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Gulf of Mexico
Helicopter Offshore System Technologies Engineering Needs Assessment

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1.0 INTRODUCTION

The National Aeronautics and Space Administration (NASA), in partnership with the Federal Aviation Administration (FAA), is conducting a research and development program to modernize the National Airspace System (NAS). The mission of NASA's Advanced Air Transportation Technologies (AATT) project is to develop advanced Air Traffic Management (ATM) concepts and decision support tools for eventual deployment and implementation by the FAA and the private sector. One major objective of the NASA AATT project is to understand and promote the needs of all user classes.

The Gulf of Mexico (GoMex) airspace has unique needs. A large number of helicopters operate in this area with only limited surveillance and sometimes-severe environmental conditions. Thunderstorms are the most frequent weather hazard during the spring, summer, and fall. In winter, reduced hours of daylight, low ceilings, strong winds, and icing conditions may restrict operations. Hurricanes impose the most severe weather hazard. The hurricane season, from June through October, normally requires at least one mass evacuation of all offshore platforms.

Currently there are about 325 onshore heliports, more than 4,000 offshore structures including about 2,000 with helidecks, and over 35,000 people working offshore at any given time. Employees and equipment are transported to offshore platforms daily by a fleet of 636 helicopters valued at over $800 million. To demonstrate the importance of these operations, in 1996 15% of the oil and 27% of the natural gas produced in the United States, valued at over $16 billion, came from the Gulf of Mexico. Production is expected to double from these levels by the year 2000 and double again by 2005. These projections come from the Mineral Management Service (MMS), a component of the United States Department of Interior.

MMS considers the Gulf to be the most important location worldwide to search for oil in the next 2 decades. One can expect that the level of helicopter services will increase significantly.

The objectives of this Engineering Needs Assessment (ENA) are to:

- describe the offshore airspace operational environment in the Gulf of Mexico; and
- identify the user and service provider needs to improve efficiency, maintain or improve safety, and meet the forecasted demand for increased operations resulting from projected growth of the helicopter fleet.

The approach used to accomplish these objectives consisted of:

- reviewing the available documentation of GoMex operations and systems (presented as Appendix B);
- interviewing the FAA Southwest Region (ASW) personnel responsible for providing Air Traffic Control (ATC) services in Houston Center's Offshore Sector;
- conducting interviews with helicopter operators serving the oil industry in the Gulf of Mexico;
- attending several of the Helicopter Safety Advisory Conference (HSAC) meetings; and,

- visiting two of the Gulf operators' helicopter operations centers, including a helicopter flight to an operational drilling rig.

This report focuses on the most dominant users of the GoMex low altitude, offshore airspace, the companies that own the total helicopter fleet that provides service to the oil industry. However, it is recognized that there are a certain number of general aviation, fish spotter, U.S. Coast Guard (USCG), Department of Defense (DOD), U.S. Customs, and Drug Enforcement Agency (DEA) aircraft that also utilize this airspace. The capabilities and needs of these other users have not been evaluated and are not included in this report.

The information gathered from the data sources identified above has been integrated and synthesized into a comprehensive description of the GoMex operational capabilities and an identification of services provider and user needs. Draft copies of this report were furnished to the service providers and to the rotorcraft operators in order to insure that the information presented was comprehensive and accurate. A final meeting with the reviewers was conducted in January 1999 to gather their comments. These comments have been incorporated into this final version of the ENA.

This document is organized as follows. Chapter 2 presents the GoMex environment in terms of operational capabilities in two categories, Offshore Operations and Offshore Systems. Chapter 3 presents a discussion of the GoMex user and service provider needs. An overall summary of the major findings of the ENA is presented in Chapter 4. Appendix A is a glossary of acronyms and Appendix B references the documents used in the development of this report.

2.0 GoMex CAPABILITIES

The capabilities reflected in the Gulf of Mexico offshore area are categorized according to Offshore Operations and Offshore Systems with sub-categories as follows:

Offshore Operations

- Fleet Characteristics
- Area of Operation
- VFR/IFR Operations

Offshore Systems

- Communications
- Navigation and Landing
- Surveillance
- Weather
- Automation

2.1 Offshore Operations

Fleet Characteristics:
The following paragraphs present fleet composition and operations statistics for the helicopter fleet serving the oil and gas industry in the Gulf of Mexico. The data indicate a growing trend in numbers of helicopters, operations, and passengers carried. This trend is expected to continue as oil and gas operations move further offshore. Table 2.1 (obtained from HSAC) presents a 1997 Gulf of Mexico Offshore Helicopter Operations and Safety review and is the principal basis for the following discussion of Fleet Statistics and Fleet Operations.

Fleet Statistics: In 1997, approximately 25 operators using 636 helicopters supported the offshore operation. With the continuing demand for oil and gas exploration, the number of helicopters is expected to approach 800 by 2005. Helicopters normally operate at low altitudes. Visual Flight Rules (VFR) operations are normally conducted at 3,500 feet or below and Instrument Flight Rules (IFR) operations at 7,000 feet or below.

Helicopter operators fall into two categories: operators conducting flights under Title 14, Code of Federal Regulations (CFR) Part 91 who transport their own employees with about 8% of the fleet, and operators conducting flights for hire under Title 14 CFR Part 135. About 80% of the total helicopter fleet are single-pilot, single-engine, and certified for VFR flight only. While all aircraft can operate in the VFR environment, about 20% are equipped to operate in the IFR environment. [Note that the Federal Air Regulations (FAR) nomenclature has recently been changed to CFR.]

Table 2.1 HSAC Operations and Safety Review

Helicopter Safety Advisory Conference (HSAC)

1997 GULF OF MEXICO (GOM) OFFSHORE HELICOPTER OPERATIONS & SAFETY REVIEW

FIVE YEAR GOM OFFSHORE HELICOPTER OPERATIONAL DATA

YEAR	TYPE HELICOPTER					PASSENGERS CARRIED	HOURS FLOWN	NUMBER OF FLIGHTS
	SINGLE ENGINE (SE)	LIGHT TWIN (LT)	MEDIUM TWIN (MT)	HEAVY TWIN (HT)	TOTAL FLEET			
1993	372	136	103	NR	611	3,363,982	420,013	1,543,863
1994	334	138	87	NR	559	2,978,150	397,016	1,408,831
1995	313	117	133	NR	563	3,483,152	413,314	1,527,318
1996	321	102	117	NR	540	3,579,345	441,797	1,668,401
1997	380	114	131	11	636	3,759,642	471,513	1,705,629

Note: 1997 data based on information from 25 helicopter operators

NR = Not Reported Previously

1997 GOM HELICOPTER FLEET OPERATIONAL DATA (from 25 Operators)

Passengers per Day per 5 Day Week	14,640	Annual Hours Per Aircraft	741
Flights Per Day	4,673	Flights Per Aircraft	2,682
Average Flight Duration in Min.	17	Passengers Flown Per Year	5,911

1997 GOM OFFSHORE HELCOPTER ACCIDENT DATA

NUMBER OF ACCIDENTS				INJURY CLASSIFICATION					AIRCRAFT DAMAGES			RATES		
Aircraft Category				Injuries		Severity			Classification			Accidents Per 100,000		
Type Aircraft	# Accidents	# Fatal	# Eng Related	Pax	Crew	Minor	Serious	Fatal	Minor	Substantial	Total Loss	Flight Hours	Fatal Acc 100k Hrs	100k Flights
SE	5	1	1	6	3	7	2	1	1	2	3	1.73	0.35	0.45
LT	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
MT	1	0	0	0	2	0	2	0	0	0	1	0.91	0.00	0.30
HT	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Totals	6	1*	1	6	5	7	4	1	1	2	4	1.27	0.21	0.35

* One mid-air collision resulted in damages to two aircraft.

