Environmentally Safe and Affordable Solution for FPCON B Security Requirement

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Abstract

The Temporary implementation of Force Protection Condition Bravo (FPCON B) required to set an overwatch on each Department of Defense (DoD) installation gate across the country. Currently, the overwatch consists of a police cruiser with an idling engine that adversely affects environment, energetic resources, and economical budget across the DoD installations. At the same time, it presents a health concern to cruiser occupant. This paper proposes four courses of action (COAs) for a specific installation; three of these propose solutions to reduce environmental, energetical, economical, and health risks impacts, while the fourth is the cost of doing nothing. Although this report considers one DoD installation, COAs are applicable to any DoD dependency under same situation. It was found that, although current practice does not harm cruiser occupant, three COAs reduced the environmental footprint, energy use and costs over 5 times, and the break-even point is reached at around 2.5 to 5 years.

Introduction

On May 8th, 2015, by the order of the Commander of the United States Northern Command (US NORCOM), the Force Protection Condition (FPCON) was temporarily risen from Alpha to Bravo, impacting security measures at all installations in the continental United States [1]. Although the Security Forces Squadron (SFS) designs their own security strategy within FPCON B guidelines for each installation, and this implementation is said to be temporary, among other strategies, installations opted to assemble an overwatch per gate, consisting of having a guard inside a police cruiser, with the engine idling, facing traffic flow at a prudent distance from the gate. This overwatch provides a secondary intervention measure after the main guard house with the smallest reaction time. As of May 2022, this temporary requirement still continues, with no signs of being eliminated any time soon.

Real world situations, ranging from domestic protests against government installations to the real risk of war due to the Russian invasion of Ukraine, forecasts that FPCON B measures will remain for a very long time. This forecast makes SFS reframe the current situation and consider better solutions for the gate overwatch, other than having a vehicle idling for long periods of time.

See Table 1 for details and pros and cons analysis per COA.

Table 1
Proposed COA (Courses of Action)

COA-1 Status - Quo + Lowest Initial Cost + Fastest Response Time − Highest Maintenance Cost − Environmentally Unsafe − Personnel Health Concerns	**COA-3 EV Auto** + Fast Response Time + Environmentally Safe + Reduced Personnel Health Concerns + Aligns with recent Executive Orders − Carries Implementation Cost − Novel implementation − Construction required
COA-2 Guard House Temp Facilities + Environmentally Safe + Reduced Personnel Health Concerns + Construction required − High Implementation Cost − Reduced Response Time − Construction required	**COA-4 IRT – Idling Reduction Tech** + Fast Response Time + Environmentally Safe + Reduced Personnel Health Concerns + Aligns with recent Executive Orders + In use on other installations − Carries Implementation Cost − Cruise Modification required − Construction required

Methodology

The information required to support this paper is a result of Qualitative and Quantitative methods from a wide range of reputable sources. This paper relied heavily on quantitative figures. Some information was obtained interviewing related personnel such as police cruiser users, supervisors, and technicians. Information gathered was used to quantify amounts used later for calculations in this report.

Interviews revealed that police cruisers get gas tanks filled three times a week and run 2000 mi per year. This information was key on determining energy consumption of police cruisers.

Subject Matter Experts (SMEs) indicated factors to account for Energy, Occupational Health and Environmental impacts. Came out that to measure Energy in Therms, and Fumes like CO, CO_2, VOC levels in grams were the indicators to watch the most experts care about.

Police Cruiser technical data was obtained directly from the records available from the US Department of Energy dependencies and are specific for brand, model, and year for the two models considered, which are 2018 Ford F150 and 2018 Dodge Durango. Collected data goes from cruiser efficiency measured in MPG (Miles per gallon), Idling recommendations and Fuel tank size.

Occupational Health concerns were addressed comparing similar cases to private vehicles in Hong Kong [3]. Research provided data about how harmful fumes levels are inside a car cabin under similar conditions.

Each vehicle burn fuel at different rates depending on if are idling or running. Annual mileage was used to calculate fuel usage when the car is in motion. Idling time were assumed to be the same as installation gate hours. Since total fuel use is known, calculated idling fuel was obtained subtracting "running vehicle" fuel use to total fuel used. Likewise, idling time were also used to forecast the amount of electric power required in lieu of fuel for the same benefit. Power loads were based on DoD heating, ventilating and air-cooling standards.

Therefore, this paper presents four COAs (Courses of Action) where COAs 2 to 4 tries to reduce engine idling time by using external power source instead of generating it from the idling engine.

The four COAs are:

- COA #1 – Status Quo – It is customary in the DoD that among recommendations to attend an issue, the alternative of "maintain current situation" is present. Thus, this COA sets the baseline for all other recommendations included in this paper.
- COA #2 – Guard House – This alternative is expected to reduce economic cost and environmental footprint while increases the reaction time. The expectation is the guard to remain in the house until his action is required.
- COA #3 – EV (Electric Vehicle) – This alternative is expected to reduce economic and environmental costs and keep current reaction time. The expectation is electric power keep guard conformable in the cruiser cabin until his action is required.
- COA #4 – IRTs (Idling Reduction Technologies) – Similar to COA 3, this alternative modifies the police cruiser to accept external electric power to keep cabin conformable and use fuel to power the engine while driving. This alternative also keeps current reaction time.

