

The Bill Blackwood
Law Enforcement Management Institute of Texas

Alternate Fuel Police Vehicles
A Feasibility Study

An Administrative Research Paper
Submitted in Partial Fulfillment of
the Requirements for the Institute

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July, 2000

ABSTRACT

Mandates by the Environmental Protection Agency and the Texas Natural Resource Conservation Commission are requiring major metropolitan areas to convert their motor vehicle fleet to an alternate fuel. Although emergency vehicles are specifically exempt from these mandates, local government entities can earn additional compliance points by including them in the conversion. It has become imperative that law enforcement professionals review the feasibility of using alternate fuel vehicles (AFV) as emergency vehicles and the affect it will have on the service we provide.

A determination will be made on the feasibility of AFV s as emergency vehicles by a survey of information from existing research and current programs. The alternate fuels that are available include gasoline, propane, ethanol, methanol and compressed natural gas (CNG). A review of the existing programs indicates the fuel of choice is CNG. Many of the existing programs have proven to be successful and we must examine how that success has affected the service they provide. Information from the evaluation of AFV s by other agencies will show that these vehicles are not acceptable in all situations. Some of the factors that will be discussed are the land area of the jurisdiction and the availability of the alternate fuel that is chosen. It has been proven that conversion to an alternate fuel program has the potential of a positive impact on the agencies budget especially with the current trend in the cost of gasoline. Concerns of officer safety have proven to be no greater with CNG vehicles than they are with gasoline vehicles.

The conclusion of this review indicates there are some applications where the AFV does not affect the service we provide to the public but the intended application must be taken into consideration when choosing your fleet.

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Introduction

In an effort to comply with Federal and State regulations on protecting the environment, the managers of governmental entities are considering measures that may jeopardize the service police officers provide to the citizens and the safety of the officers. The Environmental Protection Agency (EPA) and the Texas Natural Resource Conservation Commission (TNRCC) have set standards that require government agencies in highly populated areas to introduce alternate fuel vehicles into their fleet. Government agencies that comply with these standards are awarded Program Compliance Credits (PCCs) that may be banked for later use, traded, or sold to other entity in the same compliance area. This standard exempts emergency vehicles. Managers are considering the use of emergency vehicles as a part of attaining or exceeding the required PCCs.

This project will investigate the feasibility of using alternate fuel vehicles in the law enforcement environment. The research will examine the impact on the department's budget, the performance of the vehicles, and officer safety. Sources of information from published reports and Internet information will be compared and contrasted, and a survey of the students in the Leadership Command College will be conducted to understand how this issue is affecting departments of all sizes and demographic locations. The results of the study will determine the feasibility of using alternate fuel vehicles and identify the changes that will occur in the service provided to the public, in officer safety, and in savings to the department budget. A large part of this research will specifically concern the use of Compressed Natural Gas (CNG) as an alternate fuel. The Dallas / Fort Worth International Airport Department of Public Safety will be placing three CNG vehicles into the Department of Public Safety's fleet in the fall of 1999. A log of fuel use, maintenance cost, and vehicle performance as compared to the gasoline-fueled vehicles will

provide a basis for the comparison of the current day product. Officers evaluation forms will provide information on the ergonomics and communication abilities. The vehicles used in the on-site research will be 1999 Ford Police Interceptors.

This research will take into consideration the history of alternate fuel vehicle's (AFV) and provide information to agency department heads that are confronted with the decision of adding them to their fleet. Information will be included on the vehicle dynamics, acceleration, top speed, braking ergonomics, and fuel economy. It will include information obtained from an actual study of vehicles in service as well as the results of prior research.

It is anticipated the research will demonstrate a compromise in the performance of the vehicles and officer safety in some applications.

Review of Literature

The question of a compromise in the service we provide to the public will center on the performance of the alternate fuel vehicles. Many factors must be taken into consideration when making a decision on including an entity's emergency vehicle fleet in the alternate fuel plan. There are currently a number of alternate vehicle fuels to consider including propane, electricity, ethanol, methanol and compressed natural gas (CNG). Some of the concerns expressed about alternate fuels include the availability of refueling facilities, vehicle fuel storage abilities and the stability of the fuel in case of accidents or unfriendly environments. Compressed natural gas is becoming a fuel of choice for entities that are converting their fleet. Those who promote the use of CNG are quick to point out the availability of natural gas at a more economical price than other alternates. While it is true natural gas is readily available, it is also true service areas to compress the natural gas for use in CNG vehicles are very costly. Public service areas for fueling these vehicles are promoted to be readily available, but many of these areas are staffed

