AN

AIR WEATHER SERVICE HISTORY OFFICE

SPECIAL STUDY

MISSION ACCOMPLISHED:

THE AIR WEATHER SERVICE

IN

DESERT SHIELD/DESERT STORM

August 1990 - April 1991

by

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Edited by

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AIR WEATHER SERVICE
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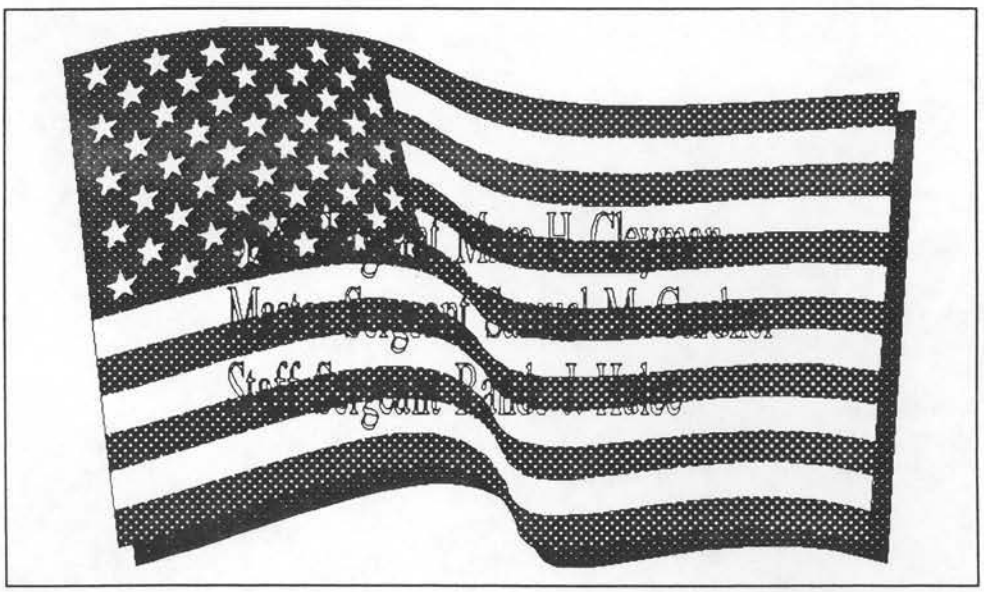
DEDICATION

This book is dedicated to all the men and women of Air Weather Service who served in the Operation DESERT SHIELD/DESERT STORM weather support force between 7 August 1990 and 28 February 1991, and especially Staff Sergeant Marc H. Cleyman, Master Sergeant Samuel M. Gardner, and Staff Sergeant Rande J. Hulec, who were killed in the crash of a Military Airlift Command C-5 aircraft at Ramstein AB Germany, on 29 August 1990 while deploying to Operation DESERT SHIELD, and First Lieutenant Cynthia A. Borecky, who was severely injured in the same accident.



FOREWORD

Operation DESERT SHIELD/STORM tested our mettle. Air Weather Service personnel were involved in all facets of both operations and served at all organizational levels. The support effort involved the total AWS team. Active and reserve military and civilian weather troops worked together to provide the full spectrum of products and information combatant commanders needed to help them attain national security objectives. Troops in the theater as well as those who remained at home worked long hours and surmounted numerous challenges and obstacles. Those in the field lived in austere conditions, were separated from their loved ones for an extended period, and some moved with the Army to engage Iraqi forces. Everyone focused on the mission and got the job done. We must never forget our successes came at a cost--three of our comrades-in-arms lost their lives accomplishing the mission.

To all who served, this history outlines what and how you did, the hurdles you overcame, and the difference you made. To future generations of weather warriors, this history will, hopefully, better equip you to face future challenges.

JOHN J. KELLY, JR.
Brigadier General, USAF
Director of Weather
DCS/Plans and Operations

PREFACE

Operation DESERT SHIELD/DESERT STORM was the largest and most important military operation in which the United States engaged since the war in Southeast Asia almost a generation ago. It was not only large and important, it was, from a military standpoint, hugely successful. Beginning as a limited defensive contingency operation intended to protect Saudi Arabia from Iraq, it ended as a large, full-scale, air and ground offensive war aimed at ejecting Iraqi forces from Kuwait. The combat phase of the operation was not only successful, it was short and relatively free of casualties.

When the Persian Gulf contingency operation began in early August 1990 few, if any, persons in Air Weather Service anticipated that before it was over it would extend and challenge Air Weather Service to its utmost, perhaps as never before. But such was the case. Nevertheless, Air Weather Service, due especially to the hard work and dedicated efforts of its people in the deployed weather support force, was able to successfully accomplish its mission of providing weather support to the air and ground forces participating in the operation. To be sure, it encountered its share of problems and experienced some failures and shortcomings, but overall, Air Weather Service had a right to be proud of its performance.

In the special study that follows, I have attempted to tell (and document) the complete story, from start to finish, of Air Weather Service's participation in DESERT SHIELD and DESERT STORM, the buildup and combat phases, respectively, of the Persian Gulf operation, I have employed both chronological and topical approaches in this account, using whichever one seemed most suitable for illuminating a particular facet of the story. Chapters I, II, VI, and VII are, to a large extent, chronological in nature, portraying the evolution of Air Weather Service support to the operation from the inception of DESERT SHIELD through the end of DESERT STORM, and briefly noting the drawdown of weather support operations and the weather support force during the redeployment period. Chapters III, IV, and V are primarily topical, describing the weather information system used by Air Weather Service in the operation; the centralized products, satellite imagery, and other means through which Air Weather Service supported its weather support force deployed in the DESERT SHIELD/STORM theater; and the operations of the weather support force. Chapter VIII, also topical, deals primarily with the lessons learned by Air Weather Service in the operation.

I wish to express my appreciation to the many people who helped make it possible for me to write this account. I want to especially thank the nearly 50 people who consented to be interviewed by me as part of my research for this project. Some were members of the deployed weather support force, others directed or supported the weather support force from positions at Headquarters Air Weather Service, the 5th Weather Wing, Air Force Global Weather Central, or the US Air Force Environmental Technical Applications Center. They provided me with insights and information I otherwise would not have been able to obtain. Particular thanks goes to several persons who submitted to extraordinarily lengthy interviews (ranks and positions indicated are those during DESERT SHIELD/STORM): Brigadier General John J. Kelly, Jr., Commander, Air Weather Service; Colonel James W. Goldey, Commander, 1690th Weather Group Provisional; Lieutenant Colonel Gerald F. Riley, Officer in Charge of the US Central Command Air Forces weather support element; Lieutenant Colonel William S. Weaving, Vice Commander, 1690th Weather Group Provisional; Lieutenant Colonel William H. Campbell, Officer in Charge of the US Central Command Army Forces weather support element; and Colonel William S. Koenemann, Commander, 5th Weather Wing.

Additionally, I want to thank the Headquarters Air Weather Service Crisis Action Team and Headquarters 5th Weather Wing for providing me access to their voluminous collection of DESERT SHIELD/STORM documents. I also wish to acknowledge the support provided to me in this project by

Colonel Gene J. Pfeffer, Vice Commander, Air Weather Service; Colonel Gerald F. Riley, formerly Chief, Exercise and Contingency Management Division, Headquarters Air Weather Service; and Colonel Carlton L. Bjerkaas and Lieutenant Colonel Thomas N. Walker, former and present Directors of Resource Management, Headquarters Air Weather Service. Janice E. Hoffmann, Sue W. Oller, and Darlene M. Sandheinrich contributed to the editing and assembly of this document. Special recognition is due to Ms. Rita M. Markus, my editorial assistant. I am greatly indebted to her for the vast amount of work she did in editing this document and preparing it for publication.

William E. Nawyn

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Air Weather Service Historian
December 1992

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1990

July

17 Jul — Saddam Hussein accused Kuwait and the United Arab Emirates of conspiring with the US to lower world oil prices and weaken Iraq. Warned he might have to take direct action.

18 Jul — Iraqi foreign minister accused Kuwait of stealing Iraqi oil, building military installations on Iraqi soil, and refusing to forgive Iraq's debts to Kuwait incurred during Iraq's war with Iran.

24 Jul — Iraq reported to have 30,000 troops massed along Kuwaiti border.

29 Jul — United States (US) Central Intelligence Agency warned the White House an Iraqi attack on Kuwait was imminent.

August

2 Aug — **100,000 IRAQI TROOPS INVADE KUWAIT;** capture Kuwait City.

US President George Bush condemned invasion.

US Central Command Air Forces (USCENTAF or CENTAF) activated response cell.

5th Weather Wing (5WW) received Joint Chiefs of Staff warning order; activated crisis action team (CAT).

3 Aug — United Nations (UN) resolution condemned Iraqi invasion of Kuwait and demanded immediate and unconditional withdrawal of Iraqi forces.

4 Aug — President Bush decided US should put a military force in Saudi Arabia as a warning to Saddam Hussein not to invade Saudi Arabia.

5 Aug — President Bush promised that Iraq's invasion of Kuwait "will not stand."

6 Aug — UN Security Council imposed economic sanctions against Iraq.

7 Aug — King Fahd approved the deployment of multinational forces into his country for defense against possible Iraqi attack.

PRESIDENT BUSH ORDERED US AIR AND GROUND TROOPS TO SAUDI ARABIA as part of multinational force.

OPERATION DESERT SHIELD COMMENCED with deployment of two F-15 Squadrons from the 1st Tactical Fighter Wing, Langley Air Force Base (AFB), Virginia, and elements of 82d Airborne Division, Fort Bragg, North Carolina. The 1st Tactical Fighter Wing weather

officer, Capt Judith E. Dickey, immediately deployed to support F-15 squadrons. Arrived at Dhahran, Saudi Arabia, in evening of 8th.

Initial USCENTAF headquarters element deployed to Saudi Arabia.

Headquarters Air Weather Service (AWS) established CAT.

8 Aug Iraq declared permanent annexation of Kuwait.

UN Security Council demanded immediate withdrawal of Iraqi troops from Kuwait.

The first AWS person to arrive in the DESERT SHIELD theater, SSgt John N. Poole of Detachment 3, 26th Weather Squadron, landed at Riyadh, Saudi Arabia, at 1010 local time with a Military Airlift Command (MAC) airlift control element. About 3 hours later the next two AWS persons to arrive in the theater, 1Lt Todd M. Fasking and TSgt Keith E. Daniels, both from Detachment 10, 15th Weather Squadron, landed at Dhahran with another MAC airlift control element.

Lt Col Gerald F. Riley, USCENTAF staff weather officer (SWO), and commander, 3d Weather Squadron, accompanied by two other weathermen, deployed from Shaw AFB, South Carolina, to Riyadh to provide weather support to USCENTAF, form CENTAF Forward weather support element, and become acting officer in charge (OIC) of the DESERT SHIELD WSF (WSF). Arrived in morning of 9th.

First Army support weather team deployed from Fort Bragg to Dhahran to support XVIII Army Corps and 82d Airborne Division. Arrived on 9th.

5WW activated prepositioned emergency support assistance request as contained in 5WW Operations Order 02-FY to support DESERT SHIELD operations.

Air Force Global Weather Central (AFGWC) began to function as tactical forecast unit for DESERT SHIELD theater.

9 Aug UN resolution declared Iraq annexation of Kuwait null and void.

5WW transmitted initial concept of operations for DESERT SHIELD.

AWS had deployed 49 persons to DESERT SHIELD theater by end of day.

10 Aug Arab League condemned Iraq's action and agreed to send troops to defend Saudi Arabia.

Total US forces in DESERT SHIELD theater reached 25,000.

AWS weather team at Incirlik Air Base (AB), Turkey, began Quick Reaction Communications Terminal (QRCT) transmissions to DESERT SHIELD theater.

CENTAF Weather became operational in Riyadh; sent first situation report (sitrep) to US Central Command (USCENTCOM or CENTCOM) and 5WW.

11 Aug CENTAF Weather received first SWO bulletins from AFGWC via Department of Defense's Automatic Digital Network (AUTODIN).

12 Aug First full day of successful QRCT network operations; four nodes on net.

5WW assumed direct management of the Time-Phased Force Deployment Document for Air Force weather forces.

First special operations weather team (from Air Force Special Operations Command) arrived in DESERT SHIELD theater.

13 Aug CENTAF Rear constituted at Headquarters Tactical Air Command, Langley AFB.

Headquarters USCENTCOM Army Forces (USARCENT or ARCENT) weather team arrived in Riyadh.

Headquarters CENTCOM Special Operations Forces (SOCCENT) weather team arrived in DESERT SHIELD theater.

14 Aug First meeting between AWS and Saudi Arabian Meteorological and Environmental Protection Administration (MEPA) officials. Lt Col Riley represented AWS.

MEPA requested AWS assistance in acquiring a chemical downwind forecast capability.

AWS had deployed 112 persons to twelve different locations in the DESERT SHIELD theater.

mid-Aug US Air Force Environmental Technical Application Center (USAFETAC) began issuing seasonal small area descriptive climatologies and point climatologies for DESERT SHIELD theater.

16 Aug Brig Gen John J. Kelly, Jr., AWS Commander, directed reorganization and enlargement of AWS CAT.

General Kelly approved deployment of Mark IV Defense Meteorological Satellite Program (DMSP) van to DESERT SHIELD.

17 Aug CENTAF Weather send/receive Automated Weather Network (AWN) teletype became operational.

19 Aug CENTAF commander requested deployment of Mark IV DMSP van.

SOCCENT Weather receive-only AWN teletype became operational.

20 Aug DESERT SHIELD Forecast Unit (DSFU) produced and transmitted its first joint operational area forecast (JOAF).

21 Aug MEPA authorized AWS personnel access to its forecast offices at several airfields.

MEPA letter to Lt Col Riley recommended using existing New York to Jeddah circuit to provide direct link for exchange of weather data between MEPA and AFGWC.

22 Aug CENTAF tasked deployment of two Marwin tactical rawinsondes.

AFGWC issued its first chemical downwind message.

General Kelly appointed 5WW as lead wing for Operation DESERT SHIELD.

24 Aug Col James W. Goldey, CENTCOM SWO and 1st Weather Squadron commander, arrived in Riyadh accompanied by two weather officers to support CENTCOM and become OIC of the Operation DESERT SHIELD WSF. Lt Col Riley became full-time CENTAF SWO and OIC of the CENTAF weather support element.

26 Aug General H. Norman Schwarzkopf, Commander in Chief, USCENTCOM, arrived in Riyadh.

28 Aug CENTCOM Weather became fully operational in Riyadh.

29 Aug MAC C-5 bound for DESERT SHIELD crashed on takeoff at Ramstein AB, West Germany, killing 13 of 17 persons aboard. Dead included three AWS non-commissioned officers. Survivors included one severely injured AWS officer.

30 Aug Mark IV DMSP van arrived in Riyadh.

31 Aug Total US forces in DESERT SHIELD theater reached 90,000.

DSFU took over as QRCT/Goldwing net control station.

AWS had deployed 240 persons to 22 different locations in the DESERT SHIELD theater.

September

3 Sep Mark IV DMSP van became operational and provided first satellite imagery to DSFU and CENTCOM SWO.

ARCENT Weather became fully operational in Riyadh.

4 Sep US confirmed presence of American forces in other Persian Gulf states besides Saudi Arabia.

6 Sep Headquarters AWS held special memorial service remembering the three AWS members who lost their lives in the C-5 crash at Ramstein AB on 29 August.

DSFU divided JOAF into two parts: an unclassified weather bulletin and a classified special support bulletin.

ARCENT Weather came up on QRCT/Goldwing network.

7 Sep Headquarters AWS directed a complete scrub of the WSF with a view to paring it to the smallest size possible.

Receive-only Air Force Digital Graphics System (AFDIGS) facsimile circuit became operational at CENTCOM Weather.

QRCT Plus transmit-only system became operational at Incirlik AB.

9 Sep — US President George Bush and Soviet Union President Mikhail Gorbachev met in Helsinki, Finland, and issued joint declaration condemning Iraqi invasion of Kuwait.

Lt Col William S. Weaving, Director of Operations, 5th Weather Squadron, arrived in Riyadh to become ARCENT SWO and OIC of the ARCENT weather support element.

12 Sep — Headquarters AWS requested DMSP System Program Office (SPO) to accelerate acquisition of a small tactical satellite terminal for use in DESERT SHIELD theater.

mid-Sep — DSFU began to obtain weather graphics products via Naval Oceanographic Data Display System.

21 Sep — DSFU achieved full operational status; AFGWC became DSFU back-up.

26 Sep — CENTCOM Weather attained full send/receive AWN capability.

28 Sep — QRCT/Goldwing network divided into separate CENTAF and ARCENT networks.

General Kelly directed formation of a provisional weather group in DESERT SHIELD Theater.

30 Sep — AWS DESERT SHIELD WSF consisted of 291 persons stationed in 28 different locations.

late-Sep — Embryonic, six-node CENTAF tactical facsimile in-theater circuit, with DSFU as network control station, became operational.

October

early-Oct — ARCENT weather obtained receive-only AFDIGS circuit.

Two Army communications maintenance detachments arrived in theater. Part of their task was to provide maintenance support to Goldwings and QRCTs.

2 Oct — US Congress adopted resolution supporting President Bush's deployment of US military forces to the Persian Gulf.

Nearly half of Iraq's one million-man army now deployed in Kuwait and southern Iraq.

4 Oct — USCENTCOM imposed an overall 250,000-person ceiling on DESERT SHIELD forces. Air Force limit was 32,500.

ARCENT Weather began receiving weather data over AWN.

5 Oct — Headquarters AWS requested MAC to support acquisition of six Marwin rawinsondes.

6 Oct — US officials reported buildup of forces in DESERT SHIELD theater was virtually complete.

12 Oct — ARCENT Weather took over net control responsibilities for Army Goldwing weather network.

MEPA approved using existing Jeddah, Saudi Arabia, to New York circuit to provide direct link for exchange of weather data between MEPA and AFGWC.

18 Oct Taif, Saudi Arabia, had first reported thunderstorm in the Persian Gulf theater during DESERT SHIELD.

ARCENT Weather send/receive AUTODIN terminal became operational.

30 Oct ARCENT SWOs provided the Army's 513th Military Intelligence Battalion with a detailed scientific and climatological analysis of the fall and winter weather in the DESERT SHIELD theater, which the battalion briefed to General Schwarzkopf.

31 Oct Total US forces in DESERT SHIELD theater reached 228,000.

Headquarters AWS announced 300-person limit on DESERT SHIELD WSF.

AWS DESERT SHIELD WSF consisted of 303 persons stationed in 33 different locations.

late-Oct All tactical air base weather teams had receive-only AWN capability.

November

1 Nov MAC activated Headquarters 1690th Weather Group Provisional (WGP). Included 20 detachments and 8 operating locations.

8 Nov **PRESIDENT BUSH ORDERED AN ADDITIONAL 200,000 AMERICAN TROOPS DEPLOYED TO DESERT SHIELD.** The majority of the troops would come from the Army's VII Corps in Germany.

9 Nov Secretary of Defense Richard C. Cheney announced that the Pentagon no longer planned to rotate troops to DESERT SHIELD forces. Troops already deployed would stay for the duration of the operation.

16 Nov DMSP SPO awarded contracts to two corporations for production of prototype Rapid Deployment Imagery Terminals (RDITs).

19 Nov Saddam Hussein announced he was sending 250,000 more troops to Kuwait and southern Iraq.

Lt Col Weaving became vice commander of 1690WGP. Lt Col William H. Campbell, Director of Operations, 7th Weather Squadron, became ARCENT SWO and OIC, ARCENT weather support element.

27 Nov ARCENT Weather relocated to Eskan Village complex in Riyadh, resulting in loss of all its hardwire communications for approximately 7 weeks.

29 Nov **UN SECURITY COUNCIL ADOPTED US SPONSORED RESOLUTION 678 AUTHORIZING THE USE OF FORCE AGAINST IRAQ (if it did not withdraw from Kuwait by 15 January 1991.)**

30 Nov AWS DESERT SHIELD WSF consisted of 305 persons.

December

1 Dec — DMSP satellite F-10 launched by Air Force Space Command at request of AWS Commander.

21 Dec — Saddam Hussein reasserted Iraq would not leave Kuwait by UN deadline.

ARCENT US Army, Europe Automated Weather System network became operational in DESERT SHIELD theater.

24 Dec — AFGWC began to issue medium range (4-7 days) forecasts for DESERT SHIELD theater.

31 Dec — Total US forces in DESERT SHIELD theater reached 331,000.

General Kelly directed 5WW to begin aggressive effort to obtain full send/receive teletype and facsimile capability for all deployed units in DESERT SHIELD theater.

AWS DESERT SHIELD WSF consisted of 412 persons.

1991

January

early-Jan — DSFU received its first usable facsimile data from AFGWC over AFDIGS circuit.

1 Jan — AWS, with CENTCOM approval, requested Air Force Systems Command (AFSC) to provide Saudi Arabia a copy of a chemical dispersion model produced by Armstrong Aeromedical Research Laboratory.

5 Jan — President Bush warned Iraq to withdraw from Kuwait or "face the terrible consequences."

7 Jan — Operation PROVEN FORCE in support of DESERT SHIELD/STORM officially began.

9 Jan — US Secretary of State James F. Baker, III, met with Iraq Foreign Minister Tariq Aziz at Geneva, Switzerland, in unsuccessful effort to resolve Persian Gulf crisis.

11 Jan — TPS-68 tactical weather radar shipped from West Germany to Taif, Saudi Arabia.

12 Jan — Congress adopted resolution authorizing President Bush to use force against Iraq pursuant to UN Security Council Resolution 678.

ARCENT Weather began to produce the tactical operations area forecast for Army support weather teams.

14 Jan — First AWS (2d Weather Wing) personnel deployed from West Germany to Incirlik AB in support of Operation PROVEN FORCE.

15 Jan Iraq had approximately 550,000 troops in Kuwait and southern Iraq.

UN deadline passed without Iraqi withdrawal from Kuwait.

An in-theater reconstituted DSFU became available for operations at Taif.

AWS weather teams in DESERT SHIELD theater began to acquire their own Standard Base Level Computer system send/receive terminals.

16 Jan MEPA activated MEPA-DSFU weather data circuit.

17 Jan **THE GULF WAR BEGAN; OPERATION DESERT SHIELD BECAME OPERATION DESERT STORM.** At 0050 (1650, 16 January, Eastern Standard Time), coalition air forces launched air campaign against Iraq and Iraqi forces in Kuwait.

Total US forces in DESERT SHIELD/STORM theater reached 454,000.

18 Jan Iraq launched first Scud missile attacks on Israel and Saudi Arabia.

MEPA-National Weather Service (Jeddah-Washington DC via New York) weather data circuit became operational.

19 Jan US ground forces in Saudi Arabia began to move north to positions closer to the Saudi-Kuwait border.

22 Jan Iraq began setting fire to Kuwaiti oil refineries and oil fields.

AFSC shipped Armstrong Laboratory chemical dispersion model to Saudi Arabia.

23 Jan AFGWC began transmitting work charts based on data received from special sensor microwave imagers mounted on DMSP satellites to the DSFU.

25 Jan Iraq released millions of gallons of Kuwaiti crude oil into the Persian Gulf.

Total CENTAF aircraft sorties against Iraq reached 25,000.

26 Jan ARCENT Weather issued its first contingency weather package.

27 Jan Coalition air forces achieved air supremacy over Iraq.

29 Jan CENTAF Weather began issuing separate 3-day (72-hour) planning forecasts for Baghdad, northern Iraq, and Kuwait Theater of Operations (KTO) three times per day.

30 Jan TPS-68 tactical weather radar became operational at Diego Garcia in support of Strategic Air Command operations.

31 Jan AWS DESERT STORM WSF consisted of 459 persons.

February

Feb — USAFETAC published SWANEA (Southwest Asia-Northeast Africa): A Climatological Study, Vol II: The Middle East Peninsula.

2 Feb — AFGWC issued its first extended medium range (6-10 days) forecast for the DESERT STORM theater.

8 Feb — US ground forces completing movement into tactical assembly areas; some moving into forward assembly areas and attack positions.

10 Feb — The six Marwin rawinsondes procured by AWS arrived in the DESERT STORM theater.

11 Feb — AFGWC issued its first extended range (11-15 days) outlook for the DESERT STORM theater.

13 Feb — All major ARCENT combat elements in place.

15 Feb — DMSP SPO awarded contract to Harris Corporation for the production of five RDITs.

16 Feb — Total CENTAF aircraft sorties against Iraq reached 75,000.

17 Feb — ARCENT Weather began briefing a weather effects matrix for the KTO to the ARCENT Commander and his staff.

20 Feb — First RDIT arrived in DESERT STORM theater.

22 Feb — General Schwarzkopf noted that all combat forces dedicated to DESERT STORM had arrived in theater.

President Bush set noon, 23 February, Eastern Standard Time, as the deadline for Iraq to begin withdrawing from Kuwait.

23 Feb — Saddam Hussein failed to comply with the deadline set the previous day. President Bush ordered General Schwarzkopf to "use all forces available, including ground forces, to eject the Iraqi Army from Kuwait."

AWS DESERT STORM WSF reached peak strength of 475 persons stationed at 40 different locations.

24 Feb — **GROUND OFFENSIVE AGAINST IRAQ BEGAN** at 0400 (2000, 23 February, Eastern Standard Time); coalition forces rapidly advance into Kuwait and Iraq.

Saddam Hussein declared "the mother of battles" had begun.

Total US forces in the DESERT STORM theater reached 537,000.

25 Feb — Eleven of 27 ARCENT weather teams were in Iraq or Kuwait.

26 Feb — Saddam Hussein ordered Iraqi forces to withdraw from Kuwait.

USAFETAC reported to General Merrill E. McPeak, Chief of Staff of the Air Force, that the weather for DESERT STORM was worse than climatology suggested it would be and that it was the worst in at least 14 years.

27 Feb Coalition forces liberated Kuwait City and swept into Iraq as far as the Euphrates River and the vicinity of Basrah.

Twenty-five Iraqi soldiers surrendered in western Kuwait to Capt F. Paul Bridges and A1C Charles M. Limbaugh of the Army's 1st Infantry Division (Mechanized) weather team.

Iraq agreed to UN terms for a cease-fire; promised to comply with all 12 UN resolutions directed against it.

27/28 Feb **PRESIDENT BUSH,** declaring that Kuwait was liberated, the Iraqi army defeated, and US military objectives met, **ORDERED A PROVISIONAL CEASE FIRE EFFECTIVE 2400, 27 FEBRUARY, EASTERN STANDARD TIME, (0800, 28 FEBRUARY, IN THE DESERT STORM THEATER)**, exactly 100 hours after ground campaign began.

28 Feb Total number of CENTAF DESERT STORM aircraft sorties reached (and ended at) 108,000.

The weather team of the Army's 3d Special Forces Group entered Kuwait City with an American military convoy.

A MAC airlift control element weather team and an AWS Army special operations weather team tactical element arrived at Kuwait City International Airport to set up weather support operations.

March

1 Mar CENTAF Commander issued redeployment concept of operations which included "first in, first out" as general redeployment principle to be followed.

2 Mar Four members of the 3d Special Forces Group weather team participated in first post-liberation flag-raising ceremony at American embassy in Kuwait City.

3 Mar Coalition and Iraqi military commanders met to discuss cease-fire terms and issues. Iraqis accepted coalition terms.

5 Mar Total US forces in DESERT STORM theater reached peak of 541,000.

7 Mar Redeployment of a symbolic representative contingent of US troops (approximately 5,000) included two members of AWS WSF, one each from Air Force and Army support teams.

10 Mar **LARGE-SCALE REDEPLOYMENT OF US TROOPS FROM OPERATION DESERT STORM BEGAN.**

15 Mar CENTAF Weather shut down the QRCT network. Base weather station at Incirlik AB assumed responsibility for transmitting weather data to the AWS weather teams remaining in the DESERT STORM theater.

18 Mar DSFU issued its last product and ceased operations. AFGWC reassumed function as tactical forecast unit for DESERT STORM theater.

27 Mar Lt Col Riley redeployed. Maj Curtis A. Reutner succeeded him as CENTAF SWO and OIC, CENTAF Weather.

28 Mar Colonel Goldey redeployed. Lt Col Weaving, 1690WGP Vice Commander, succeeded him as Commander, 1690WGP.

April

1 Apr Approximately 300 persons left in AWS DESERT STORM WSF.

3 Apr UN Security Council passed resolution establishing permanent cease-fire in the Persian Gulf, subject to Iraq's acceptance of terms.

7 Apr Iraq accepted terms of UN permanent cease-fire resolution.

12 Apr **UN PERMANENT CEASE-FIRE RESOLUTION WENT INTO EFFECT (11 APRIL IN US); PERSIAN GULF WAR OFFICIALLY ENDED.**

18 Apr CENTCOM Weather ceased operations.

20 Apr Lt Col Weaving redeployed. Lt Col Campbell, ARCENT SWO and OIC, ARCENT Weather and ARCENT weather support element, succeeded him as Commander, 1690WGP.

May

1 May Lt Col Campbell redeployed. Lt Col Jerry R. Thornberry, VII Corps SWO, succeeded him as ARCENT SWO, OIC, ARCENT Weather, and Commander, 1690WGP.

Approximately 120 persons left in AWS DESERT STORM WSF.

11 May ARCENT Weather ceased operations.

12 May Lt Col Thornberry redeployed. Maj Reutner, OIC, CENTAF Weather, succeeded him as Commander, 1690 WGP.

JUNE

1 June Only approximately 50 persons left in AWS DESERT STORM WSF.

25 Jun The four remaining 1690WGP units in Persian Gulf area became part of sustaining WSF.

July

26 Jul The last person to have served in AWS DESERT SHIELD/STORM WSF prior to the initial cease-fire on 28 February redeployed.

October

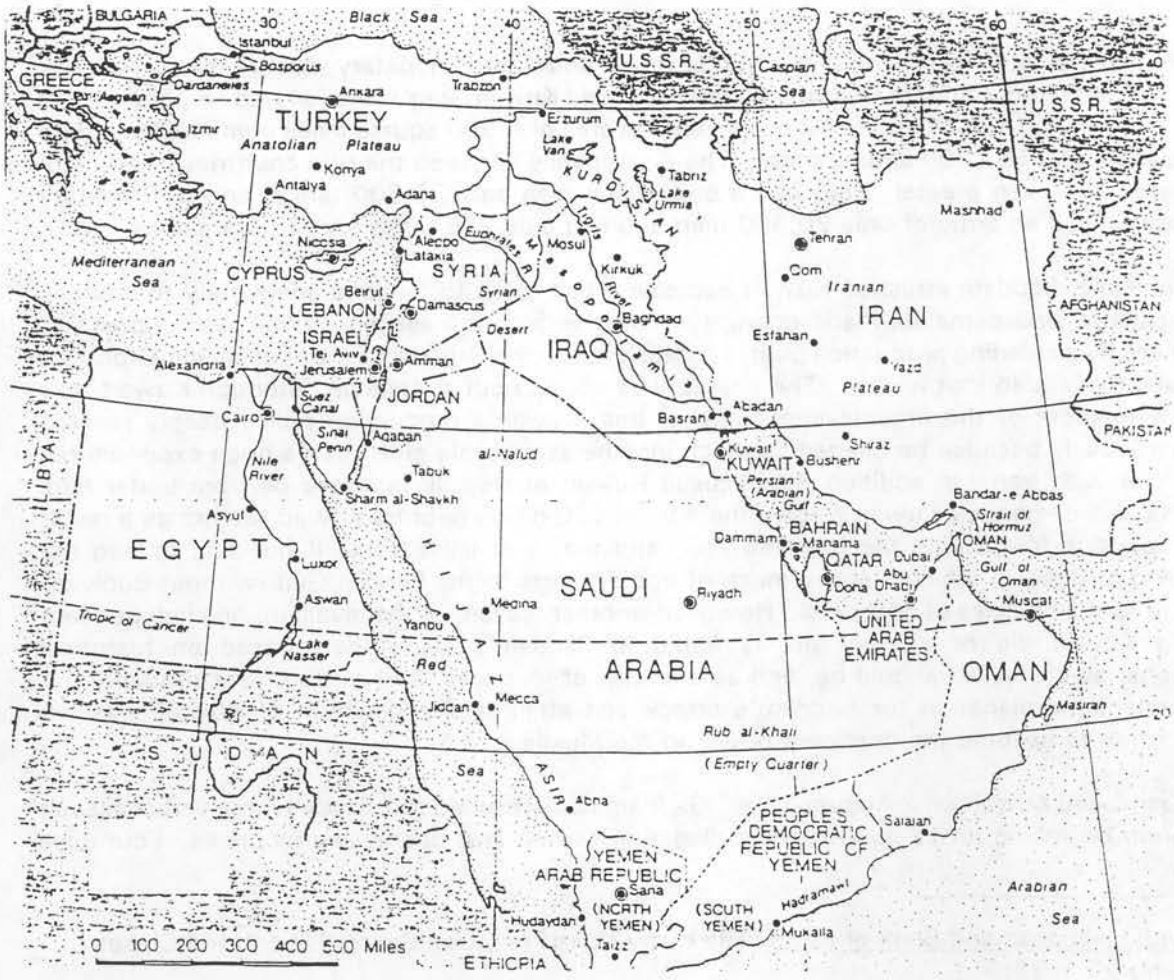
1 Oct The 1690WGP ~~deactivated~~ inactivated.

CHAPTER I

THE BEGINNING

Prelude

Since the end of World War II, the Middle East--the region stretching from Egypt on the west to Pakistan on the east (see Figure I-1)--has been an unstable region frequently afflicted with violence, sometimes internal in nature, sometimes taking the form of international wars. The list of conflicts includes fighting in Palestine between Jews and Arabs prior to the formation of the state of Israel,



The Middle East

Figure I-1

three subsequent wars between Israel and Arab countries, a joint British-French military intervention in Egypt, internal violence in Lebanon, an Islamic revolution in Iran, an Israeli invasion of Lebanon, and war between Iraq and Iran. With its vast oil resources and its strategic location in the Cold War, the Middle East was a continuing concern to the United States (US). Consequently, the US often pursued a vigorous diplomacy in the area and, on two occasions prior to 1990, intervened militarily in Lebanon.

Almost in the center of the Middle East, at the head of the Persian Gulf and flanking the Tigris and Euphrates Rivers, lies the country of Iraq. Part of the Ottoman (Turkish) Empire prior to World War I, following the war it became, for all intents and purposes, part of the British Empire. It became a nominally independent monarchy in 1932 and, as the result of a leftist, pan-Arab revolution, a republic in 1958. A decade later, a faction of the international Baathist Arab Socialist party seized control of the country. In 1979 Saddam Hussein, a member of that party, took office as president, in effect dictator, of Iraq. Barely a year after Saddam Hussein assumed power, he launched an attack on Iran, Iraq's neighbor to the east, which had very recently experienced a successful revolution led by radical Islamic fundamentalists. After eight years of inconclusive fighting, 120,000 Iraqi casualties, and the expenditure of $112 billion, Saddam agreed in August 1988 to a United Nations-brokered cease-fire with Iran.[1]

Three years later, undeterred by the severe human and monetary costs of the recently concluded war with Iran, Saddam Hussein militarily invaded Kuwait, Iraq's tiny, oil rich neighbor to the southeast. Kuwait had a population of 2 million and an area of 6,900 square miles compared to Iraq's 19 million people and 167,900 square miles. The discrepancy between the two countries in terms of military power was even greater. Iraq had a one-million man army, 5,500 tanks, and 500 military aircraft. Kuwait had an army of only 20,300 men and had only 275 tanks and 36 warplanes.[2]

Ostensibly, Saddam attacked Kuwait because it had failed to respond adequately to charges he leveled against, and demands made upon, it. For one thing, he alleged Kuwait was depressing world oil prices by exceeding production quotas established by the Organization of Petroleum Exporting Countries and demanded that it stop. The charge was not without substance, although Kuwait was not the only member of the organization guilty of this. Kuwait's production policy deeply rankled Saddam, particularly because he needed as much income as possible given Iraq's huge expenditures during the war with Iran. In addition, he accused Kuwait of illegally pumping oil from under Iraqi territory. He also demanded Kuwait forgive the $10 to $20 billion debt Iraq owed Kuwait as a result of Kuwaiti loans to Iraq during the Iran-Iraq War, and that it at least lease, if not sell, to Iraq the Kuwaiti island of Bubiyan which blocked much of Iraq's access to the Persian Gulf (without Bubiyan, Iraq had only about 18 miles of coastline). However, another reason for the invasion, one independent of anything Kuwait did or did not do, is found in Saddam's claim that, based on historical considerations, all of Kuwait should be, and as a matter of fact was, part of Iraq. But probably the most fundamental explanation for Saddam's attack and attempted annexation of Kuwait was his ambition for Iraq to become the dominant power in the Middle East.[3]

Iraq invaded Kuwait on 2 August 1990. Saddam had preceded the attack with a verbal assault on the country beginning on 17 July with his allegation Kuwait was depressing oil prices. Four days

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[1]The World Almanac and Book of Facts, 1991, p 720; art (U), Lisa Beyer, "The World Closes In," Time, 20 Aug 90, p 28.

[2]The World Almanac and Book of Facts, 1991, pp 720, 726; chart, Time, 13 Aug 90, p 17.

[3]The World Almanac and Book of Facts, 1991, p 68; art (U), Lisa Beyer, "The Crude Enforcer," Time, 6 Aug 90, pp 46-47; art (U) Lisa Beyer, ""Iraq's Power Grab," Time, 13 Aug 90, pp 17-19.

later, giving more force to his accusation, he began to move troops to the Kuwaiti border. By the end of the month, he had massed at least 120,000 troops along the border. Within five hours of the beginning of the invasion, Iraqi forces captured Kuwait's capital city, Kuwait City; they completed the occupation of the entire country in 12 hours. On 6 August, Saddam announced Iraq was annexing Kuwait. In the meantime, he began to mass troops along Kuwait's border with Saudi Arabia, an action possibly signalling an incursion into that country.[4]

The US Response

The US and the United Nations (UN) reacted quickly to Saddam's conquest of Kuwait. Already on the day of the invasion US President George Bush denounced Iraq's action as "naked aggression" and banned imports from Iraq. The following day the UN Security Council condemned the invasion and demanded Iraq withdraw its forces. The same day the US and the Soviet Union issued a joint statement also condemning the invasion and called for an embargo against Iraq. Three days later the UN Security Council voted to impose economic sanctions against Iraq.[5]

On 4 August, President Bush, in consultation with Secretary of Defense Richard B. Cheney, Chairman of the Joint Chiefs of Staff Colin L. Powell, and Commander in Chief (CINC) of the US Central Command (USCENTCOM) General H. Norman Schwarzkopf, decided the US should put a military force in Saudi Arabia, particularly in view of Saddam's threatening gestures toward Saudi Arabia. The very next day Cheney, accompanied by Deputy National Security Advisor Robert Gates, General Schwarzkopf, and Lieutenant General Charles A. Horner, Commander of US Central Command, Air Forces (USCENTAF), traveled to Saudi Arabia to meet with King Fahd and persuade him to allow the US to use Saudi Arabia as a base for a military operation to counter Iraq's advance. The requested permission came on 7 August. The same day President Bush ordered US military aircraft and troops to Saudi Arabia. Operation DESERT SHIELD was underway. The next day, declaring that "a line has been drawn in the sand," the president informed the nation he had deployed US forces to Saudi Arabia to protect that nation from a possible attack by Iraq. He warned the American people to be prepared for a lengthy commitment.[6]

Over the next several weeks, in addition to rapidly building up American forces in Saudi Arabia, President Bush carefully constructed an international military coalition that would commit troops to Saudi Arabia under the auspices of the UN. The coalition eventually came to include more than 30 nations, including Britain, France, two Arab countries, Egypt and Syria, in addition to Kuwait and Saudi Arabia. By late October a multinational force of nearly 240,000 persons, well over 200,000 of whom

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[4]HQ USAF/CAFH, The Persian Gulf War: An Air Staff Chronology of DESERT SHIELD-DESERT STORM (S/NF/WN), an Air Staff Historical Study, compiled by Capt S. B. Michael, CAFH, 1992, hereafter cited as USAF/CAFH DS/DS Chronology (S/WN/NF), pp 1-13, info used (U); art (U), Lisa Beyer, "Iraq's Power Grab," Time, 13 Aug 90, pp 16, 19-20.

[5]USAF/CAFH DS/DS Chronology (S/WN/NF), pp 11-15, info used (U); The World Almanac and Book of Facts, 1991, pp 68-69.

[6]USAF/CAFH DS/DS Chronology (S/WN/NF), pp 12-15, info used (U); art (U), Lisa Beyer, "Read My Ships," Time, 20 Aug 90, pp 18-22.

were American military personnel, was in the Persian Gulf theater, mostly in Saudi Arabia, where it assumed defensive positions.[7]

Complying with President Bush's order, military authorities began deploying the first US military units to Saudi Arabia in the evening of 7 August. The initial deployment included a 2,300-man contingent from the Army's 82d Airborne Infantry Division from Fort Bragg, North Carolina; 48 F-15 fighter aircraft from the Air Force's 1st Tactical Fighter Wing at Langley Air Force Base (AFB), Virginia; several Strategic Air Command (SAC) B-52 bombers from airbases in the continental US; and a USCENTCOM headquarters element from MacDill AFB, Florida. Strategic airlift operations also began in the evening of 7 August with the departure from Charleston AFB, South Carolina, of a Military Airlift Command (MAC) C-141, manned by an Air Force Reserve crew, bound for Dhahran, Saudi Arabia. Even before this, an initial USCENTAF contingent comprised of 9th Air Force personnel left Shaw AFB, South Carolina, at 0900 eastern daylight time, 7 August, aboard a specially equipped SAC EC-135, arriving in Riyadh, Saudi Arabia, at 0430 eastern daylight time (1230 local time) the following day.[8]

The USCENTCOM and USCENTAF contingents were in the vanguard of deploying units because Saudi Arabia lay within USCENTCOM's geographic area of responsibility (AOR) and its commander in chief, General Schwarzkopf, would direct the Persian Gulf operation, quickly given the code name DESERT SHIELD. USCENTCOM, (or simply CENTCOM), given its AOR, had, of course prepared for possible operations in southwestern Asia. Indeed, when the Persian Gulf crisis erupted, CENTCOM was in the process of updating a 1988 Southwest Asia contingency plan, including the development of force requirements. Also by way of preparation, CENTCOM conducted various training exercises. Every other year it held GALLANT EAGLE in the desert areas of the southwestern US, an area similar in many respects to large portions of the CENTCOM AOR. Just shortly before the beginning of DESERT SHIELD it had fortuitously conducted a command post exercise at Eglin AFB, Florida, in which it practiced for operations in the Persian Gulf region. The command also biennially sponsored BRIGHT STAR, a large scale, combined exercise held in Egypt and other countries in the CENTCOM AOR, most recently in the fall of 1989. It also conducted other exercises in the AOR from time to time. Indeed, it was holding a combined exercise in the Persian Gulf region with several Arab states when Iraq invaded Kuwait.[9]

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[7]USAF/CAFH DS/DS Chronology (S/WN//NF), pp 136-37, info used (U); chron (U), TAC, "DESERT SHIELD/STORM Chronology, 2 August 1990 - 3 April 1991," n.d., hereafter cited as TAC DS/DS Chronology (U), p 36; art (U), Michael Kramer, "Wait a Minute," Time, 5 Nov 90, p 38.

[8]The World Almanac and Book of Facts, 1991, pp 68-69; TAC DS/DS Chronology (U), p 4; USAF/CAFH DS/DS Chronology (S/WN/NF), p 14, info used (U); rprt (U), n.a., "Conduct of the Persian Gulf War: Final Report to Congress Pursuant to Title V of the Persian Gulf Conflict Supplemental Authorization and Personnel Benefits Act of 1991 (Public Law 102-25)", Apr 92, hereafter cited as Title V Report (U), pp 44-46, E-17 - E-18, E-23.

[9]Report #2 (S), AWS, "An Analysis of Air Weather Service Support to Operations DESERT SHIELD/DESERT STORM," 6 Dec 91, hereafter cited as AWS DS/DS Report #2 (S), p 21 (Sec 3.1.1), info used (U); intvw (U), William E. Nawyn, AWS/HO, with Col Peter F. Abt, AWS DCS/DO, LTC Ronald R. Wall, AWS/ADO, Col Terry C. Tarbell, 5WW/DO, and Maj Norman E. Buss, AWS/DOJ, 10 May 91, hereafter cited as AWTB Intvw (U), p 6; intvw (U), W.E. Nawyn, AWS/HO, with Col James W. Goldey, CENTCOM/SWO, OICWSF, and 1690WGP/CC (and 1WS/CC), 16 May 91, hereafter cited as Goldey Intvw (U), p 2.

The Air Weather Service Response

Initial Actions

As the situation in the Persian Gulf became more threatening, Air Force and Army commands that would deploy forces to the area under the existing CENTCOM contingency plan started to make specific preparations for such an eventuality. Air Weather Service (AWS), too, began planning for the deployment of a Weather Support Force (WSF) to the Persian Gulf region. Under the contingency plan, AWS itself would deploy a sizable number of personnel to support Air Force units. On the other hand, Army weather support teams would automatically deploy with the Army units they supported. During the days and hours while they awaited possible orders to execute the deployment, major Army and Air Force commands developed and frequently revised their deploying force structure. As they did so, AWS also made changes in the force it planned to deploy. In keeping with guidance from Tactical Air Command (TAC), AWS planned for a 30-day operation with minimum force size.[10]

By 7 August AWS had decided upon an initial USCENTAF (or simply CENTAF) weather support element of 18 persons (four officers, eight forecasters, and six observers)--a force much smaller than that specified in the contingency plan. Based upon the units that the Army indicated it would deploy initially (an XVIII Corps advanced echelon and an 82d Airborne Division brigade), AWS planned for an initial US Central Command, Army [Forces] (USARCENT, or simply ARCENT) weather support element of two officers, two forecasters, and six observers. However, due to airlift constraints at the time of the actual initial deployment, AWS reduced the Air Force weather support element by one forecaster and the XVIII Corps team by three observers. It also, at the last minute, replaced one of the observers assigned to the 82d Airborne brigade with an additional forecaster.[11]

In mid-July, about the time Saddam Hussein was beginning his verbal assault on Kuwait, AWS received its first indication that a crisis was brewing in the Middle East. During the remainder of the month, Headquarters AWS considered its options should the situation lead to a US military operation. The crisis, of course, did lead to a US decision to deploy troops to the Persian Gulf. AWS, along with other American military organizations, immediately swung into action or, perhaps more precisely, reaction. For the next couple of weeks AWS had time to do little else than respond to the rapidly unfolding events and deployment taskings. Nevertheless, it did attempt to find some time to look ahead and anticipate what might happen next. But the immediate business following President Bush's first deployment orders was to establish a crisis action team (CAT) at Headquarters AWS. Formed within Deputy Chief of Staff (DCS) Operations, the CAT was composed primarily of Readiness Directorate personnel headed by Lieutenant Colonel Ronald R. Wall. Unfortunately, at the moment, AWS had no Deputy Chief of Staff for Operations. The DCS for Operations had departed on 3 August and his replacement, Colonel Peter F. Abt, had not yet arrived. Thus, the Assistant DCS for Operations, Colonel Terry C. Tarbell, was temporarily the acting DCS for Operations.[12]

On 16 August the Commander of AWS, Brigadier General John J. Kelly, Jr., directed DCS Operations to expand the membership of the CAT beyond its own personnel. Consequently, a number

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[10]AWS DS/DS Report #2 (S), pp 21-22 (Secs 3.1.1, 3.1.2), info used (U).

