Bob Holden, Governor • Stephen M. Mahfood, Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

MAR 20 2001

Mr. Michael T. Dauterman, P.E.
Environmental Engineer
General Motors, Truck Group
P.O. Box 444
1500 East Route A
Wentzville, MO 63385

APPROVAL LETTER 2001-02

Dear Mr. Negley:

This is to inform you of approval of the Vapor Recovery system, which your company submitted for Missouri Performance Evaluation Testing Procedure (MOPETP) testing and approval. MOPETP testing was performed at the General Motors (GM) Wentzville Assembly Center at 1500 East Route A, Wentzville, Missouri 63385.

The GM Wentzville Assembly Center has a unique vapor recovery configuration not similar to a normal gasoline dispensing facility. Therefore, this system was subjected to the MOPETP "Novel Facility" testing protocols, which provide more flexibility to the Air Pollution Control Program (APCP) to modify the testing protocol to the type of system at this specific facility. The MOPETP was concerned with the assembly line fueling which used an unapproved Anguil system and a unique nozzle for routine initial vehicle fueling. Vapors from the fueling are collected by the Syncrotek nozzle, in a co-axial fashion, on a robotic assisted conveyor, and transported to the Anguil incinerator to be destroyed by combustion. Gasoline for the fueling was provided by two above ground storage tanks. These tanks presented a large and unique emission challenge to be controlled to meet the overall efficiency standards.

The GM Wentzville vapor recovery system has no return lines for vapor from the fueling area to the tanks. All vapors from the initial fueling are routed directly to the Anquil incinerator. Before the start of the MOPETP testing, the two storage tanks were manifolded together, insulated, and sun shielded to reduce fugitive emissions during non-fueling times. In addition, appropriate pressure/vacuum (P/V) valves, Protecto Seal 836C, were installed on the tanks to reduce emissions from breathing and working losses.

Initial fueling on the assembly line was into standard vehicle fuel tanks (i.e. not On-Board Refueling Vapor Recovery). This MOPETP approval applies to these standard tanks and no others. If GM makes changes to the vehicle fuel tanks, or any other vapor handling components than those tested in this MOPETP test, then GM will have to request a MOPETP technical review committee meeting to determine the extent of re-testing necessary for approval.

RECYCLED PAPER

Vehicle Matrix
This is a GM Assembly plant; therefore, there are a limited number of different vehicle fuel tanks and specific fuel volumes related to the fueling activities on the assembly line. Subsequently, MO/TP-201.2A was not used to create the vehicle matrix. Instead, a statistical number of each type of fuel tank and fuel volume were used. This matrix is presented in the table below. The ratios used for each fueling amount and tank type is representative of the numbers used during normal operations at the facility.

Vehicle matrix used for GM Wentzville vehicle fueling emissions for the Synchrotek Nozzle System testing, July 15-16, 1997.

Gallons of Fuel Dispensed	Standard Fuel Tank	Plastic Fuel Tank	Square Fuel Tank	Total
8	3	3	3	**9**
5	2	2	2	**6**
Totals	5	5	5	**15**

Listing of tests performed during the GM Wentzville MOPETP.

Test	DATE
Bench Testing (Modified MO/TP-201.2B)	August 1, 1997
	March 14, 1997
Static Pressure (Leak Decay) Testing (Modified MO/TP-201.3B)	August 9, 1997
	September 11, 1997
Static Pressure (Leak Decay) Testing (Modified MO/TP-201.3B)	October 11, 1997
	November 8, 1997
	December 13, 1997
	January 10, 1998
	February 14, 1998
	March 7, 1998
Stage II Efficiency Test (Modified MO/TP-201.2) Vehicle fueling in July; Incinerator in November	July 15-16, 1997
	November 11, 1997
Spillage and Pseudo-Spillage (MO/TP-201.2C)	July 15-16, 1997
Final V/L Testing	March 10, 1998

Bench Testing: MO/TP-201.2B
The MOPETP requires bench testing of nozzles, P/V valves, and drain valves for transition flow and leak rates at 2"WC (or 0.75 of the nominal cracking pressure of the P/V valve). These tests are required in order to provide data to be used in evaluating the pressure related fugitive emissions of the full system, and to document system performance before and after the 180-day durability test. In addition, bench testing of backpressure is required for nozzles, hoses, breakaways, whip hoses, dispensers, and vapor shear valves. These data will be used to provide a matrix of backpressures of components to be used to determine compatibility of components. Bench testing was performed at the beginning and end of the 180-day durability test.

