FEASIBILITY OF JP-8 TO JET A FUEL CONVERSION AT U.S. MILITARY FACILITIES

THESIS

Lance A. Vann, Captain, USAF

AFIT/GLM/ENS/08-13

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GLM/ENS/08-13

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THESIS

Presented to the Faculty

Department of Operational Sciences

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

Lance A. Vann, BS

Captain, USAF

March 2008

AFIT/GLM/ENS/08-13

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Lance A. Vann, BS
Captain, USAF

Approved:

Bradley E. Anderson, Lt Col, USAF (Chairman) date

Dr. Alan W. Johnson (Member) date

AFIT/GLM/ENS/08-13

Abstract

In FY06, The Department of Defense (DoD) military grade jet fuel expenditures eclipsed $6.6 billion dollars. In a search for more cost effective options, the Office of the Secretary of Defense Comptroller recently expressed interest in the quantity of commercial Jet A fuel that the United States Transportation Command uses in lieu of military grade JP-8. In accordance with AFSO 21 and LEAN concepts, this research examines the technical feasibility and opportunity for cost avoidance of a conversion from JP-8 to Jet A at six Northwestern United States military installations. The technical feasibility analysis examines the chemical likeness of JP-8 and Jet A and identifies any aircraft or equipment that may impede a complete conversion. Accordingly, the opportunity for cost avoidance is considered through an analysis of military and commercial grade jet fuel influenced by West Coast refinery prices. The results show no technical barriers to a complete conversion, but there is no opportunity for cost avoidance.

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To my wife and son: without your support, this effort would not have been possible.
Thank you and I love you both.

Acknowledgments

I would like to express my sincere appreciation to my research advisor, Lt. Col. Bradley Anderson, for his guidance and support throughout the course of this thesis effort. The insight and experience was certainly appreciated. I would, also, like to thank my sponsor, Major Stephen "Duff" Wier, from the Air Force Petroleum Office for both the support and latitude provided to me in this endeavor.

I am also indebted to the many DoD and contractor petroleum professionals who spent their valuable time explaining the processes and procedures they used in their respective fields. Special thanks go to Mr. Tom Rasmussen, who served as my guiding light and was always available to answer my questions.

Lance A. Vann

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I. Introduction

Background, Motivation, and Problem Statement

The Department of Defense (DoD) performs budget execution and performance reviews routinely throughout each fiscal year. These reviews are performed on at least a quarterly basis, but often times much more frequently. Execution and performance reviews allow the DoD's budgetary leadership an opportunity to reassess the allocation of funds and determine whether the military services are meeting their planned performance goals against current budget projections. During a review in fiscal year (FY) 2007, the Office of the Secretary of Defense (OSD) Comptroller was particularly interested in types of available jet fuels and amounts that the DoD is currently using. He asked the attending members of the United States Transportation Command (USTRANSCOM) leadership two very specific questions: "How much Jet A fuel does USTRANSCOM use as opposed to JP-8?" and "Why doesn't the United States Air Force (USAF) fuel its C-5 and C-17 fleets with commercial fuel?" (C4E, 2007:2). The rationale for such questions is definitely warranted noting DoD expenditures on jet fuel alone.

In his remarks to the Air Force Energy Forum, the Secretary of the Air Force (SECAF) stated that the USAF spent approximately 6.6 billion dollars on aviation fuel in FY06. This is 1.6 billion dollars more than budgeted for that year alone (Wynne, 2007). Furthermore, in FY05 the Defense Energy Support Center (DESC) purchased 4.96 billion dollars worth of Jet Propellant -8 (JP-8) and Jet Propellant Thermally Stable (JPTS). This figure was greater than 1.4 billion dollars more than the previous year according to the 28th edition of the DESC Fact Book (DESC Fact Book, 2006:20). Although this is a relatively short period of time, a 35% price increase can be established between FY05 and FY06. Under the current trend, it can be surmised that each ten dollar increase in the price of a barrel of oil, costs the USAF more than half a billion dollars.

When using the term billion, it is important to recognize the sheer volume of money the United States government is dedicating to fuel alone. If one sat down to count a billion dollars and could count them at a rate of one per second, every second of every day, it would take more than 30 years to finish this task. Therefore, 1.4 and 1.6 billion dollar increases in funding to the USAF fuel budget certainly demand the collective attention of DoD leaders and government lawmakers.

In response, the SECAF currently emphasizes several initiatives dealing with continual process improvements and overall cost avoidance. The Air Force LEAN concept was adopted from the private sector and focuses mainly on reducing waste and quality improvements. From this, the USAF developed a service specific process know as Air Force Smart Operations 21 (AFSO 21). AFSO 21 was championed to expand LEAN concepts beyond depot operations and embrace value maximizing and/or waste minimizing ways of accomplishing our military mission (Wynne, 2006). In order to capitalize on long-term process improvements and initiate a culture shift throughout our service, initiatives such as these are imperative. Therefore, one should first look at any short term improvements that may immediately avoid costs rather than continually expending those funds throughout the long-term solution development. For example, the DoD currently focuses on long-term solutions such as flight simulator purchases, jet engine fuel economy improvements, and alternative fuel development. However, all of the development time and effort the DoD spent on these long-term solutions could have possibly introduced immediate cost avoidance by simply using commercial Jet A versus JP-8. This paradox now sheds a bit more light on the OSD Comptroller's earlier questions: "How much Jet A fuel does USTRANSCOM use as opposed to JP-8?" and "Why doesn't the USAF fuel its C-5 and C-17 fleets with commercial fuel?" (C4E, 2007:2).

Research Focus

Using the background information noted in the introduction, the focus of this research is an investigation of the technical feasibility and cost of using Jet A to replace JP-8 at multiple northwestern United States military installations. Following the questions initiated by the OSD Comptroller, this study documents the relevant bulk JP-8 supply chain for the Pacific Northwest and identifies options for storing and issuing Jet A in lieu of JP-8. This research also determines if the applicable aircraft or equipment can use Jet A as a primary or alternate fuel and provides a cost assessment of any feasible options.

Research Objectives, Questions, and Goals

Although commercial aircraft routinely receive JP-8 fuel at military bases and occasionally military aircraft receive Jet A fuel when landing at commercial locations, little documentation explores the overall impact of a complete shift in the DoD's first tier fuel requirement from JP-8 to Jet A. Most fuel related studies focus on fuel economy improvements and cost avoidance efforts in the logistics field, rather than a complete switch to a conventional commercial product. The result of this study should determine if a switch from JP-8 to Jet A is feasible and if any costs can be avoided through such actions. Investigative questions in need of analysis include:

1. What is the jet fuel delivery supply chain from the refinery to the selected military installations?
2. Can any supply chain savings be recognized by switching from JP-8 to Jet A?
3. What types of aircraft and/or equipment are fueled by the military installations of interest?
4. Can the aircraft and/or equipment fueled by the military installations of interest use Jet A in lieu of JP-8?
5. Are there large enough price differentials in the purchase price of Jet A and JP-8 for the DoD to recognize significant cost avoidance?

Methodology

Foremost, mapping of the JP-8 supply chain is accomplished by analyzing contract solicitations and delivery methods agreed upon when the relevant contracts were awarded. With this data, the researcher is able to note any methods of storage and transportation that may become more cost effective by handling a single grade of jet fuel versus both JP-8 and Jet A.

Next, the technical feasibility of using Jet A versus JP-8 is determined by gathering consumption data from the Fuels Automated Management System (FAMS). This data contains information such as airframe or equipment serviced and gallons of jet fuel issued to each. One year's worth of data was supplied by the data sponsor in order to assess the likelihood of being able to refuel with Jet A in lieu of JP-8. By sorting the data by airframe or equipment type, and cross referencing with type specific technical manuals or data from established research, one can determine if Jet A is approved as a primary, alternate, or emergency fuel.

A tertiary analysis required by this research includes a chemical comparison between JP-8 and Jet A in order to highlight any chemical differences that may hamper efforts of a conversion from military to commercial grade jet fuel. Technical Order (TO) 42B1-1-14, dated 1 May 2006, is used as the standard of comparison for this analysis. Differences in specific gravity at 60ºF, density in pounds per gallon, and freeze point all highlight chemical differences between the two fuels (TO42B1-1-14, 2006:3). However, JP-8's freeze point is the only property addressed in TO 42B1-1-14 that significantly differs from that of Jet A (Bartsch, 2006:93). A complete analysis of this data, and extreme aviation routes requiring a more stringent freeze point, is further addressed in the data analysis.

The fourth and final assessment of this research is a fuel cost differential analysis in order to quantify the opportunity for cost avoidance if Jet A was purchased versus JP-8 at the military installations of interest. This research is conducted as the result of a similar study recently conducted on the Charleston Defense Fuel Supply Point (DFSP) in South Carolina. The Charleston DFSP analysis assessed price differentials between Jet A and JP-8 at a large east coast supply hub. The results of this study indicated that a complete conversion from JP-8 to Jet A would net an annual cost avoidance of $520,922 dollars for the Charleston DFSP (C4E, 2007:28). Variables that were examined include refinement specifications for each fuel, economies of scale, price of procurement between fuels, and airline pricing factors. After speaking with Air Force Petroleum Agency (AFPET) personnel at Ft. Belvoir, Virginia, it was decided that the same methodology should be used when assessing other locations for possible cost avoidance unless a superior method is introduced prior to the culmination of this research. From the Enhanced Fuel Distribution System Study (EFDSS) in 2003, it was found that jet fuel purchased from the Texas Gulf Cost was as much as .0459 dollars per gallon more expensive than jet fuel purchased at inland and west coast locations (C4E, 2007:30). As a result, AFPET suggested that a similar study be accomplished at west coast locations to see if analogous savings could be recognized as those found to exist at the Charleston DFSP. Using recommendations from the Puget Sound DFSP, AFPET, and DESC personnel, McChord AFB, Fairchild AFB/ANG Unit, Kingsley Field ANG Base, Whidbey Island NAS, Fort Lewis, and Yakima Firing Range were chosen as the subjects of this research since their operations are similar to those of the locations analyzed for the Charleston study.

Limitations

Due to time, monetary, and knowledge constraints related to this topic, the test results and data availability are heavily dependent on time sensitive data obtained from AFPET and DESC. Although a large percentage of the test data occurred within the past five years, this research is heavily reliant on existing cost analysis assumptions from previously contracted outside agencies. Future study recommendations and the improvement of these limitations are addressed in the conclusions of this document.

Implications

Recent DoD budget execution and performance reviews highlighted the inability of our military branches to control fuel expenditures within the budgetary guidelines put in place each fiscal year. This dilemma, coupled with the steep increase in the price of crude oil per barrel, is an escalating problem that captured the attention of our military's top leaders. Solutions to this problem are routinely characterized by large investments of research and development time on top of exorbitant initial capital investments. If Jet A is found to be a feasible and more economical jet fuel when compared to JP-8, the DoD could immediately start reaping monetary benefits during the time gap required for the fruition of most of the long-term jet fuel solutions. Furthermore, through the use of this cost analysis template, studies of additional fuel markets and military supply points could be accomplished in DoD's existing academic environments.

II. Literature Review

Introduction

Simplistic jet engines were first designed and operated, mainly in a research and development capacity, during the first part of World War II. The Heinkel HE 178 was the first operable jet aircraft and took its inaugural flight on 27 August 1939. A gasoline driven, aviation turbine engine, developed by Hans Von Ohain, first propelled the Heinkel and marked the genesis of jet powered flight (British Petroleum, 2007). With the onset of the jet era, advances in jet fuel technology were soon to follow. Soon after the HE 178's flight in 1939, Sir Frank Whittle developed a comparable jet engine to power the Gloster E28/32's pioneering flight on 14 May 1941 (British Petroleum, 2007). During this period, wartime consumption had greatly diminished the availability of standard gasoline. Therefore, Whittle developed his turbine engine around the concept of jet propulsion with a kerosene based fuel. As a result of wartime shortages and Whittle's drive to succeed, the first kerosene based jet fuel was developed and kerosene remains the distillate of choice for most all jet fuels in use today.

Development of Jet Fuel Grades

As the performance requirements and dependability demands for turbine jet engines increased, the refinement of kerosene based jet fuels followed suit. Due to the dynamics of the jet engine, early proponents lauded its resiliency and claimed that it could run on most anything from whisky to peanut butter (British Petroleum, 2007). According to U.S. published guidance AN-F-32, the first official U.S. kerosene based fuel was labeled JP-1 in 1944. After World War II, world military powers began using what is known as "wide-cut fuel" to power its jet engines. The term wide-cut is applied here since this fuel is derived from the distillation boiling range between that of gasoline and kerosene (Chevron, 2004:1). This action was first brought about due to availability concerns for gasoline and kerosene; especially during times of war. By order of volatility, gasoline is much more volatile than kerosene due to its lower flashpoint. Since early jet fuel's distillation requirements ranged between those of kerosene and gasoline, a much more volatile fuel was produced when compared to strictly kerosene based propellants. Additionally, it had an even more restrictive freeze point of -60º C. Unfortunately the discriminative freeze point warranted longer refinement time and tended to limit availability. This quickly drove the development of JP-2 in 1945, JP-3 in 1947, and JP-4 in 1951 in order to increase fuel availability. Although the availability issues were being addressed, safety concerns gradually took a toll on the development of wide-cut fuels. JP-4 was riddled with shortcomings associated with high altitude evaporation, increased fire risks, and less survivable plane crashes (Chevron, 2004:1). As a result, JP-5 was a high flashpoint, kerosene based jet fuel developed as a blending agent to one of the initial naval aviation fuels. This increased flashpoint propellant was first adopted by the U.S. Navy in 1952 and remains the predominant worldwide naval jet fuel today. With the onset of developmental, high performance aircraft, new fuels had to be developed in order to meet the restrictive demands of experimental jet engines. JP-6 was a specialty jet fuel created for use in XB-70 aircraft in 1956. Upon cancellation of this project, the specification for JP-6 was retired just as quickly as it was developed. Much like the creation of JP-6, JP-7 was conceived as a result of the development of the SR-71 in the late 1960s. Due to the demands of high altitude flight and supersonic cruising speeds, this fuel was developed in order to reduce residual vapor pressure and control its thermal oxidative stability. In order to alleviate dangers related to low flashpoint and carcinogenic effects, the Air Force switched to JP-8 in the 1990s. "Although JP-8 has replaced JP-4 in most every case, the potential need for JP-4 under emergency situations necessitates maintaining this grade in specifications MIL-DTL-5624 and Defence Standard 91-88." (British Petroleum, 2007). Furthermore, military grade JP-8 requires the addition of MIL-PRF-25071 Corrosion Inhibitor/ Lubricity Improver (CI/LI), MIL-DTL-85470 Fuel System Icing Inhibitor (FSII), and Static Dissipator Additive (SDA) (TO 42B1-1-14, 2006).

First, CI/LI is a two fold additive to control fuel corrosion factors and improve jet fuel lubricity. Corrosive compounds potentially present in jet fuel include organic acids, mercaptans, by-products of microbial growth, and contamination from trace amounts of sodium, potassium, and other alkali metals in the fuel can cause corrosion in the turbine section of the engine. Furthermore, "The naturally occurring compounds that provide jet fuel with its natural lubricity can be removed by hydrotreating – the refining process used to reduce sulfur and aromatic content." (Chevron, 2004:31). As a preventative, the DoD resigns to the mandatory addition of CI/LI to JP-8 fuel. Second, FSII is an additive to military grade JP-8 to control the formation of ice crystals in jet fuel. A common misconception tied to FSII is that it will actually control the freezing of JP-8. Alternately, it controls the forming of ice crystals in any water contained in the jet fuel. Lastly, SDA is a JP-8 additive that increases the rate of a fuel's charge dissipation by increasing its conductivity (Chevron, 2004:32). When jet fuel moves through most any medium, it accumulates an electrical charge that can subsequently spark and create the potential for an explosion. As a result, anti-static additives are required in order to reduce the risks associated with JP-8 distribution. The true need for additive injections of CI/LI, FSII, and SDA to JP-8, or other fuels, is a project currently under investigation by AFPET (Bartsch, 2006:6).

Following the success of military jet propulsion development, the commercial jet airline industry began its rise in popularity in the early 1950s. In order to guarantee U.S. and worldwide availability, a fuel standard had to be developed to satisfy the propulsion needs of multiple types of commercial jet aircraft. Currently there are two grades of commercial jet fuel that dominate the market; Jet A and Jet A-1. Both products are essentially the same kerosene based fuels except for freeze point specifications. Jet A-1 is a more restrictive jet fuel and holds a freeze point to -47ºC. Adversely, Jet A holds a freeze point specification of -40ºC per the American Society for Testing and Materials (ASTM) D1655 (TO42B1-1-14, 2007:3). JP-8 and Jet A-1 are almost identical with the exception of military additives. The reason for the use of Jet A versus Jet A-1 in the United States is driven from the demands placed on refineries. From greatest to least U.S. refinery demands are gasoline, diesel, and jet fuel respectively. According to the Energy Information Administration (EIA), the fuel demands in other countries are primarily diesel followed by gasoline and jet fuel (EIA, 2007:3). Gasoline distillation robs crude oil of light hydrocarbons and leaves only heavy hydrocarbons for jet fuel production. Therefore, Jet A falls on the production spectrum much closer to diesel than gasoline and is produced in the U.S. as a result of the high demand for gasoline products. Figure 1 depicts the gallons of refined petroleum products produced as a result of U.S. gasoline demand. It is important to note that slightly more than 44 gallons of petroleum products can be produced from a 42 gallon barrel of crude oil. Due to the heating process required for fractional distillation, the fuel molecules expand in response and produce a less dense product. In response, fewer light hydrocarbon molecules, with a lower freeze point, are left over for jet fuel production. Conversely, European distillation demands range more toward the kerosene/diesel end of the spectrum allowing Jet A-1 to be produced with less regard for gasoline distillation demands (Bartsch, 2006:5). Therefore, Jet A is produced in the U.S. with a freeze point of -40º C and Jet A-1 is produced in Europe with a more stringent freeze point of -47º C.

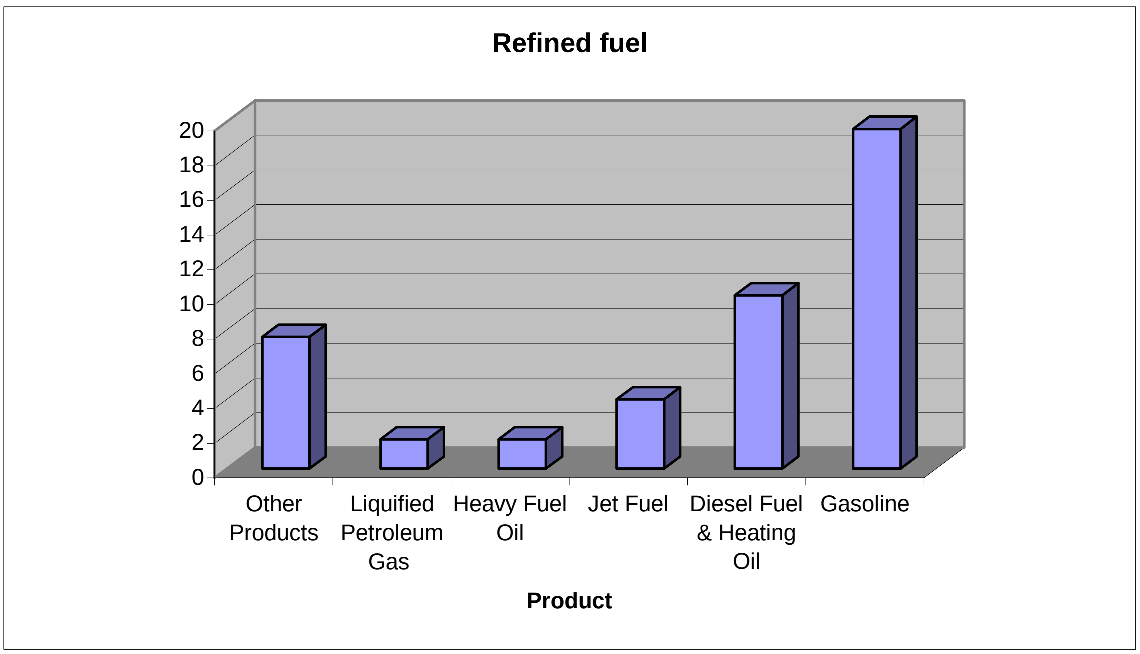

Figure 1. Gallons/Barrel of Petroleum Products Rendered to Meet U.S. Demands (EIA, 2007)

Policy Drivers for Mandatory JP-8 Usage

The catalyst for DoD policy development concerning JP-8 is tied to the sheer volume our military consumes and the logistical implications of ensuring the availability of fuel for any/all military mission requirements. In order to reduce logistics related hazards, the DoD enacted a plan to adopt a single fuel for use on the battlefield. In response, the military branches had to agree on a single fuel for flying and land based missions. Following a 2004 revision to the single battlefield fuel concept, the demand for JP-8 grew exponentially when it was determined to be the DoD fuel of choice (DoD Directive 4140.25, 2004:3). Furthermore, increased military demand coupled with the growing price of crude oil further emphasizes the DoD's continued JP-8 reliance and possible vulnerabilities. According to the 2007 DESC Fact Book, the DoD consumed approximately three billion gallons of JP-8 in 2006 at a price tag of more than $6.5 billion dollars (DESC Fact Book, 2006:21). Scarcity, supply chain disruptions, and the price of crude oil growing beyond $100 dollars per barrel has driven the DoD to develop and enact modern day energy policies to ensure future capabilities. Since price is generally touted as a key driver for such policies, the DoD is now searching for less costly alternatives to JP-8. In response, DESC and AFPET continually examine new opportunities for cost avoidance when contracting for jet fuel under existing military specifications.

