the base year inventory. However, these inventories will relate to the base year inventory with regard to the emissions sources included, pollutants, temporal aspect, and other key aspects. For planning purposes, the base year inventory will provide a way for decision makers to consider the sources of emissions that contribute relevant pollutants and to consider emissions reductions strategies. With this in mind, emission sources need to be prepared to report their emissions annually. Current and accurate emission estimates will be needed over a number of years to satisfy the multiple requirements for emission data outlined above.

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Study Area

The Basin's energy production areas will be the focus for the preparation of the emissions inventory. Extensive coordination between state, local, tribal, and federal agencies will be necessary to collect production and emissions data from oil and gas facilities.

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Figure 1 shows the locations of some of the production. Production has continued to expand in the area since Figure 1 was created; the expansion will be accounted for in the emissions inventory.

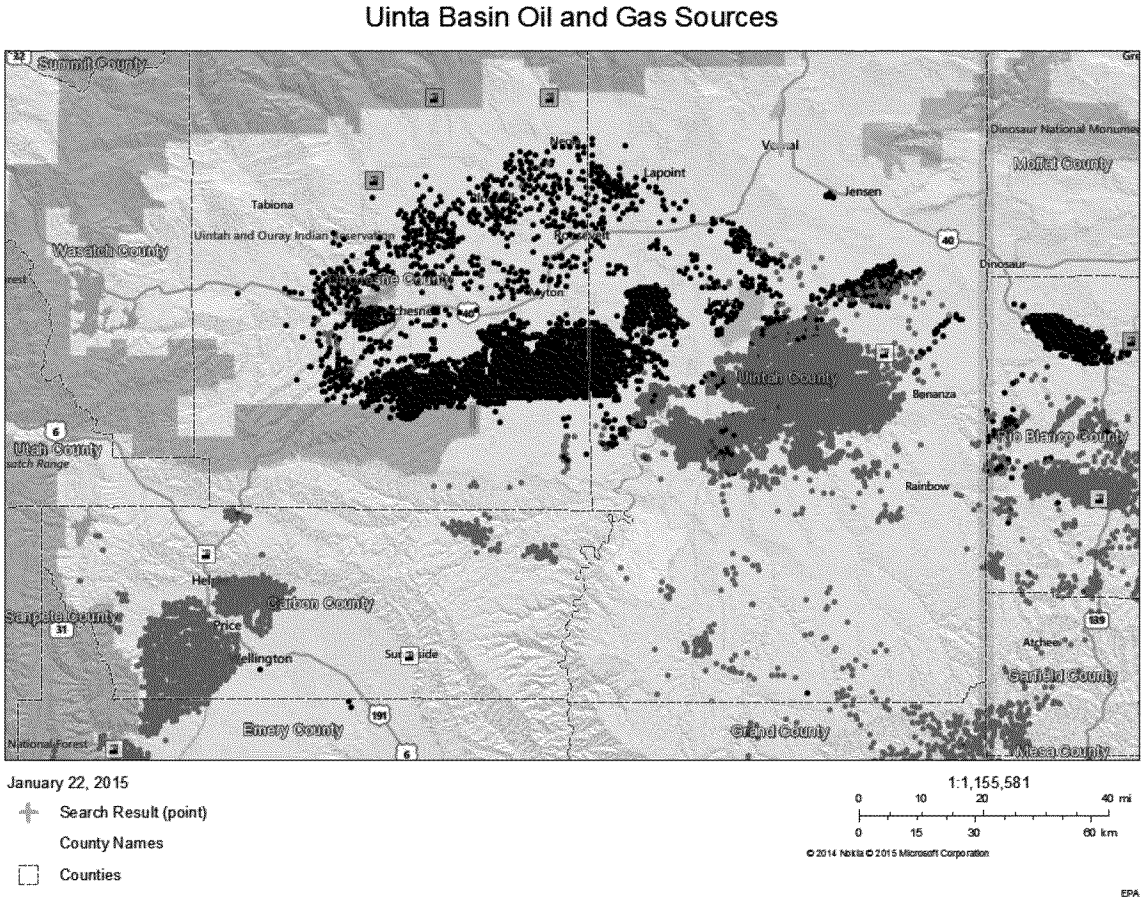

Figure 1 The Uinta Basin in northeastern Utah showing some of the energy production areas located in the area.[1]

The emissions inventory area of interest needs to be defined. Air quality monitoring in and surrounding the Basin in recent years suggests that emission sources are more extensive than previously thought. For example, higher ozone concentrations have been monitored in Rangely, Colorado (Rio Blanco County). A more complete analysis of area's air quality monitoring can be found in Appendix A of this plan.

