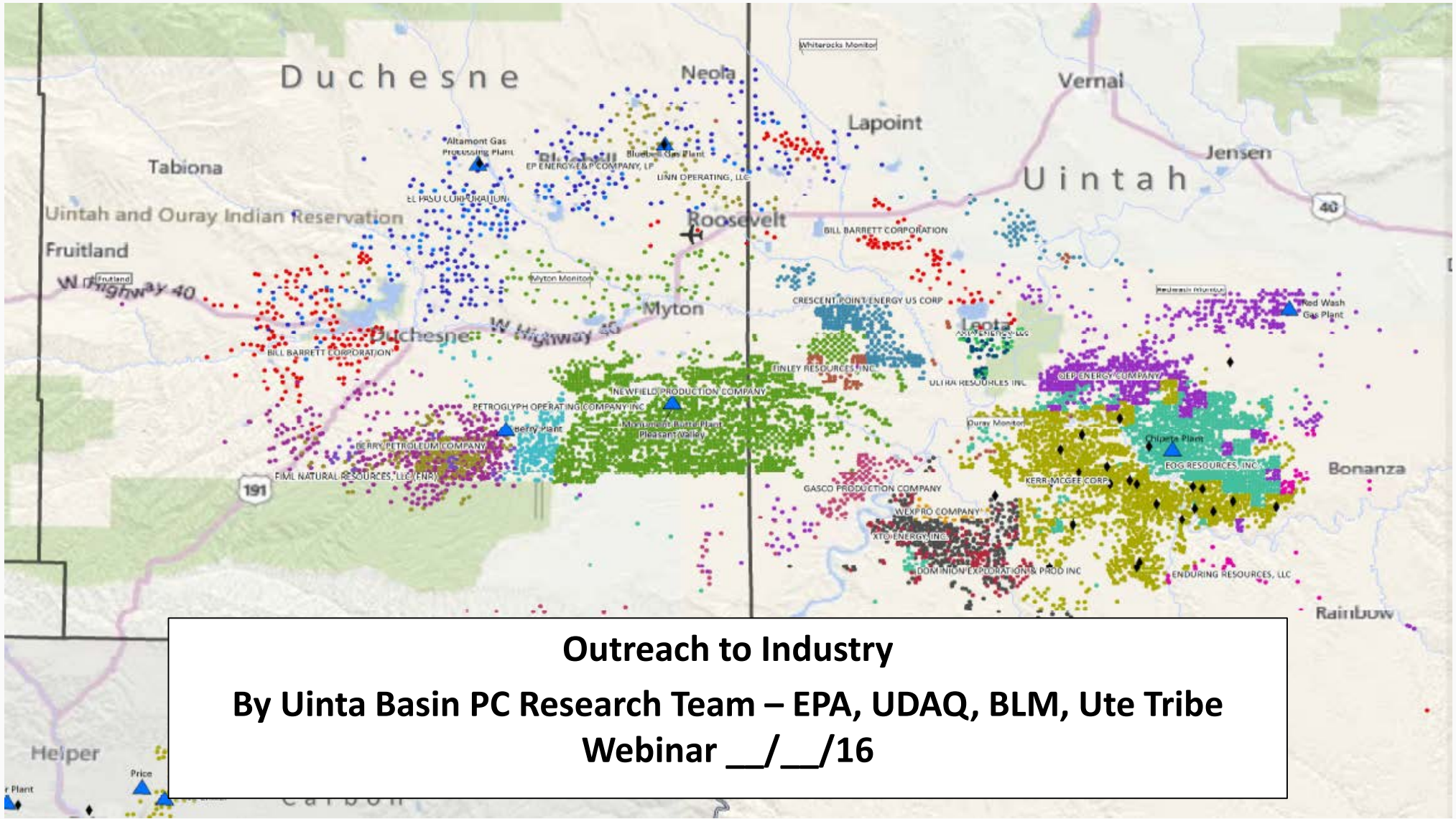
Uinta Basin Pneumatic Controller Research Project



Outreach to Industry

By Uinta Basin PC Research Team – EPA, UDAQ, BLM, Ute Tribe

Webinar __/__/16

Purpose of this Meeting

- EPA and collaborators are planning a research effort in the Uinta Basin to improve information on well pad pneumatic controller (PC) emissions and measurement methods

- This meeting introduces the study to industry and begins communication on study input and potential cooperation

Outline

- Background
- Objectives
- Project Elements
- Why Uinta Basin
- Why Pneumatic Controllers
- What We Know So Far
- Data Gaps to Fill
- Project Plan
- Project Cooperator Input