[11]AWS DS/DS Report #2 (S), pp 21-23 (Secs 3.1.2, 3.1.3, 3.1.4), info used (U).

[12]LTC R.R. Wall in AWTB Intvw (U), pp 1-4.

of individuals from the two other DCS's at Headquarters AWS, Program Management and Technology, also became members of the CAT. At the same time the CAT also began to operate around-the-clock. By the end of August there were 5 CAT teams working three, 8-hour shifts on a rotating basis. The day shift consisted of 9 or 10 persons, the swing and mid-shifts of 5 or 6. The CAT provided two briefings each day to General Kelly, one in the morning and the other in late afternoon. Preparing for the briefings and following up on questions raised at the briefings began to occupy much, if not most, of the CAT's time.[13]

Meanwhile, General Kelly, wanting all of his senior leadership present should hostilities erupt in the Persian Gulf, ordered Colonel Abt, then on leave in Europe, to report to Headquarters AWS immediately rather than in mid-October as originally scheduled. Colonel Abt arrived on 23 August. Following instructions from General Kelly to separate the responsibility for the day-to-day operations of the CAT from the management of DCS Operations, Colonel Abt made Colonel Tarbell the overall CAT director with Lieutenant Colonel Wall as his assistant, while he himself supervised DCS Operations and tried to look at the broad, larger picture of AWS's role in the rapidly expanding DESERT SHIELD operation.[14]

In late September General Kelly reduced the required CAT briefings from two to one each day. A short time later DCS Operations trimmed the size of the CAT teams to two or three personnel per shift. From mid-November to almost mid-January the CAT worked two 8-hour shifts a day with four or five people on each shift. Beginning on 11 January 1991, as hostilities became imminent in the Persian Gulf, and continuing until 27 February, when the initial, provisional cease-fire went into effect, the CAT again operated 24-hours-per-day with three shifts of two to four persons each. Meanwhile, in November Colonel Wall succeeded Colonel Tarbell as overall CAT director and Major Norman E. Buss replaced Colonel Wall as Director of Readiness and assistant CAT director.[15]

Headquarters AWS and Lead Wing Roles

Under Air Weather Service Regulation (AWSR) 55-2, "Operations: AWS Tactical Weather Support," and other existing war plans, in each contingency operation AWS would have a lead wing, that is, one weather wing that would function as the weather support coordinator and immediate manager of the deployed weather support force. In concept, the role of Headquarters AWS in a contingency operation was to develop AWS policy for the operation, provide guidance to the lead wing, and work multiple-wing issues upon the request of the lead wing. However, neither AWSR 55-2 nor any other written document delineated the exact roles of Headquarters AWS and the lead wing, creating a degree of ambiguity in roles that in DESERT SHIELD/STORM led to some confusion and blurring of functions and responsibilities. This, in turn, contributed to Headquarters AWS exercising

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[13]LTC R.R. Wall and Maj N.E. Buss, in AWTB Intvw (U), pp 4-5; msg (S), AWS/DO to AIG 8380/DO, "AWS CAT Activation," 172030Z Aug 90, info used (U); msg (U), HQ AWS/DOJ to 5WW/DOX, "Subject of Ref A: A Rigorous Analysis of AWS in Operations DESERT SHIELD/STORM," 071245Z May 91.

[14]Col P.F. Abt in AWTB Intvw (U), p 5.

[15]Msg (U), HQ AWS/DOJ to 5WW/DOX, "Subject Ref A: Rigorous Analysis of AWS in Operations DESERT SHIELD/STORM," 071245Z May 91; msg (U), HQ MAC/DPO to ALMAC/CC, et al, "Senior Officer Announcements," 071330Z Nov 90.

more direct management of the deployed WSF in the operation than originally envisioned under the lead wing concept, especially after it began to appear the lead wing did not have the capability of handling by itself the task of organizing and managing weather support for an operation as large and complex as DESERT SHIELD. Without doubt, DESERT SHIELD/STORM tested, taxed, and extended the lead wing role more than any preceding contingency operation.[16]

In addition to its general oversight and guidance functions, Headquarters AWS provided several valuable, more specific services during DESERT SHIELD/STORM. Perhaps the most important of these was acting as agent for the lead wing with the other wings, something on which it expended a great deal of time and effort. It also carried out projects to enhance weather support, such as arranging for new weather equipment. In addition, it worked with other Air Force commands such as MAC and the Air Force Communications Command (AFCC) to obtain support and assistance for these and other AWS initiatives and projects to improve weather support operations. Another much-needed function performed by the headquarters, especially as time went on and DESERT SHIELD developed into a lengthy operation, was to sit back and, from its vantage point, analyze and assess AWS performance, anticipate obstacles AWS might encounter if DESERT SHIELD continued on, and address issues before they became problems.[17]

Although AWSR 55-2 did not specifically spell out the role of the lead wing as compared to that of Headquarters AWS, it did state the lead wing was to "tailor the WSF to the specific requirements and operations of the supported forces." The regulation also listed several "factors" the lead wing was to take into consideration in carrying out its mandate. Together, the statement and the factors indicated the lead wing had "total, unequivocal managerial responsibility for caring, feeding, equipping, and sustaining a WSF specifically tailored for an operation." This, however, still did not necessarily make clear the focus of responsibility for certain actions and functions in every situation. Nor, of course, did it specify the methods and procedures for the lead wing to utilize in carrying out its responsibilities.[18]

For DESERT SHIELD/STORM, the lead wing role went to the 5th Weather Wing, commanded by Colonel William S. Koenemann. This was logical since the 5th Wing's 1st Weather Squadron supported USCENTCOM and CENTCOM's Special Operations Forces (SOF) component, while its 3d and 5th Weather Squadrons supported the Air Force and Army components of CENTCOM, CENTAF and ARCENT. As lead wing, 5th Wing's responsibilities encompassed almost all aspects of AWS's participation in DESERT SHIELD/STORM. Its initial responsibilities centered mostly around deploying

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[16]AWSR 55-2, "Operations: AWS Tactical Weather Support," 26 May 89, p 4; intvw (U), W.E. Nawyn, AWS/HO, with Brig Gen John J. Kelly, Jr., USAF/XOW (AWS/CC during DS/DS), 25 Feb 92, hereafter cited as Kelly Intvw, pp 4, 8-11; intvw (U), W.E. Nawyn, AWS/HO, with Col George L. Frederick, AWS/CC (AWS/CV during DS/DS), 19 Feb 91, hereafter cited as Frederick Intvw, pp 2-3, 5-6, 9; Col P.F. Abt in AWTB Intvw (U), p 5; AWS DS/DS Report #2 (S), pp 6 (Sec 2.1.1), 8-9 (Secs 2.1.2-i, 2.1.3, 2.2.1), pp 14-16 (Secs 2.2.2-g, 2.2.4), info used (U).

[17]Kelly Intvw (U), p 10; Frederick Intvw (U), p 2; Col R.R. Wall in AWTB Intvw (U), pp 9, 11, 13, 17.

[18]AWSR 55-2 (U), "Operations: AWS Tactical Weather Support," p 4; AWS DS/DS Report #2 (S), p 9 (Sec 2.2.1), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Col William S. Koenemann, 5WW/CC, 4 Jun 91, hereafter cited as Koenemann Intvw, pp 20-21.

and constituting a viable WSF. Once it accomplished this, its work focused on managing the WSF and supporting its needs.[19]

Fortunately, when DESERT SHIELD began, 5th Weather Wing had ready 5th Weather Wing Operations Order (OPORD) 02-FY, a document published in June 1989 that described the concepts and procedures for providing weather support to USCENTCOM and its components in the event of their deployment. It provided guidance for both the deployment and the employment of the WSF. It indicated not only what the 5th Wing, but also what other AWS units were to do, and included the types of products and communications circuits required.[20]

Initial Response of the 5th Weather Wing

5th Weather Wing involvement in DESERT SHIELD began on 2 August. At approximately 0730 local time on that day, Mr. Stanley W. Tkach, 5th Wing's liaison with the TAC Battle Staff, received a telephone call informing him Headquarters TAC was activating the TAC Battle Staff. He and Lieutenant Colonel Mark D. Maxwell, 5th Wing's Chief of Plans, reported to the battle staff immediately and, at 0900, they received word Iraq had invaded Kuwait. The Joint Chiefs of Staff (JCS) had issued a warning order directing the Commander in Chief, CENTCOM (USCINCCENT) to consider courses of action to counter the Iraqi threat to Saudi Arabia. TAC, as the provider of tactical air forces to CENTCOM, responded to the JCS order by immediately beginning to mobilize its fighter wings. The 5th Weather Wing, as the provider of weather support to both CENTCOM and TAC, started immediately to make plans for a WSF to accompany the initial TAC aircraft assets that might deploy to Saudi Arabia. Over the next several days, until the order to deploy forces came on 7 August, the 5th Wing planners, under the direction of Mr. Tkach, developed as many as 16 different plans in response to constantly changing instructions from higher headquarters.[21]

Also on 2 August, the 5th Wing activated a CAT to handle matters related to the deployment operation that would likely occur soon. It did not, however, begin around-the-clock operations until a week later, after the deployment of American forces had already begun. At that time it formed three, five or six person CAT teams who worked twelve-hour shifts. Originally, the CAT consisted only of personnel from the Operations Division, but it soon became apparent the CAT needed people with various areas of expertise and, consequently, the wing added persons from other headquarter divisions as well. Conditions in the CAT in the early days of DESERT SHIELD became rather hectic and tense as the rapidly expanding operation increased the CAT workload and, thereby, the pressure on CAT

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[19]AWS DS/DS Report #2 (S), pp 9-15 (Secs 2.2.1, 2.2.2), info used (U); point paper (U), Col P.F. Abt, AWS/DO, "Management of the DESERT SHIELD Weather Support Force," 4 Jan 91.

[20]OPORD 02-FY (S), "USCENTCOM Weather Support (U)," 5WW, 15 Jun 89, pp iii, 1-6, info used (U).

[21]Intvw (U), W.E. Nawyn, AWS/HO, with Stanley W. Tkach, 5WW/DOX, hereafter cited as Tkach Intvw, pp 2-3; Koenemann Intvw (U), p 2.

members. Fortunately, the pace eased up a bit after a few weeks as the scheduled initial deployments started reaching completion.[22]

The 5th Wing's response to the sudden demands of DESERT SHIELD was hampered by the fact it was just undergoing the normal summer round of permanent change of stations and retirements when the operation began, causing temporary manning shortages. Particularly disruptive to 5th Wing operations was the retirement of two key lieutenant colonels a few days after DESERT SHIELD began. However, Headquarters AWS covered their loss by sending two other lieutenant colonels to the wing to take their place until permanent replacements arrived a couple of weeks later. It also dispatched a master sergeant to the wing on temporary duty. In addition to assigning them duties in their areas of expertise, the wing used all three to augment its CAT.[23]

One of the new arrivals was Lieutenant Colonel John V. St. Onge. At the recommendation of Colonel St. Onge, the wing formed a five-man team to oversee CAT operations--a kind of "senior battle staff," as the colonel later called it--that would act as the chief CAT decision-making body, control and coordinate CAT operations, ensure continuity, prevent duplication of effort, and interact with their counterparts at Headquarters AWS. Colonel St. Onge headed this body and as such, became the chief CAT director. The oversight body worked day shifts only--officially one twelve-hour shift five days per week, but frequently on weekends as well.[24]

As the lead wing, 5th Wing became the focal point for all DESERT SHIELD/STORM weather support activities and a "lifeline" connecting the WSF deployed to the Persian Gulf theater with AWS back in the continental US. To that end, it tried to remain in daily contact with the WSF by telephone or other means, which, because of the time differential, often meant calling in the middle of the night. For the duration of the operation the wing totally immersed itself in performing this role. Not only the CAT, but practically the whole headquarters staff became involved in supporting the WSF in some way.[25]

Beginning immediately, and lasting throughout the operation, one of the most important tasks of the 5th Wing was to plan and direct the deployment of the weather forces--deciding and arranging how many and who or what (that is, both people and equipment) would deploy, when they would deploy, and where they would deploy. To this end, the wing coordinated with its 3d and 5th Weather Squadrons, which were initially responsible for developing the CENTAF and ARCENT weather forces, respectively, time phased force deployment data (TPFDD) documents. Beginning 12 August, when Headquarters TAC began to function as CENTAF Rear, the wing assumed direct management of the TPFDD for Air Force weather forces. The 5th Squadron continued to manage the Army weather forces

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[22]Chron (S), HQ 5WW, "Narrative and Chronology of Operation DESERT SHIELD, 25 Jul-31 Dec 90 (U)," [Apr 91], hereafter cited as 5WW DESERT SHIELD Chronology (S), found in App 9, classified annex to hist rprt (U), 5WW, Jul-Dec 90, pp 9-1, 9-2, info used (U); intvw (U), W.E. Nawyn, AWS/HO, with LTC Donald R. Hood, 5WW/DOR, 6 Jun 91, pp 2-3; intvw (U), W.E. Nawyn, AWS/HO with LTC John V. St. Onge, Chief, 5WW/DOX, 3 Jun 91, hereafter cited as St. Onge Intvw, pp 2, 4; intvw (U), W.E. Nawyn, AWS/HO, with LTC John O. Nett, TRADOC SWO, 7 Jun 91, pp 3-5.

[23]AWS DS/DS Report #2 (S), p 6 (Sec 2.1.2-a), info used (U); 5WW DESERT SHIELD Chronology (S), p 9-2, info used (U); Koenemann Intvw (U), pp 32-33; St. Onge Intvw (U), pp 2-4.

[24]St. Onge Intvw (U), pp 2-3, 35-36.

[25]AWS DS/DS Report #2 (S), pp 9-10 (Sec 2.2.2-a), info used (U); Koenemann Intvw (U), pp 31-32; St. Onge Intvw (U), pp 8-9, 35.

TPFDD. The wing also had the task of arranging transportation for deploying weather personnel and equipment.[26]

Perhaps the foremost responsibility of the 5th Wing was to provide support of various kinds to the deployed WSF. It constantly monitored the needs of the WSF and provided decision assistance to its leaders. It gave guidance to the force in dealing with personnel issues such as manpower requirements, emergency leaves, and replacements for deployed personnel. It tracked the deployment and location of tactical meteorological equipment and helped sustain the WSF in the field by arranging for a continuing flow of supplies and equipment. As the primary point of contact in the US for "scientific" support to DESERT STORM, the wing coordinated the procurement of Electro-Optical Tactical Decision Aid (EOTDA) software and climatological data and their dissemination to the WSF. The wing also became involved in communications matters affecting the WSF--for example, serving as a conduit for the coordination of communications networks, monitoring communications equipment, providing communications security (COMSEC) materials, and dealing with communications maintenance issues.[27]

Another important function of the 5th Wing was gathering and disseminating information and being a "center of information [for AWS] on what was going on." This was a valuable service and, in time, this perhaps became the wing's biggest job. The wing expended much time and effort in coordinating and communicating with Headquarters AWS--answering its questions, serving as a conduit between Headquarters AWS and the WSF, and providing information to the AWS CAT for commander briefings. It also spent considerable time in communicating with its own squadrons and other wings and in preparing for its own briefings.[28]

All the other AWS weather wings also became involved with DESERT SHIELD/STORM to a greater or lesser degree. During the three weeks following the beginning of DESERT SHIELD each of the other numbered wings also activated CATs, beginning with the 2d and 7th on 7 August. AFGWC never activated a CAT as such. An important, if not the most important, function of the other wing CATs was to provide support to the 5th Wing as it levied assessments on the wings for personnel and equipment (both meteorological and communications) to deploy to the Persian Gulf theater. The 1st and 4th Wings roles in supporting the operation were very limited.[29]

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[26]AWS DS/DS Report #2 (S), p 10 (Sec 2.2.2-b), info used (U). For more detail on TPFDD development, see Tkach Intvw (U), pp 13-18.

[27]AWS DS/DS Report #2 (S), pp 12-14 (Sec 2.2.2-d,e,f), info used (U); St. Onge Intvw (U), pp 6-7; point paper (U), Col P.F. Abt, AWS/DO, "Management of the DESERT SHIELD Weather Support Force," 4 Jan 91.

[28]Koenemann Intvw (U), pp 6, 24; AWS DS/DS Report #2 (S), pp 8-10 (Secs 2.1.2-i, 2.2.2-a), info used (U).

[29]AWS DS/DS Report #2 (S), pp 17-18 (Sec 2.3), info used (U); hist rprt (U), 2WW, Jul-Dec 90, p 156; hist rprt (U), 7WW, Jul-Dec 90, DO Chronology, n.p.; msg (S), 3WW/DOJ to AWS/DOJ, "3WW/Sitrep [#1]," 092136 Aug 90, info used (U); hist rprt (U), 4WW, Jul-Dec 90, classified annex (S), Atch 1-1, info used (U); hist rprt (U), 1WW, Jul-Dec 90, Sup Doc 6.

The First AWS Deployments

As already noted,[30] the first Air Force units to deploy to DESERT SHIELD were two squadrons of F-15 fighters from the 1st Tactical Fighter Wing at Langley AFB. The wing weather officer, Captain Judith E. Dickey, and a weather support team comprised of three noncommissioned officers (NCOs) and two airmen deployed ahead of the aircraft. Captain Dickey left on the morning of 7 August and arrived at Dhahran on the evening of the 8th. Three of the members of her team arrived on the morning of 9 August and the other two that evening.[31]

Captain Dickey, however, was not the first AWS person to set foot in the Persian Gulf theater to participate in Operation DESERT SHIELD. That honor belongs to Staff Sergeant John N. Poole of the 15th Weather Squadron's Detachment 3 at Charleston AFB, who landed in Riyadh aboard a C-141 airlifter out of Charleston with a MAC airlift control element at 1010 local time, 8 August. Next to arrive were First Lieutenant Todd M. Fasking and Technical Sergeant Keith E. Daniels, both from Detachment 10 of the 15th Weather Squadron at McGuire AFB, New Jersey. They came with another MAC airlift control element aboard a C-141 out of McGuire that touched down at Dhahran, at 1310 local time, 8 August. Technical Sergeant Fred A. Wilburn of the 26th Weather Squadron's Detachment 20 at Barksdale AFB, Louisiana, arrived at Riyadh a few hours later (approximately 1800 local time) aboard a SAC KC-10 tanker. Thus, when Captain Dickey debarked on the evening of the 8th of August, she became the fifth person from AWS to arrive in the DESERT SHIELD theater. These five constituted the vanguard of an AWS WSF that was eventually to become nearly 500 persons strong.[32]

Meanwhile, three members of AWS--Lieutenant Colonel Gerald F. Riley, Jr., Major Frank L. Kendrick, and Senior Airman Vince B. Bowman--had deployed from Shaw AFB in the early morning of 8 August with the second group of the advanced USCENTAF headquarters element, arriving at Riyadh late in the morning of the 9th. Colonel Riley was commander of the 5th Wing's 3d Weather Squadron and staff weather officer (SWO) to the CENTAF commander, Lieutenant General Horner, who had deployed to Saudi Arabia on a preceding flight to establish and head USCENTCOM Forward. Major Kendrick was chief of the Plans Branch at 3d Squadron and Senior Airman Bowman was an observer from the 5th Weather Squadron's Detachment 3 at Fort Bragg.[33]

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[30]See above, p 4.

[31]5WW DESERT SHIELD Chronology (S), p 9-1, info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Capt Judith E. Dickey, Det 6, 1690WGP/CC (and Det 7, 3WS), 7 Jun 91, hereafter cited as Dickey Intvw, p 2; telecon (U), W.E. Nawyn, AWS/HO, with TSgt S.G. Green, Det 7, 3WS (and Det 6, 1690WGP), 16 Oct 91.

[32]Atch (U), [MAC] Movement Flow Chart, 7-9 Aug, to fax msg (U), SSgt J.N. Poole, Det 3, 15WS (and 1690WGP), to W.E. Nawyn, AWS/HO, 12 Dec 91; telecon (U), W.E. Nawyn, AWS/HO, with SSgt J.N. Poole, Det 3, 15WS (and 1690WGP), 17 Oct 91; telecons (U), W.E. Nawyn, AWS/HO, with TSgt K.E. Daniels, Det 10, 15WS (and Det 6, 1690WGP), 17 Oct 91, 12 Nov 91; telecon (U), W.E. Nawyn, AWS/HO, with MSgt F.A. Wilburn, Det 20, 26WS (and Det 28, 1690WGP), 16 Oct 91; telecon (U), W.E. Nawyn, AWS/HO, with LTC G.F. Riley, Chief, AWS/DOJ, 15 Oct 91.

[33]5WW DESERT SHIELD Chronology (S), pp 9-1, 9-2, info used (U); intvw (S), W.E. Nawyn, AWS/HO, with LTC Gerald F. Riley, Jr, CENTAF/SWO and CENTAF WSE/OIC (and 3WS/CC), hereafter cited as Riley Intvw (S), pp 2-3, info used (U).

Colonel Riley added Senior Airman Bowman to the weather party a few hours before departure at the request of Major John A. White III, the XVIII Army Corps staff weather officer, so he could serve as a data relay for the Ready Brigade of XVIII Corps' 82d Airborne Division, which would be deploying very shortly. Senior Airman Bowman, thus, probably became the first AWS Army weather support person to arrive in the Persian Gulf area. However, Technical Sergeant Michael D. Nardi, also from Detachment 3 of the 5th Weather Squadron, and the NCO in charge (NCOIC) of the weather team supporting the Ready Brigade, arrived shortly afterwards.[34]

DESERT SHIELD weather support grew rapidly as other AWS personnel quickly followed on the heels of the earliest deployees. By the end of 9 August, AWS had already deployed 49 persons to the Persian Gulf.[35]

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[34]5WW DESERT SHIELD Chronology (S), p 9-1, info used (U); Riley Intvw (S), p 2, info used (U); telecon (U), W.E. Nawyn, AWS/HO, with MSgt S.A. Lord, Det 3, 5WS (and Det 3, 1690WGP), 17 Oct 91.

[35]List (U), S.W. Tkach, 5WW/DOX, [AWS Personnel Deployed to DESERT SHIELD/STORM,] n.d. [ca 15 Sep 91,] hereafter cited as Tkach, List of Deployed AWS Personnel (U), Sep 91.

CHAPTER II

BUILDING THE WEATHER SUPPORT FORCE

Deployment Policies and Processes

The first task facing the 5th Weather Wing as lead wing when DESERT SHIELD got underway was to see to it that deploying Air Force and Army units had weather teams to go with them. This meant it had to determine how many and what weather support people it should deploy and make sure it sent out the taskings to deploy them. In theory, this should not have been too difficult. The principle covering how many and who should deploy was relatively simple and straightforward: Weather people would deploy with the customers they supported. Moreover, war plans such as OPlan 1002-88 stipulated the size of weather support teams required for various scenarios and circumstances (e.g., bare or equipped bases, number and types of aircraft).[1]

In practice, however, sizing weather support teams and selecting who should deploy proved to be far more complicated, at least for teams supporting Air Force units, than the basic principle suggested. In part this resulted from the speed with which the DESERT SHIELD deployment expanded, but also from the fact that, unlike Army support weather teams, AWS personnel supporting Air Force units, for several reasons, did not automatically deploy with the units they supported. The aircraft wing they supported did not always deploy in its entirety and, therefore, neither did its supporting weather team. Further, the Air Force frequently deployed more than one flying unit to a particular base in the DESERT SHIELD theater and they did not each need all of their normal weather support complement with them. Then, too, the 5th Wing frequently deployed weather teams in increments--first an initial person or two to accompany the advance element of the unit the team supported and then, later, the other members of the team. Sometimes, however, for one reason or another, including instructions from higher headquarters to deploy a minimum number of people and later the imposition of deployment ceilings, the others never did deploy. The 5th Wing's need for special expertise in certain deployed assignments also made the deployment process more complex.[2]

The deployment process AWS followed had at least two unintended consequences for deployed weather units supporting Air Force customers. First, it frequently led to the formation in the theater of composite weather support teams with members drawn from various stateside units who had never worked together before. Second, the personnel deployed tended to be relatively junior officers and enlisted persons. Often senior and more experienced officers and NCOs were left at home stations "minding the store." Deployed weather teams supporting Army units, on the other hand, although they included many young members, generally deployed as a unit with their customers and, therefore, had

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[1]Koenemann Intvw (U), pp 9, 19-21; St. Onge Intvw (U), p 5; Tkach Intvw (U), p 7.

[2]Tkach Intvw (U), pp 3-4, 6-8, 10-11; Maj N.E. Buss in AWTB Intvw (U), pp 10-11; Koenemann Intvw (U), pp 9-10; St. Onge Intvw (U), pp 5-6.

experience in working together prior to deploying. Moreover, commanders of the Army weather teams deployed with their troops; very few Air Force weather support detachment commanders did.[3]

It was not only the deployment process, however, that led to the deployment of relatively inexperienced personnel. Another factor was an initial perception that the operation would be a short one--only a show of force--and it was, therefore, not necessary to disrupt home station operations. Still another was the failure to fully realize and react soon enough to the fact that the US had begun a major contingency operation and AWS was deploying a very large WSF, a force that needed senior leadership even at the cost of disrupting home station operations. The failure was due, at least in part, to the early uncertainty as to what the real mission of the DESERT SHIELD operation was and to the many separate deployment decisions that had to be made quickly without much time to look at the overall picture.[4]

In determining the size of weather support teams, 5th Wing's deployment manager, Mr. Tkach, and his assistants used existing war plans as their beginning point. They then made changes up or down as needed--which meant many. Initially, as they responded to the guidance received to keep manning to a minimum, they tended to adjust downward rather than upward. Other factors also led to subtracting rather than adding. For example, restricted beddown facilities in the theater, the Air Force policy of frequently deploying less than all the aircraft from a particular unit, and the presence of two or more aircraft units at a particular deployed location, made it advisable to deploy less than the full doctrinally-prescribed complement of weather support personnel. Overall, however, because of the rapid expansion of the DESERT SHIELD operation, not only in personnel but also in the number of locations to which American forces deployed--far more than envisioned by the war plans, AWS deployed many more personnel than it had expected to under the war plans.[5]

TAC, in its capacity as CENTAF Rear, was the overall deployment manager for Air Force assets. It developed the basic Air Force deployment plan, the TPFDD which established requirements, means, and schedules for deployment of Air Force forces. The Army's Forces Command (FORSCOM) developed the TPFDD for the Army. The TPFDDs contained all the information necessary to deploy personnel and equipment. They were dynamic documents that changed almost constantly as TAC and FORSCOM planners added new requirements and modified others to reflect expanding and changing needs. The US Transportation Command kept an overall TPFDD covering the deployment of all US forces being sent to the Persian Gulf theater and was responsible for determining and providing all the necessary CONUS (continental US) transportation and overseas airlift and sealift.[6]

In general, the process for getting AWS personnel deployed in support of Air Force units involved determining and sourcing deployment requirements and then submitting them to TAC, which

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[3]Kelly Intvw (U), pp 30-31; Frederick Intvw (U), p 5; Tkach Intvw (U), pp 10-11, 24-25; Col T.C. Tarbell in AWTB Intvw (U), pp 29-30; Goldey Intvw (U), p 14; Riley Intvw (S), pp 17-18, info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Col William S. Weaving, 1690WGP/CV (and 5WS/CC), hereafter cited as Weaving Intvw, pp 18-19; AWS DS/DS Report #2 (S), p 34 (Secs 3.2.9, 6.2-c), info used (U); Koenemann Intvw (U), pp 9-10; St. Onge Intvw (U), pp 10-11.

[4]Kelly Intvw (U), pp 3, 4-6, 31-32; Col T.C. Tarbell in AWTB Intvw (U), pp 29-30; Koenemann Intvw (U), p 9.

[5]Tkach Intvw (U), pp 4, 8, 24; St. Onge Intvw (U), pp 5-6; Koenemann Intvw (U), p 9; AWS DS/DS Report #2 (S), pp 35-36 (Sec 3.4), info used (U).

[6]Tkach Intvw (U), pp 7, 14; St. Onge Intvw (U), pp 7-8.

would enter them into the TPFDD. TAC accepted changes or deletions in the requirements up to five days before the scheduled deployment date. The 5th Wing established deployment requirements for AWS personnel and, working through Headquarters AWS, assigned requirements to the appropriate wing or wings, including, of course, itself. The 5th Wing did not directly source the requirements (except for its own). This was the responsibility of each individual weather wing. In actual practice, 5th Wing, Headquarters AWS, and the other wing or wings coordinated with each other to come up with the personnel needed to source each requirement. In choosing deployees they used various criteria. One was expertise. 5th Wing listed, in order of importance, experience with and/or in forecasting, Army support, VOLANT LIGHTNING (an AWS training exercise), EOTDAs, and Quick Reaction Communications Terminals (QRCTs), as desirable for deploying personnel. Other criteria used were availability (e.g., pending retirement, permanent change of station, or educational assignment), training, and the needs of their home stations.[7]

The procedures for arranging the deployment of Army weather support teams were quite similar. The 5th Wing's 5th Weather Squadron at Fort McPherson, Georgia, an Army support unit, was in a better position to build and source the requirements and to work with FORSCOM, the manager of the Army TPFDD. Therefore, while the 5th Wing and the 5th Squadron worked together in building and sourcing the requirements, the squadron took care of the mechanics involved in the process, including submitting the requirements to FORSCOM.[8]

Mr. Tkach and his people began the deployment process by identifying a requirement for weather support personnel and coordinating it with the supported Air Force unit. If the supported unit approved it, they coordinated the requirement with the wing or wings they determined should source it, usually requesting a certain person or persons from a particular unit or units. Once Mr. Tkach reached agreement with the wing or wings on the sourcing, the 5th Wing deployment manager submitted, with justification, the requirement. It now contained specific information concerning the persons deploying (personal information, from what unit, to where deploying, and what equipment each would carry) to the appropriate office at Headquarters TAC. After review and approval by this office, TAC entered it into the TPFDD--a line entry for each person. Next, the requirement went to the Joint Deployment System at Headquarters MAC which returned it to TAC for an accuracy check. Following this the TAC manpower people, who created the deployment manning document and built a levy flow, sent it to the base or bases at which the proposed AWS deployees were stationed. Each base then generated deployment orders. The TPFDD prescribed when and how the deployees would move from the base to the point of embarkation and their port of debarkation in theater. Of course, breakdowns and delays at certain points and other glitches sometimes disrupted the process.[9]

The 5th Wing encouraged deploying personnel to carry with them on their flight, besides their personal gear, as much job-related equipment as they could handle or weight-restrictions allowed. Thus, the deployees, particularly the early ones, frequently found themselves carrying tactical meteorological and communications equipment, meteorological satellite receivers, and/or small

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[7]Tkach Intvw (U), pp 6-7; Col P.F. Abt in AWTB Intvw (U), pp 8-9; msg (U), 5WW/CAT to AFGWC/CAT, et al, "Background Factors for DESERT SHIELD Deployed Personnel," 051844Z Dec 90; msg (U), 5WW/DP to AIG 8128/CC, "Personnel Actions in Support of Operation DESERT SHIELD--Personnel Policy Guidance Message Number 1," 241235Z Aug 90.

[8] AWS DS/DS Report #2 (S), pp 10-11 (Sec 2.2.2-b), info used (U); telecon (U), W.E. Nawyn, AWS/HO, with S.W. Tkach, 5WW/DOX, 24 Oct 91.

[9]Tkach Intvw (U), pp 13-18.

computers, and sometimes even supplies such as teletype or facsimile paper. The 5th Wing entered such equipment and supplies they took with them into the TPFDD.[10]

Mr. Tkach and his folks at the 5th Weather Wing also had the responsibility of keeping track of deployed personnel after they arrived in the theater. This was not an easy task. Nevertheless, they generally were able to say where a particular person was at a particular time. They passed on this type of information to Headquarters AWS and it, therefore, was also usually aware at all times of the location of each deployed AWS person.[11]

Getting Established in Theater

CENTAF Weather

As mentioned earlier,[12] Lieutenant Colonel Riley and two other AWS persons arrived in Riyadh on 9 August with part of the advanced CENTAF headquarters element. Dead tired, they disembarked at about 11:00 a.m. into a 100-degree plus temperature and, after waiting for about an hour, were taken to the Marriott Hotel which was to become their temporary home. After another hour of waiting in the lobby of the hotel, they were able to go to their room and rest a bit. However, their day was not yet over. Around 4:00 in the afternoon a bus arrived to take them to the location selected for Headquarters CENTAF, the Royal Saudi Air Forces (RSAF) headquarters building, approximately two miles down King Abdul Aziz Road from the Marriott. Here they worked until about 11:00 p.m. at which point they finally "crashed," as Colonel Riley put it, and went back to the hotel for some badly needed rest.[13]

The next day, 10 August, Colonel Riley and his people worked at getting the Headquarters CENTAF Forward weather station set up. Before the day was over they were able to send out the first situation report from CENTAF Weather to USCINCCENT at MacDill AFB. After operating out of an office on the second floor of the RSAF building for two or three days, they managed to get their own space, a conference room located on the third floor. Here they could set up their weather gear and communications equipment. From there they ran 250 feet of cable up to an antenna which they erected on the roof of the building. They began to present weather briefings, usually two per day, to

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[10]5WW DESERT SHIELD Chronology (S), p 9-21, info used (U); St Onge Intvw (U), pp 7-8; intvw (U), W.E. Nawyn, AWS/HO, with Major Robert P. Callahan, 5WW/DOK, and MSgt Joe E. Brackett, 5WW/DOK, 6 Jun 91, hereafter cited as Callahan/Brackett Intvw, p 2; msg (U), TAC/5WW to ALL, "TACMET/TACCOM Equipment," 141716Z Aug 90; Dickey Intvw (U), pp 3-4.

[11]Tkach Intvw (U), p 18; LTC R.R. Wall and Maj N.E. Buss in AWTB Intvw (U), pp 10, 43.

[12]See above, Chapter I, p 11.

[13]Riley Intvw (S), pp 2-4, info used (U).

Major General Thomas R. Olsen, vice commander of the Ninth Air Force and acting CENTAF Forward commander, and his staff almost immediately.[14]

Approximately 6 weeks later CENTAF moved the weather station to the basement of the building, primarily so it would be close to the CENTAF Operations staff, most of whom were in the basement. It shared an area with personnel from CENTAF's Communications and Computer Systems. The RSAF command post was also in the basement. The CENTAF's Tactical Air Control Center was located, at least until December, outside in the parking lot of a building located behind the RSAF building.[15]

Meanwhile, many more AWS personnel began to arrive in the Persian Gulf theater on the heels of the initial arrivals. Among the earlier arrivals were the first two weather support persons to Special Operations Command, CENTCOM (SOCCENT), Captain Steven D. Skidmore, the staff weather officer to the commander, and Technical Sergeant Glynn Erwin, both of whom deployed to Riyadh on 12 August. They, however, did not remain in Riyadh but went with SOCCENT headquarters to King Fahd Air Base (AB) near Dhahran.[16]

Colonel Riley initially not only functioned as the CENTAF Forward SWO and officer in charge (OIC) of the CENTAF weather support element, but also as the senior AWS officer in the theater and as the acting commander of the entire DESERT SHIELD WSF. As such, he attempted to keep abreast of who was arriving, when they arrived, and where they were. But given the limited communications capabilities, both intratheater and intertheater, this was not an easy job. For making contacts with other locations in theater, he had to use primarily tactical telephones. Communications with the CONUS was mostly via the Automatic Digital Network (AUTODIN), which had a terminal at the US Military Trade Mission located in a compound adjacent to the RSAF Headquarters area.[17]

CENTCOM Weather

Colonel Riley served as acting officer in charge of the AWS DESERT SHIELD WSF (OICWSF) until Colonel James W. Goldey arrived in Riyadh on 24 August. Colonel Goldey was commander of the 1st Weather Squadron, the AWS unit that supported CENTCOM, and as such, the SWO to the USCENTCOM commander in chief, General Schwarzkopf. According to doctrine, the CENTCOM SWO deployed when the commander in chief did. Initially, General Schwarzkopf deployed CENTAF Commander Lieutenant General Horner to the Persian Gulf to set up and become commander of USCENTCOM Forward while he himself remained in the CONUS for the time being. Consequently, Colonel Goldey did not deploy at that point. When General Schwarzkopf left for the Gulf in late August, Colonel Goldey and two CENTCOM staff weather officers, Majors Nancy E. Holtgard and

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[14]Riley Intvw (S), p 4, info used (U); msg (S), COMUSCENTAF FWD/WE to USCINCCENT/CCJ3-W, et al, "Initial Report," 101100Z Aug 90, info used (U); msg (S), COMUSCENTAF FWD/WE to COMUSCINCCENT/CCJ3-W, et al, "USCENTAF Weather Sitrep 02," 111900Z Aug 90, info used (U).

[15]Riley Intvw (S), pp 4-5, 7, info used (U).

[16]Riley Intvw (S), pp 5,15, info used (U); Tkach, List of Deployed AWS Personnel (U), Sep 91.

[17]Riley Intvw (S), pp 5-6, info used (U).

Joseph D. Brod, deployed with him. Even then it did not occur, however, without a hitch. Colonel Goldey and his team were, due to shortages of space on aircraft, more than once cut from flight manifests. Finally, the colonel in effect told the CENTCOM assistant chief of staff that if he thought General Schwarzkopf wanted weather support segments in his staff briefings, he better get the three CENTCOM staff weather officers on a flight soon. The assistant chief of staff thereupon immediately put them on the manifest for an early flight.[18]

Colonel Goldey and his two majors left MacDill AFB aboard a crowded MAC C-14l about noon on 23 August and arrived in Riyadh at approximately 2100 local time on the following evening. Their first order of business was to proceed to the billeting arranged for them by CENTCOM Forward in separate hotels, and get some sleep. The colonel's hotel was immediately across the street from the Ministry of Defense and Aviation (MODA), a building complex that included a beautiful five-story stone and marble structure which would become the site of USCENTCOM headquarters. Like the RSAF building where Headquarters CENTAF was located, the MODA complex fronted on King Abdul Aziz Road, but three miles to the south.[19]

The next morning Colonel Goldey visited the MODA building to find out where his work space would be. It turned out to be four stories underground in an area of the building never before occupied. The Saudi Arabian government had specifically prepared this area about ten years before for possible use by the US in the event of some sort of contingency. The area was wired for electric current and it had a few telephones, but in general, its communications capabilities were totally inadequate. It was also devoid of furniture. The Saudi government, however, quickly rectified the situation. In a few days a commercial contractor had installed a switchboard and many new communications lines. Colonel Goldey's team had furniture within 2 days. CENTCOM communicators had already established circuits for weather teletype and facsimile systems, so they were ready to turn the circuits on as soon as the hardware and internal lines were in place. Thus, in 2 or 3 days CENTCOM Weather was able to receive alphanumeric weather data from the CONUS on its teletype. Due to modem problems, however, it was a little longer before CENTCOM Weather received facsimile products. By 28 August, the three CENTCOM SWOs were providing daily weather briefings to General Schwarzkopf and his staff.[20]

The CENTCOM SWO office was strategically located in the center of the whole CENTCOM work area. General Schwarzkopf's war room was only about 15 feet away. The Joint Operations Center was next door in one direction and the Joint Intelligence Center was across the hall. Next door in another direction was the Combined Coalition Center Command Post. Center personnel frequently cut through the weather office to go from center to center. The classified vault where planners were to make many targeting decisions later on was not far away.[21]

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[18]Goldey Intvw (U), pp 2-3.

[19]Goldey Intvw (U), p 4; atch 3 (U), [Col J.W. Goldey, 1690WGP/CC], "Draft Article Submitted to AWS/PA by Col Goldey," n.d., hereafter cited as Goldey Draft Article, to ltr (U), LTC W.S. Weaving, 1690WGP/CV, to Maj Gen J.W. Collens, USAF (Ret), "Request for Information--Desert Shield/Storm," 15 Apr 91, w/6 atchs, hereafter cited as ltr (U), Weaving to Collens, 15 Apr 91.

[20]Goldey Intvw (U), pp 4-5; atch 3 (U), Goldey Draft Article, to ltr (U), Weaving to Collens, 15 Apr 91.

[21]Note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

Meanwhile, Colonel Goldey established contact with Lieutenant Colonel Riley at CENTAF Weather and assumed his assigned post as OICWSF, enabling Colonel Riley to devote full time to his duties as the CENTAF SWO and OIC of the CENTAF weather support element. The two officers quickly decided to leave the theater tactical forecast unit (TFU), which CENTAF Weather had already begun to set up, at CENTAF rather than move it to CENTCOM, as called for by AWS weather support doctrine. The chief reason for this decision was that CENTCOM Weather simply had no space available in its office area for the TFU. It shared what was only a medium-sized office with four other Headquarters CENTCOM functional areas and, consequently, the room already had as many as 15 people and eight desks in it, not to mention the weather teletype and facsimile machines. There was no other room available for CENTCOM Weather. Besides, CENTCOM Weather's location four stories underground was not conducive to effective TFU operations. The two men briefly considered moving the TFU to Riyadh AB, which would give it the advantage of being near the Defense Meteorological Satellite Program (DMSP) tactical readout van, but concluded that the location would be too remote from the three WSF headquarters. The 5th Wing subsequently concurred in their decision to collocate the TFU with CENTAF Weather. The TFU, soon referred to as the DESERT SHIELD Forecast Unit (DSFU), remained at CENTAF Weather as long as it continued in operation.[22]

Colonel Goldey and Colonel Riley also agreed to assign the TFU the task of tailoring its general forecast products to Air Force operations, which was the primary function of a tactical weather analysis center (TWAC), so they would not have to establish a separate TWAC. To a large extent the lack of additional space, this time at CENTAF, drove this decision, too. But pressure from the rear, e.g., Headquarters MAC, for AWS to hold down the number of people deploying (a separate TWAC called for an additional 12 persons) also played a role. Indeed, by this time the two officers were spending many hours trying to figure out at what locations in the theater they could safely reduce manning by one person in order to fill new in-theater manpower requirements.[23]

ARCENT Weather

Senior Airman Bowman and Technical Sergeant Nardi were the earliest Army support weather persons to arrive in the Persian Gulf theater, but not far behind was the six-man weather team of the 82d Airborne Division's Aviation, or Ready Brigade, headed by First Lieutenant Peter C. Clement and Master Sergeant Stephen A. Lord. It arrived at Dhahran either later on the 9th or on the 10th of August. Major White, the XVIII Corps staff weather officer, also landed at Dhahran about the same time. Other Army weather support personnel followed.[24]

Meanwhile ARCENT, the Army component of CENTCOM, established its headquarters in the basement of the Royal Saudi Land Forces (RSLF) building, located on King Abdul Aziz Road only two blocks from CENTCOM. The approximately 500 Headquarters ARCENT personnel, including two weather support people, found themselves "housed" for the first month or so in the vast, unpartitioned

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[22]Goldey Intvw (U), pp 5-6; msg (S), USCINCCENT/WE to 5WW/CAT, et al, "Weather Support Concept (U)," 072300Z Sep 90, info used (U); msg (S), 5WW/CAT to USCINCCENT/WE, et al, "Weather Support Concept (U)," 081600Z Sep 90, info used (U).

[23]Goldey Intvw (U), p 6.

[24]Telecon (U), W.E. Nawyn, AWS/HO, with MSgt S.A. Lord, Det 3, 5WS (and Det 3, 1690 WGP), 17 Oct 91; Riley Intvw (S), p 5, info used (U).

underground parking garage of the building, with sleeping cots lined up in long rows, no air conditioning, only a couple of showers, one bathroom, and the noise associated with one room containing 500 people. Living conditions in this place were not very pleasant, although compared with those under which their Army colleagues in the desert existed, perhaps no so bad.[25]

Major White was the senior ARCENT weather support officer present, but Captain Michael Davison, who reached Riyadh around the 11th or 12th of August, functioned as the ARCENT SWO for approximately a month. Realizing that a more senior officer than a captain was needed as SWO to the ARCENT commander, AWS leaders directed Lieutenant Colonel William S. Weaving, Director of Operations for the 5th Weather Squadron at Fort Bragg, to deploy to Saudi Arabia. After undergoing a crash mobility training session and enduring a lengthy, 53-hour airplane trip, Colonel Weaving arrived at Riyadh on 9 September to assume the dual role of ARCENT SWO and officer in charge of the ARCENT weather support element.[26]

When Colonel Weaving arrived, Captain Davison and Senior Master Sergeant Paul D. Bradley were in the process of setting up ARCENT Weather in a room they had just been assigned a day or two before on the seventh floor of the RSLF building. Colonel Weaving soon managed to get a desk in a next door room, giving him a quiet place to work. The room actually belonged to a Saudi Arabian prince who was in the field and not expected to return until after DESERT SHIELD was over. The first real task facing the colonel after his arrival was to get the station operational. The biggest challenge associated with this was to acquire a communications capability--particularly to establish connections between the Army and Air Force weather communications systems and with deployed Army weather teams in the field. Communications experts spent many days studying how to make all the necessary connections. Implementing the circuits posed even greater difficulties. As a result, a considerable amount of time elapsed before ARCENT Weather obtained the communications capability it needed.[27]

Initial Organization and Manning

After Colonel Goldey's arrival, the DESERT SHIELD WSF organizational structure took on the form it was to have for the next two and a half months. Colonel Goldey was the senior officer present in the DESERT SHIELD theater and, as such, was the OICWSF. He also served as the Chief of the Weather Division, Directorate of Operations, USCENTCOM, and SWO to USCINCCENT, General Schwarzkopf. Immediately under Colonel Goldey were Lieutenant Colonel Riley, OIC of the CENTAF weather support element--i.e, all the weather teams supporting Air Force resources deployed to DESERT SHIELD; Lieutenant Colonel Weaving, OIC of the ARCENT weather support element (beginning 10 September)--i.e, all the weather teams supporting Army units deployed to DESERT SHIELD; and Captain Skidmore, SWO to General James J. Lindsay, the SOCCENT commander. However, in keeping with the ARCENT organizational scheme, the ARCENT weather teams at the division, brigade, and regiment level reported directly to the XVIII Corps SWO, Major John R. Conley (after 23 September), who, in turn, reported to Colonel Weaving. Colonels Riley and Weaving, of course, also continued to

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[25]Weaving Intvw (U), p 3; atch 4 (U), rprt, LTC W.S. Weaving, 1690WGP/CV, [Col Weaving's Comments,] n.d., hereafter cited as Weaving Comments (U), to ltr (U), Weaving to Collens, 15 Apr 91.