1997 GOM OFFSHORE HELICOPTER ACCIDENT CAUSES/INFO

	ENGINE	BIRD STRIKE	WEATHER	TAIL ROTOR	MID AIR	HELIDECK DESIGN/SIZE	INJURIES DUE TO ENGINE
Single Eng	1	1	1	1	1	0	0
Light Twin	0	0	0	0	0	0	0
Med Twin	0	0	1	0	0	0	0
Hvy Twin	0	0	0	0	0	0	0

None of the above causes are official. During 1997, there was one single engine ditching due to tail rotor system malfunction, not recorded as an accident by the FAA. There were 3 ONSHORE (non offshore related) oil exploration seismic accidents in the GOM area, suspected to be tail rotor malfunction (2), and pilot induced (1). Leading suspected causes of ALL oil indutry accidents in the GOM area both onshore and offshore were tail rotor system malfunction (3) and weather related (2).

FIVE YEAR GOM OFFSHORE HELICOPTER ACCIDENT DATA

NUMER OF ACCIDENTS				INJURY CLASSIFICATION					AIRCRAFT DAMAGES			RATES		
Aircraft Category				Injuries		Severity			Classification			Accidents Per 100,000		
Year	# Accidents	# Fatal	# Eng Related	Pax	Crew	Minor	Serious	Fatal	Minor	Substantial	Total Loss	Flight Hours	Fatal Acc 100k Hrs	Flights
1993	7	1	NR	7	7	13	0	1	1	1	5	1.66	0.24	0.45
1994	3	3	NR	9	2	0	1	10	0	0	3	0.76	0.76	0.21
1995	5	3	NR	7	3	1	1	8	1	1	3	1.21	0.73	0.33
1996	7	4	NR	7	4	0	0	11	1	2	4	1.58	0.91	0.42
1997	6	1	1	6	5	7	4	1	1	2	4	1.27	0.21	0.35

As a service to HSAC Membership, this GOM Offshore Helicopter Statistical Report is compiled annually from information submitted voluntarily by the membership. The information is neither verified nor reviewed for accuracy and should be treated as unofficial. The data is believed to be representative; however, HSAC assumes no liability for accuracy or completeness.

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Fleet Operations: Helicopter operations are characterized by heavy traffic with operations ranging from 4,000 to 9,000 flights daily. The higher number of operations occurs on crew change days, typically Tuesdays through Thursdays. The distance from a takeoff to the next landing constitutes a flight and may vary from hundreds of feet between offshore facilities to over 200 nautical miles in support of deepwater exploration projects. The average flight duration is 17 minutes consisting of shore-to-platform, platform-to-platform, and platform-to-shore operations. Almost 10,000 passengers are carried each day (based on a 7-day week, this works out to 70,000 passengers/week) on nearly 5,000 flights or on average about 2 passengers per flight. Over 3.6 million passengers are transported by helicopter each year. Offshore jobs support about 50,000 people. Because of schedules, e.g., 2 weeks on and then 1 week off, the actual number working offshore at any given time is about 35,000.

Analysis of data contained in the Petroleum Helicopters, Inc. (PHI) Annual Report for 1998 indicates that while approximately 20% of their fleet of about 278 helicopters is IFR equipped, over 40% of the available passenger seats are provided by the IFR fleet. According to the FAA's Draft Gulf of Mexico Program Mission Needs Statement, "The accepted level of traffic for the offshore sector is currently 25-30 per hour. During IFR days, moderate levels of traffic (10-12 operations at the same time) can cause delays to reach an hour or longer." This indicates the potential for more IFR flights should significant improvements to the IFR system be implemented.

Returning to Table 2.1, helicopter operations including passengers carried, hours flown and number of flights have increased by 26%, 19% and 21% respectively since 1994. If these trends continue, the users and service providers may find it necessary to meet these increases in demand with the application of new and emerging technologies (e.g., satellite communications, tiltrotor aircraft) and revised ATC procedures consistent with the needs.

Other operations are conducted in the Gulf: fish-spotting, usually at altitudes from 800 to 3,000 feet, and within 20 nautical miles of shore; DEA aircraft; low altitude USCG missions (some at 250 knots); and, other low-altitude general aviation (GA) aircraft. The Gulf of Mexico has a significant amount of military Special Use Airspace (SUA), consisting mostly of Warning Areas. These Warnings Areas do not prohibit entry to aircraft operating VFR; however, these flights operate at their own risk. IFR aircraft are also at risk due to potential spill-outs (i.e., military aircraft accidentally exiting the SUA during exercises) from the Warning Areas.

Approximately 6 accidents occur per year. Half of these involve fatalities. On average, 4 helicopters per year are damaged beyond repair. Additional accident data are provided in Table 2.1. These data include specific accident information for the five year period from 1993 to 1997 with additional detail provided for the year 1997 including injuries, and damage by aircraft type as well as accident causes by aircraft type.

According to Robert Williams, Vice Chairman, Exploration and Production (E&P) Forum Aviation Subcommittee: "The offshore helicopter accident rates are favorable when compared to rates for both helicopter and airplane operations outside the oil industry. For example, the accident rate per 100,000 hours for all commercial helicopter operations in the U.S. was 3.33 and the fatal rate 0.76 while the E&P Forum rate world-wide was 1.16 and 0.35 respectively" (based on 1997 data). According to Table 2.1, the corresponding average rates for the Gulf of Mexico over the five year period from 1993 to 1997 were 1.30 and 0.57 respectively. The corresponding five year world-wide offshore helicopter accident data rates are 1.45 and 0.73 respectively. The Gulf of Mexico accident statistics are thus favorable compared to world-wide rates and to U.S commercial helicopter rates.

Avionics: The majority of the fleet flies with VFR avionics, which includes a single 720 channel Very High Frequency-Amplitude Modulation (VHF-AM) communications transceiver, a 180-channel VOR receiver, Mode-3 A/C transponder, and Global Positioning System (GPS) or LORAN-C receiver for area navigation. Most users are currently transitioning from LORAN-C to GPS basic equipment.

The FAA must certify all equipment in the aircraft used for navigation, communication, and surveillance. Manufacturers must build equipment to government requirements and receive FAA certification before making it available to aircraft operators. For example, as new GPS receivers are certified for helicopter use, manufacturers must conduct factory demonstrations and flight-tests to show that they are in compliance with the government requirements. After installation, FAA inspectors observe in-flight operation to ensure that systems perform as required.

As of the summer of 1998, about 55% of the fleet had GPS installed. By October 8, 1998 100% of the IFR equipped helicopters were outfitted with Technical Standard Order (TSO) C-129 GPS navigators. Ultimately 100% of the fleet will be equipped with GPS. However, some delay will be incurred since operators prefer to wait until they purchase new helicopters outfitted with GPS rather than install GPS on older helicopters.

There are 131 medium twin and 11 heavy twin helicopters that are IFR equipped and certified to perform offshore IFR instrument approach or descent procedures. Examples of PHI helicopter equipage are shown below in Table 2.2. In addition to the normal communications, navigation, and surveillance avionics required for IFR operations, weather radar systems are also required for offshore IFR operations. IFR equipped aircraft use weather radar in mapping mode for obstacle detection during approach and landing on an offshore helideck.

Table 2.2 PHI Helicopter Equipage Examples

	IFR CAPABLE	VHF	LORAN	GPS	VOR	ADF	ELT	AFCS	RADAR
BELL206B		X	X	X			X		
BELL206L-1		X	X				X		
BELL206L-4		X		X			X		
BELL407		X		X			X		
AS350B		X		X			X		
MBB 105CBS		X	X				X		
BELL212	X	X	X	X	X	X	X	X	X
BELL412	X	X	X	X	X	X	X	X	X
SIKORSKY-76	X	X	X	X	X	X	X	X	X
BELL214ST	X	X	X	X	X	X	X	X	X

Area of Operation:

The Gulf's oil and gas exploration and production activities are located along 600 nautical miles (nm) between Brownsville, TX and Pensacola, FL out to 200 nm offshore. Current exploration and production efforts are extending this area further offshore to the south and east. Onshore bases support the flow of equipment and personnel to offshore locations.

The Gulf of Mexico low-altitude Offshore Sector is dominated by helicopter operations in support of offshore oil and gas exploration and production. Houston Air Route Traffic Control Center (ARTCC), five adjacent Terminal Radar Approach Control (TRACON) facilities, and two Automated Flight Service Stations (AFSS) support operations in the Offshore Sector.