Since the system tested did not have vapor connection to the storage tanks, there was no pressure on the nozzle valves to cause backpressure or leakage; thus, bench testing was required only for the P/V valves on the above ground storage tanks (ASTs).

P/V Valves – Leak Test: The ProtectoSeal 836C P/V valves (SN171075 on Tank #2 and SN171074 on Tank #11) were tested at the manufacturing facility and at the site. Both P/V valves were new. Tests were performed at the start of the 180-day durability test and at the end of the 180-day test. Since these types of P/V valves had not been tested for MOPETP or CARB certification, the specifications were estimated from those for the standard P/V valves. Both valves were within the specifications for cracking and leaking during the first test on July 28, 1997. Both valves cracked at lower pressures during the final test on March 14, 1998, and had flows greater than 1 SCFH at 7.2" WC. However, both cracked within the limits of 6 to 10" WC and reached 6.4" WC and 7.0" WC before reaching 1 SCFH respectively.

Since the pressure release criteria for this Novel Facility was uncertain, it was felt that these values were sufficient to pass. The final values for the tests were used for determining the breathing losses from the tanks. Since the valve on Tank #2 (SN171075) appeared to have changed more significantly, the O-ring was checked on April 14, 1998.

There was no real damage to either O-ring – some dirt and oil was present and there was evidence of some indentation. It is suggested that a PID be used by GM personnel to check the vents annually. If the results of this inspection reveal there is sufficient leakage to be detectable, then GM should replace the O-rings.

180-Day Durability Test

The 180-day durability test consisted of requiring all equipment to remain the same for the 180-day period. Maintenance forms were completed and kept by facility personnel, as well as records of the active vacuum and temperatures for the Anguil System. Continuous temperature and pressure monitoring of the ASTs was performed.

Continuous Temperature and Pressure Testing

Continuous temperature and pressure data were collected for the full 180-days. This was the first MOPETP test, and the requirements for the temperature and pressure monitoring had not been completely set. The temperature and pressure of each tank were monitored. The ambient temperature was monitored at a shed near the tanks. Barometric pressure was determined from airport data. The calibration of the pressure monitors was checked once per month at the time of the leak decay tests. No formal calibration data was provided.

Leak Decay Tests

Leak decay tests were performed before the start of the 180-day durability test, and each month during the test, as well as once at the end of the test. All leak decay tests passed. There were some test periods for which the pressure increased rather than decreased. This was due to the

diurnal warming and pressure build of the above ground tanks (AST). Subsequently, the MOPETP test team determined that a modification of the test procedure to include a time period to allow the system to come to equilibrium. This is especially necessary when the pressure had been greater than 2" WC at the start of the test and the pressure needed to be reduced back to zero.

Stage I Efficiency Test: MO/TP-201.1
The Stage I Efficiency Test (MO/TP-201.1) was performed on February 28, 1998, after the end of the 180-day durability testing. No volume flow was observed at the Root's meter at the vent pipes indicating that there was no release through the vent pipes during the bulk fuel delivery. With no emissions at that point, Dames & Moore determined the mass emissions as 0 lbs./1000 gallons of fuel delivered. The average pressure of the tanks during the delivery was 0.1" WC and the slight positive pressures were significantly less than the cracking pressure of the P/V valves.

Vehicle Fueling Tests: MO/TP-201.2
Since it was difficult to monitor emissions at the nozzle/fillport interface due to the automated nozzle at the plant, it was determined that monitoring at this point could be done along with monitoring of the vapor recovery parameter and incinerator parameters using "mock" cars at a time when the assembly line was down. Only vapor recovery and incinerator parameters would be monitored during the assembly line operations, at a different time, in order to include the effect of the assembly line activities on the emissions.