Background

- RARE Grant funding for Regional Projects
  - The Regional Applied Research Effort (RARE) is an Office of Research and Development (ORD) program administered by the Office of Science Policy (OSP) that responds to the high-priority research needs of EPA Regions
- EPA Region 8 proposed emission measurement Research project for pneumatic controllers in the Uinta Basin

  "Characterizing Emissions from Pneumatic Controllers at Oil and Natural Gas Well Pads in the Uinta Basin Using Extractive Sampling and Hyper-spectral Imaging Technologies"
- Awarded $125k to conduct in FY16

Background

- Collaborators – Project Team
  - EPA ORD – Office Research & Development
  - EPA Region 8
  - UDAQ – Utah Division Of Air Quality
  - Ute Tribe – Air Program
  - BLM – Utah State Office, Vernal Field Office
- Training on technical aspect of pneumatic controllers (PCs) delivered by Reid Smith, BP to Project Team (training he had developed for API)
- EPA ORD has secured contractor (Jacobs Technologies) to assist with the onsite measurement portion of the study

Project Objectives I

- Improve understanding of PC emissions
  - Is it a PC emission or fugitive/malfunction?
  - Acquire emission factor (EF) measurement data
- Improve emissions measurement methods
  - Augmented Hi-Flow sampling
  - Test research methods (QOGI and speciation)
- Advance PC activity factor (AF) information
  - Acquire/mine additional AF data
  - Explore possible AF actuation data gathering