Department of Defense Petroleum Agencies

In order to enact a switch from JP-8 to Jet A, at least two DoD petroleum agencies must be in agreement before the Air Force and other military branches can adopt commercial jet fuel usage for military applications. AFPET is responsible for determining the feasibility of the usage of certain jet fuels while DESC is accountable for jet fuel purchasing agreements between the government and commercial fuel refineries. Therefore, without AFPET's technical certification and favorable DESC cost effectiveness results, new jet fuels cannot be considered as options for the United States armed forces. Herein lies the importance of the price differentials highlighted in the results section of this document.

AFPET is a field operating agency that reports directly to the USAF Director of Logistics Readiness through the Office of the Deputy Chief of Staff for Logistics, Installations, and Mission Support. This agency is the Air Force focal point for all Defense Logistics Agency (DLA) fuel-related support issues. With regards to this research, AFPET is responsible for fuel technical support, quality assurance, and product distribution for all Air Force fuels. Furthermore they, "develop, evaluate, and recommend new or improved technologies to enhance the effectiveness and efficiency of fuel operational support capabilities." (Department of the Air Force, 2007). With this in mind, AFPET is the agency that is ultimately responsible for determining the technical feasibility of using Jet A for military applications. This organization's focus is on the certification of new or improved jet fuel options without stringent regard for budgetary constraints. Alternately, the fiscal responsibility of this process resides within the purchasing processes and policies defined by DESC.

The DESC falls under the leadership of the Defense Logistics Agency (DLA) and is responsible for effective and economic solutions to the DoD's energy requirements. Some of their earliest purchasing efforts date back to 1945, during World War II, when they were known as the Joint Army-Navy Purchasing Agency. In 1964, this agency was renamed the Defense Fuel Supply Center (DFSC) when the procurement of all military fuel and coal became their responsibility. In 1990, their duties grew to include the supply and management of natural gas, in addition to fuel and coal. Following restructuring actions of the late 1990's, DFSC was redesignated the Defense Energy Support Center with a goal of solely managing energy products versus energy infrastructure. (DESC, 2007). With this in mind, competitive contracting for energy products became the main focus of DESC and is a top driver for the need of a cost analysis of contract pricing for Jet A versus JP-8.

TO42B1-1-14 Chemical Comparisons of Jet Fuels

The purpose of TO42B1-1-14 is, "to designate the grades of fuel for use in USAF aircraft and to provide technical information on military and commercial aviation fuels." (TO42B1-1-14, 2006). This document places JP-8, Jet A-1, Jet A, and TS-1 in the same "kerosene type" category due to their extremely similar chemical make-up. However, it states that wide-cut, high flash point kerosene type, kerosene type, and aviation gasoline can all be used in all turbojet and turboprop aircraft with certain restrictions. Furthermore, it designates fuel types as primary, alternate, or emergency fuels and defines them as:

> Primary Fuel - the fuel or fuels used during aircraft tests to demonstrate system performance through the complete operating range for any steady state and transient operating condition.

Alternate Fuel - a fuel authorized for continuous use. The operating limits, thrust outputs, and thrust transients, shall not be adversely affected.

Emergency Fuel – a fuel which may cause significant damage to the engine or other systems; therefore its use shall be limited to one flight. (TO42B1-1-14, 2006)

Table 1 is an excerpt from this document that more explicitly highlights the differences among the various types of jet fuels. When comparing JP-8 to Jet A, differences in specific gravity, density, and freeze point are the only chemical differences noted between the two fuels. However, JP-8's freeze point is the only property addressed in TO 42B1-1-14 that significantly differs from that of Jet A (Bartsch, 2006:93).

For all USAF aircraft, TO42B1-1-14 defaults the ultimate fuel usage decision to the specific airframe's technical manual. However, JP-8/JP-5 is listed as a primary fuel choice and Jet A/A-1 is listed as a secondary choice as long as SDA, FSII, and CI/LI are added at the recommended levels expressed in the specific technical manuals. For the purposes of this research, USAF applicability analysis for each airframe likewise defaults to the flight manuals for each aircraft.

It is important to note that this TO serves as the sole determinant of primary and alternate fuels for all Army, Navy, and Marine aviation applications in this study. Therefore, the primary and alternate fuels for all Army, Navy, and Marine aviation applications include JP-8/JP-5 and Jet A/A-1 respectively (TO42B1-1-14, 2006). Building upon this chemical difference, an assessment of the actual need for a more stringent fuel with a seven degree lower freeze point is required.

Table 1. Fuel Characteristics

Property	MIL-DTL-5624		MIL-DTL-83133	ASTM D1655		ASTM D6615	ASTM D910	GOST 10227
	JP-4	JP-5	JP-8	Jet A	Jet A-1	Jet B	100, 100LL	TS-1
Specific Gravity at 60°F (MIN)	0.751	0.788	0.775	0.775	0.775	0.751	—	0.775
Specific Gravity at 60°F (MAX)	0.802	0.845	0.840	0.840	0.840	0.802	—	—
Specific Gravity at 60°F (typical) [1]	0.769	0.817	0.805	0.817	0.817	0.769	0.703	—
Density, pounds/gallon (typical) [1]	6.4	6.8	6.7	6.8	6.8	6.4	6.0	6.7
Flash Point, MIN, °C (°F)	–29 (–20) [2]	60 (140)	38 (100)	38 (100)	38 (100)	–29 (–20) [2]	–32 (–25)	28 (82)
Vapor Pressure, psi (range)	2.0 – 3.0	—	—	—	—	2.0 – 3.0	5.5 – 7.0	—
Freezing Point, MAX, °C (°F)	–58 (–72)	–46 (–51)	–47 (–53)	–40 (–40)	–47 (–53)	–50 (–58)	–58 (–72)	–50 (–58)
Viscosity at –40°C, mm^2/s (estimated)	3.6	16.5	15	15	15	3.6	1.2	8 max
BTU per gal (MIN) [3]	115,000	120,000	119,000	119,000	119,000	115,000	109,000 [4]	123,573
BTU per pound (MIN)	18,400	18,300	18,400	18,400	18,400	18,400	18,700	18,444
Fuel System Icing Inhibitor	yes	yes	yes	Preferred [5]			Optional	Preferred [5]
Corrosion Inhibitor/ Lubricity Improver	yes	yes	yes	Preferred [5]			Optional	Preferred [5]
Static Dissipator Additive	yes	no	yes	Preferred [5]			Optional	Preferred [5]

[1] Typical average for fuels procured since 1970 in Continental U.S.A.
[2] Typically measured values, no specification requirement stated.
[3] Value based on minimum fuel specific gravity from specification and reported to three significant figures.
[4] Value based on typical fuel specific gravity.
[5] See Paragraph 1.5, Step a.

Effects of Freeze Point Differentials Between Jet A and JP-8

As noted earlier, the only significant technical difference between Jet A and JP-8 is the difference in freeze point. Jet A has a higher freeze point of -40ºC and JP-8 has a more stringent freeze point of -47ºC. Furthermore, "all commercial turbine powered aircraft operating from airports in the continental United States (CONUS) use American Society for Testing and Materials (ASTM) D1655 Jet A fuel." (Bartsch, 2006:5). Due to diesel demand outside of the CONUS, all other countries around the world utilize ASTM D1655 Jet A-1 fuel; with a lower freeze point of -47ºC. Therefore, it can be assumed that JP-8 is actually the same as Jet A-1 with the inclusion of military additives. Due to the strict standards highlighted in DoD Directive 4140.25, a jet fuel with the most extreme limits had to be designated as the single battlefield fuel for all U.S. military applications. Following this regulation, field equipment and vehicles such as tanks, trucks, generators, and aircraft were all required to primarily operate on one type of fuel. Since jet fuel levied the most stringent fuel requirements, JP-8 was designated as the single battlefield fuel of the future (DoD Directive 4140.25, 2004:3). However, is this strict requirement actually warranted given the weather conditions faced during CONUS military flights?

In October of 2006, AFRL released an in-depth report addressing the actual need for JP-8 versus Jet A utilization, in CONUS military flights, for C-5, C-17, and C-130 transport aircraft. Figure 2 depicts the most extreme freezing conditions that Air Mobility Command (AMC) aircraft faced during FY04-05. The depicted route is that of a LC-130 belonging to the 109th Air Wing (AW) at Scotia, NY. It is important to note that only one in 1144 AMC C-130 missions would even be impacted by temperatures less than -40ºC and that they only originated in Scotia, NY during the month of January. C-5 and C-17 missions never faced temperatures that would require the use of JP-8 during this same time period. Therefore, it can be assumed that the 109th AW potentially holds the only AMC missions that would require jet fuel with a more stringent freeze point and should not be included in the list of CONUS bases for a JP-8 to Jet A conversion (Bartsch, 2006:86). As a result, the decision to replace JP-8 with Jet A should depend more on costs rather than technical considerations.

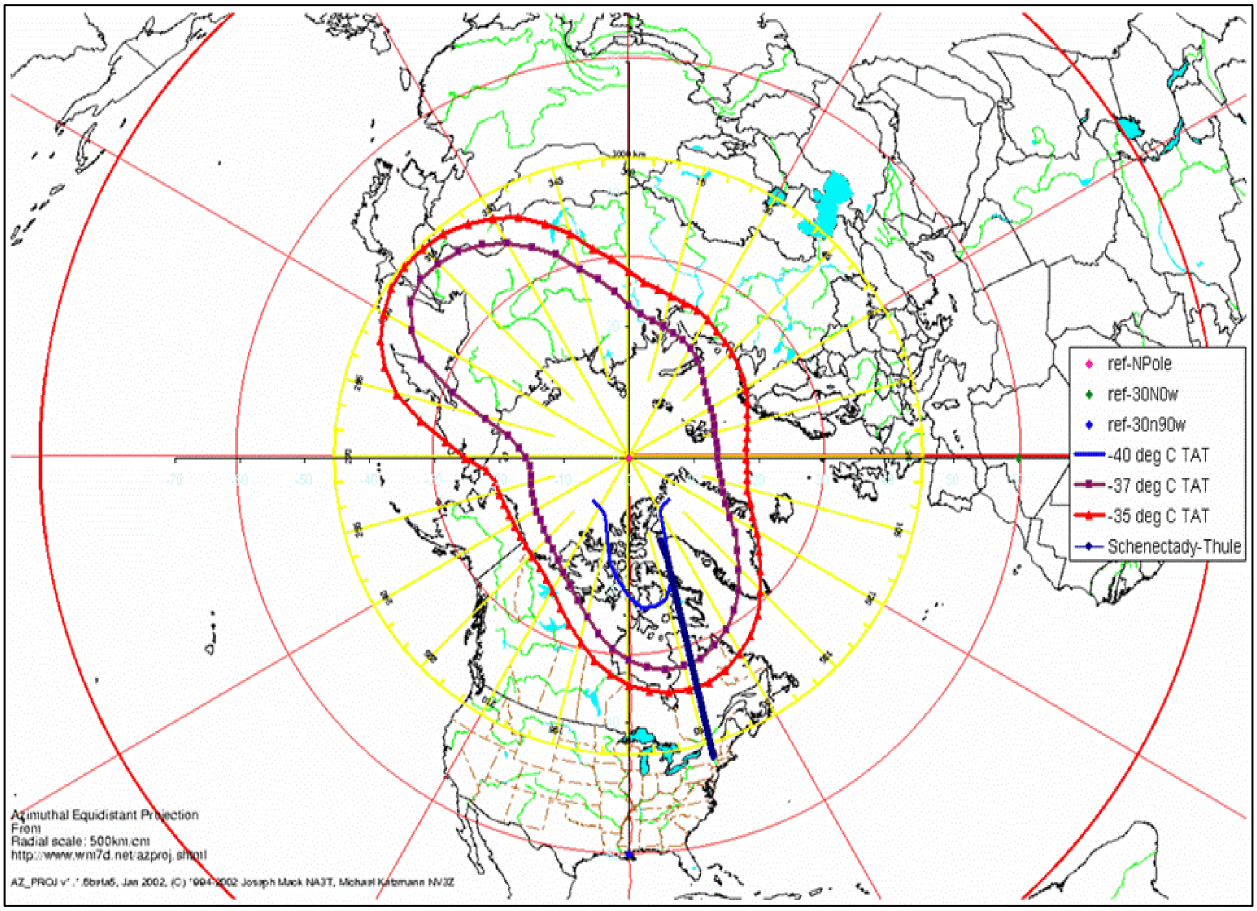

Figure 2. C-130 Route from NY to Greenland with January Temperatures (Bartsch, 2006:87)

Prior JP-8 to Jet A Conversion Research

In order to address questions concerning the technical and financial merits of a JP-8 to Jet A conversion, C4E Inc. was contracted by AFPET for two separate studies in 2003 and 2007. The first study was titled the Enhanced Fuel Distribution System Study (EFDSS) and dealt mainly with the jet fuel supply chain and technical aspects of such a conversion. In conclusion, this research noted the chemical differences, technical requirements of aircraft, and cost benefits associated with a full DoD worldwide transition to commercial Jet A or Jet A-1. The main differences highlighted between the two fuels included their freeze point differential and potential savings between $39 and $137 million dollars annually with the full DoD adoption of commercial jet fuel usage. Specifically, “The JP-8/Jet A price differential, based upon average cost at origin without additives, ranges from .0104 to .0459 dollars per gallon, depending upon acquisition area. For Jet A-1, the potential savings range is from .0095 to .0287 dollars per gallon.” (C4E, 2003:246). Likewise, C4E’s latter study in 2007 produced similar results, but narrowed the focus to CONUS adoption of Jet A.

The setting of the 2007 study is the U.S. East Coast and pertained to military installations that received JP-8 from DFSP Charleston. Noting the freeze point differential between the two fuels, it was established that the vast majority of aircraft and equipment at these locations were approved to utilize Jet A as a primary or alternate fuel. Therefore, the defining factor of a JP-8 to Jet A conversion in this geographic area rested with a cost analysis. C4E found, “a calculated cost differential of .004951 dollars per gallon between JP-8 and Jet A during the period from July 2005 through July 2007.” (C4E, 2007:30). The summarized overall savings noted through a JP-8 to Jet A conversion at DFSP Charleston equated to $520,922 in this two year period. C4E additionally stated that they, “believe the potential saving at Charleston is probably lower than the saving would be for inland and West Coast locations.” (C4E, 2007:30).

In order to continue this research, AFPET established a new geographical area of study in the Pacific Northwestern U.S. With consideration to assigned airframe, mission requirements, and gallons of JP-8 utilized per year, McChord AFB proved to be most similar to the operations at Charleston AFB. Furthermore, upon recommendation from the Puget Sound DFSP and approval from AFPET, five additional JP-8 using military installations were selected due to their influence by West Coast jet fuel prices. By employing a similar technical feasibility and cost analysis methodology as the 2007 Charleston Jet A study, more information can be gained to help determine if a conversion from JP-8 to Jet A is warranted. The mechanisms employed for this area specific study are discussed in depth in the methodology chapter of this research and answers to the cost analysis questions are found in the analysis section.

III. Methodology

Introduction

The two governing objectives of this research focus on the technical feasibility and cost analysis of a CONUS DoD conversion from JP-8 to Jet A. Accordingly two DoD organizations oversee and validate the technical and cost questions posed in this study; AFPET and DESC. AFPET's vision is to, "operate an Air Force Fuels Service Control Point (SCP) that is mission concentrated, agile, and warfighter focused, overseeing inventories, facilities, distribution, and technical support world-wide." They also provide, "critical information technology support and technical services to military agencies." (Department of the Air Force, 2007). However, DESC's mission is to, "provide the DoD and other government agencies with comprehensive energy solutions in the most effective and economical manner possible" (DESC, 2007). Building upon the mission objectives of technical certification and economic cost avoidance within these two organizations, the goal of this chapter is to describe the methodology used to satisfy both areas of interest. In doing so, actual research data is used in examples highlighting the evaluation methods. As a result, this research strives to answer the questions of whether a conversion from JP-8 to Jet A is technically sound and cost effective for six Pacific Northwestern military installations.

The methodology of this research is divided in four phases: 1) Planning Factors, 2) Supply Chain Mapping, 3) Technical Feasibility Analysis, and 4) Price Analysis. Investigative questions presented in the research introduction section provide a convenient roadmap for the specific steps to this method. However, before the investigative questions can be approached the military installations of interest and analysis software must first be decided in Phase I. The only criteria provided by the research sponsor, AFPET, was selection of several bases influenced by West Coast jet fuel pricing.

Once the installations recommended by the Puget Sound DFSP were agreed upon by AFPET, this study examines the supply chain and determines JP-8 usage quantities at these locations. Answers to investigative questions one and two, dealing with supply chain related efficiencies, are addressed through a supply chain distribution analysis in Phase II.

Phase III deals with investigative questions three and four concerning the technical feasibility of replacing JP-8 with Jet A. Through the use of TO42B1-1-14, the chemical differences between JP-8 and Jet A are highlighted and discussed. Additional information is taken from the 2007 Charleston AFB Jet A study and the 2003 EFDSS in order to determine if the airframes refueled at the installations of interest were approved to use Jet A as a primary or alternate fuel.

Phase IV deals with the comparison of refinery prices for Jet A and JP-8 as part of investigative question five. This is accomplished using section B14.04 from the awarded JP-8 contracts, solicitations for these contracts, Platts pricing data, and multiple equations either developed in earlier studies or formulated throughout the course of this research.

Phase I: Planning Factors

Selection of Military Installations of Interest

According to the literature review, pricing patterns differ between various geographic areas within the CONUS. Military installations of interest were first established upon expert recommendation from the Puget Sound DFSP and AFPET. Since two goals of this research were to conduct an analysis similar to the 2007 Charleston Jet A study and simultaneously examine West Coast pricing mechanisms, McChord AFB and the surrounding military installations proved to be the optimal setting for this study. AFPET recommended working through the Puget Sound DFSP to develop a list of acceptable military facilities. Furthermore, the military installation's contract prices had to be heavily influenced by U.S. West Coast jet fuel prices. After selection, these locations were then approved as acceptable by the research sponsor at AFPET due to their JP-8 usage levels and West Coast influenced contract pricing. The initial facilities included, McChord AFB, Fairchild AFB, Mt. Home AFB, Kingsley Field ANG Base, Whidbey Island NAS, Fort Lewis, Yakima Firing Range, and Port Angeles Coast Guard Station (CGS). After initial evaluation, Mt. Home AFB and Port Angeles CGS were removed from this list due to discrepancies that placed them outside the scope of this research. Criteria necessary to meet the stipulations of this study included the sole influence of West Coast pricing mechanisms and receipt of JP-8 between October 2006 and September 2007. Mt. Home AFB was dropped from the study because its JP-8 prices were influenced by West Coast, Rocky Mountain, and U.S. Gulf Coast pricing criteria (DESC Market Research, 2007). Furthermore, Port Angeles CGS was also removed from the study because they failed to receive JP-8 shipments during the time period under assessment (AFPET Plans and Programs, 2007).