The FAA classifies 17 areas along the coast as high-density helicopter operating areas, with hundreds of heliports and landing areas. These areas are concentrated at key coastal points to reduce operational and maintenance overhead. Current locations of the onshore facilities are shown in Figure 2.1. Table 2.3 separates the onshore facilities into 31 onshore hubs with 325 heliports that support operations to over 2,000 offshore structures with helidecks. The offshore structures consist of platforms, rigs, barges, and seismic vessels.

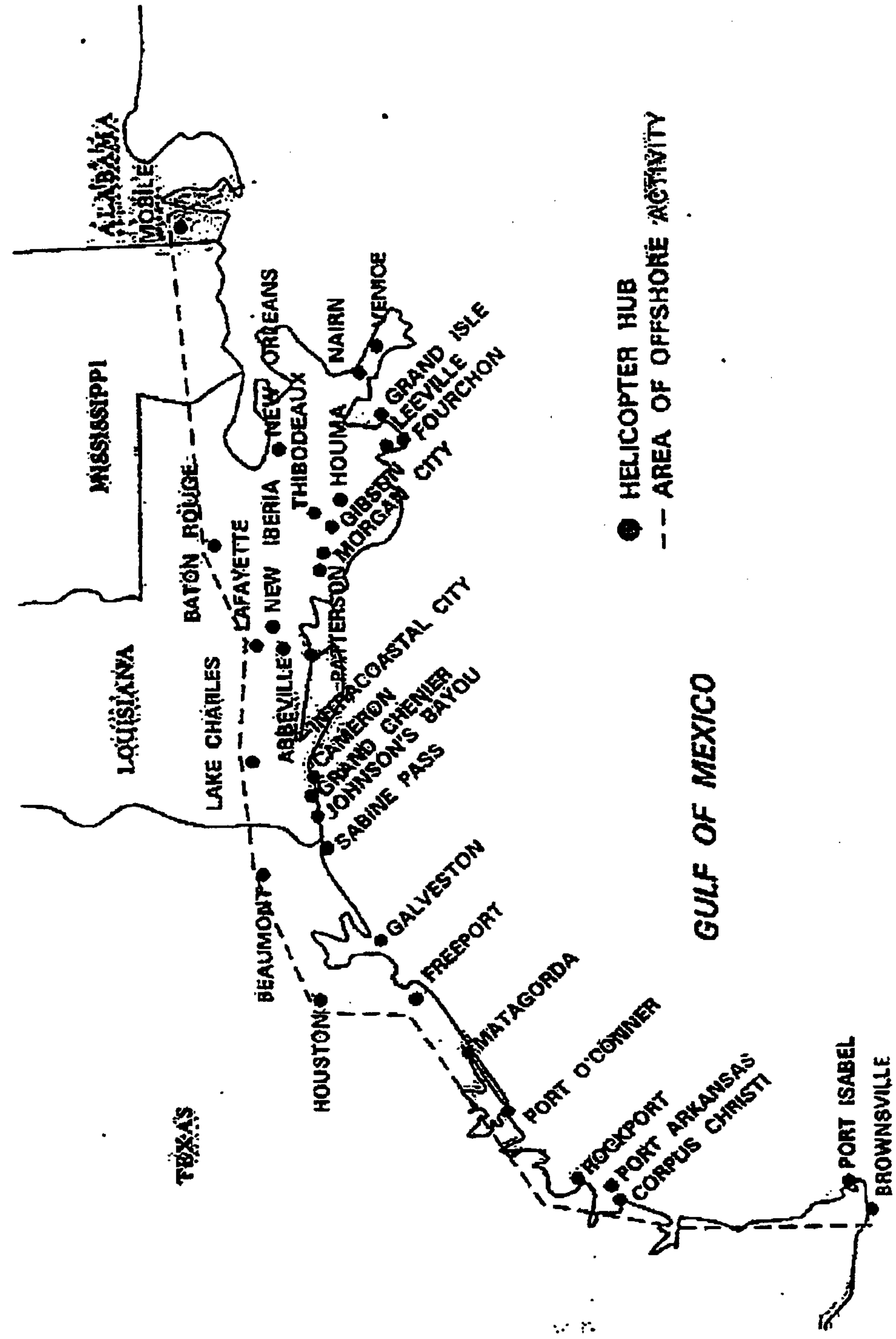

Figure 2.1 Onshore Helicopter Hubs

Table 2.3 Helicopter Landing Areas, 1996

Onshore Hubs and Heliports	
Hubs	31
Heliports	325
Offshore Helidecks	
Platforms	1981
Rigs	256
Barges	17
Seismic Vessels	16

VFR/IFR Operations:
HSAC and the Gulf Operators that were interviewed have stated that approximately 95% of helicopter operations are presently conducted under VFR and 5% under IFR. Interviews with the users have revealed that a significant number of days with marginal VFR conditions (low ceiling or visibility) exist in the Gulf and that VFR helicopters will fly under these conditions when necessary.

IFR equipped helicopters may operate either under IFR or VFR rules, depending on the prevailing weather conditions and the basic weather minimums listed in the CFRs for the airspace of intended flight. When the weather falls below VFR minimums, the helicopters must operate under IFR.

Helicopters typically operate over the Gulf under VFR without utilizing Air Traffic Control (ATC) separation services. In areas where radar coverage is available, ATC routinely provides VFR Flight Following services. When flights cannot be conducted under VFR conditions, the low operating altitudes and line-of-sight limitations on communications and radar signals limit FAA surveillance and make mandatory the use of non-radar separation standards.

Based on FAA Order 7110.65 and the Airman's Information Manual radar separation standards for aircraft at the same altitude are a minimum of three miles for aircraft operating within 40 miles of the radar and five miles for aircraft operating beyond 40 miles from the radar. Vertical separations are established at 1,000 feet below flight level (FL) 290 and at 2,000 feet above FL 290. In non-radar airspace, longitudinal separations of 20 nm or 10 minutes are generally applied unless separation is achieved by means of specified time of departure, specified time of arrival at a fix, or hold for a specified time at a fix.

Non-radar separation standards in use in the Gulf also require a lateral protected airspace of 6 miles each side of course between two aircraft on parallel courses. These standards require air traffic separation that is much greater than radar separation and, therefore, cannot accommodate the efficient movement of large numbers of helicopters.

Users flying VFR can fly direct routes of their own choice, without filing a flight plan, minimizing time en route and fuel consumption. Companies such as Chevron, which own and operate their own helicopters, operated under CFR Part 91, and transport their own employees without the requirement for VFR Flight Following. In contrast CFR Part 135 operators are required to perform VFR Flight Following when carrying passengers. VFR Flight Following currently requires communications between helicopters and company operations centers for receiving and processing pilot position reports. VFR Flight Following is described by CFR Part 135; Sec. 135.79.

As exploration moves further from shore, larger helicopters will be required to handle the movement of people and equipment. The fleet is expected to grow, maintaining 20% of the helicopters capable of operating under IFR. As the IFR system becomes more efficient, it is expected that the number of IFR operations will increase, in particular, in marginal VFR conditions. HSAC estimates that delay due to IFR conditions can cost the oil companies in excess of $250,000 per hour in crew overtime and other operating costs.

Houston ARTCC operates a radio communications network with limited offshore coverage. Currently, the FAA has 2 frequencies operated from 6 locations that provide limited offshore communications capability. Most traffic in the low-altitude Offshore Sector is beyond ATC radio coverage, and requires secondary relay of messages through the Automated Flight Service Stations, company channels and/or by other aircraft. VFR flights do not contact Houston ARTCC and receive all services (e.g., VFR Flight Following) from company resources.

IFR flights must use onshore telephone or radio to initiate flight plans. All in-flight communications from ATC (e.g., clearances, closings, altitude and speed instructions) beyond the range of FAA radio coverage must be forwarded between Houston ARTCC and company operations centers. According to the FAA's Gulf Mission Needs Statement, direct communications between controllers and offshore aircraft are required in order to increase capacity and improve operational efficiencies in the offshore airspace.

