

# Data Acquisition and Management for MOVES

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FACA Modeling Workgroup Meeting

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## Our Goal

- Provide quality assured vehicle and second by second (SBS) emission data to MOVES



## The Schedule

- Load data into the Mobile Source Observation Database (MSOD) by July 2003
- Provide pre-bin , QC'd data to MOVES team by late summer 2003



## Process

- Obtain high quality emission data from recognized sources
- Modify MSOD to accommodate that data
- QA, amend, and load data into MSOD
- Provide cleaned and aligned emissions data to MOVES



# ERG Obtains Emissions Data

- Find data from recognized sources
- Contact PIs and get the data
- Convert to MSOD formats
- Assure data quality using EPA software
- Deliver data and a report on their process
- Engage EPA and the PI's in correcting and amending the data upon EPA review



# QA and Load Data

- Is the data reasonable?
- Correct or amend delivered data
- Load the data into MSOD



# Data reasonable?

- Use fuel economy, emissions, and fuel parameters to perform a carbon balance check
- Compare bag emissions against aggregated second by second emissions
- Compare the drive schedule against the aggregated speed and time data
- Field level checks for upper and lower bounds for measured data and conformance to MSOD categories for non measured data



# Correct, Amend, Order, and Load Data

- Fix what errors one can and exclude bad data
- Fill data gaps
  - VIN decoder derived data to amend and check vehicle data
  - Program documentation to fill gaps in testing information
  - Contact the PI's and ERG for more detail
- Establish test order and identify replicate tests
- Load the Data





# QC and Realign Stored Data

- Look at all stored SBS data for unusual transients and remove them -spikes, plateaus, and drop outs
- Check emission data for alignment to vehicle speed and produce a corrected table
- Provide to MOVES SBS data that when aggregated is within  $\pm 10\%$  of bag data



## 16 Groups of Data Delivered

- **13 Special Studies**
  - 10,760 vehicles
  - 35,489 tests
- **3 I/M Program data**
  - 2,588,744 vehicles
  - 5,216,259 tests



# Special Studies

- 2 were vehicle sampling programs
  - in-use vehicles
  - in-use fuels
- 11 were traditional laboratory test programs
  - in-use vehicles
  - Some used special test fuels some used in-use fuels



# I/M Programs

- **Arizona Car Care**
  - I/M 147 drive schedule
  - 317,192 tests mostly fast pass
- **British Columbia AirCar Program**
  - I/M 240 drive schedule
  - 532,792 tests mostly fast pass
- **Colorado Air Care**
  - I/M 240 drive schedule
  - 4,366,275 tests mostly fast pass



# Delivered Vs Loaded Data

Programs	Loaded	Delivered Vehicles	Delivered Tests	Vehicles Loaded	Tests Loaded
AZ_IM	No	234,123	317,192	0	0
BC_IM	No	460,225	532,792	0	0
CARB_N20	Yes	41	64	41	64
CARB_UCC96	Yes	42	395	42	394
CECERT_HDD	Yes	8	312	8	312
CECERT_NH3	Yes	35	54	35	54
CO_IM	No	1,885,396	4,366,275	0	0
CRC_AQIRP	No	85	4,696	0	0
CRC_E55_59	Yes	25	701	25	629
CRC_S_LDVI	Yes	12	510	12	508
ETC_N20	No	4	71	0	0
NCHRP	Yes	344	878	337	877
NCSU_TRAF	Yes	7	787	7	787
TXDOT_UT	Yes	10	126	0	0
WVU	Yes	205	2,350	184	1,768
NYIPA	Yes	9,942	24,889	9,900	24,877
I/M Totals		2,579,744	5,216,259	0	0
Non-I/M Totals		10,760	35,833	10,591	30,270



## Seconds of Data Loaded

Program	Seconds of Data
CARB_UCC96	496,827
CECERT_NH3	82,262
CRC_E55_59	631,380
CRC_S_LDVI	618,567
NCHRP	1,379,200
NYIPA	10,856,336
WVU	1,891,677
CECERT_HDD	235,607
NCSU_TRAF	362,815



## Current Status

- **Most of the special studies are loaded**
  - Auto Oil and TXDOT data are not loaded
  - Concentration and Engine Out data has not been loaded
- **Have not loaded I/M data - not be used in MOVES2004**
- **Dynamometer test data that has been loaded has been delivered to MOVES team**