Required Software

Following the establishment of the military facilities of interest, a capable and commonly available data analysis tool was selected. Electronic spreadsheets were chosen as the medium for the technical feasibility and cost differential analysis. The utility of this research depends on calculations performed with software that is widely utilized for military and private sector applications. In order to easily replicate this and other comparisons throughout various jet fuel markets, a standard analysis template is constructed and utilized in order to ensure standardization throughout all future comparisons. Therefore, electronic spreadsheets provide a combination of portability and replicability that may otherwise be diminished through the use of specialized software.

Phase II: Supply Chain Mapping

Contract Solicitations

In order to determine the jet fuel delivery supply chain, two primary sources of information were required: contract solicitations and section B14.04 of finalized JP-8 contracts. Contract solicitations are documents presented to various vendors as required by DESC Bulk Fuels Contracting and contain information on grades of fuel required, installations requiring fuel, gallons up for contract, and if additives and transportation are necessary. These documents are readily available for military and commercial vendor procurement through the DESC website. Solicitation number SP0600-06-R-0161 specifically pertains to all contracts solicited in the Rocky Mountain/West Coast areas (DESC, 2008). A summary of the data that pertains to the six military installations of interest can be found in Appendix C. According to the website, required delivery methods from the refinery are listed in Table 2. As listed in the acronyms section, the abbreviation TT indicates a tank truck, TK represents an ocean tanker, BG represents a barge, and PL represents a pipeline.

Table 2. Contract Solicitation Delivery Methods

Contract Solicitations	
Installation	*Mode*
Fairchild AFB	PL
Whidbey Island NAS	BG
Kingsley Field	TT
McChord AFB	PL/TT
Ft. Lewis	TT
Yakima Firing Range	TT

Section B14.04 for Finalized JP-8 Contracts

To validate supply chain distribution data, it is important to compare the delivery methods required in the solicitations with the final delivery methods listed in the finalized contracting documents. In order to determine the specific contracts that correspond with the installations of interest, two additional pieces of data are required: JP-8 contract numbers for each installation and contract sections B14.04 from the finalized contracts. AFPET analysts provided the researcher with the specific contract numbers and DESC Market Research provided sections B14.04 for each contract. If data sponsorship from these specific organizations is not available, requests should be forwarded to the DESC Bulk Fuels Contracting Office at least one month in advance of the required data delivery date. All documentation pertaining to specific contract numbers is summarized in Table 3. This table shows that contract number SP0600-06-D-0517 supported McChord AFB, Ft. Lewis, and Yakima Firing Range from October 2006 through September 2007. Alternately, contract number SP0600-06-D-0502 supports Fairchild ANG Unit/AFB, Whidbey Island NAS, and Kingsley Field ANG Unit.

Table 3. Base Specific Contract Numbers

Contract Numbers				
Location	*DODACC*	*1 Oct 05-30 Sep 06*	*1 Oct 06-30 Sep 07*	*1 Oct 07-30 Sep 08*
McChord AFB, WA	FP4479	SP0600-05-D-0517	SP0600-06-D-0517	SP0600-07-D-0502
Fort Lewis, WA	UY7014	SP0600-05-D-0517	SP0600-06-D-0517	SP0600-07-D-0502
Yakima Firing Range, WA	W908C0	SP0600-05-D-0517	SP0600-06-D-0517	SP0600-07-D-0502
Fairchild ANG & AFB, WA	FP4620	SP0600-05-D-0521	SP0600-06-D-0502	SP0600-07-D-0499
Whidbey Island NAS, WA	N00620	SP0600-05-D-0521	SP0600-06-D-0502	SP0600-07-D-0499
Kingsley Field ANG, OR	FP6372	SP0600-05-D-0521	SP0600-06-D-0502	SP0600-07-D-0499

Using this information, the researcher procured sections B14.04, from October 2006 through September 2007, for these specific contracts. Section B14.04 for the final awarded contract establishes the transportation modes that were actually awarded in the final contract (DESC Market Research, 2007(1)). All documentation pertaining to contract sections B14.04 are found in Appendix B. In addition to transportation modes, section B14.04 contains information pertaining to product line item number, quantity awarded, base unit and market price of the product, and the cost per gallon for additives and transportation if they are included in the award price. In order to establish the JP-8 supply chain for investigative question one, the mode of transportation is taken from this document and summarized in Table 4.

Table 4. Final Contract Delivery Methods

Final Contracts	
Installation	*Mode*
Fairchild AFB	TK
Whidbey Island NAS	TK
Kingsley Field	TK
McChord AFB	PL
Ft. Lewis	TT
Yakima Firing Range	TT

Information contained in table 4 is somewhat different than the transportation modes required in the contract solicitations summarized in Table 2. In order to explain this discrepancy, the researcher utilizes the supply chain summary provided by AFPET Plans and Programs analysts. This information is summarized in Table 5.

Table 5. JP-8 Supply Chain Summary

AFPET Data	
Installation	*Mode*
Fairchild AFB	TK to DFSP Vancouver/BG to DFSP Pasco/PL to Fairchild
Whidbey Island NAS	TK to DFSP Puget Sound/BG to Whidbey Island
Kingsley Field	TK to DFSP Vancouver/TT to Kingsley Field
McChord AFB	PL to McChord
Ft. Lewis	TT to Ft. Lewis
Yakima Firing Range	TT to Yakima Firing Range

By assessing contract solicitations, section B14.04 of the contracts, and AFPET's overall breakdown, it is found that section B14.04 for each contract lists the first required mode of transportation. Alternately, the contract solicitations list the last mode of required transportation in the distribution supply chain. The information in Table 5 is then used to fill in the intermediate transportation modes that are not found in the contract solicitations or section B14.04. For example, table 5 information for Fairchild AFB shows that JP-8 must first move via ocean tanker from the refinery to DFSP Vancouver, then by barge from DFSP Vancouver to DFSP Pasco, and finally from DFSP Pasco via pipeline to Fairchild AFB. This example is the most extensive transportation network faced throughout the course of this research. For the purposes of this study, it is extremely important to cross reference all data received from the various data sources. Since the supplied data did not flow directly from DESC Bulk Fuels Contracting, this is the only way to ensure data validity. The results of this supply chain data gathering satisfy the requirements of investigative question one. Furthermore, the identified modes of transportation, listed in Appendix E, are utilized for an overall supply chain cost avoidance evaluation for investigative question two. The overall findings are presented in the analysis section of this study.

Phase III: Technical Feasibility Analysis

Technical considerations are assessed though investigative questions three and four to determine if specific aircraft or equipment limitations could hamper a complete conversion from JP-8 to Jet A. As mentioned in the literature review, aircraft and equipment have three fuel categories, primary, alternate, or emergency. The only acceptable options for this research include aircraft that can use Jet A as a primary or alternate fuel since emergency fuel options may lead to engine damage (TO42B-1-14, 2006:1). For the aircraft and equipment encountered in this research, TO 42B1-1-14 and the 2007 Charleston AFB Jet A Study are used as reference documents in order to determine if Jet A can be used in lieu of JP-8.

FAMS Data Analysis

To analyze JP-8 specific data from the most recent fiscal year, Fuels Automated Management System (FAMS) files were extracted by AFPET for October 2006 through September 2007. Due to the level of data collected in FAMS, determination of the type of equipment refueled, grade of fuel used, and the number of gallons received is easily established. The full list of FAMS summaries for the six military facilities under analysis is available for reference in Appendix A. The “BUYER” column is the organization that purchased the fuel, “TYPE VEHICLE” is the airframe or equipment piece that was refueled, and "QUANTITY" is the column that expresses the number of gallons of JP-8 that were received. As seen in table 6, by sorting the data by vehicle type, several different nomenclatures for essentially identical vehicle types of are identified. The input of this data is user specific and personally determined by the individual technicians entering the vehicle type. For example, an F-16 Falcon has three separate entries listed in table 6: F016, F016C, and F016D. The C and D suffixes on this particular airframe delineate between the various models of F-16s that were produced. Due to the personal preferences of the individual technicians, other entries such as F-16 and F16 were also encountered throughout the data. Assuming that all F-16 variants utilize the same primary and alternate fuels, a standardized simplification technique is used to combine all models of F-16 fighters and other airframes with multiple models (AFPET, 2008). For the purposes of this research, all F-16 Falcon variants are pooled in to a category labeled "F016."

Table 6. Raw FAMS JP-8 Usage Data from Fairchild AFB

BUYER	TYPE VEHICLE	QUANTITY
GENERAL SERVICES ADMIN		112825
GENERAL SERVICES ADMIN	***	0
DOT FAA ACCT DIV ACC 21A	C20	1970
NASA DRYDEN FLIGHT RESEARCH CNTR CA	B001B	2866
NASA DRYDEN FLIGHT RESEARCH CNTR CA	F015B	5254
HILL AFB (UT)	F016	746
HILL AFB (UT)	F016C	158780
HILL AFB (UT)	F016D	6673
TINKER AFB (OK)	E003B	1216209
TINKER AFB (OK)	E003C	10297
WRIGHT-PATTERSON AFB (OH)	EC130H	2985
FP2403 FF PMO LIMESTONE AVPOL	***	19834
FP2403 FF PMO LIMESTONE AVPOL	EQIP	1820

The "Type Model Series (TMS) Code" column in table 7 is indicative of how this same technique is applied to all aircraft and equipment types encountered throughout this research. Additionally, data for the "Jet A Compatibility Info" column is determined using TO 42B1-1-14 or the 2007 Charleston Jet A Study. The data is then sorted by gallons issued and placed in decreasing order. For example, C-17 Globemasters receive the majority of JP-8 issues at McChord AFB.

Table 7. Standardized and Sorted JP-8 Issues for MChord AFB

McChord AFB JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
C017	Jet A w/FSII approved for use	38,154,027	83.23%
C130	Jet A w/FSII approved for use	799,659	1.74%
C005	Jet A w/FSII approved for use	483,264	1.05%
E003	Jet A listed as approved alt fuel	462,944	1.01%
MD011	Comm A/C commonly using Jet A	346,795	0.76%
B757	Comm A/C commonly using Jet A	202,449	0.44%

Table 8 expresses four types of FAMS data that is encountered throughout the course of this research. The first subtotal in line five includes helicopters, ground equipment, and aircraft in which Jet A is approved as a primary or alternate fuel. Helicopters and ground equipment are included in this subtotal since freeze point is not an issue for ground usage or aircraft flown at low altitudes.

All aircraft included in the subtotal numbers on line nine are for aerial refueling requirements. Jet A compatibility for the in-flight receivers could not be determined under the scope of this research. However, the same issue is addressed in the 2007 Charleston Jet A Study. For the Charleston research it was decided that, "the aerial refueling airframes were at these locations to support base assigned aircraft, or to perhaps serve as static displays at an air show." (C4E, 2007:30). Therefore, it is acceptable to assume that additized Jet A usage is acceptable for all in-flight receivers in this research, but should be analyzed further in future studies.

The subtotal in line fourteen of table 8 is one in which no vehicle type was entered or technical aircraft manuals were either classified or unavailable. Therefore, the total in line ten of table 8 shows that more than 95% of the aircraft refueled at McChord AFB, from October 2006 to September 2007, could use Jet A as a primary or alternate fuel. Once this total is summed with line fourteen, a "Grand Total" of all JP-8 fuel issues at McChord AFB is listed in line fifteen. An identical computation is conducted for all six installations of interest and the results are presented in the analysis section of this study.

Table 8. Summation of Approved/Unapproved Jet A Usage

F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	1,355	0.00%
C002	Navy Cargo A/C/Jet A is approved alt	1,347	0.00%
T006	Jet A w/FSII approved for use	394	0.00%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	355,932	0.78%
Subtotal	**Jet A is an approved primary or alt fuel**	**41,988,478**	**91.60%**
KC130	Jet A w/additives approved for use	131,514	0.29%
KC135	Jet A w/FSII is approved alt fuel	1,436,501	3.13%
KC010	Jet A w/FSII is approved primary fuel	127,443	0.28%
Subtotal	**Jet A w/additives may not be approved for all receiver A/C**	**1,695,458**	**3.70%**
TOTAL	**Jet A approved for above A/C**	**43,683,936**	**95.29%**
	Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code	2,157,140	4.71%
Subtotal	**Data not available to determine authorized Jet A usage**	**2,157,140**	**4.71%**
Grand Total	**All JP-8 issues at McChord AFB**	**45,841,076**	**100.00%**

Phase IV: Price Analysis Methodology

Investigative question five deals with the cost analysis of a complete conversion from JP-8 to Jet A at the six Pacific Northwest military facilities of interest. As mentioned in the introduction, the goal of the price analysis is to compare monthly prices that DESC pays for JP-8 in West Coast areas against equivalent prices that DESC would pay for Jet A if approved for use. To analyze comparable prices between Jet A and JP-8, several factors are first considered in order to develop an "apples to apples" comparison. Much like the methodology used in the mapping of the JP-8 supply chain, a combination of contract solicitation data and information from section B14.04 of the final contract award documents is utilized for the price analysis. In addition to this information, Platts pricing data must be used to establish West Coast specific pricing mechanisms for the determination of monthly prices that DESC pays for JP-8 and Jet A.

Contract Solicitations

Contract solicitations are documents presented to various vendors, as required by DESC Bulk Fuels Contracting, and contain information on grades of fuel required, installations requiring fuel, gallons up for contract, and if additives and transportation are necessary. A synopsis of all solicitation information utilized for this research may be referenced in Appendix C. Figure 3 is a solicitation example specific to Fort Lewis and is contained in solicitation number SP0600-06-R-0161 for the Rocky Mountain/West Coast areas. Line item 0156 is specific only to the requirements for Fort Lewis. The pertinent information contained in figure 3 is the quantity of JP-8 up for contract, mode of transportation required, and instructions noting if additives are necessary.

```
0156            FORT LEWIS            TACOMA                WA

                UY7014               846177250      UY7014
        QUANTITY 2,000,000 8A QUANTITY 0 SA QUANTITY 1,800,000

  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP PUGET SOUND
        MODE    RECEIPT%  FSII      SDA       CI
        TRUCK             REQUIRED  REQUIRED  REQUIRED
```

Figure 3. Contract Solicitation Excerpt for Ft. Lewis
(DESC Vendor Resources, 2006)

Section B14.04 from Finalized JP-8 Contracts

The data contained in a contract solicitation is then compared to the terms that are agreed upon in section B14.04 of the final contract. Through the use of this data and information provided through the DESC Bulk Fuels Contracting Office, specific line item information is determined for each base. In order to highlight the pertinent contract information for Ft. Lewis, the researcher must first establish what line item and schedule notes apply. Figure 4 is section B14.04 for contract SP0600-06-D-0517 and contains JP-8 contract information for multiple bases from October 2006 to September 2007.

The line items noted in figure 4 can apply to various bases. Therefore, the award quantities may pertain to a single or several different military installations (DESC Bulk Fuels Contracting, 2007). In order to determine the specific line item that applies to Ft. Lewis, information from the contract solicitation in figure 3 must be utilized. Since the fuel quantity required for Ft. Lewis ranged between 2M and 1.8M gallons, line item 0101 is the only line item for contract SP0600-06-D-0517 that applies to bases other than

McChord AFB. Line item 0101 calls for an overall total of 3.4M gallons of JP-8 and easily satisfies Ft. Lewis' minimum contract solicitation requirement of 1.8M gallons.

Mode of delivery is also denoted in figure 4's line item 0101 by the abbreviation "TT" for tank truck. This mode of delivery matches up with the mode of delivery required in Ft. Lewis' contract solicitation, but this is just a mere coincidence. Since this line item was awarded with the stipulation "Free On Board (FOB) Origin," the cost of transportation is not included in the contract award price and is the responsibility of the DoD. If the cost of transportation is included in the award price, the line item will hold the designation of FOB Destination. If JP-8 is awarded as FOB Destination, the mode of transportation should match the required mode in the contract solicitation. If not, amendments to the awarded contract should contain the changes and can also be found on the DESC website.

The cost per gallon for transportation will be denoted in the schedule notes of contract section B14.04 and identify the specific line items for which they apply. The only transportation costs identified in figure 4 pertain to line item 0201 only and are not applicable for Ft. Lewis.

The last item of interest in line item 0101 denotes the final Base Unit Price (BUP) and information specifying if additive costs are included or not. According to the DESC Bulk Fuel Contracting Office, the inclusion and pricing of SDA and FSII are normally the only additives that are noted within a bulk fuel contracting document. Although the additive CI/LI is a requirement for Ft. Lewis, its cost per gallon is so miniscule that it is absorbed but rarely noted in the BUP (DESC Bulk Fuels Contracting, 2008). Therefore, figure 4 shows that JP-8 for Ft. Lewis was awarded with the cost of all additives included in the final BUP. Accordingly, the price per gallon of each respective additive is listed in schedule note 3 of figure 4. For example, the price for FSII and SDA in the schedule notes are calculated as follows:

FSII = Cost for FSII + Cost for CI/LI

SDA = Cost for SDA only

Schedule note 2 is also circled in figure 4. This schedule note determines the Base Market Price (BMP) for JP-8 in the west coast areas under this contract. The BMP is the starting price for all JP-8 bids under this contract and can actually be more or less than the BUP at the culmination of the award process. Although these prices are noted as effective on 14 February 2006, they merely establish a baseline to use against monthly prices as they increase or decrease throughout the coming fiscal year. The prices that DESC pays under this contract were not exercised until 1 October 2006.

In summary, by referencing installation specific contract solicitations and cross referencing with contract specific B14.04 sections, line items that pertain to specific installations were identified. Therefore, base specific costs for additives and transportation were identified through B14.04 line items and quantified in the schedule notes. In section B14.04, the military installations of interest will correspond to specific line item BUPs, but the overall BMP applies to all bases serviced under that specific contract. Therefore, the overall BUP is $1.857217 and the specific BMP for Ft. Lewis is $1.847317. The next step is establishment of a base/line item specific differential between the BUP and BMP in order to account for any applicable additive and transportation costs.

U. S. Oil and Refining Company
SP0600-06-D-0517
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B14.04 ESTIMATED SUPPLIES TO BE FURNISHED (DOMESTIC BULK) (DESC JUN 1992)

(a) Prices indicated hereunder are subject to adjustment pursuant to the terms of this contract.

(b) The maximum and minimum quantities are defined in the DELIVERY-ORDER LIMITATIONS – SCOPE OF CONTRACT clause.

(c) The refined product to be furnished hereunder, f.o.b. point, method of delivery, and estimated quantity are as follows:

(DESC 52.207-9F20)

ITEM DESC	**EST. QTY/USG JP8**	**MODE**	**(FEBRUARY 14, 2006) BASE UNIT PRICE NSN: 9130-01-031-5816**
0101	3,400,000	TT	$1.857217 w/ FSII and SDA
FOB ORIGIN DELIVERY AT TACOMA, WA			
0201	50,000,000	PL	$1.870917 w/ FSII and SDA
FOB DESTINATION DELIVERY MCCHORD AFB, WA (RFP LINE ITEM 0157)			

SCHEDULE NOTES:

1. U. S. Oil & Refining's offer under solicitation SP0600-06-R-0161, dated May 11, 2006, and correspondence dated June 15, 2006; June 29, 2006; June 30, 2006; July 18, 2006; July 20, 2006 and August 23, 2006 are hereby incorporated in this contract by reference.