Due to assembly line operations, emission data was taken at two different times. Thus, it is difficult to determine which effects were due to the assembly line and which were due to the changes in Reid Vapor Pressure (RVP) and temperatures between July and November. It appears from calculations that the difference between the two data sets are most likely due to the differences in RVP and temperature between the two periods. The separation in time provided information (although incomplete) on emissions during the two different time periods. The results have been averaged for the final determination of vehicle fueling emission factors and uncontrolled emission factors.

In order to allow for a verification of proper operation without needing to repeat the full efficiency testing, V/L values and active vacuum values were determined for each set of tests in July and November of 1999 as well as a final post set test in March 1998. A comparison of these values with the active vacuum values recorded during the 180 day test suggests that the system was operating within the 95% efficiency during the full 180 day testing.

The challenge mode tests suggest that an active vacuum less than 20" WC provided sufficient efficiencies during the low emissions produced in July. The November data suggest that active vacuum less than 20" WC might produce efficiencies less than 95%. The active vacuum values reported did not go below 20" WC during the 180 days.

Summary of active vacuum, V/L, and efficiency data for all testing.
Listing of tests performed during the GM Wentzville MOPETP.

Test	DATE
Bench Testing (Modified MO/TP-201.2B)	August 1, 1997
	March 14, 1997
Static Pressure (Leak Decay) Testing (Modified MO/TP-201.3B)	August 9, 1997
	September 11, 1997
	October 11, 1997
	November 8, 1997
	December 13, 1997
	January 10, 1998
	February 14, 1998
	March 7, 1998
Stage I Efficiency Test (MO/TP-201.1)	February 28, 1998
Stage II Efficiency Test (Modified MO/TP-201.2)	July 15-16, 1997
Vehicle fueling in July; Incinerator in November	November 11, 1997
Spillage and Pseudo-Spillage (MO/TP-201.2C)	July 15-16, 1997
Final V/L Testing	March 10, 1998

Spillage and Pseudo-spillage Testing (MO/TP-201.2C)
Spillage and pseudo-spillage testing were performed by General Motors testing contractor in conjunction with the vehicle fueling emission testing on July 15, 1997. Prior to the testing, a calibration on butcher paper was carried out and used in determining the volumes of spills during the testing. The values determined for spillage and pseudo-spillage together are less than the value for spillage allowed by the MOPETP based on the value used by CARB (0.75 lbs. emission/1000 gallons dispensed).

Determination of the Overall Efficiency of the System Tested
The MOPETP requires that the overall efficiency of the system be at least 95% as determined from the ratio of the total emission factor determined at the site divided by the total for an equivalent uncontrolled facility. The value for the uncontrolled facility is determined using the same fuel vapor pressure (RVP) and temperature conditions as the MOPETP testing as well as facility specific issues for novel systems such as the GM facility. The overall efficiency includes the contributions from emissions at the vent pipes, tanker truck connection during bulk fuel delivery (Loading) as determined by using the Stage I Efficiency test, the losses at the nozzle/vehicle fillport during vehicle fueling (Vehicle Fueling), as determined during the Stage II Efficiency test, losses due to spillage and pseudo-spillage (Spillage/Pseudo-spillage), as determined by MO/TP-201.2C, pressure related fugitive losses determined from the bench test leak rates (MO/TP-201.2B), and the continuous tank pressure data (Breathing).

The MOPETP provides values for emissions at an uncontrolled facility in Table 2 of MOPETP-21 page 39. These bulk fuel and vehicle fueling emission factors are based on a GDF (refueling) facility with 7.8 RVP and USTs in northern California in May (provided by CARB). In order to make an appropriate comparison for determination of efficiency, emission factors relative to the RVP and temperatures during the GM MOPETP testing were used.