The following paragraphs describe the VFR and IFR operations in the Gulf of Mexico.

VFR Operations: For autonomy, flexibility, efficiency, and economy, operators prefer to operate using VFR. They have on average 320 to 340 days per year of visual meteorological conditions (VMC) although ceilings and visibility can vary between marginal VFR and VFR. In addition, during some number of days with low ceiling and visibility, operations are constrained to operate below the cloud layer and at lower altitudes than they might ordinarily fly. This results in an increase in the density of flight operations per available altitude that could lead to an increased risk of flight path incursions. The problem is exacerbated by the lack of traffic advisories that cannot be provided because of the lack of surveillance coverage.

Normally, aircraft are required to file Defense VFR (DVFR) flight plans. However, this requirement may be waived for aircraft conducting oil-related operations and fish spotting activities within the Air Defense Identification Zone (ADIZ), North of 28°

N latitude. Operators request waivers to CFR 99.11 (ADIZ Flight Plan Requirements), which, after a review by North American Air Defense Command (NORAD), are issued by, and filed at Houston ARTCC. However, due to the lack of surveillance coverage, this procedure leads to intercepts of unidentified flights by the military. In 1998, 87 intercepts were launched against VFR helicopters costing $16,000 per intercept, based on DOD estimates, for a total of about $1.4M.

VFR Flight Following is required for Part 135 operations. Although not required for Part 91 operators, flight following capabilities are desired. Flight following systems for VFR operations vary widely in capacity, accuracy, and update frequency. Capabilities range from: pilot reports at takeoff, coastal crossing, and arrival via VHF radio and manual entry of the information at the operations center; to, automatic flight following with update rates ranging from 30-60 seconds relayed by VHF radios and remote microwave or satellite data links to the company operations center computers.

The sequence of events for a routine helicopter flight starts with a pre-flight briefing. Weather at the destination, as well as departure point and en route, is checked. Sometimes the weather is checked again if conditions had been marginal. At larger heliports, there is a common frequency used to clear takeoffs. After rising several feet and hovering, the pilot announces takeoff. The pilot notifies company operations by radio when he/she reaches open water. Flights are often 500 feet or below in a single engine helicopter operating VFR over water. There is limited night flying since it is considered hazardous by the companies because of the potential for spatial disorientation. Medical emergencies or delivery of necessary critical parts are generally the only reasons that night flights are permitted or scheduled. For the approach and landing, wind direction is critical. Wind conditions are checked either using radio contact with the rig or by flying close to the rig and observing the windsock. The rig or platform is then called to alert them to prepare the landing environment which includes crash-fire-rescue where available. Depending upon flight objectives the pilot then either returns to the onshore base or flies to another rig or platform.

IFR Operations: The 142 (i.e., 131 medium twin + 11 heavy twin helicopters in Table 2.1) dual-pilot, dual-engine IFR-capable helicopters are used when larger payloads are required or for more distant Gulf operations. Specialized pilot training is required to fly IFR in the Gulf of Mexico offshore airspace. IFR operations begin with pilots receiving weather information from company dispatchers, Automated Weather Observing System (AWOS), or certified weather observers located throughout the Gulf. Pilots file flight plans with the appropriate Flight Service Station (FSS) via commercial telephone, VHF voice communications, Direct User Access Terminal (DUAT), or with Houston ARTCC via VHF voice communications. Flight planning includes determining the passenger list, cargo list, fuel requirements for destination, alternate and return plus a 30-minute fuel reserve. IFR clearances are relayed through company dispatchers and pilots via commercial telephone, prior to boarding the aircraft on the helipad. Other aircraft within the range of FAA communications may relay ATC clearances and instructions. Dispatchers and FSSs may issue weather updates.

IFR filing criteria require an alternate destination if either forecast or reported weather (ceiling and visibility) is not at or above 2,000 ft and 3 statute miles for at least 1 hour before and after the estimated time of arrival. (Instrument Meteorological Conditions (IMC) exist when the ceiling is less than or equal to 1,000 ft and the visibility is less than or equal to 3 miles). An approved alternate facility must have fuel available, positive VHF communications, and forecast or reported weather at or above 800 ft and 2 miles visibility.

ATC surveillance and communication coverage at the platform level is limited. ATC surveillance coverage at the onshore hubs is also limited. As a result, IFR service to helicopters operating in these areas is based on non-radar procedures and is commonly referred to as a "one in/one out" operation. This can generate delays of 1 or more hours in IMC conditions.

Specific IFR operational difficulties for the Galveston, Intercoastal City and Grand Isle locations have been reported by company pilots to PHI and were provided by PHI for use in this report. These locations span the Gulf Coast (see Figure 2.1) and are, therefore, representative of operational difficulties encountered in the Offshore Sector. The pilots' comments are quoted below:

- Galveston: "The biggest problem was communications. The drill ship was 135 nm south of Galveston. Communications with Houston Center is a problem 100 nm out at 5,000 ft and below. Communications with PHI Comm Center is a problem 100 nm out at 1,000 ft and below. Usually we could request our inbound clearance while we were still at altitude. They would give us a long Void time (30-40 minutes) if we were the only traffic in the area. The other option was to shut down on the drill ship and use the phone to get our clearance. The Void time had to be almost as long so that we could get back to the aircraft and in the air to meet the Void time. Houston approach's remote site (communications) at Galveston did not work last spring or summer. We had to be less than 10 nm from Galveston to talk to them. Houston approach controls the airspace at Galveston. The nearest offshore weather is 100 miles from the drill ship."

- Intracoastal City: "Communications with Houston Center is a problem (95 nm out and 500 ft and below). Most of the time you are relaying information to Houston Center through other aircraft or you are requesting information from Houston through other aircraft. Weather requests from non-PHI weather sources once you are airborne are not normally of any use because it usually gets to you too late."

- Grand Isle: "Our IFR from Grand Isle suffers mostly from the lack of offshore weather reporting. Right now all we really have is: Fourchon, Grand Isle, Venice and MP299 (AWOS). There is a competitor's weather station in the South Timbalier area but (we are) never able to get an official weather report. Usually "It looks pretty good." Therefore, there are times we have to resort to the FAGX (Gulf Coast Forecast) and are only able to use HEDAs (Helicopter En Route Descent Areas). As for communications, we have the repeaters here at Grand Isle and an RCO (Remote Communications Outlet) at ST 172C; the only real problem area is out about 55 nm southeast in the South Pass and MC 280 area. We are usually unable to talk to Houston Center below 1,000 ft and have to rely on the Grand Isle communications people to close flight plans and request clearances via phone. Sometimes the inbound clearance is delayed because of Houston Center workload and our people are put on hold. Sometimes up to 20 minutes."

The FAA's Southwest Region and HSAC have worked together to develop an IFR navigational route structure in the Gulf of Mexico that, while increasing capacity and enhancing safety, would decrease pilot and controller workload. On October 8, 1998 the "Grid System" was implemented. The grid replaced an IFR route structure in mostly non-radar airspace that utilized LORAN-C and radials from shore based VORs. Because of the inflexible route structure, IFR flights, under the old system, routinely required aircraft to fly several miles off of a direct routes and resulted in additional workload for ATC. IFR delays frequently exceeded one hour. According to James Karanian in his recent article, "The Future is Now: The Gulf of Mexico Grid System", this system will:

- utilize satellite (GPS) navigation for a point-to-point navigation capability resulting in substantial fuel and time savings;
- increase capacity thereby allowing more IFR operations which in turn will create relief from delays and the associated costs;
- reduce workload of controllers and flight crews;
- make IFR flights in marginal VMC conditions more appealing than choosing to fly VFR to avoid delays; and
- accomplish all of the above with the understanding there will be no direct FAA budget support.