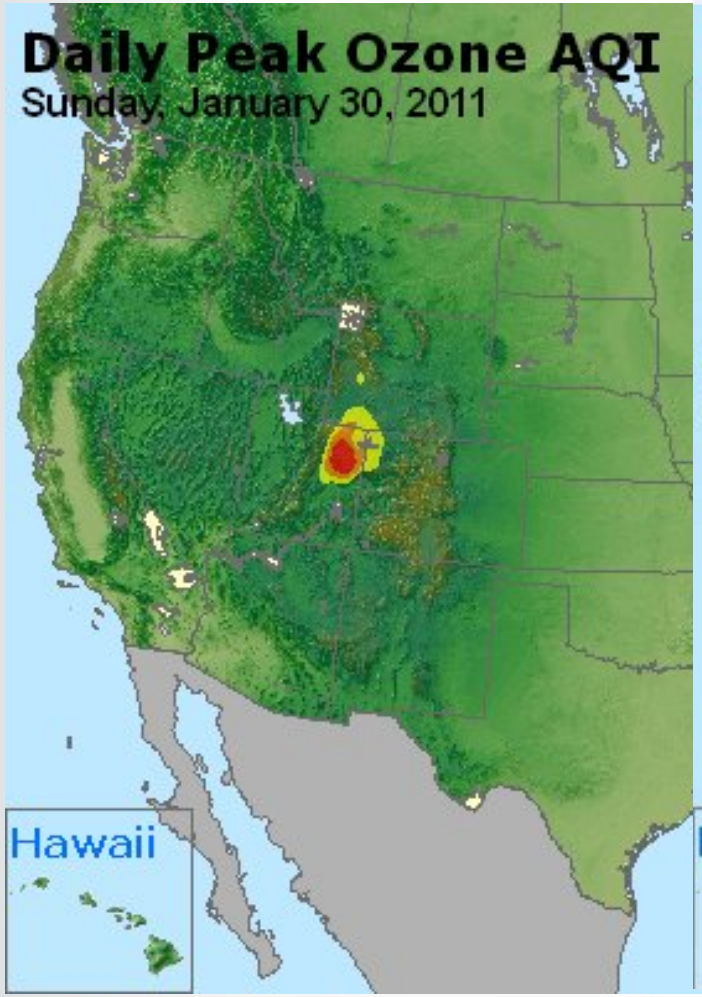
Project Objectives II

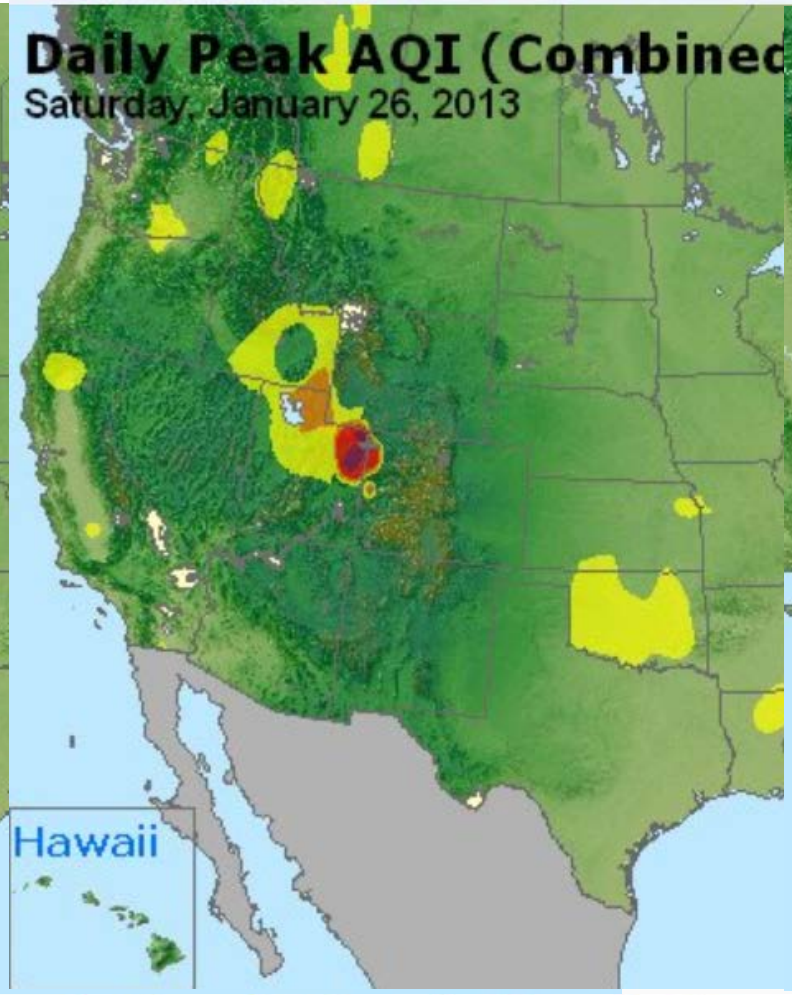
- Contribute to Uinta Basin Emissions Inventory development
- Build Capacity in Government Agencies (Tribal/State/EPA/BLM) and Industry EHS by training environmental staff on pneumatic controller (PC) operation, observation, and measurement
- Improve understanding of the impact of maintenance on PC emissions
- Contribute to PC observation and measurement protocol advancement

Project Scope

- Onsite Emissions Measurement Study
  - 24 field days in August/September 2016 - Executed by Jacobs Technologies
  - Conducted with industry cooperators
  - Emission Factor (EF) and some Activity Factor (AF) objectives
  - PC system data gathering to allow engineering calculations
  - OGI observation to assign emission points (PC or fugitive)
  - Augmented Hi-Flow sampling emission measurements
  - Advanced methods testing such as QOGI, speciation
  - Design statistically representative sampling with cooperators
- Additional Activity Factors (AF) Data Gathering activities
  - April - September 2016 executed by project collaborators
  - Execute onsite PC data gathering protocols at other sites
  - Mine information coming in under other programs

Why Uinta Basin?





Good | Moderate | USG | Unhealthy | Very Unhealthy | Hazardous

Why Pneumatic Controllers?

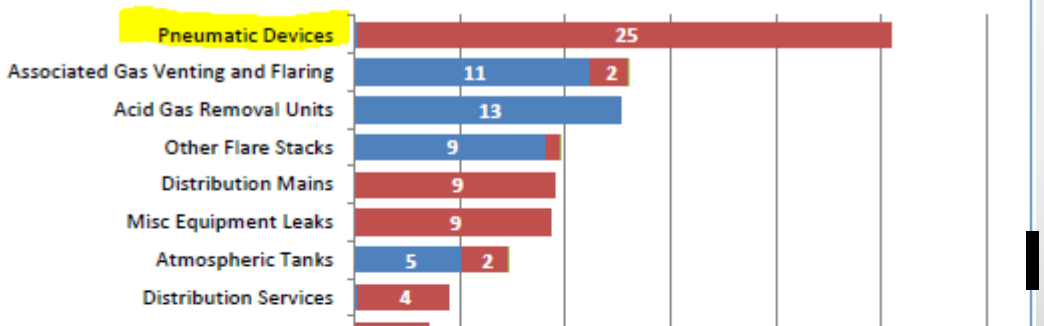
- Large emission source
  - 3rd largest VOC contributor (after tanks and glycol dehydrators – WRAP III)
  - 1st largest methane contributor (GHGRP-W Onshore Production)

- Recent regulatory attention on PCs
  - NSPS OOOO requirements on low-bleed (<6 cfh) or no-bleed of gas
  - UDAQ pneumatic retrofit rule
  - BLM proposed "Waste Prevention, Production Subject to Royalty, and Resource Conservation"