Loading. For the Stage I test, an RVP of 11.3 pounds per square inch (psi) was used as an average of the RVP of the gasoline used during the 180 day period and average temperatures during the period were also used in the AP-42 equations. The following table provides the appropriate uncontrolled values, as well as the values obtained during the GM MOPETP testing. The values for the uncontrolled emissions during a bulk fuel delivery for comparison with the Stage I emissions from MO/TP-201.1 were determined using Equation 3-1 obtained from AP-42 (U.S.EPA, 1995). The nominal molecular weight used is 70 lbs./lb-mole. This value is reasonable for the higher RVP gasoline used during the bulk fuel delivery testing at the site. A table of saturation factors as well as average temperatures for various regions of the country at various times are provided in AP-42.

Loading Emission equation: $L = 12.46\ SPM / T$
L = loading loss emission factor, lbs. Of vapor emitted/1000 gallons of liquid loaded
S = saturation factor from AP-42, 5th ed. Table 5.2 (0.6)
P = true vapor pressure of the liquid loaded, psia from AP-42 Ch.7.1.3 Eq. 12a
M = molecular weight of vapors, lbs./lb-mole (assume 70)
T = temperature of liquid delivered, ^{o}R ($^{o}F + 460$)

An RVP of 11.3 psi was used which was the average of the RVP values of gasoline used during the 180 day period. The average temperature of the fuel during testing was used and the saturation factor of 0.6 was used. The resulting value was 13.60 lbs. of vapor emitted/1000 gallons gasoline dispensed. These emissions are similar to those of a normal GDF under the same conditions since the equation used is representative of those facilities.

Vehicle Fueling. Uncontrolled vehicle fueling emissions can be calculated using an empirical formula found it AP-42:

$$E_r = 264.2 * [((-5.909) - (0.0949 * \Delta T) + (0.08848 * T_d) + 0.485) * RVP]$$

where:
E_r = emission rate, mg VOC/liter of liquid loaded
ΔT = temperature difference between vehicle fuel and dispensed fuel, (^{o}F)
T_d = dispensed fuel temperature, (^{o}F)
RVP = Reid vapor pressure of the dispensed fuel, psia

The resulting value using the AP-42 values for the 7.8 RVP and AP-42 estimated temperature result in a value of 8.5 lb/1000 gallons the vehicle fueling emissions which is similar to the emission factor of 8.4 lbs/1000 gallons used by CARB. The values determined using this AP-42 equation with temperatures and RVP values at the GM novel facility are presented in Table 3-4 along with the corresponding values determined from the concentrations and volumes determined at the vapor recovery line.

Summary of vehicle fueling emission factors for the GM novel facility.

Source	Uncontrolled Emission Factor Lbs. VOC/1000 gallons dispensed	
	Synchrotek Nozzle/Anguil System	
Test Date	**July 15, 1997**	**November 10, 1997**
AP-42 Calculations	4.55	18.52
Determined Using Vapor Recovery Data	2.87*	42.87

* The challenge mode with lower active vacuum had a value of 4.48 and the OPW backup nozzle tests had a value of 3.67 lb VOC/1000 gallons dispensed. Both were performed in July 1997.

Initial testing at GM indicated that the initial fueling into "green" or previously unused tanks caused a significant initial burst of emissions as the fuel hit the sides of the tank, causing greater emissions. The vacuum on the nozzle was adjusted up to reduce this effect. The average of the July and November data (22.87 lb/1000 gallons dispensed) was used for the uncontrolled value in the following table "Summary of Emission Factors and Efficiency Determinations" and the corresponding average of controlled emissions (0.66 lb/1000 gallons dispensed) was used for the controlled vehicle fueling value. It should be noted that this value is low to an undetermined amount since the CO emissions were not determined and included in the July value and the vehicle nozzle/fillport interface emissions were not determined during the November testing.

Spillage/Pseudo-spillage. The total value for uncontrolled spillage and pseudo-spillage used by CARB is 0.75 lbs. vapors emitted/1000 gallons dispensed. This value has been used for the uncontrolled value in table titled "Summary Of Emission Factors And Efficiency Determinations." The controlled value is 0.046 lbs. vapors emitted/1000 gallons dispensed as determined by the testing at the facility. Early preliminary tests showed much greater spillage. GM provided a modification to the nozzle, which greatly reduced the amount of spillage.