2. Prices shall be adjusted in accordance with Clause B19.33 ECONOMIC PRICE ADJUSTMENT-PUBLISHED MARKET PRICE (DOMESTIC BULK) (DESC MAR 2003). The Base Market Price for JP8 is $1.847317, effective February 14, 2006, for theWest Coast/Offshore EPA area. Unit prices on all invoices will be rounded to four decimal places (i.e. $.XXXX).

3. For both line items, the amount included in the price per gallon for delivery with Fuel System Icing Inhibitor (FSII) is $0.008500, and for Static Dissipator Additive (SDA) is $0.000100.

4. For line item 0201, the amount included in the price per gallon for transportation is $0.025000. This cost shall remain firm and fixed for the life of the contract.

Figure 4. Section B14.04 from Contract SP0600-06-D-0517
(DESC Market Research, 2007)

DESC Monthly JP-8 Price Establishment

When the BUP is subtracted from the BMP, an initial differential is derived that accounts for additives, transportation, and other costs that may be included within this contract. In order to arrive at a final differential, applicable additive and transportation costs must first be removed from this figure. Table 9 is an excerpt of the September 2007 data from the price comparison spreadsheet for contract number SP0600-06-D-0517. The full version of this workbook is found in Appendix D. As seen in this figure, the final differential for Ft. Lewis is the difference between BUP and BMP void of all applicable additive and transportation costs noted in contract section B14.04 for contract SP0600-06-D-0517. This step is extremely important since the comparison price for Jet A will be void of all transportation and additive costs also. Therefore, the differential calculations are derived by:

Initial Differential = BUP - BMP

Final Differential = Initial Differential – Additive Costs – Transportation Costs

Table 9. Differential thru Sep 07

Item/Mode	BUP	BMP	Initial Differential
0101/TT (Ft Lewis & Yakima)	1.857217	1.847317	0.009900
0201/PL (McChord)	1.870917	1.847317	0.023600

FSII/CI/LI	SDA	Trans	Final Differential
0.008500	0.000100	0.000000	**0.001300**
0.008500	0.000100	0.025000	**-0.010000**

Following the establishment of a final pricing differential between the BMP and BUP, DESC's monthly JP-8 prices are determined through the use of Platts pricing data for the Los Angeles pipeline (LA Pipe), San Francisco pipeline (SF Pipe), and Seattle barges (DESC Market Research, 2007(2)).

> "Platts, a division of The McGraw-Hill Companies, is a leading global provider of energy and metals information. With nearly a century of business experience, Platts serves customers across more than 150 countries. From 14 offices worldwide, Platts serves the oil, natural gas, electricity, nuclear power, coal, petrochemical, and metals markets. Platts' real time news, pricing, analytical services, and conferences help markets operate with transparency and efficiency. Traders, risk managers, analysts, and industry leaders depend upon Platts to help them make better trading and investment decisions." (Platts, 2008).

As a result of their vast databases, DESC relies on Platts extensively in order to develop pricing baselines for DoD energy requirements (DESC Market Research, 2007).

Since the prices DESC pays for JP-8 are set every Tuesday morning, a monthly specific BMP equivalent is derived by taking the previous five business day's midpoint average for SF Pipe, LA Pipe, and Seattle barge (DESC Market Research, 2007). In order to remain consistent with the 2007 Charleston Jet A study, the final Tuesday of each month is chosen as the sampling point. For example, the BMP established in figure 4 is $1.847317 per gallon of JP-8 and is effective as of 14 February 2006. It is important to note that 14 February 2006 is not the date that DESC exercises this pricing, it is only the date that the pricing baseline is established. Prices under this baseline will not be exercised until 1 October 2006 (DESC Market Research, 2007). Table 10 is an excerpt of Platts data provided by DESC Market Research and highlights how the BMP listed in figure 4 can be derived using this formulation. By averaging the midpoint prices for LA

Pipe, SF Pipe, and Seattle Barge from 6 February to 10 February 2006, the BMP for the following Tuesday, 14 February 2006, is computed.

Platts 5-Day Monthly Midpoint Price Avg = (SF Pipe + LA Pipe + Seattle Barge) ÷ 3

Table 10. Platts 5-Day Midpoint Pricing Average

	JetKero Los Angeles Pipe (USC)	JetKero San Francisco Pipe (USC)	JetKero Seattle Barge (USC)
Date	Midpoint	Midpoint	Midpoint
02/06/2006	192.3750	192.3750	192.3750
02/07/2006	186.9500	186.4500	186.9500
02/08/2006	183.0500	182.5500	183.0500
02/09/2006	182.4500	181.9500	182.4500
02/10/2006	179.5000	179.0000	179.5000
Average($/gal)			1.847317

It is important to note that this price is in agreement with the BMP listed in schedule note two of figure 4. This process is applied throughout the research to derive the Platts 5-day price averages for the last Tuesday of each month. The genesis for this calculation is founded on previous equations developed for the 2007 Charleston Jet A study. However, modifications and updates for this specific price analysis were approved by DESC Market Research and implemented in this study . Once the final pricing differential is applied to each month’s 5-day pricing avearge, a monthly price that DESC pays for JP-8 is determined with the following equation:

DESC JP-8 Price = Platts 5-Day Monthly Midpoint Average + Final Differential

DESC Equivalent Jet A Price Establishment

The second portion of the price analysis pertains to the calculation of an equivalent price DESC would pay for Jet A if it were ever approved for routine usage. Three overall factors are considered in order to generate a monthly Jet A price: Platts Low Five-Day Price Average, 30-day payment term surcharges, and an Airline Pricing Factor (APF) (C4E, 2007:19). In order to arrive at a monthly price that airlines routinely pay for Jet A, a calculation similar to the five-day midpoint average is used. Table 11 is a spreadsheet excerpt showing Platts 5-Day Low Price Average.

Platts 5-Day Lowpoint Average = (SF Pipe + LA Pipe + Seattle Barge) ÷ 3

Table 11. Platts 5-Day Low Pricing Average

	JetKero Los Angeles Pipe (USC)	JetKero San Francisco Pipe (USC)	JetKero Seattle Barge (USC)
Date	**Low**	**Low**	**Low**
02/06/2006	192.0000	192.0000	192.0000
02/07/2006	186.7000	186.2000	186.7000
02/08/2006	182.8000	182.3000	182.8000
02/09/2006	182.2000	181.7000	182.2000
02/10/2006	179.2500	178.7500	179.2500
Average ($/gal)			**1.844567**

Airline Pricing Factor

"Commercial airlines have reported to DESC representatives that they are able to procure commercial Jet A at the Platts jet low price plus $.002 to $.0025." (C4E, 2007:19). C4E applied a $.00225 average APF to the Platts low prices in the Charleston Jet A Study and the same figure is applied to the pricing data for this research. The APF remains constant for all pricing calculations in this study and is circled for reference in figure 5.

Cost of Money

The last factor to consider is a surcharge that accounts for the 30-day pricing terms of the DoD as opposed to immediate payment terms generally implemented by commercial airlines. This figure labeled "Cost of Money" is circled for reference in figure 5. Cost of Money is calculated by multiplying the, "annualized cost of capital to refiners, at the prime lending rate, by the fraction of a year between delivery and payment; 30/365 or .082192." (C4E, 2007:19). Since this research timeframe is synonymous with the 2007 Charleston Jet A Study, the same prime lending rate of .0825 is used. The resultant term is then multiplied by Platts 5-Day Low Pricing average to arrive at a 30 day payment term surcharge DESC would pay for Jet A. For example:

Cost of Money = Platts 5-Day Lowpoint Average × Prime Lending Rate × (Payment Term ÷ Days in the Year)

Figure 5 is data from October 2006 from the price analysis spreadsheet of contract number SP0600-06-D-0517. The full version of this workbook can be referenced in Appendix D. As seen below, when APF and Cost of Money are added to Platts 5-Day Low Price Average, an equivalent price DESC would pay for Jet A is computed. This process is repeated on a monthly basis, from October 2006 thru September 2007, for the six study bases covered by contract numbers SP0600-06-D-0517 and SP0600-06-D-0502.

DESC Jet A Price = Platts 5-Day Lowpoint Average + APF + Cost of Money

		LA Pipe Low	SF Pipe Low	Seattle Barge Low
DESC Jet A Equivalent	10/23/2006	176.1500	176.1500	176.1500
Platts Low + APF + Cost of Money	10/24/2006	181.3500	181.3500	181.3500
	10/25/2006	187.7500	187.7500	187.7500
	10/26/2006	184.0000	184.0000	184.0000
	10/27/2006	184.8500	184.8500	184.8500
		Average		**1.828200**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012397**
		Price		**1.842847**

Figure 5. DESC Jet A Equivalent Price Calculation

DESC JP-8 and Jet A Price Comparisons

Rather than conducting a day by day comparison of DESC Jet A and JP-8 prices, the price of each fuel is calculated for the last Tuesday of every month. Since the weekly price of JP-8 is set every Tuesday morning by DESC, this pricing timeframe allows for a standard monthly analysis and is likewise utilized in the 2007 Charleston Jet A Study (C4E, 2007:19).

Once the monthly calculation for each fuel is determined, the price that DESC would pay for Jet A is subtracted from the price they pay for JP-8. If the result is a negative number, the price of JP-8 is cheaper than Jet A. Adversely, if the result is positive, Jet A could be purchased cheaper than JP-8. As a reminder, the price for JP-8 is determined per contract line item. Therefore, fiscal year average JP-8 prices that apply to individual bases are compared to fiscal year averages for an overall DESC Jet A Price. As a result, the incursion or avoidance of costs are calculated as they pertain to each base rather than a weighted average per each contract. In summation of this process, figure 6 is the "Summary" tab from the workbook for contract number SP0600-06-D-0517. A full version of this workbook can be referenced in Appendix D. The circled cells respectively denote the average yearly JP-8 price per contract line item, the average yearly price DESC would pay for Jet A, and the differences between these prices. An overall average of these differences is calculated in the final column.

DESC Prices	**Oct-06**	**Nov-06**	**Dec-06**	**Jan-07**	**Feb-07**	**Mar-07**
0101/TT (Ft Lewis & Yakima) JP-8	1.831752	1.868202	1.945552	1.797802	1.844902	1.886852
0201/PL (McChord) JP-8	1.820452	1.856902	1.934252	1.786502	1.833602	1.875552
DESC Jet A Equivalent Price	1.842847	1.879796	1.957720	1.808918	1.856338	1.898320
Differences						
0101/TT (Ft Lewis & Yakima)	**-0.011095**	**-0.011594**	**-0.012168**	**-0.011116**	**-0.011436**	**-0.011468**
0201/PL (McChord)	**-0.022395**	**-0.022894**	**-0.023468**	**-0.022416**	**-0.022736**	**-0.022768**

DESC Prices	**Apr-07**	**May-07**	**Jun-07**	**Jul-07**	**Aug-07**	**Sep-07**	**Avg**
0101/TT (Ft Lewis & Yakima) JP-8	2.044002	2.123885	2.167035	2.185485	2.110835	2.284055	**2.007530**
0201/PL (McChord) JP-8	2.032702	2.112585	2.155735	2.174185	2.099535	2.272755	**1.996230**
DESC Jet A Equivalent Price	2.057090	2.135954	2.180152	2.198475	2.123571	2.297462	**2.019720**
Differences							
0101/TT (Ft Lewis & Yakima)	**-0.013088**	**-0.012069**	**-0.013117**	**-0.012990**	**-0.012735**	**-0.013407**	**-0.012190**
0201/PL (McChord)	**-0.024388**	**-0.023369**	**-0.024417**	**-0.024290**	**-0.024035**	**-0.024707**	**-0.023490**

Figure 6. Summary of Price Differences for Contract SP0600-06-D-0517

When assessing the technical feasibility of a JP-8 to Jet A conversion, JP-8 usage data was obtained for the six study bases from October 2006 through September 2007. The spreadsheet containing this data can be referenced in Appendix D. For example, figure 7 shows that McChord AFB issued 45,841,076 gallons of JP-8 from October 2006 through September 2007. When this total is multiplied by the base specific, yearly average price differential between Jet A and JP-8, a dollar figure is established that quantifies costs incurred or avoided through a complete fuel conversion. For example:

Base Specific Price Difference between Jet A/JP-8 =
Yearly Avg, Base Specific JP-8 Cost – DESC Jet A Equivalent Price

Costs Incurred/Avoided =
Gallons of JP-8 Issued per Base × Base Specific Price Difference between Jet A/JP-8

Figure 7 is FY07 fuel savings data from contract number SP0600-06-D-0517 and can be referenced in Appendix D. As expressed in figure 7, a JP-8 to Jet A conversion would incur a total of $1,106,221.68 of additional costs for McChord AFB, Ft. Lewis, and Yakima Firing Range. This same methodological process is then repeated in order to analyze the three remaining military installations of interest.

Base	Gallons Used	Line Item/Mode	Savings	Added Costs
McChord AFB	45,841,076.00	0201/PL		**$1,065,444.48**
Fort Lewis	2,758,722.00	0101/TT		**$32,945.03**
Yakima Firing Range	655,843.00	0101/TT		**$7,832.17**

Figure 7. FY07 Added Fuel Costs for Contract SP0600-06-D-0517

IV. Results and Analysis

Introduction

The in-depth analysis of data gathered from DESC, AFPET, and C4E is summarized in the following pages of this chapter. Qualitative information from the personal interviews, military installation specific data, and past research is utilized to address investigative questions one through four and quantitative data from pricing calculations is utilized to address investigative question five. In review, the investigative questions are as follows:

1. What is the jet fuel delivery supply chain from the refinery to the selected military installations?
2. Can any supply chain savings be recognized by switching from JP-8 to Jet A?
3. What types of aircraft and/or equipment are fueled by the military installations of interest?
4. Can the aircraft and/or equipment fueled by the military installations of interest use Jet A in lieu of JP-8?
5. Are there large enough price differentials in the purchase price of Jet A and JP-8 for the DoD to recognize significant cost avoidance?

Investigative Question #1: What is the jet fuel delivery supply chain from the refinery to the selected military installations?

JP-8 supply is generally contracted on a yearly basis, barring production stoppages and/or contract defaults, and the delivery methods employed in the supply chain may change from year to year (DESC Bulk Fuels Contracting, 2008). The following data is organized in descending order by the gallons of jet fuel issued at each military installation between October 2006 and September 2007. The overall three year contracting snapshot was provided directly from the AFPET Plans and Programs office and is cross referenced for validity with contract solicitations and section B14.04 for contracts SP0600-06-D-0517 and SP0600-06-D-0502. The importance of this three year snapshot is the establishment of the fluidity of available and employed transportation methods. Table 12 contains the name of the military installation under review, gallons issued by that installation, and a percentage of the overall total issued gallons the installation received. Furthermore, a breakdown of base specific usage is presented following table 12.

Table 12. Gallons of JP-8 Issued in FY07

Customer Base Name	Product	Quantity	Percent
Fairchild AFB/ANG Unit, WA	JP-8	45,862,382	35.1
McChord AFB, WA	JP-8	45,841,076	35.1
Widbey Island Naval Station, WA	JP-8	26,864,288	20.5
Kingsley Field ANG, OR	JP-8	8,773,864	6.7
Fort Lewis, WA	JP-8	2,758,722	2.1
Yakima Firing Range, WA	JP-8	655,843	0.5
		130,756,175	**100.0**

Fairchild AFB/ANG Unit

According to FAMS data, 45,862,382 gallons of JP-8 were issued from Fairchild AFB and the Fairchild ANG Unit. This total is slightly above the second largest JP-8 user, McChord AFB, by only 21,306 gallons. Although these two locations have different DoD Activity Address Codes (DODAAC), they share the same geographic location and receive fuel shipments jointly.

For all three contracting periods, these two locations received JP-8 via the same modes of transportation. JP-8 is first shipped via ocean tanker from the refinery to DFSP Vancouver. The fuel is then shipped to DFSP Pasco by barge before finally arriving at Fairchild AFB via pipeline.

McChord AFB

In FY07, 45,841,076 gallons of JP-8 were issued from McChord AFB. The transportation supply chain supporting this demand consisted of two different shipping arrangements between FY06 and FY08. In FY06, JP-8 was delivered first by barge from the refinery to DFSP Puget Sound. The fuel was then moved by tank truck on to McChord AFB. In order to exercise emergency delivery procedures, JP-8 was also delivered direct from the refinery to this installation by tank truck and pipeline during this period. Starting in FY07 through FY08, all of the JP-8 deliveries are made to McChord AFB via direct pipeline from the refinery.

Whidbey Island NAS

In FY07, 26,864,288 gallons of JP-8 were issued from Whidbey Island NAS. For FY06, JP-8 was delivered first via barge from the refinery to DFSP Puget Sound then onward again by barge to Whidbey Island NAS. Starting in FY07 through FY08, JP-8 is delivered via ocean tanker from the refinery to DFSP Puget Sound then onward to Whidbey Island NAS by barge.

Kingsley Field ANG Unit

In FY07, 8,773,864 gallons of JP-8 were issued from the Kingsley Field ANG Unit. In FY06, jet fuel was delivered directly to this installation from the refinery via ocean tanker. From the beginning of FY07 through FY08, JP-8 is shipped from the refinery to DFSP Vancouver via ocean tanker, and then transported by tank truck from DFSP Vancouver to the installation.

Ft. Lewis

In FY07, 2,758,722 gallons of JP-8 were issued from Ft. Lewis. Beginning in FY06 through FY08, all jet fuel deliveries were shipped directly via tank truck from the refinery to the installation.

Yakima Firing Range

In FY07, 655,843 gallons of JP-8 were issued from Yakima Firing Range. In FY06 jet fuel was first delivered by barge to DFSP Puget Sound, then via tank truck from DFSP Puget Sound to the installation. From FY07 through FY08, all JP-8 deliveries are transported directly from the refinery to the base via tank truck.

JP-8 Distribution Supply Chain Summary

The mode specific transportation information presented in this section allows for the assessment of supply chain efficiencies that may or may not be gained through a complete conversion from JP-8 to Jet A at the six identified military bases. Although no specific quantification can be produced from investigative question one, a map of the transportation supply chain is established from commercial vendor to the specific military bases. Using this transportation network, coupled with proposed efficiencies from the 2003 EFDSS and 2007 C4E Charleston Jet A Study, supply chain cost avoidance or incursion, related to a jet fuel conversion is addressed in investigative question two.

Investigative Question #2: Can any supply chain savings be recognized by switching from JP-8 to Jet A?

Upon completion of the transportation supply chain map in Appendix E, it is evident that the transportation modes employed are extremely variable due the nature of governmental contracts. Since JP-8 supply is generally contracted on a yearly basis, barring production stoppages or contract defaults, the delivery methods employed in the jet fuel supply chain routinely change from year to year (DESC Bulk Fuels Contracting, 2008). Therefore, any cost avoidance or incursion related to transportation mode will remain variable unless a long term mode of shipment is adopted and mandated when contracting for each military installation. However, previous research does offer some theoretical cost avoidance related to jet fuel shipments.

According to the EIA, more than 25 billion gallons of kerosene type jet fuel was produced for U.S. consumption in FY06 (EIA, 2008). Of that 25 billion gallons, the DoD JP-8 and JPTS requirements accounted for a total of only 3.4 billion gallons (DESC Fact Book, 2006:21). As a result, FY06 DoD jet fuel purchases accounted for only 13.6% of U.S. jet fuel consumption. Therefore, elimination of one relatively low volume product should produce pipeline related efficiencies along the supply chain (C4E, 2007:22). Unfortunately the only relevant information pertaining to quantification of these JP-8 related efficiencies stems from a single source in the 2002-03 EFDSS petroleum industry survey.