The grid, shown in Figure 2.2, is comprised of a set of en route waypoints, positioned every 20 minutes of latitude and longitude, extending along the U.S. coast from Brownsville, Texas, to Mobile, Alabama, and extending southward to the Mexico FIR boundary. The 20 minutes of latitude equates to 20 nm and the northernmost waypoints are no closer longitudinally than 17.43 nm. This distance assures ATC separation (lateral protected airspace of 6 nm each side of course) between two aircraft on parallel courses utilizing adjacent waypoints within the grid.

There are three requirements for operating IFR using the grid:

- the aircraft must be equipped with (TSO C-129) certified GPS navigational equipment;

- each operator must receive approval from a Principal Operations Inspector at the appropriate Flight Standards District Office; and
- each operator must be a signatory to the Houston ARTCC Offshore IFR Helicopter Operations Letter of Agreement.

The pilot executes an instrument descent approach using either Offshore Standard Approach Procedures (OSAP) or the Helicopter En Route Descent Area letdown plates until encountering Visual Meteorological Conditions (VMC).

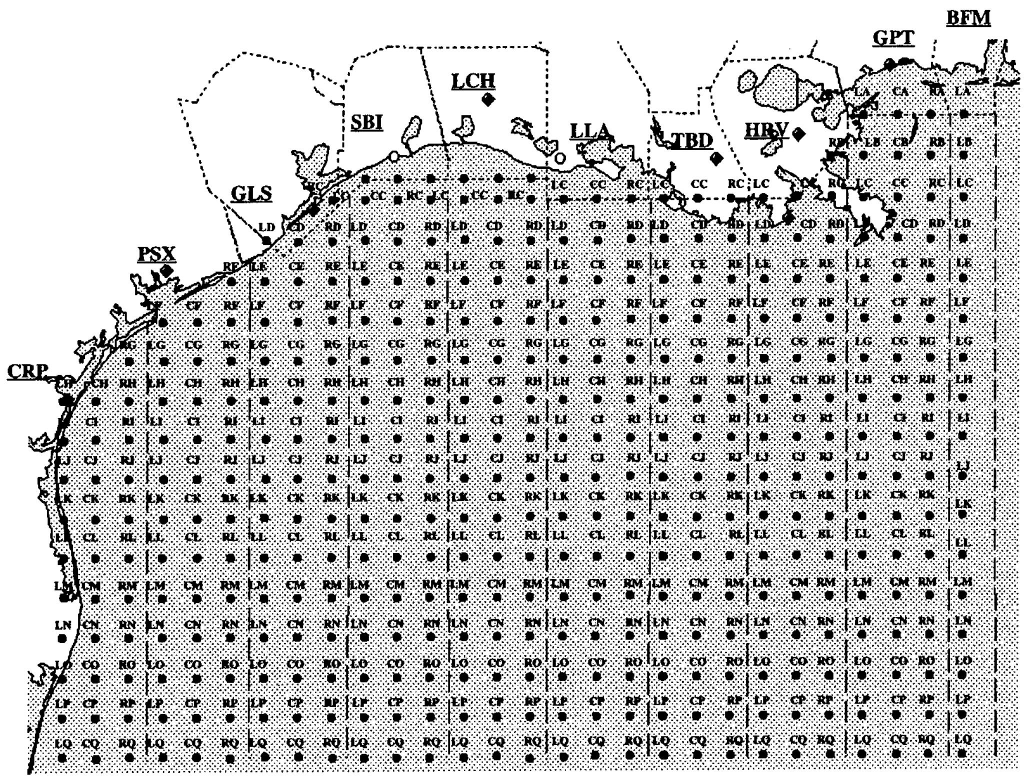

Figure 2.2 GPS Waypoint Grid

2.2 Offshore Systems

The following paragraphs describe the systems currently available to support offshore operations.

Communications:
Companies operating in the Gulf currently use their own communications systems, typically consisting of dedicated VHF radio frequencies for analog voice. Air-to-ground transmissions are relayed remotely by microwave repeaters. Companies use their own communications systems for company-proprietary information, flight following operations, and the relay of ATC information.

GoMex communications networks encounter line-of-sight limitations, low-altitude VHF radio coverage gaps, and maintenance problems due to the physical locations on oil rigs. Pilots currently relay the closing of their flight plans via company radios, other aircraft, or through an FSS. Company communications personnel are required to relay all clearances and air traffic instructions verbatim, including cancellations of ATC clearances and reports of non-delivery of clearances. This relay of information increases the probability of errors and inhibits efficient operations. Delays to the following aircraft may also occur when users who descend below VHF radio coverage cannot report closure of flight plans to ATC.

Current procedures for arrival at major multi-company bases (e.g., Intracoastal City, LA) include use of a common advisory frequency for VFR and a discrete frequency for IFR traffic. Since pilots in VFR and IFR aircraft do not operate on the same frequency, a mix of uncontrolled VFR and IFR traffic may result during low visibility conditions in the offshore airspace.

All offshore helipads have two-way communications for coordination with inbound traffic. Several offshore operators have placed manned or remote-relay flight following facilities in key areas to track aircraft and provide voice-only broadcast warnings of severe weather. The Shell Corporation's Gulfnet 6000 Network, Petrocomm, Datacom, and SOLA Communications and Consortium Partners are examples of industry communications networks.

Gulfnet 6000 is a digital network that is based on a backbone consisting of a set of relays established on oil platforms. A digital microwave link provides communication from platforms to the shore. The Petrocomm system has the capability to use satellites as a back link to the shore.

Navigation and Landing:
The Gulf has excellent GPS coverage because of latitudes near the equator. Most helicopters operating in the Offshore Sector are being transitioned to GPS for navigation. In the case of IFR operations, GPS is now the primary means of navigation. Very few problems have been encountered with GPS, which has proved to have greater accuracy,

reliability, and availability than LORAN-C during its three years of use. However, due to unresolved issues of signal integrity, GPS is not currently approved as a sole means of navigation. This means that aircraft must carry other navigation devices (such as VOR) that are approved for sole means navigation.

The new GPS grid for offshore IFR en route navigation, described in the IFR Operations section, allows greater flexibility in routing. Twenty-nine new GPS special Standard Instrument Approaches (SIAPs) to onshore locations were implemented in October 1998.

On-board weather radar is required for obstacle clearance for all offshore IFR operations. The existing offshore routing system, the related onshore and offshore approach and departure infrastructure, and flight following procedures have been revised to incorporate GPS positioning.

Surveillance:
ATC radar surveillance is virtually non-existent in the Offshore Sector due to line-of-sight limitations. Helicopter operators have developed VFR Flight Following methods, which provides an estimate of the locations of aircraft from pilot position reports and/or automated position-reporting systems.

For example, Chevron uses a system based on the Loran Offshore Flight Following (LOFF) system that was developed in the 1970s. Implementation of LOFF was deferred as a result of the ATC controllers strike in 1981. The existing Chevron system, known as FLT TRAK, is based on transmitting aircraft-derived position data via an analog data link to a shore-based operations center. Position reports received at the center are processed and displayed, and are tracked by operations personnel. According to Chevron, the cost of the microwave link to shore is $250,000 per year. This includes two frequencies, one for voice and one for data. Because of the limited number of aircraft using FLT TRAK, the cost per hour of aircraft usage is on the order of $10.00 per hour.

Note that the Chevron operations fall under CFR Part 91 requirements and flight following is not legally required. However, Chevron has voluntarily elected to implement FLT TRAK.

PHI uses an alternative method that relies on pilot-initiated position reports. This method relies on communications from the pilot to the company dispatcher located at an onshore operations center. Position reports received at the Center are manually entered into this system by the dispatcher and displayed. An alarm mechanism triggers if a pilot does not report position within the required time interval. Both the Chevron and the PHI systems are used solely to provide a flight following capability and are not used for separation of helicopters.

See-and-avoid is the only available mechanism for air-to-air separation assurance presently used by the helicopters serving the oil industry in the Gulf of Mexico. However, operators have been evaluating, on a small scale, the Ryan TCAD and the B.F. Goodrich "Skywatch" systems, which are both aimed at enhancing pilot awareness of nearby aircraft. Other users including the military and the Coast Guard have some aircraft equipped with the Traffic Alert and Collision Avoidance System (TCAS).