Breathing. Breathing losses were calculated using the TANKS3 program from the U.S. Environmental Protection Agency because the normal value used for MOPETP and CARB determinations (1 lb. vapors emitted/1000 gallons dispensed) is for USTs. ASTs, especially the non-vaulted tanks at GM, have much greater uncontrolled breathing losses (8.6 lbs. vapors emitted/1000 gallons dispensed). An average RVP of 10 psi was used in the calculations to represent the average over the 180 days and average temperatures were used for this time period. The controlled value was determined from the bench testing data on the P/V valves showing the leak rate at various pressures and the continuous temperature and pressure monitoring providing a distribution of number of minutes that the tank spent in various pressure ranges. The final value was 0.54 lbs. vapor emitted/1000 gallons dispensed. This value would have been much higher without modifications to the tanks made by GM at the beginning of the testing:

1) Manifolding the tanks for both liquid and vapor,
2) Covering the tanks with reflective material to reduce the temperature effects,
3) Installing proper P/V valves.

Even with these laudable efforts, the efficiency of the reduction of the breathing losses of the above ground tanks was only 93.7%.

Summary of emission factors and efficiency determinations.

Source	Emission Factors in lbs. Vapors Emitted/1000 Gallons of Fuel Dispensed		Efficiency Relative to Uncontrolled System
	Uncontrolled System	Synchrotek Nozzle/Anguil System	Synchrotek Nozzle/Anguil System
Loading	13.60	0	100%
Vehicle Fueling	22.87	0.66	97.1%
Spillage/Pseudo-Spillage	0.75	0.05	93.9%
Breathing (Pressure Related Fugitives)	8.60	0.54	93.7%
TOTAL	**45.82**	**1.25**	**97.3%**

Summary of emissions for each source in tons/year.

Source	Emission Rates in tons/year (using the total of 804,000 gallons/yr)		Reduction of Emissions in tons/year
	Uncontrolled System	Synchrotek Nozzle/Anguil System	Synchrotek Nozzle/Anguil System
Loading	5.47	0.00	5.47
Vehicle Fueling	9.19	0.27	8.93
Spillage/Pseudo-Spillage	0.30	0.02	0.28
Breathing (Pressure Related Fugitives)	3.46	0.22	3.24
TOTAL	**18.42**	**0.50**	**17.92**

Results of Testing

The Anguil System with Synchrotek nozzle installed at the GM Wentzville Plant in Wentzville, Missouri passed the overall efficiency at 97.3%. The OPW backup nozzle had a very slightly lower efficiency but was still greater than 97% and was proposed to be used for less than 1% of the fueling.

This system is MOPETP approved as a Novel Facility with the maintenance and testing requirements listed below. Since this is a novel facility, the approval for this system is unique and for this specific site utilizing these specific components (including nozzles and vehicle tank specifications) as set up at this facility. If any of these components change, retesting will be required as determined by a Technical Review Committee (TRC) Meeting. The extent of testing will depend on the extent of the changes.

The following maintenance and testing requirements are included in this approval and will serve as conditions of approval.

Maintenance and testing requirements:

1. Maintenance shall be performed as specified in the Work Plan.

2. Leak Decay testing as required by the Operating Permit (every 5 years). The modified test for ASTs developed for GM must be used to account for higher pressures in the tanks as well as the increase in pressure due to rise in temperature which is more significant for the ASTs than for USTs.

3. Continued monitoring and documentation of incinerator temperatures, active vacuum values, and fuel drop records.

4. It is suggested that a PID be used to check the vents annually. If the results of this inspection reveal there is sufficient leakage to be detectable then the O-rings should be replaced.

5. If vehicle tank configurations are changed in any way, testing may be required as determined by a TRC meeting.

6. When ORVR vehicles are produced at the facility, it is recommended that the incinerator system be removed and testing of the ORVR as a vapor recovery system be performed prior to change.

7. If the nozzle or other components are changed, testing may be required as determined by a TRC meeting.

8. Any change which modifies the storage tanks or the vapor path in any way must be preceded by an application to the St. Louis Regional office of the Missouri Department of Natural Resources, Stage II unit for a construction permit.