[26]Weaving Intvw (U), pp 2-3.

[27]Weaving Intvw (U), pp 5-6.

function as SWOs to the CENTAF commander, Lieutenant General Horner, and the ARCENT commander, Lieutenant General John J. Yeosock, respectively.[28]

Colonel Goldey at first had only a small, five-person staff at CENTCOM Weather. Consequently, he found it difficult to fulfill his responsibilities as both SWO to CINCCENT and OICWSF of the growing WSF, particularly the latter, and he and his staff ended up working long and hard hours with little time off. His preferred management style was to leave his three subordinates in charge of CENTCOM component weather elements free to perform their jobs with a minimum of interference on his part. Nevertheless, he coordinated with Lieutenant Colonels Riley and Weaving daily by telephone, proffered advice as needed, and tried to find time for a staff meeting every week. He also provided guidance to Captain Skidmore, the SOCCENT SWO, although, since the SOCCENT headquarters was not located in Riyadh, he did not have many personal meetings with the captain. Colonel Goldey was never able to find time to make personal visits to WSF units. However, Lieutenant Colonel Weaving, with a larger staff and a smaller geographic area to cover, made several trips to the Army weather support teams in the field and Lieutenant Colonel Riley, who initially also had a very small staff, began travelling to CENTAF units in October.[29]

Lines of command were not as easy to establish for the several weather teams supporting DESERT SHIELD from outside of the immediate Persian Gulf theater. AWS attached weather teams at Cairo West AB, Egypt, and, after a time, the Indian Ocean island of Diego Garcia (geographically located in the US Pacific Command AOR) to the DESERT SHIELD WSF. Following a period of some uncertainty, it placed weather teams deployed to Europe (Moron AB, Spain, and a few bases in Great Britain and France) to support SAC DESERT SHIELD/STORM operations to the 2d Weather Wing.[30]

The experiences of AWS personnel setting up operations at locations in the theater outside of Riyadh, especially at bare airbases and Army encampments, generally were quite different from those of the people establishing weather offices and stations at command headquarters in Riyadh. By comparison, headquarters personnel had few and relatively minor problems. Weather teams (sometimes individuals) often deployed to isolated locations in strange environments where they had to start from scratch, frequently having nothing in the way of working facilities, furniture, and even, sometimes, equipment. In spite of this, they somehow managed to begin operations within a short time, frequently taking weather observations within 24 hours. Generally their working facilities (and living accommodations) continued to be much more spartan than those of their colleagues in Riyadh. This was particularly true for Army weather teams.[31]

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[28]Msg (S), 5WW/CAT to 1WW/CAT, et al, "AWS Concept of Operations/Operation DESERT SHIELD (U)," 070706Z Sep 90, info used (U); atch 3 (U), Goldey Draft Article, to ltr (U), Weaving to Collens, 15 Apr 91; Goldey Intvw (U), pp 8-9; AAR (U), USARCENT SWO, [ARCENT Weather Team Final After Action Report--Operations DESERT SHIELD and DESERT STORM,] n.d., hereafter cited as ARCENT SWO AAR, pp 1-2 (Secs I-1 and I-2); intvw (U), W.E. Nawyn, AWS/HO, with Maj John R. Conley, XVIII Corps/SWO (and 6WS/DO), 18 Jul 91, hereafter cited as Conley Intvw (U), p 2.

[29]Goldey Intvw (U), pp 7, 11, 32-33; Weaving Intvw (U), p 16.

[30]JULLS Long Reports (S), SAC/DOWXP, JULLS Number 31234-62871 (00010), [Area of Responsibility Operational Control (U),] and JULLS Number 31524-73069 (00026), [Non-AOR Provisional Weather Units (U),] in SAC JEMP Report (S), 29 Mar 91, pp 9, 24, info used (U); AWS DS/DS Report #2 (S), p 61 (Atch 4), info used (U).

[31] Dickey Intvw (U), pp 3-6; atch 3 (U), Goldey Draft Article, to ltr (U), Weaving to Collens, 15 Apr 91; Riley Intvw (S), p 8, info used (U).

In a few instances commanders sent some of their weather support people back to the United States or refused to accept as many persons as AWS wanted to send to them. This was not necessarily because these commanders did not want or sufficiently appreciate weather support, but perhaps because they had insufficient facilities and/or logistical support available (a number of places were short on tents, cots, and even food) or were under manning ceilings (some imposed by host nations).[32]

Late in August, as a result of a tragic aircraft accident, AWS incurred its first and only DESERT SHIELD/STORM-related fatalities. Shortly after midnight on 29 August a MAC C-5 airlifter crashed almost immediately after takeoff from Ramstein AB, West Germany. The plane carried medical supplies, dry rations, material handling equipment, and, in addition to ten crewmembers, seven military passengers destined for the DESERT SHIELD theater of operations. Thirteen of the 17 persons aboard died in the crash. Four AWS personnel were on the aircraft; three, all from the 2d Weather Wing, perished. Those killed were Staff Sergeant Marc H. Cleyman and Master Sergeant Samuel M. Gardner, Jr., of Detachment 14, 31st Weather Squadron, and Staff Sergeant Rande J. Hulec of the 31st Weather Squadron's Detachment 2. First Lieutenant Cynthia A. Borecky of Detachment 5 of the 5th Wing's 3d Weather Squadron survived, suffering two broken ribs, two broken ankles, and second-degree burns over 60 percent of her body. AWS remembered the three AWS members who lost their lives in the accident in a special memorial service at Scott AFB on 6 September.[33]

Initial Buildup of the Weather Support Force

Manning Growth and Geographic Expansion

The AWS DESERT SHIELD WSF grew by leaps and bounds. By 14 August, only one week after the first AWS deployees left for the Persian Gulf, AWS had deployed more than 100 persons to twelve different locations, including Moron AB in Spain and the American naval base on the British-owned island of Diego Garcia in the northern Indian Ocean. Five of the locations were in Saudi Arabia: Riyadh, Dhahran International Airport, Jeddah (King Abdul Aziz International Airport), King Khalid International Airport near Riyadh, and Taif. The others were Al Dhafra and Bateen in the United Arab Emirates, Thumrait and Masirah in Oman, and Shaikh Isa in Bahrain. By 31 August AWS had deployed 240 persons to 22 locations, including one Army field encampment. During September, the force increased to a total of 291 persons assigned to 28 locations, including four Army field encampments. September saw the essential completion of the initial AWS (and overall US) DESERT SHIELD deployment. The WSF expanded by only twelve persons in October, but by the end of the month,

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[32]Goldey Intvw (U), pp 19-20, 22; Koenemann Intvw (U), p 7; Tkach Intvw (U), pp 3-4.

[33]Msg (U), AFNEWS/IIBD to AIG 9333, et al, "Air Force News Service," Item #533, "C-5 Galaxy Crash," 292200Z Aug 90; AWS Form 5 (U), "AWSLine Report," [29 Aug 90], w/1 Atch: AF Form 1924 (U), "Events Log," 28 Aug 90; msg (U), AWS/CC to AIG 8380, "Air Weather Service News Releases," 131700Z Sep 90.

AWS weather teams were deployed to a total of 33 locations, 20 of them in Saudi Arabia (including ten Army unit camps in the field).[34]

Manning Restrictions

Although the WSF increased rapidly, the rate of growth was still barely sufficient to keep up with the expanding requirements and, taking the force as a whole, manning never became excessive. From the beginning, AWS policy was to keep manning to a minimum. Higher authorities, including TAC and MAC, as well as the Army's FORSCOM, largely drove the policy, either explicitly or by implication. TAC, for example, instructed the 5th Weather Wing to go with the bare minimum of people and FORSCOM's guidance to the wing for initial Army weather support manning was similar. In another example, CINCMAC, General Hansford T. Johnson, initially implied that perhaps there were too many weather people in the DESERT SHIELD theater since there wasn't much "weather," i.e, variation in the weather, in Saudi Arabia. AWS later convinced General Johnson that weather would have an impact on DESERT SHIELD operations. Nevertheless, the benign weather in the theater during the initial deployment contributed to the minimum manning policy. Another factor was the conclusion reached by some deployed Air Force wing commanders in the early phase of the operation that they had too many weathermen.[35]

On 7 September AWS directed a complete "scrub" of the WSF, i.e., a careful, hard reappraisal of weather support requirements with a view to paring the support force to the smallest size possible. Between this date and 31 October, AWS, 5th Wing, and the CENTCOM SWO scrubbed and rescrubbed the WSF. Meanwhile, on 4 October USCINCCENT imposed an overall ceiling of 250,000 in DESERT SHIELD forces. The Air Force limit within the total was 32,500. On 14 October USCENTAF forbad supporting major commands to deploy any additional personnel to the DESERT SHIELD theater without, in effect, its approval. The only exception was a one-for-one replacement of personnel who had to leave the theater for emergencies, separation from the service, or other special reasons. As a

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[34]Tkach, List of Deployed AWS Personnel (U), Sep 91; 5WW DESERT SHIELD Chronology (S), pp 9-3, 9-5, 9-7, and 9-10, info used (U); AWS DS/DS Report #2 (S), p 52 (Atch 3), info used (U); sitrep (S), 5WW Alert Staff to AWS/DOJ, et al, "Sitrep 07 (U)," 141600Z Aug 90, info used (U); sitrep (S), 5WW/CAT, "5WW Sitrep Nbr 24/Operation DESERT SHIELD (U)," 311531Z Aug 90, info used (U); sitrep (S), 5WW/CAT, "5WW DESERT SHIELD Sitrep #55--as of 01/1500Z Oct 90 (U)," 011700Z Oct 90, info used (U).

The 20 locations in Saudi Arabia were Riyadh, King Khalid International Airport near Riyadh, Dhahran International Airport, King Abdul Aziz International Airport near Jeddah, Taif, Khamis Mushait, King Fahd Air Base, Al Jubail, Tabuk, King Khalid Military City, and the encampments of the U. S. Army's XVIII Corps, 82d Airborne Division, 82d Airborne Division Aviation Brigade, 24th Infantry Division, 24th Infantry Division Aviation Brigade, 1st Cavalry Division, 1st Cavalry Division Aviation Brigade, 3d Armored Cavalry Regiment, 3rd Cavalry Regiment Aviation Squadron, and 12th Aviation Brigade. The other 13 locations were as follows: Al Dhafra, Bateen, Sharjah, Al Ain, and Al Minhad in the United Arab Emirates; Thumrait, Masirah, and Seeb in Oman; Shaikh Isa in Bahrain; Doha in Qatar; Cairo West AB in Egypt; Moron AB in Spain; and the island of Diego Garcia. See sitrep (S), 5WW/CAT, "5WW DESERT SHIELD Sitrep #83--as of: 29/1600Z Oct 90 (U)," 291730Z Oct 90, info used (U).

[35]Tkach Intvw (U), pp 7-8: AWS DS/DS Report #2 (S), pp 32-33 (Sec 3.2.7), info used (U); Col R.R. Wall in AWTB Intvw (U), pp 12-13; Koenemann Intvw (U), pp 7-8.

consequence of the scrubs and the manning ceilings, AWS on 31 October announced that it was limiting the WSF to 300 persons (60 officers, 137 forecasters, 101 observers, and two administrative persons) and instructed Colonel Goldey to redistribute the force as necessary to comply with the final manning scrub.[36]

The personnel ceilings, the AWS/5th Weather Wing manning scrub, and deployment and manning policies in general, together or separately, had several detrimental effects on AWS WSF manning. The deployment policy of at first deploying to particular locations only the minimum number of people required to accomplish the initial set up work, with the idea of increasing the manning later as needed, made a lot of sense when AWS inaugurated it. The second stage, however, never worked the way it was supposed to since the manning scrub and deployment ceilings imposed in October made it very difficult to deploy additional persons to the theater. As one consequence, larger, key units in the theater such as CENTCOM Weather and CENTAF Weather lacked sorely needed managerial expertise since AWS deployment doctrine called for sending management-trained persons in later, rather than in initial deployments. Under the circumstances, very few ever deployed. In addition, the manpower scrub and limitations made it virtually impossible to correct, at least in the short term, the overly junior composition of the Air Force WSF by deploying more senior officers and NCOs to the theater. By making it necessary to do much reshuffling of deployed weather personnel, these scrubs helped to bring about the composite weather units found in many locations.[37]

The ceiling and scrubs, by causing AWS to resort to non-doctrinal manning, also led to manning shortfalls at some weather units in the theater. For example, doctrine called for one officer, four forecasters, and three observers at deployed Air Force base weather stations, but AWS scrubbed the manning to 1-3-3. The NCO dropped was, in many cases, an experienced station chief. Further, the limitations prevented the deployment of full doctrinal Army weather support. The scrub reduced Army corps weather teams from 25 to 16 persons, standard division teams from 25 to 15, and the 101st Air Assault Division team from 34 to 30.[38]

Manning constraints also contributed to personnel shortages at higher headquarters levels. As previously noted,[39] at CENTCOM Weather Colonel Goldey found it difficult to perform all his duties with an initial staff of only five people (two officers, two NCOs, and an administrative specialist). Although in this case the scrub increased his staff to 11 persons (5 officers, 5 forecasters, and 1 administrative specialist), 2 of whom were assigned to operate the DMSP van, which was not collocated with CENTCOM Weather, manning was still less than adequate. At CENTAF Weather Lieutenant Colonel Riley, for a time, made do with himself, two other officers, an NCO, and an airman.

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[36]AWS DS/DS Report #2 (S), pp 23-24 (Sec 3.1.4), info used (U); Frederick Intvw (U), p 5; Col R.R. Wall in AWTB Intvw (U), pp 12-14; Tkach Intvw (U), pp 8-10; msg (S), USCINCCENT/CCCC to USCENTAF FWD HQS Element, et al, "Force End-strength Ceiling," 041700Z Oct 90, info used (U); msg (S), USCENTAF/CV to AIG 10322 and USCENTAF Rear/BS, "Operation DESERT SHIELD Air Force Manpower Limitation," 141110Z Oct 90, info used (U). For AWS DESERT SHIELD weather support force manning under the final AWS/5WW scrub, see AWS DS/DS Report #2 (S), p 41 (Atch 2), info used (U).

[37]AWS DS/DS Report #2 (S), pp 23 (Sec 3.1.4-a [S]), 34-35 (Secs 3.2.9, 3.3 [S]), info used (U); Tkach Intvw (U), pp 7-11, 24-25; Col R.R. Wall in AWTB Intvw (U), p 10.

[38]AWS DS/DS Report #2 (S), pp 32-36 (Secs 3.2.7, 3.3, 3.4), info used (U); Tkach Intvw (U), pp 24-25; LTC R.R Wall in AWTB Intvw (U), p 16.

[39]See above, this chapter, p 21.

Late in the year, after CENTCOM lifted the October manpower limitations, CENTAF Weather finally received additional people and reached the pre-planned manning level of seven persons (consisting, however, of four officers and three NCOs, rather than the doctrinal five officers and two NCOs), which proved to be at least adequate. Manning at ARCENT Weather (eventually four officers, four forecasters, six observers, and one administrative specialist) was sufficient. The SOCCENT weather team was also adequately manned, although it had only one person (an officer) assigned to it. It originally had two (one officer and one forecaster), but this turned out to be more than needed and the forecaster was soon reassigned elsewhere.[40]

The manning shortages did not result in a WSF incapable of doing its job. The two major shortfalls were those at CENTCOM Weather and CENTAF Weather. Overall, although manning was limited and weather teams had to work hard and put in long hours, the Air Force and Army weather teams had sufficient manpower to perform their mission.[41]

Females constituted nearly nine percent of the DESERT SHIELD/STORM WSF. A total of 39 women deployed during the course of the operation, 26 in the initial buildup before 31 October. Ten of the 39 were officers (1 major, 3 captains, 6 lieutenants). However, the maximum present in the theater at any one time was 37. Culturally-formed attitudes and customs toward women in the Arab host nations sometimes created problems for base weather stations with females in leadership positions as well as for the women themselves. Arab, particularly Saudi Arabian, male officers were reluctant to deal with American female officers on an equal basis. In situations where such dealings were necessary, they sometimes refused to have anything directly to do with their American female counterparts, working instead with or through the women's male subordinates. Obviously, this made communication difficult, or at least inefficient, and made the work of the AWS women officers harder, not to mention the personal frustrations this situation created for them.[42]

Training for Deployment

Some AWS personnel deployed to DESERT SHIELD without adequate training in certain respects. The relative youth and inexperience of the deployed WSF was a contributing factor to this, but there were others also--for example, training policy and training practices. There are different kinds of training--for example, forecasting and observing, equipment, and mobility. All deployees were well trained professionally, that is, in forecasting and observing. Army support personnel, who trained and exercised as teams with the units they supported, were generally better trained for deployment than Air Force support personnel. Many of the Air Force support personnel deployed were deficient in mobility training, particularly in regards to Southwest Asia. All deployees were trained up to the basic level (Phase I) standard required by AWSR 55-50. However, only persons filling primary and alternate mobility positions had to be trained up to the most advanced or Phase IV level, which included

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[40]AWS DS/DS Report #2 (S), pp 24-27 (Secs 3.2.1-3.2.5), pp 34-35 (Sec 3.3), info used (U); Goldey Intvw (U), pp 6-7; Riley Intvw (S), pp 15-17, info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 33-34.

[41]AWS DS/DS Report #2 (S), pp 34-36 (Secs 3.3, 3.4), info used (U); Tkach Intvw (U), p 10; Col R.R. Wall in AWTB Intvw (U), p 13.

[42]Tkach, List of Deployed AWS Personnel (U), Sep 91; Riley Intvw (S), p 18, info used (U); Dickey Intvw (U), pp 18-20.

acquiring familiarity with Southwest Asia. The size of the DESERT SHIELD deployment necessarily resulted in many AWS personnel being sent to Southwest Asia with only Phase I mobility training.[43]

Many AWS Air Force deployees also had little or no training in the tactical, meteorological, and communications equipment they had to use in the theater mostly because the equipment systems were new and not all AWS units had yet received the equipment. But also, in some cases, units had not displayed a sufficient sense of urgency in getting its people trained in the equipment. Further, frequently deploying personnel had little experience with high frequency (HF) radio communications operations. AWS had only begun to field the QRCT HF systems used by its Air Force support units in 1990 and some of the deployees had never even seen one before arriving in Southwest Asia. Consequently, the junior AWS officers and enlisted personnel in the Air Force weather support units had much to learn when they arrived in the Persian Gulf theater. For the most part, however, they learned rapidly and were able to cope with the challenges posed by the DESERT SHIELD/STORM operation.[44]

After it began to be evident to AWS that the DESERT SHIELD operation was going to be both large and lengthy and likely require the rotation of personnel after a time (which, incidentally, never actually occurred), and in view of the training shortcomings of the persons already deployed, it began to address the question of whether it had enough persons with tactical training to sustain future deployments. It quickly determined it should inaugurate special tactical training programs for potential future deployees. On 30 August the 5th Wing requested Colonel Abt, AWS DCS for Operations, to consider developing an AWS-wide accelerated tactical training program. The very same day Headquarters AWS made the decision to proceed with such a program and assigned the task of developing it to a working group looking at long term issues. The following day the AWS CAT requested AWS wings to intensify electro-optical and tactical communications training and instruction in Southwest Asia climatology as well as to identify personnel who already had experience or training in these and other technical areas.[45]

By 20 September AWS had decided to tailor its existing VOLANT LIGHTNING tactical training course, conducted by the 6th Weather Squadron at Eglin AFB, to DESERT SHIELD operations and to schedule seven 5-day sessions between 1 October and 7 December designed for persons with limited experience in a tactical environment. The course would include a Southwest Asia meteorological orientation and hands-on training on QRCTs and in the use of tactical meteorological satellite imagery dissemination systems including Wraase satellite receivers. Up to 28 persons, drawn primarily from the AWS wings located in the continental US, could attend each session.[46]

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[43]Kelly Intvw (U), pp 16-17, 26; Koenemann Intvw (U), pp 38-39; AWS DS/DS Report #2 (S), pp 229-231 (Secs 6.2, 6.3), info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 28-29; Weaving Intvw (U), pp 17-18.

[44]Kelly Intvw (U), pp 17-19; AWS DS/DS Report #2 (S), pp 229-231 (Secs 6.2, 6.3), info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 28-30; Riley Intvw (S), p 18, info used (U).

[45]Tkach Intvw (U), pp 22-23; msg (U), AWS/CV to AIG 8380/CV, "DESERT SHIELD Personnel Rotation Plan," 141530Z Sep 90; msg (U), 5WW/CAT to AWS/DO, et al, "Accelerated Tactical Training," 300325Z Aug 90; msg (U), HQ AWS/CAT to AIG 8366/DO, "DESERT SHIELD Long-Term Challenges," 312125Z Aug 90. For Brig Gen Kelly's views on personnel rotation issues, see Kelly Intvw (U), pp 3, 6-7.

[46]Msg (U), HQ AWS/DO to 1WW/DO, et al, "DESERT SHIELD VOLANT LIGHTNING," 201900Z Sep 90.

In response to a suggestion from Headquarters AWS, both the 1st and 2d Weather Wings also stepped up tactical training. The 1st Wing quickly arranged, through its 20th Weather Squadron, for training sessions, dubbed VOLANT LIGHTNING WEST, at Kadena AB, Okinawa, Japan. The squadron conducted the first session from 15 through 19 October. The course included chemical warfare defense equipment and weapons training. The 2d Wing expanded QRCT training to include potential DESERT SHIELD deployees and sent out headquarters personnel to assist personnel at subordinate units to complete their training.[47]

In a separate action later, the Commander of AFGWC, Colonel Adrian A. Ritchie, Jr., in November ordered preparations begun for an in-house DESERT SHIELD tactical training course at AFGWC. His main concern was to ensure AFGWC would be ready to deploy additional personnel (up to that time it had only deployed six) should this become necessary to replace casualties the DESERT SHIELD WSF might incur if hostilities broke out in the Persian Gulf theater. During January and February 1991 AFGWC conducted several sessions of the 1-week course which nearly 100 persons attended. Using 5th Weather Wing training materials as well as AFGWC experts, the course aimed to train attendees for deployment either to the DESERT SHIELD Forecast Unit or to tactical base weather stations. It included chemical warfare defense equipment, weapons, and full Phase I and Phase II mobility qualification training, as well as technical training specifically tailored to Southwest Asia.[48]

Working and Living Conditions in Theater

CENTCOM Weather remained in its crowded quarters four stories underground in one of the structures in the MODA complex in Riyadh for the duration of the DESERT SHIELD/DESERT STORM operation. The building in which it was located was modern, but operating efficiently out of the tiny, cramped room to which it had been assigned was a challenge--even with only a small, six-person staff. However,the room was in a strategic location very near the CENTCOM war room and next to three important Headquarters CENTCOM directorates: Joint Operations, Joint Intelligence, and Coalition, Coordination, and Integration. Moreover, it was eventually able to acquire a second office in another building about a mile up the street, initially a small room on the fourth floor, later two rooms on the first floor. Unfortunately, due in part to the inadequate communications at the second location, CENTCOM Weather was never able to take full advantage of this additional space.[49]

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[47]Point paper (U), 1WW/DOJ, "VOLANT LIGHTNING WEST," 19 Oct 90; art (U), Capt R. Granger, Det 8, 20WS, "Constant Training Keeps WX Members Ready," AWS Observer, Aug 91, p 4; Hist Rprt (U), 5WW, Jul-Dec 90, p 17.

[48]Intvw (U), W.E. Nawyn, AWS/HO, with Col James A. Phillips, AFGWC/DO, 13 Jun 91, hereafter cited as Phillips Intvw (U), pp 2-3; intvw (U), W.E. Nawyn, AWS/HO, with Col Adrian A. Ritchie, Jr., AWS/CC, 12 Jun 91, hereafter cited as Ritchie Intvw (U); intvw (U), W.E. Nawyn, AWS/HO, with Maj James P. Millard, AWS/DOO, 20 Jun 91, hereafter cited as Millard Intvw (U), p 3; memo (U), AFGWC/DOO to AFGWC/WF, "DESERT SHIELD In-House Training," 5 Nov 90; draft msg (U), AFGWC/CAT to 5WW/CAT and USCINCCENT/Weather, "Background Factors for DESERT SHIELD Deployment Personnel Pool," [ca 4 Dec 90].

[49]Atch 3 (U), Goldey Draft Article, to ltr (U), Weaving to Collens, 15 Apr 91; atch 5 (U), rprt, LTC W.S. Weaving, 1690WGP/CV to Col J.W. Goldey, 1690WGP/CC, "After Action Input - DESERT SHIELD/STORM," 22 Mar 91, hereafter cited as Weaving DS/DS AAR, in AAR (U) CENTCOM/WE, [CENTCOM AARs,] n.d. [ca. 25 Mar 91], w/11 atchs, hereafter cited as CENTCOM Weather Staff

Meanwhile, CENTCOM Weather personnel continued to enjoy excellent housing. They lived in hotels until around the end of September, at which time they moved to furnished apartments, paid for by Saudi Arabia, in a walled compound about five miles from the MODA complex. They used buses, also provided by the Saudi government, to travel back and forth between their working and living facilities.[50]

CENTAF Weather remained in its second assigned location, a former storage area in the basement of the RSAF building in Riyadh that it shared with another function, for about 2 months. In November it moved to another area of the basement, this time to a room of its own. As a former storage area, the room wasn't lavish--pipes and vents were hanging from the ceiling, but it provided sufficient space and adequate power for CENTAF Weather's needs and it was only a short distance from General Horner's war room. However, being in the basement, it was not well suited for HF operations. By this time it was clear the air war, if there was going to be one, would be directed from the RSAF basement. Thus, CENTAF Weather found itself in a strategic location--a prime spot upon which other functions cast envious eyes. More than once Colonel Riley had to fight to keep it. But he managed to hang on to it, and CENTAF Weather remained in these quarters until the end of DESERT STORM.[51]

The Saudi government first billeted CENTAF Weather personnel in hotels in downtown Riyadh, but after about six weeks, i.e, in mid-September, it moved them out to a mammoth, virtually brand new housing complex about 20 miles south of the center of Riyadh consisting of many individual townhouse-type dwellings and apartment buildings, including one high rise, perhaps 5,000 units all told. The Saudi government had constructed the complex, called Eskan Village, several years before as, according to one version, a place to house members of Saudi Arabia's nomadic, desert-roaming Bedouin tribes. The Bedouins, however, had found the buildings too confining and preferred to remain in the desert. Eskan Village remained empty until the Saudi government, largely for security reasons, began moving in thousands--perhaps as many as 20,000--American military personnel during DESERT SHIELD. It wanted to get the Americans out of the downtown hotels because it feared terrorist attacks. For this reason, too, it set up tight security and a perimeter defense at the complex. The Eskan Village location made it necessary for CENTAF Weather personnel to commute, at least once daily, between their living and working quarters. The Saudi government, however, provided buses for this purpose.[52]

Although the Eskan Village buildings were new, due to their lengthy vacancy, they needed repairs in order to make them fully habitable--e.g., many of the plumbing and electrical fixtures were out of order. Fortunately, however, the already installed air conditioning system still worked. The buildings had refrigerators and stoves when the Americans moved in, but lacked other kinds of furniture. Colonel Riley and his people at first occupied largely barren rooms devoid of beds and other furnishings. Before long, however, the Saudi government provided them with comfortable beds, couches, chairs, and other furniture. In January, they even received, compliments of the government

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AARs (U).

[50]Atch 5 (U), Weaving DS/DS AAR, to CENTCOM Weather Staff AARs (U).

[51]Riley Intvw (S), pp 6-7, info used (U); AAR (U), LTC G.F. Riley, Jr, CENTAF/SWO, [CENTAF SWO After Action Report,] n.d., Sec E, hereafter cited as CENTAF SWO AAR (U).

[52]Riley Intvw (S), pp 11-14, info used (U); Weaving Intvw (U), pp 3-4.

of Japan, television sets for their quarters. At that point, they were, as Colonel Riley remarked, "living in tall cotton."[53]

The ARCENT weather team moved from its living quarters in the basement garage of the RSLF building out to Eskan Village at approximately the same time as the CENTAF Weather people. On 27 November ARCENT Weather, after operating out of its assigned room on the seventh floor of the RSLF building for more than 2 months, and on the orders of the ARCENT chief of staff, also moved out to Eskan. ARCENT moved it to Eskan, at least in part, to give it the additional space it needed as a result of the deployment of the Army VII Corps to the DESERT SHIELD theater. Nevertheless, wanting to remain near the intelligence and operations staffs at the RSLF building, ARCENT Weather initially opposed the move. Lieutenant Colonel William H. Campbell, now the OIC of the ARCENT weather support element even tried, without success, to persuade the ARCENT chief of staff to reverse his decision. ARCENT was also moving several other headquarters functions to Eskan. This was partly because the Saudi government desired to reoccupy some of the offices in the RSLF building and partly because ARCENT wanted to reduce, in the interests of increased efficiency and security, the great amount of traveling between Eskan Village and downtown Riyadh made necessary by the fact that many Headquarters ARCENT personnel now lived at Eskan. American military personnel always traveled by bus from one location to the other, but the possibility of a terrorist attack on the buses was never totally absent. None, however, ever actually occurred.[54]

The shift to Eskan worked out well for ARCENT Weather, at least after a few weeks. It now had the additional space needed because of the increase in its personnel resulting from the arrival of VII Corps. Its new quarters were relatively spacious--a five-room apartment in the Eskan high rise. The move, however, initially resulted in severe communications problems. For approximately a month ARCENT Weather was without operational hardwire circuits. In the meantime, it had to rely entirely on HF communications. Fortunately, hostilities did not begin during this time and, by the end of December, the circuits were installed and operational. Also on the negative side, ARCENT Weather, for a time, still had to operate a work center at the RSLF building to support the intelligence and operational staffs since Eskan did not have the necessary communications circuits. This required a good deal of traveling back and forth which put an additional strain on its personnel. This situation came to an end in early January when the intelligence and operational staffs, as well as the ARCENT command section, also moved to Eskan.[55]

SOCCENT Weather was collocated with Headquarters SOCCENT in a new building at King Fahd International Airport near Dhahran for the entire DESERT SHIELD/STORM operation. The weather teams supporting Headquarters Air Force Special Operations Command (AFSOC) and Headquarters Army Special Operations Command (ARSOC) were located in the same building, as were the headquarters they supported. The SOCCENT and AFSOC weather teams were billeted approximately seven miles from SOCCENT headquarters; the ARSOC team had quarters immediately next to the headquarters building.[56]

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[53]Riley Intvw (S), pp 12-14, info used (U).

[54]Goldey Intvw (U), pp 9-10; Weaving Intvw (U), pp 2-3; ARCENT SWO AAR (U), Atch 1-2-2.

[55]ARCENT SWO AAR (U), pp 3, 4-5 (Sec I-3a).

[56]AAR (U), Capt T. Lauten, SOCCENT/SWO and Det 1, 1690 WGP/CC (and HQ 1WS), to USCINCCENT/J3-W, "DESERT SHIELD/STORM AAR," 6 May 91, w/7 atchs, hereafter cited as SOCCENT SWO AAR (U), p 4; Riley Intvw (S), p 5, info used (U).

Working and living conditions in the field, with the field defined as anywhere in theater outside of Riyadh, were generally far more austere than in Riyadh, except perhaps for other large urban centers such as Dhahran or Jeddah. As Colonel Goldey put it, "overcoming difficulties was what [life in the field] was all about." Each weather team had to adapt to its environment if it was to accomplish its mission of providing effective support to its customers. Generally speaking, AWS weather teams supporting Air Force units worked under circumstances much superior to those of the teams supporting Army units. Among the former, personnel staffing base weather stations at civilian airports and permanent airbases usually enjoyed better working facilities than did their colleagues at temporary, more or less bare bases. Some base weather stations were located in airport terminal buildings, others in tents.[67]

Army support weather teams, going where their supported units went, found themselves not only in the desert away from population centers, but also sometimes in isolated locations miles from main roads (e.g., the 101st Air Assault Division's 3d Brigade weather team was about 50 miles from a main road). Mostly, the Army support teams worked out of tents or vans or even, sometimes, outside in the open. Under such conditions, sand in their equipment was a constant problem. The 82d Airborne Division weather team was probably unique in that at both the division's initial and forward positions it operated in a "hard" facility (i.e, a building).[68]

The weather team supporting the 1st Infantry Division (Mechanized) had what Lieutenant Colonel Weaving called "probably...the best designed five-ton van in the Army's inventory." It had its entire weather station set up in the van:

> [Their observing work station has] everything that they need at their fingertips,...places for their barometers, places for their clocks, and everything...all either tied in or framed in. They've got places to lay out their charts [and] places for all of the regs that they need to have right at their fingertips. They've got a separate work station for their GOLDWING. They've got...all their communications equipment lined up so that their air conditioning unit keeps it all cool. They've got a sink, they've got a microwave, they've got a refrigerator. The sink drains on to the ground for their equipment so that when they are in a sandy environment...[the] water coming down draining into the ground hole helps establish a good ground for their equipment. They keep bunks set up inside their van so that they are all individually lighted and...air conditioned so that people that are trying to sleep can control their...sleeping area....There is also a little work station for the SWO to sit at a small desk and preview his briefing slides and so on before

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[67]Atch 3 (U), Goldey Draft Article, and Atch 4 (U), Weaving Comments, to ltr (U), Weaving to Collens, 15 Apr 91; Goldey Intvw (U), pp 15-16; Koenemann Intvw (U), p 28; Dickey Intvw (U), pp 15-16.

[68]Weaving Intvw (U), pp 22-23; intvw (U), W.E. Nawyn, AWS/HO, with LTC William H. Campbell, ARCENT/SWO, ARCENT WSE/OIC (and 7WS/DO), 1 Jul 91, hereafter cited as Campbell Intvw (U), pp 11-12; intvw (U), W.E. Nawyn, AWS/HO, with Capt F. Paul Bridges, 1ID(M)/SWO and Det 19, 1690WGP/CC (and Det 8, 5WS/CC), and SSgt Duane P. Bullard, 1ID(M)/ASWO and Det 19, 1690WGP (and Det 8, 5WS/NCOIC), 19 Jul 91, hereafter cited as Bridges/Bullard Intvw (U), pp 7-8.

he...gives a briefing. The whole thing is self-contained and easily set up...in about 2 hours time or less.[59]

The majority of the WSF lived in tents, sometimes in 10- to 15-person tents located in tent "cities." A considerable number of Air Force support personnel, however, had "hard" billets such as trailers or hastily-erected, pre-fabricated buildings, but Army weather support people, since they usually lived in more austere locations out in the desert, generally did not. Among the few who did were several persons at King Fahd International Airport who slept in the parking garage of the terminal building and the 82d Airborne weather team that slept for a time in a warehouse. Many Army weather teams slept in large "double-hulled" Bedouin tents, others wound up in small, two-man pup tents. Some didn't even have tents, but slept out in the open on cots--perhaps under camouflage, covered with a poncho, or partially protected by a jerry-rigged shelter of some sort. There were also times and places where two persons working different shifts had to share the same cot. At the 3rd Brigade of the 101st Air Assault Division, the three-man observer team dug into the side of a sand dune to make a sleeping area. They placed sandbags all around the dug out area and covered it with tent canvas and camouflage. The only furnishings in the dugout were three cots for sleeping. A few Army weather teams, however, enjoyed the luxury of air-conditioned tents.[60]

Everywhere out in the field, heat, sand, and creatures such as scorpions, snakes, and extremely aggressive flies combined to make life rather miserable. At first the challenge was to survive the heat, later on, to endure the cold. The ubiquitous sand and dust got into everything--equipment, tents, clothing, not to mention hair and mouths. Army weather teams out in the desert again generally had the worst of it. Even though their overall water supply was always adequate, they often did not have the luxury of a shower available. If they did, the shower probably had only cold water. In many places, persons simply poured water over themselves in an attempt to simulate a shower. The Army teams ate mostly "meals, ready to eat" (MREs), but also generally had one regular hot meal per day and in some instances, two. They usually had radios in their tents and, later on, after the first of the year, even television sets--once again compliments of the government of Japan.[61]

For the most part, the morale of the WSF remained high during Operation DESERT SHIELD/STORM. A small minority complained, but most members of the force accepted and learned to cope with whatever situation they found themselves in, worked hard, and kept their spirits high. However, AWS had to return several persons to the US for medical or psychological reasons. It also found it necessary to discipline three members of the WSF for violating the ban on the use of alcoholic beverages in the theater. Probably the hardest thing on morale was the uncertainty that surrounded the duration of their deployment. The abandonment of rotation plans which military authorities had contemplated for a time added to that uncertainty. Deployed personnel now became more eager than ever to get the operation

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[59]Weaving Intvw (U), p 32.

[60]Atch 3 (U), Goldey Draft Article, atch 4 (U), Weaving Comments, and atch 6 (U), rprt, LTC W.S. Weaving, [Iraq/Kuwait Visit,] 11 Apr 91, to ltr (U), Weaving to Collens, 15 Apr 91; brfg slides (paper) (U), [AWS/DOJ], "DESERT SHIELD Orientation," n.d.; Goldey Intvw (U), pp 15-16; Weaving Intvw (U), pp 22-23; Campbell Intvw (U), pp 11-12; msg (S), ARCENT Main/G2-SWO to USCINCCENT/Weather, et al, "Fourth Visit to DESERT SHIELD Army Support WETMS," 081718Z Nov 90, info used (U).

[61]Atch 4 (U), Weaving Comments, to ltr (U), Weaving to Collens, 15 Apr 91; Goldey Intvw (U), pp 15-16; Weaving Intvw (U), pp 22-23, 24; Campbell Intvw (U), pp 11-12; msg (S), ARCENT Main/G2-SWO to USCINCCENT Weather, et al, "Fourth Visit to DESERT SHIELD Army Support WETMs (U)," 081718Z Nov 90, info used (U).

over. Thus, morale soared when the air war commenced in mid-January and they could begin to see the end coming.[62]

Management of the Weather Support Force

Under the lead wing concept, management of the WSF resided with the 5th Weather Wing. However, as was mentioned earlier,[63] Headquarters AWS also became involved in direct management, due, at least partly, to the lack of a clarity as to the exact roles of the lead wing and Headquarters AWS and the consequent blurring of their respective functions. But it also resulted from a desire on the part of the AWS commander to stay on top of matters concerning the deployed WSF. This required the AWS staff to remain informed of what was transpiring in the Persian Gulf theater and, frequently, why. This, in turn, led Headquarters AWS to send, through the 5th Weather Wing, many requests for information--over 300 during the course of the operation--to WSF leaders. The stream of questions placed an extra burden on the WSF headquarters staffs--especially at CENTCOM and CENTAF, forcing them to direct time and energy away from resolving issues before they became problems, which, ironically, resulted in another round of questions from the rear.[64]

This Headquarters AWS practice was not popular with either the deployed WSF or the 5th Wing. It gave rise to charges from both, as well as from within Headquarters AWS itself, that Headquarters AWS was doing too much micromanaging of the WSF. Colonel Goldey, at CENTCOM Weather, as well as Lieutenant Colonel Riley at CENTAF Weather, found themselves, with their limited staffs, in the position where they frequently did not have either the time or the resources to answer all the Headquarters AWS questions. This experience, which they and all the senior deployed weather personnel found very frustrating, created an "us" versus "them" outlook in many instances. Colonel Koenemann called the frequent inability of the 5th Wing to answer questions to the complete satisfaction of Headquarters AWS the most disappointing aspect of the wing's role in Operation DESERT SHIELD/STORM. The questions were most burdensome, however, during the first four months of Operation DESERT SHIELD. They began to taper off in December, after the WSF became more settled and manning stabilized. They became relatively few in number after actual hostilities began in mid-January. Although at the time the questions, suggestions, and proddings from HQ AWS

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[62]Atch 4 (U), Weaving Comments, to ltr (U), Weaving to Collens, 15 Apr 91; Goldey Intvw (S), pp 11-12, 15, 30, info used (U); Weaving Intvw (U), pp 23-24; Campbell Intvw (U), p 11; Koenemann Intvw (U), pp 26-27; Conley Intvw (U), 18 Jul 91, p 4.

[63]See above, Chapter 1, pp 6-7.

[64]Draft Report #2 (S), AWS, "An Analysis of Air Weather Service Support to Operations DESERT SHIELD and STORM," Apr 91, hereafter cited as Draft AWS DS/DS Report #2 (S), Sec 2.2.2, info used (U); AWS DS/DS Report #2 (S), pp 8 (Secs 2.12-i, 2.1.3), 14-15 (Secs 2.2.2-g, 2.2.3-d), info used (U); Kelly Intvw (U), p 24; Koenemann Intvw (U), pp 24-25; Campbell Intvw (U), p 23; Goldey Intvw (U), pp 10-11, 13-14, 19; Riley Intvw (S), p 38, info used (U); Col R.R. Wall in AWTB Intvw (U), pp 11, 20; Col T.C. Tarbell in AWTB Intvw (U), p 30.

were not particularly appreciated out in the theater, many proved to be very valuable and useful, some even prescient.[65]

General Kelly agreed that he had micromanaged (although he preferred to call it microwatched), perhaps had even gone overboard, but had done so only when necessary "to ensure that what we had out there [was] ...a WSF...providing the support that was needed" and probably no more than many other senior commanders--CINCMAC, for example. "I was," he stated, "absolutely determined we were not going to replicate some of the dumb things we did in Vietnam." He maintained, however, that the number of questions was not excessive, given the length and size of the DESERT SHIELD/STORM operation and when, again, compared with other commanders. Moreover, he insisted, "most of the questions tended to focus not on questioning why, but questioning why not." He admitted, however, that answering the questions placed an extra burden on the deployed headquarters staffs in Riyadh.[66]

Establishment of a Provisional Weather Group

About a month after the first WSF personnel arrived in the Persian Gulf theater and after it had become apparent the DESERT SHIELD operation might last for some time, AWS began to take steps to implement already existing plans to organize the deployed WSF on a more permanent basis. AWS contingency plans called for establishing a provisional weather group and appropriate subordinate units in the event of an extended operation. Forming a provisional organization had several advantages and no significant disadvantages. It would create a more efficient and more cohesive, as well as more visible, organization by better integrating the WSF and erecting a clear-cut command structure and chain of command. Perhaps equally important, it would promote esprit de corps and, thereby, the morale of the WSF. In addition, it would help deployees to locate their duty assignments when they arrived in theater, make it easier to account for deployed equipment and material, and provide weather support leaders with nonjudicial punishment authority (in other words, enable commanders to better maintain discipline). Besides, TAC and MAC were in the process of establishing in-theater provisional organizations. It seemed advisable for AWS to do likewise.[67]

AWS plans called for setting up a provisional weather group with two subordinate provisional squadrons, one for Air Force support, the other for Army support. This basically had been the plan followed by AWS in Southeast Asia during the Vietnam War 25 years earlier. However, after considerable discussion, AWS decided not to use the two squadron concept in Southwest Asia but

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[65]Koenemann Intvw (U), pp 30-31; Goldey Intvw (U), pp 12-14; Riley Intvw (S), pp 38-40, info used (U); CENTAF SWO AAR (U), Sec K-1; LTC R.R. Wall in AWTB Intvw (U), pp 11, 20; Maj N.E. Buss in AWTB Intvw (U), p 21; Col T.C. Tarbell in AWTB Intvw (U), pp 30-33; St. Onge Intvw (U), pp 9-10, 29-30, 34.

[66]Kelly Intvw (U), pp 11-16. For Colonel Frederick's view on this issue see Frederick Intvw (U), pp 4, 6-7.