WRAP Phase III Emission Inventory – Uinta Basin

Description	2012 Emissions				
	NOx (tons/year)	VOC (tons/year)	CO (tons/year)	SOx (tons/year)	PM10 (tons/year)
Dehydrator	225	30,665	189	0	17
Pneumatic devices	0	25,083	0	0	0
Condensate tank	0	21,719	0	0	0
Oil Tank	0	20,722	0	0	0
Pneumatic pumps	0	14,322	0	0	0
Permitted Sources	3,184	4,355	2,517	8	48
Unpermitted Fugitives	0	3,212	0	0	0
Truck Loading of Oil	0	1,391	0	0	0
Venting - Compressor Startup	0	1,300	0	0	0
Venting - Compressor Shutdown	0	1,233	0	0	0
Artificial Lift	3,053	955	34,750	2	136
Compressor engines	3,169	695	4,236	0	46
Venting - blowdowns	0	460	0	0	0
Truck Loading of Condensate	0	445	0	0	0
Drill rigs	4,773	362	1,507	3	236
Venting - initial completions	0	332	0	0	0
Heaters	1,671	95	1,420	11	132
Miscellaneous engines	199	63	201	0	1
Venting - recompletions	0	51	0	0	0
Workover rigs	271	22	91	0	15
Gas Plant Truck Loading	0	12	0	0	0
Condensate tank flaring	2	0	9	0	0
Dehydrator Flaring	0	0	1	0	0
Initial completion Flaring	1	0	4	0	0
Total	**16,547**	**127,495**	**44,925**	**24**	**631**

Figure 6: 2014 Reported Process Emission Sources



What We Know So Far

UINTA BASIN SUMMARY

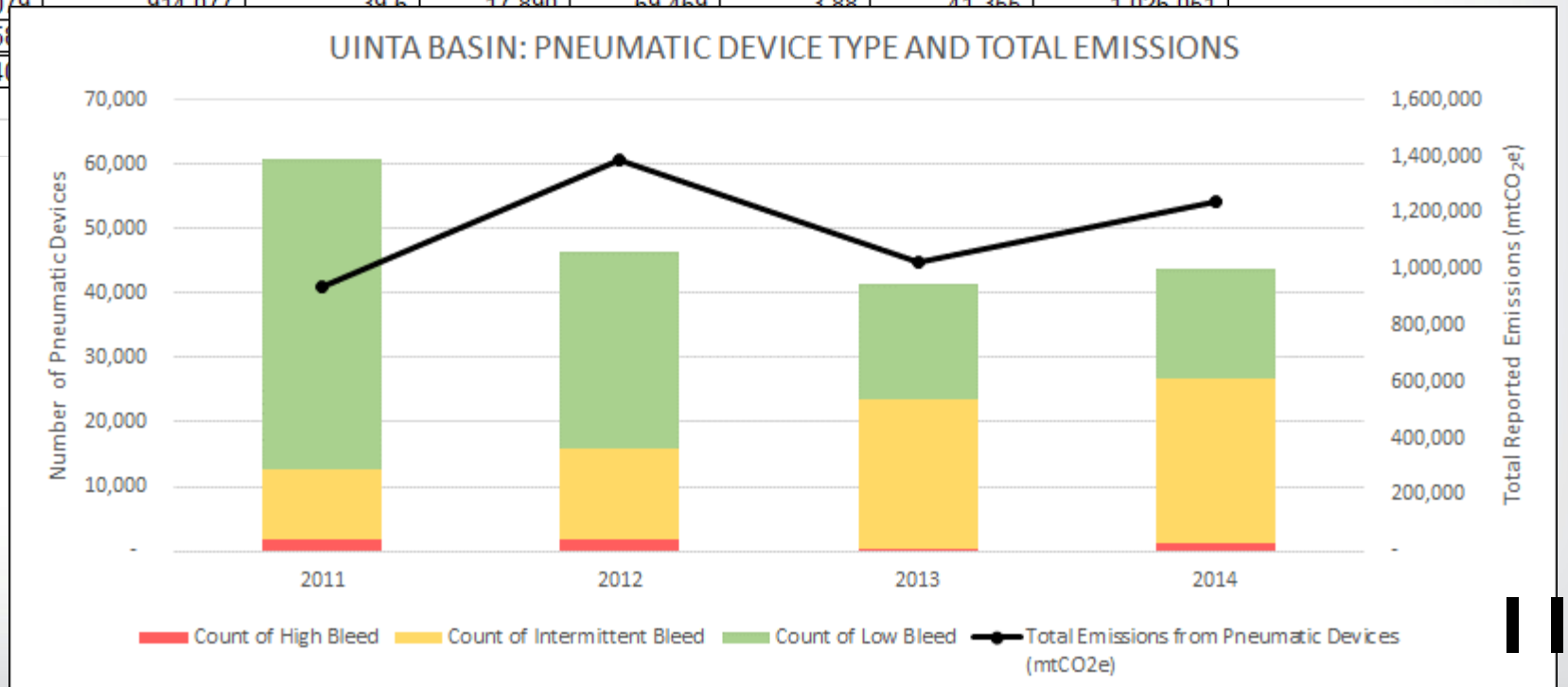
*All emissions values have been standarized to reflect AR4 GWPs