According to C4E, two large volume pipelines and one small volume pipeline indicated that turbine jet fuels constituted 12.5%, 23%, and 24% respectively of their total annual volume. The two large volume pipelines indicated that only 5% of their monthly volume averages were made up by JP-8 and the small volume pipeline failed to respond to this question. Furthermore, the two large volume lines indicated that efficiencies related to operations flexibility and Jet A shipping rates were achievable, but failed to produce a quantifiable measure to support this statement. Even though the small volume pipeline did not indicate the percentage of their total volume made up by JP-8, they did provide a cost savings estimate of .02 to .025 dollars per gallon for a full CONUS transition from JP-8 to commercial Jet A (C4E, 2007:22).

In theory, a reduction in the number of stored, transported, and refined products should produce cost avoidance through a DoD-wide conversion from JP-8 to Jet A, but quantifiable measures are lacking. Without an updated industry-wide survey specifically pertaining to this question coupled with extended future research, the answer to this question remains hypothetic versus proven.

Investigative Question #3: What types of aircraft and/or equipment are fueled by the military installations of interest?

AFPET Plans and Programs division analysts provided FAMS usage data for the six Pacific Northwest military installations of interest. As explained in the methodology, aircraft and equipment were separated and grouped by the TMS code column of the exported electronic spreadsheets. As a reminder, airframes that expressed various model designations were grouped under a single generic designator for each airframe. For example, all models of F-16 Falcons were combined in to the F016 category when applicable. However, if an unrecognizable TMS code is entered, or if personnel completely fail to enter a designation, the JP-8 recipient is unidentifiable. In the raw data, a blank cell or the designator "***" is indicative of this error. Table 13 is an example of the sorted and grouped data from Kingsley Field ANG Unit. However, the spreadsheets containing summarized data from all six installations can be found in Appendix A.

Table 13. Kingsley Field ANG Unit FY07 JP-8 Customers

	Kingsley Field JP-8 Issue Summaries
TMS Code	**Jet A Compatibility Info**
F015	Jet A is an approved alt fuel
F016	Jet A is an approved fuel
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)
C130	Jet A w/FSII approved for use
C021	Jet A is an approved fuel
Helicopters	Freeze point not a problem/Jet A approved in all
FALCON	Commercial plane used by Kalitta Charters/Jet A approved
T038	Jet A w/FSII is an approved primary fuel
C023	Sherpa Turbo Prop/Jet A approved
T001	Jet A w/FSII approved for use
Non-Fly	Freeze point not a problem (ground equip, generators, etc)
KC135	Jet A w/FSII is approved alt fuel

Investigative Question #4: Can the aircraft or equipment fueled by the military installations of interest use Jet A in lieu of JP-8?

Technical considerations are assessed though investigative question four to determine if specific aircraft or equipment limitations could hamper a complete conversion from JP-8 to Jet A. As mentioned in the literature review, aircraft and equipment have three fuel categories, primary, alternate, or emergency. The only acceptable options for this research include aircraft that can use Jet A as a primary or alternate fuel since emergency fuel options may lead to engine damage (TO42B-1-14, 2006:1). For the aircraft and equipment encountered in this research, TO42B1-1-14 and the 2007 Charleston AFB Jet A Study are used as reference documents in order to determine if Jet A can be used in lieu of JP-8.

Although TO42B1-1-14 is primarily designed as a reference document for USAF aircraft, chapter two addresses Army aircraft and chapter three addresses Naval and Marine airframes. Chapter two of this TO specifically states, "In order of decreasing precedence, fuel for Army aviation applications is as follows: 1) JP-8/JP-5 & 2) Jet A/Jet A-1 with SDA, FSII, and CI (TO42B1-1-14, 2006:8). Therefore, unless specifically stated in table 2-1 of the TO, it is assumed that all Army aviation applications can utilize Jet A as a primary or alternate fuel. Chapter three of this TO also states, "a) Authorized primary fuels for all Navy and Marine Corps aircraft: JP-5, JP-8 & b) Authorized alternate fuels for all Navy and Marine Corps aircraft: Jet A, Jet A-1, and TS-1." (TO42B1-1-14, 2006:10). Accordingly, this research relies on the assumption that all Naval and Marine airframes can utilize Jet A as an alternate fuel.

As mentioned in the methodology, the gallons received and issued out by aerial refueling aircraft are included in the totals for airframes that could use Jet A as a primary or alternate fuel. This rationale is founded on prior results from the 2007 Charleston Jet A Study and is based on the theory that the tanker missions are involved strictly in the support of primary aircraft operating out of the military installations of interest (C4E, 2007:24). However, two airframes of interest are specifically addressed in this study; the F-22A Raptor and B-1B Lancer.

C4E states that Jet A-1 is approved as an alternate fuel for the F-22A, but Jet A is not; according to TO 1F-22A(EMDAV)-1. The seven degree centigrade freeze point differential between the two fuels could be the rationale behind this specification or perhaps Jet A usage approval was an oversight in the testing procedures. Either way, test models of the F-22A had a requirement for JP-8 to be refrigerated prior to take-off due to the unique heat sink requirements of the fuel system. Since pre and post take-off overheating of key components proved problematic without refrigeration, jet fuel freezing was found highly unlikely in CONUS missions (C4E, 2007:25). Likewise, Jet A-1, not Jet A, is approved as an alternate fuel in the B-1B Lancer according to TO 1B-1B-1. Although the fuel system is not used as an extensive heat sink, erroneous assumptions related to jet fuel usage, fuel additives, and freeze point are found multiple times in the B-1B technical manual. Therefore, the absence of Jet A usage approval in the technical manuals for these two airframes appear to be oversights rather than founded on test results that prove otherwise. Revision of the F-22A and B-1B technical manuals to include Jet A usage is recommended in the conclusions of this study.

According to a test of 1,597 JP-8 samples by DESC in 2006, only eight exhibited the minimum freeze point of -40ºC and 1,007 met or exceeded the -47ºC requirement for Jet A-1 (C4E, 2007:26). Additionally TO42B1-1-14 specifically states that Jet A or Jet A-1, with additives, are the secondary jet fuels of choice for all USAF applications. However, this document defaults the final discretion for primary or alternate fuel selection to the aircraft specific technical manual (TO42B1-1-14, 2006:2). With regards to previous research findings and results of DESC fuel testing, it is established that Jet A is an acceptable alternative fuel for all USAF aircraft operating out of the six military installations of interest.

Fairchild AFB/ANG Unit

The combined JP-8 issue totals for Fairchild AFB and Fairchild ANG Unit were the largest amounts encountered throughout this research. The 45,862,382 gallons issued made up more than 35% of the grand total for all military facilities of interest. Due to the operational requirements of Fairchild AFB, the bulk of their refueling requirements consisted of KC-135 missions along with F-15, F-18, and F-16 fighters. As a result of the supportive role of the KC-135, it is assumed that the vast majority of their in-flight receivers consisted of the three afore mentioned fighters. Furthermore, approximately 84% of the installation’s JP-8 customers could utilize Jet A as a primary or alternate fuel. The remaining 16% of the JP-8 customers fell into a category whose technical manuals did not express guidelines for Jet A usage, were unavailable, or faulty TMS codes were entered.

Almost 80% of the 6.2 million gallons listed as unapproved for Jet A usage were comprised of fuel issues to the B-1B Lancer. Additionally, more than 780,000 gallons of JP-8 were issued to foreign M2000 Mirages and British Tornados. Unfortunately technical manuals for foreign airframes were unavailable under the scope of this research.

The Fairchild ANG Unit issued more than 6.9 million gallons of the combined total of 45,862,382 gallons for both installations. Approximately 98% of the fuel issued through the Fairchild ANG Unit went to receivers who were approved to utilize Jet A as a primary or alternate fuel. The small percentage of receivers who were not approved were once again comprised mainly of B-1B Lancers and foreign fighter aircraft. A summary of all JP-8 issues for Fairchild AFB and the Fairchild ANG Unit can be found in Appendix A.

McChord AFB

McChord AFB issued 45,841,076 gallons of JP-8 in FY07. This total is only 21,306 less than the total combined JP-8 issues for Fairchild AFB and the Fairchild ANG Unit. Due to the Air Mobility Command (AMC) driven requirements for the C-17 Globemaster, more than 83% of all refueling requirements went to this airframe. According to the 2007 Charleston Jet A Study, Jet A with the addition of FSII is approved for use as an alternate fuel for the C-17 (C4E, 2007:7). Furthermore, more than 95% of the refueling requirements were for aircraft that were already approved to utilize Jet A as a primary or alternate fuel. Of the 4.7% that were not, 99.8% of these were comprised of invalid TMS code entries.

Whidbey Island NAS

Whidbey Island NAS issued 26,864,288 gallons of JP-8 in FY07. This total comprises 20.5% of the total 130,756,175 research gallons issued from the six military installations of interest. Approximately 83% of the total gallons issued were consumed by EA-6/6B Prowlers and P-3 Orions who can use Jet A as a primary or alternate fuel. Jet A usage could not be determined for only 1.97% of the total gallons issued and were caused due to erroneous or non-entry of TMS codes.

Kingsley Field ANG Unit

Kingsley Field ANG Unit issued 8,773,864 gallons of JP-8 in FY07. This total makes up only 6.7% of the overall gallons issued and is 13.8% less than the next largest

JP-8 issuer; Whidbey Island NAS. More than 92% of Kingsely Field's issues were consumed by F-15 Eagle fighters and Jet A usage for only .86% of the JP-8 customers could not be determined due to erroneous TMS codes.

Ft. Lewis

The largest consumers of JP-8 at Ft. Lewis consisted of rotary wing airframes and C-17 Globemaster aircraft who consumed 27.3% and 14.5% of 2,758,722 gallons of JP-8 respectively. Interestingly, Jet A usage for more than half of the total fuel receivers could not be determined due to erroneous or non-entry of TMS codes. It is important to note that Ft. Lewis only comprised 2.1% of all of the fuel issues at the six military installations of interest.

Yakima Firing Range

The JP-8 issues at Yakima Firing Range comprised only .5% of the total 130,756,175 gallons under assessment. Rotary wing aircraft received 71,512 gallons of JP-8 and the other 584,331 gallons were issued to customers whose TMS codes were entered erroneously or bypassed. Jet A was approved as a primary or alternate fuel for all airframes that could be identified.

Investigative Question #5: Are there large enough price differentials in the purchase price of Jet A and JP-8 for the DoD to recognize significant cost avoidance?

The six military installations of interest were supplied by two separate contracts. Contract number SP0600-06-D-0502 supplied Fairchild AFB/ANG Unit, Whidbey Island

NAS, and Kingsley Field ANG Unit. The three remaining installations, McChord AFB, Ft. Lewis, and Yakima Firing Range, were all supplied by contract number SP0600-06-D-0517. A summary of the added costs associated with a complete conversion from JP-8 to Jet A is found in Table 14 and is followed by sections containing contract specific pricing information.

Table 14. Added Costs Associated with a Jet A Conversion

Base	Gallons Used	Contract	Line Item/Mode	Added Costs
McChord AFB	45,841,076.00	SP0600-06-D-0517	0201/PL	**$1,065,444.48**
Fort Lewis	2,758,722.00	SP0600-06-D-0517	0101/TT	**$32,945.03**
Yakima Firing Range	655,843.00	SP0600-06-D-0517	0101/TT	**$7,832.17**
Fairchild ANG & AFB	45,862,382.00	SP0600-06-D-0502	0101/TK	**$154,654.15**
Whidbey Island NAS	26,864,288.00	SP0600-06-D-0502	0101/TK	**$90,590.01**
Kingsley Field	8,773,864.00	SP0600-06-D-0502	0101/TK	**$29,586.66**
Total				**$1,381,052.50**

Contract number SP0600-06-D-0517

Contract number SP0600-06-D-0517 was awarded to U.S. Oil and Refining Company and supplied McChord AFB, Ft. Lewis, and Yakima Firing Range. Line item 0201 of the contract corresponds to McChord AFB and was awarded FOB Destination with all additives included. Therefore, the costs of transportation and additives had to be removed from the initial differential in order to properly compare the refinery prices for Jet A and JP-8. The final differential for McChord AFB was -.010000 dollars per gallon. Alternately, Ft. Lewis and Yakima Firing Range were awarded FOB Origin, but likewise had the charge for additives included in the BUP. The final differential for Ft. Lewis and Yakima Firing Range was .001300 dollars per gallon. From October 2006 through

September 2007, a complete conversion from JP-8 to Jet A would have imposed additional costs in the amount of $1,065,444.48 for McChord AFB, $32,945.03 for Ft. Lewis and $7,832.17 for Yakima Firing Range.

Contract Number SP0600-06-D-0502

None of the six Pacific Northwest military installations of interest exhibited cost avoidance through a complete conversion from JP-8 to Jet A. Contract number SP0600-06-D-0502 was awarded to BP West Coast Products LLC and supplied JP-8 to Fairchild AFB/ANG Unit, Whidbey Island NAS, and Kingsley Field ANG Unit. Since this contract was awarded FOB Origin and without additives, the DoD is responsible for providing transportation to the end user and injection of the needed additives. Therefore, the final differential between the BUP and the BMP is .009870 dollars per gallon. From October 2006 through September 2007, a complete conversion from JP-8 to Jet A would have imposed additional costs in the amount of $154,654.15 for Fairchild AFB/ANG Unit, $90,590.01 for Whidbey Island NAS, and $29,586.66 for Kingsley Field ANG Unit.

Summary

The investigative questions presented in this section assess the overall technical feasibility and opportunity for cost avoidance of a CONUS conversion from JP-8 to Jet A. The results of investigative question one provided a map of the fuel distribution framework supporting the six military installations of interest. Using this framework, investigative question two assessed transportation modes for cost avoidance if JP-8 were removed from the CONUS supply chain. Investigative questions three and four assess the technical feasibility of a JP-8 to Jet A conversion with the use of FY07 FAMS data, TO 42B1-1-14, and aircraft specific technical manuals. Lastly, investigative question five assessed the costs associated with a conversion from a military to commercial grade jet fuel for the DoD. Further discussion of the results of these investigative questions and recommendations for future research are found in the conclusion section of this study.

V. Conclusions

Introduction

The purpose of this research was to assess the technical feasibility and cost associated with a DoD conversion from JP-8 to Jet A. Working with recommendations from prior research and geographic bounds of the Pacific Northwest, an analysis of six military installations was conducted. In order to assess the technical feasibility, FAMS data was collected from the selected installations of interest for FY07. This data was used to determine the total gallons of jet fuel issued by each installation and the specific airframes or equipment that received JP-8. With the results of prior research and jet fuel TOs, a determination was made concerning the chemical likeness and aircraft usage feasibility between Jet A and JP-8. With respects to fiscal limitations, a cost comparison between the two jet fuels was also accomplished. A map of the specific distribution network between the refineries and installations of interest enabled the researcher to asses the logistics arena for possible cost avoidance. Furthermore, the manner in which prices of Jet A and JP-8 were compared was founded upon previous research, but revised in a manner to more accurately account for associated additive, transportation, and overall monthly refinery costs. Lastly, data analysis conclusions and recommendations for future research summarize the impacts of this research effort.

Chemical Comparison

When comparing JP-8 to Jet A, differences in specific gravity, density, and freeze point are the only chemical differences noted between the two fuels. However, JP-8's freeze point is the only property addressed in TO 42B1-1-14 that significantly differs from that of Jet A (Bartsch, 2006:93). Jet A has a higher freeze point of -40ºC and JP-8 has a more stringent freeze point of -47ºC. After an assessment of likely air transport missions, it was found that only one flight path introduced temperatures in excess of Jet A's freeze point. Furthermore, this flight path from Scotia, NY to Thule, Greenland only exhibited these temperatures in the month of January. According to Universal Technology Corporation:

> "There are no significant aircraft operating penalties associated with using Jet A in USAF transport aircraft in CONUS. The few missions that would require changes because of temperature limits are not significantly affected themselves nor is there a significant effect when the individual mission impacts are aggregated across the fleets." (Bartsch, 2006:94)

Although freeze point did not exhibit any impediments to routine CONUS air transport missions, Jet A usage for aerial bombardment, fighter escort, and associated low temperature loiter times should be addressed in future research efforts. **However, the findings under the scope of this research did not highlight any chemical limitations associated with a conversion from JP-8 to Jet A.**

Authorized Usage

Following the chemical comparison of Jet A and JP-8, aircraft compatibility and usage was addressed. FAMS data was provided by the AFPET Plans and Programs division and sorted by military installation. Once each installation was segregated, data was sorted by total gallons of JP-8 issued to each airframe. Table 20 exhibits the results for acceptable Jet A usage at the six military installations of interest.

Table 15. Percentages for Approved Jet A Usage

Customer Base Name	Product	Quantity	Jet A Approved
Fairchild AFB/ANG Unit, WA	JP-8	45,862,382	86%
McChord AFB, WA	JP-8	45,841,076	95%
Widbey Island Naval Station, WA	JP-8	26,864,288	98%
Kingsley Field ANG, OR	JP-8	8,773,864	99%
Fort Lewis, WA	JP-8	2,758,722	49%
Yakima Firing Range, WA	JP-8	655,843	11%

McChord AFB, Whidbey Island NAS, and Kingsley Field ANG Unit respectively revealed that 95%, 98% and 99% of their JP-8 customers could utilize Jet A as a primary or alternate fuel. The small percentage of those airframes whose Jet A usage could not be determined are discussed in the analysis section and could easily be remedied through technical manual revisions and validation of erroneous TMS codes. Alternately, Fairchild AFB/ANG Unit only exhibited an 86% compatibility rating for Jet A usage. Through revision of the B-1B Lancer and F-22 Raptor technical manuals and clarification of TMS codes, nearly 80% of the non approved usage would become acceptable. Therefore, approximately 97% of the airframes refueling at McChord AFB could accept either Jet A or JP-8 with no impediments. Likewise, clarification of the TMS codes at Ft. Lewis and Yakima Firing Range would most likely eliminate all of the Jet A usage impediments at these locations. **Thus, there appear to be no technical implications that would limit a full conversion from JP-8 to Jet A at the six military installations of interest.**

Price Analysis

The manner in which prices of Jet A and JP-8 were compared was founded upon previous research, but revised in a manner to more accurately account for associated additive, transportation, and overall monthly refinery costs. Rather than using weighted averages for the development of DESC JP-8 prices, base specific pricing baselines were gleaned from section B14.04 of the finalized contracts. Furthermore, the actual costs for additives and transportation were subtracted from military jet fuel prices to ensure a bare refinery price for JP-8 was compared with a bare refinery price for Jet A. As a result, an "apples to apples" comparison of actual commercial and military grade jet fuel prices was accomplished rather than using averages to account for base specific fuel prices, additive costs, and transportation charges. This method was presented to and validated by a panel of subject matter experts from AFPET, DESC, and C4E at a conference in February of 2008.

As a result, contract solicitations, section B14.04 of the finalized contracts, and Platts midpoint prices for West Coast areas were utilized to develop a monthly price that DESC pays for JP-8. Additionally, 30-day payment surcharges, APFs, and Platts Lowpoint prices for West Coast areas were utilized to develop an equivalent monthly price that DESC would pay for Jet A. After transportation and additive costs were netted out of the DESC JP-8 price, the equivalent price of Jet A was subtracted from this total. This scenario was conducted on a monthly basis, from October 2006 through September 2007, and averaged per location to produce a price differential between Jet A and JP-8. This price difference is then multiplied by the total FY07 gallons issued by each military installation. As a result, it would have cost the DoD approximately $1.38 million dollars more to purchase Jet A in lieu of JP-8 in FY07.