[67]Frederick Intvw (U), p 8; Koenemann Intvw (U), p 22; LTC R.R. Wall in AWTB Intvw (U), p 40; AWS/XT hist input (U), Jul-Dec 90; ltr (U), HQ MAC/XPM to HQ AWS/DO, "Provisional Units for DESERT SHIELD," 18 Sep 90; msg (U), AWS/CAT to 5WW/CAT, et al, "Provisional Weather Units for DESERT SHIELD," 231305Z Oct 90; msg (S), AWS/CAT to 5WW/DO, et al, "Activation of DESERT SHIELD Provisional Units (U)," 022345Z Nov 90, info used (U).

instead appoint two deputy commanders under the provisional weather group commander, one to manage Air Force support and one to manage Army support, who would also function as directors of operations on the provisional group headquarters staff. AWS would establish detachments and operating locations as needed directly under the provisional weather group. The desire to keep WSF staffing to a minimum played a role in the decision, but probably the main driving force behind it was Headquarters AWS's reluctance to establish two squadrons at a time when AWS was undergoing a restructuring process that included the elimination of almost all existing AWS weather squadrons.[68]

On 6 September the AWS CAT asked MAC's Directorate of Manpower and Organization for advice on whether to establish a provisional organization in the Persian Gulf theater. As a major command, MAC had the power to create provisional structures when it deemed them necessary. The directorate replied on 18 September that MAC was currently reviewing the advisability of forming provisional units. Two days later Headquarters MAC announced it would establish a number of provisional units, including weather units. On 28 September General Kelly formally directed the formation of a provisional weather group, and 3 days later approved the proposed structure incorporating the two deputy commander concept and setting up a number of detachments and operating locations under the group.[69]

General Johnson, CINCMAC, approved the creation of the 1690th Weather Group (Provisional) (WGP) with the structure proposed by AWS on 9 October. On 20 October General Horner, the CENTAF Commander, concurred with its establishment. Meanwhile, AWS and the MAC Manpower and Organization Directorate worked out the specifics of the group's structure, including all the necessary detachments, operating locations, and work centers. On 31 October Headquarters MAC issued a special order activating the 1690th WGP at Riyadh, and another activating 20 provisional weather detachments and eight provisional operating locations at various locations in or near the DESERT SHIELD theater, all effective 1 November. Acting through its 1610th Airlift Division (Provisional), MAC also issued another special order on 11 November which appointed Colonel Goldey the commander of the 1690th WGP.[70]

Establishing the detachments and operating locations of the 1690th WGP had negative effects for Army support weather teams. They frequently failed to receive mail or equipment bearing numbered 1690th WGP designations instead of the more standard, familiar addresses (such as the SWO of a particular division). This meant that the teams had to track down the equipment they were supposed to get but didn't, not always an easy task. Moreover, by creating numbered detachments

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[68]Frederick Intvw (U), pp 5, 8; Koenemann Intvw (U), pp 22-24; LTC R.R. Wall in AWTB Intvw (U), p 40.

[69]Ltr (U), Col T.C. Tarbell, AWS CAT Dir (AWS/ADO), to HQ MAC/XPM, "Provisional Units for DESERT SHIELD," 6 Sep 90; ltr (U), HQ MAC/XPM to HQ AWS/DO, "Provisional Units for DESERT SHIELD," 18 Sep 90; msg (S), HQ MAC/CAT to USCENTAF Fwd Hqs Element/COMALF, et al, "SWA Base Level Organizational Structures (U)," 201300Z Sep, info used (U); brfg (S), n.a., "Decision Briefing: Provisional Units (U)," 1 Oct 90, info used (U).

[70]SSS (S), HQ MAC/XPM, "Organizational Concept for Airlift Provisional Units (U)," 12 Oct 90, w/4 tabs, tab 2-4 wd, tab 1: msg (S), CINCMAC/CC to CENTAF/CC, et al, "Organizational Concept for Airlift Provisional Units (U)," 131906Z Oct 90, info used (U); msg (S), CENTAF/CC to CINCMAC/CC, et al, "Organizational Concept for Airlift Provisional Units," 201100Z Oct 90, info used (U); ltr (S), HQ AWS/CAT to HQ MAC/CAT, "Request to Establish Provisional Units (U)," 8 Oct 90, w/2 atchs (S), info used (U); SO GA-11 (S), HQ MAC, 31 Oct 90, info used (U); SO GA-17 (S), HQ MAC, 31 Oct 90, info used (U).

at both the corps and division levels which reported directly to the provisional weather group, the new structure was at odds with the Army chain of command. Divisional weather teams consequently adopted the practice of reporting to the WGP through their corps weather team rather than directly.[71]

The special order establishing the 1690th WGP attached the group to the 5th Weather Wing for command, but to USCENTCOM for operational control and the host unit at Riyadh for logistical support. Operational control of the 1690th's Air Force support units rested with CENTAF, its Army support units with ARCENT. A 1690th detachment created specifically to provide weather support to special operations forces was under the operational control of SOCCENT. The two deputy commanders technically functioned as directors of operations for the 1690th WGP's commander, but also continued to serve in their respective capacities as SWO to the CENTAF commander and OIC of the CENTAF weather support element and as SWO to the ARCENT commander and OIC of the ARCENT weather support element. In addition to the 20 detachments and eight operating locations, the 1690th WGP also had four work centers, all located in Riyadh. Three--the Tactical Air Control Center, Airlift Control Center, and Base Weather Operations were under the supervision of the CENTAF's Deputy Commander for Operations, the other, the DESERT SHIELD Tactical Forecast Unit, operated directly under the 1690th WGP commander.[72]

Additional Buildup of the Weather Support Force

By 31 October 1990, the US had deployed, as noted earlier,[73] over 200,000 personnel to DESERT SHIELD and total coalition forces numbered approximately 240,000. But Saddam Hussein still showed no signs of pulling his army out of Kuwait. On 8 November President Bush ordered the US military to deploy more than 150,000 additional troops to the Persian Gulf. Up to this time the deployed forces had adopted a purely defensive posture; the additional manpower would give the coalition an offensive capability. By 17 January US strength had reached 454,000, including 49,000 Air Force personnel and more than 1,100 aircraft. Most of the additional personnel came from Army forces stationed in West Germany.[74]

On 29 November the UN authorized the use of force against Saddam if he did not withdraw from Kuwait by 15 January 1991. Saddam, however, continued his refusal to leave. A final, last

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[71]Note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

[72]Msg (S), HQ MAC/CAT to USCENTAF Fwd HQ Element/COMALF, et al, "Implementation of Provisional Organization Structure," n.d. [ca early Nov 90], info used (U); msg (S), HQ MAC/CAT to USCENTAF Fwd Hqs Element/COMALF, et al, "SWA Base Level Organizational Structures (U)," 201300Z Sep 90, info used (U); tab 1 (S), msg, CINCMAC/CC to USCENTAF/CC, et al, "Organizational Concept for Airlift Provisional Units (U)," 131906Z Oct 90, to SSS (S), HQ MAC/XPM, "Organizational Concept for Airlift Provisional Units (U)," 12 Oct 90, w/1 tab, info used (U); Goldey Intvw (U), p 11; msg (S), AWS/CAT to 5WW CAT, et al, "Activation of DESERT SHIELD Provisional Weather Units (U)," 022345Z Nov 90, info used (U).

[73]See above, Chapter I, pp 3-4.

[74]Art (U), "Raising the Ante," Time, 19 Nov 90, pp 48-49; art (U) Richard Lacayo, "A Reluctant Go-Ahead," Time, 21 Jan 91; USAF/CAFH DS/DS Chronology (S/WN/NF), pp 132, 136, 240, 445, info used (U); Tkach Intvw (U), p 5.

minute meeting on 9 January between US Secretary of State James F. Baker and the foreign minister of Iraq ended without any progress in resolving the crisis. Three days later, both houses of the US Congress voted to support President Bush in the use of force if Saddam Hussein did not meet the 15 January deadline. On 16 January (Washington DC time), since Saddam still was giving no indication of leaving Kuwait, coalition air forces, primarily US, began hostile air operations against Iraq.[75] With the beginning of hostilities, DESERT SHIELD became DESERT STORM.

The AWS WSF grew commensurately with the increase in the DESERT SHIELD combat forces. When CENTCOM lifted the overall Persian Gulf theater ceiling following President Bush's orders to send more troops to the theater, it also lifted the manning cap on the AWS WSF. From 31 October to 15 January the force increased from 303 to 428 persons. Most of the growth occurred in December, which saw AWS deploying more than 100 additional personnel. When the air war began, the WSF operated from 35 locations--20 in Saudi Arabia (including all of the Army weather teams), seven in the United Arab Emirates, three in Oman, and one each in Qatar and Bahrain. Three weather teams remained at MAC and SAC DESERT SHIELD support bases outside of the Persian Gulf theater. AWS's regular peacetime weather detachment at Incirlik AB, Turkey, augmented by more than 20 persons drawn mostly from the 2d Weather Wing in West Germany, also provided support to DESERT SHIELD. Over the next 6 weeks, while US and other coalition air forces conducted their air campaign against Iraq, the WSF continued to grow, reaching a peak in late February of 475 persons stationed at 40 different locations.[76] (See Figures II-1 and II-2.)

Over half of the growth in the WSF in the November to mid-January timeframe occurred in the Army support element, due mostly to the deployment to the Persian Gulf theater of the VII Corps from Germany and the 1st Infantry Division (Mechanized) from the US. This increased from 103 persons on 31 October to 201 on 17 January. Integrating the VII Corps weather teams, who had never trained for a Southwest Asia deployment, became one of the major challenges of the period for the DESERT SHIELD WSF. On the whole, the process went well even though the weather teams from Europe had a lot to learn in a short time. To help raise their level of readiness as quickly as possible, the 5th Wing

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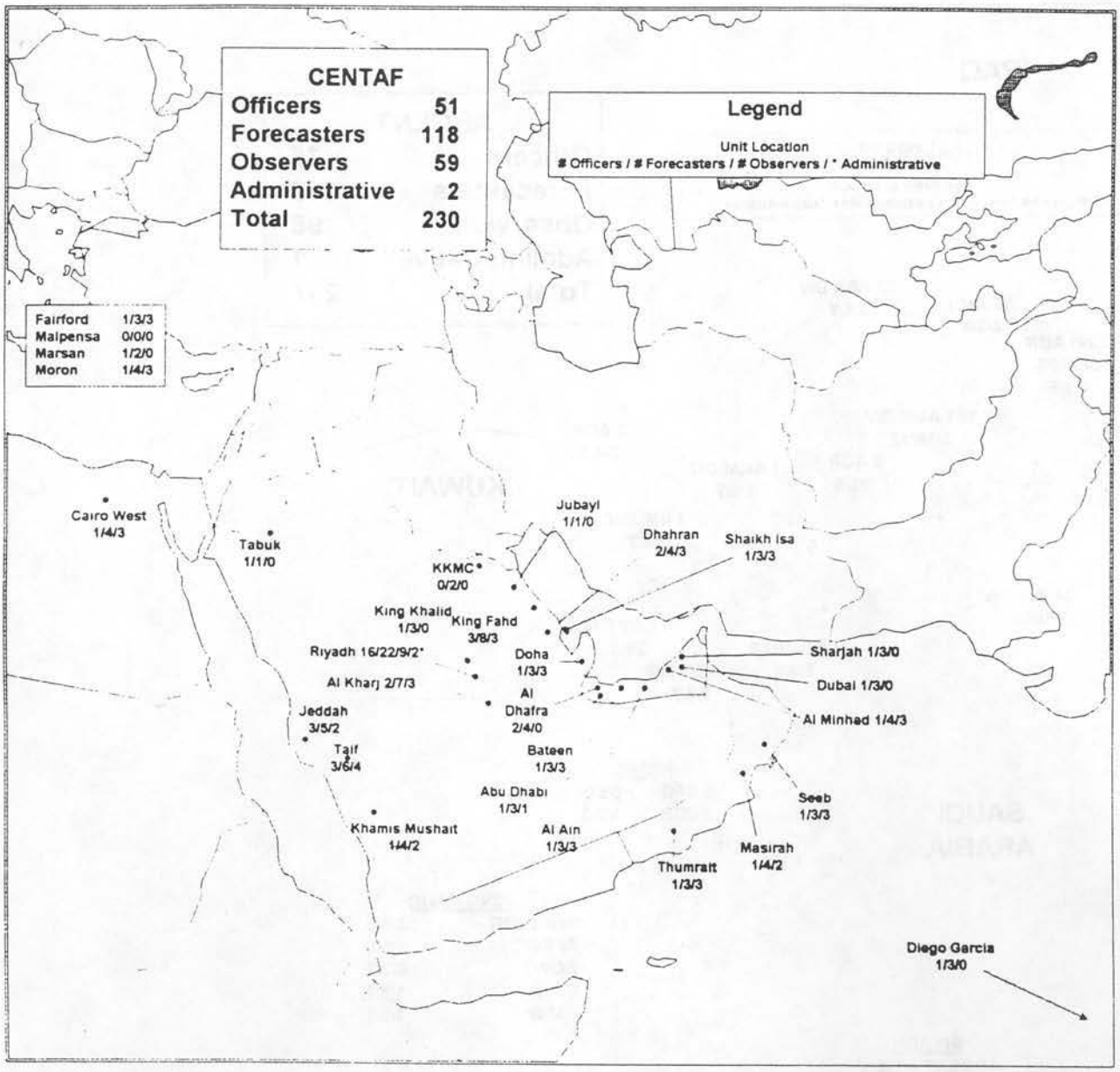
[75]USAF/CAFH DS/DS Chronology (S/WN/NF), pp 160, 221, 226, 239, info used (U).

[76]LTC R.R. Wall in AWTB Intvw (U) p15; Tkach, List of Deployed AWS Personnel (U), Sep 91; AWS DS/DS Report #2 (S), pp 24 (Sec 3.1.4-d), 47-51 (Atch 3), 56-69 (Atch 3), info used (U). For a complete breakdown of the weather support force at its peak, see AWS DS/DS Report #2 (S), pp 42-44 (Atch 3), info used (U).

The locations as of 24 February 1991 were as follows: In Saudi Arabia: Air Force, Army, and special operations support - King Khalid Military City; CENTCOM, Air Force, and Army support - Riyadh; Air Force and special operations support - King Fahd AB; Air Force support only - King Khalid Int'l Airport (Riyadh), Dhahran Int'l Airport, King Abdul Aziz Int'l Airport (Jeddah), Al Jubail, Al Kharj, Khamis Mushait, Tabuk, Taif; Army support only - encampments of the Headquarters VII Corps, Headquarters XVIII Corps, 1st Armored Division, 1st Cavalry Division, 1st Infantry Division (Mechanized), 3d Armored Division, 24th Infantry Division, 82d Airborne Division, 101st Air Assault Division, 12th Aviation Brigade, 2d Armored Cavalry Regiment, 3d Armored Cavalry Regiment. In the United Arab Emirates: Abu Dhabi, Al Ain, Al Dhafra, Al Minhad, Bateen, Dubai, Sharjah. In Oman: Masirah, Seeb, Thumrait. In Bahrain: Shaikh Isa. In Qatar: Doha. Outside of the Persian Gulf: Moron AB, Spain; Cairo West AB, Egypt; British naval base, Diego Garcia; RAF Fairford, United Kingdom; Mont De Marsan AB, France. See AWS DS/DS Report #2 (S), pp 50, 59 (Atch 3), info used (U).

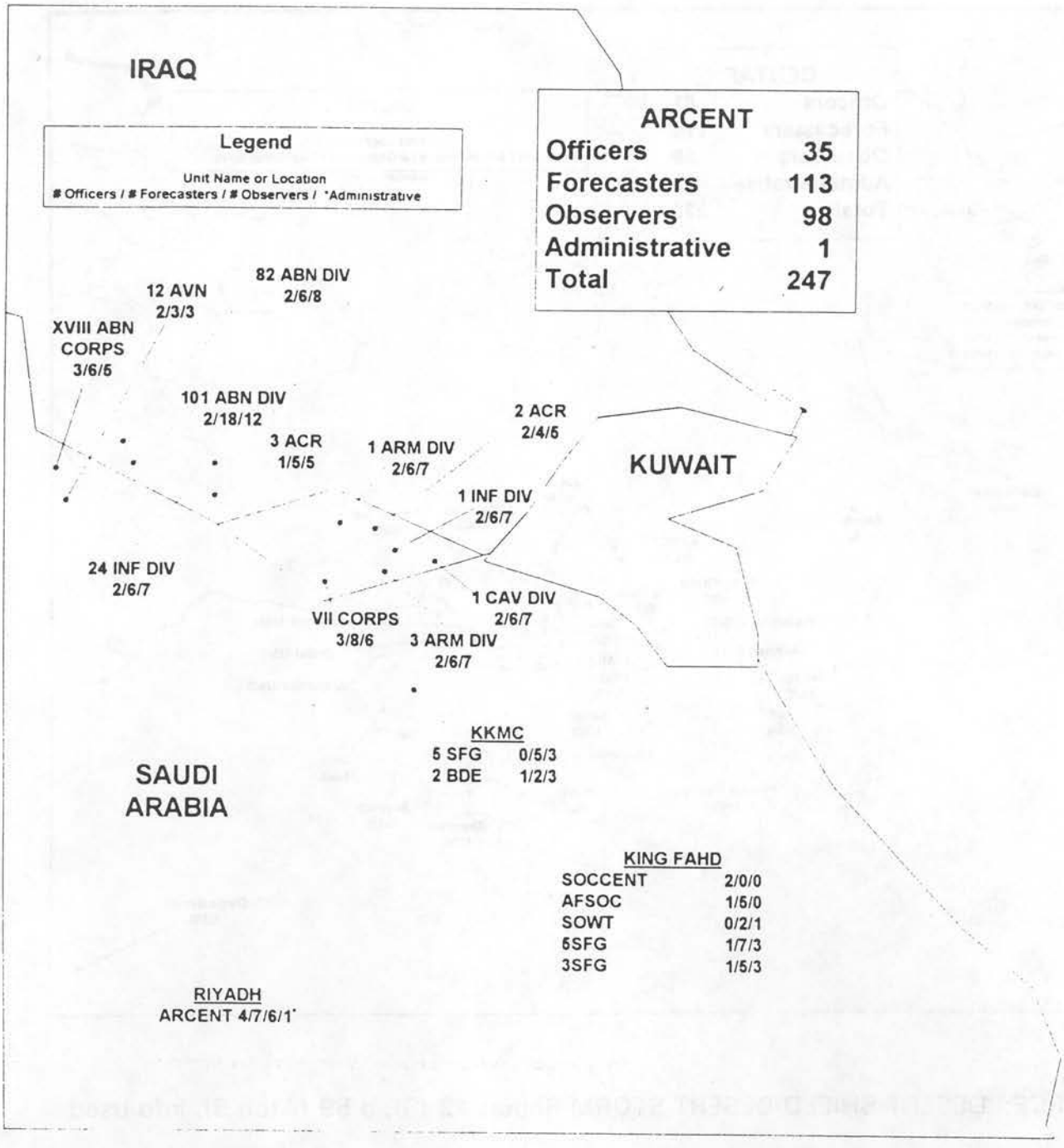
LOCATION AND ASSIGNED MANNING STRENGTH OF CENTAF SUPPORT WEATHER UNITS ON OR ABOUT 17 JAN 91



SOURCE: DESERT SHIELD/DESERT STORM Report #2 (S), p 59 (Atch 3), info used (U).

Figure II-1

LOCATION AND ASSIGNED MANNING STRENGTH OF ARCENT SUPPORT WEATHER UNITS 24 FEB 91



SOURCE: DESERT SHIELD/DESERT STORM Report #2 (S), p 51 (Atch 3), info used (U)

sent them training materials (e.g., climatology and forecasting techniques for the Persian Gulf region).[77]

With the expansion of the WSF and the consequent need to station weather support teams at more locations, AWS, on three occasions--once in November 1990 and twice in January 1991--requested MAC to activate additional provisional units. In response, on 11 January, MAC issued a special order activating four more provisional detachments (but also inactivating one operating location) effective 15 January. On 6 February, during the DESERT STORM period, MAC promulgated yet another special order which activated an additional three detachments and three operating locations effective immediately. This made for a total of 27 provisional weather detachments and 10 provisional weather operating locations, the peak number of units the 1690th WGP reached during Operation DESERT SHIELD/STORM. Fifteen detachments and eight operating locations supported CENTAF units, 11 detachments and two operating locations ARCENT forces, and one detachment SOCCENT units. These figures do not include the AWS operating locations at Moron AB and those at Royal Air Force Base (RAF) Fairford, United Kingdom, and Mont de Marsan AB, France, in February nor the AWS detachment at Incirlik AB, all of which AWS considered part of the DESERT SHIELD WSF, although not part of the 1690th WGP.[78]

Meanwhile, on 16 November Lieutenant Colonel Campbell replaced Lieutenant Colonel Weaving as the ARCENT SWO and deputy commander of the 1690th WGP for Army weather support. Colonel Weaving then became 1690th vice commander, although in reality he functioned more as the group's director of operations, to which post he was able to bring valuable knowledge and understanding of Army weather support operations. Colonel Campbell had been director of operations for the 7th Weather Squadron at Heidelberg, Germany, which provided weather support to the VII Corps. He was, therefore, well acquainted with VII Corps leaders and familiar with its weather support requirements. Lieutenant Colonel Jerry R. Thornberry became the VII Corps SWO when it deployed to DESERT SHIELD. Colonel Thornberry and Major Conley, the XVIII Corps SWO, worked directly under Colonel Campbell.[79]

As the 15 January deadline approached and the likelihood of hostilities increased, CENTAF Rear at Langley AFB directed all functional managers of deployed personnel to make plans for "attrition replacements", i.e, additional personnel and equipment to send to the Persian Gulf to replace wartime casualties and equipment losses. In response, the 5th Wing developed a personnel attrition replacement concept which called for AWS to acquire and maintain an ongoing ten percent attrition replacement capability. Under the concept, AWS would designate, by name, the persons who it would deploy as attrition replacements and require these individuals to be ready to deploy within 72 hours of notification and also create an additional ten percent backup attrition capability. At the request of the 5th Wing, Headquarters AWS took the lead in developing a specific plan for implementing the

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[77]AWS DS/DS Report #2 (S), pp 47, 50 (Atch 3), info used (U); ARCENT SWO AAR (U), pp 3-4 (Sec I-3a); Campbell Intvw (U), p 24; Koenemann Intvw (U), p 39; msg (U), AWS/CAT to 5WW/CAT, et al, "DESERT SHIELD Technical Training Package," 301741Z Nov 90.

[78]Ltr (S), HQ AWS/CAT to HQ MAC/CAT, "Request to Establish Additional Provisional Units (U)," 14 Nov 90, w/1 atch, info used (U); ltr (S), HQ AWS/CAT to HQ MAC/CAT, "Request to Establish Additional Provisional Units (U)," 8 Jan 91, info used (U); SO GA-42 (S), HQ MAC, 11 Jan 91, info used (U); ltr (S), HQ AWS/CAT to HQ MAC/CAT, "Request to Establish Additional Provisional Units (U)," 31 Jan 91, w/1 atch, info used (U); SO GA-48 (S), HQ MAC, 6 Feb 91, info used (U); AWS DS/DS Report #2 (S), pp 42-44 (Atch 3), info used (U).

[79]Weaving Intvw (U), pp 16-17; Campbell Intvw (U), pp 2, 21.

concept. By 11 January it had completed a plan which gave the 5th Wing authority to directly task particular wings and identify specific individuals for deployment. Fortunately, AWS never had to implement the attrition plan since it did not incur any combat casualties.[80]

Shortly after the beginning of DESERT SHIELD, AWS began to consider whether, in the light of the lengthening and expanding operation and President Bush's decision to activate up to 200,000 reservists, it might have to recall Air Force Reserve individual mobilization assistants (IMAs) to active duty, as provided for in its planning documents. AWS concluded it could profitably use IMAs as backfills for AWS units with empty slots created by deployments to DESERT SHIELD. However, the Air Staff's requirement that active forces demonstrate that active duty personnel were not available to fill a manning requirement before using Air Force Reserve or Air National Guard personnel made it difficult for AWS to use IMAs. Nevertheless, AWS was eventually able to acquire the services of 13 Air Force Reserve and Air National Guard personnel as backfills in CONUS weather stations.[81]

Although Air Force policy during DESERT SHIELD/STORM called for using all available active duty resources before activating reserve forces, MAC advised AWS if the Army called up a combat unit for which an Air National Guard unit provided weather support, AWS should ask for the activation also of the supporting weather flight. AWS subsequently sought and successfully obtained the activation of one Air National Guard weather flight. On 5 February 1991 AWS requested MAC to immediately activate the 165th Weather Flight, Louisville, Kentucky, on the grounds it provided weather support to the 20th Special Forces Group, an Army National Guard unit that had been ordered to active duty on 1 February. MAC, after coordinating with the National Guard Bureau and the state of Kentucky, acceded to AWS's request and on 11 February ordered the 13-person weather flight to mobilize. Four days later MAC directed the flight to deploy to Fort Bragg by 23 February to train with the 20th Special Forces Group in preparation for deploying with it to the Persian Gulf theater at a "later date." That later date, however, never came since DESERT STORM ended before the two units completed their training.[82]

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[80]Tkach Intvw (U), pp 22-24; msg (U), 5WW/CAT to AWS/CAT, et al, "Attrition Replacements," 041832Z Jan 91; msg (S), 5WW/CAT to AWS/CAT, "Personnel Attrition Replacement Concept (U)," 071956Z Jan 91, info used (U).

[81]Msg (U), HQ AWS/CAT to MACOS/XPXP, "Scrub of IMAs for 200K," 302230Z Aug 90; AWS DS/DS Report #2 (S), p 33 (Sec 3.2.8), info used (U); ltr (U), [5WW/]RF to [5WW/]DO, "Use of ANG Weather Flight Personnel," 12 Oct 90; msg (U), HQ MAC/CAT to AWS/CAT, et al, "Activation of Air National Guard Weather Flights," 232345Z Nov 90.

[82]Intvw (U), W.E. Nawyn, AWS/HO, with LTC Donald R. Hood, 5WW/DOR, 6 Jun 91, pp 5-7; SSS (S), AWS/DOJR, "Mobilization Request for 165th Weather Flight (U)," 5 Feb 91, w/1 atch, info used (U); msg (U), AWS/CAT to 5WW/CAT, et al, "Calling Up ANG Weather Flights," 270145Z Nov 90; msg (U), HQ MAC/CAT to 123TAW/CC, et al, "Execution - Presidential Mobilization of Selected Ready Reserve - Operation DESERT STORM," 111800Z Feb 91; msg (U), HQ MAC/CAT to 123TAW/CC, et al, "Deployment Order for the 165th Weather Flight," 152317Z Feb 91.

CHAPTER III

THE WEATHER INFORMATION SYSTEM

Tactical Meteorological Equipment

TACMET Deployed

AWS deployed several types of tactical meteorological (TACMET) systems to the DESERT SHIELD/STORM theater for the use of its WSF: the GMQ-33 Tactical Cloud Height Detector Set, AN/TMQ-34 Tactical Meteorological Observing Set, TMQ-36 Tactical Wind Measuring Set, Back-Up Observing System (BOS), Marwin Tactical Upper Air Sounding System, TPS-68 Tactical Radar Set and, for obtaining satellite data, the Wraase Satellite Receiver, Rapid Deployment Imagery Terminal (RDIT), and Mark IVB DMSP readout van. All except the TPS-68 radar and Mark IVB van were small, easily transportable systems which could, if necessary, be carried by deploying personnel, which, as mentioned earlier,[1] is exactly what many AWS deployees did in the early stages of DESERT SHIELD. Later, however, much of the equipment arrived by airlift.[2]

All of these systems except the Marwins and the RDIT were in the AWS inventory when DESERT SHIELD began. However, the GMQ-33, TMQ-34, and TMQ-36 were all new, recently purchased systems with which AWS personnel as yet had not become very familiar. The GMQ-33 was a self-contained, battery-powered device using laser technology capable of measuring cloud bases to at least 3,000 feet. It weighed 31 pounds, measured 14 by 12 by 14 inches, and could generally be set up by one person in less than 30 minutes. The TMQ-34 was a 20-pound, battery-powered unit which enabled weather observers to manually measure precipitation and electronically measure barometric pressure, temperature, dewpoint, and wind speed and direction. One person could set it up in five minutes. The TMQ-36 was a somewhat larger, also battery-powered, 120-pound system shipped in five containers. It took about half an hour for one person to set it up. It consisted of a digital readout-recorder, three remote digital readout devices connected by wire, and a collapsible mast equipped with sensors. It measured wind speed and direction, gust strength and spread, peak winds,

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[1] See above, Chapter II, pp 15-16.

[2] AWS DS/DS Report #2 (S), pp 217 (Secs 5.2, 5.2.1), 219-220 (Sec 5.2.2-d through h), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with CMSgt Rufus D. Grizzle, 5WW/DOOF, and MSgt William A. Brothers, 5WW/DOOJ, 5 Jun 91, hereafter cited as Grizzle/Brothers Intvw (U), pp 2-3.

and the standard deviation of wind speed. AWS sometimes referred to the three systems together as the Tactical Observing System.[3]

The Back-up Observing System (BOS), a designation introduced during DESERT SHIELD, consisted of a belt weather kit, Sims anemometer, and Taylor barometer. The belt weather kit included a compass, thermometer, rain gauge, and sling psychrometer, as well as several circular hand computers used to calculate pressure altitude, station pressure, and dewpoint. The sling psychrometer was a thermometer on a chain which was slung in a circle to measure air temperature and dewpoint. As its name indicates, the BOS was a secondary system to be used in the event the primary systems, the GMQ-33, TMQ-34, and TMQ-36, failed. As it turned out, since many CONUS-based AWS units still did not possess the primary systems, their personnel deployed only with belt weather kits and, consequently, many deployed units at first also had only belt weather kits.[4]

When DESERT SHIELD began, AWS had a TACMET employment policy in place, but experience in and feedback from the theater soon brought AWS to review its original policy. The result was that on 15 October General Kelly approved a new TACMET deployment policy. Building on the previous policy, the new policy required the following to have a GMQ-33 and TMQ-34: each weather team supporting flying missions or a special forces operations base; the Army support tactical operations center; each Army airfield, landing zone, and mobile observing team; each special forces operations or forward operating base; each special operations weather team; the Air Force Special Operations Control Center and the Air Force Special Operations Detachment. It required only one TMQ-36 at each bare airbase instead of two as under the old policy. In addition, the new policy stipulated there should be a BOS at every location and/or with each weather team. However, the TMQ-34, not the BOS, was the doctrinally designated primary back-up system for the GMQ-33 and TMQ-36.[5]

The increasing number of weather support teams deployed to the Persian Gulf, along with the new TACMET requirements, created an ever greater demand for tactical equipment. The demand was immediate since many deployed units did not have the new TACMET equipment. The 5th Wing, therefore, immediately began to collect and ship TACMET to units in the theater. Not surprisingly, for the first month or so there was a degree of confusion as to what, where, and how much equipment had been deployed, and to what was left. Inevitably, shortfalls (as defined under the new AWS TACMET policy) appeared at deployed units. However, after it began to require TACMET status reports three times per week from the field (including what TACMET was where and its operational status), the wing soon got the TACMET situation under control.[6]

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[3]CMSgt R.D. Grizzle in Grizzle/Brothers Intvw (U), p 2; hist (S), AWS, CY 89, pp 252-257, info used (U); brfg (U), Capt M.S. Sorrels, HQ AWS/DOJR, to AWS/CC, et al, "TACMET Doctrine," 15 Oct 90.

[4]St. Onge Intvw (U), p 13; msg (S), 5WW/CAT to AWS/CAT, et al, "DESERT SHIELD TACMET Requirements," 271630Z Sep 90, info used (U); atch 1 (U), "Draft Concept of Operations for Tactical Meteorological Equipment," to memo (U), HQ AWS/DO to 1WW/DO, et al, "Draft TACMET COP," [ca 5 Apr 90], w/1 atch; CMSgt R.D. Grizzle in Grizzle/Brothers Intvw (U), p 2.

[5]Draft AWS DS/DS Report #2 (S), Sec 5.2.2.2-a,b, info used (U); AWS DS/DS Report #2 (S), pp 217-218 (Sec 5.2.2-a), info used (U); msg (U), AWS/DO to AIG 8148, "New TACMET Doctrine," 152300Z Oct 90.

[6]AWS DS/DS Report #2 (S), pp 217-218 (Sec 5.2.2-a,b), info used (U); St. Onge Intvw (U), p 12; intvw (U), W.E. Nawyn, AWS/HO, with Maj Daniel V. Ridge, 5WW/DNC, 7 Jun 91, pp 3, 6, hereafter cited as Ridge Intvw (U); CMSgt R.D. Grizzle in Grizzle/Brothers Intvw (U), p 2.

The 5th Wing began by sending whatever equipment it could spare from its own units. After exhausting its own assets it began to task the other AWS wings, and even some Air National Guard weather flights, for available equipment. In essence, it requisitioned all AWS TACMET except for equipment which wings or other units had to hold in reserve for other possible contingencies. The 5th Wing also ordered 40 TMQ-34s and all the GMQ-33s in stock from the Sacramento, California, Air Logistics Center (SM-ALC) equipment depot. Meanwhile, Headquarters AWS and the 5th Wing agreed to a ten percent spare rate for all the TACMET, but later, the 5th Wing unilaterally raised the TMQ-34 spare rate to 20 percent due to the many operational failures this system was experiencing. By the end of DESERT SHIELD/STORM, AWS had deployed 73 GMQ-33s, 105 TMQ-34s, and 13 TMQ-36s in support of the operation.[7]

TACMET Performance

TACMET performance was mixed. Overall, the equipment probably proved to be less rugged than advertised. Performance of individual types ranged from very good for the TMQ-36 to poor for the TMQ-34. The TMQ-36 worked almost flawlessly. None of the 13 sets failed; it had a 100 percent in-commission rate for the operation. The Taylor barometer operated reliably as did, for the most part, the belt weather kit and the Sims anemometer. The thermometers in the belt weather kit had a tendency to break easily and sand and dust getting into the rotating mechanism of the anemometer sometimes degraded its performance. The GMQ-33 generally did well. Only 13 of the 73 sets deployed had problems, usually when moisture got into their optical sensors. The 5th Wing restored seven of the sets to service by replacing their optical units. Three of the sets were still at 5th Wing awaiting replacement of their optical units when DESERT STORM ended. The wing returned two sets to depot because of multiple problems. The overall in-commission rate of the GMQ-33 was 78 percent.[8]

The TMQ-34, however, had many problems. Both heat and moisture adversely affected its performance. The former caused the most trouble in the early part of DESERT SHIELD, the latter during the later stages of the operation. The ever present dust and sand also degraded its performance. Deployed units experienced problems with almost all of the TMQ-34's component parts, including the wind sensor, temperature-dewpoint sensor, computer unit, barometer, circuit cards, rain gauge, wiring, and cable. The 105 TMQ-34s deployed to DESERT SHIELD/STORM experienced 51 failures. Deployed units sent 18 systems back to the 5th Weather Wing for repairs, 15 due to the failure of component parts and three because of wiring problems. The TMQ-34's overall in-commission rate was a low 59 percent.[9]

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[7]AWS DS/DS Report #2 (S), pp 218-220 (Sec 5.2.2-b,d,f,g), info used (U); St. Onge Intvw (U), pp 12-13; intvw (U), W.E. Nawyn, AWS/HO, with LTC Donald R. Hood, 5WW/DOR, 6 Jun 91, pp 4-5; Grizzle/Brothers Intvw (U), pp 2-3, 15-16.

[8]AWS DS/DS Report #2 (S), pp 219-220 (Sec 5.2.2-d,f,h), info used (U); Riley Intvw (S), pp 25-26, info used (U); Grizzle/Brothers Intvw (U), pp 2, 8.

[9]Draft AWS DS/DS Report #2 (S), Sec 5.2.22-h, info used (U); AWS DS/DS Report #2 (S), pp 220 (Sec 5.2.2-g), 223-224 (Atchs 26, 27), info used (U); Goldey Intvw (U), pp 24-25; Riley Intvw (S), pp 25, info used (U); Campbell Intvw (U), p 17; ARCENT SWO AAR (U), pp 28-29 (Sec III-1).

The TMQ-34 components that failed most frequently were the temperature-dewpoint and wind sensors. Eleven of the 18 systems returned to the 5th Wing needed replacements for their sensor units. The system was designed for the observer to step outside wearing the sensor unit around his or her neck and then take it back inside after making the required observation. But the wind sensor needed several minutes to stabilize and during this time, in the hot desert environment, the unit heated up causing the temperature-dewpoint sensor to provide an inaccurate reading. Meanwhile, blowing sand, if present, sometimes got into the wind sensor, making it too inaccurate. Consequently, observers found it diffcult, if not impossible, to use both the wind sensor and the temperature-dewpoint sensor in the same observation. The sensors also became inaccurate in the rain.[10]

There were also several other problems with the TMQ-34. For example, the cable connecting the sensor and computer units was only six feet long, so observers could not remote the sensor unit outside to provide continuous data while keeping the computer unit inside. Moreover, the constant wrapping and unwrapping of the cable which the observing procedure required sometimes resulted in the cable breaking.[11]

In fairness to the TMQ-34, it should be pointed out that deployed weather teams often did not use it in the way they should have in terms of its design. As suggested by its short cable and the observing procedure it required, the manufacturer had not designed the TMQ-34 for remote operations. Yet weather teams frequently left the equipment mounted outside where it was exposed continuously to the elements, thus contributing to its failures. In the case of the Army weather teams out in the field, this was usually unavoidable; they had no "inside" to which they could take their equipment." In a sense, the fact that it, as a meteorological system intended for operating in a tactical environment, was not designed to be operated remotely or where it might be outside all the time was perhaps the system's basic flaw, which suggests that the system should not have been procured for the purpose intended.[12]

The weather teams deployed to DESERT SHIELD were not the first to encounter problems in operating the TMQ-34. AWS had received reports of shortcomings in the system, including the difficulty of obtaining accurate, simultaneous readings with the wind and temperature/dewpoint sensors, in March and April 1990, but it had not had time to rectify these problems before DESERT SHIELD began.[13]

As the magnitude of the problem with the TMQ-34 became apparent, Headquarters AWS and the 5th Wing, as well as units in the field, set to work to devise temporary work-arounds. One obvious action for units in the theater was to fall back on the BOS when the TMQ-34 failed. Some units, if

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[10]AWS DS/DS Report #2 (U), pp 220 (Sec 5.2.2-g), 223-224 (Atchs 26, 27), info used (U); Riley Intvw (S), p 25, info used (U); Campbell Intvw (U), p 17; Grizzle/Brothers Intvw (U); Goldey Intvw (U), pp 24-25.

[11]Grizzle/Brothers Intvw (U), p 7.

[12]Note (U), LTC T.P. Walters, HQ AWS/DPM, to W.E. Nawyn, HQ AWS/HO, [TMQ-34 Performance,] 4 May 92; note (U), LTC R.R. Wall, HQ AWS/DDO, to W.E. Nawyn, HQ AWS/HO, [TMQ-34 Performance,] 11 May 92; AWS DS/DS Report #2 (S), p 220 (Sec 5.2.2-g), info used (U); Goldey Intvw (U), pp 24-25; note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

[13]Msg (U), AWS/PML to AIG 8380/DOO, et al, "TMQ-34, Tactical Meteorological Observing Set, Performance," 152237Z Mar 90; ltr (U), HQ 1WW/DOO to AWS/PML, "TMQ-34 Meteorological Observing Set Performance," 19 Apr 90, w/1 atch wd.

their entire TMQ-34 system did not fail, continued to use the parts that worked and substituted the BOS for the ones that didn't--e.g., if the wind sensor broke, use the Sims anemometer instead--while awaiting a replacement system. Colonel Riley made an attempt to create a repair capability in Riyadh, but this failed because the necessary test equipment and spare parts were lacking. Thus, deployed units had to go along with the established maintenance concept, which meant sending the broken TMQ-34s back to the US for repair. The approximate turn-around time for this process was at first a totally unacceptable 2 months.[14]

The existing AWS logistics support concept for deployed TACMET equipment called for returning a broken system to its home unit if it could not be repaired locally. Trained maintenance personnel at the home base would either repair the equipment or, if repairing it was beyond their capability, send it to the repair depot at SM-ALC. The 5th Wing succeeded in cutting the turn-around time for the TMQ-34s down to 3 to 5 weeks by getting permission for deployed units to send the broken TMQ-34s directly to the depot and persuading the depot to send out a replacement before it received the broken system. However, this was still too long, so the 5th Wing's Chief Master Sergeant D. Rufus Grizzle and Master Sergeant William A. Brothers, with the help of the TAC communications people, made arrangements to have the TMQ-34s repaired at Langley AFB, which would make it unnecessary to ship the equipment all the way across the continent to California. This further expedited the repair process and reduced the turn-round time to less than 2 weeks.[15]

The 5th Weather Wing's decision to raise the TMQ-34's spare rate from 10 to 20 percent also helped to overcome the problems created in the field by the system's high failure rate. To implement this new policy, the 5th Wing requisitioned as many additional systems as it could find and shipped them off to the Persian Gulf. As a result of the shorter repair time and the 20 percent spares policy, the deployed WSF had plenty of operational TMQ-34s on hand by the time DESERT STORM hostilities began in mid-January.[16]

Meanwhile, Headquarters AWS and the 5th Wing, with the assistance of SM-ALC, began working on more permanent and/or long-term solutions to the TMQ-34 problem. They were hampered in this effort, however, by the fact that the manufacturer of the TMQ-34, the Tele-Signal Corporation, had ceased to exist and they could, therefore, not obtain its assistance in making basic changes in the system itself. AWS, therefore, enlisted the help of SM-ALC in devising ways to improve TMQ-34 performance. However, events overtook this project. DESERT STORM ended before it got very far.[17]

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[14]Draft AWS DS/DS Report #2 (S), Sec 5.2.2-h, info used (U); AWS DS/DS Report #2 (S), p 220 (Sec 5.2.2.2-g), info used (U); Riley Intvw (S), pp 25-26, info used (U); Grizzle/Brothers Intvw (U), pp 8-9.

[15]Draft AWS DS/DS Report #2 (S), Sec 5.2.2.2-h, info used (U); AWS DS/DS Report #2 (S), pp 218-219 (Sec 5.2.2-c), info used (U).

[16]AWS DS/DS Report #2 (S), pp 218-219 (Sec 5.2.2-c), info used (U); Riley Intvw (S), p 25, info used (U); Grizzle/Brothers Intvw (U), pp 4, 15-16.

[17]Msg (S), 5WW/CAT to AWS/CAT, et al, "Lessons Learned," 071927Z Dec 90, info used (U); msg (U), 5WW/CAT to AWS/CAT, "TMQ-34s," 221307Z Jan 91; mfr (U), 2Lt W.S. Strickland, AWS/PMT, to AWS/PMT, "SM-ALC Actions to Improve TMQ-34 Uptime," 24 Jan 91; memo (U), LTC P.J. Johnson, AWS/PMT, to AWS/APM, et al, "Cat Tasker #17--(Items 3A and 3C)," 30 Jan 91; point paper (U), AWS/PMLM, "TMQ-34 Transportable Meteorological Observing Set Supportability for Col Frederick's Executive Review at SM-ALC," 20 Feb 91.

Obtaining timely maintenance was a problem connected not only with the TMQ-34, but with all deployed TACMET equipment. The AWS TACMET maintenance concept going into DESERT SHIELD was not workable for a contingency operation conducted a long distance from the US. This came through loud and clear from the theater. It simply took too long to return a broken TACMET system to the US for repairs and then ship it all the way back to the Persian Gulf theater.[18]

The 5th Wing's aggressive action to shorten the TACMET repair turn-around time by taking greater control over the repair process, not only of the TMQ-34, but all TACMET, even to the point of doing the repairs itself, was successful, but it still was only a short-term fix. The 5th Wing recognized this and, consequently, began to consider, as a long-term solution to the problem, establishing an in-theater TACMET maintenance capability. This would require, among other things, deploying repair technicians to the theater along with the testing devices and spare parts they would need to do their job. The wing soon concluded, due to the lack of spare parts, it would not be feasible, at least at that time, to repair TACMET equipment in the theater. It, therefore, began instead to concentrate on building up in the theater a large store of spare systems which deployed weather units could tap as the need arose.[19]

Procurement of the Marwin Tactical Rawinsonde

AWS also deployed eight Marwin tactical rawinsondes (i.e., upper air sounding systems), which provided upper air data needed for chemical dispersion, turbulence, and other kinds of forecasting, to the Persian Gulf theater during DESERT SHIELD/STORM. A small, lightweight system manufactured by the Vaisala Corporation of Woburn, Massachusetts, a Marwin system consisted of a processor unit, printer, and antennas, all of which could be shipped in three boxes weighing a total of 122 pounds. This was exclusive of the spare parts kit and the radiosondes, balloons, and helium needed to operate the system. The system was easy to use and could be operated by one person.[20]

The Marwin was not in the AWS inventory when DESERT SHIELD began. At that time the GMD-5 transportable rawinsonde set was AWS's tactical upper air sounding system. The GMD-5, however, was a large, bulky, piece of equipment that for its deployment required an entire C-130 aircraft, two 10-ton tractors, and one 36-foot van, as well as an 18-wheeler flat-bed truck at its point of debarkation to take it to its deployed location. It was, in other words, not a truly tactical system. Consequently, particularly since airlift was hard to come by, AWS never seriously considered deploying the GMD-5 to DESERT SHIELD. Instead, it initiated an effort to quickly acquire and deploy several of the much smaller and more mobile Marwin systems, which, several months before, it had already

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[18]Riley Intvw (S), pp 25-26, info used (U); Weaving Intvw (U), pp 19-20; Campbell Intvw (U), p 13; Koenemann Intvw (U), pp 16-17.

[19]AWS DS/DS Report #2 (S), pp 218-219 (Sec 5.2.2.2-c), info used (U); Koenemann Intvw (U), pp 16-17, 31; msg (S), 5WW/CAT to AWS/CAT, et al, "Lessons Learned," 071927Z Dec 90, info used (U); msg (U), 5WW/CAT to AWS/CAT, "TMQ-34s," 221307Z Jan 91; tasker (U), [AWS/]CAT to AWS/PM, "TACMET Maintenance Concept," [ca 22 Jan 91], w/2 atchs, atch 2: memo (U), LTC P.J. Johnson, AWS/PML, to APM, et al, "Cat Tasker #17--(Items 3A and 3C)," 30 Jan 91.