Pneumatic Devices Type and Emissions

	High Bleed			Intermittent Bleed			Low Bleed			Basin Totals	
	Count of High Bleed	Total Emissions from High Bleed ($mtCO_2e$)	Average Emissions per High Bleed Device	Count of Intermittent Bleed	Total Emissions from Intermittent Bleed ($mt\ CO_2e$)	Average Emissions per Intermittent Bleed Device	Count of Low Bleed	Total Emissions from Low Bleed ($mtCO_2e$)	Average Emissions per Low Bleed Device	Total Pneumatic Device Count	Total Emissions from Pneumatic Devices (mtCO2e)
2011	1,807	161,918	89.6	10,892	583,526	53.6	48,100	194,250	4.04	60,799	939,694
2012	1,923	163,358	84.9	13,849	1,088,566	78.6	30,538	136,472	4.47	46,310	1,388,395
2013	386	42,505	110.1	23,079	914,077	39.6	17,890	69,469	3.88	41,355	1,026,051
2014	1,151	149,038	129.5	25,5[illegible]							
Totals	5,267	516,818	98.1	73,4[illegible]							

Tons Methane (2014)/device 3,566

EPA Greenhouse Gas Reporting Program – Subpart W



What We Know So Far

- Skewed emission distributions, fat tail, "super-emitter" … a small % of sources account for a large % of emissions – **not fixed in time or space**
  - Wellpads – 86 natural gas wellsites … ~5% sites → ~60% of emissions
  - Wellpads-Compressor Stations-Gas Plants – Barnett Shale region … 2% sites → 50% of emissions and 10% sites → 90%
  - Midstream Compressor Stations – 114 CSs … 25 CSs vented >1% of gas processed, 4 CSs vented >10% gas processed
  - Midstream Compressor Stations – 114 CSs … 30% sites → ~80% of emissions
  - Gas Plants - 16 gas processing plants … 45% sites → ~80% of emissions
  - Transmission Compressor Stations – 45 CSs … 10% sites → ~ 50% of emissions
  - Abandoned Wells – 19 abandoned wells… 3 of the 19 wells had CH4 flow rates three orders of magnitude larger than the median flow rate
  - Well Liquid Unloading – 107 wells with liquid unloadings …
    w/o plunger lift: 20% wells → 83% of emissions
    w/ plunger lift and manual: 20% wells → 65% of emissions
    w/ plunger lift and automatic: 20% wells → 72% of emissions
  - Pneumatic Controllers – 377 controllers … 20% devices → 96% of emissions

What We Know So Far

COMPARISON OF PNEUMATIC CONTROLLER STUDIES

Research Component	Methane Emissions from Process Equipment at Natural Gas: Production Sites in the United States: Pneumatic Controllers. Allen, D. et al	Pneumatic Controller Emissions from a Sample of 172 Production Facilities. Oklahoma Independent Petroleum Association (OIPA)	Determining Bleed Rates for Pneumatic Devices in British Columbia. Prasino Group
Date	2014	2014	2013
Location	4 Regions incl. "Rocky Mtn" **Below focus on Rocky Mtn**	Oklahoma	British Columbia, Alberta
# Sites	**7** 3 Operators 2 Basins	**172** 8 Operators 6 geographic areas	8 Operators 30 producing fields
# PCs	**125** 117 intermittent 8 continuous	**680** 659 Intermittent 21 continuous	**581** 254 level, 43 positioner, 142 pressure, 41 temperature, 101 transducer
Emission measurements	-Fox flow meter (model #FT2A) for supply gas line into controller (117 PCs measured) -Hi-Flow for gas discarged from controller (20 PCs measured)	No measurements - engineering calculations of controller-actuator system with actuation frequency observations	Calscan (Hawk 9000 Meter) Positive displacement bellows meter (log over time @ 5 sec intervals, flow rates down to zero, any type of gas)
# Actuations	Counted in 15 min	Counted in 15 min	Log emissions over 30 min for "static & dynamic" emission rate
Observation period	15 minute	15 minute	30 minute
Site-specific gas compostion data	% C1, C2, C3, C4+ (%mol) by site	One representative sample per geographic area	Not discussed
Rate of leaks/malfunctions	"equipment issues" at **7.4%** of all 377 PCs measured	Not assessed	Not assessed