Although a conversion from JP-8 to Jet A exhibit no technical inhibitions, a cost analysis revealed that the price of Jet A is actually more expensive than JP-8 in the Pacific Northwest. **Therefore, a conversion from JP-8 to Jet A at the six military installations of interest is not supported by this research.**

Recommendations for Future Research

Recommendation 1: It is important to recognize that the price differential between Jet A and JP-8 were the smallest under contract SP0600-06-D-0502. Furthermore, all JP-8 and Jet A prices for this comparison were based on Seattle's waterborne fuel shipments or extremely similar prices. For example, DESC's equivalent Jet A price calculation utilized Platts prices associated with Seattle Barge Lowpoint prices. All deliveries for this contract were waterborne as opposed to pipeline or tank truck. Since a comparison of waterborne Jet A prices against waterborne JP-8 prices was assessed, the most accurate comparison between Jet A and JP-8 may occur under this contract. Unfortunately, mode specific pricing is not available through Platts and one of the prices utilized for the West Coast areas coincidentally happens to be based on Seattle barge prices founded in Pacific Northwest markets. If Platts pricing data specifically accounted for Tacoma pipeline or tank truck shipments, much smaller price differences may be encountered for installations under contract SP0600-06-D-0517. Unfortunately, Platts does not track this data and the sensitivity of pricing baselines should be addressed in future research.

Recommendation 2: In order to validate the technical assumptions of the 2003 EFDSS, 2007 Charleston Jet A Study, and this research effort, further research should be conducted concerning Jet A usage as a primary or alternate fuel. Evidence is presented in the analysis section that substantiates the assumption of Jet A usage in the F-22A Raptor and B-1B Lancer. Since TO42B1-1-14 recommends fuel usage in the manner presented in the specific aircraft's technical manuals, airframes such as these have limited fuel options for trivial reasons. However, no revisions to the technical flight manuals for these aircrafts have been mandated nor pursued through official channels. Therefore a research effort, in conjunction with AFRL and the original aircraft manufacturers, could lead to Jet A usage approval in many airframes that are not currently approved.

Additionally, access to a database of the fuel requirements of foreign aircraft should be developed or made readily available to any contractor, government agency, or DoD institutions conducting research concerning the compatibility of Jet A as a primary or alternate fuel. Outside of the CONUS, other countries utilize Jet A-1 which is identical to JP-8. However, the approval for foreign military aircraft to burn Jet A versus JP-8 is not likely addressed in their respective technical manuals.

The substitution of Jet A over JP-8 will continue to be assessed for cost avoidance in the future. Furthermore, joint exercises between the US and our allies are becoming commonplace and the likelihood of Jet A usage should be addressed prior to any transition from JP-8 to commercial jet fuel. If Jet A was ever determined to be the most economical choice for the DoD, additional JP-8 storage requirements would be necessary when conducting joint foreign exercises. Therefore, foreign aircraft manufacturer approval of Jet A usage is necessary to alleviate this likely future requirement.

Recommendation 3: Is there a true need for usage of FSII, SDA, & CI/LI? If so, can the currently recommended additive percentages be reduced to more cost effective levels without negatively effecting military aircraft? The current levels of additives required in JP-8 tend to be founded on random mishaps rather than concrete test results and well tested evidence. For example, is the use of SDA warranted or based on in-tank conductive foam insulation issues that have since been resolved? It was found that the likelihood of a static discharge in the fuel was unlikely, but the continued use of SDA is based on intuition rather than supporting evidence (C4E, 2003:43). However, the same levels of SDA are still mandated when using JP-8. Therefore, further research concerning discontinued use of, adjusted levels of injection, and injection point placement of jet fuel additives is necessary.

Recommendation 4: The survey used to prepare the results of the 2003 EFDSS is more than five years old now. Furthermore, the upward pricing trend for jet fuel seems to be escalating much faster than expected due to increased oil competition from developing countries. Therefore, there is a current need for the DoD to sponsor a new survey of commercial jet fuel refiners. The basis of the survey would be validation of past pricing assumptions still held to be true, evaluation of the propensity of commercial refineries to do business with the DoD, and to assessment of the current need for/value of the APF and cost of money calculations.

The DoD sometimes proves to be a risky business partner with commercial jet fuel refineries. Commercial airlines buy much more fuel, in regular increments, and provide a much more predictable purchase pattern than the DoD. Additionally, the government enforces very stringent fuel specifications and defines relatively inflexible contract terms with very little room for contractor negotiation or grounds for escape. Furthermore, the DoD requires 30-day payment terms whereas commercial airlines are required to pay upon delivery. An updated survey could address issues such as these and allow for contractor input that may improve jet fuel cost avoidance for the DoD.

As explained in the methodology, the APF and cost of money calculations are two additional costs that are added to the Platts averages when developing an equivalent Jet A price DESC would pay. However, these calculations are based on the results of rapidly aging data and the results of the 2003 EFDSS survey. In order to develop the most accurate prices the DoD would pay for Jet A, this topic should be specifically addressed in a new survey and updated according to the results.

Summary

This research and two earlier studies present compelling evidence that there are no technical or chemical inhibitions related to a CONUS conversion from JP-8 to Jet A. However, contrary to prior research, the methodology this study employed for the analysis of Jet A and JP-8 prices revealed added costs versus cost avoidance associated with a CONUS conversion. Although this research does not support a Jet A conversion at the six military installations of interest, recommendations for future research pertaining to transportation mode specific fuel pricing analysis, revision of aircraft specific technical manuals, the true need for fuel additives, and increased commercial industry input are presented. That being established, further research of this subject is definitely warranted considering the current jet fuel pricing trends and DoD budget limitations.

Appendix A: Summary of FAMS Data

Fairchild AFB JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
F015	Jet A is an approved alt fuel	5,410,104	13.90%
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	2,781,721	7.15%
F016	Jet A is an approved fuel	2,408,077	6.19%
RC135	Military version of B707/Jet A approved	1,382,575	3.55%
E003	Jet A listed as approved alt fuel	1,271,848	3.27%
A10	No restrictions for Jet A w/FSII and CI/LI	1,241,759	3.19%
E/EA6B	Navy Prowler/Jet A is approved alt	1,232,388	3.17%
E008	Military version of B707/Jet A approved	556,879	1.43%
C017	Jet A w/FSII approved for use	493,097	1.27%
B052	Authorized alt fuel	344,265	0.88%
C130	Jet A w/FSII approved for use	198,989	0.51%
E004	Military version of B747/Jet A approved	170,451	0.44%
Helicopters	Freeze point not a problem/Jet A approved in all	112,673	0.29%
C005	Jet A w/FSII approved for use	32,666	0.08%
C009	Jet A w/FSII approved for use	26,191	0.07%
AV8B	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	16,567	0.04%
B757	Comm A/C commonly using Jet A	8,445	0.02%
C040	Military version of B737/Jet A approved	8,319	0.02%
C032	Military version of B757/Jet A approved	5,238	0.01%
E002C	Navy Turbo Prop "Hawkeye"/Jet A is "Acceptable"	4,303	0.01%
P003	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	4,219	0.01%
C020	Military version of comm Gulfstream/Jet A approved	4,056	0.01%
T038	Jet A w/FSII is an approved primary fuel	3,536	0.01%
B737	Comm A/C commonly using Jet A	3,480	0.01%
DC009	Comm A/C commonly using Jet A	3,315	0.01%
C021	Jet A is an approved fuel	2,983	0.01%
T001	Jet A w/FSII approved for use	1,671	0.00%
SW4	Fairchild "Metro"/Jet A is a primary fuel	1,267	0.00%
C026	ANG Metroliner, Jet A approved	1,196	0.00%
F005	Jet A is an approved fuel	1,016	0.00%
C012	Army Huron/Jet A is a primary	824	0.00%
FALCON	Commercial plane used by Kalitta Charters/Jet A approved	765	0.00%
UC35	Beechcraft "Bonanza"/commonly uses Jet A	476	0.00%
UV18	Military version of comm DHC-6/Jet A approved	277	0.00%
C023	Sherpa Turbo Prop/Jet A approved	237	0.00%
FW4	Comm charter used by Berry Aviation/Jet A approved	120	0.00%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	350,509	0.90%
Subtotal	**Jet A is an approved primary or alt fuel**	**18,086,502**	**46.48%**
KC135	Jet A w/FSII is approved alt fuel	13,565,071	34.86%
KC010	Jet A w/FSII is approved primary fuel	1,013,976	2.61%
KC130	Jet A w/additives approved for use	21,268	0.05%
Subtotal	**Jet A w/additives may not be approved for all receiver A/C**	**14,600,315**	**37.52%**
TOTAL	**Jet A approved for above A/C**	**32,686,817**	**83.99%**
Unknown	**Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code**	6,228,470	16.01%
Subtotal	**Data not available to determine authorized Jet A usage**	**6,228,470**	**16.01%**
Grand Total	**All JP-8 issues at Fairchild AFB**	**38,915,287**	**100.00%**

Fairchild ANG JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
F015	Jet A is an approved alt fuel	793,502	11.42%
B052	Authorized alt fuel	232,832	3.35%
F016	Jet A is an approved fuel	167,725	2.41%
C017	Jet A w/FSII approved for use	80,656	1.16%
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	78,810	1.13%
A10	No restrictions for Jet A w/FSII and CI/LI	60,155	0.87%
E/EA6B	Navy Prowler/Jet A is approved alt	38,972	0.56%
RC135	Military version of B707/Jet A approved	34,328	0.49%
E003	Jet A listed as approved alt fuel	23,433	0.34%
C005	Jet A w/FSII approved for use	21,788	0.31%
E008	Military version of B707/Jet A approved	13,046	0.19%
EC130	Jet A w/FSII approved for use	6,747	0.10%
RC/C026	ANG Metroliner, Jet A approved	6,021	0.09%
E004	Military version of B747/Jet A approved	149	0.00%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	1,720	0.02%
Subtotal	**Jet A is an approved primary or alt fuel**	**1,559,884**	**22.45%**
KC135	Jet A w/FSII is approved alt fuel	5,167,964	74.39%
KC010	Jet A w/FSII is approved primary fuel	73,774	1.06%
Subtotal	**Jet A w/additives may not be approved for all receiver A/C**	**5,241,738**	**75.45%**
TOTAL	**Jet A approved for above A/C**	**6,801,622**	**97.91%**
Unknown	**Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code**	145,473	2.09%
Subtotal	**Data not available to determine authorized Jet A usage**	**145,473**	**2.09%**
Grand Total	**All JP-8 issues by Fairchild ANG**	**6,947,095**	**100.00%**

McChord AFB JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
C017	Jet A w/FSII approved for use	38,154,027	83.23%
C130	Jet A w/FSII approved for use	799,659	1.74%
C005	Jet A w/FSII approved for use	483,264	1.05%
E003	Jet A listed as approved alt fuel	462,944	1.01%
MD011	Comm A/C commonly using Jet A	346,795	0.76%
B757	Comm A/C commonly using Jet A	202,449	0.44%
F015	Jet A is an approved alt fuel	143,530	0.31%
F016	Jet A is an approved fuel	127,339	0.28%
L1011	Comm A/C commonly using Jet A	124,525	0.27%
AN124	Russian comm A/C commonly using Jet A	118,893	0.26%
B747	Comm A/C commonly using Jet A	87,533	0.19%
B737	Comm A/C commonly using Jet A	63,821	0.14%
B727	Comm A/C commonly using Jet A	53,616	0.12%
E006	Military version of B707/Jet A approved	52,557	0.11%
C040	Military version of B737/Jet A approved	51,569	0.11%
G1	Comm Gulfstream/Jet A approved	42,625	0.09%
DC010	Comm A/C commonly using Jet A	41,017	0.09%
C009	Jet A w/FSII approved for use	36,388	0.08%
EA006B	Navy Prowler/Jet A is approved alt	31,681	0.07%
C032	Military version of B757/Jet A approved	29,907	0.07%
A10	No restrictions for Jet A w/FSII and CI/LI	24,925	0.05%
C021	Jet A is an approved fuel	23,536	0.05%
B767	Comm A/C commonly using Jet A	19,597	0.04%
A310	Comm A/C commonly using Jet A	19,184	0.04%
T001	Jet A w/FSII approved for use	16,724	0.04%
C037	Military version of comm Gulfstream/Jet A approved	14,004	0.03%
C020	Military version of comm Gulfstream/Jet A approved	9,664	0.02%
Helicopters	Freeze point not a problem/Jet A approved in all	8,616	0.02%
P003	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	7,485	0.02%
C012	Army Huron/Jet A is a primary	4,634	0.01%
SW4	Fairchild "Metro"/Jet A is a primary fuel	4,433	0.01%
C140	UAE Air Force/Jet A approved	3,731	0.01%
AV8B	Jet A auth alt fuel for all Navy/Marine A/C	3,674	0.01%
C160	German Air Force/Jet A approved	3,091	0.01%
LJ035	Comm Learjet/Jet A approved	2,665	0.01%
DC009	Comm A/C commonly using Jet A	2,394	0.01%
T038	Jet A w/FSII is an approved primary fuel	2,076	0.00%
UC35	Beechcraft "Bonanza"/commonly uses Jet A	1,798	0.00%
C026	ANG Metroliner, Jet A approved	1,599	0.00%
T045	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	1,481	0.00%
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	1,355	0.00%
C002	Navy Cargo A/C/Jet A is approved alt	1,347	0.00%
T006	Jet A w/FSII approved for use	394	0.00%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	355,932	0.78%
Subtotal	**Jet A is an approved primary or alt fuel**	**41,988,478**	**91.60%**
KC130	Jet A w/additives approved for use	131,514	0.29%
KC135	Jet A w/FSII is approved alt fuel	1,436,501	3.13%
KC010	Jet A w/FSII is approved primary fuel	127,443	0.28%
Subtotal	**Jet A w/additives may not be approved for all receiver A/C**	**1,695,458**	**3.70%**
TOTAL	**Jet A approved for above A/C**	**43,683,936**	**95.29%**
	Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code	2,157,140	4.71%
Subtotal	**Data not available to determine authorized Jet A usage**	**2,157,140**	**4.71%**
Grand Total	**All JP-8 issues at McChord AFB**	**45,841,076**	**100.00%**

Whidbey Island NAS JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
E/EA6B	Navy Prowler/Jet A is approved alt	13,520,798	50.33%
P003	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	8,766,973	32.63%
C009	Jet A w/FSII approved for use	840,437	3.13%
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	802,723	2.99%
DC009	Comm A/C commonly using Jet A	606,728	2.26%
C040	Military version of B737/Jet A approved	484,147	1.80%
C130	Jet A w/FSII approved for use	360,154	1.34%
C017	Jet A w/FSII approved for use	252,170	0.94%
Helicopters	Freeze point not a problem/Jet A approved in all	223,622	0.83%
C005	Jet A w/FSII approved for use	88,374	0.33%
B747	Comm A/C commonly using Jet A	68,438	0.25%
B757	Comm A/C commonly using Jet A	50,649	0.19%
F015	Jet A is an approved alt fuel	31,388	0.12%
C020	Military version of comm Gulfstream/Jet A approved	29,504	0.11%
C037	Military version of comm Gulfstream/Jet A approved	24,784	0.09%
T043	Military version of B737/Jet A approved	24,633	0.09%
B707	Comm A/C commonly using Jet A	13,276	0.05%
E002C	Navy Turbo Prop "Hawkeye"/Jet A is "Acceptable"	11,608	0.04%
B767	Comm A/C commonly using Jet A	11,399	0.04%
MD011	Comm A/C commonly using Jet A	7,615	0.03%
F016	Jet A is an approved fuel	7,475	0.03%
S003	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	7,044	0.03%
F014	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	6,345	0.02%
A007E	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	4,822	0.02%
T045	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	4,584	0.02%
T039	Navy Sabreliner, Jet A approved	4,281	0.02%
C021	Jet A is an approved fuel	4,077	0.02%
AV8B	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	3,477	0.01%
UC35	Cessna Citation/Jet A is an approved fuel	3,235	0.01%
LEER	Comm A/C commonly using Jet A (misspelled TMS code)	1,355	0.01%
T001	Jet A w/FSII approved for use	991	0.00%
C012	Army Huron/Jet A is a primary	921	0.00%
FALCON	Commercial plane used by Kalitta Charters/Jet A approved	873	0.00%
T038	Jet A w/FSII is an approved primary fuel	479	0.00%
DHC6	Comm DeHavilland "Twin Otter"/Jet A approved	469	0.00%
UC12	Huron - Gulfstream/Jet A is primary	334	0.00%
T044	Military version of comm King Air/Jet A approved	150	0.00%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	36,970	0.14%
Subtotal	**Jet A is an approved primary or alt fuel**	**26,307,302**	**97.93%**
KC707	Military version of B707/Jet A approved	13,395	0.05%
KC130	Jet A w/additives approved for use	13,382	0.05%
Subtotal	**Jet A w/additives may not be approved for all receiver A/C**	**26,777**	**0.10%**
TOTAL	**Jet A approved for above A/C**	**26,334,079**	**98.03%**
Unknown	**Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code**	530,209	1.97%
Subtotal	**Data not available to determine authorized Jet A usage**	**530,209**	**1.97%**
Grand Total	**All JP-8 issues at Whidbey Island NAS**	**26,864,288**	**100.00%**

Kingsley Field JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
F015	Jet A is an approved alt fuel	8,101,589	92.34%
F016	Jet A is an approved fuel	152,431	1.74%
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	138,170	1.57%
C130	Jet A w/FSII approved for use	6,608	0.08%
C021	Jet A is an approved fuel	5,319	0.06%
Helicopters	Freeze point not a problem/Jet A approved in all	2,534	0.03%
FALCON	Commercial plane used by Kalitta Charters/Jet A approved	846	0.01%
T038	Jet A w/FSII is an approved primary fuel	670	0.01%
C023	Sherpa Turbo Prop/Jet A approved	263	0.00%
T001	Jet A w/FSII approved for use	249	0.00%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	95,475	1.09%
Subtotal	**Jet A is an approved primary or alt fuel**	**8,504,154**	**96.93%**
KC135	Jet A w/FSII is approved alt fuel	193,962	2.21%
Subtotal	**Jet A w/additives may not be approved for all receiver A/C**	**193,962**	**2.21%**
TOTAL	**Jet A approved for above A/C**	**8,698,116**	**99.14%**
Unknown	**Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code**	75,748	0.86%
Subtotal	**Data not available to determine authorized Jet A usage**	**75,748**	**0.86%**
Grand Total	**All JP-8 issues at Kingsley Field**	**8,773,864**	**100.00%**

Ft. Lewis JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
Helicopters	Freeze point not a problem/Jet A approved in all	753,637	27.32%
UC35	Cessna Citation/Jet A is an approved fuel	4,466	0.16%
UC12	Huron - Gulfstream/Jet A is primary	80,172	2.91%
L35	Learjet 35/Comm A/C commonly using Jet A	4,447	0.16%
G2	Guldstream 2/Comm A/C commonly using Jet A	2,361	0.09%
FALCON	Commercial plane used by Kalitta Charters/Jet A approved	4,362	0.16%
F018	Jet A is auth alt fuel for all Navy/Marine A/C (TO42B1-1-14)	6,343	0.23%
C017	Jet A w/FSII approved for use	401,081	14.54%
C009	Jet A w/FSII approved for use	1,508	0.05%
C040	Military version of B737/Jet A approved	7,446	0.27%
C037	Military version of comm Gulfstream/Jet A approved	3,180	0.12%
C026	ANG Metroliner, Jet A approved	450	0.02%
C023	Sherpa Turbo Prop/Jet A approved	19,447	0.70%
C021	Jet A is an approved fuel	3,343	0.12%
C130	Jet A w/FSII approved for use	25,909	0.94%
C020	Military version of comm Gulfstream/Jet A approved	1,543	0.06%
Non-Fly	Freeze point not a problem (ground equip, generators, etc)	24,839	0.90%
TOTAL	**Jet A approved for above A/C**	**1,344,534**	**48.74%**
Unknown	**Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code**	1,414,188	51.26%
Subtotal	**Data not available to determine authorized Jet A usage**	**1,414,188**	**51.26%**
Grand Total	**All JP-8 issues at Ft. Lewis**	**2,758,722**	**100.00%**

Yakima Traning Center JP-8 Issue Summaries			
TMS Code	**Jet A Compatibility Info**	**Gal Issued**	**Percentage**
Helicopters	Freeze point not a problem/Jet A approved in all	71,512	10.90%
TOTAL	**Jet A approved for above A/C**	**71,512**	**10.90%**
Unknown	**Operating Manuals are not available for the following aircraft, does not address Jet A use, or no TMS code**	584,331	89.10%
Subtotal	**Data not available to determine authorized Jet A usage**	**584,331**	**89.10%**
Grand Total	**All JP-8 issues at Yakima Training Center**	**655,843**	**100.00%**

Customer Base Name	Product	Quantity	Percent
Fairchild AFB/ANG Unit, WA	JP-8	45,862,382	35.1
McChord AFB, WA	JP-8	45,841,076	35.1
Widbey Island Naval Station, WA	JP-8	26,864,288	20.5
Kingsley Field ANG, OR	JP-8	8,773,864	6.7
Fort Lewis, WA	JP-8	2,758,722	2.1
Yakima Firing Range, WA	JP-8	655,843	0.5
		130,756,175	**100.0**

Appendix B: Contract Sections B14.04

B14.04 ESTIMATED SUPPLIES TO BE FURNISHED (DOMESTIC BULK) (DESC JUN 1992)

(a) Prices indicated hereunder are subject to adjustment pursuant to the terms of this contract.