## Documentation-ERG Reports

- Phase I - initial data delivery (fall 2002)
- Phase II - additional data delivery (spring 2003)
- Phase III - address shortcomings in the delivered data (summer 2003)





## Documentation - EPA

- Data Acquisition and Management Team (DAMT) Process Control Chart
- Data Processing Flow Chart
- Preprocessor Programs
- SBS Data Checking Programs
  - Aggregated Data
  - Transient Data
- Carbon Balance Program
- EPA Evaluate Program & Manual
- EPA EFLoad Program & Manual
- Alignment Program



# Data Used In Moves

Programs	Vehicles	Tests
N Y IPA	9,900	24,877
N C H R P	337	875
W V U	154	1,128
CD H O T _ P M	104	104
LD V _ A C _ A	62	1,106
LH D T _ L D T	46	1,421
O B D _ A	46	160
C A R B _ U C C	42	394
C Y C L E S _ A	38	946
T I E R _ 1	36	464
G R A N T 9 7 _ N Y	35	266
C E C E R T _ N H 3	35	54
C R C _ E 5 5 _ 5 9	25	478
9 8 N 2 0 A	23	193
L H D T _ C	18	562
S H O O T _ O U T A	17	32
T I E R _ 1 _ B	15	119
C R C _ S _ L D V	12	334
L H D T _ A	10	623
R O V E R _ A	8	64
L H D D T _ A	6	120
L H D T _ B	2	104
O E M _ 2 1 0 0	2	18
L H D T _ E V A P	2	12



# NYIPA

- Evaluate new I/M technology versus I/M240
- In-use vehicles and fuels
  - exemptions: < 2 years and > 25 years old, > 8500 lbs, and 4 wheel drive
  - Tank fuel
- Ambient conditions were uncontrolled but measured
- Aggregate emissions were derived from SBS data



# NYIPA

- I/M240 followed the EPA guidance document
- Preconditioning - Oil temp > 180 F or within 25 minutes of previous test
- Reports
  - "Evaluation of Simultaneous Emissions Test Data From The NYTEST Instrumentation/Protocol Assessment Pilot Study", May 2000
  - "Amendment 1 and 2 Project Summary Report" January 2002
  - "IPA Amendment #3 Project Summary Report" July 2002



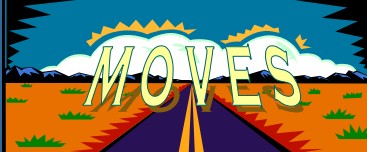
# NYIPA

Program	Vehicles	Class	Tests	Avg Temp	Min Temp	Max Temp	Avg Weight
NYIPA	5,492	CARS	14,613	73.79	42.2	103.1	3,170
NYIPA	1,380	LDTs	3,415	74.51	45.3	101	3,886
NYIPA2002	2,367	CARS	4,872	73.74	52.8	98.2	3209.13
NYIPA2002	661	LDTs	1,977	74.73	54.7	98.8	3928.14



# West Virginia University

- 6 data deliveries across multiple HD test programs
- Portable chassis dynamometer that couples to the vehicles axle not the tires
- Uncontrolled but measured ambient conditions
- Aggregate emissions derived from SBS
- Many different fuels - CNG and different types of diesel fuels



# WVU Data

Program	Class	Vehicles	Cycles	Fuels	Tests
CRC_E55_59	HDDV7	10	7	1	234
CRC_E55_59	HDDV8	14	7	1	258
CRC_E55_59	TRUCK	1	7	1	14
GRANT97_NY	TRUCK	35	3	1	290
WVU_1	HDDV6	1	29	9	42
WVU_1	HDDV7	3	29	9	12
WVU_1	HDDV8	52	29	9	690
WVU_1	TRUCK	8	29	9	46
WVU_2	BUS	11	10	6	123
WVU_2	HDDV5	1	10	6	3
WVU_2	HDDV7	2	10	6	7
WVU_2	HDDV8	8	10	6	55
WVU_2	TRUCK	17	10	6	100
WVU_3	BUS	8	4	3	71
WVU_4	BUS	26	8	6	289
WVU_4	HDDV8	6	8	6	12
WVU_4	TRUCK	1	8	6	1