[20]AWS DS/DS Report #2 (S), p 219 (Sec 5.2.2-e), info used (U); mfr (U), Capt J.J. Baer, AWS/PMT, "MARWIN (Vaisala) System," 17 Jul 89; St. Onge Intvw (U), p 31.

decided to procure. Meanwhile, it was able to borrow two Marwins from the US Navy, which was already using the system, and deploy them to the Persian Gulf before the end of August.[21]

AWS had recognized the mobility problem with the GMD-5 for at least two years prior to DESERT SHIELD and, in February 1989, had inaugurated a program to acquire a lightweight, tactical rawinsonde. By early 1990 AWS had settled on the Marwin. However, by the time DESERT SHIELD began, AWS had not yet obtained the money to purchase the 12 Marwins it wanted, nor did funding seem to be imminent.[22]

By September 1990 Headquarters AWS had concluded that it needed six Marwins to deploy to the Persian Gulf theater (including the two needed to replace the systems borrowed from the Navy), particularly on the grounds that if war broke out it might not continue to receive the upper air data it was currently obtaining from Saudi Arabian sources. The 5th Weather Wing concurred. CENTCOM Weather was not so sure; it felt the data being received from the two borrowed systems and the Saudis were adequate for the present. Headquarters AWS, however, was not as confident as CENTCOM Weather that the Saudis would continue to provide upper air data in the event of hostilities. It, therefore, decided to launch an attempt to procure six Marwin systems under the new Rapid Response Process Program the Air Staff announced on 28 September. The new program was specifically designed to "execute directed programs to quickly bring needed operational capability on line." Headquarters AWS felt that the Marwins qualified for the program.[23]

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[21]AWS DS/DS Report #2 (S), pp 156 (Sec 4.4.2-b), 219 (Sec 5.2.2-e), info used (U); Frederick Intvw (U), pp 6, 7; hist (S), AWS, CY 89, p 250, info used (U); msg (S), AWS/CAT to All AWS Wing CATs, "Lessons Learned from DESERT SHIELD (U)," 100404Z Sep 90, info used (U); msg (S), HQ AWS/CAT to 5WW/CAT, "DESERT SHIELD Upper-Air Observations (U)," 242231Z Sep 90, info used (U); msg (S), COMUSCENTAF FWD HQ/CC to USCINCCENT/CCCC, et al, "Movement of Mobile Rawinsonde Equipment to AOR (U)," 220335Z Aug 90, info used (U); msg (S), 5WW/Alert Staff to AWS/DOJ, et al, "5WW SITREP Nbr 16/Operation DESERT SHIELD (U)," 231121Z Aug 90, info used (U).

[22]Hist (S), AWS, CY89, pp 249-252, info used (U); point paper (U), HQ AWS/PMT, "Letter to US Navy on Joint Procurement of Tactical Rawinsonde Equipment," 23 Feb 90; ltr (U), HQ AWS/PM to SPAWAR PMW 141, "Procurement of Tactical Rawinsonde Equipment," 28 Feb 90; memo (U), AWS/XTP to AWS/PMT, "TACRAWIN Table of Allowance Issue," 15 May 90; ltr (U), HQ AWS/XTPP to 1600 MES/CC, "FASCAP Proposal for Light TACRAWIN Systems," 1 Aug 90, w/1 atch; point paper (U), HQ AWS/PMT, "Letter to US Navy on AWS Commitment to Participate in Contract to Purchase Tactical Rawinsonde Equipment," 21 Sep 90; ltr (U), HQ AWS/PM to SPAWAR PMW 141, "Procurement of Tactical Rawinsonde Equipment," [ca 25 Sep 90].

[23]Koenemann Intvw (U), p 19; memo (S), LTC D.P. Regan, HQ AWS/PMC, to LTC R.R. Wall, AWS/DOJ, [MARWIN Purchase and Employment,] 13 Sep 90, w/reply and 2 comments, info used (U); msg (S), AWS/CAT to 5WW/CAT, "Today's Questions (U)," 151425Z Sep 90, info used (U); memo (S), Col T.C. Tarbell, AWS/ADO, to AWS/XT, "Tactical Rawinsonde - MARWIN MW 12 Justification," 21 Sep 90, info used (U); msg (S), HQ AWS/CAT to 5WW/CAT, "DESERT SHIELD Upper-Air Observations (U)," 242231Z Sep 90, info used (U); msg (S), 5WW/CAT to AWS/CAT, et al, "DESERT SHIELD Upper Air Observations (U)," 291410Z Sep 90, info used (U); telefax (U), AWS/CAT to 5WW/CAT, [AWS Package for CINCMAC Concerning Need for Tactical Upper Air Data Collection,] 5 Oct 90, w/4 atchs.

On 5 October Headquarters AWS requested MAC to support its Marwin initiative. The same day it directed the 5th Wing to instruct Lieutenant Colonel Riley to advocate the initiative before Colonel James C. Crigger, who, as the CENTAF Director of Operations, would have to validate the requirement for the Marwins. MAC approved the Marwin proposal a few days later. On 16 October Colonel Crigger validated the Marwin requirement, but warned that he could not authorize additional manpower to operate the systems. On 22 October MAC informed the Air Staff of the need for tactical rawinsondes in the Persian Gulf theater. The Vice Chief of Staff of the Air Force, General Monroe W. Hatch Jr., who had principal responsibility for the Rapid Response Process Program, approved the tactical rawinsonde initiative on 5 November. In addition, he directed the Air Force Logistics Command (AFLC) to procure the six systems requested by using a contract the Navy had awarded to Vaisala on 30 September. The Air Staff, he added, would provide $437,000 to fund the acquisition. On 15 November SM-ALC transferred to the Navy the funds necessary to pay Vaisala for the six Marwins. By December all the procurement actions were complete.[24]

Under the Navy contract, Vaisala was to deliver the Marwins no later than 28 March 1991. However, it had the systems ordered for AWS ready for government inspection by 20 January. Consequently, in late January AWS was able to ship all six to the theater, where they arrived on 10 February--still in time to be of some use during DESERT STORM, the combat phase of the Persian Gulf contingency operation, already in progress. CENTCOM Weather deployed three of the new systems to King Fahd AB (two to replace the borrowed Navy units and one to be used as a spare) and one to King Khalid Military City, both in Saudi Arabia, and one each to Thumrait and Seeb, both in Oman.[25]

The maintenance concept for the Marwin was similar to that for other TACMET equipment. If any Marwin experienced a problem the operators could not rectify by using the spare parts kit, they would have to send the system back to the 5th Wing which would return it to Vaisala for repair. However, the Marwin proved to be a reliable piece of equipment; only one had to be sent back to the US.

Deployment of the TPS-68 Tactical Weather Radar

Another tactical meteorological system deployed by AWS in support of DESERT SHIELD/STORM was the TPS-68 tactical weather radar. It deployed two--one to Taif, Saudi Arabia;

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[24]Telefax (U), AWS/CAT to 5WW/CAT, [AWS Package for CINCMAC Concerning Need for Tactical Upper Air Data Collection,] 5 Oct 90, w/4 atchs; msg (S), USCENTAF/DO to HQ MAC/XRA, et al, "Validation of TACRAWIN Acquisition (U)," 161600Z Oct 90, info used (U); msg (U), HQ MAC/XR to HQ USAF/XOX, et al, "Combat-Mission Need Statement for a Tactical Upper Air Data Collection Instrument," 221945Z Oct 90; msg (U), HQ USAF/XOO to HQ MAC/XR, et al, "Tactical Upper Air Data Collection Instrument," 062130Z Nov 90; ltr (U), COMSPAWARSYSCOM to HQ AWS/PM, "Procurement of Tactical Rawinsonde Equipment," 2 Nov 90; msg (U), HQ AWS/PMT to 5WW/DOO, et al, "Tactical RAWIN System," 231900Z Nov 90; msg (U), HQ AWS/PM to SAF/AQLZ, et al, "Tactical Upper Air Data Collection Instrument," 032100Z Dec 90.

[25]Msg (U), HQ AWS/PM to SAF/AQLZ, et al, "Tactical Upper Air Data Collection Instrument," 032100Z Dec 90; msg (U), HQ AWS/PM to SAF/AQLZ, et al, "Tactical Upper Air Data Collection Instrument," 182100Z Dec 90; msg (S), USCINCCENT Weather to 5WW/CAT, et al, "MARWIN Operations (U)," 271443Z Jan 91, info used (U); AWS DS/DS Report #2 (S), p 156 (Sec 4.4.2-b), info used (U).

the other to Diego Garcia. Neither arrived at its assigned location until January 1991, relatively late in the operation. However, once operational, both radars performed well and provided useful weather data. They were the first TPS-68s to support combat operations.[26]

The officer in charge of the weather team at Taif had already in September called for the deployment of a TPS-68 to Taif since the Saudi weather radar there was inoperable. Headquarters AWS decided, however, that the deployment could be deferred until around the beginning of 1991 since climatological data indicated a very low probability of thundershowers or, for that matter, any precipitation at that location before then. On 7 October the 5th Wing informed Headquarters AWS that in its view a TPS-68 was definitely required at Taif and requested the headquarters staff to assist it in filling the requirement. After the CENTAF Director of Operations, Colonel Crigger, validated the requirement and formally requested AWS to station a tactical radar at Taif, the 5th Wing proceeded to make arrangements to deploy the TPS-68 based in Germany. The radar was shipped to the Persian Gulf on 11 January, but because of the demands on intratheater airlift, it took some time before it actually arrived at Taif.[27]

AWS began considering the possibility of deploying a tactical weather radar to Diego Garcia in support of the SAC forward operating location there in early November 1990. On 26 November the 4300th Bomb Wing (Provisional) on the island requested a weather radar. Before the end of the month the 1st Wing, headquartered at Hickam AFB, Hawai, had begun making arrangements to deploy the AWS TPS-68 at Andersen AFB, Guam, to Diego Garcia. On 18 January Pacific Air Forces approved the deployment; the following day the 1st Weather Wing directed its 20th Weather Squadron to immediately deploy the radar. It arrived in Diego Garcia on 28 January. Various factors contributed to delaying the deployment until late January: the initial inoperable condition of the Andersen radar; the unavailability of qualified operators and maintainers; delays in receiving the required in-theater validation for the deployment from CENTAF Forward; and difficulties in obtaining airlift for the deployment both because MAC had higher airlift priorities and because only a C-5 was big enough to carry the 6,500-pound, 83 by 87 by 147 feet radar. However, once it arrived, the radar was immediately installed and reached full operational capability on 30 January.[28]

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[26]Draft AWS DS/DS Report #2 (S), Sec 5.2.2-d, info used (U); AWS DS/DS Report #2 (S), pp 221 (Sec 5.2.3), 284 (App D), info used (U).

[27]Msg (S), USCINCCENT Weather to 5WW/CAT, et al, "USCENTCOM Weather Support Force SITREP 21 (U)," 151920Z Sep 90, info used (U); msg (S), 5WW/CAT to USCENTCOM/CCJ3-W, et al, [classified title,] 162218Z Sep 90, info used (U); msg (S), 5WW/CAT to AWS/CAT, "Radar Requirements (U)," 071628Z Oct 90, info used (U); msg (S), USCENTAF/DO/WE to USCENTAF Rear/DO/SC/WE, et al, "Deployment of Tactical Weather Radar (U)," 140310Z Dec 90, info used (U); msg (S), 5WW/CAT to USCINCCENT Weather, et al, "AOR Action Items (U)," 120227Z Jan 91, info used (U); msg (S), 5WW/CAT to HQ AWS/CAT, "CAT-to-CAT Question 19 Jan 91 (U)," 191718Z Jan 91, info used (U).

[28]Draft AWS DS/DS Report #2 (S), Sec 5.2.2-d, info used (U); hist rprt (U), 1WW, 1 Jan-30 Jun 91, p 5, Sup Doc 14: rprt (U), 1WW CAT to HQ AWS/CAT, "Lessons Learned--Deployment of Tactical Weather Radar, AN/TPS-68," n.d.; 1WW DESERT SHIELD SITREPS, Nbrs 28, 30 (16, 18 Jan 91) (S), info used (U); 1WW DESERT STORM SITREPS, Nbrs 1-10 (19-28 Jan 91) (S), info used (U); AWS DS/DS Report # 2 (S), pp 221 (Sec 5.2.3), 284 (App D), info used (U).

Meteorological Communications Systems

AWS cannot perform its mission without meteorological equipment, both fixed and transportable, but communications systems are equally essential. Communications is "the life blood for weather support."[29] It does little good to have meteorological equipment that ingests all sorts of weather data if there is no means to disseminate the data to those who need it to develop weather products and to pass on the products to those who use them. Weather communications systems provide these absolutely essential means.

In DESERT SHIELD and STORM, AWS utilized essentially two types of communications systems: fixed, long-range systems and tactical (or transportable), intratheater systems. AWS used the first to get data from the Persian Gulf theater to the US and weather products from the US to the theater; the second to disseminate raw data and weather products within the theater, collect weather data for transmission to the US, and distribute products received from the US within the theater. The long-range systems transmitted data primarily by means of a combination of landline circuits and satellite communications. Intratheater communications used mostly HF radio equipment, although it also included microwave, troposcatter and satellite relay systems, and eventually some hardwire circuits as well. CENTCOM's Joint Communications Support Element had responsibility for configuring long-range circuits and arranging to have them brought into the operational theater. AFCC and other communications engineers provided and maintained fixed communications; AWS was responsible for its own tactical communications.[30]

AWS employed primarily two long-range systems to transmit weather data and products between the US and the Persian Gulf: the Automated Weather (teletype) Network (AWN) and the Air Force Digital Graphics (weather facsimile) System (AFDIGS). It also used the Automatic Digital Network (AUTODIN), a common-user Department of Defense communications system, and the Navy's Naval Oceanographic Data Dissemination System (NODDS). In theater, AWS relied heavily on an HF radio system called the Quick Reaction Communications Terminal (QRCT) by AWS and the Goldwing by the Army's FORSCOM and, after the Army's VII Corps arrived in Saudi Arabia beginning in late November, on the US Army, Europe, Automated Weather System (UAWS), another HF system. It also acquired a fixed intratheater tactical facsimile (TACFAX) circuit and a Tactical Imagery Dissemination System (TIDS) for in-theater distribution of weather graphics products and satellite imagery, respectively.

AWS contingency weather support doctrine called for full duplex (i.e., send/receive) teletype and receive-only facsimile circuits from AFGWC to all headquarters weather units and all Air Force airbase support weather teams in the operational theater. Army weather teams at the division level would have access to Army multi-channel circuits providing similar capabilities. According to the doctrine, Air Force weather teams deployed to the field would rely on HF radio for the first 30-60 days, by which time AWS would have deployed its Tactical Weather System (TWS) and hardwire lines would be in place to each location. However, weather communications doctrine had to give way to the imperatives of the operational situation. Various factors such as airlift constraints, communications

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[29]Phillips Intvw (U), p 5.

[30]AWS DS/DS Report #2 (S), p 201 (Sec 5.1.2.1), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Maj Robert W. Keefer, AWS/DOJ, 23 Jul 91, hereafter cited as Keefer Intvw (U), pp 2-3; Tkach Intvw (U), pp 25-26.

engineering limitations, communications saturation, and the sheer size of the DESERT SHIELD/STORM operation itself led to deviations from doctrine and pre-contingency plans.[31]

One of the first doctrinal casualties was AWS's TWS. This system consisted of six Tactical Weather Analysis Centers and six Tactical Airbase Weather Stations. Each center and station was housed in large transportable shelters (six for each center and four for each weather station) requiring 36 tons of airlift for deployment. Although Lieutenant Colonel Riley, the acting OIC of the deployed WSF, had not asked for it, the 5th Wing immediately requested TAC to deploy the TWS. However, by mid-August TAC's Deputy Chief of Staff for Command, Control, Communications, and Computers, in conjunction with CENTAF's communications people, had decided not to deploy the system due to a shortage of airlift as well as other reasons. The system was, for example, basically outdated. Moreover, TAC considered the plan to use the TWS unworkable because the system was incompatible with modems and facsimile receivers that would be used in the operational theater. Besides, the rapid expansion of the operation soon resulted in many more locations in the theater requiring tactical weather communications than the TWS could service. TAC did agree, however, to strip the shelters of their usable equipment and send it to the theater.[32]

Scrapping the TWS did not terminate AWS's requirements for tactical teletype and facsimile communications systems. Thus, communications experts at TAC and the 5th Wing, in coordination with CENTAF's Deputy Chief of Staff for Communications-Computer Systems and CENTAF Weather, immediately set to work to devise a workable substitute system. They completed the task by mid-September. The new configuration pared down the number of hardwire teletype send/receive locations to four and placed greater and more long-term reliance on HF radio communications than original plans envisioned.[33]

The difficulties associated with the TWS was only the beginning. As in previous contingencies, AWS continued to encounter many communications problems throughout the DESERT SHIELD/STORM operation. This was not something unique to AWS. Communications problems were usually widespread in contingencies--for example, in URGENT FURY, the Grenada incursion of 1983. Actually, AWS probably had less difficulty with communications in DESERT SHIELD/STORM than in earlier contingencies, even though there was, of necessity, a lot of last-minute, on the scene improvisation. Moreover, communications tended to improve as time went on.[34]

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[31]AWS DS/DS Report #2 (S), pp 171 (Sec 5.1.1.1), 201 (Sec 5.1.2.1), 207 (Sec 5.1.3.1), info used (U); LTC R.R. Wall in AWTB Intvw (U), pp 21-22; Tkach Intvw (U), pp 25-26; Keefer Intvw (U), 13 Jul 91, pp 2-3.

[32]AWS DS/DS Report #2, p 202 (Sec 5.1.2.2-b), info used (U); Col P.F. Abt in AWTB Intvw (U), p 6; Keefer Intvw (U), p 3; Maj R.P. Callahan in Callahan/Brackett Intvw (U), p 3; msg (S), 5WW/CAT to AWS/CAT, et al, "DESERT SHIELD Fixed Weather Comm History (U)," 071528Z Dec 90, info used (U).

[33]AWS DS/DS Report #2 (S), p 202 (Sec 5.1.2.2-b), info used (U); Keefer Intvw (U), p 3; msg (S), 5WW CAT to AWS/CAT, et al, "DESERT SHIELD Fixed Weather Comm History (U)," 071528Z Dec 90, info used (U).

[34] Goldey Intvw (U), p 22; Riley Intvw (S), pp 21-22, 24, info used (U); Campbell Intvw (U), p 17.

Long-Range Communications Systems

Weather data traveled between the Persian Gulf theater and the US and western Europe via a combination of landlines and satellite links. However, the relatively low priority assigned to weather information during the early stages of DESERT SHIELD led to slow implementation of weather circuits--anywhere from 2 to 6 months. Indeed, communications engineers did not finish installing three of the four hardwire teletype circuits provided for by the substitute communications plan agreed to in late September until mid-January. Deteriorating weather in the theater as winter approached provided significant impetus to the installation process. But, in any event, the number of long-range lines dedicated to weather data under the plan was limited. In addition, once installed the circuits experienced problems. Serious signal deterioration occurred, particularly in AFDIGS circuits, due to multiple analog-digital conversions of the data (made necessary by the use of different types of circuits and several satellite hops) and frequent circuit bridging. Moreover, incompatible modems complicated interfaces between landlines and satellite links and between the automated digital weather switches (ADWS) at Carswell AFB, Texas, and RAF Croughton, United Kingdom, and terminal equipment in the operational theater. A shortage of terminal equipment caused additional problems.[35]

Automated Weather Network

AWS's alphanumeric weather teletype circuits (the AWN) to CENTCOM and CENTAF went by landline from AFGWC through the Carswell weather switch to Forts Meade and Detrick, Maryland, and by satellite relay from there to the Persian Gulf theater. ARCENT received its teletype data from the Croughton switch via an Army communications site at Landstuhl, Germany. CENTCOM Weather bridged teletype data to SOCCENT. The DSFU at CENTAF Weather had full duplex teletype capability by the middle of August; CENTCOM Weather had receive-only capability by 28 August and full send/receive capability by 26 September. ARCENT Weather, although able to receive teletype data via the AWN, never acquired full send/receive capability.[36]

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[35]Draft AWS DS/DS Report #2 (S), Sec 5.1.3.8, Atch X, info used (U); AWS DS/DS Report #2 (S), pp 203 (Sec 5.1.2.2-b), 205-206 (Sec 5.1.2.3), 208 (Sec 5.1.3.2-a), 210 (Secs 5.1.3.3, 5.1.3.4), info used (U); Phillips Intvw (U), p 5; msg (S), 5WW/CAT to AWS/CAT, et al, "DESERT SHIELD Fixed Weather Comm History (U)," 071528Z Dec 90, info used (U); msg (S), USCINCCENT/CCJ6-CP to USCINCCENT/J3-Weather, et al, "AWN/MEDS Circuitry Channelized over SHF Satellite (U)," 101818Z Sep 90, info used (U); msg (U), CENTAF SYSCON/SCX to HQ TAC/BS-SC, et al, "Tactical Weather 1200bd Teletype Interface," 061006Z Feb 91; atch 1 (U), rprt, "Lessons Learned Listing," to ltr (U), HQ 5WW/DOX to AWS/DOJ, "DESERT SHIELD/DESERT STORM Lessons Learned," 27 Mar 91, w/1 atch, hereafter cited as 5WW/DOX Lessons Learned Listing; atch 1 (C), "DAMI-POI JULLS Inputs," to ltr (C), USAF/XOWX to AWS/DO, "Lessons Learned Inputs from HQ, Department of the Army, Directorate of Policy and Operations, Imagery Division," 15 Apr 91, info used (U).

[36]Maj R.P Callahan in Callahan/Brackett Intvw (U), pp 12, 16; intvw (U), W.E. Nawyn, AWS/HO, with Maj Larry J. Waite, AFGWC/DOOK, 12 Jun 91, hereafter cited as Waite Intvw, p 14; msg (S), CCSC/XPW to USCINCCENT/CCJ-6CP, et al, "DESERT SHIELD Weather Communications Plan (U)," 201815Z Sep 90, info used (U); msg (S), USCINCCENT/CCJ6-CP, to AWS/CAT, et al, "DESERT SHIELD Weather Communications Summary (U)," 041000Z Oct 90, info used (U); chart (S), n.a., "Phase I Teletype Network (U)," n.d. [ca Jan 91], info used (U); atch 11 (U), rprt, Maj J.D. Brod, CENTCOM/ASWO, to 1690WGP/CC "Desert Shield/Storm After Action Report," 25 Mar 91, hereafter

The full send/receive AWN teletype circuits for weather teams at all airbase locations in the Persian Gulf theater, as called for by AWS doctrine, never materialized. Indeed, reality fell far short of doctrine. Dedicated circuits were at a premium, especially on communications satellites. It was simply impossible for AWS to obtain the channels on the satellites it would need to implement the doctrinal requirements. Besides, neither the Carswell nor the Croughton switch had enough ports to support a send/receive capability at each location. It was also unlikely that AWS would be able to get the necessary hardwire lines in theater. Thus, the substitute communications plan developed in September requested only four dedicated, full duplex circuits--the one already in operation at the DSFU and one each from Carswell to Dhahran, Al Dhafra, and Taif, all in Saudi Arabia. Air Force communications engineers, however, were slow to install the three remaining circuits. Dhahran and Taif did not become operational until mid-January, just before the air war began; Al Dhafra not until early February. Thus, for all of DESERT SHIELD, the WSF had only one dedicated send/receive AWN circuit available. This was, however, bridged as a receive-only circuit to other bases. To transmit data, the weather teams at these locations had to use their HF radios.[37] (See Figure III-1.)

Meanwhile, Army communications engineers worked at getting AWN teletype circuits to Army weather support units. Army weather communications doctrine called for send/receive teletype capability at echelons above corps, corps, divisions, aviation brigades, and armored cavalry regiments. On 28 September, Colonel Weaving, the ARCENT SWO, requested the ARCENT Directorate of Information Systems for Command, Control, Communications, and Computers to connect both ARCENT Weather and the XVIII Corps weather team to the AWN. ARCENT Weather had a receive-only capability (via the Croughton switch) by 4 October. But Army communications engineers determined they could not provide the bridging necessary to bring the AWN from ARCENT to the XVIII Corps, much less to lower echelons. Instead, the Army acquired a line directly from the Carswell switch to the corps. Later, after the VII Corps also deployed to the Persian Gulf, the Army obtained a dedicated line for that corps as well, but, in this instance, via Croughton.[38]

Standard Base-Level Computers

By late December Headquarters AWS began to feel that, with DESERT SHIELD now underway for more than 4 months, it was high time to acquire the send/receive teletype capability at all Air Force

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cited as Brod DS/DS AAR (U), to CENTCOM Weather Staff AARs (U), p 2; brfg (S), 5WW/DOX, "The DESERT SHIELD/STORM Weather Story," paper copy, [circa 30 May 91], slides (paper copies) 12, 30, 36, hereafter cited as 5WW DS/DS Summary Brfg (S).

[37]AWS DS/DS Report #2 (S), pp 201 (Sec 5.1.2.1), 203 (Sec 5.1.2.2-b), info used (U); LTC R. R. Wall in AWTB Intvw (U), pp 22-23; Riley Intvw (S), pp 21-22, info used (U); Maj R.P. Callahan in Callahan/Brackett Intvw (U), p 5; 5WW DS/DS Summary Brfg (S), slides (paper) 25, 30, 36, info used (U); msg (S), USCINCCENT/Weather to 5WW/CAT, et al, "Answers to DESERT SHIELD AOR Action Item #4 (U)," 091501Z Jan 91, info used (U); chart (S), n.a., "Phase I Teletype Network (U)," n.d. [ca Jan 91], info used (U).

[38]Weaving Intvw (U), p 6; ARCENT SWO AAR (U), pp 18-19 (Sec II-1c,d,e); memo (S), USARCENT/SWO to USARCENT/G6, "Request for Services - Weather Communications for DESERT SHIELD (U)," 28 Sep 90, info used (U); memo (S), ARCENT/SWO to CENTCOM/SWO, "Weather Circuits for XVIII Corps (U)," 2 Oct 90, info used (U); msg (S), USCINCCENT/CCJ6-CP to AWS/CAT, et al, "DESERT SHIELD Weather Communications Summary (U)," 041000Z Oct 90, info used (U).

CENTAF COMMUNICATIONS
17 JAN 91

		TTY S/R	TTY R/O	QRCT	TACFAX/ TIDS	SBLC 14 Feb 91)
Riyadh BWS	1690 WGP	+	■	■	■	■
CENTCOM		+	■	+	■	+
CENTAF DSFU		■	+	■	■	■
Diego Garcia	OL-D	+	+	+	+	+
Tabuk	OL-E	+	■	■	■	■
Jubayl	OL-F	+	+	■	+	+
Al Dhafra	DET 2	■	■	■	■	■
Bateen	DET 2, OL-A	+	■	■	■	■
Abu Dhabi	DET 2, OL-J	+	■	■	■	■
Al Minhad	DET 4	+	■	■	■	■
Sharjah	DET 4, OL-B	+	■	■	■	■
Dubai	DET 4, OL-K	+	□	■	■	■
Dhahran	DET 6	■	■	■	■	■
Shaikh Isa	DET 6, OL-C	+	■	■	■	■
King Fahd	DET 8	+	■	■	■	■
Doha	DET 10	+	■	■	■	■
Taif	DET 12	■	■	■	■	■
Jeddah	DET 14	+	■	■	■	■
Thumrait	DET 16	+	■	■	■	■
Al Ain	DET 18	+	■	■	■	■
Masirah	DET 20	+	■	■	■	■
Seeb	DET 22	+	■	■	■	■
Cairo West	DET 24	+	■	■	■	■
Khamis Mushait	DET 26	+	■	■	■	■
King Khalid	DET 28	+	■	+	■	■
Al Kharj	DET 30	+	■	■	■	■

Legend
■ Available
□ Programmed
\+ Not Required

SOURCE: AWS DESERT SHIELD/DESERT STORM Report #2 (S), p 192 (Atch 21), info used (U).

Figure III-1

weather stations in the DESERT SHIELD theater called for by doctrine, rather than only at the DSFU and the other three scheduled, but still non-operational, locations. In early January, at the direction of General Kelly, the 5th Wing launched an aggressive effort to acquire the greater send/receive capability. It quickly called together communication experts from Headquarters AFCC, AWS, AFGWC, and the 5th Wing at the wing headquarters on 7 January, who came up with both a short-term and long-term proposal to achieve the desired goal without using more dedicated, long-range lines, which still remained pretty much of an impossibility. For the long term, they proposed obtaining "smart computers" that would immediately begin transmitting data when polled by the Carswell weather switch. The UGC-129 teletype terminals used in the Persian Gulf theater did not currently have such a rapid response capability. As a short-term measure, they recommended utilizing TAC's Standard Base Supply System/Computer Assisted Maintenance System network which already connected most Air Force bases in the theater. The idea of using this network originated in a suggestion from Colonel Buford R. Witt, CENTAF's DCS for Communications-Computer Systems, to Colonel Riley, who passed it on to the 5th Wing.[39]

The Standard Base Supply System/Computer Assisted Maintenance System was a standard Air Force communications network used primarily by TAC for supply purposes. It included not only intratheater circuits, but a long-range circuit to Langley AFB as well; in fact, it worked off of TAC's Standard Base Level Computer (SBLC) at Langley (leading AWS personnel to usually refer to it as the SBLC network). Since CENTAF Communications-Computers officials, CENTCOM Weather, and CENTAF Weather all advocated using the SBLC network, AWS and the 5th Wing decided to go ahead with this as the short-term solution. At the same time, however, they also decided to proceed with the proposed, long-term "smart terminal" plan. CENTAF Communications-Computers immediately began to implement the short-term initiative by quickly ordering additional SBLC terminals for the weather stations so weather teams could enter data directly into the network. While they awaited their terminals, weather teams could take their weather data in paper form to the nearest SBLC terminal. By the time the war started in mid-January, many CENTAF weather teams were already using the SBLC network. By 7 February 23 Air Force weather teams had received their own SBLC terminals.[40] (See Figure III-1.)

To utilize the SBLC network, weather teams at each base first entered their weather observations and other data into their own or nearest SBLC terminal. The data then went across the Atlantic Ocean to Langley and back to the DSFU in the theater via the long-range circuit. At the DSFU, personnel manually inserted the data into the AWN for transmission to other users, including AFGWC. As CENTAF Weather observed, the SBLC system was "manpower intensive [and] cumbersome" and still did not fully satisfy AWS requirements. It did, however, provide weather teams with a send capability of sorts and substantially improved the timeliness of their weather observations--observations

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[39]LTC R.R. Wall in AWTB Intvw (U), pp 22-23; Kelly Intvw (U), pp 19-21; Maj R.P. Callahan in Callahan/Brackett Intvw (U), pp 6-9; msg (U), AWS/CC to TAC/5WW/CC, et al, "DESERT SHIELD Weather Data," 312300Z Dec 90; msg (S), 5WW/CAT to USCINCCENT Weather, et al, "AOR Action Items (U)," 030347Z Jan 91, info used (U); msg (U) 5WW/CAT to USCINCCENT Weather, et al, "Transmit Capability for CENTAF WETMS," 082345Z Jan 91.

[40]LTC R.R. Wall in AWTB Intvw (U), p 23; Maj R.P. Callahan in Callahan/Brackett Intvw (U), pp 8-10; Waite Intvw (U), p 9; msg (U), 5WW/CAT to USCINCCENT Weather, et al, "TTY Send Capability," 101659Z Jan 91; msg (S), 5WW/CAT to USCINCCENT Weather, et al, "DESERT SHIELD Weather Comm Issues (U)," 142218Z Jan 91, info used (U); msg (U), USCENTAF Weather to USCINCCENT Weather, et al, "Phase II Send/Receive Weather Teletype Terminals for CENTAF WETMS," 231100Z Jan 91; msg (U), 5WW/CAT to HQ AWS/CAT/PML, "Phase IIA Send/Receive Weather Teletype Terminals for CENTAF WETMS," 242203Z Jan 91.

now got to the DSFU approximately one hour after being taken instead of three. The system was not perfect, but it worked.[41]

Air Force Digital Graphics System

Unlike the AWN teletype circuits, the initial AFDIGS facsimile circuits to CENTCOM and CENTAF went directly from AFGWC to Fort Meade by commercial lines and then forward to the Persian Gulf theater by satellite relay. CENTCOM Weather had an operational receive-only facsimile circuit by 7 September. The story at CENTAF Weather, however, was very different. Although the DSFU acquired its circuit in August, technicians could not get it to produce usable data. In an attempt to overcome the problem, communications engineers routed the circuit into Thumrait, Oman, where the local communications technician was able to get acceptable data and pass it on to Riyadh by another satellite relay. However, this didn't work either. Apparently due to the multiple satellite hops and analog-to-digital conversions on the circuit, the terminal at the DSFU still did not provide usable data. Finally, in mid-December AFGWC was able to establish a facsimile circuit to CENTAF Weather by using a commercial line to Headquarters TAC at Langley AFB and a tactical satellite relay from there directly to the DSFU. At long last, in early January the DSFU received its first usable AFDIGS facsimile data. To receive the data, the DSFU used an Alden 9315TRT recorder, which produced excellent weather charts.[42]

During the long period it was unable to receive facsimile data over Air Force circuitry, the DSFU turned for help to the Navy's NODDS, which contained meteorological products from the Navy Fleet Numerical Oceanographic Central at Monterey, California. The DSFU personnel had deployed with the software and modem necessary to access the NODDS and they were, therefore, immediately able to tap into the system, which produced very useful data. Later, CENTAF approved accessing it through a commercial satellite link out of Riyadh which the Saudi Arabian government paid for. For the first

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[41]AWS DS/DS Report #2 (S), p 204 (Sec 5.1.2.2-b), info used (U); AWTB Intvw (U), p 23; Goldey Intvw (U), p 32; Riley Intvw (S), p 22, info used (U); Maj R.P. Callahan in Callahan/Brackett Intvw (U), pp 8-10; Waite Intvw (U), pp 9-10; msg (S), USCENTAF Weather to 1690WGP BWS/WE, et al, "Transmit Capability for CENTAF WETMs," 071700Z Jan 91, info used (U).

[42]AWS DS/DS Report #2 (S), pp 207-208 (Sec 5.1.3.2), info used (U); Riley Intvw (S), pp 21-22, info used (U); Maj R.P. Callahan in Callahan/Brackett Intvw (U), pp 5-6; atch 11 (U), Brod DS/DS AAR (U), p 3, to CENTCOM Weather Staff AARs (U); brfg slide (S), n.a. [AWS/DOJ], "CENTAF Fax Problem (U)," [9 Sep 91], info used (U); msg (S), 5WW/CAT to AWS/CAT, "CAT to CAT Questions (U)," 240250Z Sep 90, info used (U); msg (S), USCINCCENT/CCJ6-CP TO AWS/CAT, et al, "DESERT SHIELD Weather Communications Summary (U)," 041000Z Oct 90, info used (U); msg (U), HQ AFGWC/DOO to HQ AWS/CAT, et al, "EURDIGS Signal Retransmission from AFGWC to DESERT SHIELD AOR," 131700Z Nov 90; msg (S), AFGWC/CAT to 5WW/CAT, et al; "EURDIGS Signal Retransmission from AFGWC to DESERT SHIELD AOR (U)," 042145Z Dec 90, info used (U); msg (U), AFGWC/CAT to 5WW/CAT, et al, "DESERT SHIELD AFDIGS," 112250Z Dec 90; msg (S), AFGWC/CAT to 5WW/CAT, et al, "Bridging Equipment Needed for DESERT SHIELD AFDIGS Connectivity at AFGWC (U)," 121910Z Dec 90, info used (U).

4 months or more of its operations, the DSFU relied primarily on NODDS for the facsimile data it needed, although it was able also to intercept HF facsimile broadcasts from Moscow.[43]

ARCENT Weather, too, had problems getting decent facsimile data. It didn't have any at all until October. Early that month, at the request of Colonel Weaving, ARCENT's Directorate of Information Systems for Command, Control, Communications, and Computers took action to acquire facsimile data for ARCENT Weather via a dedicated European Digital Graphics System (EURDIGS) circuit originating at Croughton. The receive-only circuit, routed through Pirmasens, Germany, was soon operational, but the quality of the data it provided was not very good. When ARCENT Weather moved to Eskan Village in late November, it lost both its teletype and facsimile circuits. Both eventually became operational again, but data quality on the facsimile circuit did not improve. During this time ARCENT Weather was able to at least partially overcome its facsimile problem by intercepting HF facsimile broadcasts from Diego Garcia, the Soviet Union, and England. ARCENT Weather, like the DSFU, used an Alden 9315TRT to receive the facsimile weather charts.[44]

Since the Army was no more able to bridge the facsimile circuit than the receive-only AWN teletype circuit from ARCENT Weather to the XVIII Corps, ARCENT arranged for an AFDIGS circuit from AFGWC directly to the corps weather team. After the VII Corps arrived in the theater, it, too, obtained a facsimile circuit from Croughton, but the circuit never became very reliable. Both corps, however, lost their circuits when they moved forward to take positions along the Iraqi border shortly before the beginning of the war.[45]

Automatic Digital Network

AWS was also able to use AUTODIN. Since this was a common-user teletype network used by all the Armed Forces for many types of messages (tasking orders, commander situation reports, requests for spare parts, and many more), it was generally the first communications system installed at deployed locations. Thus, it had the advantage of being available sooner and in more locations than the lower priority weather communications circuits. Moreover, communications engineers--whether Air Force or Army--were much more familiar with this system than with the often unique circuits that AWS required. In addition, it provided secure communication--it could handle messages up to the secret level. AUTODIN served as a very helpful and reliable backup hardwire communications system

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[43]AWS DS/DS Report #2 (S), p 208 (Sec 5.1.3.2), info used (U); Riley Intvw (S), p 21, info used (U); note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 22 Jun 92; Maj R.P. Callahan in Callahan/Brackett Intvw (U), pp 17-18; Capt J.D. Murphy in intvw (U), W.E. Nawyn, AWS/HO, with Capt John D. Murphy, DSFU/CC (and Det 7, 3WS/CC) and Capts Thomas E. Coe and Jeffrey E. Johnson, DSFU members (and 5WW/DNS), 7 Jun 91, p 12, hereafter cited as Murphy/Coe/Johnson Intvw (U).

[44]Weaving Intvw (U), pp 8-9; Campbell Intvw (U), p 15; intvw (U), W.E. Nawyn, AWS/HO, with MSgt William J. Boyle, ARCENT Weather/NCOIC (and 5WS/DOJ), 18 Jul 91, p 9, hereafter cited as Boyle Intvw; ARCENT SWO AAR (U), p 19 (Sec II-2d); memo (S), LTC W.S. Weaving, USARCENT/SWO, to USARCENT/G6, "Request for Services - Weather Communications for DESERT SHIELD (U)," 28 Sep 90, info used (U); msg (S), USCINCCENT/CCJ6-CP to AWS/CAT, et al, "DESERT SHIELD Weather Communications Summary (U)," 041000Z Oct 90, info used (U).

[45]ARCENT SWO AAR (U), p 19 (Sec II-2d); Conley Intvw (U), pp 7-8.

for AWS to use when necessary. The main problems with it were that it was not an AWS dedicated system, its teletype equipment was rather slow and cumbersome, and other military organizations with traffic of a higher priority than AWS units also used it. Moreover, the large volume of weather data AFGWC and deployed units sometimes poured into the system rather easily saturated it. They, therefore, had to use AUTODIN selectively.[46]

AFGWC was connected directly to AUTODIN for both transmitting and receiving weather data. It utilized AUTODIN to send out essentially two types of information: centralized products such as forecast bulletins created at AFGWC and raw weather data from units in the theater it received on the AWN through Carswell, which it then formatted and sometimes sent back to the field over the network. AFGWC normally sent the formatted data back via the AWN, but it could use AUTODIN when necessary. AFGWC could also receive weather data from the theater on AUTODIN.[47]

CENTAF Weather began to receive weather bulletins over Headquarters CENTAF's AUTODIN terminal on 11 August, only three days after Lieutenant Colonel Riley's arrival at Riyadh, but it did not acquire its own dedicated terminal until November. CENTCOM Weather and ARCENT Weather also had early access to their respective headquarters' AUTODIN terminal. The former got its own dedicated send/receive terminal on 28 September; the latter on 18 October. Later on, as a result of its move to Eskan Village, ARCENT Weather had an interval of nearly a month (27 November to 24 December) when it had no AUTODIN connectivity.[48]

The ARCENT weather support element probably made more use of AUTODIN than either CENTCOM Weather or the DSFU at CENTAF Weather. Since it was not possible to "lower" the AWN below the corps level, the CENTCOM Directorate of Information Systems, Command, Control, Communications, and Computers suggested that perhaps ARCENT Weather and the XVIII Corps weather team could utilize AUTODIN to send and receive weather data to and from Army division weather teams. Shortly thereafter, on 28 September (in the same letter in which he asked for dedicated teletype and facsimile circuits to the XVIII Corps and Army division weather teams), Colonel Weaving requested the ARCENT Directorate of Information Systems, Command, Control, Communications, and Computers to arrange for dedicated AUTODIN teletype circuits from ARCENT Weather to the XVIII Corps weather team and through it on to the division and aviation brigade weather teams. The XVIII Corps weather team soon got its dedicated send/receive terminal and the VII Corps team did also after it arrived in theater, but the requested dedicated terminals at the division and aviation brigade levels never became a reality. However, division and brigade weather teams were able to use their unit's AUTODIN terminals, which frequently were located quite near to the weather station.[49]

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[46]AWS DS/DS Report #2 (S), pp 205 (Sec 5.1.2.2-f), 206 (Sec 5.1.2.4), p 213 (Secs 5.1.4.3, 5.1.4.4), info used (U); Callahan/Brackett Intvw (U), pp 19-20; Waite Intvw (U), p 2.

[47]Callahan/Brackett Intvw (U), p 19; Waite Intvw (U), pp 3-4.

[48]Riley Intvw (S), p 9, info used (U); 5WW DESERT SHIELD Chronology (S), p 9-3, info used (U); atch 11 (U), Brod DS/DS AAR, p 3, to CENTCOM Weather Staff AARs (U); ARCENT SWO AAR (U), atch I-2.

[49]Weaving Intvw (U), p 6; Campbell Intvw (U), p 16; ARCENT SWO AAR (U), pp 5-6 (Sec I-3a), 15-17 (Sec II-2a); 54-55 (Sec VII-1t); memo (S), LTC W.S. Weaving, USARCENT/SWO, to USARCENT/G6, "Request for Services - Weather Communications for DESERT SHIELD (U), 28 Sep 90, info used (U); ltr (S), ARCENT/SWO to All DS Army Weather Units with GW Computer Systems, 10 Oct 90, info used (U).

AUTODIN proved to be very valuable to ARCENT Weather and the Army weather teams at the two Army corps. They could use it to exchange weather data with other Army weather teams in the theater and also send data to AFGWC for retransmission to other weather units. But it was not particularly beneficial to the weather teams at the division and brigade levels. Although they had acquired access to AUTODIN through their own unit's communications center, this generally did not work out very well because the unsophisticated teletype equipment found at this level often became saturated and was unable to handle all the weather data the teams wanted to send. However, since Army communications engineers installed AUTODIN lines quickly after a unit had "jumped" (i.e., moved to a new location)--which happened frequently immediately before and during the combat period, access to AUTODIN did sometimes enable weather teams to again send and receive weather data in a relatively short time after they had suspended operations due to the jump.[50]

Tactical Communications

Tactical communications are no less vital to weather support than long-range communications; perhaps they are more so. As one AWS officer put it, weather people "live and die" with their tactical communications (TACCOM). They have to receive data from all over the potential or actual battlefield to make their forecasts. But, unfortunately, in DESERT SHIELD/STORM, AWS encountered a number of problems in this area. Some of these did not come as surprises. TACCOM had been an area of weakness for a long time. AWS had, however, introduced some improvements over the past several years and was still working to overcome the problems when DESERT SHIELD began. Just a few months earlier Headquarters AWS had formed a working group and then, in June 1990, convened a conference to address TACCOM issues. The conference identified a number of problems and proposed actions to solve them. However, the operation began before any substantial progress could be made to implement the solutions and so the problems remained.[51]

The distinction between long-range and tactical communications systems tended to break down within the Persian Gulf theater. Long-range circuits became, in effect, tactical circuits or were used as tactical circuits after reaching the theater. The SBLC system, tactical use of the AUTODIN by Army weather teams, and tactical extensions of the AFDIGS and EURDIGS facsimile circuits are examples of this. Moreover, TACCOM terminal equipment was, of necessity, sometimes employed in long-range as well as intratheater circuits. Still, AWS used certain equipment and established tactical communications networks in the theater that were clearly tactical in nature.

High Frequency Radio Communications (QRCT/Goldwing, UAWS)

The primary tactical communications system used by AWS in the DESERT SHIELD/STORM theater was the QRCT/Goldwing. It provided the basic and most widely used means of communication within the theater. Indeed, it is not much of an exaggeration to say that it was the AWS TACCOM system. Without it, intratheater weather communications would have been virtually impossible.

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[50]Conley Intvw (U), pp 7-8; ARCENT SWO AAR (U), pp 5-6 (Sec I-3a), 15-16 (Sec II-2a), 54-55 (Sec VII-1t).

[51]Keefer Intvw (U), pp 9-10.