[1] Map and production area locations provided by EPA's NEPA Assist. More information can be found at http://www.deq.utah.gov/locations/U/uintahbasin/docs/2012/02Feb/June2010-_Air_Issues.pdf.http://www.epa.gov/compliance/nepa/nepassist-mapping.html

Emission Data

Emission data collection for the Basin will involve the coordination of industry and a number of agencies working together. Patrick Barickman of the Utah Department of Environmental Quality (UDEQ), submitted a white paper on preparing an inventory for the Basin, in which he expressed the following goals:

- An estimate of emissions from all of the exploration, production, and distribution sources in the Basin;
  - Any source large enough to be permitted or registered by state or federal agencies would submit detailed, equipment-based information.
  - Sources below the permitting or registration threshold (5 TPY VOC for both) would be estimated using standard inventory techniques for creating "area source" inventories.
  - Estimates for mid-stream sources such as pipelines which are not currently accounted for in the inventory, are needed for a comprehensive assessment.
- A database structure (schema) that includes a "tribal overlay" that allows tribal, state and federal collaboration without impinging on state or tribal sovereignty regarding data ownership and management rights;
- A protocol for QA/QC of inventory inputs and submittals; and
- A protocol for periodic (annual) updates to the inventory.

EPA agrees that UDEQ's goals are relevant for developing an emissions inventory that will likely be used to develop an ozone attainment SIP, and TIP or FIP. Projected emissions for future growth also need to be addressed.

The designation of the Basin will depend on whether air quality monitoring or modeling determines that the area is in nonattainment for a NAAQS standard. Current monitoring shows that the ozone NAAQS is being exceeded in the Basin. Based on non-regulatory monitoring, it appears that $PM_{2.5}$ levels are also elevated. Concentrations of these pollutants from monitored data may be found in Appendix A.

Development of the inventory begins with the National Emission Inventory (NEI). This national inventory requires that states report emissions from their largest sources on an annual basis. Statewide emission sources are reported by the state every three years to the NEI. The periodic reporting provides an opportunity to establish a base emissions level for the state. Studies suggest that oil and gas emissions may be underreported in the NEI. Results from a 2012 field study in the Uinta Basin of Utah suggest emission rate of methane leakage at 6.2 to 11.7% of the total production (8.9% +/- 2.7%). EPA GHG Inventory equated to 1.42% in 2012.[2] Therefore,

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EPA Region 8, along with the Ute Indian Tribe and UDEQ, expect the oil and gas industry to supplement emissions data currently reported to the state.

The oil and gas industry report their annual greenhouse gas emissions under the Greenhouse Gas (GHG) Reporting Rule (40 CFR Part 98 Subpart W) for sources with emissions greater than 25,000 metric tons of CO_2 equivalent ($mtCO_2e$). The emissions include fugitive and vented carbon dioxide (CO_2), methane (CH_4), and combusted CO_2, nitrous oxide (N_2O), and CH_4. As part of the reporting rule, equations are provided to determine the amount of emissions of these GHG gases. The calculations may also be modified to determine emissions of volatile organic compounds (VOC) and criteria pollutants.

There are additional tools available to use in determining emissions from the oil and gas industry. The Oil and Gas Emission Estimation Tool (tool) developed by EPA utilizes activity and emission factor data reported by state and local agencies to calculate emissions. Where state and local input data are not available, nationally-averaged default data is used. To supplement this data, EPA analyzed information in the U.S. GHG Inventory and Subpart W of the GHG Reporting Rule for potential use in the tool. As a result of this analysis, data from these EPA sources were used in the tool to estimate emissions for several source categories. Specifically, data from these programs were used in the following source categories:

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- Condensate Tanks;
- Liquids Unloading;
- Pneumatic Devices; and
- Well Completions.

The tool is undergoing improvements but it remains a valuable means to determine emissions, in cases where information on emissions is not readily available.