## NCHRP- Data used for CMEM

- FTPs, US06s, and 5 different MEC cycles
- Tank Fuel





## NCHRP

Class	Vehicles	Tests	AVG_Temp	MIN_Temp	Max_Temp	AVG_Weight
CARS	197	541	74	64	89	3001
LDTs	140	333	75	68	93	3879



## CARB Data

- CARB\_UCC96 - data used to update EMFAC
- UC, FTP, and 8 new cycles
- California Phase 1 Fuel

Class	Vehicles	Tests	AVG_Weight
CARS	32	295	3164.41
LDTs	10	99	4098.48



# CARB Data

- CARB N<sub>2</sub>O - 64 vehicles tested for N<sub>2</sub>O
- Four drive schedules, UC, MEC, EC, and the MUC

Class	Vehicles	Tests	Fuels
CAR	33	17	CA Phase 2 W inter
CAR	33	33	CA Phase 2 Summer
LDT 1	5	2	CA Phase 2 Summer
LDT 1	5	8	CA Phase 2 W inter
LDT	3	4	CA Phase 2 W inter



# CRC 1997 Sulfur Testing

- 12 Model Year 1997 cars tested on 7 fuels with the FTP

FUELNAME
California Phase 2 RFG with 150 ppm Sulfur
California Phase 2 RFG with 40 ppm Sulfur
Federal RFG with 100 ppm Sulfur
Federal RFG with 150 ppm Sulfur
Federal RFG with 330 ppm Sulfur
Federal RFG with 40 ppm Sulfur
Federal RFG with 600 ppm Sulfur



## CECERT Ammonia

- FTPs on California Phase II Fuel
- FTPs, FWYs, NYCCs, US06s on Tank Fuel
- Standard lab ambient conditions



# CECERT Ammonia

Class	Vehicles	Cycle	Fuel
CARS	20	FTP	California Phase II
CARS	19	FTP	Tank
CARS	19	FWY	Tank
CARS	19	NYCC	Tank
CARS	19	US06	Tank
LTDS	15	FTP	California Phase II
LTDS	14	FTP	Tank
LTDS	14	FWY	Tank
LTDS	14	NYCC	Tank
LTDS	14	US06	Tank



## EPA Sponsored Studies

- Past testing contracted or performed by EPA
- SBS data was collected
- Lots of cycles
- Multiple fuels in many programs



# EPA Data

Program	Class	Vehicles
98N20A	CARS	10
98N20A	LDTs	13
CDHOT_PM_A	CAR	80
CDHOT_PM_A	LDTs	24
CYCLES_A	LDTs	16
CYCLES_A	CARS	19
LDV_AC_A	LDTs	14
LDV_AC_A	LDV	48
LHDDT_A	LHDDTS	6
LHDT_A	LDTs	10
LHDT_B	LDTs	2
LHDT_C	LDTs	18
LHDT_EVAP	LDTs	2
LHDT_LDT	LDTs	46
OBD_A	CARS	31
OBD_A	LDTs	15
OEM_2100	CARS	1
OEM_2100	LDTs	1
ROVER_A	LHDTs	8
SHOOT_OUTA	CARS	17
TIER_1	CARS	15
TIER_1	LDTs	21
TIER_1_B	CARS	6
TIER_1_B	LDTs	9





# EPA Data

Program	Fuels	Schedules
98N20A	2	4
CDHOT_PM_A	1	1
CYCLES_A	1	17
LDV_AC_A	1	15
LHDDT_A	1	9
LHDT_A	5	13
LHDT_B	5	12
LHDT_C	1	12
LHDT_EVAP	2	4
LHDT_LDT	5	13
OBD_A	2	2
OEM_2100	1	4
ROVER_A	2	4
SHOOT_OUTA	1	3
TIER_1	2	10
TIER_1_B	1	7



## Closing

- **What have we found?**
  - Researchers report data in complex formats
  - Researchers do not collect all key information
- **What would we like to see from research programs?**
  - Simple formats using a primary key for each record
  - Thorough data dictionaries
  - Complete vehicle and test conditions information



## Contact

- **Copies of MSOD**
  - Carl Fulper e-mail  
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- **Copies of the above documentation**
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