only by appointment even during normal business hours. The ability of traveling in a CNG vehicle is limited by the fuel storage capacity and refueling restrictions. Many police departments have experienced situations where officers were required to travel beyond their mileage limitations that resulted in an emergency vehicle being towed back to the department for refuel. Some of these situations have occurred when officers have become involved in a pursuit or other circumstances beyond their control. The CNG vehicles received by the Dallas / Fort Worth Airport Department of Public Safety in Dallas, Texas were equipped with a fuel gauge that is unreliable because to properly measure the stored fuel requires a pressure gauge that requires a line from the fuel tank to a gauge located in the passenger compartment. This has caused officers to rely on the mileage they have traveled to determine their fuel status.

Situations where officers perform their duties while the vehicle is idling make this an unreliable source of fuel reserve. The vehicles also use more fuel when the vehicle is accelerated rapidly or travels at high speed that contributes to the fuel gauge problem. Standards set for CNG vehicles require a fuel storage compartment that is sealed from the passenger area of the vehicle and this standard prohibits the line required for the fuel gauge.

The use of alternate fuel for police vehicles is not a new idea. In 1974 the city of Brewton, Alabama purchased an alternative fuel system known as BiPac. A BiPac allows for the storage and use of a secondary source of fuel. At the time this trial vehicle was placed into service, gasoline cost was approximately forty cents a gallon and an equivalent amount of natural gas was approximately eight cents a gallon. The program was a success and resulted in a large savings to the City in the cost of fuel. In 1983, the City converted the remainder of its fleet to the BiPac system. Brewton elected to install a conversion kit on their existing gasoline engines, which allowed the original gasoline system to remain intact providing a fuel option. The officers

reported there were no detectable difference in the performance of the vehicle when the fuel was switched by engaging a hand operated control mounted under the dash. In addition to a reduction in the cost of fuel, there has also been a savings in vehicle maintenance. The reduction in maintenance cost was found to be a product of the cleaner burning fuel and added 20,000 miles to the life expectancy of the vehicles. Disadvantages identified by the City of Brewton included the loss of trunk space and warn that departments considering the system should expect a 20 percent power loss when running on CNG. (The Police Chief, 1983)

The City of Atmore, Alabama converted it's fleet of nine vehicles to CNG in 1976. They have also built a refueling station that services the agency's needs plus those of the public works department. This facility provides for both slow fill stations for overnight refueling and fast fill stations where the police officers fuel their units. The officers average refueling their units two and three times per eight-hour shift. They also found that fueling with CNG is at least twice to three times less time consuming and is less messy than filling up with gasoline. (The Police Chief, 1983)

Methodology

Research conducted in 1991 examined methanol, electricity, propane and compressed natural gas as an alternate source of fuel for police vehicles. This research identified propane as the best possible source because it has low emissions and is economical, available and easy on engines. Propane has been in use by several agencies in Canada, Australia and the U.S. for more than ten years. Methanol also has low emissions and burns cleaner than gasoline but it has about half of the energy of gasoline and the fumes contain formaldehyde, which is highly toxic and known to cause cancer. The use of electricity as an alternate fuel would eliminate emissions of the gasoline engine that damage the environment, but could cause the release of tons of

additional pollutants into the air that would be generated from central power plants established to recharge the batteries. They would also result in a reduced range and an extended refuel time. It is also estimated that the use of electric powered vehicles would result in increased cost of operation. The American Natural Resources based in Detroit, MI has stated "CNG is the best motor fuel available in North America because of its superior emission performance, abundant domestic supply and excellent safety record." CNG has been identified as a fuel that reduces engine wear, provides superior cold weather starts and high octane for negligible engine knock. The down sides identified with the use of CNG include a shorter driving range, a slight loss of power in dual fuel systems and some safety concerns due to the high storage pressure of up to 3,000 psi. The final alternate fuel examined in this study was propane. This fuel was first used in automobiles in the 1920's and in 1991, it was estimated there was over 350,000 vehicles powered by propane. Propane was identified as the best alternate to gasoline when addressing the concerns of the range of the vehicle. To compare the range of the vehicles, alternate fuel vehicles were filled the equivalent of an amount of gasoline required to travel 100 miles. The result of this range of travel test indicates CNG to be the least desired fuel. (See Figure 1). (Law and Order, September 1991)