Although communication by QRCT/Goldwing had its share of problems, the system proved to be a lifesaver for AWS in providing weather support during DESERT SHIELD/STORM.[52]

Current AWS tactical communications doctrine called for a light-weight, "first-in" communications capability for contingency operations. The QRCT/Goldwing provided this capability. The QRCT (officially the AN/GRQ-27) resulted directly from URGENT FURY, the Grenada contingency operation of 1983. One of the lessons AWS learned in that operation was it needed a small, truly transportable TACCOM system that would not be dependent upon separate airlift for deployment--that is, it needed a system that deploying weather personnel could take with them. Over the next several years AWS worked with AFCC to procure such a system. Eventually it decided to purchase the same TACCOM system that the Army was procuring, i.e., the Goldwing. Slightly modified, the Goldwing in Air Weather Service nomenclature became the Quick Reaction Communications Terminal or QRCT. When DESERT SHIELD began AWS was just in the process of getting the QRCTs it had ordered and distributing them to its Air Force support units and, consequently, many of these still did not have any.[53]

The QRCT was a transportable, secure (i.e., equipped to transmit classified data) communications system using an HF radio designed to operate over medium distances (100 to 1,000 miles) and intended to provide tactical communications for the first 30-60 days of a contingency operation (i.e., until communications engineers installed fixed, hardwire circuits). It had both a voice and hardcopy transmitting and receiving capability and was able to receive weather data by either analog facsimile or alphanumeric teletype. It functioned as an information management workstation capable of displaying, processing, and manipulating data. Major components of the QRCT included a Transworld TW-100F HF radio, Gridcase 1307 laptop computer, Grid 2137 10-megabyte hard disk drive, Intel 8088 microprocessor, Grid Datawatch printer, Frederick 1280A modem, Alden 9315TRT-R weather graphics recorder, GRA-4 Insulator antenna, and a KG-84 cryptographic device.[54]

Personnel deploying to DESERT SHIELD carried their QRCTs and Goldwings with them and were, therefore, able to get the systems operational quickly--usually within 24 to 72 hours--after reaching their station in theater. Indeed, Army weather teams were able to set up their Goldwings in from 2 to 6 hours. CENTAF Weather at Riyadh had its QRCT operational and communicating with four other weather teams by 12 August, 3 days after the arrival of Lieutenant Colonel Riley, the CENTAF SWO. Over the next several weeks, as weather personnel deployed to additional locations, the QRCT/Goldwing network gradually expanded--6 nodes by 16 August, 19 by 2 September, 25 by 19 September. The DSFU at CENTAF Weather began to function as net control station on 31 August. ARCENT Weather came up on the network on 6 September. On 28 September, the network, having grown to an unmanageable size, CENTAF and ARCENT established their own separate networks of 20 and 5 nodes respectively. ARCENT Weather continued as a node on the CENTAF network. Two weeks later it took over net control station responsibilities for the ARCENT network. By mid-October

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[52]Maj R.P. Callahan in Callahan/Brackett Intvw (U), p 12; atch 1 (U), brfg, [5WW/DO], "Lessons Learned," n.d. [ca 15 Mar 91], to ltr (U), 5WW/DO to 5WW/DOX, et al, "DESERT SHIELD/STORM Lessons Learned," 27 Feb 91, hereafter cited as 5WW/DO DS/DS Lessons Learned Brfg.

[53]AWS DS/DS Report #2 (S), p 171 (Sec 5.1.1.1), info used (U); hist (S/NF), AWS, CY 85-86, pp 187-188, info used (U); hist (U), AWS, CY 87-88, pp 216-220; hist (S), AWS, CY 89, pp 264-267, info used (U).

[54]Atch 1 (U), "Quick Reaction Communications Terminal (AN/GRQ-27)," to memo (U), HQ AWS/DO to HQ AWS/XT, "Purchase of Tactical Communications Equipment," 17 Jan 91, w/2 atchs; art (U), "Weather Systems Give Allied Forces an Edge," AWS Observer, May 91, p 9.

CENTAF's QRCT net had increased again to 27 nodes. The ARCENT Goldwing net grew to as many as 18 nodes, although it averaged between 10 and 12 (the number varied as units gained and lost hardline communications). After the VII Corps arrived in the theater ARCENT sub-divided its network into XVIII Corps, VII Corps, and SOCCENT nets.[55] (See Figures III-1 and III-2.)

Since the QRCT was a new piece of equipment, most AWS personnel deploying to DESERT SHIELD to support Air Force units had little if any experience, or even training, with it or, for that matter, with HF communications in general. They, therefore, had a lot of learning to do after they arrived in theater. The AWS Army weather support teams, on the other hand, were very familiar with their Goldwings. Not only had they possessed them for some time, but they had also practiced using them while they trained in the field, as part of normal procedure, with the Army units they supported. They were, therefore, initially far more proficient in operating their Goldwings than their Air Force support counterparts were in using their QRCTs. However, the Air Force support teams, through dedicated effort and with valuable assistance from the few persons who were acquainted with the QRCT--e.g., Chief Master Sergeant Benjamin L. Coughran and Master Sergeant Dennis E. Nappier from CENTCOM Weather and Technical Sergeant Kenneth R. Gibson from CENTAF Weather, who traveled from unit to unit training personnel in operating their QRCTs, managed to get their QRCTs set up and working. The Air Force operators gradually became more adept at using their QRCTs, eventually to the point where they were probably as efficient as the Army operators. The operators of both the QRCT and Goldwing systems were mostly weather observers.[56]

High frequency communications can be hard to work with; it certainly was during DESERT SHIELD/STORM. It was very much affected by such factors as ionospheric propagation and the time of day. Performance changed from day to day, even from hour to hour, and it was very difficult to use at night, often for as much as 8 or 9 hours, due largely to atmospheric conditions. The quality of HF operations also depended upon operator skill. In order to make the adjustments necessary to enhance performance and, in general, to use the QRCTs and Goldwings effectively, operators had to be familiar with the vagaries of HF and the conditions that adversely affected its ability to transmit and receive data. Such familiarity came primarily through training and experience. Since Air Force operators initially were deficient in both, QRCT communication was, at least in the beginning, erratic and unsatisfactory. HF was fine as a first-in, temporary TACCOM system, but AWS and its Air Force WSF neither expected nor wanted to use the QRCT for the long term. Nevertheless, it remained a TACCOM mainstay for Air Force support weather teams throughout DESERT SHIELD/STORM. Army support weather teams, however, since the Army units they supported were mobile, expected to remain heavily dependent on their Goldwings for TACCOM throughout the entire operation.[57]

The rapid expansion and consequent increase in traffic on the QRCT and Goldwing networks and the inability to operate much at night made it necessary for the net control stations to establish

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[55]AWS DS/DS Report #2 (S), pp 174 (Sec 5.1.1.2-d(2)), 176 (Sec 5.1.1.2-f), info used (U); Keefer Intvw (U), p 6; 5WW/DO DS/DS Lessons Learned Brfg (U); 5WW DESERT SHIELD Chronology (S), pp 9-3, 9-4, 9-5, 9-6, 9-7, 9-9, info used (U); ARCENT SWO AAR (U), Atch I-2; brfg slide (U), [AWS/DOJ], "DESERT SHIELD HF Communications," n.d. [ca Jan 91].

[56]Col R.R. Wall in AWTB Intvw (U), pp 18-19; Keefer Intvw (U), pp 6-7; Koenemann Intvw (U), p 13; MSgt J.E. Brackett in Callahan/Brackett Intvw (U), p 20; Riley Intvw (S), p 31, info used (U); note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 22 Jun 92. For a discussion of the lack of training that Air Force weather support teams had on QRCTs, see Kelly Intvw (U), pp 17-19.

[57]AWS DS/DS Report #2 (S), pp 174-176 (Sec 5.1.1.2-d(2)(3)), info used (U); Koenemann Intvw (U), pp 13-14; Keefer Intvw (U), p 3; Conley Intvw (U), p 15.

ARCENT COMMUNICATIONS
24 FEB 91

		TTY R/O	TACFAX/ TIDS	UAWS	GOLDWING
ARCENT	1690 WGP	■	■	■	■
12 AVN BDE	OL-G	+	+	+	■
2 BDE	OL-L	■	■	■	+
SOCCENT	DET 1	■			■
XVIII ABN CORPS	DET 3	□	□	+	■
18 ABN AVN		+	+	+	■
82 ABN DIV	DET 5	+	+	+	■
82 ABN DIV AVN		+	+	+	■
24 INF DIV	DET 7	+	+	+	■
24 INF DIV AVN		+	+	+	■
101 ABN DIV	DET 9	+	+	+	■
101 ABN DIV AVN		+	+	+	■
1 CAV DIV	DET 11	+	+	+	■
1 CAV DIV AVN		+	+	+	■
VII CORPS	DET 13	□	■	■	■
11 AVN		+	+	■	+
1 ARM DIV	DET 15	+	+	■	+
1 ARM DIV AVN		+	+	■	■
3 ARM DIV	DET 17	+	+	+	■
3 ARM DIV AVN		+	+	■	+
1 INF DIV	DET 19	+	+	+	■
1 INF DIV AVN		+	+	■	+
2 AIR CAV REG	DET 21	+	+	■	+
2 AIR CAV REG AVN		+	+	+	+
3 AIR CAV REG	DET 23	+	+	+	■
3 AIR CAV REG AVN		+	+	+	■

Legend	
■	Available
□	Programmed
+	Not Required

SOURCE: AWS DESERT SHIELD/DESERT STORM Report #2 (S), p 187 (Atch 20), info used (U).

Figure III-2

rules and times for operating on the network. Each established blocks of time and scheduled specific time periods within each block for field units and the net control stations to transmit data. Typically, the net control stations set up a 3-hour block with the net control transmitting to the field for one hour and the weather teams transmitting their data during the remaining 2 hours of the block in ordered sequence (near the end of the operation this got to be more like one-half hour for net control and two and one-half hours for the weather teams). This meant that each weather team could send out its weather observations only once every 3 hours, which made its data less timely than desirable, but the most timely possible under the circumstances.[58]

Very soon after DESERT SHIELD began, AWS, through its 2d Weather Wing, established a QRCT HF broadcast at Incirlik AB, Turkey, to relay AWN weather data to the weather teams deployed in the Persian Gulf theater. Indeed, the Incirlik QRCT served as the interim net control station until the DSFU assumed that function on 31 August. The broadcasts continued throughout the duration of the operation. Initially, the transmissions were not always successful because units in the theater frequently could not receive them. As a result, in late August the 2d Wing initiated action to increase the power of the Incirlik broadcast. This was successfully accomplished when the 31st Weather Squadron's Detachment 19, based at Incirlik, succeeded in hooking up a second QRCT to a three-kilowatt transmitter and a MAC World Airways voice antenna at Incirlik. The new jerry-rigged QRCT "system plus," which could transmit only, became operational on 7 September. The original Incirlik QRCT, however, continued to operate in both send and receive modes.[59]

When the Army's VII Corps weather teams deployed to the Persian Gulf beginning in late November 1990 they brought with them as their TACCOM system the UAWS, thereby introducing a second HF TACCOM system into the theater. US Army Europe had developed and procured UAWS for use in Europe by its weather teams independent of FORSCOM, which had purchased the Goldwing. It fielded UAWS in 1988. The system used a Zenith Z-248 computer and included a 500-watt Harris radio. Unfortunately it was not compatible with the Goldwing. Although the Goldwing used a different radio (125-watt Transworld TW-100F) and computer (Gridcase), the incompatibility resulted primarily from the modems the two systems used. UAWS employed the high-speed, 2,400 baud Harris 3466; the Goldwings used the much slower, 600 baud Fredericks 1280A. FORSCOM planned to rectify the incompatibility problem in a future Goldwing upgrade, but, obviously, that didn't help for DESERT SHIELD/STORM. Fortunately, AWS and Army communicators had devised and practiced a work-around well before DESERT SHIELD began. This involved positioning both a UAWS and Goldwing system at a particular site and then manually transferring floppy discs from one to the other for retransmission of the data they contained to deployed weather teams via the other system's network. This slowed down data handling, but it worked as a temporary fix.[60]

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[58]AWS DS/DS Report #2 (S), pp 175 (Sec 5.1.1.2-d(2), 176 (Sec 5.1.1.2-f), info used (U); Keefer Intvw (U), pp 3-4.

[59]Msg (S), 5WW/DO to 1WW/DO, et al, "Concept of Operations (U)," 090100Z Aug 90, info used (U); msg (S), 5WW/CAT to 7WS/DOX, et al, "AWS Concept of Operations/Operation DESERT SHIELD (U)," 291825Z Aug 90, info used (U); msg (S), 2WW/CAT to AWS/DOJ, et al, "Incirlik QRCT Use of Giant Voice Transmitter (U)," 290915Z Aug 90, info used (U); msg (S), 2WW/CAT to AWS/CAT, et al, "Data Flow for DESERT SHIELD Support Update (U)," 051415Z Sep 90, info used (U); action item #16 (U), [AWS] CAT Director, "Incirlik HF Broadcast Increased Power," opened 27 Aug 90, closed 9 Sep 90.

[60]Hist (S), AWS, CY 89, pp 268-269, info used (U); Campbell Intvw (U), pp 224-25; Boyle Intvw (U), pp 6-7.

Since UAWS and Goldwing were incompatible, ARCENT Weather had to establish two HF networks, one for XVIII Corps, the other for VII Corps. The ARCENT Weather net control station functioned as the Goldwing/UAWS interface. It had one person dedicated to operating each system at all times. The VII Corps UAWS net became operational on 21 December. The ARCENT net control station originally set up the network on a 1-hour data collection--data transmission cycle, the schedule followed in Germany, but when that proved to be unworkable for DESERT SHIELD, it switched the net to a more satisfactory 2-hour cycle.[61] (See Figure III-2.)

Once the VII Corps weather teams overcame a few initial problems, UAWS performed well in DESERT SHIELD/STORM, better than it had ever done during exercises in Germany. The UAWS maintenance concept called for returning broken equipment to Europe for repair, at best a cumbersome procedure. However, since VII Corps weather teams deployed with spares and there were few equipment failures, maintenance never became a problem. One user raved that UAWS had performed "beyond belief in its capabilities and overall performance." Lieutenant Colonel Campbell, the OIC of the ARCENT weather support element, observed that UAWS performance was "a real success story."[62]

QRCT/Goldwing Problems

In contrast to its experience with UAWS, the WSF had many problems with the QRCTs and Goldwings. This was at least partly because the QRCTs and Goldwings were in continuous service for a much longer time than UAWS (almost seven months compared to slightly more than two months). Some of the problems arose out of the previously mentioned general shortcomings of any HF communication system--which to some extent the VII Corps weather teams were, because of their experience and through experimentation with the UAWS, able to mitigate to a certain extent--and the Air Force weather support teams' lack of training and/or experience with the QRCTs. But there were also problems attributable to other factors, including weaknesses in the QRCT/Goldwing itself and the absence of an adequate in-theater maintenance support capability.

Shortly after the start of DESERT SHIELD, Headquarters AWS found it advisable to replace the narrowband antennas that were part of the QRCT and Goldwing systems, although at the time leaders at the 5th Wing and of the WSF in the theater did not consider it necessary. QRCT operators currently had to manually recut and realign the antennas as they changed frequencies in response to changing atmospheric conditions and as day gave way to night and vice versa. In order to get maximum reception and transmission capability, it was vital they set the antennas accurately; lack of accuracy seriously degraded performance. As a result of the experience with and some investigation of the QRCT by some of its staff members, Headquarters AWS had concluded the deployed weather teams could improve QRCT performance, or at least operate their QRCTs more easily and efficiently, if their QRCTs had wideband antennas. Between 5 and 10 September Headquarters AWS developed a plan for procuring the new antennas. On 14 September it instructed the 5th Wing to immediately purchase

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[61]AWS DS/DS Report #2 (S), p 177 (Sec 5.1.1.2-g), info used (U); msg (S), 5WW/CAT to AWS/CAT, "CAT-to-CAT Questions Status (U)," 162222Z Nov 90, info used (U); Weaving Intvw (U), pp 12-13; ARCENT SWO AAR (U), pp 5 (Sec I-3a), 24-25 (Sec II-4a,b), Atch I-2-2; Campbell Intvw (U), p 24.

[62]AWS DS/DS Report #2 (S), p 179 (Sec 5.1.1.2-i), info used (U); ARCENT SWO AAR (U), pp 24 (Sec II-4b), 27 (Sec II-4e); Campbell Intvw (U), pp 24-25.

45 Barker and Williamson model A-C 3.5-30 megahertz continuous coverage folded dipole antennas. The antennas arrived in late October and November.[63]

The QRCT and Goldwing component causing the most trouble was the Grid hard disk drive system used with their Gridcase laptop computers. A significant number of hard drives crashed--9 for the CENTAF QRCTs alone--and several times as many of the removable 10 megabyte hard disk cartridges failed. There was no one cause for the problem. Certainly the hot and dusty environment in which the QRCTs and Goldwings operated was a major factor. When operators removed the hard disks from the computer, dust and sand could easily penetrate the drives. Operator mishandling also contributed to the crashes--for example, neglecting to remove the cartridges from the computer when not in use or, alternatively, removing them too soon, before the heads had retracted. An apparent inability to tolerate sustained use appeared to be a another factor in the hard drive crashes. In any event, hard drive and disk breakdowns became a serious problem for the QRCTs and Goldwings.[64]

To alleviate the hard disk problem, 5th Wing purchased additional cartridges and shipped them to the theater as spares. In addition, the 5th Wing took steps to replace the Grid hard drives in the QRCTs with new units. FORSCOM, likewise, initiated an effort to procure new hard drives for the Goldwings. In January the 5th Wing joined FORSCOM's program and forwarded $90,000 to FORSCOM to purchase 36 replacement hard disk drives for the QRCTs. The new drives, however, did not arrive in theater before the end of DESERT STORM.[65]

Other problems associated with the Gridcase computers, as well as a weakness in the radios used with the systems, also hampered QRCT and Goldwing operations. The computer handled data too slowly for efficient operations. Moreover, the software it used had several deficiencies. For example, the software was designed in such a way that the systems totally reject garbled messages. In addition, software limitations prevented the net control stations from polling the nodes on their network. AWS managed to arrange for several software improvements that rectified some of the problems, but others remained throughout the entire operation, including the rejection of garbled messages. AWS was still working the problem when DESERT STORM hostilities ended. The inadequate power (125 watts) of their TW-100F radios further impeded the operations of the two

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[63]AWS DS/DS Report #2 (S), p 174 (Sec 5.1.1.2-d(1)), info used (U); Col R.R. Wall in AWTB Intvw (U), pp 17-18, info used (U); Koenemann Intvw (U), pp 14-15; St. Onge Intvw (U), pp 14-15; action item #25 (U), HQ AWS/PM/XT, [Obtain Omni-directional Antenna for QRCT/Goldwing,] opened 5 Sep 90, [closed ca 15 Sep 90]; msg (U), USCINCCENT/Weather to 5WW/DO, et al, "AWS High Frequency Pamphlet," 091238Z Nov 90; msg (U), AWS/CAT to 5WW/CAT, "Dipole Antenna Purchase," 140355Z Sep 90.

[64]AWS DS/DS Report #2 (S), pp 178 (Sec 5.1.1.2-i), 180 (5.1.1.4), info used (U); St. Onge Intvw (U), pp 18-19; Keefer Intvw (U), p 8; Maj R.P. Callahan in Callahan/Brackett Intvw (U), p 4; atch 4 (U), rprt, TSgt W.M. Anderson, NCOIC, 1690WGP/LG, "DESERT SHIELD/STORM After Action Report," 25 Mar 91, hereafter cited as 1690WGP/LG DS/DS AAR to CENTCOM Weather Staff AARs (U); msg (U), USCENTAF/WE to 1TFW Deployed/WE, et al, [Goldwing (AN/GRC27) Hard Disk Drive Failures,] 310005Z Oct 90; msg (U), USCINCCENT/Weather to 5WW/DO, et al, "AWS High Frequency Pamphlet," 091238Z Nov 90.

[65]Koenemann Intvw (U), p 14; Keefer Intvw (U), p 8; Maj R.P. Callahan in Callahan/Brackett Intvw (U), p 4; msg (U), 5WW/CAT to AWS/CAT, et al, "Evaluation of the Gridcase Hard-disk Drive Requirement," 192257Z Nov 90; msg (U), CINCFOR/FCJ3-CAT to 5WW/CAT, et al, "Goldwing/QRCT Issues," 071430Z Dec 90; msg (U), 5WW/CAT to AWS/PM, et al, "Hard-disk Drives for DESERT SHIELD Quick Reaction Communication Terminals," 111529Z Jan 91.

TACCOM systems. However, a bigger problem for QCRT and Goldwing operators was the shortage of usable frequencies on which to operate, something not the fault of the systems themselves.[66]

The lack of adequate maintenance support also threatened Goldwing and QRCT operations, especially the latter. Initially neither the Goldwings or QRCTs had any in-theater maintenance support. The Army weather support teams, however, had at least deployed with a few spares. On the other hand, the only way the Air Force support teams could get a QRCT replaced or repaired, if it could not be done on site, was to ship the broken system back to a depot in the US. This procedure, the weather teams found, was not feasible in practice. The 3 to 4 weeks it took was far too long. The Army's FORSCOM alleviated the situation when it deployed two communications maintenance detachments, the 158th from Fort Bragg and 159th from Fort Hood, Texas, to the theater. They did not arrive, however, until early October. At the request of AWS, FORSCOM authorized the detachments to maintain AWS TACCOM equipment, but with the provision that repair of Army Goldwings should take precedence over fixing Air Force QRCTs.[67]

The two detachments became invaluable for the continuation of Goldwing and QRCT operations. They deployed with six spare systems and a supply of spare parts. After arrival, they established a repair procedure whereby WSF units brought their broken Goldwings and QRCTs to the detachments for repair. If they could, they replaced a broken component immediately with a spare, if not, they repaired the system, usually within 48 hours. If for some reason they could not fix a particular system at all, they, as a last resort, returned it to the US. This procedure functioned extremely well for ARCENT weather support teams because the detachments were located at Dhahran, near to the deployed Army units, initially stationed in relatively close proximity to each other in northeastern Saudi Arabia. It didn't work out quite as well for the Air Force weather teams since they were scattered throughout the theater, making it harder for them to bring their broken QRCTs to the detachments. In actual practice, the teams shipped the QRCTs to CENTAF Weather, which sent them by intratheater airlift or, on two or three occasions, by automobile, to the detachments at Dhahran. Nevertheless, this procedure was immeasurably more effective than shipping the equipment back to the US and, on the whole and for the time being, worked acceptably.[68]

The Air Force weather support teams, however, began to find it much harder to follow the new maintenance procedure in January when the Army units started to move forward in anticipation of the outbreak of hostilities. When the Army units moved, the maintenance detachments moved with them, making it virtually impossible for the CENTAF weather teams to keep track of where they were. Even

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[66]AWS DS/DS Report #2 (S), pp 173 (Sec 5.1.1.2-d(1)), 175, 176 (Sec 5.1.1.2-d(2)), 179 (Sec 5.1.1.3-b), 180 (Sec 5.1.1.4-c), info used (U); msg (U), USCINCCENT/Weather to 5WW/CAT, et al, "Goldwing Software Modifications/Corrected Copy," 181357Z Dec 90; Tasker #21 (U), HQ AWS/CAT, "Goldwing Software Modifications," 7 Feb 91, w/1 atch; ARCENT SWO AAR (U), pp 22-23 (Sec II-3c,d).

[67]AWS DS/DS Report #2 (S), p 180 (Sec 5.1.1.3-d), info used (U); Col T.C. Tarbell and LTC R.R. Wall in AWTB Intvw (U), pp 25-26; msg (U), AWS to 5WW, et al, "AN/GRQ-27 Component Replace Concept of Operations," 110245Z Aug 90; Conley Intvw (U), pp 16-17; Koenemann Intvw (U), pp 17-18.

[68]AWS DS/DS Report #2 (S), pp 178-179 (Sec 5.1.1.2-i), 180 (Sec 5.1.1.3-d), info used (U); LTC R.R. Wall in AWTB Intvw (U), p 26; Weaving Intvw (U), pp 20-21; note (U), LTC G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 22 Jun 92; ltr (S), ARCENT/SWO to CENTCOM/SWO, "Maintenance Support from the 158th and 159th Maintenance Detachments (U)," 5 Oct 90, info used (U).

Army weather teams at times lost contact with them. The new difficulties made it apparent that while having the Army detachments repair QRCTs might provide a solution to the maintenance problem during a relatively stable peacetime situation, it did not meet operational requirements under fluid wartime conditions.[69]

The need to use communications security (COMSEC) materials in QRCT and Goldwing operations created another problem area associated with these systems apart from the equipment itself. Since the QRCTs and Goldwings were intended to operate in a secure mode (i.e., transmit classified data), the weather teams that would be using them deployed with COMSEC codes and with keytapes for the KG-84 data encryption device that was a part of both systems. While some initial confusion existed over what keytapes to use at what time, the biggest and most persistent COMSEC problem was getting outdated keytapes replaced on time. Difficulties in this area hampered, sometimes delayed, and at times, threatened to prevent secure operations. Inasmuch as the weather teams had deployed with a 2- or 3-month supply of keytapes, some needed a new supply as early as 1 October. FORSCOM provided the initial supply for both the CENTAF and ARCENT weather support teams and agreed to replenish the ARCENT weather teams when necessary, but the 5th Wing, as lead wing, had to see to it that the CENTAF weather support units got the keytapes they needed.[70]

The 5th Wing had some difficulty in meeting its responsibility to replace CENTAF weather support unit keytapes. The CENTAF Communications-Computer Systems COMSEC custodian did not immediately establish in-theater COMSEC accounts (in fact, he did not do so until January 1991). As a result, since some AWS weather teams needed new keytapes by the beginning of October, the wing, working with Headquarters AWS, tried to find or devise an acceptable channel to resupply AWS units with keytapes directly from Langley AFB as expeditiously as possible. FORSCOM initially refused to approve the transfer of its keytapes to the 5th wing because CENTAF had not yet established the Air Force COMSEC account in the DESERT SHIELD theater. At this point, Headquarters AWS stepped in and, after extensive coordination with FORSCOM, developed a method of sending the tapes to the theater that was acceptable to the Army command. Under this method, FORSCOM would transfer the keytapes to the Langley AFB COMSEC account custodian and the wing then would make arrangements to transport the tapes to the theater by courier. The wing chose to use designated couriers, usually passengers on the TAC rotator flights out of Langley. The 5th Wing managed to send off its first shipment of tapes to the theater in late September.[71]

The courier method, while workable, was far from ideal. For one thing, it was slow. The flights from Langley to Riyadh went quickly, but the distribution of the tapes within theater took some time. Consequently, on the first shipment some CENTAF weather teams received their new keytapes with only hours to spare and one got its tape late, temporarily preventing it from transmitting data in

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[69]AWS DS/DS Report #2 (S), pp 178 (Sec 5.1.1.2-i), 180 (Sec 5.1.1.3-d), info used (U); Weaving Intvw (U), p 21; Keefer Intvw (U), p 11.

[70]AWS DS/DS Report #2 (S), p 214 (Secs 5.1.5.1, 5.1.5.2), info used (U).

[71]AWS DS/DS Report #2 (S), pp 214-216 (Secs 5.1.5.2-c, 5.1.5.4), info used (U); msg (S), HQ AWS/CAT to 5WW/CAT, "CAT-to-CAT Questions for 12 Sep 90 (U)," 121517Z Sep 90, info used (U); ltr (U), AWS/ADO to HQ MAC/SCO, "DESERT SHIELD Weather Communications Concerns," 24 Oct 90.

a secure mode. The method also created, because of the number of couriers involved, a greater risk of keytape loss or compromise.[72]

The 5th Weather Wing dispatched a second set of keytapes in early December. Meanwhile, Headquarters AWS arranged to have the National Security Agency develop a keytape specifically for AWS that would be valid for 1 year. While the agency had developed the keytape by mid-December, because of the continuing lack of in-theater CENTAF COMSEC accounts to handle distribution, AWS was not able to send it to theater until March 1991, after the war was over, with an effective date of 1 June.[73]

ARCENT weather teams also had trouble getting new keytapes. Even though ARCENT had COMSEC custodians in theater and the teams informed them of their keytape requirements, the teams frequently would still not get their keytapes from FORSCOM on time. As a result, some were unable to transmit on the Goldwing network for a time. On at least one occasion several units never got their tapes at all. FORSCOM shipped five Goldwing tapes from Army National Guard weather flights to units in the field, but only one of them received its tape.[74]

Overall, QRCT and Goldwing operating performance was mixed. The Goldwings performed well for the ARCENT weather teams, better than the QRCTs did for the CENTAF weather teams, due mostly to more skilled Army weather team operators and technicians and partly to easier access to the maintenance detachments. Nevertheless, the Air Force weather support teams, in spite of many problems with or related to the QRCTs and using them much longer than they ever anticipated, had in the QRCTs a workable TACCOM system that contributed much to their ability to perform their mission.[75]

Tactical Facsimile Network

The AWS WSF also established a second in-theater TACCOM network, an analog TACFAX network to disseminate weather graphic products among the deployed units. AWS plans called for a hardwire network that would connect the CENTCOM, CENTAF, ARCENT, and SOCCENT headquarters weather stations with each other, CENTAF Weather with weather teams supporting Air Force units,

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[72]AWS DS/DS Report #2 (S), pp 215 (Sec 5.1.5.2), 216 (Secs 5.1.5.3, 5.1.5.4), info used (U); ltr (U), AWS/ADO to HQ MAC/SCO, "DESERT SHIELD Weather Communications Concerns," 24 Oct 90; note (U), LTC G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 22 Jun 92.

[73]AWS DS/DS Report #2 (S), pp 215-216 (Sec 5.1.5.2-c,d), info used (U); msg (S), 5WW/CAT to AWS/CAT, et al, "Operational Readiness of the DESERT SHIELD Weather Support Force (U)," 041308Z Jan 91, info used (U); msg (C), "AWS/CAT to 5WW/CAT, "Key Tape Status (U)," 151325Z Jan 91, info used (U); msg (U), HQ AWS/CAT to Comdr FORSCOM/FCJ2-ISA, et al, "Requirements for USKAT-A10145," 021325Z Nov 90; msg (U), HQ AWS/CAT to 5WW/CAT, "COMSEC Support for Deployed AWS Units," 201347Z Dec 90.

[74]AWS DS/DS Report #2 (S), p 214 (Sec 5.1.5.2-b), info used (U).

[75]Campbell Intvw (U), pp 24-25; ARCENT SWO AAR (U), p 20 (Sec II-3a); St. Onge Intvw (U), p 19; Keefer Intvw (U), p 7; atch 4 (U), 1690WGP/LG, DS/DS AAR to CENTCOM Weather Staff AARs (U).

ARCENT Weather with Army corps weather teams, and Army corps and divisions with each other. An embryonic CENTAF network consisting of CENTAF Weather, CENTCOM Weather, and four CENTAF weather support units was operational by 30 September. The DSFU functioned as net control. CENTAF communications engineers had expanded the circuit to include 18 units by 31 October and all the CENTAF weather support units then in theater by mid-November. All the weather teams which arrived in the Persian Gulf theater during the additional DESERT SHIELD buildup beginning in early November had their TACFAX connection by mid-January. Until such time as they received the hardwire connection, the CENTAF units relied mostly on HF intercepts for facsimile data. Meanwhile, the DSFU could not transmit AFDIGS charts over the network or, for that matter, use AFDIGS data in generating its own products until it finally received its first usable data over the AFDIGS circuit from AFGWC in early January 1991. Prior to this time it transmitted or used only data it received from within theater or other sources, primarily NODDS. It used an Alden 9316B scanner to send out facsimile data.[76] (See Figure III-1.)

The story was different at ARCENT and SOCCENT. ARCENT Weather never received TACFAX data while it was located at the RSLF Building due to the lack of space in the building for additional hardwire circuits. However, on 7 January, a few weeks after it moved to Eskan Village, it finally got its TACFAX circuit, enabling it to receive data from the DSFU. Army Signal Corps engineers eventually succeeded in bringing the VII Corps weather team into the TACFAX network, but the XVIII Corps team never attained connectivity. The first weather TACFAX circuits for SOCCENT weather units did not become operational until mid-December. One unit did not receive its TACFAX until 12 February, almost 4 weeks after the air war had begun. Before they got their own TACFAX circuits, ARCENT and SOCCENT weather teams, like the CENTAF weather units, relied on intercepted HF weather broadcasts for their facsimile data.[77] (See Figure III-2.)

Apart from the fact that some weather teams did not get connected to the TACFAX circuit for some time, the main problem with TACFAX was that it had to share a circuit with the AWS's TIDS network, also operating in the theater.[78] Since AWS communications took up a great deal of circuit space, CENTAF Communications-Computer Systems simply did not have the circuit capacity in theater to allocate a dedicated circuit to each network. Sharing the circuit hampered operations and caused delay in data transmission on both networks. To make the operation of the shared circuit as efficient as possible, the DSFU established an around-the-clock transmission schedule of four hours for TACFAX followed by two hours for TIDS. In other respects the TACFAX circuit worked well. The circuit proved to be reliable and the charts and other data received were good.[79]

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[76]AWS DS/DS Report #2 (S), pp 176 (Sec 5.1.1.2-d(4)), 188-192 (Atch 21), 207-208 (Secs 5.1.3.1; 5.1.3.2-a,b), 188-192 (Atch 21), info used (U); Riley Intvw (S), pp 21-22, info used (U); Maj R.P. Callahan in Callahan/Brackett Intvw (U), p 5; note (U), LTC G.F.Riley. Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 9 Jul 92.

[77]AWS DS/DS Report #2 (S), pp 176 (Sec 5.1.1.2-d(4)), 188-192 (Atch 21), 209-210 (Sec 5.1.3.2-c,d), info used (U); Weaving Intvw (U), pp 8-9; Maj R.P. Callahan in Callahan/Brackett Intvw (U), pp 8-9; ARCENT SWO AAR (U), pp 17-18 (Sec II-2b), Atch I-2-2.

[78]See below, Chap IV, pp 87-88.

[79]AWS DS/DS Report #2 (S), p 208 (Sec 5.1.3.2-a), info used (U); Riley Intvw (S), p 23, info used (U); Campbell Intvw (U), p 15; Boyle Intvw (U), p 9; Atch 11 (U), Brod DS/DS AAR to CENTCOM Weather Staff AARs (U); ARCENT SWO AAR (U), pp 17-18 (Sec II-2b).

Probably no TACCOM equipment outperformed the Alden 9315 transmitter-receivers, whether the 9315TR (transmitter/receiver), 9315TRT (upgraded transmitter/receiver), or 9315TRT-R (further upgraded receiver only) versions. Since the 9315s were a basic component of both the QRCTs and Goldwings, every WSF unit, whether at headquarters or out in the field, possessed at least one. Users characterized the 9315 as rugged, reliable, and extremely well performing--in short, an excellent piece of equipment.[80]

[80]MSgt J.E. Brackett in Callahan/Brackett Intvw (U), pp 11-12; Campbell Intvw (U), p 17; Koenemann Intvw (U), p 14; Keefer Intvw (U), pp 4-5; Atch 4 (U), 1690WGP/LG DS/DS AAR, to CENTCOM Weather Staff AARs (U).

CHAPTER IV

SUPPORTING THE WEATHER SUPPORT FORCE

To accomplish its mission most effectively, the AWS WSF deployed to DESERT SHIELD/STORM, as did any deployed WSF, needed assistance from outside of its operational theater. This assistance included logistical as well as meteorological support. Headquarters AWS and the 5th Wing provided and/or arranged for various types of out-of-theater support, some of which have already been mentioned. AWS wings other than the 5th, especially the 2d, also contributed. AFGWC and the US Air Force Environmental Technical Applications Center (USAFETAC), its chief subordinate organization, supplied valuable centralized weather products. DMSP and other weather satellites provided vitally important satellite imagery. Several other organizations--e.g, the US Navy's Oceanographic Systems Center, furnished limited, but useful, support.

Centralized Products from AFGWC

When the DESERT SHIELD deployment began, AFGWC immediately started getting requests for weather data for the Atlantic Ocean and Mediterranean Sea as well as Saudi Arabia, Kuwait, and Iraq. Already anticipating such requests as a result of intelligence information it had received, it immediately began sending out a synoptic discussion bulletin (SWO 42), the "official forecast" for the deployed forces, and other products such as forecasts for terminal points and refueling areas, flight hazards, and cloud conditions. As DESERT SHIELD continued and expanded, it brought a sense of urgency to AFGWC. Approximately 50 AFGWC personnel came to work regularly on DESERT SHIELD support and many more part of the time. Overall, AFGWC increased its product output by about 30 percent to meet DESERT SHIELD/STORM weather data requirements.[1]

For the next several weeks, until the DSFU became operational, AFGWC functioned as the tactical forecast unit (TFU) for the DESERT SHIELD theater and supported the bulk of the requirements coming from the theater. In the early stages of the operation a lack of complete and accurate data from the theater, due largely to Saudi Arabia and other nearby countries turning off their weather data transmissions for fear of aiding Iraq, hampered AFGWC's efforts to generate the required products. To get its products to the theater, it initially used AUTODIN since dedicated weather communications channels were not immediately available. At the same time it worked with USCENTCOM and USCENTAF in getting the long-haul AWN and AFDIGS circuits into the theater as soon as possible.[2]

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[1]AWS DS/DS Report #2 (S), pp 111-112 (Secs 4.2.1.1, 4.2.1.2), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Maj Kenneth B. Stokes, Chief, AFGWC/WFO, 12 Jun 91, p 2, hereafter cited as Stokes Intvw (U); Ritchie Intvw (U); AFGWC/CC, 12 Jun 91; art (U), C.D. Marsan, "Weather Systems Give Allied Forces an Edge," AWS Observer, May 91, p 9.

[2]AWS DS/DS Report #2 (S), p 111 (Sec 4.2.1.1), info used (U); msg (S), 5WW/CAT to 7WS/DOX, et al, "AWS Concept of Operations/Operation DESERT SHIELD (U)," 291825Z Aug 90, info used (U); Waite Intvw (U), p 2; Mr K. Runk and Mr J. Albrecht in intvw (U), W.E. Nawyn, AWS/HO, with

On 21 September the DSFU became operational and, at that point, AFGWC stepped down to the role of "hot backup" to the DSFU, at the same time forming a Contingency Support Cell that was prepared to reassume the DSFU function, if necessary. It also continued to develop TFU-type products (including the SWO-42 bulletin) in a "shadow mode." But primarily it now began to provide support to the DSFU in specific areas where it did not have expertise or capability. When the DSFU ceased operations on 18 March 1991, a couple of weeks after DESERT STORM hostilities ended, AFGWC again took over the role of tactical forecast unit for the WSF, which included resuming production of the official SWO 42 bulletin.[3]

AFGWC provided weather data and centralized products, analyses, and other services for DESERT SHIELD/STORM. It developed approximately 32 different types of specialized products. It issued some for only a few days, others for the entire operation. Probably its single most important product was the SWO 42 bulletin. Other products, most of which were bulletins incorporating several parameters, included flight plans for MAC, SAC, and TAC aircraft (sometimes more than 600 per day), flight hazard forecasts, flight level winds, air refueling track forecasts, terminal forecasts, chemical downwind messages, surface and upper air winds, forecasts, point analyses, weather inputs for electro-optical tactical decision aids, cloud-free forecasts, and HF propagation predictions. It disseminated these products not only to AWS weather teams supporting the Air Force and Army, but also to Marine and Navy units (AFGWC also received some Navy weather products), as well as civilian government agencies (e.g., the State Department).[4] (See Figure IV-1.)

Medium- and Extended-Range Forecasts

During the later stages of DESERT SHIELD and during DESERT STORM, AFGWC produced an important product that included a medium-range and extended medium-range forecast plus an 11-15 day outlook. It inaugurated the product on 24 December as only a medium-range (4-7 day) forecast developed in response to a support assistance request (SAR) received from CENTAF Weather five days earlier. A little over a month later, on 29 January, AWS, responding to a request from CENTCOM, instructed AFGWC to extend its medium-range forecast to ten days and also asked it to assess its capability to extend the product out to 15 days. On 2 February AFGWC transmitted its first extended medium-range (6-10 day) forecast. On the same day it informed AWS it could develop a 10-15 day outlook or, as AFGWC preferred to call it, a "trend forecast discussion," which would, however, only

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LTC Kenneth A. Nash, AFGWC/WFM, Mr Kim Runk, Chief Forecaster, AFGWC/WFP, and Mr Jay Albrecht, AFGWC/WFM, hereafter cited as Nash/Runk/Albrecht Intvw (U), pp 4-5; Millard Intvw (U), p 4.

[3]AWS DS/DS Report #2 (S), p 111 (Sec 4.2), info used (U); rprt (U), AFGWC/DOO to AWS/DOJ, "AFGWC After Actions Report - Operation DESERT STORM," 16 Apr 91, hereafter cited as AFGWC AAR (U); Stokes Intvw (U), pp 3-4; msg (U), AFGWC to 5WW, et al, "AFGWC SITREP #4 for 22 Sep 90," 221635Z Sep 90; msg (S), AWS/CAT to AFGWC/DO, et al, "AFGWC SW Asia Products (U)," 211424Z Sep 90, info used (U); msg (S), AFGWC/WFO to 5WW/CAT, et al, "AFGWC Products to Support DESERT SHIELD (U)," 231518Z Sep 90, info used (U).

[4]AWS DS/DS Report #2, pp 111-112 (Secs 4.2, 4.2.1.2), info used (U); Millard Intvw (U), p 14; msg (U), AFGWC/DOO to 5WW/DOX, [AFGWC Products List,] n.d. [late Apr 91]; hist rprt (U), AFGWC, 1 Jan -30 Jun 91, Tab D; Stokes Intvw (U), pp 3-5, 8-9; intvw (U), W.E. Nawyn, AWS/HO, with Capt Robert L. Haase and Mr George Krause, AFGWC/WSE, pp 2-5; AFGWC AAR (U).

PRODUCTS ISSUED BY
AIR FORCE GLOBAL WEATHER CENTRAL
AS OF 25 APR 91

NUMBER	NAME	DATE REQUESTED	DATE STARTED	DATE STOPPED
1	WX SUPPORT 291B	28 JAN 91	28 JAN 91	5 APR 91
2	XRAY	-	30 SEP 90	9 FEB 91
3	FXXX36	16 AUG 90	17 AUG 90	CONTINUING
4	DOWNWIND2	13 SEP 90	14 SEP 90	22 MAR 91
5	FXU865	31 JAN 91	1 FEB 91	25 MAR 91
6	NAVY SPECIAL WX/TFU BULLETIN	-	30 JUL 90	2 MAR 91
7	TFU BULLETIN/ SWO 42	-	23 JUL 90	CONTINUING
8	WETSTUFF	5 DEC 90	17 DEC 90	10 APR 91
9	JIMBO 1,2,3,	4 JAN 91	4 JAN 91	8 FEB 91
10	DET 2 CLOUD FREE	-	1983	CONTINUING
11	DOR CHARTS	-	PRO-1990	CONTINUING
12	WINDY	18 JAN 91	TRD-CONTINGENCY	SAR
13	CASA ONE	28 DEC 90	29 DEC 90	29 DEC 90
14	SANDFLEA	7 JAN 91	8 JAN 91	14 JAN 91
15	GOLDRUSH	8 JAN 91	9 JAN 91	1 MAR 91
16	SWO 44	1 SEP 90	2 SEP 90	22 OCT 90
17	CAMEL	-	23 OCT 90	30 OCT 90
18	SHORT FUSE	-	8 AUG 90	14 AUG 90
19	HRT DEPLOYMENT	-	10 AUG 90	12 AUG 90
20	EO FAX CHART	14 AUG 90	17 AUG 90	23 AUG 90
21	3WW SUPPORT	-	15 JAN 91	30 JAN 91
22	CLASSIFIED TITLE	-	10 AUG 90	11 AUG 90
	LIST OF WSP/WOPS PRODUCTS			
1	FEME CHART	19 DEC 90	24 DEC 90	CONTINUING
2	FEME BULLETIN	19 DEC 90	24 DEC 90	CONTINUING
3	CHIEF FCSTR COMPOSITE	N/A	1 NOV 90	CONTINUING
4	FAME	15 AUG 90	15 AUG 90	CONTINUING
5	FTD CLASSIFIED	-	JAN 90	CONTINUING
6	SWO 10	-	?	CONTINUING
7	SWO 22	-	15 AUG 90	CONTINUING
8	VOLANT DOOM FOR DS	23 AUG 90	23 AUG 90	CONTINUING
	ADDITIONAL SELF-INITIATED PRODUCTS			
1	FWW WIND WINDS BULLETINS (WWXX 85, 88, 89, KGWC)	-	31 AUG 90	CONTINUING
2	ADDITIONAL RWN WINDS (FXUS 60-64, 67 KGWC)	-	5 FEB 91	CONTINUING

SOURCE: AWS DESERT SHIELD/DESERT STORM Report #2 (S), pp 115-116 (Atch 12), info used (U).

Figure IV-1

"slightly exceed pure climatology." The next day AWS instructed AFGWC to develop the longer range outlook. AFGWC issued its first 11-15 day trend forecast discussion on 11 February, but produced it for only a short time. The 11-15 day requirement ended when hostilities ended on 28 February. AFGWC continued, however, to transmit the medium- and extended medium-range forecast to the Persian Gulf theater through the redeployment period and beyond.[5]

Producing the 11-15 day outlook was one of the toughest, most challenging tasks AFGWC faced during DESERT SHIELD/STORM. Forecasting as far out as 15 days was at the outer edge of, if not beyond, the state of the art. This was probably the first time that anyone tried to put out a detailed forecast for that far into the future. Existing numerical forecast models only went out ten days. Nevertheless, AFGWC decided to give it its "best shot." The tasking for the 15 day outlook was very specific, directing forecasts for each day and for each region in the theater, and calling for specific parameters such as cloud cover, wind speeds, precipitation, and visibility. The small team assembled by AFGWC to produce the trend forecast discussion worked hard to create a respectable product that was as accurate as possible. The result, however, was more a depiction of the weather pattern that might be expected during a given 11-15 day window than a true forecast. Unavoidably it included much interpretation and guesswork. Keeping the short-, medium-, extended medium-range, and the 11-15 day forecasts internally consistent presented a problem and required daily consultations among those responsible for each type of forecast.[6]

To accomplish its task, the extended outlook team employed innovative methods and used climatology, medium-range forecast models, and other tools available. Its first and perhaps most important step was to gather and assimilate regional climatological data. USAFETAC, the Naval Oceanography Command, and the Naval Environmental Prediction Research Facility were its chief sources for this data. Once it had the data, the team carefully examined them with a view to obtaining answers to a list of questions that it had compiled. Next the team viewed and compared data that it was able to secure from ten-day global medium-range forecast models used by the US National Meteorological Center (NMC) at Suitland, Maryland, and the European Center for Medium Range Forecasting in the United Kingdom. It also utilized forecast products obtained from the United Kingdom Meteorological Office and the German Meteorological Geophysics Office. After analyzing all this data, the team met with AFGWC's chief forecaster and medium-range forecasters to discuss and reach agreement on the 7-10 day extended medium-range portion of the extended outlook.[7]

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[5]AWS DS/DS Report #2 (S), p 112 (Sec 4.2.1.2), info used (U); Phillips Intvw (U), p 7; LTC K.A. Nash in Nash/Runk/Albrecht Intvw (U), p 2; AFGWC AAR (U); msg (U), AFGWC/WFO to CENTAF/Weather and 5WW/CAT, "Routine SAR: Request for Medium-Range Forecast," 212215Z Dec 90; ltr (U), AWS/CAT to AFGWC/DO, "Medium-Range Forecast Product," 29 Jan 91; ltr (U), AFGWC/DO to AWS/CAT, "Medium-Range Forecast Product," 2 Feb 91; msg (U), AWS/CAT to AFGWC/DO, "Extended Medium-Range Forecast Product," 031723Z Feb 91.