Projecting future year emissions inventories in the oil and gas sector is complicated by the fact that there is a life cycle to the amount of production from individual wells and thus from well fields in aggregate. It is therefore EPA's conclusion that annual emissions estimates from oil and gas industry sources be required. The state of Utah has noted its preference to use the 2014 NEI triennial year as the base year for an attainment demonstration[3]. However, EPA has not proposed or finalized its guidance for the

[2] Citation: Karion, A., et al. (2013), *Methane emissions estimate from airborne measurements over a western United States natural gas field*, Geophys. Res. Lett., 40, 4393–4397, doi:10.1002/grl.50811.

[3] Based on conversions between the Utah DEQ and EPA Region 8 during the October 8, 2014 Uinta Basin Oil and

anticipated new ozone NAAQS. Based on the schedule for finalizing the new ozone NAAQS and the CAA requirements, the guidance will likely indicate that the earliest year that can be used for the base year will be 2015. EPA recognizes that this does not fit in with the triennial reporting period for the NEI.

The general plan for coordination of data collection is outlined in Figure 2. The state has proposed that emission data be collected using a spreadsheet format currently in development. See Appendix B. Industry would be required to complete the spreadsheet annually by answering a series of questions about their operations and emissions sources. Industry will also be responsible for calculating emissions from its production equipment. UDEQ will supplement the data being collected with information it has obtained through its existing permit program. For sources subject to the state program, UDEQ will be responsible for the quality assurance of the data; EPA Region 8 will be responsible for the quality assurance of data for sources in Indian country.

How these emissions may be calculated will be addressed in Appendix B. EPA has promulgated regulations establishing a federal minor source registration program in Indian country (40 CFR §§49.151-49.165). Oil and gas sources greater than 5 tons per year VOC must submit emissions data as part of the registration requirement.

EPA recommends that UDEQ's inventory database be the collection point for submitting the emissions data. Utah intends to use the data for its permit program and for the possible development of a SIP. The Tribe and EPA will use the data to assess attainment of the new ozone NAAQS and any subsequent requirement for a TIP or FIP.

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Gas Emission Inventory Improvement Meeting.

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Figure 2 Emission Inventory Data Coordination

Figure 2 Coordination of data collection between the Tribe, State, EPA, and industry.

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What data should be collected?

Table 1 Emission Sources associated with Oil and Gas Operations[4]

List A – Emission Sources Always Included	List B – Emission Sources Less Common	List C – Emission Sources Rarely Required
Condensate/Oil Storage Tanks	Amine Units	Drill Rigs
Produced Water Storage Tanks	Traffic Dust	Completion/Frac Engines
Pneumatic Controllers	-Construction Vehicles	Workover Engines
Pneumatic Pumps	-Operations Vehicles	Well Pad Construction Equipment
External Combustion Units	Completion Gas Venting/Flaring	Road Construction Equipment
-Heater Treaters	Well Blowdowns (Liquids Unloading)	Pipeline Construction Equipment
-Line Heaters	Engine Blowdowns	Wind Erosion from Ground Clearing
-Tank Heaters	VRU Blowdowns	Tailpipe Emissions
-Reboilers	List C – Emission Sources Rarely Required	- Operations Vehicles
Internal Combustion Units	Drill Rigs	- Tanker Trucks
-Compressor Engines (NG or diesel)	Completion/Frac Engines	
-Generators (NG or diesel)	Workover Engines	
Turbines	Well Pad Construction Equipment	
Dehydration Units	Road Construction Equipment	
-TEG Dehys	Pipeline Construction Equipment	
- EG Dehys	Wind Erosion from Ground Clearing	
Hydrocarbon Loading	Tailpipe Emissions	
Flares and Combustors	- Operations Vehicles	
Fugitive Component Leaks	- Tanker Trucks	
Production Gas Venting/Flaring		

Table 1 lists sources of emissions from oil and gas capture operations. Listed as either A, B, or C

[4] Table provided by Steyskal et.al, "Emission Methodologies and Reporting Systems." This presentation was given at the October 8, 2014 Uinta Basin Oil and Gas Emissions Inventory Improvement meeting in Roosevelt, Utah.

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sources, the letter designation signifies how common these emissions sources are found in a typical oil and gas operation. List A sources are commonly found and B and C are less common or rarely found as part of the operation. Each source from the three lists will be reviewed against the sources found in the Uinta Basin and a determination made as to whether the emissions from the source will be part of the inventory.