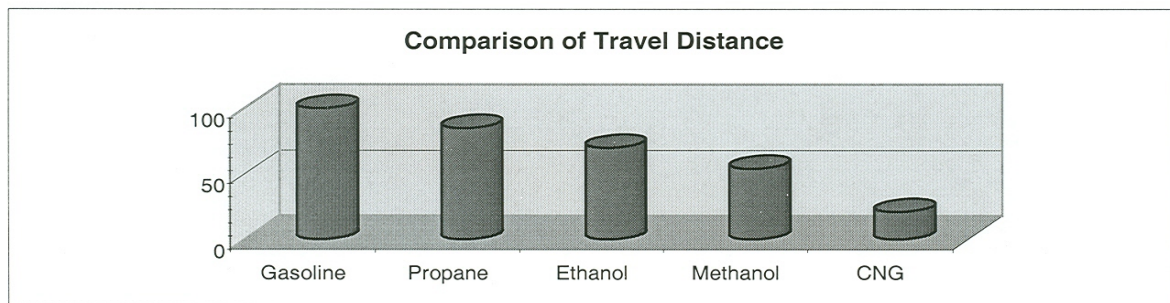


Figure 1

In September of 1998, the Michigan State Police (MSP) conducted extensive evaluations of the performance capabilities of each new model of police vehicles. The 1999-year model vehicles were evaluated to test the vehicle dynamics, acceleration, top speed, braking, ergonomics, communications and fuel economy. These test vehicles included a Ford Police Interceptor powered with CNG and a Ford Police Interceptor powered with gasoline. Both vehicles were equipped with a 4.6 Liter (281 cubic inch displacement) sequential port fuel injected engine. The vehicles high-speed pursuit handling characteristics were tested on a 1.635-mile road-racing course that consists of hills, curves, and comers. Each vehicle was driven at lease twelve times around the track by three different drivers and the nine fastest laps were averaged. The gasoline vehicle's average was one-minute twenty-six seconds and the CNG vehicle's average was one minute thirty-one seconds. In the acceleration testing, the gasoline vehicle accelerated from zero to sixty in 8.55 seconds, zero to eighty in 14.96 seconds and zero to one hundred in 25.33 seconds with a top speed of 129 miles per hour. The CNG vehicle accelerated from zero to sixty in 12.40 seconds, zero to eighty in 20.85 seconds and zero to one hundred in 38.21 seconds with a top speed of 106 miles per hour. The MSP standard for the acceleration test is zero to sixty within 10 seconds, zero to eighty within 17.2 seconds and zero to one hundred in 28.2 seconds (Figure 2).

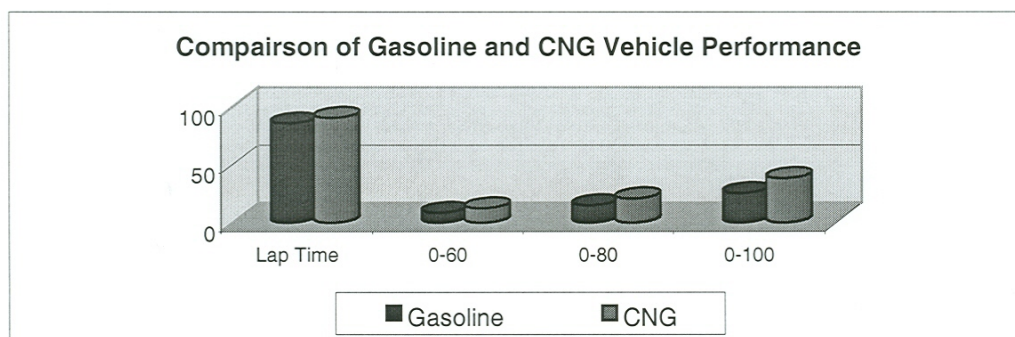


Figure 2

In braking tests the CNG vehicle scored an average stopping distance of 149.3 feet traveling at an average speed of 60.55 miles per hour and the gasoline vehicle averages were 139.9 feet traveling at an average speed of 60.28 miles per hour. The fuel economy was tested with the gasoline vehicle averaging 15.9 miles per gallon and the CNG averaging 14.3 miles per gallon on an equivalent amount of fuel. Tests were also conducted to evaluate the vehicles ability to provide a suitable environment for the officers and accommodate the required emergency equipment. The gasoline and CNG vehicles are the same with the exception of the type of fuel. The major difference noted in this evaluation was the lack of trunk space in the CNG equipped vehicle due to the fuel storage tank. The results of this evaluation indicate the CNG equipped vehicle failed to meet the standards required by the Michigan State Police. (National Law Enforcement Corrections Technology Center Bulletin, October, 1998)