Weather:

The companies currently obtain National Weather Service (NWS) data three times each day. In addition, FSS standard products and company radio-relay of weather activity from automated weather stations or certified weather observers located on platforms are available. Figure 2.3 illustrates the locations of Automated Weather Observation Stations (AWOS), Supplementary Aviation Weather Reporting Stations (SAWRS), and the Next Generation Automated Weather Observation Stations (NEXWOS). It also depicts the NWS buoys in the Gulf, indicated in the figure by the nomenclature NWS 42001,2,3 and NWS 41003. Another source of weather information is from pilot reports (PIREPs). Pilots have a responsibility to report significant weather conditions and will frequently relay this information to the operations centers and to other pilots.

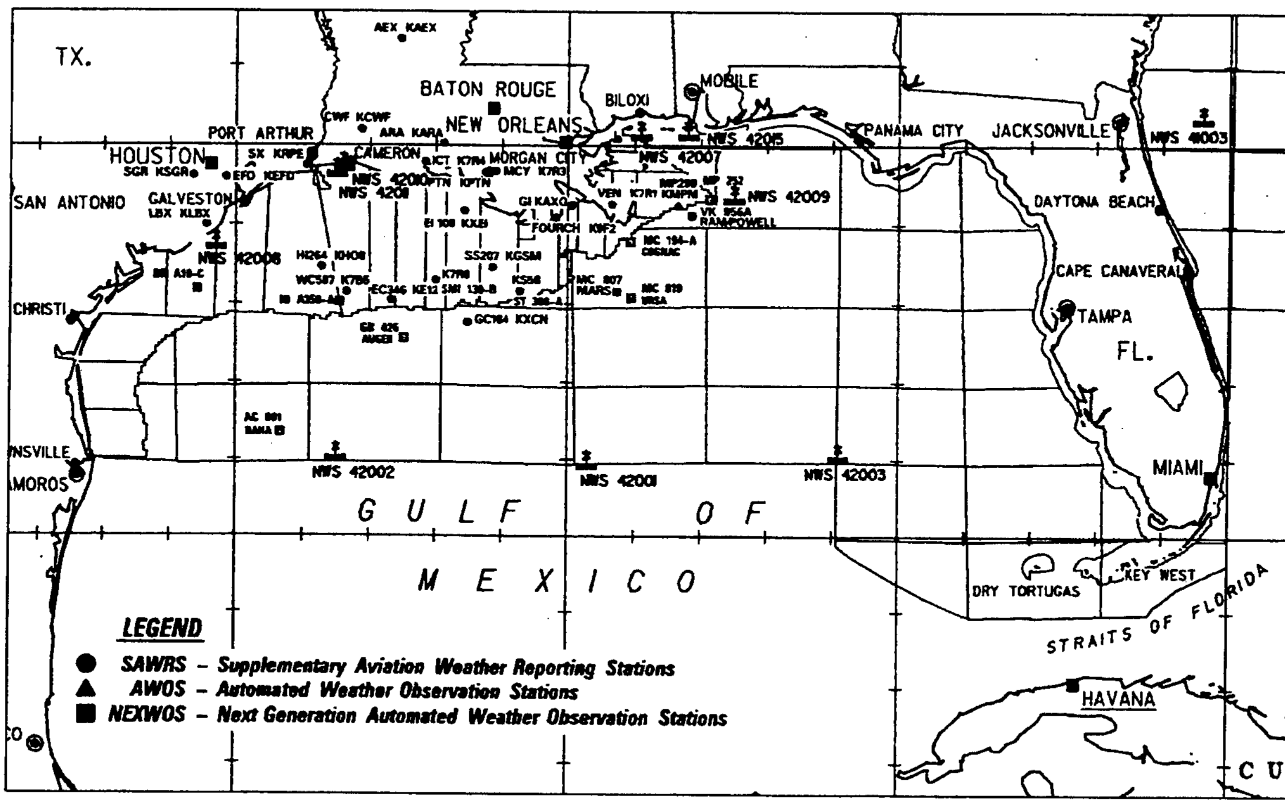

Figure 2.3 Weather Sources

Offshore Part 135 operators need weather reports within several miles of their point of landing in order to initiate an instrument approach. Specifically, a flight plan to an IFR destination without the required weather observations may be filed provided:

1. *It is an offshore destination*
2. *It has weather observations taken by observers at two different stations meeting the requirements of FAR 135.213(b) within an area not to exceed forty nautical miles between observation points. The observation coverage area may not exceed the distance between the observation sites + ten nautical miles at either end and may not have a lateral width greater than forty miles either side of the center point between the lateral width dimension. For example if the stations are forty nautical miles apart, a rectangle sixty nautical miles in length and eighty miles in width at its widest point would be the approved coverage area or,*
3. *It has one station with weather observations within ten nautical miles of the destination that meets the requirements of FAR 135.213(a).*

This set of conditions has been quoted directly from the Chevron Operations Specifications, Section A5.b. Several offshore operators have weather observers in key areas to provide the weather observations needed for offshore IFR approach and landing as well as to provide voice-only broadcast warnings for severe weather.

Automation:
Currently flight following systems such as the Chevron FLT TRAK system are the only automated systems in use. Chevron is presently experimenting with a commercial system that provides automated flight following capability using satellite technology.

The Southwest Region and HSAC personnel are looking at new approaches to improve operations in the Gulf (see referenced article, "The Future is Now: The Gulf of Mexico Grid System"). Two new applications currently being developed are "Automated Mapping" and "Flight Progress Reporting": Automated Mapping, a proposed PC-based tool, may provide controllers enhanced mapping capabilities within their non-radar offshore airspace. Currently, a controller has to rise physically from his/her control position in order to plot a helicopter's route and protected airspace, using a ruler and grease pencil. The planned automated mapping tool will display route and protected airspace information automatically, at the controller's position.

The other PC-based tool, Flight Progress Reporting (FLIPR) may be integrated into the automated mapping tool. FLIPR will have the ability to display pilot progress reports sent by company data link. The intent is for non-verbal progress reports to be utilized for continuous updates of where the aircraft has been, thus allowing more efficient use of non-radar airspace.

3.0 GoMex NEEDS ASSESSMENT

Improvements in navigation, surveillance, communications, weather, and automation services will benefit users and service providers. The constraints on current user operations described in Section 2.1 and the system limitations described in Section 2.2 have led the users and the FAA to cooperate actively in joint efforts to improve the safety and efficiency of Gulf operations.

The following needs assessment is the result of interviews with users and service providers; data collection and site visits to the Houston ARTCC and oil and industry flight operations support centers of PHI and Chevron; and discussions with the Volpe National Transportation Systems Center personnel. The assessment is categorized according to Offshore Operations and Offshore Systems with sub-categories, identical to those used in Chapter 2 as follows:

Offshore Operations

- Fleet Characteristics
- Area of Operation
- VFR/IFR Operations

Offshore Systems

- Communications
- Navigation and Landing
- Surveillance
- Weather
- Automation

The needs expressed by the ATC service providers and the helicopter community, as represented by those serving the oil and natural gas industry, are described below. These needs have been expressed in various documents including the Gulf of Mexico Communications/ Navigation/ Surveillance/ Automation Operational Concept (CONOPS), Draft 2.3 (1/30/98) [ASW document], briefings presented at HSAC meetings, and the FAA GoMex Mission Needs Statement.

Additionally, needs were also identified as a result of site visits to the PHI and Chevron operations centers, a flight to an oil platform, and in meetings with Shell. Initial drafts of this document were circulated to the primary service provider (Southwest Region) and the HSAC user community to assure that the needs identified in the following paragraphs accurately represents their views. The user and service provider needs are summarized in a single table in Chapter 4. Further, an analysis of these identified needs has been performed resulting in a consolidation into a smaller, comprehensive set of unprioritized major needs. This set of major needs is expected to drive the evolution of the communications, navigation, surveillance, weather, and automation systems in the Gulf of Mexico offshore environment.