(b) The maximum and minimum quantities are defined in the DELIVERY-ORDER LIMITATIONS - SCOPE OF CONTRACT clause.

(c) The refined product to be furnished hereunder, f.o.b. point, method of delivery, and estimated quantity are as follows: (DESC 52.207-9F20)

ITEM	**ESTIMATED QTY/GAL**	**MODE**	**BASE UNIT PRICE (USD/USG)** (February *14, 2006*)
DESC		*JP-8*	*NSN: 9130-01-031-5816*
0101	210,320,000	TK	$1.857187 *without additives*

FOB ORIGIN DELIVERY OF JP-8 AT CHERRY POINT, WA.

ITEM	**ESTIMATED QTY/GAL**	**MODE**	**BASE UNIT PRICE (USD/USG)** (June 27, *2006*)
DESC		*F-76*	*NSN: 9140-00-273-2377*
0201	84,315,000	TK	$2.166900 *without additives*

FOB ORIGIN DELIVERY OF F-76 AT CHERRY POINT, WA.

SCHEDULE NOTES:

1. Prices shall be adjusted in accordance with Clause B19.33, ECONOMIC PRICE ADJUSTMENT – PUBLISHED MARKET PRICE (DOMESTIC BULK) (DESC MAR 2003). For JP-8 the base market price is $1.847317, effective February 14, 2006 for the Offshore West Coast JP-5/JP-8 EPA area. For F-76 the base market price is $2.186900, effective June 27, 2006 for the Offshore West Coast F-76 EPA area. Invoices shall be rounded to five decimal points (i.e. $X.XXXXX).

2. Contract prices include the Washington State Hazardous Substance Tax of 0.7%.

B14.04 ESTIMATED SUPPLIES TO BE FURNISHED (DOMESTIC BULK) (DESC JUN 1992)

(a) Prices indicated hereunder are subject to adjustment pursuant to the terms of this contract.
(b) The maximum and minimum quantities are defined in the DELIVERY-ORDER LIMITATIONS – SCOPE OF CONTRACT clause.
(c) The refined product to be furnished hereunder, f.o.b. point, method of delivery, and estimated quantity are as follows:

(DESC 52.207-9F20)

ITEM DESC	EST. QTY/USG JP8	MODE	(FEBRUARY 14, 2006) BASE UNIT PRICE NSN: 9130-01-031-5816
0101	3,400,000	TT	$1.857217 w/ FSII and SDA
FOB ORIGIN DELIVERY AT TACOMA, WA			
0201	50,000,000	PL	$1.870917 w/ FSII and SDA
FOB DESTINATION DELIVERY MCCHORD AFB, WA (RFP LINE ITEM 0157)			

SCHEDULE NOTES:

1. U. S. Oil & Refining's offer under solicitation SP0600-06-R-0161, dated May 11, 2006, and correspondence dated June 15, 2006; June 29, 2006; June 30, 2006; July 18, 2006; July 20, 2006 and August 23, 2006 are hereby incorporated in this contract by reference.

2. Prices shall be adjusted in accordance with Clause B19.33 ECONOMIC PRICE ADJUSTMENT-PUBLISHED MARKET PRICE (DOMESTIC BULK) (DESC MAR 2003). The Base Market Price for JP8 is $1.847317, effective February 14, 2006, for theWest Coast/Offshore EPA area. Unit prices on all invoices will be rounded to four decimal places (i.e. $.XXXX).

3. For both line items, the amount included in the price per gallon for delivery with Fuel System Icing Inhibitor (FSII) is $0.008500, and for Static Dissipator Additive (SDA) is $0.000100.

4. For line item 0201, the amount included in the price per gallon for transportation is $0.025000. This cost shall remain firm and fixed for the life of the contract.

```
0156           FORT LEWIS           TACOMA                   WA
           UY7014                846177250    UY7014
QUANTITY 2,000,000 8A QUANTITY 0 SA QUANTITY 1,800,000

  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP PUGET SOUND
MODE    RECEIPT%  FSII      SDA       CI
TRUCK             REQUIRED  REQUIRED  REQUIRED
0157           MCCHORD AFB          TACOMA                   WA
           FP4479                846128240    MCCHORD
QUANTITY 55,000,000 8A QUANTITY 0 SA QUANTITY 47,300,000

  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP PUGET SOUND
MODE    RECEIPT%  FSII      SDA       CI
PIPE              REQUIRED  REQUIRED  REQUIRED
PIPE MODE RESTRICTED TO DESTINATION OFFERS
TRUCK             REQUIRED  REQUIRED  REQUIRED
0158           NAS WHIDBEY          OAK HARBOR               WA
           N00620                844905290    WHIDBEY
QUANTITY 23,000,000 8A QUANTITY 0 SA QUANTITY 20,700,000

  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP PUGET SOUND
MODE    RECEIPT%  FSII      SDA       CI          MAX PARCEL       MIN
PARCEL
BARGE             REQUIRED  REQUIRED  REQUIRED    10,000 BBLS
0159           YAKIMA FIRING CTR    YAKIMA                   WA
           W908C0                848420251
QUANTITY 400,000 8A QUANTITY 0 SA QUANTITY 360,000

  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP PUGET SOUND
MODE    RECEIPT%  FSII      SDA       CI
TRUCK             REQUIRED  REQUIRED  REQUIRED
0169           KINGSLEY FLD         KLAMATH FALLS            OR
           FP6372                857681240    KINGSLEY
QUANTITY 6,500,000 8A QUANTITY 0 SA QUANTITY 5,850,000
  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP VANCOUVER
MODE    RECEIPT%  FSII      SDA       CI
TRUCK             REQUIRED  REQUIRED  REQUIRED
0171           FAIRCHILD AFB        FAIRCHILD AFB            WA
           FP4620                840558240    FAIRCHDAFB
QUANTITY 22,000,000 8A QUANTITY 0 SA QUANTITY 0

  ** END USER CAN BE SUPPLIED THROUGH TERMINAL DFSP VANCOUVER
MODE    RECEIPT%  FSII      SDA       CI
PIPE              NONE      NONE      REQUIRED
```

Appendix D: Price Analysis Spreadsheets

Contract SP0600-06-D-0502

Equations	
Initial Differential	BUP - BMP
Final Differential	Initial Differential - Applicable Additive Costs - Applicaple Trans Costs
DESC JP-8 Price	Platts Midpoint 5 Day Avg +/- Final Differential
30 Day Payment Surcharge	Prime Lending Rate * Payment Period Fraction * Platts Low 5 Day Avg
Payment Period Fraction	30/365 (Payment terms in days/Number of days per year)
DESC Jet A Price	Platts Low 5 Day Avg + Cost of Money + APF

Acronyms	
APF	Airline Pricing Factor (.00225)
BMP	Base Market Price (Denoted in contract)
BUP	Base Unit Price (Denoted in contract)

Item/Mode	Award Prices	Base Mkt Price	Differential
0101/TK Fairchild, Whidbey Island & Kingsley Field	1.857187	1.847317	0.009870

FSII/CI/LI	SDA	Trans	Final Differential
0.000000	0.000000	0.000000	**0.009870**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	**SF Pipe Mid**	**Seattle Barge Mid**
DESC JP-8	10/23/2006	176.4000	176.4000	176.4000
Platts Mid + Differential	10/24/2006	181.6000	181.6000	181.6000
	10/25/2006	188.0000	188.0000	188.0000
	10/26/2006	184.2500	184.2500	184.2500
	10/27/2006	185.1000	185.1000	185.1000
		Average		**1.830700**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		1.830700	0.009870	**1.840570**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	10/23/2006	176.1500	176.1500	176.1500
Platts Low + APF + Cost of Money	10/24/2006	181.3500	181.3500	181.3500
	10/25/2006	187.7500	187.7500	187.7500
	10/26/2006	184.0000	184.0000	184.0000
	10/27/2006	184.8500	184.8500	184.8500
		Average		**1.828200**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012397**
		Price		**1.842847**

31 Oct 2006 JP-8/Jet A Difference/TK	**-0.002277**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	11/16/2006	185.0500	185.0500	185.0500
Platts Mid + Differential	11/17/2006	185.6500	185.6500	185.6500
	11/20/2006	186.4750	186.4750	186.4750
	11/21/2006	190.5500	190.5500	190.5500
	11/22/2006	185.8500	185.8500	185.8500
		Average		**1.867150**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		1.867150	0.009870	**1.877020**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	11/16/2006	184.8000	184.8000	184.8000
Platts Low + APF + Cost of Money	11/17/2006	185.4000	185.4000	185.4000
	11/20/2006	186.3500	186.3500	186.3500
	11/21/2006	190.3000	190.3000	190.3000
	11/22/2006	185.6000	185.6000	185.6000
		Average		**1.864900**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012646**
		Price		**1.879796**

28 Nov 2006 JP-8/Jet A Difference/TK	**-0.002776**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	12/18/2006	198.3000	198.3000	198.3000
Platts Mid + Differential	12/19/2006	193.8500	193.8500	193.8500
	12/20/2006	195.5500	195.5500	195.5500
	12/21/2006	191.2750	191.2750	191.2750
	12/22/2006	193.2750	193.2750	193.2750
		Average		**1.944500**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		1.944500	0.009870	**1.954370**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	12/18/2006	198.0500	198.0500	198.0500
Platts Low + APF + Cost of Money	12/19/2006	193.6000	193.6000	193.6000
	12/20/2006	195.4500	195.4500	195.4500
	12/21/2006	191.1500	191.1500	191.1500
	12/22/2006	192.9000	192.9000	192.9000
		Average		**1.942300**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.013170**
		Price		**1.957720**

26 Dec 2006 JP-8/Jet A Difference/TK	**-0.003350**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	01/22/2007	175.1000	175.1000	175.1000
Platts Mid + Differential	01/23/2007	181.7750	181.7750	181.7750
	01/24/2007	181.9000	181.9000	181.9000
	01/25/2007	178.2000	178.2000	178.2000
	01/26/2007	181.4000	181.4000	181.4000
		Average		**1.796750**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		1.796750	0.009870	**1.806620**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	01/22/2007	174.8500	174.8500	174.8500
Platts Low + APF + Cost of Money	01/23/2007	181.6500	181.6500	181.6500
	01/24/2007	181.6500	181.6500	181.6500
	01/25/2007	177.9500	177.9500	177.9500
	01/26/2007	181.1500	181.1500	181.1500
		Average		**1.794500**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012168**
		Price		**1.808918**

30 Jan 2007 JP-8/Jet A Difference/TK	**-0.002298**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	02/16/2007	183.3500	183.3500	183.3500
Platts Mid + Differential	02/20/2007	179.5000	179.5000	179.5000
	02/21/2007	183.3000	183.3000	183.3000
	02/22/2007	186.4250	186.4250	186.4250
	02/23/2007	189.3500	189.3500	189.3500
		Average		**1.843850**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		1.843850	0.009870	**1.853720**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	02/16/2007	183.1000	183.1000	183.1000
Platts Low + APF + Cost of Money	02/20/2007	179.2500	179.2500	179.2500
	02/21/2007	183.0500	183.0500	183.0500
	02/22/2007	186.3000	186.3000	186.3000
	02/23/2007	189.1000	189.1000	189.1000
		Average		**1.841600**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012488**
		Price		**1.856338**

27 Feb 2007 JP-8/Jet A Difference/TK	**-0.002618**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	03/19/2007	185.6000	185.6000	185.6000
Platts Mid + Differential	03/20/2007	184.1000	184.1000	184.1000
	03/21/2007	185.7000	185.7000	185.7000
	03/22/2007	191.3000	191.3000	191.3000
	03/23/2007	196.2000	196.2000	196.2000
		Average		**1.885800**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		1.885800	0.009870	**1.895670**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	03/19/2007	185.3500	185.3500	185.3500
Platts Low + APF + Cost of Money	03/20/2007	183.8500	183.8500	183.8500
	03/21/2007	185.4500	185.4500	185.4500
	03/22/2007	191.0500	191.0500	191.0500
	03/23/2007	195.9500	195.9500	195.9500
		Average		**1.883300**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012770**
		Price		**1.898320**
27 Mar 2007 JP-8/Jet A Difference/TK				**-0.002650**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	04/16/2007	209.4500	209.4500	209.4500
Platts Mid + Differential	04/17/2007	201.1750	201.1750	201.1750
	04/18/2007	201.7000	201.7000	201.7000
	04/19/2007	202.1500	202.1500	202.1500
	04/20/2007	207.0000	207.0000	207.0000
		Average		**2.042950**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		2.042950	0.009870	**2.052820**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	04/16/2007	209.2000	209.2000	209.2000
Platts Low + APF + Cost of Money	04/17/2007	200.8000	200.8000	200.8000
	04/18/2007	201.6500	201.6500	201.6500
	04/19/2007	202.1000	202.1000	202.1000
	04/20/2007	206.7500	206.7500	206.7500
		Average		**2.041000**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.013840**
		Price		**2.057090**
24 Apr 2007 JP-8/Jet A Difference/TK				**-0.004270**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	05/21/2007	217.6000	212.6000	217.6000
Platts Mid + Differential	05/22/2007	211.4500	206.4500	211.4500
	05/23/2007	213.5000	208.5000	213.5000
	05/24/2007	213.2500	208.2500	213.2500
	05/25/2007	213.9500	208.9500	213.9500
		Average		**2.122833**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		2.122833	0.009870	**2.132703**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	05/21/2007	217.1000	212.1000	217.1000
Platts Low + APF + Cost of Money	05/22/2007	210.9500	205.9500	210.9500
	05/23/2007	213.2500	208.2500	213.2500
	05/24/2007	213.0000	208.0000	213.0000
	05/25/2007	213.7000	208.7000	213.7000
		Average		**2.119333**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014371**
		Price		**2.135954**

29 May 2007 JP-8/Jet A Difference/TK	**-0.003251**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	06/18/2007	218.9000	213.9000	218.9000
Platts Mid + Differential	06/19/2007	218.3250	213.3250	218.3250
	06/20/2007	218.7750	213.7750	218.7750
	06/21/2007	217.0750	212.0750	217.0750
	06/22/2007	218.2500	213.2500	218.2500
		Average		**2.165983**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		2.165983	0.009870	**2.175853**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	06/18/2007	218.6500	213.6500	218.6500
Platts Low + APF + Cost of Money	06/19/2007	218.2000	213.2000	218.2000
	06/20/2007	218.4000	213.4000	218.4000
	06/21/2007	216.7000	211.7000	216.7000
	06/22/2007	218.0000	213.0000	218.0000
		Average		**2.163233**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014669**
		Price		**2.180152**

26 Jun 2007 JP-8/Jet A Difference/TK	**-0.004299**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	07/23/2007	218.4750	217.9750	218.4750
Platts Mid + Differential	07/24/2007	215.1500	214.6500	215.1500
	07/25/2007	219.5750	219.0750	219.5750
	07/26/2007	217.2500	216.7500	217.2500
	07/27/2007	222.6000	222.1000	222.6000
		Average		**2.184433**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		2.184433	0.009870	**2.194303**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	07/23/2007	218.1000	217.6000	218.1000
Platts Low + APF + Cost of Money	07/24/2007	214.9000	214.4000	214.9000
	07/25/2007	219.2000	218.7000	219.2000
	07/26/2007	217.0000	216.5000	217.0000
	07/27/2007	222.3500	221.8500	222.3500
		Average		**2.181433**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014792**
		Price		**2.198475**

31 Jul 2007 JP-8/Jet A Difference/TK	**-0.004172**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	08/20/2007	211.7250	211.2250	211.7250
Platts Mid + Differential	08/21/2007	209.7000	209.2000	209.7000
	08/22/2007	208.8500	208.3500	208.8500
	08/23/2007	210.1000	209.6000	210.1000
	08/24/2007	215.3500	214.8500	215.3500
		Average		**2.109783**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		2.109783	0.009870	**2.119653**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	08/20/2007	211.3500	210.8500	211.3500
Platts Low + APF + Cost of Money	08/21/2007	209.4500	208.9500	209.4500
	08/22/2007	208.6000	208.1000	208.6000
	08/23/2007	209.8500	209.3500	209.8500
	08/24/2007	215.1000	214.6000	215.1000
		Average		**2.107033**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014287**
		Price		**2.123571**

28 Aug 2007 JP-8/Jet A Difference/TK	**-0.003917**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	09/17/2007	226.8500	226.3500	226.8500
Platts Mid + Differential	09/18/2007	226.2300	225.7300	226.2300
	09/19/2007	224.1550	223.6550	224.1550
	09/20/2007	229.5900	229.0900	229.5900
	09/21/2007	235.5100	235.0100	235.5100
		Average		**2.283003**
Item/Mode		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TK		2.283003	0.009870	**2.292873**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	09/17/2007	226.6000	226.1000	226.6000
Platts Low + APF + Cost of Money	09/18/2007	225.9800	225.4800	225.9800
	09/19/2007	223.7800	223.2800	223.7800
	09/20/2007	229.0900	228.5900	229.0900
	09/21/2007	235.2600	234.7600	235.2600
		Average		**2.279753**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.015459**
		Price		**2.297462**
25 Sep 2007 JP-8/Jet A Difference/TK				**-0.004589**

DESC Prices	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07
0101/TK FAFB, WINAS & Kingsley Fld JP-8	1.840570	1.877020	1.954370	1.806620	1.853720	1.895670
DESC Jet A Equivalent Price	1.842847	1.879796	1.957720	1.808918	1.856338	1.898320
Differences						
0101/TK FAFB, WINAS & Kingsley Fld	**-0.002277**	**-0.002776**	**-0.003350**	**-0.002298**	**-0.002618**	**-0.002650**

DESC Prices	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Avg
0101/TK FAFB, WINAS & Kingsley Fld JP-8	2.052820	2.132703	2.175853	2.194303	2.119653	2.292873	**2.016348**
DESC Jet A Equivalent Price	2.057090	2.135954	2.180152	2.198475	2.123571	2.297462	**2.019720**
Differences							
0101/TK FAFB, WINAS & Kingsley Fld	**-0.004270**	**-0.003251**	**-0.004299**	**-0.004172**	**-0.003917**	**-0.004589**	**-0.003372**

Base	Gallons Used	Line Item/Mode	Savings	Added Costs
Fairchild ANG & AFB	45,862,382.00	0101/TK		**$154,654.15**
Whidbey Island NAS	26,864,288	0101/TK		**$90,590.01**
Kingsley Field	8,773,864	0101/TK		**$29,586.66**

Contract SP0600-06-D-0517

Equations	
Initial Differential	BUP - BMP
Final Differential	Initial Differential - Applicable Additive Costs - Applicable Trans Costs
DESC JP-8 Price	Platts Midpoint 5 Day Avg +/- Final Differential
30 Day Payment Surcharge	Prime Lending Rate * Payment Period Fraction * Platts Low 5 Day Avg
Payment Period Fraction	30/365 (Payment terms in days/Number of days per year)
DESC Jet A Price	Platts Low 5 Day Avg + Cost of Money + APF