Additional sources to be reviewed for their emissions impacts on air quality in the Basin:

- Formaldehyde emissions from methanol use and combustion sources
- Well preparation for production
- Natural gas leaks from production, processing, transmission and storage
- Pumps not included in Table 1 or the 2012 revision to the New Source Performance Standards
- Evaporation ponds
- Pipeline blowdowns
- Unintentional gas carrythrough

Modeling Domain

The air quality modeling system includes a meteorological model, an emissions processing system and a photochemical air quality model. Each component of the modeling system is defined on a 3-dimensional, gridded model domain. The model simulates the emissions and chemical reactions that occur within each grid cell and the transport of polutants between grid cells. Because ozone can be transported long distances, a system of nested grids with increasingly refined spatial resolution is used to simulate ozone transport from the global to local scale. For example, a global scale chemistry-transport model is used to specify boundary conditions for a coarse grid 36-km resolution domain over North America, and a nested 4-km or 1-km grid may be used for local scale modeling. It is expected that boundary condition data will be provided by other regional and global scale modeling studies, and that the Basin study will perform simulations for a domain that includes Utah, western Colorado and southwestern Wyoming a spatial resolutions of 4 to 1 km. Emissions data for Colorado and Wyoming will be provided by the Three-State Air Quality Study (3SAQS) by March 2015. The anticipated modeled year are either 2011 or 2013. Monitoring data collected for the same years will determine which year should be modeled. A year where monitoring shows high ozone concentration would be the preferred year to model. Since the modeled year may not correspond to the year chosen for the base year inventory, the need to collect emissions data over a number of years is apparent.

The model vertical resolution is typically represented by approximately 40 layers extending from

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the surface to the lower stratosphere, with vertical resolution near the surface on the order of 10's of meters. However, because winter ozone formation occurs under conditions that differ from typical summer ozone episodes, the stakeholders will work together to identify a model domain that is appropriate for winter conditions. For example, enhanced vertical resolution and additional layers may be needed near the surface. Emissions data are needed for each source category to determine the vertical layer in which emissions occur, e.g., stack height, exit velocity, and gas temperature are needed to estimate the plume height of each emissions source.

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Appendix A

Monitored Data

The Uinta Basin Unclassifiable Area is defined as Uintah and Duchesne Counties in Utah. Non-regulatory monitors have recorded NAAQS violations in AQS beginning in December 2009. Table A-1 shows the design values for the three non-regulatory monitors in the Uinta Basin. These design values were derived from the fourth maximum value measured at the monitoring site during a three year period. The current NAAQS is 75 parts per billion based on the annual fourth-highest daily maximum 8-hr concentration, averaged over three years.

3 Year Period	Ouray	Redwash	Dinosaur NP
2009-2011	100	88	--
2010-2012	101	88	77
2011-2013	106	94	92
2012-2014	93	81	84

Table A-1 Ozone Design Values from monitored data in the Uinta Basin

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Intermittent, short-term $PM_{2.5}$ monitoring detected elevated $PM_{2.5}$ in Vernal in 2007 and 2013, and in Roosevelt in 2013. The Vernal data detected both peak and 98th percentile concentrations above the NAAQS during winter temperature inversions. Roosevelt data showed two winter exceedance days in 2013, with a 98th percentile value using only the first 6 months of 2013 at the level of the NAAQS (35 ug/m3).

Outside the towns of Roosevelt and Vernal, monitoring was done at one or more stations during 2009-2014. Rural exceedances outside Roosevelt and Vernal occurred during a dust storm in 2012, and during wildfire smoke events in 2013.

Data sets with exceedance level data shown in bold type are summarized in Table A-2

Year	Location	Method	Peak $PM_{2.5}$	98th Percentile $PM_{2.5}$
2007	Vernal	FRM	**63.3**	**51.8**
2012	Roosevelt	TEOM	**53.8**	29.6
2012	Ouray	FDMS TEOM	**45.9**	27.4
2012	Myton	1405 TEOM	**37.5**	34.6
2012	Dragon Road	Met One BAM	**78.6**	20.2
2012	Rangely, Co.	Met One BAM	**36.3**	24.9

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2013	Vernal	TEOM	**55.7**	**42.0**
2013	Roosevelt	FDMS TEOM	**41.7**	35.0

Table A-2 $PM_{2.5}$ data monitored in the Uinta Basin ($\mu g/m^3$)

Just outside the Uinta Basin Unclassifiable Area, in Rangely, Colorado, National Park Service recorded a Regulatory violation 2011-2013 of 77 ppb; preliminary 2012-2014 data there show attainment at 74 ppb.