Findings

Safety concerns have been addressed by pointing out that CNG is lighter than air and quickly dissipates into the atmosphere when spilled. The tanks have also responded favorably when tested by the Department of Transportation with gunfire, bonfires and dynamite for safety. According to the Gas Research Institute, no fatalities, bum accidents or other serious injuries associated with CNG have occurred in 430 million miles of vehicle operation. (Law and Order, September 1991). When compared to gasoline the ignition point of CNG provides a greater margin of safety in the case of a leak. While gasoline ignites at approximately 600 degrees Fahrenheit CNG ignites at approximately 1200 degrees Fahrenheit. The ignition of natural gas also requires a narrow range of 5-14% volume in air. Federal Motor Vehicle Standards 303 and 304 require natural gas cylinders to be much thicker and stronger than gasoline tanks. They are required to withstand normal environmental and service risks along with being capable of

surviving a bonfire and penetration by a 30-caliber bullet without rupture. A survey was conducted of 8,331 fleet vehicles in service as transportation in schools, municipal and business fleets that traveled over 178 million miles. This survey shows only seven of the vehicles were involved in a fire incident and only one of these was related to a failure of the fueling system. With over 85,000 CNG vehicles in operation in the United States, an incident of a ruptured tank has not been reported. In Italy where there are over 300,00 CNG vehicles in operation, only one incident of a ruptured tank has been reported in the past three years. The investigation of incidents that involve the rupture of a natural gas tank have involved some form of chemical attack or physical damage to the composite over wrap of the involved cylinder. After rigorous testing by the Rocky Hill, CT Police Department and the King County, Washington Police Department, officers found the CNG vehicles to be as safe and reliable as their gasoline powered vehicles. (The Natural Gas Vehicle Coalition Technology Committee Bulletin, October, 1999)

Discussion/Conclusions

The impact to the agencies budget could be a tremendous savings when you not only consider the cost of the fuel, but also the pending legislation providing tax incentives and government grants. The Airport Air Quality Improvement Act will provide ten airports with two million dollars in matching grants to convert their gasoline powered fleets to A VS. This bill requires the vehicles to have no evaporative emissions to qualify and it is believed the majority of those vehicles will be CNG powered. Another program to assist airports to convert their fleet to AFV is sponsored by the Department of Energy and targets shuttles, taxis and baggage tugs. It is believed that this is just the tip of the iceberg and the success of these programs will quickly spread to other entities. (The Natural Gas Vehicle Coalition, October, 1999).

The survey of the Departments represented in the Leadership Command College, Module II, 41st Session, found that eight of the seventeen were in high-risk areas. Only three of these departments has ever been involved in an AFV program and only one has continued the program. The program that has been continued only has ten AFV s in a fleet of eighty-eight. The programs that were discontinued did not prove to be cost effective and experienced problems with the refueling stations (Figure 3).

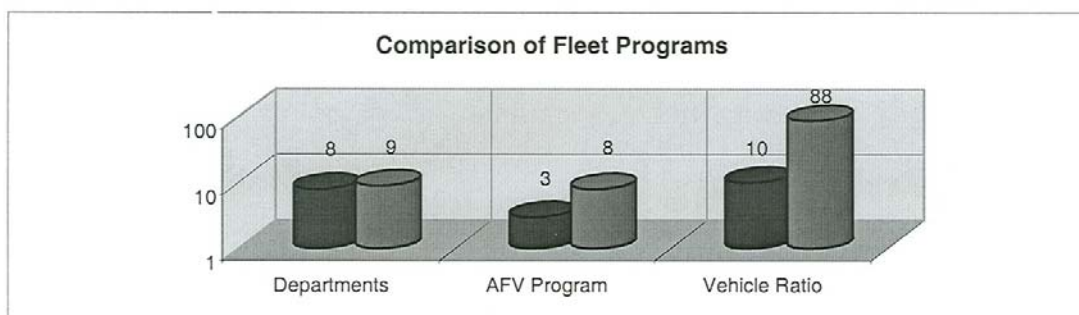


Figure 3

The requirements of the State and Federal environmental agencies are forcing local governments to consider converting their fleet from gasoline to an alternate source of fuel. They have provided financial incentives that will fund at least half of the initial cost and result a positive impact on the department's budget. A review of documents obtained from the library and Internet sources has provided the details of previous studies that were conducted for a variety reasons. A survey of a cross section of departments has identified the concerns about the cost effectiveness and refueling stations.

The decision to convert our fleet of emergency vehicles is being made by new State and Federal regulations and incentives to encourage compliance. The ability to support an AFV program is improving with modern technology and a history indicates concerns identified by the

officers are not as valid as they might have been a few years ago. Departments on the cutting edge will make plans now to implement an AFV program.

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