What We Know So Far

UT/EDF Study

Table 1. Sample Population, Categorized by Controller Application and Region (AP= Appalachian; GC = Gulf Coast; MC = Mid-Continent; RM = Rocky Mountain)

		number of controllers sampled, categorized by application							
region	separator	process heater	compressor	wellhead	.plunger lift	dehydration system	flare	sales	total
AP	14	13	0	24	1	0	0	0	52
GC	73	0	13	11	7	17	1	1	123
MC	48	11	7	0	11	0	0	0	77
RM	51	21	0	32	11	8	2	0	125
total	186	45	20	67	30	25	3	1	377

Table 2. Whole Gas Emissions from Controllers (scf/h), Categorized by Region and Application[a]

		average whole gas emission rates from controllers (scf/h), categorized by the application								
region	all devices	separator	process heater	compressor	wellhead	plunger lift	dehydration system	flare	sales	avg. w/o compressors
AP	1.7	0.3	1.3		2.8	0.0				1.7
GC	11.9	16.3		10.6	0.0	7.3	4.3	0.0	0.0	12.0
MC	5.8	4.9	0.0	20.2		6.5				4.4
RM	0.8	1.5	0.2		0.4	0.1	0.0	0.0		0.8
average	5.5	8.1	0.5	14.0	1.2	4.1	3.0	0.0	0.0	5.0

[a]Numbers of devices sampled in each category are reported in Table 1.

What We Know So Far

UT/EDF Study

Table 3. Frequency of Actuations and Emissions from Intermittent Vent Controllers Where Actuations Were Observed, Categorized by Region

region	count of devices	frequency of actuations (#/min)	avg. emission rate (scf/h)
AP	8	2.42	4.85
GC	30	0.37	20.5
MC	17	0.93	5.05
RM	25	0.43	1.72
total	80	average: 0.73	average: 9.76

UT/EDF Study, Allen et al, SI (Table S6-1)

Site Identifier	Count of Measured Pneumatic Devices	Count of Not Measured Pneumatic Devices	Total Pneumatic Devices	Count of wells	Devices/ Well	Region - RM
CW01	20	0	20	4	5.0	RM
CW02	20	0	20	4	5.0	RM
DL01	25	0	25	10	2.5	RM
DL02	32	0	32	14	2.3	RM
ZW01	20	5	25	3	8.3	RM
ZW02	5	1	6	1	6.0	RM
ZW03	3	4	7	1	7.0	RM
TOTAL RM =	**125**	**10**	**135**	**37**	**3.65**	**7** FACILITIES

What We Know So Far

OIPA Study

Results

The OIPA sample contained on average 3.83 intermittent vent controllers per site and 0.12 continuous bleed controllers per site. On average, intermittent vent controllers emitted 0.40 scfh gas and continuous bleed controllers emitted 21.54 scfh gas. Results are presented in two sections, summary of observations and summary of emissions calculations.

Exhibit 2: Key Observational Results

SITES

172 sites (205 wells) visited for data collection
162 sites (190 wells) had natural gas pneumatic controllers
10 sites (15 wells) did not have natural gas pneumatic controllers

CONTROLLERS

680 natural gas pneumatic controllers	659 intermittent vent controllers
77 controller models	21 continuous bleed controllers

AVERAGE CONTROLLER COUNTS

4.0 pneumatic controllers per site	3.6 pneumatic controllers per well
5.0 pneumatic controllers per new gas site	5.3 pneumatic controllers per new oil site
3.1 pneumatic controllers per old gas site	2.7pneumatic controllers per old oil site

ACTUATION FREQUENCIES

538 controllers (79%) had no actuations detected during the observation period and were assigned the default rate
126 controllers (19%) had actuation rates less frequent than the once per 15 minute default rate
16 controllers (2%) had actuation rates more frequent than or equal to the default rate

- 97% intermittent, 3% continuous
- 142 of 680 (21%) PCs actuated in 15 min observation
- 269 of 680 (40%) were backpressure controllers used for overpressure protection, rarely actuate
- New (>2000) sites avg #PC/site
  2.2 X Old sites

What We Know So Far

Uinta Basin Emission Inventory Workgroup – Phase I

- Workbooks from 23 operators now, 5 more due … covers 96% production in UB (=Duchesne + Uintah counties)
- Includes type of PC – Continuous: low or high and Intermittent *by Operator, by facility*
- Includes default Emission Factors (EF) [using GHGRP - Subpart W emission factors in scf/hr] and NSPS OOOO TSD (July 2011) representative gas composition for tons/year