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Appendix B

Emission Data Estimates

The pollutants and precursors that should be included in the planning inventories are dependent on the type of control strategies associated with attainment plan for the area. Because many sources emit more than one of the precursor pollutants, and because the precursor pollutants have the potential to be transported across state boundaries, EPA encourages the development of an inventory for all pollutants, where possible, to support integrated, regional-scale modeling, and control strategy development for ozone and $PM_{2.5}$.

The CAA requires all relevant precursors to be included in inventories for SIPs. The ozone and $PM_{2.5}$ implementation rules include specific language regarding the pollutants to be included.

For the 8-hour ozone NAAQS, the pollutants to be inventoried are VOC, NO_X, and CO. For the $PM_{2.5}$ NAAQS, the pollutants to be inventoried are primary emissions (including condensable PM) of PM_{10} and $PM_{2.5}$, and emissions of SO_2, NH_3, VOC, and NO_X. The EPA is specifying PM_{10} emissions to be reported because PM_{10} emissions are often used as the basis for calculating $PM_{2.5}$ emissions.

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EPA is preparing for future guidance a list of oil and gas source types for which condensable PM is expected. Oil and gas sources where condensables are expected include gas well dehydrators, well heaters, fuel fired compressor engines, heat treaters, process heaters and steam generators. This includes both point and nonpoint sized sources.

For stationary point and nonpoint sources, the EPA recognizes that emission factors for condensable emissions and speciated PM are limited, as well as emission factors for many industrial sources of filterable $PM_{2.5}$. In response to this issue, EPA has devised a mechanism to more readily collect source test data for use in developing improved emission factors. More information on this approach can be found at www.epa.gov/ttn/chief/ert/. Industry, state, local and tribal agencies should provide EPA with source test data they may collect during the preparation of PM inventories to support the development of emission factors.

The EPA on January 14, 2015 outlined a series of steps it plans to take to address methane and smog-forming VOC emissions from the oil and gas industry. Observed wintertime ozone NAAQS exceedances in the Basin may have been partly due to the methane emissions (in conjunction with VOC emissions and air chemistry). Thus, the importance of methane emissions for ozone analyses is under investigation in the Basin.

The air quality models used for modeled attainment demonstrations use methane as one of the

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modeled and input pollutants. In the past, methane would be calculated by applying a factor to the VOC emissions to calculate total organic gases (TOG). These TOG emissions are split during emissions processing for input to air quality models into "model species," which include methane.

To investigate the extent that methane emissions play any role in ozone episodes within the Basin, additional efforts may be useful to go beyond using the default VOC-to-TOG profiles and default methane fractions from the speciation profiles. It may be necessary to include improved ethane emissions to achieve sufficient model performance for a modeled attainment demonstration. Furthermore, more specific VOC-to-TOG factors and speciation profiles may be useful, particularly for analysis related to areas of very high methane emissions. Therefore, EPA is recommending that methane emission estimates be a part of the inventory.

Data Collection methods

Figure B.1 shows a draft speadsheet the UDEQ has developed to collect emissions data from the oil and gas industry. Sources would be required to complete the spreadsheet each year that emissions data are required. The spreadsheets would be collected by UDEQ for state lands and by EPA Region 8 for trust lands and combined into one emission inventory for the Basin. As of January 2015, the spreadsheet was still under development by the state.