[6]Phillips Intvw, pp 6-7; Nash/Runk/Albrecht Intvw (U), pp 2-3; intvw (U), W.E. Nawyn, AWS/HO, with Mr Jay Albrecht, AFGWC/WFM, 14 Jun 91, hereafter cited as Albrecht Intvw (U), pp 2-5, 8.

[7]Albrecht Intvw (U), pp 3-8; atch 1 (U), "Extended Range Forecasting Procedures," to memo (U), J. Albrecht, AFGWC/WFM, to [LTC K.A. Nash, Chief], WFM, "Process for Generating Eleven to Fifteen Day Forecasts for DESERT STORM," 18 Apr 91, w/1 atch; memo (U), AFGWC/WF to AFGWC/DO, "Required Assistance from the National Meteorological Center for DESERT STORM Forecast Support," 4 Feb 91; msg (U), AWS/CAT to 2WW/CAT, et al, "UKMO/STRICOM Long-Range Products for AFGWC," 102221Z Feb 91; ltr (U), Col A.A. Ritchie, AFGWC/CC, to Dr R.D. McPherson, Director, NMC, "[Request for NMC MRF Data Fields,] 14 Feb 91; memo (U), AFGWC/WFM to AFGWC/DOO, "Description of ECMWF Forecast Fields in 28WS STRIKECOM Bulletin," 19 Feb 91.

In addition, the team used two techniques to check and possibly modify the forecasts it developed from the data it had acquired, particularly the model data. The first was global teleconnections, a worldwide database which it could use to correlate features at one particular location in the northern hemisphere to every other location in the northern hemisphere to "test the model forecast wave numbers for climatological reasonability." The second was the analog forecast method known as the Baur type climatology developed by the Germans during World War II to forecast weather for central Europe. The team decided to use this because during the winter European weather features and patterns affected Middle East weather. However, the Baur method proved to be less helpful than anticipated.[8]

In spite of AFGWC's best efforts, only some of its medium-range forecasts and more extended outlooks were successful. On the whole they did not verify very well. While they were of some value (e.g., CENTAF Weather noted that the extended outlook was a useful tool), they were not accurate enough to provide forecasts for specific locations such as a particular target.[9]

Miscellaneous Support

Eager to enhance its forecast products and provide the best possible support to DESERT SHIELD, AFGWC on 27 August turned on a new, unproven forecast model, the relocatable window model. Still essentially under development, the model had never been used operationally. But on 25 August AFGWC notified the 5th Weather Wing that it had recently developed a capability to produce forecast wind fields using the relocatable window model. Two days later it began running the model's contingency window CN1 twice daily on its Cray supercomputer. The window covered the Mediterranean, North African, and Southwest Asian region with a 50-nautical mile resolution. On 17 January 1991, just as the air campaign against Iraq began, AFGWC initiated the use of a second contingency window, CN4. It covered the same region, but with a higher, 25-nautical mile resolution and focused particularly on Saudi Arabia, Kuwait, and Iraq. This, too, it ran twice every day, six hours apart from CN1. AFGWC utilized the relocatable window model primarily to build a low-level wind bulletin which it transmitted to the Persian Gulf theater to assist the WSF in predicting the dispersion characteristics of any chemical agents that Iraq might release.[10]

In January 1991, AFGWC, fearing that it might be denied surface weather data from within the Persian Gulf theater, even from friendly sources, if war should break out, initiated an attempt to make use of data transmitted by special sensor microwave imagers mounted on two DMSP weather

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[8]Albrecht Intvw (U), pp 4, 6; atch 1 (U), "Extended Range Forecasting Procedures," to memo (U), J. Albrecht, AFGWC/WFM, to [LTC K.A. Nash, Chief], WFM, "Process for Generating Eleven to Fifteen Day Forecasts for DESERT STORM," 18 Apr 91, w/1 atch.

[9]LTC R.R. Wall in AWTB Intvw (U), p 42; Ritchie Intvw (U); AWS DS/DS Report #2 (S), p 112 (Sec 4.2.1.1), info used (U); memo (U), AFGWC/WFM to AFGWC/DO, "Extended MRF Forecasting Results," 8 Feb 91, w/1 atch; msg (U), CENTAF Weather to AFGWC/DO, et al, "AFGWC Medium and Extended Range Product Feed Back," 171500Z Feb 91.

[10]Ritchie Intvw (U); ltr (U), AFGWC/DOO to 5WW/Alert Staff, "Proposed AFGWC Product - Forecast Wind Fields for Operation DESERT SHIELD, 25 Aug 90; hist rprt (U), AFGWC, Jul-Dec 90, Vol II, Tab E; intvw (U), W.E. Nawyn, AWS/HO, with Capt Keith G. Blackwell, AFGWC/SDNN, 13-14 Jun 91, pp 16-19.

satellites (the second of which, F-10, the Air Force had launched only the month before) to back up and supplement other data it received from the theater. The effort was highly successful and AFGWC was able to provide additional information useful to forecasters in the DESERT STORM theater. Innovatively interpreting the satellite sensor imagery, Forecasting Services Division personnel were able to determine clouds, winds, and even thunderstorms and from this produce work charts which included surface wind speeds over water, rainfall rates over both land and water, and surface temperatures over land. AFGWC began transmitting the charts to the DSFU twice daily on 23 January 1991.[11]

From mid-January to mid-March 1991 AFGWC provided special support to the Defense Nuclear Agency. This agency was primarily concerned with nuclear threats, but it included a chemical branch which during DESERT SHIELD/STORM had the responsibility to provide the National Military Command Center and Headquarters CENTCOM with chemical/biological agent dispersion forecasts. To provide these forecasts, the Defense Nuclear Agency required accurate chemical dispersion models and in-theater weather information. It was receiving some weather data over AUTODIN from AFGWC and additional weather information from AWS's detachment at the Pentagon. But it felt that it needed more meteorological expertise and assistance than the detachment was able to provide. Therefore, on 17 January, as the air campaign against Iraq began, the agency requested AWS to temporarily loan it three meteorological officers or NCOs to assist it in supporting DESERT STORM operations. The following day AWS instructed AFGWC to send one officer to the Defense Nuclear Agency to determine first hand its need for additional support.[12]

AFGWC appointed Captain Keith G. Blackwell from the Numerical Models Section of its Software Development Branch as the officer to go to the Defense Nuclear Agency. He arrived there on 19 January. A few days later, after he had determined that the agency needed more help, AFGWC sent three NCOs to join him. Captain Blackwell immediately made arrangements to have the Defense Nuclear Agency connected to the AWN, so that it could directly receive the more detailed weather data, particularly the in-theater observations, that it required for its chemical dispersion models. After the NCOs arrived the captain devoted all of his time to evaluating several chemical dispersion models the agency was considering using, while the NCOs provided around-the-clock meteorological support to the agency. Captain Blackwell returned to AFGWC on 8 February, but the last NCO did not leave until 9 March.[13]

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[11]LTC K.A. Nash in Nash/Runk/Albrecht Intvw (U), pp 9-13; AFGWC AAR (U); hist rprt (U), AFGWC, Jan-Jun 91, Tab J, Sup Doc DOA 2-1, "[DOA] Inputs to DO History, 1 Jan 91 through 30 Jun 91;" ltr (U), AFGWC/DO to AWS/DO, "SSM/I Tools for DESERT STORM," 28 Jan 91; telefax (U), AFGWC/WFO/WFG to CENTAF/WX, "SSMI Work Chart Description," 29 Jan 91; msg (U), AWS/CAT to 5WW/CAT, "SSM/I Analysis Work Charts," 290051Z Jan 91.

[12]AFGWC AAR (U); intvw (U), W.E. Nawyn, AWS/HO, with Capt Keith G. Blackwell, AFGWC/SDDN, 13,14 Jun 91, pp 2-3,13; msg (U), DNA/Opns to AWS/DO, "AWS Manpower Support to DNA," 171600Z Jan 91; ltr (U), AWS/DO to AFGWC/DO, "Defense Nuclear Agency Weather Support," 18 Jan 91.

[13]Intvw (U), W.E. Nawyn, AWS/HO, with Capt Keith G. Blackwell, AFGWC/SDNN, 13-14 Jun 91, pp 2-13; AFGWC AAR (U). See also, rprt (U), Capt K.G. Blackwell, AFGWC/SDNN, to AFGWC/SDNN, et al, "Report of Visit: Headquarters Defense Nuclear Agency," 12 Feb 91, w/6 atchs.

Handling Classified Weather Observations

Very early in DESERT SHIELD AFGWC ran into a problem concerning how to handle classified surface and upper air "KQ [weather] observations" it received over the unsecured, long haul weather circuits from AWS units deployed in the Persian Gulf theater. CENTCOM considered the deployed locations of American units to be classified data, hence each AWS deployed unit received an encoded four letter location identifier (which, beginning in September, AWS changed twice per month), the first two letters of which were "KQ." Weather observations of themselves were not classified, but they became classified if they included the locations of the AWS units making the observations. If weather observations were to be of value to AFGWC in developing its forecast products, it had to know where they originated and include that information along with the observations themselves in its database. But including the location immediately made the observation classified and this created the problem.[14]

The problem arose from the fact that the AFGWC computer systems were set up to ingest and manipulate only unclassified material. If AFGWC mixed in classified KQ data with unclassified data in the database it used to develop its products, the whole database became classified. AFGWC's unclassified models would then not be able to extract information from the database and AFGWC's final products became classified, which meant it could not transmit them to the theater over unsecured circuits. Nor could AFGWC customers not cleared to receive classified material access the products. Consequently, on 25 August AFGWC asked AWS for permission to ingest the KQ observations into its unclassified database. A week later AFGWC requested AWS to get definitive guidance from CENTCOM on the issue. Approximately a month later CENTCOM authorized AFGWC to use the KQ observations in its unclassified database, but only if they remained solely within the database. This, of course, did not help AFGWC a great deal since its object was not just to store the KQ data in the database, but to process and use it in developing a product that it would transmit to the theater.[15]

Meanwhile AFGWC had set to work to figure out some way to process the KQ observations and deliver a product derived in part from these observations without creating security problems. To change its whole computer system structure so that the system could use classified data was out of the question because this would take far too long. Therefore, it concentrated on finding a temporary solution. The result was a work-around whereby it masked originating locations by assigning each KQ observation to a bogus location in a part of the world where it could not possibly have originated, such as down near the South Pole or out in the Pacific Ocean somewhere. In this way AFGWC could incorporate the KQ observations into its unclassified database without showing their real locations and then send them to its automated Satellite Data Handling System where Contingency Support Cell personnel could display and manipulate them, using their true location, in a classified environment. Unfortunately, AFGWC had to expend many manhours even to devise and implement the work-around.

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[14]AWS DS/DS Report #2 (S), p 227 (Sec 5.4.1), info used (U); Phillips Intvw (U), pp 3-4.

[15]Phillips Intvw (U), pp 3-4; intvw (U), W.E. Nawyn, AWS/HO, with LTC James H. Love, Chief, AFGWC/WFG, 12 Jun 91, p 4; Millard Intvw (U), pp 11-12; ltr (U), AFGWC/DO to AWS/DO, "Ingesting DESERT SHIELD KQ Observations into AFGWC Data Base," 25 Aug 90; ltr (U), AFGWC/DOO to AWS/CAT, "DESERT SHIELD Security Issues," 1 Sep 90; AWS DS/DS Report #2 (S), p 227 (Sec 5.4.2), info used (U).

For example, it took five AFGWC software experts almost 3 months to develop the necessary software.[16]

Implementation of MEPA-AFGWC Circuit

AFGWC also encountered a problem in obtaining weather observations taken by Saudi Arabian weather stations. When DESERT SHIELD began Saudi Arabia terminated the dissemination of wind and air pressure data from its weather stations because it did not want Iraq to get this type of information. It feared that Iraq would use this data to help it plan chemical attacks. The Saudi government was not opposed per se to sharing this data with the US and the AWS WSF deployed in the Persian Gulf region, but it would not permit transmission of the data in such a way that Iraq might be able to intercept it. It allowed AWS personnel in Saudi Arabia to go in person to Saudi weather stations to get weather observations. This, of course, did not help AFGWC, several thousand miles away. The KQ observations from deployed AWS units provided AFGWC with data from some locations in Saudi Arabia, but they left rather large geographical gaps which AFGWC wanted filled to increase the accuracy of its database. It, therefore, sought ways to get additional weather observations.[17]

About 3 weeks into DESERT SHIELD, AFGWC discovered that Saudi Arabia already had a weather circuit in place from its Meteorological and Environmental Protection Association (MEPA), in effect the Saudi weather service, at Jeddah to the US National Weather Service's National Meteorological Center via New York City. The Saudi government intended that the circuit would become part of the worldwide weather network of the World Meteorological Organization (WMO). However, the circuit, although completed several months before, was not yet operational, primarily because it still had unresolved protocol and configuration problems, involving particularly modems and multiplexers. Nevertheless, AWS and AFGWC decided that this circuit could provide the means by which AFGWC could get the Saudi weather observations and began immediately to work towards this end. Colonel Riley subsequently brought up this possibility at a meeting he had with MEPA officials on 14 August. A few days later the CENTAF Forward Commander, Major General Olsen, contacted Saudi officials about using the circuit to transmit weather observations to NMC. Sometime later, the Saudi Air Force, speaking for the Saudi government, agreed MEPA could use the circuit for this purpose. Consequently, AFGWC and AWS began to make arrangements for getting the data from NMC to AFGWC via the Carswell weather switch. They completed this process by the end of September.[18]

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[16]Phillips Intvw (U), pp 3-4; intvw (U), W.E. Nawyn, AWS/HO, with LTC James H. Love, Chief, AFGWC/WFG, 12 Jun 91, pp 4-5; Waite Intvw (U), pp 11-13; msg (U), AFGWC/DO to HQ AWS/CAT, "Automating Classified Observation Handling Processes," 141930Z Sep 90; Ritchie Intvw (U); AWS DS/DS Report #2 (S), pp 114 (Sec 4.2.1.4), 228 (Sec 5.4.4), info used (U).

[17]Koenemann Intvw (U), p 20; Millard Intvw (U), pp 5-6.

[18]Koenemann Intvw (U), p 20; Millard Intvw (U), pp 5-6; Waite Intvw (U), pp 4-6; AFGWC AAR (U); ltr (U), N. Murshid, Dir, Telecommunication, MEPA, to R. Hamilton, NWS/ARSAD, [MEPA-NMC Circuit Problems,] 31 Dec 90; ltr (U), Col J.W. Goldey, OICWSF, 1690WGP/CC, to Maj Gen J.W. Collens, USAF (Ret), [Information about AWS in DESERT SHIELD/STORM,] 3 May 91, w/1 atch, hereafter cited as ltr (U), Goldey to Collens, 3 May 91; ltr (U), Maj Gen T.R. Olsen, Comdr, CENTAF Fwd, to Lt Gen Ahmed I. Behery, Comdr, RSAF, [Request for Saudi Weather Data,] 19 Aug 90; ltr (U), Lt Gen A.I. Behery, Comdr, RSAF, to Lt Gen C.A. Horner, COMUSCENTAF, [MEPA-AFGWC Circuit,] n.d. [ca Aug

The next step, once the Saudis approved using it to transmit the weather observations, was to get the MEPA-NMC circuit operational. This proved to be considerably more difficult. More than four months elapsed before it happened. The main reason for this extremely long time was not so much the insurmountability of the circuit's problems as the absence of strong leadership in resolving them. Because it was not their circuit, AWS and AFGWC could not take the lead. In their eyes, it seemed that MEPA wasn't pushing hard enough to take care of the problems. But there were other reasons too, especially the lack of coordination and communication between agencies involved in the establishment of the circuit.[19]

These agencies included, in addition to MEPA, the National Weather Service, MCI Communications Corporation and the American Telephone and Telegraph (AT&T) Corporation, as well as other Saudi agencies and American contractors. MCI International was the long-haul carrier for the Jeddah-New York City satellite segment, AT&T owned the New York City-NMC portion of the circuit, and AT&T's Paradyne subsidiary was the supplier and installer of terminal equipment at Jeddah and New York City--where the chief equipment problems existed. To get all these to work together, especially in the absence of a strong driver, was a "nightmare." But MCI especially seems to have "dropped the ball" here and, in general had been rather unresponsive to the problem.[20]

The upshot of all of this was that no real effort to solve the problem with the circuit occurred until early January when perhaps the likelihood of hostilities beginning shortly lent a greater sense of urgency to the situation. The National Weather's Service's James Fenix played a prominent role in persuading the parties to get serious. On 3 January he requested MCI's Manager for Service Delivery, Albert Malet, to correct the problem as soon as possible. The following day he repeated his request. Pointing out that the need to exchange data with MEPA was "becoming operationally critical," Fenix urged Malet to "do what will take the shortest amount of time to make this circuit sound and reliable for operational use." Four days later, on 8 January, Malet finally issued instructions to install the proper modems at both ends of the circuit, condition the circuit for the use of the modems, and, following this, take steps to increase the speed of the circuit in compliance with a MEPA request. At about the same time MEPA sent a communications engineer to the US to work with NMC, MCI, and AT&T to resolve the problems. As a result of this concerted effort, on 18 January, only a few days after installation of the proper, compatible equipment, and only a matter of hours after resolution of a final communications engineering problem, the circuit finally became operational.[21]

90]; action item #15 (U), AWS/PM, "Saudi Winds-Direct Circuit," opened 27 Aug 90, closed 2 Oct 90.

[19]Koenemann Intvw (U), pp 20, 21-22; Millard Intvw (U), pp 6-7; Waite Intvw (U), pp 5-6; msg (U), HQ AFGWC/CAT to 5WW/CAT, et al, "Establishing MEPA-NWS Data Circuit," 151715Z Nov 90.

[20]Millard Intvw (U), p 7; Waite Intvw (U), pp 5-6; msg (U), HQ AFGWC/CAT to 5WW/CAT, et al, "Establishing MEPA-NWS Circuit," 151715Z Nov 90; atch 7 (U), telefax cover sheet, J. Fenix, NWS/NOAA, to R. Hamilton, MEPA/ARSAD, 27 Nov 90, to telefax (U), J. Fenix, NWS/NOAA, to A. Malet, MCI/Mgr Svc Delivery, 4 Jan 91, w/7 atchs; telefax cover sheet (U), J. Fenix, NWS/NOAA, to R. Hamilton, MEPA/ARSAD, 7 Jan 91.

[21]Telefax (U), J. Fenix, NWS/NOAA, to A. Malet, MCI/Mgr Srvc Delivery, [Bringing MEPA-NMC Circuit to Operational Status,] 3 Jan 91, w/8 atchs (partial file of Fenix correspondence re MEPA-NMC circuit); telefax (U), J. Fenix, NWS/NOAA, to A. Malet, MCI/Mgr Srvc Delivery, [Correction of Problems on MEPA-NMC Circuit,] 4 Jan 91, w/7 atchs (partial file of Fenix correspondence re MEPA-NMC circuit); memo (U), LTC L. Irvin, 5WW/IMA, to Col J.E. Sands, Jr, 5WW/CV, "Washington-Jeddah Circuit," 10 Jan 91, w/1 atch: telefax (U), A. Malet/MCI Mgr Srvc Delivery, to P. Saxena, Jeraisy Computer, [Actions Necessary to Get MEPA-NMC Circuit Operational,] 8 Jan 91; memo (U), LTC L.

Through these 4 plus months AFGWC tried to hasten the solution of the problem through frequent contacts with the National Weather Service, MEPA, and MCI, and by enlisting the assistance of AWS, the 5th Wing, and through the latter, Colonel Goldey in the DESERT SHIELD theater. But its role was, in the nature of the case, secondary, and in spite of its efforts and those of Headquarters AWS, nothing much happened until the major players, meaning MEPA, the National Weather Service, and MCI, got together to seriously attack the problem. For AFGWC and AWS it was a long, frustrating battle trying to get organizations over which they had no control to move forward on resolving this issue.[22]

Once the circuit became operational, AFGWC almost immediately started to receive the Saudi weather observations. These observations were frequently more timely than those received from deployed AWS weather teams before they had access to the SBLC network. AFGWC also began to retransmit the Saudi observations to the WSF via the AWN. The Saudi government permitted such dissemination of the observations, but still required that they be kept out of WMO channels. Although MEPA sent the observations to AFGWC using only standard International Civil Aviation Organization location identifiers, AFGWC, in order to better protect them from unauthorized customers and/or being inadvertently sent into WMO channels, used KQ identifiers when transmitting them over the AWN. On 27 March 1991 AFGWC, following the example of Saudi Arabia itself, lifted all restrictions on the receipt and dissemination of Saudi weather data.[23]

AFGWC made a significant contribution to the weather support provided by AWS during DESERT SHIELD/STORM. AFGWC personnel felt AFGWC had done well, as did Colonel Frederick, the AWS Vice Commander, who remarked that it had done "an outstanding job." After action reports from other organizations also contained positive comments on AFGWC's role. They called AFGWC's support "timely" and "responsive" and summarized it in such terms as "outstanding" and "excellent." At the same time, however, they also pointed out weaknesses and limitations in AFGWC's products. CENTCOM Weather staff after action reports, for instance, observed that AFGWC's SWO 42 bulletin tended to be too pessimistic, especially in regards to winds and visibilities, and that its products often lacked horizontal consistency.[24]

Irvin, 5WW/IMA, to Col J.E. Sands, Jr, 5WW/CV, "Washington-Jeddah Circuit," 17 Jan 91; msg (U), AFGWC/DO to AWS/DO, et al, "NMC-Jeddah Circuit," 170005Z Jan 91; Waite Intvw (U), p 6; atch 1 (U), point paper, "Washington-Jeddah Circuit," to memo (U), LTC L. Irvin, 5WW/IMA to Col J.E. Sands, Jr, 5WW/CV, "Washington-Jeddah Circuit," 18 Jan 91 [1st memo], w/1 atch; memo (U), LTC L. Irvin, 5WW/IMA, to Col J.E. Sands, Jr, 5WW/CV, "Washington-Jeddah Circuit," 18 Jan 91 [2d memo]; mfr (U), D.G. Caviness, Asst Chief, AFGWC/DO, "NWS/Jeddah Circuit Status," [18 Jan 91].

[22]Millard Intvw (U), pp 6-7; msg (U), 5WW/CAT to USCINCCENT Weather, et al, "Items of Interest 11-19," 200345Z Nov 90; msg (U), AFGWC/DO to AWS/DO, et al, "NMC-Jeddah Circuit," 170005Z Jan 91; Koenemann Intvw (U), p 20; Phillips Intvw (U), p 8; Waite Intvw (U), p 5.

[23]Phillips Intvw (U), p 8; Millard Intvw (U), pp 12-13; Waite Intvw (U), pp 5-8; AFGWC AAR (U); AWS DS/DS Report #2 (S), p 227 (Sec 5.4.2), info used (U); ltr (U), AWS/DO to AFGWC/DO, "Saudi Observation Dissemination," 24 Jan 91; memo (U), unknown to 5WW/CAT, [Dissemination of Saudi Observations,] 25 Jan 91; ltr (U), 5WW/DOX to Det 7, AFGWC/CC, "Release of Saudi Data," 27 Mar 91.

[24]Millard Intvw (U), p 14; Stokes Intvw (U), pp 9-10; Frederick Intvw (U), p 11; AWS DS/DS Report #2 (S), p 113 (Secs 4.2.1.2, 4.2.1.3), info used (U); atch 2 (U), rprt, Maj N.E. Holtgard, USCENTCOM/ASWO, to 1690WGP/CC, "DESERT SHIELD/STORM After Actions Report," 25 Mar 91, hereafter cited as Holtgard DS/DS AAR, and atch 3 (U), rprt, Maj L.L. Moore, USCENTCOM/SWO

Climatology from USAFETAC

To operate in the unfamiliar, harsh environment of the Persian Gulf region, the AWS DESERT SHIELD/STORM WSF needed climatological information. Most weather teams deployed with some published climatological material, but even then, what they had was not sufficient for them to adequately support their customers, particularly in apprising them of the changes in the weather they could expect toward the end of the calendar year. Consequently, within hours of the commencement of the DESERT SHIELD deployment, USAFETAC, AWS's primary purveyor of climatological data, began to receive requests, usually through the 5th Weather Wing, for climatology applicable to the operational theater. USAFETAC (usually referred to simply as ETAC), responded quickly and over the next several months distributed large amounts of relevant climatological data. This data proved to be very useful to the WSF and, passed on to the customers supported, "enhanced operations and affected major strategic decisions."[25]

The climatological information distributed by ETAC consisted of documents published by ETAC or other organizations prior to the beginning of DESERT SHIELD, reports produced and published by ETAC during DESERT SHIELD/STORM, and responses by ETAC to SARs it received from the field during the operation. Most of the climatology used by the WSF came either directly or indirectly from ETAC, but some also came from other sources, both from within and outside of AWS. ETAC provided climatological data not only to the AWS WSF, but also to Headquarters AWS, US National Command Authorities, the Navy, the Marine Corps, and even to Canadian forces deployed to the Persian Gulf.[26]

Fortunately, ETAC already had developed descriptive climatologies covering the Persian Gulf area prior to the onset of DESERT SHIELD. Probably the most important was The Persian Gulf Region: A Climatological Study, originally published in May 1988, when the US Navy was escorting oil tankers transiting the Persian Gulf enroute to and from Kuwait during the Iran-Iraq war. This study became a "best seller" during DESERT SHIELD/STORM. The US Marine Corps alone distributed 10,000 copies to its units. Deployed AWS units used it extensively in teaching forecasters about weather in the operational theater and in briefing their commanders and operational staffs. In October 1988, ETAC had also come out with another extensive climatological document dealing with the Persian Gulf area, "The Persian Gulf Region: A Refractivity Study." In addition, ETAC had, using its mainframe computers, in 1989 begun to build up what it called the Relational Data Base Management System, which enabled its personnel to rapidly access all sorts of climatological information. As a result, during

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Augmentee, to 1690WGP/CV, "After Action Input - DESERT SHIELD/STORM," 23 Mar 91, to CENTCOM Weather Staff AARs (U).

[25]AWS DS/DS Report #2 (S), pp 117 (Sec 4.2.2.1), 119 (Sec 4.2.2.2c), 123 (Sec 4.2.2.3), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with LTC James C. St.John, USAFETAC/CV, 14 Aug 91, hereafter cited as St. John Intvw (U), p 2; Koenemann Intvw (U), p 31; AFGWC AAR (U); tab H (U), hist rprt, USAFETAC, Jul-Dec 90, p 43, to hist rprt (U), AFGWC, Jul-Dec 90.

[26]AWS DS/DS Report #2 (S), pp 118, 120 (Secs 4.2.2.2b-d), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Maj Charles W. Tuttle USAFETAC/ECO, and Mr Kenneth R. Walters, USAFETAC/ECR, 14 Aug 91, hereafter cited as Tuttle/Walters Intvw (U), pp 5-6; tab H (U), hist rprt, USAFETAC, Jul-Dec 90, p 43, to hist rprt (U), AFGWC, Jul-Dec 90; list (U), [USAFETAC/ECR], "[Small Area Study] Distribution List," n.d.

DESERT SHIELD/STORM ETAC could respond to requests for climatology much more quickly than before.[27]

ETAC also published a number of climatological documents during DESERT SHIELD/STORM. Beginning in mid-August 1990, it issued seasonal, small area descriptive climatologies for ten regions within the Persian Gulf theater, as well as point climatologies for specific locations in the theater. In February 1991, it published another comprehensive climatological study, SWANEA (Southwest Asia-Northeast Africa): A Climatological Study, Vol II: The Middle East Peninsula, as a follow-on to the 1988 Persian Gulf study. At the time it was also working on a third volume in the series, but it was not able to issue this until June 1991, well after DESERT STORM was over.[28]

In addition, ETAC responded to at least 23 SARs during DESERT SHIELD/STORM, about half of which originated with either CENTCOM or CENTAF Weather. These asked for such information as diurnal curves of temperature and visibility for Baghdad from September through December; frontal weather for southern Iraq, Kuwait, and northern Saudi Arabia; windroses, temperature, and humidity for Riyadh and Bahrain; and diurnal dewpoint curves for Kuwait City. ETAC was usually able to respond to the requests in less than 72 hours. For a time ETAC also provided radar refractivity climatology products in addition to its 1988 refractivity study. While they were useful in providing understanding of the nature of the refractivity problem, the WSF did not use them a great deal because refractivity never became a major concern during DESERT SHIELD/STORM.[29]

Very early in DESERT SHIELD deployed SWOs requested ETAC to provide electro-optical tactical decision aids (EOTDAs) based on climatology since field units did not have enough data to create their own. Immediately assembling a special team of approximately eight people and a bank of six or seven microcomputers, ETAC inaugurated a crash program to develop the desired EOTDAs. Working every day during the next three weeks, the team, using ETAC target climatology and target data provided by field units, created some 800 EOTDAs covering the months of August through November for 160 different locations in the Persian Gulf theater. ETAC did not go beyond November because by that time units in the field would presumably be able to operate their own EOTDAs. Since the weather in the theater was very stable (hot and sunny) during the August-November period, the climatology-based EOTDAs produced by ETAC were probably about as accurate as any that units in the field would have produced during that timeframe. ETAC EOTDAs covering the December-February time period would not have been as accurate. Creating EOTDAs was as close to direct operational support for DESERT SHIELD that ETAC came. This was probably the first time ever that EOTDAs were, in effect, a centralized product.[30]

On 2 November, AFGWC, responding to instructions from Headquarters AWS, formally tasked ETAC to present a monthly climatology briefing to General Kelly, the AWS Commander. Actually,

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[27]AWS DS/DS Report #2 (S), pp 118-119 (Sec 4.2.2.2b), info used (U); St. John Intvw (U), pp 2,4-6; Tuttle/Walters Intvw (U), pp 2-3.

[28]Tab I (U), hist rprt, USAFETAC, Jan-Jun 91, p 40, to hist rprt (U), AFGWC, Jan-Jun 91; AWS DS/DS Report #2 (S), p 120 (Sec 4.2.2.2-d), info used (U); St. John Intvw (U), pp 9-10.

[29] AWS DS/DS Report #2 (S), pp 118 (Sec 4.2.2.2-b), 120 (Sec 4.2.2.2--d), 122 (Sec 4.2.2.2-e), 141-143 (Atch 19), info used (U).

[30]St. John Intvw (U), pp 2-4; Tuttle/Walters Intvw (U), p 2; AWS DS/DS Report #2 (S), p 121 (Sec 4.2.2.2-d), info used (U); AFGWC AAR (U); tab H (U), hist rprt, USAFETAC, Jul-Dec 90, p 43, to hist rprt (U), AFGWC, Jul-Dec 90.

ETAC had already twice (in August and October) briefed General Kelly on Persian Gulf climatology. But ETAC now began to prepare a comprehensive, detailed package covering synoptic, aviation, electro-optical, and refractivity climatology for each month, beginning with November. It based the information in the packages on the Persian Gulf study, but incorporated data acquired through additional research and tailored more precisely in regards to time and place. ETAC received many requests for the briefing packages. Consequently, it not only briefed each monthly package to General Kelly and his command section, but also mailed copies to CENTCOM Weather and AWS wings as well as to Navy and Army units and agencies--about 45 copies all together.[31]

As might be expected, the many different ETAC climatological products varied in their accuracy. On the whole, its descriptive climatologies were excellent. On the other hand, due to the limited state of the art, ETAC's frontal weather climatology was not accurate enough for Army ground forces to rely on it for operational decisions. ETAC's use of Saudi weather observations based on observing practices different from (and, from the AWS perspective, inferior to and less accurate than) those used by AWS observers in creating its database led to, at least potentially, inaccuracies in its climatological products. Sometimes, too, climatologies from different sources conflicted with each other. In general, however, the ETAC products were very useful and helpful to the deployed WSF and other ETAC customers.[32]

ETAC was not the only source of climatological information for the deployed WSF. For example, the 5th Wing responded to four SARs while AFGWC and Headquarters AWS's Detachment 2 at the Pentagon to one each. At the request of the 5th Wing, the US Navy's Naval Oceanographic Command, through its detachment located at Asheville, North Carolina (close to ETAC's Operating Location A), provided a particularly valuable climatological product, the personal computer version of the Summary of Meteorological Observations, Surface. Placed on approximately 75 diskettes, each of which contained observations for a number of specific stations, this summary proved to be very useful for CENTCOM Weather, the DSFU, and ARCENT Weather. Other organizations supplying climatology included the Computer Flight Plans Section at AFGWC, the climatology branches at the 2d, 5th and 7th Weather Wings, and the National Oceanic and Atmospheric Administration (NOAA).[33]

Imagery from Meteorological Satellites

Meteorological satellites orbiting the earth over Southwest Asia provided vital weather information for the deployed WSF, indeed, satellite imagery was probably its single most important source of meteorological data. To put it differently, satellite imagery was an "absolutely essential," "indispensable tool" for providing weather support to DESERT SHIELD/STORM. During most of the

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[31]Msg (U), AFGWC/CAT to USAFETAC/DO, "DESERT SHIELD Climo Briefing," 022000Z Nov 90; msg (U), AWS/CAT to AFGWC/CAT, "DESERT SHIELD Climatology," 312135Z Oct 90; Tuttle/Walters Intvw (U), pp 7-9; AWS DS/DS Report #2 (S), p 120 (Sec 4.2.2.2-c), info used (U); St. John Intvw (U), pp 5,9; AFGWC AAR (U).

[32]AWS DS/DS Report #2 (S), pp 117-118 (Sec. 4.2.2.2-a), 121 (Sec 4.2.2.2-e), 123-124 (Secs 4.2.2.3, 4.2.2.4), info used (U); note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, [Accuracy of Climatologies Based on Saudi Data,] 1 Jul 92.

[33]AWS DS/DS Report #2 (S), pp 118-120 (Sec 4.2.2.2-b,c,d), 122 (Sec 4.2.2.2-e), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with LTC Kenneth A. Peterson, 5WW/DN, 6 Jun 91, pp 5-6.

operation, the WSF used two satellite data receiving systems to acquire satellite imagery: a DMSP tactical terminal located in a Mark IV readout van, and small, portable, Wraase tactical terminals possessed by every Army support weather team. During DESERT STORM AWS deployed a new small satellite tactical terminal to the theater, the Rapid Deployment Imagery Terminal (RDIT). The DMSP van was able to receive data from European Meteorological Satellites (METEOSATs) and US NOAA civilian weather satellites as well as from DMSP military weather satellites. However, the Wraase could receive data only from the civilian satellites, the RDIT only from the DMSP satellites. The DMSP van used the TIDS at the DSFU to distribute satellite imagery to in-theater weather units.[34]

Deployment of Mark IV DMSP Van

If the WSF was to have direct access to DMSP satellite imagery, it had to have a Mark IV van close at hand, i.e., located in or near its headquarters units in Riyadh. This was easier said than done. AWS war plans, e.g., the 5th Wing's O2-FY plan, called for deployment of the van approximately three weeks after the commencement of a contingency operation, meaning, in this case, about 28 August. General Kelly, the AWS Commander, placed high emphasis on getting a van--specifically the Air Force-owned van at MacDill AFB dedicated to CENTCOM use--deployed according to plan so the WSF would have this vital resource quickly. However, for various reasons, AWS ran into problems. For one thing, the rapidly expanding DESERT SHIELD deployment placed huge demands on airlift and the van was big, bulky, and heavy. Weighing 14.8 short tons, and 25 feet long, 6 feet wide, and 8 feet high, the van, including its generator trailer, required three quarters of a C-141 aircraft for airlift. Besides, plans or no, the van had a relatively low priority. Any higher priority was hard to come by because CENTCOM at first saw little or no urgency in deploying it since the weather support in the theater was the same, i.e, sunny and hot, every day. Consequently, AWS had to work hard to get the van deployed as quickly as it wanted.[35]

Fortunately, AWS was able to obtain the support of Major General Olsen, the CENTAF Forward Commander, for the van's early deployment. On 16 August Colonel Goldey (then still at MacDill), in his capacity as the CINCCENT SWO, talked to General Burton Moore, Director of Operations for CENTCOM, about deploying the van, but with no success. When Colonel Goldey admitted that the weather in the theater would not change until around mid-October at the earliest, the general told him to come back again in late September. On 17 August General Kelly requested the USCINCCENT CAT at MacDill to expedite the deployment of the van. CENTCOM Operations replied the following day that the van would not deploy. However, by this time AWS recognized that the most effective way to get something to happen was to have it "pulled" from the theater rather than "pushed" from the US, in other words, what was needed was for a high ranking officer in the field to state a requirement for the van. Indeed, on the same day Colonel Goldey made his pitch to General Moore, Headquarters AWS instructed Colonel Riley in Riyadh to try to persuade CENTAF Forward and ARCENT to request the van. Colonel Riley made the attempt and, 3 days later, 19 August, General Olsen sent word to General Kelly

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[34]AWS DS/DS Report #2 (S), p 159 (Sec 4.5.1), info used (U); atch 2 (U), Holtgard DS/DS AAR (U), to USCENTCOM Weather Staff AARs (U); memo (U), LTC R.E. Townsend, AFGWC/WF to AFGWC/DOO, "Lessons Learned--DESERT STORM/SHIELD," 21 Mar 91.

[35]AWS DS/DS Report #2 (S), p 159 (Sec 4.5.2-b(1), info used (U); LTC R.R. Wall in AWTB Intvw (U), pp 11-12; Goldey Intvw (U), pp 3-4, 28; Koenemann Intvw (U), pp 12; notes on info sheet (U), n.a., [Manpower Force Element Listing,] 20 Dec 89.

that he believed the time had come when "it would be prudent" to deploy a DMSP terminal to DESERT SHIELD.[36]

Armed with the CENTAF Forward Commander's support, AWS was now able to get the van deployed in less than 2 weeks. General Kelly quickly forwarded General Olsen's stated requirement for the van to the USCINCCENT CAT and requested its assistance in seeing that the van received the "highest priority." On 21 August, CENTCOM Operations promised the AWS Commander it would "work to provide lift" for the van "as priorities allowed." Meanwhile, General Kelly persuaded General Johnson, CINCMAC, to advocate raising the priority of the van deployment. Two days later TAC entered the van into the TPFDD and the next day, 24 August, CENTAF Rear at Langley AFB validated airlift. The van departed MacDill aboard a MAC C-141 on 29 August and arrived in Riyadh late on the 30th. It arrived in the theater only a couple of days later than called for by operational plans.[37]

Once the van arrived, Colonels Goldey and Riley immediately set to work to get it operational. The first step was to decide where to locate it. They wanted it in Riyadh, preferably at or near the DSFU at CENTAF Weather. However, this was not feasible from a reception standpoint because CENTAF Weather was located in an urban area surrounded by high rise buildings. Consequently, they selected, as their second choice, one of three alternative sites on Riyadh AB suggested by the Saudi base commander. It was not an ideal location because the distance between the van and the DSFU, approximately five miles, would have its costs in terms of data timeliness. On 1 September the WSF leaders formally asked the Saudi base commander for permission to position the van at the site they had selected. The required permission came late the next day. Workers now unpacked and set up the van. It became operational at 2107 local time, 3 September, approximately 3 days after it arrived in Riyadh.[38]

On two occasions AWS considered deploying a second DMSP van (there were nine) to Saudi Arabia as a backup. The first time was in early October. However, CENTCOM Weather counseled against it on the grounds that, first, CENTCOM and CENTAF would not agree to such a proposal

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[36]Goldey Intvw (U), pp 3-4; Koenemann Intvw (U), p 12; SATCOM conversation (S), HQ AWS and LTC G.F. Riley, CENTAF/SWO, [Miscellaneous Items,] 16 Aug 90, info used (U); msg (S), 1WS/LN to 5WW/CC, et al, "DESERT SHIELD DMSP Concerns (U)," 272105Z Sep 90, info used (U); msg (U), AWS/CC to USCINCCENT/CAT, et al, "Request for AN/TMQ-35 Defense Meteorological Satellite Program Direct Readout Terminal (U)," 170020Z Sep 90; msg (S), COMUSCENTAF FWD/CC to AWS/CC, et al, "Meteorological Satellite Imagery for Operation DESERT SHIELD," 191230Z Aug 90, info used (U).

[37]Msg (S), 1WS/LN to 5WW/CC, et al, "DESERT SHIELD DMSP Concerns (U)," 272105Z Sep 90, info used (U); msg (S), AWS/CC to USCINCCENT/J3, et al, "Meteorological Satellite Imagery for Operation DESERT SHIELD (U)," 201800Z Aug 90, info used (U); msg (S), USCINCCENT/CCJ3 to AWS/CC, et al, "Meteorological Satellite Imagery for Operation DESERT SHIELD (U)," 211510Z Aug 90, info used (U); msg (S), AWS/CAT to 4WW/CAT, "Information on DMSP Van (U)," 112214Z Oct 90, info used (U); annex A (S), atch 1, p 1-20, to hist rprt (U), 4WW, Jul-Dec 90, info used (U); msg (S), USCINCCENT/Weather to 5WW/CC, et al, "DESERT SHIELD DMSP Concerns (U)," 010107Z Oct 90, info used (U); St. Onge Intvw (U), p 19.

[38]AWS DS/DS Report #2 (S), pp 159 (Sec 4.5.2-a(2)), 169 (Sec 4.5.4), info used (U); CENTAF SWO AAR (U), Sec C-1; msg (S), USCINCCENT/Weather to 5WW/CC, et al, "DESERT SHIELD DMSP Concerns (U)," 010107Z Oct 90 (U), info used (U); msg (S), AWS/CAT to 4WW/CAT, "Information on DMSP Van (U)," 112214Z Oct 90, info used (U).

because neither planned to establish any backup communication capabilities and second, CENTCOM had imposed a personnel ceiling for the theater. CENTCOM Weather suggested that AWS, as an alternative, continue its initiative to procure a small, tactical satellite receiver and use a Wraase satellite receiver as an interim backup. Consequently, AWS dismissed the idea for the time being and instead positioned a Wraase at Taif, the site planned for an alternate DSFU and an alternate CENTAF headquarters, if CENTAF established one. AWS also made plans to put a RDIT tactical receiver at Taif when one became available. In late December, as war in the Persian Gulf began to appear imminent and the possibility of losing the van at Riyadh became more real, AWS once more discussed the deployment of a second van, but again dropped the idea for the same reasons as it had in October.[39]

When DESERT STORM began in mid-January, TAC, at the request of CENTAF, directed AWS to source the DMSP van at Eglin AFB as an "attrition reserve asset" to replace the Riyadh van in the event it was destroyed or became inoperational for some other reason and to prepare it to deploy on 72 hours' notice. Responding quickly to the TAC directive, by 22 January Headquarters AWS had the Eglin van ready for immediate deployment. The Riyadh van, however, continued operating without a hitch through the end of DESERT STORM and AWS never deployed a second DMSP van.[40]

Disseminating Satellite Data

For the DESERT SHIELD WSF to receive satellite imagery, the deployment of the DMSP van was not sufficient. The next step was to disseminate the imagery received by the van to the weather units in the DESERT SHIELD operational theater. A deployed DMSP van used the TIDS to distribute satellite imagery to weather units deployed in the operational theater. Under the DMSP van deployment concept, each van deployed with four Harris 850 Laserfax receivers (the standard number for all AWS DMSP vans) which it would distribute to deployed CENTAF support weather units to enable them to receive satellite data. The vans, therefore, were able initially to disseminate satellite imagery to only four weather units.[41]

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[39]Msg (S), AWS/CAT to HQ AFSC/SCS, et al, "Initial Request for DMSP Van Support (U)," 032015Z Oct 90, info used (U); msg (S), 5WW/CAT to USCENTCOM/Weather, et al, "Second DMSP Van (U)," 040209Z Oct 90, info used (U); msg (S), AWS/CAT to 4WW/DO, "Initial Request for DMSP Van Support (U)," 042045Z Oct 90, info used (U); msg (U), AWS/CAT to 5WW/CAT, "Action Item Update (6 Oct 90)," 070230Z Oct 90; Riley Intvw (S), pp 29-30, info used (U); msg (S), USCINCCENT/Weather to 5WW/CAT, et al, "Backup METSAT Capability (U)," 121432Z Oct 90, info used (U); note on msg (S), AWS/CAT to 4WW/CC, et al, "DMSP Van Deployment (U)," 141300Z Oct 90, info used (U); msg (S), AWS/CAT to 2049CCSG/SCLK, et al, "DMSP Van Deployment Status (U)," 152300Z Oct 90, info used (U); msg (S), 5WW/CAT to 4WW/CAT, "Second DMSP Mk IV Van for DESERT SHIELD (U)," 211321Z Dec 90, info used (U); AWS DS/DS Report #2 (S), p 163 (Sec 4.5.2-a(12)), info used (U).

[40]Msg (S), USCENTAF/SCX to HQ TAC/SCO, "Request for Weather Radar [sic] (U)," 111335Z Jan 91, info used (U); msg (S), 5WW CAT to AWS/CAT, et al, "Mark IV Attrition Reserve (U)," 161248Z Jan 91, info used (U); msg (S), AWS/CAT to AFLC/SCS, et al, "Request for DMSP Van (U)," 171930Z Jan 91, info used (U); msg (S), HQ AFLC/SC to AWS/CAT, et al, "Request for DMSP Van (U)," 181906Z Jan 91, info used (U); msg (U), 1972CG/LG to HQ AFSC/WE, et al, "DMSP Van Status," 221458Z Jan 91.

[41]AWS DS/DS Report #2 (S), p 160 (Sec 4.5.2-a(3)(5)), info used (U); St. Onge Intvw (U), p 20.