A	B	C	D	E	F	G	H	I
	Device Type				Emission Factors			Emissions
					VOC (tons/hr)			
Facility Unique ID #	High Bleed (#)	Intermittent Bleed (#)	Low Bleed (#)	Average Hours Per Device	High	Intermittent	Low	VOC (tons/yr)
					0.000219178	7.96804E-05	8.21918E-06	0.00
					0.000219178	7.96804E-05	8.21918E-06	0.00
					0.000219178	7.96804E-05	8.21918E-06	0.00

- QA work underway
- Workbooks to be compiled into single database by ~Mar-Apr ’16 to facilitate analysis
- No accounting for malfunctions

What We Know So Far

Emission Factors being used …

	Continuous–Low scf/device-hr	Continuous-High scf/device-hr	Intermittent scf/device-hr	Notes
CDPHE	0.14	12.4	1.72	UT/EDF Study – Rocky Mtn Region. Whole gas. Cannot recreate from SI
ODEQ - PCs	1.05 scf/device-hr			OIPA Study – engr calculations - Whole gas 3.6 devices/well
ODEQ - Fugitives	Avg. malfunction rate 50 scf/device-hr x 3% malfunction rate x 3.6 device/well x # wells			To account for malfunctions. Emission rate and Malfunc. rate per UT/EDF
GHGRP-W Western U.S.	1.39	37.3	13.5	Default whole gas factor

Data Gaps to Fill

1) Emission PC measurements in Uinta Basin
2) Uinta Basin specific activity counts (#PC/well, by function, type …)
3) Site-specific gas composition
4) Assessment of malfunction frequency
5) Understanding of reason for malfunction and level of effort required for fix

Onsite Emissions Measurement Study

Executed by Jacobs Technologies (EF and AF objectives)

I. Study Preparation (Jan. 2016 - Aug. 2016)

A. Development of protocols (see 2016 Uinta Basin Pneumatic Controller Study Protocol Brief)

B. PC Activity Data Gathering Protocol Complete - April 2016

C. Quality assurance project plan development

D. Instrument builds and pre deployment testing (mostly in RTP)

II. Project Planning with Operators

A. Representative sites by operator, age, well type, production volume – how to make random

B. Agree on data to be collected e.g. PC Type (continuous: high or low; intermittent), function, count by site, make/model, # actuations, count of malfunctioning PCs (aural and IR camera), leaks in supply tubing & repairs made real time