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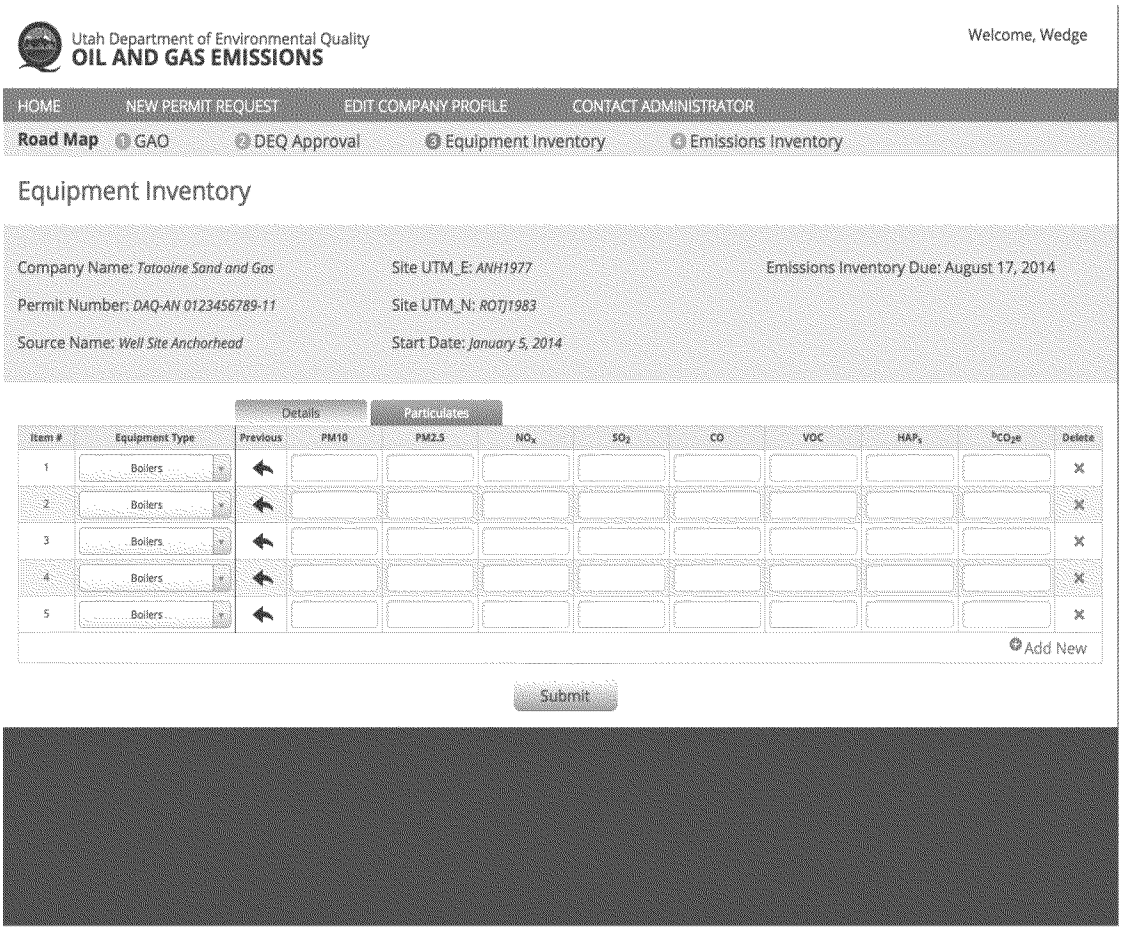

Figure B.1 Example of data collection spreadsheet provided by Utah DEQ[5]

Utah has reviewed Wyoming's efforts to obtained emissions data from the oil and gas industry and may incorporate Wyoming's ideas into their own spreadsheet. Wyoming has a data system for the reporting of emissions. IMPACT is the Wyoming Air Quality Division's (AQD) new online Inventory, Monitoring, Permitting, And Compliance Tracking (IMPACT) data system. The system will be used to submit applications, reports, and documents electronically to Wyoming AQD.

The system's functionalities include:

- Facility Management
  -Make updates to facility configurations
  -Make changes to facility contacts

- Permitting (NSR and Title V)
  -Create and submit NSR permit applications
  -Create and submit Title V permit applications

- Emissions Reporting
  -Create and submit Title V emission inventories

- Compliance Reporting
  -Create and submit compliance reports including stack tests, CEMs, RATAs, etc

Aspects of Wyoming Impact data system may be incorporated into Utah's data collection system for oil and gas industry in the Uinta Basin.

Electronic Data Reporting

EPA Region 8 will work with the Ute Indian Tribe and Utah DEQ to make the data reporting more efficient. One possibility is to use the Central Data Exchange (CDX). The CDX (http://cdx.epa.gov/epa_home.asp) is the point of entry of emissions performance data reports to EPA. It provides capabilities for submitters to submit and access their data electronically and enables OAR to effectively manage the incoming data.

Affected industrial facilities are required to use the Electronic Reporting Tool (ERT) to generate

[5] Form taken from the Utah Department of Environment Quality Web site. http://www.deq.utah.gov/FTP/index.htm

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files containing emissions source test data. ERT can be adapted for sources to submit emission inventory data. The facilities could submit these files to CDX using The Compliance and Emissions Data Reporting Interface (CEDRI). The submission files are stored in the CDX archives and would be available to submitters and authorized EPA reviewers immediately upon submission.

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