3.1 Offshore Operations

Fleet Characteristics:
The users want to achieve the maximum operational capabilities and utilization of the helicopter fleet and to have the flexibility to cope with present and future demands of the oil and natural gas markets. Service providers want to expand services to safely accommodate the increase in demand. In addition, users want to minimize system inefficiencies that may lead to wasted fuel, reduced payloads, delayed and cancelled flights, and overtime costs. Service providers want to minimize IFR system constraints that contribute to these inefficiencies. Fleet composition may well evolve with the introduction of new rotorcraft technology, with more speed, range, and passenger and payload capacity. However, it is difficult to determine how rotorcraft use will affect total fleet numbers.

Avionics should be small, multi-functional, and cost-effective. New avionics must fit into the footprint of existing avionics in the helicopter. There is a desire to minimize the proliferation of avionics in the cockpit.

Service providers want to facilitate users acceptance of the evolving ATC offshore systems. Both the users and the service providers desire a streamlined certification process for avionics and procedures.

Area of Operation:
It is expected the Gulf area of operations will continue to expand farther to the south (beyond 26° N), requiring increasing coverage for company communications, flight following operations, and weather information. In order to provide improved ATC services in the existing and expanding area of operation, the FAA Southwest Region has established the goal of converting the Offshore Control Area into an environment in which domestic radar separations and procedures can be applied. Thus, the service providers deem increased ATC communication and surveillance coverage essential. Improved weather information, coverage, and access is also desired by the users to support improved safety and efficiency of Gulf operations.

VFR/IFR Operations:
The nature of GoMex operations dictate that most will continue to be conducted under VFR. However, during periods of poor weather which cause VFR operations to be inefficient, unsafe, or impossible, a need for IFR operations exists. Successful development of an efficient, flexible ATC system that provides domestic IFR services for offshore operations, with full communications and surveillance capability would meet this need.

IFR separation standards based on procedural separation may be reduced through the use of emerging technologies such as Automatic Dependent Surveillance - Broadcast (ADS-B). IFR separation standards similar to a radar surveillance environment, with improved operational procedures that take advantage of improved capabilities, are the goal. To provide for more economical operations, the ATC system must minimize indirect routings and holding in the air, or on the ground, and, where possible, minimize fuel reserve requirements. The concepts of free flight, i.e., direct flight from point-to-point in IMC conditions with minimal ATC intervention, are very appropriate as they hold the greatest promise for achieving the efficiencies required for more economical helicopter operations.

The users and the FAA want to increase overall system capacity while maintaining or improving safety. Near-term objectives include: company-proprietary VFR flight following with automatic position reporting; notification to pilots that flight following is being performed; more cost-effective company communications and company/ATC messages; better access to weather information; improved IFR services; and, cockpit display of traffic information (CDTI). Service providers want improved capability to respond quickly to users' requests and emergencies and to be able to grant more requests for direct routes. The ultimate objective is a safe, efficient, and flexible operational environment.

3.2 Offshore Systems

The offshore system needs have been categorized according to the functions they perform, i.e., communications, navigation and landing, surveillance including flight following, weather, and automation. The following paragraphs address the identified needs of the users and the service providers in each of these functional areas.

Communications:

Though current company communications appear to be adequate, users want more cost-effective service. They need a reliable two-way company data link to support their offshore operations. Company information includes passenger and cargo manifests, lift-off and touchdown times, aircraft location, and emergency notifications.

Service providers want more reliable communications with the users and other ATC facilities. Direct pilot/ATC controller communications is needed to provide ATC services similar to those available in the radar environment.

The communications system must support transmission of:

- weather information to be transmitted to the aircraft;
- pilot position reports;
- Pilot Reports (PIREPs) to be down-linked to the operations center;
- aircraft system status information to be down-linked to operations centers;
- emergency communications to be simulcast;
- direct and reliable voice and data communications between users and ATC with coverage available to the surface or platform levels; and,
- capacity to service the current and projected demand.

Existing and planned communications systems include commercial communications networks such as Petrocomm and Gulfnet 6000; FAA Remote Communication Outlets (RCOs), Remote Telecommunications Relays (RTRs); Remote Communication Air/ Ground (RCAGs); and, the FAA Buoy Communications System (BCS).

The BCS consists of a suite of buoy-based communications equipment and a suite of shore-based equipment. Aircraft VHF-AM radio messages are received by the buoy-based equipment and relayed on L-band via satellite to an earth station. The messages are then transmitted to Houston ARTCC via leased circuits.

The FSS modernization program may put five additional RCOs on offshore platforms to accommodate user and service provider ATC communication needs. However, even with these improvements, many of the needs identified in this chapter will remain.

A good example is the identified need for company data link. In addition to the above, needs have been identified that are specific to the service providers. These include:

- rapid communications with other ATC facilities for flight coordination;
- reliable communications links that allow timely message delivery with good quality;
- automatic transfer of information between facilities; and,
- ATC data link for delivery of clearances, flight plans and flight plan modifications

Navigation and Landing:
LORAN-C and VOR/DME were the primary navigation systems in use prior to the implementation of GPS and the GPS grid. The VOR/DME offshore route structure lacked the flexibility for operators to utilize direct routes in the Gulf, thereby increasing fuel costs and reducing efficiency. All IFR operators strongly desire direct routings. The GPS offshore en route grid system was implemented on October 8, 1998.

According to Karanian in his recent article "The Future is Now: The Gulf of Mexico Grid System", a pilot in the grid needs only file the departure point, the first en route waypoint, the last en route waypoint prior to the approach, and the destination. This structure supports more flexible routing than the previous VOR radial route structure which required filing a combination of NAVAIDS and radials.

Users desire the capability to fly at desired times, a capability that is often denied in IFR conditions. They also want to fly direct routes with the ability to land anywhere in the Gulf offshore area of operations.

In addition, some users would like to take off from heliports and airports as far as Dallas/Fort Worth Airport (DFW) with more passengers than currently carried and fly directly to any offshore platform via a direct route. Such distances are now feasible but not with the desired payload. The Bell 609 tiltrotor, for example, has a specified 750 nm range capability and up to 1,000 nm with additional fuel. Cruise speeds are up to 275 knots and the service ceiling is 25,000 ft. However, the Bell 609 only carries from 6 to 9 passengers.

The user community has, for the most part, transitioned to GPS, replacing LORAN-C, for area navigation. Navigation systems based on GPS may, in the future, require additional interference protection and upgrades accommodating additional civil frequencies.

GPS is presently a primary means of navigation in the Gulf of Mexico but has not been certified as a sole means navigation system. Thus, additional navigation equipment such as VOR/DME must be available for use on board the helicopter.

Surveillance:
The users want automatic VFR Flight Following, and FAA provided IFR services. Though companies today want their own flight following capability, in the future they have expressed a desire for a common VFR/IFR system that will let them perform the flight following function while keeping other company information proprietary. Companies have expressed a willingness to share their flight following information with organizations such as FAA, NORAD, and DEA. This will result in reducing the number of intercepts launched by the military on unidentified VFR helicopters and could result in annual savings to the government of about $1.4M per year based on 1998 data.

Users desire flight following coverage down to 50 ft above the surface and over existing and projected areas of activity. This will improve search and rescue capabilities and will provide accurate proprietary company/operator tracking of departure, en route, and arrival status of all company flights. The system should also be capable of accommodating the projected aircraft fleet. Though users desire the more than 140 IFR-certified aircraft to be displayed on FAA systems while flying IFR, they ultimately do not want to have to carry an ATC surveillance system and a company flight following system. A single system is preferred.

The pilots want the Cockpit Display of Traffic Information (CDTI) to see all the other traffic in their immediate vicinity, implying an air-to-air capability that will supplement "see-and-avoid" under VFR, and ATC separation under IFR.

Controllers also want to see the positions and data blocks of all IFR aircraft in real-time on their display. Update rates on the order of 12 seconds would provide an environment similar to the domestic radar environment in en route airspace. Four to five second update rates are required in terminal airspace. Surveillance coverage of the entire Offshore Control Area is desired.