III. Primary Field Measurements (Aug. - Sept. 2016)

A. On-site PC Activity Data Gathering

B. PC Observation Protocol (OGI)

C. PC Emissions Measurement Protocols: Primary (augmented Hi-Flow) and Research (QOGI, TFS, Frog, etc.)

IV. Data Analysis and Reporting (Oct. 2016 – Mar. 2017)

Additional AF Data Gathering Activities

Primarily executed by project collaborators

I. Preparation and options analysis (Jan. 2016 - April 2016)

A. Development of PC Activity Data Gathering Protocol (same as onsite study)

B. Investigation of other AF potential data sources

C. Build secondary data use into project QAPP (Jacobs)

II. Project Planning with Operators

A. Can collaborators visit sites to execute PC data gathering and possibly OGI observation protocol?

B. Investigate ways to acquire actuation tracking data (are there options?)

III. Primary Field Work (May. - Sept. 2016)

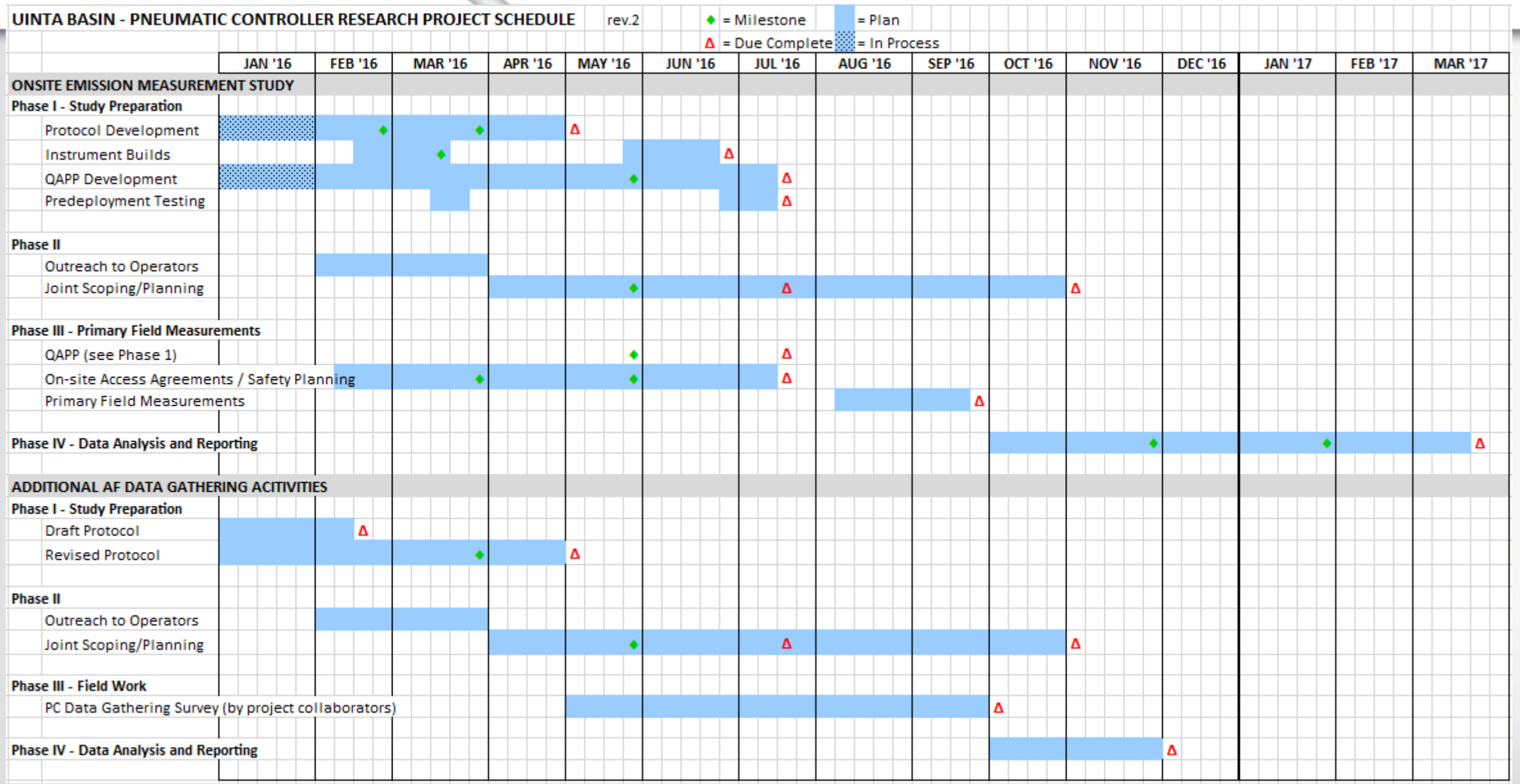
A. On-site PC Activity Data Gathering (by EPA/Collaborators)

B. Gathering AF information from other sources

IV. Data Analysis and Reporting (Oct. 2016 – Mar. 2017)

A. Integrate AF information into report (Jacobs)

Project Schedule



Onsite Emissions Measurement Study
Envisioned Measurement Details

- Perform with Operator's Instrumentation Technician present
  - Assure safe measurement operations
  - Record accurate and complete information is gathered
- Execute onsite PC data gathering protocol
  - Understand and document the PC system
  - Record information for engineering calculations
  - Determine potential for manual actuation
- Execute OGI observation protocol
  - Document the operational state of the PC system
  - Record and assign emission points
  - Estimate actuation sequence (if intermittent)
- Execute measurement protocols
  - Record time-resolved emissions (augmented Hi-Flow)
  - Acquire speciation data (evacuated canister)
  - Execute research measurements

Project Cooperator Input

- What data gaps do you see?
- What does “building capacity” look like to you?
- Your thoughts on the plans
- Is there synergy with API Standard 4590, Pneumatic Controllers currently underway?
- Opportunities for collaboration and site access?

UB PC Research Collaborator Team

Name	Organization	Email	Tel. #
Adam Eisele	EPA Region 8	Eisele.adam@epa.gov	303-312-6838
Chris Dresser	EPA Region 8	Dresser.chris@epa.gov	303-312-6385
Cindy Beeler	EPA Region 8	Beeler.cindy@epa.gov	303-312-6204
Eben Thoma	EPA Office Research & Development	Thoma.eben@epa.gov	919-541-7969
Leonard Herr	BLM – Utah	lherr@blm.gov	801- 539-4094
Michael Stovern	EPA Region 8	Stovern.michael@epa.gov	303-312-6635
Mike Natches	Ute Tribe - Air	miken@utetribe.com	435-725-4974
Minnie Grant	Ute Tribe – Air Lead	minnieg@utetribe.com	435-725-4900
Nancy Daher	Utah Div. of Air Quality	NDaher@utah.gov	801-536-4078
Parik Deshmukh	Jacobs Technologies	Parikshit.Deshmukh@jacobs.com	919-541-2980
Whitney Oswald	Utah Div. of Air Quality	woswald@utah.gov	801-536-4468