Results and Discussion

Occupational Health Impact Results

Installation's Occupational Health office informed that fumes emanation they monitor are carbon monoxide CO and carbon dioxide CO_2. Studies shows that CO and CO_2 measured levels inside a cabin on newer idling car averages of 1.7 ppmv for CO and 3,096 ppmv for CO_2. OSHA established their maximum exposure limit for each fume as 5 ppmv for CO and 5,000 ppmv for CO_2 during an 8-hour period [6].

Energy Impact Results

Fuel and Electricity energy, as many more sources of energy are measured in therms. The U.S. Energy Information Administration (EIA) under the US Department of Energy averaged energy from fuel as 1.25 therms per gallon, which represents 5,655 therms per year per vehicle in this report. In contrast one 1 therm equals 29.3 kw-h representing 790 therms per year per vehicle if they were fully electric. This represents environmental and economic benefits explained in their respective section in this report.

Environmental Results

Fume emanations that the Environmental Office cares the most are CO (carbon monoxide), CO_2 (carbon dioxide), NOx (Oxide Nitrates), and VOCs (Volatile Organic compounds) as these are the most harmful gases to the environment.

Currently, if no action is taken, 2.98 of Mg CO are to be expelled into the environment each year. COA 2, COA 3 and COA 4 represents a huge environmental pollution reduction of 75 to 96 percent, as shown in Figure 1.

Figure 2 shows the carbon dioxide emanations under current conditions COA 1. If no action is taken, 627.8 of Mg CO_2 will continue to hit the environment. COA 2, COA 3 and COA 4 offers a pollution reduction of 97%. Similarly Figure 3 and Figure 4 shows reduction of 97% and 81% respectively for NOx (Nitrogen Oxides) and VOCs (Volatile Organic Compounds).

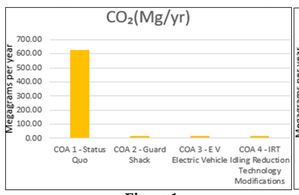

Figure 1
Carbon Monoxide per COA per year

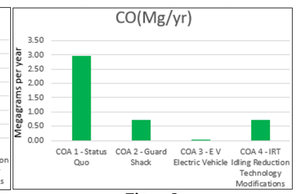

Figure 2
Carbon Dioxide per COA per year

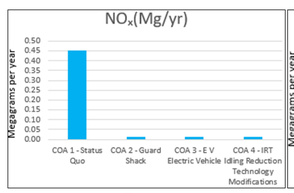

Figure 3
Nitrous Oxide per COA per year

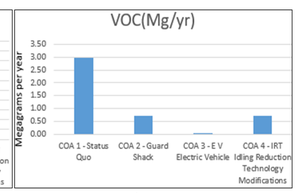

Figure 4
Volatile Organic Compounds

Economic Results

Implementation costs for COA 2, 3 and 4 are very similar and depend on electrification. It averages $36,000 per vehicle. COA 1 shows no cost, as it is the cost of doing nothing. Figure 5 shows energy cost to run operations per COA. Note that COAs 2, 3 and 4 cut energy expense in half; about $6500 savings per year.

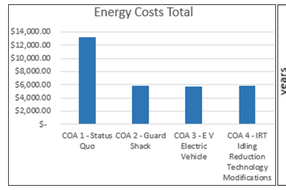

Figure 5
Total Energy Cost per COA per Year

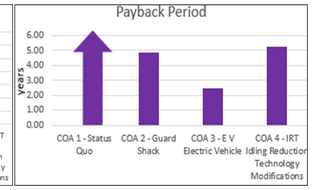

Figure 6
Payback period per COA

Given the projected implementation costs and savings per year, expected payback periods were calculated as shown on Figure 6. Note that COA 1 never reaches a payback period since it is the status quo. Other COAs reaches payback around 5 years while COA 2 reaches it in half of time.

Conclusions

Occupational Health Impact Results

There is no reason believe fume levels affects occupant health in a vehicle maintained under DoD standards. Average levels of CO and CO_2 levels meets OSHA regulation.

Energy Impact Conclusions

Overwatch operations on electric would require at least 13 times less energy compared to current dependency on fuel.

For any of COAs 2 through 4, energy use per year were calculated close to 115 therms compared to1400 to 1515 from fuel per year.

Environmental Impact Conclusions

Focusing on byproducts CO (carbon monoxide), CO_2 (carbon dioxide), NOx (Oxide Nitrates), and VOCs (Volatile Organic compounds). It was concluded that electrification of the overwatch operation will reduce CO emissions between 75% to 96%, CO_2 to be cut in 97%, NOx 97%, and VOCs in 81%.

Economic Impact

COA 1, Status Quo, does not require implementation cost, but requires $18,045 on operational costs per year.

COA 2 and COA 4 cost around $35,000 to implement, however requires $8,000 per year for a payback close to 5 years.

COA 3 which also require near $35,000 to implement, due lower operational costs of $2,900, shows faster payback of 2.5 years.

Thus overall, informed decision is to recommend COA #3, the EV solution since uses less energy, produces less fumes, costs less to operate and has a faster payback period.

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