Weather:
Users indicate the need for more timely delivery of weather products and for greater integration of existing products. For example, users provide weather information to the NWS but have difficulty in accessing it in an official form for briefing purposes. In addition, the integration of weather information from various sources into comprehensive aviation weather products is also desired. Accurate weather forecasts for flight planning is of higher value to the users than getting real-time weather in the cockpit and has also been expressed as a need by the users. The major issue is not lack of weather sensors or data, but improved integration of weather information from multiple sensors, improved

models and forecasting. Additional sensors would, however, improve the coverage, accuracy, and timeliness of available weather information. Distribution of these aviation weather products to the helicopter operations centers, the pilots, the FAA and other interested government entities (such as NWS, Coast Guard, and the DOD) is also a major consideration.

There is a high potential value of an aviation weather observation and forecast system capable of providing estimated and forecasted weather parameters at points coincident with the GPS grid system. This will permit a pilot, when using the GPS grid to plan his/her flight, to obtain weather information along this same route-of-flight.

Automation:
Automation needs are discussed as they relate to data processing and decision support tools. Data processing can be described as the ability to process and display the position of all properly equipped aircraft. Within seconds (radar data latency specification) of the transmission of aircraft position data, the data processing system must identify and display the updated information. Redundancy, reliability and security must be incorporated into the system. Ambiguity between targets must be eliminated. Automated aviation weather data collection, processing and distribution, along with automatic position reporting and flight following, is desired. Additional automation needs include an automatic indication to the pilot that he/she is being "flight followed".

An automated capability for the generation of passenger and cargo manifests once a two-way data link is available will mitigate additional pilot workload. This can be accomplished using a bar code scanning technique of passenger ID and cargo bar codes.

Decision support tools available to the controller must support safe separation and the implementation of conflict identification and alert. Such tools would detect a pending violation of separation standards and alert the controller. A decision support tool such as conflict probe could predict potential conflicts several minutes in advance based upon aircraft position and planned flight so that potential airspace conflicts can be resolved. These capabilities can provide aircraft-to-aircraft and aircraft-to-airspace (e.g., SUA) separation. Obstacle avoidance during approach, however, would still remain the responsibility of the pilot using weather radar in the mapping mode.

4.0 SUMMARY

The capabilities of the present system identified in Chapter 2 and the user and service provider needs discussed in Chapter 3 have been analyzed to determine a composite set of high level GoMex capabilities and needs. The result of this analysis is presented as Table 4.1. This table serves as the basis for Gulf of Mexico Helicopter Offshore System Technologies Recommended Development Path which is presented as a separate document. The needs are not prioritized.

Table 4.1 Present Capabilities and Identified Needs

Present Capability	***Identified Need***
Pilot position reports; Automatic Flight Following (FLT TRAK) at Chevron only (analog system)	Automate flight following
Voice communications on VHF analog radios	Provide company two-way data link
See-and-avoid for visual separation	Provide a display of traffic information in the cockpit
NWS weather reports available 3 times daily; FSS standard products; and company weather data	Improve access to NWS weather information
Gulf weather sensors and weather observers exist. NWS processing and forecasting is available	Improve weather sensing, processing, and forecasting
Voice relay messages - indirect communications	Implement direct pilot/controller data and voice communications
Relayed voice position reports; grease pencil map board at Houston ARTCC	Implement ATC surveillance, tracking, and display of aircraft
IFR services based on non-radar procedures	Develop IFR procedures for reduced separations in the Gulf based on ATC surveillance

APPENDIX A: GLOSSARY

AATT	Advanced Air Transportation Technologies
ADF	Automatic Direction Finder
ADIZ	Air Defense Identification Zone
ADS-B	Automatic Dependent Surveillance - Broadcast
AFCS	Automatic Flight Control System
AFSS	Automated Flight Service Station
AM	Amplitude Modulation
ARTCC	Air Route Traffic Control Center
AS	Aerospatiale
ASW	FAA Southwest Region
ATC	Air Traffic Control
ATM	Air Traffic Management
AWOS	Automated Weather Observing System
BCS	Buoy Communications System
CDTI	Cockpit Display of Traffic Information
CFR	Code of Federal Regulations
DEA	Drug Enforcement Agency
DFW	Dallas/Fort Worth Airport
DME	Distance Measuring Equipment
DOD	Department of Defense
DUAT	Direct User Access Terminal
DVFR	Defense Visual Flight Rules
ELT	Emergency Locator Beacon
ENA	Engineering Needs Assessment
FAA	Federal Aviation Administration
FAGX	Gulf Coast Area Forecast
FAR	Federal Air Regulation
FIR	Flight Information Region
FL	Florida, Flight Level
FLIPR	Flight Progress Reporting
FSS	Flight Service Station
GA	General Aviation
GoMex	Gulf of Mexico
GPS	Global Positioning System
HEDA	Helicopter En Route Descent Area
HSAC	Helicopter Safety Advisory Conference
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Condition
LA	Louisiana
LOFF	LORAN Offshore Flight Following
LORAN-C	Long Range Navigation System-C
MMS	Mineral Management Service
NAS	National Airspace System

NASA	National Aeronautics and Space Administration
NEXWOS	Next Generation Automated Weather Observation Stations
NORAD	North American Air Defense Command
NWS	National Weather Service
OSAP	Offshore Standard Approach Procedure
PC	Personal Computer
PIREP	Pilot Report
PHI	Petroleum Helicopters, Inc.
RCAG	Remote Communications Air/Ground
RCO	Remote Communications Outlet
RTR	Remote Telecommunications Relay
SAWRS	Supplementary Aviation Weather Reporting Stations
SIAP	Standard Instrument Approach
SUA	Special Use Airspace
TCAS	Traffic Alert and Collision Avoidance System
TRACON	Terminal Radar Approach Control
TSO	Technical Standard Order
TX	Texas
US	United States
USCG	United States Coast Guard
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omni-directional Range

APPENDIX B: BIBLIOGRAPHY

Draft Gulf of Mexico Program, Mission Needs Statement Number(xxx); Federal Aviation Administration, March 30, 1998.

National Airspace System Architecture 4.0, Draft; Federal Aviation Administration, January 1999

A Concept of Operations for the National Airspace System in 2005-Narrative (Final); Federal Aviation Administration, September 30, 1997.

A Concept of Operations for the National Airspace System in 2005 - Operational Tasks & Scenarios (Draft); Federal Aviation Administration, February 5, 1998.

Gulf of Mexico Communications/Navigation/Surveillance/Automation Operational Concept (CONOPS), Draft 2.3; Federal Aviation Administration, January 30, 1998.

AC 90-80B – Approval of Offshore Standard Approach Procedures (OSAP), Airborne Radar Approaches (ARA), and Helicopter En Route Descent Areas (HEDA); Federal Aviation Administration, February 21, 1988.

Offshore IFR Operations in the Gulf of Mexico; Draft Advisory Circular, Federal Aviation Administration, April 13, 1998.

Gulf Coast Offshore Project; Center for Advanced Aviation System Development, The MITRE Corporation; Jim Cieplak, Stan Jones, Doyle Peed, and Todd Stock, December 1997.

Technology to Improve Services in Gulf of Mexico; Don Day, Rotor Magazine, Summer, 1997.

The Future is Now: The Gulf of Mexico Grid System; James Karanian, Journal of ATC, January - March 1999.

A Joint Government/Industry Operational Concept for the Evolution of Free Flight; Prepared by the RTCA Select Committee on Free Flight Implementation, August 1997.

ATC Manual, FAA Order 7110.65; Federal Aviation Administration, June, 1996.

1998 Annual Report; Petroleum Helicopters Incorporated, July 1998.

Gulf of Mexico OCS Region; Mineral Management Service, www.gomr.mms.gov.

1997 E & P World-Wide Offshore Helicopter Operations and Safety Review; Robert Williams, E & P Forum Aviation Sub Committee, October 1998.

Gulf of Mexico Helicopter Offshore System Technologies Recommended Development Path; NASA document in preparation, May 1999.

Operations Specification; Chevron USA Productions Company, Certificate No.: AC2A685K, June 1996.