Acronyms	
APF	Airline Pricing Factor (.00225)
BMP	Base Market Price (Denoted in contract)
BUP	Base Unit Price (Denoted in contract)

Item/Mode	Award Prices	Base Mkt Price	Initial Differential
0101/TT (Ft Lewis & Yakima)	1.857217	1.847317	0.009900
0201/PL (McChord)	1.870917	1.847317	0.023600

FSII/CI/LI	SDA	Trans	Final Differential
0.008500	0.000100	0.000000	**0.001300**
0.008500	0.000100	0.025000	**-0.010000**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	10/23/2006	176.4000	176.4000	176.4000
Platts Mid + Differential	10/24/2006	181.6000	181.6000	181.6000
	10/25/2006	188.0000	188.0000	188.0000
	10/26/2006	184.2500	184.2500	184.2500
	10/27/2006	185.1000	185.1000	185.1000
		Average		**1.830700**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		1.830700	0.001300	**1.832000**
0201/PL (McChord)		1.830700	-0.010000	**1.820700**

		LA Pipe Low	SF Pipe Low	Seattle Barge Low
DESC Jet A Equivalent	10/23/2006	176.1500	176.1500	176.1500
Platts Low + APF + Cost of Money	10/24/2006	181.3500	181.3500	181.3500
	10/25/2006	187.7500	187.7500	187.7500
	10/26/2006	184.0000	184.0000	184.0000
	10/27/2006	184.8500	184.8500	184.8500
		Average		**1.828200**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012397**
		Price		**1.842847**

31 Oct 2006 JP-8/Jet A Difference/TT	**-0.010847**
31 Oct 2006 JP-8/Jet A Difference/PL	**-0.022147**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	11/16/2006	185.0500	185.0500	185.0500
Platts Mid + Differential	11/17/2006	185.6500	185.6500	185.6500
	11/20/2006	186.4750	186.4750	186.4750
	11/21/2006	190.5500	190.5500	190.5500
	11/22/2006	185.8500	185.8500	185.8500
		Average		**1.867150**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		1.867150	0.001300	**1.868450**
0201/PL (McChord)		1.867150	-0.010000	**1.857150**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	11/16/2006	184.8000	184.8000	184.8000
Platts Low + APF + Cost of Money	11/17/2006	185.4000	185.4000	185.4000
	11/20/2006	186.3500	186.3500	186.3500
	11/21/2006	190.3000	190.3000	190.3000
	11/22/2006	185.6000	185.6000	185.6000
		Average		**1.864900**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012646**
		Price		**1.879796**

28 Nov 2006 JP-8/Jet A Difference/TT	**-0.011346**
28 Nov 2006 JP-8/Jet A Difference/PL	**-0.022646**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	12/18/2006	198.3000	198.3000	198.3000
Platts Mid + Differential	12/19/2006	193.8500	193.8500	193.8500
	12/20/2006	195.5500	195.5500	195.5500
	12/21/2006	191.2750	191.2750	191.2750
	12/22/2006	193.2750	193.2750	193.2750
		Average		**1.944500**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		1.944500	0.001300	**1.945800**
0201/PL (McChord)		1.944500	-0.010000	**1.934500**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	12/18/2006	198.0500	198.0500	198.0500
Platts Low + APF + Cost of Money	12/19/2006	193.6000	193.6000	193.6000
	12/20/2006	195.4500	195.4500	195.4500
	12/21/2006	191.1500	191.1500	191.1500
	12/22/2006	192.9000	192.9000	192.9000
		Average		**1.942300**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.013170**
		Price		**1.957720**

26 Dec 2006 JP-8/Jet A Difference/TT	**-0.011920**
26 Dec 2006 JP-8/Jet A Difference/PL	**-0.023220**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	01/22/2007	175.1000	175.1000	175.1000
Platts Mid + Differential	01/23/2007	181.7750	181.7750	181.7750
	01/24/2007	181.9000	181.9000	181.9000
	01/25/2007	178.2000	178.2000	178.2000
	01/26/2007	181.4000	181.4000	181.4000
		Average		**1.796750**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		1.796750	0.001300	**1.798050**
0201/PL (McChord)		1.796750	-0.010000	**1.786750**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	01/22/2007	174.8500	174.8500	174.8500
Platts Low + APF + Cost of Money	01/23/2007	181.6500	181.6500	181.6500
	01/24/2007	181.6500	181.6500	181.6500
	01/25/2007	177.9500	177.9500	177.9500
	01/26/2007	181.1500	181.1500	181.1500
		Average		**1.794500**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012168**
		Price		**1.808918**

30 Jan 2007 JP-8/Jet A Difference/TT	**-0.010868**
30 Jan 2007 JP-8/Jet A Difference/PL	**-0.022168**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	02/16/2007	183.3500	183.3500	183.3500
Platts Mid + Differential	02/20/2007	179.5000	179.5000	179.5000
	02/21/2007	183.3000	183.3000	183.3000
	02/22/2007	186.4250	186.4250	186.4250
	02/23/2007	189.3500	189.3500	189.3500
		Average		**1.843850**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		1.843850	0.001300	**1.845150**
0201/PL (McChord)		1.843850	-0.010000	**1.833850**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	02/16/2007	183.1000	183.1000	183.1000
Platts Low + APF + Cost of Money	02/20/2007	179.2500	179.2500	179.2500
	02/21/2007	183.0500	183.0500	183.0500
	02/22/2007	186.3000	186.3000	186.3000
	02/23/2007	189.1000	189.1000	189.1000
		Average		**1.841600**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012488**
		Price		**1.856338**

27 Feb 2007 JP-8/Jet A Difference/TT	**-0.011188**
27 Feb 2007 JP-8/Jet A Difference/PL	**-0.022488**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	03/19/2007	185.6000	185.6000	185.6000
Platts Mid + Differential	03/20/2007	184.1000	184.1000	184.1000
	03/21/2007	185.7000	185.7000	185.7000
	03/22/2007	191.3000	191.3000	191.3000
	03/23/2007	196.2000	196.2000	196.2000
		Average		**1.885800**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		1.885800	0.001300	**1.887100**
0201/PL (McChord)		1.885800	-0.010000	**1.875800**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	03/19/2007	185.3500	185.3500	185.3500
Platts Low + APF + Cost of Money	03/20/2007	183.8500	183.8500	183.8500
	03/21/2007	185.4500	185.4500	185.4500
	03/22/2007	191.0500	191.0500	191.0500
	03/23/2007	195.9500	195.9500	195.9500
		Average		**1.883300**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.012770**
		Price		**1.898320**

27 Mar 2007 JP-8/Jet A Difference/TT	**-0.011220**
27 Mar 2007 JP-8/Jet A Difference/PL	**-0.022520**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	04/16/2007	209.4500	209.4500	209.4500
Platts Mid + Differential	04/17/2007	201.1750	201.1750	201.1750
	04/18/2007	201.7000	201.7000	201.7000
	04/19/2007	202.1500	202.1500	202.1500
	04/20/2007	207.0000	207.0000	207.0000
		Average		**2.042950**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		2.042950	0.001300	**2.044250**
0201/PL (McChord)		2.042950	-0.010000	**2.032950**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	04/16/2007	209.2000	209.2000	209.2000
Platts Low + APF + Cost of Money	04/17/2007	200.8000	200.8000	200.8000
	04/18/2007	201.6500	201.6500	201.6500
	04/19/2007	202.1000	202.1000	202.1000
	04/20/2007	206.7500	206.7500	206.7500
		Average		**2.041000**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.013840**
		Price		**2.057090**

24 Apr 2007 JP-8/Jet A Difference/TT	**-0.012840**
24 Apr 2007 JP-8/Jet A Difference/PL	**-0.024140**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	05/21/2007	217.6000	212.6000	217.6000
Platts Mid + Differential	05/22/2007	211.4500	206.4500	211.4500
	05/23/2007	213.5000	208.5000	213.5000
	05/24/2007	213.2500	208.2500	213.2500
	05/25/2007	213.9500	208.9500	213.9500
		Average		**2.122833**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		2.122833	0.001300	**2.124133**
0201/PL (McChord)		2.122833	-0.010000	**2.112833**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	05/21/2007	217.1000	212.1000	217.1000
Platts Low + APF + Cost of Money	05/22/2007	210.9500	205.9500	210.9500
	05/23/2007	213.2500	208.2500	213.2500
	05/24/2007	213.0000	208.0000	213.0000
	05/25/2007	213.7000	208.7000	213.7000
		Average		**2.119333**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014371**
		Price		**2.135954**

29 May 2007 JP-8/Jet A Difference/TT	**-0.011821**
29 May 2007 JP-8/Jet A Difference/PL	**-0.023121**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	06/18/2007	218.9000	213.9000	218.9000
Platts Mid + Differential	06/19/2007	218.3250	213.3250	218.3250
	06/20/2007	218.7750	213.7750	218.7750
	06/21/2007	217.0750	212.0750	217.0750
	06/22/2007	218.2500	213.2500	218.2500
		Average		**2.165983**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		2.165983	0.001300	**2.167283**
0201/PL (McChord)		2.165983	-0.010000	**2.155983**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	06/18/2007	218.6500	213.6500	218.6500
Platts Low + APF + Cost of Money	06/19/2007	218.2000	213.2000	218.2000
	06/20/2007	218.4000	213.4000	218.4000
	06/21/2007	216.7000	211.7000	216.7000
	06/22/2007	218.0000	213.0000	218.0000
		Average		**2.163233**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014669**
		Price		**2.180152**

26 Jun 2007 JP-8/Jet A Difference/TT	**-0.012869**
26 Jun 2007 JP-8/Jet A Difference/PL	**-0.024169**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	07/23/2007	218.4750	217.9750	218.4750
Platts Mid + Differential	07/24/2007	215.1500	214.6500	215.1500
	07/25/2007	219.5750	219.0750	219.5750
	07/26/2007	217.2500	216.7500	217.2500
	07/27/2007	222.6000	222.1000	222.6000
		Average		**2.184433**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		2.184433	0.001300	**2.185733**
0201/PL (McChord)		2.184433	-0.010000	**2.174433**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	07/23/2007	218.1000	217.6000	218.1000
Platts Low + APF + Cost of Money	07/24/2007	214.9000	214.4000	214.9000
	07/25/2007	219.2000	218.7000	219.2000
	07/26/2007	217.0000	216.5000	217.0000
	07/27/2007	222.3500	221.8500	222.3500
		Average		**2.181433**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014792**
		Price		**2.198475**

31 Jul 2007 JP-8/Jet A Difference/TT	**-0.012742**
31 Jul 2007 JP-8/Jet A Difference/PL	**-0.024042**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	08/20/2007	211.7250	211.2250	211.7250
Platts Mid + Differential	08/21/2007	209.7000	209.2000	209.7000
	08/22/2007	208.8500	208.3500	208.8500
	08/23/2007	210.1000	209.6000	210.1000
	08/24/2007	215.3500	214.8500	215.3500
		Average		**2.109783**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		2.109783	0.001300	**2.111083**
0201/PL (McChord)		2.109783	-0.010000	**2.099783**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	08/20/2007	211.3500	210.8500	211.3500
Platts Low + APF + Cost of Money	08/21/2007	209.4500	208.9500	209.4500
	08/22/2007	208.6000	208.1000	208.6000
	08/23/2007	209.8500	209.3500	209.8500
	08/24/2007	215.1000	214.6000	215.1000
		Average		**2.107033**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.014287**
		Price		**2.123571**

28 Aug 2007 JP-8/Jet A Difference/TT	**-0.012487**
28 Aug 2007 JP-8/Jet A Difference/PL	**-0.023787**

Comparison of JP-8 and Jet A prices if purchased by DESC				
		LA Pipe Mid	SF Pipe Mid	Seattle Barge Mid
DESC JP-8	09/17/2007	226.8500	226.3500	226.8500
Platts Mid + Differential	09/18/2007	226.2300	225.7300	226.2300
	09/19/2007	224.1550	223.6550	224.1550
	09/20/2007	229.5900	229.0900	229.5900
	09/21/2007	235.5100	235.0100	235.5100
		Average		**2.283003**
Item/Mode/Base		**Platts Mid Avg**	**Differentials**	**DESC JP-8 Price**
0101/TT (Ft Lewis & Yakima)		2.283003	0.001300	**2.284303**
0201/PL (McChord)		2.283003	-0.010000	**2.273003**
		LA Pipe Low	**SF Pipe Low**	**Seattle Barge Low**
DESC Jet A Equivalent	09/17/2007	226.6000	226.1000	226.6000
Platts Low + APF + Cost of Money	09/18/2007	225.9800	225.4800	225.9800
	09/19/2007	223.7800	223.2800	223.7800
	09/20/2007	229.0900	228.5900	229.0900
	09/21/2007	235.2600	234.7600	235.2600
		Average		**2.279753**
		Airline Pricing Factor (APF)		**0.002250**
		Cost of Money		**0.015459**
		Price		**2.297462**

25 Sep 2007 JP-8/Jet A Difference/TT	**-0.013159**
25 Sep 2007 JP-8/Jet A Difference/PL	**-0.024459**

DESC Prices	**Oct-06**	**Nov-06**	**Dec-06**	**Jan-07**	**Feb-07**	**Mar-07**
0101/TT (Ft Lewis & Yakima) JP-8	1.832000	1.868450	1.945800	1.798050	1.845150	1.887100
0201/PL (McChord) JP-8	1.820700	1.857150	1.934500	1.786750	1.833850	1.875800
DESC Jet A Equivalent Price	1.842847	1.879796	1.957720	1.808918	1.856338	1.898320
Differences						
0101/TT (Ft Lewis & Yakima)	**-0.010847**	**-0.011346**	**-0.011920**	**-0.010868**	**-0.011188**	**-0.011220**
0201/PL (McChord)	**-0.022147**	**-0.022646**	**-0.023220**	**-0.022168**	**-0.022488**	**-0.022520**

Apr-07	**May-07**	**Jun-07**	**Jul-07**	**Aug-07**	**Sep-07**	**Avg**
2.044250	2.124133	2.167283	2.185733	2.111083	2.284303	**2.007778**
2.032950	2.112833	2.155983	2.174433	2.099783	2.273003	**1.996478**
2.057090	2.135954	2.180152	2.198475	2.123571	2.297462	**2.019720**
-0.012840	**-0.011821**	**-0.012869**	**-0.012742**	**-0.012487**	**-0.013159**	**-0.011942**
-0.024140	**-0.023121**	**-0.024169**	**-0.024042**	**-0.023787**	**-0.024459**	**-0.023242**

Base	Gallons Used	Line Item/Mode	Added Costs
McChord AFB	45,841,076.00	0201/PL	**$1,065,444.48**
Fort Lewis	2,758,722.00	0101/TT	**$32,945.03**
Yakima Firing Range	655,843.00	0101/TT	**$7,832.17**

JP8 Delivery Methods from Refinery to Each Base

Fairchild AFB, WA –FP4620

1 Oct 06-30 Sep 07—TK from refinery to DFSP Vancouver and then BG to DFSP Pasco and finally PL to Fairchild AFB

McChord AFB, WA—FP4479

1 Oct 06-30 Sep 07—PL from refinery to McChord AFB

Whidbey Island Naval Station, WA—N00620

1 Oct 06-30 Sep 07—TK from refinery to DFSP Puget Sound then BG to Whidbey Island NAS

Kingsley Field, OR—FP6372

1 Oct 06-30 Sep 07—TK from refinery to DFSP Vancouver then TT from DFSP Vancouver to Kingsley Field ANG Base

Ft. Lewis, WA—UY7014

1 Oct 06-30 Sep 07—TT from refinery to Ft Lewis

Yakima Firing Range, WA—W908C0

1 Oct 06-30 Sep 07—TT from refinery to Yakima Firing Range

Legend

TK – Ocean Tanker
TT – Tank Truck
BG – Barge
PL - Pipeline

Appendix F: Acronym List

AFPET – Air Force Petroleum Office

AFRL – Air Force Research Laboratory

AFSO 21 – Air Force Smart Operations 21

ANG – Air National Guard

BG - Barge

BMP – Base Market Price

BUP – Base Unit Price

CGS – Coast Guard Station

CI/LI – Corrosion Inhibitor/Lubricity Improver

CONUS – Continental United States

DESC – Defense Energy Support Center

DFSC – Defense Fuel Supply Center

DFSP – Defense Fuel Supply Point

DLA – Defense Logistics Agency

DoD – Department of Defense

DoDAAC – Department of Defense Activity Address Code

EFDSS – Enhanced Fuel Distribution System Study

EIA – Energy Information Administraton

FAMS – Fuels Automated Management System

FOB – Free On Board

FSII – Fuel System Icing Inhibitor

FY – Fiscal Year

JP – Jet Propellant

JPTS – Jet Propellant Thermally Stable

OSD – Office of the Secretary of Defense

PL - Pipeline

SDA – Static Dissipator Additive

SECAF – Secretary of the Air Force

Acronym List (cont.)

TK – Ocean Tanker

TMS – Type Model Series

TO – Technical Order

TT – Tank Truck

USAF – United States Air Force

USTRANSCOM – United States Transportation Command

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Vita

Captain Lance A. Vann graduated from Central Independent School District High School in Pollok, Texas. He entered undergraduate studies at Texas A&M University in College Station, Texas where he graduated with a Bachelor of Science degree in Ecology in May 1997. He was commissioned through Officer Training School at Maxwell AFB, Alabama on 16 August 2001.

His first assignment was at Travis AFB as a Logistics Plans Officer where he served as the OIC of Exercises and Deployments in the 615th Air Mobility Operations Goup. Following the Logistics Readiness Officer career field consolidation, he transferred to the 615 Air Mobility Squadron in May of 2003 to serve as the Assitant Aerial Port Flight Commander. In July of 2004, Captain Vann transitioned to Andersen AFB, Guam and became the OIC of Material Management through July of 2005. During this period he was concurrently deployed to Ali Al Salem AB, Kuwait where he fulfilled the duties of the Installation Deployment Officer. Following his 2005 deployment, Captain Vann returned to the 36th Logistics Readiness Squadron at Andersen AFB and became the Fuels Management Flight Commander. In September of 2006, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology, as a Logistics Management graduate student. Upon graduation, he will be assigned to Headquarters AMC/A4T.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
03-07-2008	**Master's Thesis**	Sep 2007 - Mar 2008

4. TITLE AND SUBTITLE
FEASIBILITY OF JP-8 TO JET A FUEL CONVERSION AT U.S. MILITARY FACILITIES

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Vann, Lance, A., Captain, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Street, Building 642
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GLM/ENS/08-13

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AFPET/AFF
Attn: Major Stephen Wier
HQ AF Petroleum Agency (AFPET)
8725 John Kingman Rd, Suite 1227 DSN: 427-8703
Ft. Belvoir, VA 22060-6232 e-mail: Stephen.Wier@dla.mil

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
In FY06, Department of Defense (DoD) military grade jet fuel expenditures eclipsed $6.6 billion dollars. In a search for more cost effective options, the Office of the Secretary of Defense Comptroller recently expressed interest in the quantity of commercial Jet A fuel that the United States Transportation Command uses in lieu of military grade JP-8. In accordance with AFSO 21 and LEAN concepts, this research examines the technical feasibility and opportunity for cost avoidance of a conversion from JP-8 to Jet A at six Northwestern United States military installations. The technical feasibility analysis examines the chemical likeness of JP-8 and Jet A and identifies any aircraft or equipment that may impede a complete conversion. Accordingly, the opportunity for cost avoidance is considered through an analysis of military and commercial grade jet fuel influenced by West Coast refinery prices. The results show no technical barriers to a complete conversion, but there is no opportunity for cost avoidance.

15. SUBJECT TERMS
Jet Fuel, JP-8, Jet A, Technical Feasibility, Cost Avoidance, Cost Benefit, West Coast Jet Fuel Price

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
					Bradley E. Anderson, Lt. Col., USAF (ENS)
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU	111	(937) 785-3636 X 4646, e-mail: Bradley.Anderson@afit.edu