9. The Synchrotek nozzle shall not drip more than two drips per fueling cycle.

10. The Anquil incinerator shall not operate at a temperature below 600 degrees, generally around 690 degrees.

11. All satellite re-fueling facilities will be regulated as normal gasoline dispensing facilities. If necessary these facilities will be permitted and inspected by the St. Louis Regional Office, Stage II unit.

ITEM	ACTIVITY	FREQUENCY
Synchrotek Nozzle Assembly	Check trolley is free-running on beam and rollers are not seized. Repair if necessary.	Quarterly
	Check the movement of the lift cylinder. Apply lubricant as needed.	Quarterly
	Functional Check of Shock absorber and security of mounting. Repair if necessary.	Annually
	Look for any loose fasteners on trolley and secure. Always lock threaded fasteners by locknut, helical spring washer, or similar.	Annually
	Check for air leaks, pinched air lines. Replace or repair as appropriate.	Quarterly
Synchrotek Nozzle Assembly	Inspect return drive wheel.	Semi-Annually
	Visual Check for wear and tear on lift chain and pulley block. Replace or repair as appropriate.	Quarterly
Fuel Delivery System	Calibrate meters.	Annually
Fuel Filters	Check and replace.	Annually
Anguil System Fan	Follow blower and motor manufactures instructions.	Annually
Anguil Fan & Motor Bearing Lubrication	Check and clean. IF worn out or out of balance (excessive vibration) contact Anguil Environmental.	Annually
Anguil Air Proving System	Check for proper operation by increasing set point until the switch trips.	Annually
Anguil Inlet Filter	Check every two weeks of operation. Clean or replace elements, if required	Two weeks
Anguil Controllers,	Check and adjust	Annually
Configuration & Calibration Anguil Flame Rod and Spark Igniter	Check for proper air flow measurement/recording. Calibrate transmitter.	Annually
Anguil Burner Air Distribution	Inspect flame rod and spark igniter. Clean if necessary. Replace flame rod spark igniter yearly.	Annually
	Check for warping or breakage.	Annually
Cone Anguil Burner	Have burner tuning checked by Anguil or qualified Maxon Burner Technician. Technician should also check operation of burner assembly parts, such as the micro ration valve, pilot regulator and pilot gas cock.	Annually
Anguil Fuel Train	Check operation of firing rate valve and actuator. Use controller manual mode to run it through its full stroke. Check linkage for binding, slippage, wear and corrosion. Replace, if necessary.	Annually
Anguil Shut off Valve	Check main and blocking shut off valve for leakage semi –annually.	Annually
Anguil Pressure Switch	Check high and low gas pressure switches. Verify proper operation by adjusting set point up or down until the switch opens.	Annually
Anguil Gas Pressure	Verify that all gas pressures are within previously recorded parameters.	Annually
Anguil Firing Rate Valve/Actuator	Check operation for firing rate valve and actuator. Use controller manual mode to run it through its full stroke. Check linkage for binding, slippage, ear and corrosion. Replace, if necessary.	As needed
Anguil Dampers	Check system inlet and atmospheric relief dampers for free movement. Check linkage for binding, slippage, wear and corrosion. Replace, if necessary.	As needed
Anguil Catalyst	Gaskets	Annually
	Sampling with FID	Annually
	Door Gaskets	Annually
	Catalyst Modules	Annually

The Missouri Department of Natural Resources' Air Pollution Control Program approves the equipment listed below, subject to the terms and conditions of approval listed above.

List of equipment tested during the GM Wentzville MOPETP.

Component	Model	Number Tested
P/V Valves	Protectoseal 836C	2
Synchrotek Nozzle/Hose System	Synchrotek (SN SYN002)	1
Vapor Assist Nozzle	OPW 11VF (SN908141JUL7)	1
Anguil Incinerator	Anguil	1

We thank you for your cooperation in these tests. Please contact Bud Pratt of our office at (573) 751-4817 with any questions you might have.

Sincerely,

AIR POLLUTION CONTROL PROGRAM

Steven Fuller

for Roger D. Randolph
Director

RDR/bpt

c: Stage II members

Attachment