In DESERT SHIELD there were many more than four deployed weather units requiring satellite imagery by the time the DMSP van arrived in theater, therefore, the four Harris 850 receivers with which it came were totally insufficient to meet the demand. The 5th Wing immediately took action to collect and send out an additional 13 Harris 850 receivers available from other DMSP Mark IV vans. However, this was still not sufficient; on 29 September, CENTAF Weather indicated it required seven more. By this time AWS had determined that the Alden 9315TRT-R could serve as a substitute for the Harris 850, provided operators used a special plastic base paper for receiving the imagery. Consequently, to overcome the shortage of Harris 850s, in subsequent weeks it purchased and shipped to the theater a number of additional 9315TRT-Rs as well as a quantity of the special paper. Eventually the DESERT SHIELD/STORM TIDS expanded into a network of 28 locations.[42]

Unfortunately, the WSF had problems in sending and receiving satellite imagery, due in part to the large size of the TIDS network, both in the number of stations and area covered--much larger than ever envisioned in the TIDS concept. The TIDS experienced considerable signal degradation because the DSFU had to convert the TIDS signal from analog to digital for transmission over tactical communication lines, and receiving units had to convert it back to analog in order for the Harris 850s to receive it. The large number of weather units needing the satellite imagery and the considerable distance of many units from the DSFU necessitated multiple conversions in some instances. As a result, TIDS reception was, at best, only fair and frequently poor at many of the deployed weather units, especially those farthest away. The Harris 850s were not able to receive data over a noisy circuit as well as the 9315TRT-Rs; consequently, units with the 9315s were able to receive somewhat better satellite imagery than those with Harris 850s. Some of the units with the 850s, therefore, resorted to the TACFAX circuit to receive satellite imagery (the DSFU sent some imagery from the geostationary METEOSATs during TACFAX transmissions).[43]

Additional problems resulted from separating the TIDS transmitter from the DMSP van. In concept, deployed DMSP vans would transmit satellite imagery directly to weather units in the field. In DESERT SHIELD, communications technicians at the deployed van initially used a microwave link to send imagery to the USAF Technical Control Unit in the theater which, in turn, broke it up and transmitted it to the various locations needing the data. However, using the microwave link required an analog-digital-analog conversion, and, therefore, further degraded the signal. Consequently, Colonels Goldey and Riley decided to move the TIDS transmitter from the van to the DSFU at CENTAF Weather. The DSFU would then send the imagery over land line to Technical Control which would, as before, transmit it to the weather teams scattered about the theater. This worked somewhat better, but it also caused new problems. For one thing it entailed hand delivery of satellite imagery hard copy from the van to the DSFU five miles away, which created a lot more work, was time consuming, and, most importantly, significantly increased the time it took to get imagery ready for transmission to the field. In addition, it resulted in the TIDS having to share, as previously noted,[44] a circuit with

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[42]AWS DS/DS Report #2 (S), pp 6 (Sec 2.2.2-b), 160 (Sec 4.5.2-a(5)), info used (U); St. Onge Intvw (U), pp 20-21; msg (S), 5WW/CAT to AWS/CAT, "Additional TIDS Requirements (U)," 290651Z Sep 90, info used (U); memo (U), LTC T.P. Walters, HQ AWS/APM, to [HQ AWS/] CAT, "CAT Tasker #8 (Additional TIDS Terminals)," n.d. [ca 1 Oct 90]; 5WW DESERT SHIELD Chronology (S), p 9-2, info used (U); Riley Intvw (S), pp 27-28, info used (U).

[43]AWS DS/DS Report #2 (S), pp 160-161 (Sec 4.5.2-a(6)), 168-169 (Sec 4.5.4), 209 (Sec 5.1.3.2-b), info used (U); CENTAF SWO AAR (U), Sec C-2; Riley Intvw (S), p 28, info used (U); msg (S), AWS/CAT to 5WW/CAT, et al, "AWS Review of TIDS Operations in DS (U)," 161715Z Nov 90, info used (U); note (U), Col G.F. Riley, AWS/DOT, to W.E. Nawyn, AWS/HO, 1 Jul 92.

[44]See above, Chapter III, p 69.

TACFAX (following an around-the-clock schedule of 2 hours TIDS-4 hours TACFAX), which delayed the transmission of satellite imagery even more.[45]

The DMSP Mark IV van itself performed well throughout DESERT SHIELD/STORM. This was due, in no small part, to the skill and hard work of the operator/maintenance team provided by AFCC. The van compiled an overall 98 percent uptime rate and generated over 8,600 products during the course of the operation. The Mark IV obtained data from the two METEOSAT and three NOAA as well as the DMSP F8 and F9 (and F10 after its launch, at the request of AWS, in early December) satellites. It could not, however, process data from more than one satellite at a time. It relied most heavily on the DMSP and NOAA N11 satellites, mostly because they were available at optimum times for preparing briefings and supporting the DSFU. The DMSP satellites provided high quality, high resolution imagery. High resolution enabled depiction of greater detail. Unfortunately, the van could get data from the DMSP satellites only 6 hours per day, three in the morning and three in the evening. Consequently, the DMSP refresh rate was slow, making "looping" of the data impractical. The METEOSATs, on the other hand, had a very quick refresh rate of 30 minutes but provided only low resolution imagery.[46]

The imagery provided by the DMSP van, particularly the high resolution DMSP data, was of great value to DESERT STORM decisionmakers. The high resolution DMSP and NOAA imagery was especially useful for air strike target planning, assisting Air Force commanders in choosing original targets, and, when necessary, redirecting aircraft to targets with more favorable weather. Satellite imagery provided terrain information useful to Army commanders. It also showed the smoke from oil fires started by Iraq and thereby helped commanders to determine when the fires were set, which wells were on fire, what area was covered by smoke, and the direction the smoke was drifting. In short, it provided data crucial to the success of the operation.[47]

Wraase Tactical Satellite Receiver

In view of the problems it experienced in getting the DMSP van deployed and, once this occurred, in getting the TIDS to work effectively, AWS intensified efforts already under way to introduce an alternative way to disseminate satellite imagery to the deployed weather units supporting CENTAF. Specifically, it sought to give them the capability to receive imagery directly from orbiting satellites. This would reduce the need for TIDS. Most weather units supporting Army operations

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[45]AWS DS/DS Report #2 (S), pp 160-16l (Sec 4.5.2-a(6)), 208 (Sec 5.1.3.2-a), info used (U); atch 6 (U), rprt, SSgt T.D. Taylor, 1690WGP/METSAT Coordinator, to 1690WGP/CC, "AAR Meteorological Satellite Coordinator," 23 Mar 91, to CENTCOM Weather Staff AARs (U); CENTAF SWO AAR (U).

[46]AWS DS/DS Report #2 (S), pp 159-160, 162, 164 (Sec 4.5.2-a(3)(11)(14)(15)), info used (U); point paper (U), HQ AWS/DOOF, "Defense Meteorological Satellite Program Van Capabilities," 6 Sep 90; Frederick Intvw (U), pp 7-8; Riley Intvw (S), pp 26-27, info used (U); St.Onge Intvw (U), pp 19-20. For greater detail on DMSP van operations, see atch 6 (U), rprt, SSgt T.D. Taylor, 1690WGP/METSAT Coordinator, to 1690WGP/CC, "AAR Meteorological Satellite Coordinator," 23 Mar 91, to CENTCOM Weather Staff AARs (U).

[47]AWS DS/DS Report #2 (S), pp 161-162 (Sec 4.5.2-a(7)), info used (U); Goldey Intvw (U), p 26, info used (U); Weaving Intvw (U), p 12; point paper (U), HQ AWS/XTRR/DOOF, "Environmental Satellite Support to DESERT STORM--Lessons Learned," 5 Mar 91.

already had this capability. Each Army corps and division-level weather team deployed with a Wraase tactical satellite receiver as part of its Goldwing tactical communications system. They, therefore, did not depend upon the DMSP van for their satellite imagery and, hence, were not tied into the TIDS network. The Wraase included a solid-state, battery-powered receiver, two video display monitors, a printer, a parabolic dish antenna, and an omnidirectional VHF antenna with a telescopic mast. The system was very mobile and weather teams could set it up and have it receiving data in as little as 20 minutes.[48]

The Wraase could intercept data from both METEOSAT and NOAA satellites (as well as Soviet satellites), and had a looping capability. Army weather teams looked primarily to the METEOSATs for their satellite data. The METEOSATs refreshed their data every half hour, making it virtually real time and allowing the teams to loop the imagery. The Wraase could not, however, receive the encrypted, higher resolution DMSP imagery. This posed a potential problem should the civilian satellite data become unavailable. Also, the system lacked a backup or rechargeable battery to store a loop when the weather team's customer "jumped" to another location. However, the Wraase's mobility, ruggedness, reliability, timeliness, and looping capability more than compensated for these relatively minor shortcomings.[49]

In December the Army Space Command distributed new Wraase software and larger printers to a number of deployed Army weather teams using the systems. Early in 1991 AWS was able to acquire Wraases for ARCENT Weather and two Air Force locations, the DSFU at Riyadh and the proposed alternate DSFU at Taif. When DESERT STORM ended, AWS was trying to procure an additional ten Wraases to use in support of the operation, and the Army's FORSCOM was attempting to acquire them for Army aviation brigade weather teams.[50]

The Wraase proved to be one of the most useful and reliable pieces of meteorological equipment in the DESERT SHIELD/STORM theater. Users of the system extolled its virtues and many praised its performance. Some called it the best piece of equipment in the AWS inventory. They lauded its dependability and reported that it seldom, if ever, broke down.[51]

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[48]AWS DS/DS Report #2 (S), p 164 (Sec 4.5.2-b), info used (U); Weaving Intvw (U), pp 9-10; ARCENT SWO AAR (U), p 30 (Sec III-5); atch 2 (U), "Wraase Description," to memo (U), LTC R.R. Wall, AWS/ADO, to AWS/XT, "Purchase of Tactical Communications Equipment," 17 Jan 91, w/2 atchs.

[49]AWS DS/DS Report #2 (S), p 164 (Sec 4,5,2-b), info used (U); Weaving Intvw (U), pp 9-10; St.Onge Intvw (U), pp 21-23; Boyle Intvw pp 9-11.

[50]AWS DS/DS Report #2 (S), pp 164-165 (Sec 4.5.2-b), info used (U); background paper (U), "USSPACECOM and USARSPACE Visits to DESERT SHIELD AOR," 4 Dec 90; [AWS/] CAT Tasker #15 (U), "QRCT/WRAASE Purchase," 17 Jan 91, w/2 atchs; memo (U), LTC R.R. Wall, AWS/ADO, to AWS/XT, "Purchase of Tactical Communications Equipment," 17 Jan 91, w/2 atchs; memo (U), Col J.W. Overall, AWS/XT, to AF/XOOSA, "Potential DESERT SHIELD Requirements," 17 Jan 91.

[51]AWS DS/DS Report #2 (S), p 164 (Sec 4.5.2-b), info used (U); ARCENT SWO AAR (U), pp 30 (Sec III-5), 56-57 (Sec VII-1v); Campbell Intvw (U), p 17-18; Boyle Intvw (U), pp 9-10; Capt M.H. McDonald in intvw (C), W.E. Nawyn, AWS/HO, with Capt Michael H. McDonald, 101st AAD/SWO (and Det 1, 5WS/CC) and Capt. William J. Spendley, 5SFG SOWT/OIC (and Det 1, 5WS), 17 Jul 91, hereafter cited as McDonald/Spendley Intvw (C), p 38, info used (U); Bridges/Bullard Intvw (U), pp 12-13.

The Wraase, however, was not available to Air Force weather teams, at least for the moment. Consequently, in early September, AWS took a new look at a program it had initiated in November 1988 to procure a small tactical DMSP terminal for the use of Air Force support weather units in the field. Unfortunately, under this program the new terminals were not scheduled to be fielded until 1992. AWS, therefore, in conjunction with the DMSP Systems Program Office (SPO) of Air Force Systems Command's (AFSC) Space Science Division, began to explore the possibility of acquiring some type of an interim system. On 12 September it formally asked the DMSP SPO, which was the manager of the small tactical terminal program, as well as of the overall DMSP program, to accelerate the acquisition of the terminal to make it available for use in January 1991 or suggest alternatives that would provide a similar capability at about the same time.[52]

The SPO informed AWS on 20 September that it could acquire a small tactical terminal with less capability and greater size than the existing program called for within 16 weeks, but could also field a non-ruggedized, real-time data system with essentially the same capability in the same amount of time and at approximately the same cost by using existing "off-the-shelf" technology. It also suggested two other possible alternatives. On 25 and 26 September, representatives of AWS and the DMSP SPO met together to discuss the options laid on the table by the SPO and the capabilities required for an interim small terminal. On 27 September AWS decided in favor of the real-time data, off-the-shelf interim system or, as it came to be called, the Rapid Deployment Imagery Terminal (RDIT).[53]

The program for the interim small tactical terminal moved forward rapidly. At the request of AWS, General Johnson, CINCMAC, asked General Ronald W. Yates, the Commander of AFSC, to acquire the interim system under his recently inaugurated HIGH GEAR program, which was intended to meet high priority needs of AFSC customers quickly and economically. On 1 October AFSC informed the Air Force Program Executive Officer in Washington DC that it wanted to designate the RDIT program a HIGH GEAR project and requested his concurrence. He agreed to the AFSC proposal two weeks later (15 October) and announced that it had appointed a special team to manage the effort. The same day General Yates assured General Johnson that he would give the program his personal attention. On 30 October, responding to a request from AWS, the Director of Operations at CENTAF validated the need for a small tactical satellite receiver in the DESERT SHIELD theater. On 16 November the DMSP SPO awarded contracts to two vendors--the Harris and Sea Space Corporations--for the production of a prototype RDIT for delivery in January 1991. The two prototypes

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[52]AWS DS/DS Report #2 (S), p 7 (Sec 2.1.2-g), info used (U); point paper (U), HQ AWS/XTRR, "DMSP Tactical Terminal Status and Plans," 10 Sep 90; msg (U), HQ AWS/XT to SSD/MW, et al, "Request for Improved DMSP Tactical Terminals," 121900Z Sep 90; SSS (U), AWS/XTRR, "Defense Meteorological Satellite Program Transportable Terminals," 14 Sep 90.

[53]AWS DS/DS Report #2 (S), p 165 (Sec 4.5.2-c), info used (U); msg (U), SSD/MW to HQ AWS/XT, et al, "Request for Improved DMSP Tactical Terminals," 202315Z Sep 90; "PMT History, 1 Jul-31 Dec 90," in hist input, HQ AWS/PM (U), Jul-Dec 90; "XTR History, 1 Jul-31 Dec 90," in hist input (U), HQ AWS/XT, Jul-Dec 90; mfr (U), Maj F.P. Kelly, SSD/MWS/Weather Liaison Officer, "Rapid Deployment Imagery Terminal Considerations," 27 Sep 90; msg (U), HQ AWS/XT to SSD/MW, et al, "Request for Improved DMSP Tactical Terminals," 272100Z Sep 90.

would compete for the production contract. The DMSP SPO provided funding for the program. AWS issued a concept of operations for the RDIT on 28 November.[54]

Both corporations had their RDIT prototypes ready by the end of January. The Qualification Operational Test and Evaluation took place from 4 through 7 February at the US Army's Atmospheric Sciences Laboratory at the White Sands Missile Range in New Mexico. Both systems passed the test, but on 15 February the selection authorities, on the basis of superior deployability and supportability, awarded Harris the contract for an additional five systems at a cost of $1.66 million each.[56]

The Harris RDIT was partially ruggedized and was housed in 12 containers having a total weight in excess of 1,500 pounds, but only one of the containers weighed more than 110 pounds. It required a two and one-half ton truck to transport the system on land. It was, therefore, still bulky. The system came with one spare and 16 line-item replacement units. Operationally, it had a worldwide satellite tracking display capability and could store data from up to eight satellite passes. It could, however, receive only DMSP data and produce only paper printouts (i.e, no transparencies).[56]

Inasmuch as both prototypes had performed successfully during testing, AWS decided to deploy both to the Persian Gulf as soon as possible--the Harris system to SOCCENT at King Fahd AB, and the Sea Space unit to ARCENT Weather at Riyadh. It also selected CENTCOM, the DSFU, the alternate DSFU, VII Corps, and Kuwait as the sites for the five production RDITS. The Harris prototype arrived at SOCCENT Weather on 20 February, one week before the end of hostilities. It proved to be the only RDIT to see any service during DESERT STORM. The Sea Space system reached ARCENT on 7 March, about a week after the war ended; the production systems did not become available until

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[54]AWS DS/DS Report #2 (S), pp 7 (Sec 2.1.2), 165-166 (Sec 4.5.2-c), info used (U); SSS (U), AWS/XTRR, "Defense Meteorological Satellite Program Transportable Terminals," 14 Sep 90; ltr (U), Gen H.T. Johnson, CINCMAC, to Gen R.W. Yates, Comdr, AFSC, [Fielding Rapidly Deployable Satellite Receiver,] 20 Sep 90; msg (U), HQ AFSC/XR to AFPEO/SP, et al, "HIGH GEAR Designation for Lightweight DMSP Terminal," 011710Z Oct 90; msg (U), AFPEO/SP to HQ AFSC/XR, et al, "HIGH GEAR Designation for Lightweight DMSP Terminal," 151500Z Oct 90; ltr (U), Gen R.W. Yates, Comdr, AFSC, to Gen H.T. Johnson, CINCMAC, [Support for MAC Acquisition Projects,] 15 Oct 90; msg (U), HQ AWS/CXAT to USCENTAF/WE, et al, "Interim Small Tactical Terminal Capability," 171751Z Oct 90; msg (U), USCENTAF/DO to HQ MAC/XRA, et al, "Validation of Rapid Deployable Imagery Terminal," 300400Z Oct 90; PMD 3015 (U), SAF/AQSS, "Program Management Directive for the Defense Meteorological Satellite Program," 14 Nov 90; "PMT History, 1 Jul-31 Dec 90," in hist input (U), HQ AWS/PM, Jul-Dec 90; "XTR History, 1 Jul-31 Dec 90," in hist input (U), HQ AWS/XT, Jul-Dec 90; brfg slides (U), HQ SSD/MWS, "DMSP HIGH GEAR Kickoff Briefing on the RDIT," 21 Nov 90; CONOPS (U), AWS, "Concept of Operations for Rapid Deployment Imagery Terminal," 28 Nov 90.

[56]Memo (U), 2Lt W.L. Strickland, AWS/PMT, to Dir, PMT, et al, "Executive Summary: Rapid Deployment Imagery Terminal Qualification Operational Test and Evaluation," 11 Feb 91; brfg slides (U), AWS/PMT, "RDIT Production Decision Recommendation," 15 Feb 91; point paper (U), AWS/PMA, "Rapid Deployment Imagery Terminal," 19 Mar 91. The final report on the RDIT QOT&E is found in msg (U), USAFALCENT/CC to HQ MAC/XRT, et al, "MAC Project 4-42-90, Qualification Operational Test and Evaluation of the Rapid Deployment Imagery Terminal, Final Report," 201700Z Mar 91.

[56]Brfg slides (U), AWS/PMT, "RDIT Production Decision Recommendation," 15 Feb 91; brfg slides (U), [AWS/PMT], "RDIT Capabilities," [post 15 Feb 91].

later. SOCCENT Weather subsequently reported that, based on the very limited period it used the system, it had found the RDIT, overall, to be an excellent piece of equipment.[57]

Assistance in Producing Electro-Optical Tactical Decision Aids

The performance of electro-optical weapons systems is greatly affected by atmospheric conditions. EOTDAs are computerized models used primarily to predict, on the basis of environmental and target information, the performance of visual, infrared, and laser air-to-ground electro-optical weapons systems. They can be used to support specific systems or provide information about general atmospheric conditions that affect certain types of electro-optical weapons. AWS produced EOTDAs as a means of providing assistance to mission planners and decisionmakers in selecting, for example, the type of weapons to load on aircraft and what operational tactics to employ.[58]

All DESERT SHIELD/STORM WSF units having forecasters had the capability to prepare EOTDAs for their customers. However, only six Air Force weather support units in the theater actually had a unit-level EOTDA support mission. In addition, the DSFU provided EOTDA support to the Tactical Air Control Center (TACC). Five Army weather support teams provided EOTDA support to Army combat aviation brigades with AH-64 Apache helicopters. Two other teams briefed EOTDAs to their customers for planning purposes.[59]

In the first few weeks of DESERT SHIELD, AFGWC and USAFETAC provided EOTDA support to the deployed WSF. AFGWC issued a special EOTDA bulletin for the theater. ETAC, as explained earlier,[60] initiated a crash program to quickly develop a large number of climatology-based EOTDAs which the deployed weather teams could use to support their customers. The DSFU transmitted its own EOTDA product, the "General E-O Forecast," for the first time on 5 September.[61]

On 14 September General Horner, the CENTAF Commander, specifically affirmed that CENTAF needed EOTDA support. Nevertheless, the demand for EOTDAs from CENTAF units during DESERT

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[57]AWS DS/DS Report #2 (S), p 166 (Sec 4.5.2-c), info used (U); brfg slide (S), [AWS/CAT], "RDIT Sites," 26 Feb 91; point paper (U), AWS/PMA, "Rapid Deployment Imagery Terminal," 19 Mar 91; msg (S), USCINCCENT Weather to 5WW/CAT, et al, "WSF SITREP 178 (U)," 200651Z Feb 91, info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "WSF SITREP 193 (U)," 070816Z Mar 91, info used (U); SOCCENT SWO AAR (U), p 3.

[58]AWS DS/DS Report #2 (S), p 144 (Secs 4.3, 4.3.1), info used (U); info sheet (U), [AWS/XTA], "EOTDA Stuff," n.d. [ca Apr 91].

[59]AWS DS/DS Report #2 (S), pp 144-145 (Sec 4.3.1.2-a), info used (U); ARCENT SWO AAR (U), Atch 1-6.

[60]See above, this chapter, p 82.

[61]AWS DS/DS Report #2 (S), pp 144 (Secs 4.3.1.1, 4.3.1.2), 147-149 (Sec 4.3.1.2-c,d), info used (U); msg (S), 5WW CAT to AWS/CAT, et al, "5WW SITREP Nbr 29/Operation DESERT SHIELD (U)," 051658Z Sep 90, info used (U); rprt (FOUO), Capts K.F. Havener and S. Funk, HQ AWS/XTA, "The Utility of Electro-Optical Tactical Decision Aids," 10 Sep 91, p 4, info used (U).

STORM was far less than anticipated. With 2,000 or more sorties per day planned, and ten percent using electro-optical weapons, AWS expected to be swamped with requests for EOTDAs. However, this did not materialize because American and coalition air forces destroyed the Iraqi command and control capability and immobilized the Iraqi fighter defense system in a few days. Since the nature of the enemy threat determines tactics, and the nature of the Iraqi threat had altered dramatically, Air Force tactics shifted to primarily mid- and high-level bombing runs at or above 10,000 feet. The change in tactics reduced the need for EOTDAs. The main weather criteria affecting mission "go or no-go" decisions and of concern to pilots now came to be the presence or absence of cloud cover and the height of ceilings--specifically whether the ceilings were over or below 10,000 feet--over targets. Conventional weather support could provide this data. Therefore, for the remainder of DESERT STORM, the Air Force used EOTDAs mostly for "situational awareness"--i.e., providing pilots with information as to how aircraft sensors would perform in target areas so they would not be surprised--rather than for mission planning and tactical decision-making.[62]

Deficiencies in EOTDA software caused problems for deployed weather units producing EOTDAs. During most of DESERT SHIELD the weather units used computer model Mark III Version 1.1 software developed by the Air Force's Geophysics Laboratory to produce EOTDAs while they awaited the arrival of Version 2.0, which was undergoing testing. By late October AWS units in the theater suspected there was something in the EOTDA software causing inaccurate EOTDAs. Study and tests confirmed that the software did indeed have deficiencies. One of the deficiencies involved sand background models. Version 1.1 software incorporated a standard sand background using the characteristics of Florida beach sand found near Eglin AFB. It turned out that the Florida sand had a much lower reflectivity than the Saudi sand. Another part of the problem was that the software models were based on green-colored tanks instead of the tan-colored tanks employed in the Persian Gulf theater.[63]

To get a first-hand assessment of these problems, on 23 November AWS sent an experienced EOTDA forecaster, Captain Jason Tuell of the 4th Weather Wing's 2d Weather Squadron, to the DESERT SHIELD theater. While there, he was also to identify and evaluate other problems associated with EOTDA production and see what he could do to implement temporary fixes. In addition, he was

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[62]AWS DS/DS Report #2 (S), pp 144 (Sec 4.3.1.2), 146 (Sec 4.3.1.2-b), info used (U); Frederick Intvw (U), pp 16-17; rprt (FOUO), Capts K.F. Havener and S. Funk, AWS/XTA, "The Utility of Electro-Optical Tactical Decision Aids," 10 Sep 91, pp 1,4-6, info used (U).

[63]AWS DS/DS Report #2 (S), pp 149-150 (Sec 4.3.1.2-e), info used (U); msg (S), AWS/CAT to 5WW/CAT, et al, "EO Feedback Report (U)," 262250Z Oct 90, info used (U); msg (S), AWS/CAT to Geophysics Laboratory/LYA, et al, "EOTDA Feedback (U)," 302329Z Oct 90, info used (U); msg (S), AWS/CAT to 5WW/CAT, et al, "EO-TDA Questions (U)," 011255Z Oct [sic-should be Nov] 90, info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Capt Steven B. Dreksler, AWS/XTX, 12 Aug 91, hereafter cited as Dreksler Intvw (U); rprt (FOUO), Capts K.F. Havener and S. Funk, AWS/XTA, "The Utility of Electro-Optical Tactical Decision Aids," 10 Dec 91, p 7, info used (U); brfg slides (paper copy) (U), n.a., "Use of Electro-Optical Tactical Decision Aids in DESERT SHIELD," n.d. [probably early or mid-Nov 90]. Additional information on EOTDA deficiencies can be found in msg (S), USCENTAF/WE to 5WW/CAT, et al, "EO Feedback on Mark III TDA Version 1.1 (U)," 030100Z Nov 90, no info used; msg (S), USCENTAF/WE to 1TFW Deployed/WE, no info used; msg (S), USCENTAF/WE to 1TFW Deployed/WE, et al, "Effects of Sand on Radar (U)," 041200Z Nov 90, no info used; msg (S), USCENTAF/WE to 5WW/CAT, et al, "Answers to EO Questions Reference AWS Message 011255Z Oct [sic-should be Nov] 90 with Same Subject (U)," 051200Z Nov 90, no info used; msg (S), AWS/CAT to 5WW/CAT, et al, "CAT-to-CAT Request (U)," 100149Z Nov 90, no info used.

to give forecasters in the theater some training in running EOTDAs. His mission accomplished, Captain Tuell returned to the US on 14 December.[64]

When by early November AWS began to understand the nature and source of some of the EOTDA problems, it requested the Geophysics Laboratory to make any modifications to the Version 2.0 EOTDA software it had under development necessary to correct the deficiencies. The laboratory passed on the task to its software contractor, the STX Corporation. On 20 December, only a few days after Captain Tuell returned from the theater, the company delivered Version 2.1 to AWS which replaced the standard sand characteristics with those of the Saudi sand and added a tan tank variant. At about the same time the laboratory instructed STX to develop a second modification of the Mark III Version 2.0 EOTDA software that would fix still another Version 1.1 deficiency, one identified by Captain Tuell while on his visit to the DESERT SHIELD theater. The company had the new modification, called Version 2.2, ready by 14 January.[65]

Meanwhile, the 5th Wing began sending the new EOTDA software versions to the weather units in the DESERT SHIELD theater as they became available after successfully completing periods of testing. It shipped the new Version 2.0 to the theater on 2 January, just in time to get there before DESERT STORM hostilities began. Version 2.1 followed only three days later. The wing sent out Version 2.2 in mid-February.[66]

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[64]AWS DS/DS Report #2 (S), pp 149-150 (Sec 4.3.1.2-e), info used (U); Dreksler Intvw (U); brfg slides (paper copy) (U), n.a., "Use of Electro-Optical Tactical Decision Aids in DESERT SHIELD," n.d. [probably early or mid-Nov 90]; brfg slides (paper copy) (U), Capt J. Tuell, 2WS/DR, "EOTDA Support for DESERT SHIELD," 22 Dec 90. For more detail on Capt Tuell's work, activities, and findings while on his trip to the operational theater, see notes (S), [Capt J. Tuell, 2WS/DR], "Notes for 5WW Debrief," n.d. [ca 15 Dec 90], no info used.

[65]AWS DS/DS Report #2 (S), p 149 (Sec 4.3.1.2-e), info used (U); Dreksler Intvw (U); atch 1 (U), ltr, HQ 2WS/DR to 4WW/DN, "TDA Quick Fix Answers," 2 Nov 90, to ltr (U) (1st ind to 2WS/DR ltr, 2 Nov 90), 4WW/DN to AWS/XTX, [2WS/DR Response on TDA Quick Fix Answers,] 5 Nov 90; msg (U), AWS/PMA to GL/LYA, "Electro-Optical Tactical Decision Aid," 142100Z Nov 90; msg (U), AWS/PMA to GL/LYA, "Electro-Optical Tactical Decision Aid," 202100Z Nov 90; ltr (U), G.J. Higgins, STX Corp, to Capt T.J. Addison, AWS/PMA, 20 Dec 90, w/1 atch; brfg slides (paper copy) (U), Capt J. Tuell, 2WS/DR, "EOTDA Support for DESERT SHIELD," 22 Dec 90; mfr (U), LTC K. Eis, Chief, AWS/XTX, "Tuell Visit," 24 Dec 90; mfr (U), Capt S.B. Dreksler, AWS/XTX, "Updates from Mark III Version 2.0 to Version 2.1 (Released 24 Dec 90)," 2 Jan 91. For details on the additional deficiency identified by Captain Tuell, see notes (S), Capt J. Tuell, 2WS/DR, "Notes for 5WW Debrief," n.d. [ca 15 Dec 90], no info used.

[66]Dreksler Intvw (U); msg (S), 5WW/CAT to USCINCCENT Weather, et al, "Items of Interest 01-2 (U)," 030241 Jan 91, info used (U); msg (C), 5WW/CAT to USCINCCENT Weather, et al, "Items of Interest 01-04 (U)," 042331Z Jan 91, info used (U); ltr (U), D.B. Hodges, Ctr Dir, STX Corp, to Maj J.K. Hancock, GL/LYA, [Mark III Version 2.2 Software,] 14 Jan 91, w/1 atch; ltr (U), AWDS/PMA to 5WW/CAT, "Mark III EOTDA Software Version 2.2," 16 Jan 91; ltr (U), P.F. Hilton, TDA Principal Investigator, STX Corp, to Maj J.K. Hancock, GL/LYA, [Version 2.2 Testing,] 11 Feb 91, w/1 atch.

Assistance in Predicting Refractivity Effects

The AWS DESERT SHIELD/STORM WSF utilized a small, computer-based software package called the Integrated Refractive Effects Prediction System (IREPS) to provide a measure of refractivity effects support to both its Air Force and Army customers. Developed and provided to AWS by the US Navy's Oceanographic Systems Center, IREPS assessed refractive effects upon radar as well as communications, electronic warfare, and weapons guidance systems. Refractivity has reference to the bending of electromagnetic energy propagated nearly horizontally through the atmosphere, such as radar beams, by moisture, temperature, and other atmospheric conditions. Deviations from standard atmospheric conditions causes "anomalous propagations," i.e., makes electromagnetic energy to curve away from the earth or downward towards the earth, the latter sometimes resulting in ducting (the energy curving downward at a degree of curvature equal to or greater than that of the earth). Using upper air soundings to obtain data on atmospheric conditions, IREPS could show the effects of refraction on electromagnetic propagation.[67]

It was important for military radar operators in the Persian Gulf theater to understand refractivity and to have information about atmospheric conditions causing abnormal refractivity and the kind of anomalous propagation that would occur. Curvature of radar beams away from the earth results in less than normal radar range, curvature toward the earth in greater. Ducting causes a "hole" above the duct where radar beams do not penetrate. Thus, refractivity can significantly affect radar protection, either positively or adversely. Greater range was to the advantage of defenders, but attacking aircraft could exploit reduced radar range, particularly the ducting phenomenon, to their advantage--for example, by using the hole created by ducting to avoid or delay radar detection until the last minute.[68]

Unfortunately, as a Navy-developed system, IREPS was designed for use over open ocean and, therefore, assumed a smooth surface and a "horizontally homogeneous atmosphere," that is, nearly identical atmospheric conditions over a considerable horizontal distance. This made IREPS inaccurate over land, since the two assumptions are usually not valid there and, consequently, the atmosphere reacts differently. AWS, shortly before the beginning of DESERT SHIELD, had initiated an effort to acquire a refractive effects capability over land, but was unable to complete it before the end of DESERT STORM.[69]

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[67]AWS DS/DS Report #2 (S), p 152 (Secs 4.3.2.1, 4.3.2.2-b), info used (U); Koenemann Intvw (U), pp 36-37; St.Onge Intvw (U), p 33; msg (S), USCINCCENT/Weather to COMSOCCENT Deployed/J2-W, et al, "Integrated Refractive Effects Prediction System (U)," 100809Z Jan 91, info used (U); msg (S), 5WW/CAT to USCINCCENT Weather, et al, "TAC Special Assessment 018-90 (U)," 090012Z Nov 90, info used (U).

[68]AWS DS/DS Report #2 (S), p 152 (Sec 4.3.2.1), info used (U); Koenemann Intvw (U), pp 36-37; St.Onge Intvw (U), p 33; msg (S), 5WW/CAT to USCINCCENT Weather, et al, "TAC Special Assessment 018-90 (U)," 090012Z Nov 90, info used (U); msg (S), USCINCCENT Weather to COMSOCCENT Deployed/J2-W, et al, "Integrated Refractive Effects Prediction System (U)," 100809Z Jan 91, info used (U).

[69]Koenemann Intvw (U), pp 36-37; mfr (U), Capt S.B. Dreksler, AWS/XTX, "Review of 5WW Guidance on IREPS over Land," 4 Mar 91; msg (U), AWS/CS to 1WW/CV, et al, "Microwave Refractive Effects Capabilities," 131335Z Jul 90.

Within a few days after the begining of DESERT SHIELD the Air Force began to recognize that its operations might benefit from IREPS support and AWS, in view of the high probability of anomalous propagation in the Persian Gulf theater, became convinced that it should, if at all possible, supply its customers in the theater with information concerning refractivity effects. Accordingly, in spite of the uncertainty about the quality of IREPS performance over land, it directed the WSF to use IREPS to support their customers where appropriate. At the same time, AWS did not want weather units to oversell their ability to predict refractive effects or to dispense inaccurate information which could, as Colonel Goldey pointed out, have "disastrous consequences" by contributing to wrong tactical decisions. The 5th Wing and CENTCOM Weather, therefore, took pains to apprise the weather units of the limitations and inaccuracies of IREPS performance and warn them to exercise caution in using IREPS forecasts.[70]

The IREPS support provided by weather units consisted primarily of summaries of refractive conditions derived by feeding weather parameters obtained through upper air soundings into IREPS and predictions of atmospheric effects on airborne radars and communications. The DSFU, beginning on 10 September, added an IREPS section, including potential ducting levels, to its twice-daily specialized support bulletin. This product was rather generic, but it proved to be useful. The AFSOC weather team provided refractive effects support to the 1st Special Operations Wing and the Riyadh Base Weather Station did the same to SAC reconnaissance and Airborne Weather and Control System aircraft. In January AWS instructed ETAC to send IREPS software to all deployed weather units. The 5th Wing put together an IREPS training package to accompany it. Fortunately, given the limitations on AWS's ability to provide specific, high quality refractivity support, refractive effects never became a major operational concern during DESERT STORM due to the rapid collapse of the Iraqi radar and air threat.[71]

Resupply Support

Operational Order 02-FY directed deploying AWS personnel to take with them expendable supplies sufficient for 30 days. Once in theater, deployed AWS weather teams were to receive logistical assistance from the military units they supported and SWOs were to make arrangements with these organizations for both routine supplies and weather-unique items. Headquarters AWS and/or the

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[70]AWS DS/DS Report #2 (S), p 153 (Sec 4.3.2.2-b), info used (U); msg (C), NAVEASTOCEANCEN/30 to NAVOCEANCOMCEN GQ/NOCC, et al, "IREPS Support (U)," 110500Z Aug 90, info used (U); msg (U), USCINCCENT Weather to ARCENT Main/G2-SWO, et al, "Radar Propagation Statement of Requirement," 261241Z Nov 90; msg (U), 5WW/CAT to AIG 8128, et al, "Refractive Effects Support," 300052Z Nov 90; msg (U), 5WW/CAT to AIG 8128, et al, "Integrated Refractive Effects Prediction System Use over Land," 111943Z Dec 90; msg (S), USCINCCENT/Weather to COMSOCCENT Deployed/J2-W, et al, "Integrated Refractive Effects Prediction System (U)," 100809Z Jan 91, info used (U).

[71]AWS DS/DS Report #2 (S), pp 152-154 (Secs 4.3.2, 4.3.2.2-b, 4.3.2.3), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with LTC Kenneth A. Peterson, Chief, 5WW/DN, 6 Jun 91, p 7; msg (S), 5WW/CAT to AWS/CAT, et al, "5WW SITREP Nbr 34/Operation DESERT SHIELD (U)," 101232Z Sep 90, info used (U); ltr (U), HQ 5WW/DNS to All AWS Units, "Integrated Refractive Effects Prediction System Training Package," 18 Jan 91.

lead wing would replace meteorological equipment as necessary in response to requests from the OICWSF. So much for the theory. The reality was considerably different.[72]

AWS personnel did, in fact, generally deploy with the required 30 days worth of supplies and the 5th Wing, as has been noted earlier[73], did its best to provide the WSF with additional and replacement tactical meteorological equipment. However, the in-theater logistical support stipulated by the plan either never materialized or came much later than 30 days. CENTAF Weather, for instance, soon reported that the Air Force supply system would not be in place until 90 to 120 days after the beginning of the operation. This put the weather units in trouble as far as expendables were concerned. Obviously, they would run out before supplies became available through normal supply channels. The Air Force supply system finally came on line in December, but the Army's system never really functioned very well, at least not in regards to providing Army weather teams with weather-unique items. The SOCCENT weather teams' customers took care of most of their needs. SOCCENT Weather tried but was unable to acquire radiosondes for the Army Special Operations Forces' Marwin upper air sounding system through regular supply channels. It was, however, able to get some from Marine Corps units in the theater.[74]

In spite of the problems with the regular supply system, AWS units deployed to the Persian Gulf theater obtained both the supplies and the replacement equipment and parts necessary to perform their mission. However, they got this material only through many work-arounds and much improvising, both by weather units in the field and in the US. Moreover, the 5th Weather Wing expended much time, effort, and money to acquire and send out, mostly through unofficial channels, the needed expendables and equipment. Occasionally, other AWS units also shipped supplies to the theater. For example, the 2d Weather Wing dispatched a quantity of the different special papers used by the Harris 850s, Alden 9315s, and Wraases. The 5th and 6th Weather Squadrons also sent expendable supplies.[75]

The 5th Wing resupply effort was under the general direction of Chief Master Sergeant Grizzle, but early on the wing dedicated a supply NCO to work full time on obtaining and shipping supplies and, in some cases, equipment. With the assistance of other wing supply people, the NCO purchased and kept on hand quantities of expendable supplies. The wing also stockpiled extra equipment and spare parts, thus, in effect maintaining a mini-depot from which it could service requests from the theater.[76]

By the end of the DESERT SHIELD/STORM operation, the 5th Wing had purchased and shipped out $580,000 worth of equipment and supplies, most of it prior to the time DESERT STORM hostilities began on 16 January. MAC, under an emergency special program code it established for DESERT

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[72]AWS DS/DS Report #2 (S), p 233 (Sec 7.1), info used (U).

[73]See above, Chapter III, pp 42-43.

[74]AWS DS/DS Report #2 (S), pp 233-234 (Sec 7.2-a,d), info used (U); MSgt W.A. Brothers in Grizzle/Brothers Intvw (U), p 10; msg (U), 5WW/CAT to CENTAF Weather, "Supply," 112055Z Dec 90; Conley Intvw (U), p 16; Campbell Intvw (U), p 13; ARCENT SWO AAR (U), pp 62-63 (Sec VII-2a); SOCCENT SWO AAR (U), p 6.

[75]AWS DS/DS Report #2 (U), p 233 (Sec 7.1), info used (U); hist rprt (U), 2WW, Jul-Dec 90, p 156; St. Onge Intvw (U), pp 6-7; Grizzle/Brothers Intvw (U), pp 10-11, 14-15.

[76]AWS DS/DS Report #2 (S), p 234 (Sec 7.2-c), info used (U); Grizzle/Brothers Intvw (U), pp 14, 19-20; St. Onge Intvw (U), p 27.

SHIELD expenditures soon after the operation began, provided the money needed. The wing went ahead and bought material as the need arose, submitted a bill to MAC, and approximately three months later, MAC reimbursed the wing for the expenses it incurred with funds the command, in turn, received from the Air Staff.[77]

The 5th Wing shipped 40 TMQ-34s, 5 GMQ-33s, 24 Alden 9315TRTs, and 50 cases of Alden 9315TRT plastic paper to the DESERT SHIELD theater. In addition, it sent out 400 radiosondes and 250 balloons for the Marwins. The wing had successfully requisitioned the sondes from the Naval Aviation Supply Office in nearby Norfolk, Virginia. The material shipped to the theater by the wing also included such items as computers, thermometers, batteries, ink jet cartridges, 3.5-inch computer disks, teletype and printer ribbons, and teletype, TIDS, and Wraase paper.[78] (See Figure IV-2).

The wing sent most of the material by air. Much of it went by the TAC "rotator," a TAC EC-135 aircraft which flew between Tinker AFB, Oklahoma, and Riyadh once or twice a week, with a stop at Langley AFB. The wing soon discovered that it could utilize the rotator, on a space available basis, to send urgently needed supplies, parts, and small equipment to deployed weather units. Often this material was stowed on seats in the passenger compartment. Once on the aircraft, a shipment arrived in Riyadh in less than 24 hours. The wing could usually get supplies or equipment aboard a rotator within four or five days of their arrival at the 5th Wing. The wing also shipped material through regular MAC channels, but under this method a shipment took anywhere from four to eight weeks to arrive in theater. In this case it first had to go by land from Langley to, most often, Dover AFB, Delaware, where it might stay, because of the huge demand for airlift, two or three weeks before leaving. The wing also occasionally used the MAC "Desert Express" running from Charleston AFB to the theater. Not only was using the TAC rotator of great advantage time-wise, it also made it easier for the 5th Wing to track shipments and gave it a much greater ability to control their loading and unloading.[79]

To make for a more efficient distribution of the supplies, meteorological equipment, and spare parts after they arrived in theater, Colonel Goldey established a depot-like supply office near the DMSP van at Riyadh AB and assigned an NCO, Technical Sergeant William M. Anderson, to work full time receiving, storing, and distributing the material as it arrived in theater, usually by air. Sergeant Anderson was a weatherman, not a supply expert, but he rapidly learned his new job and his work soon became very helpful and the central depot concept worked very well. The sergeant met the planes carrying shipments as they arrived, checked the shipments, and unloaded them from the plane. He also parceled out the stored equipment and supplies to the units needing them and occasionally even delivered them in person to weather headquarters units located in Riyadh. Master Sergeant Brian J. Folk and Technical Sergeant Gibson from CENTAF Weather also assisted in the resupply effort. Sometimes personnel from headquarters units or other units traveling by land vehicle from Riyadh to units deployed elsewhere in the theater took with them needed equipment and supplies. Weather units

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[77]AWS DS/DS Report #2 (S), p 234 (Sec 7.2-c), info used (U); intvw (U), W.E. Nawyn, AWS/HO, with Mr Theodore N. Thompson, 5WW/AC, 6 Jun 91, pp 2,5-6; 5WW DESERT SHIELD Chronology (S), p 9-12, info used (U).

[78]AWS DS/DS Report #2 (S), p 236 (Atch 28), info used (U); St.Onge Intvw (U), pp 7, 26; MSgt W.A. Brothers in Grizzle/Brothers Intvw (U), pp 5-6; msg (U), 5WW/CAT to CENTAF Weather, et al, "Radiosonde Supply for Marwin Systems," 032053Z Jan 91.

[79]AWS DS/DS Report #2 (S), p 234 (Sec 7.2-c), info used (U); LTC R.R. Wall and Col T.C. Tarbell in AWTB Intvw (U), pp 35-37; MSgt J.E. Brackett in Callahan/Brackett Intvw (U), p 15; Koenemann Intvw (U), pp 11-12; MSgt W.A. Brothers in Grizzle/Brothers Intvw (U), pp 11-12.

SUPPLIES AND EQUIPMENT ORDERED, TRACKED, AND SHIPPED BY 5WW DURING DESERT SHIELD/DESERT STORM

1. Radiosondes and balloons for MARWIN systems(400 sondes and 250 balloons)
2. TMQ-34s (40)
3. GMQ-33s (5)
4. Alden 9315TRT (24)
5. Antenna tuners (2)
6. QRCT power supplies (2)
7. 10MB hard disk cartridges (35)
8. NICAD batteries
9. UGC 129 ribbons
10. Ink jet cartridges
11. Tabulating paper
12. Alps printer ribbon
13. 3.5-inch disks/cleaning kits
14. Alden 9315TRT/9315T paper
15. TTY paper (white)
16. TDS paper/film
17. Density altitude wheels
18. Wraase paper
19. Computers
20. Thermometers (small BWK, celsius)

SOURCE: AWS DESERT SHIELD/DESERT STORM Report #2 (S), p 236 (Atch 28), info used (U).

Figure IV-2

in the field often used opportune airlift to get the material they ordered. In many cases they were able to purchase supplies such as computer disks and typewriter ribbons locally.[80]

The 5th Wing's resupply program made an important contribution to the WSF's ability to perform its mission. Without the equipment and supplies the wing acquired and sent to the operational theater, weather support would have been less effective. The 5th Wing effort was appreciated in the field. After the operation was over, both CENTAF Weather and ARCENT Weather reported that the wing had done an outstanding job in providing their units with expendable supplies, especially weather-unique items. The XVIII Corps SWO remarked, in effect, that his weather team couldn't have done its job without the 5th Wing's supply efforts.[81]

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[80]AWS DS/DS Report #2 (S), p 233 (Sec 7.2-b), info used (U); Grizzle/Brothers Intvw (U), p 9; atch 4 (U), 1690WGP/LG DS/DS AAR, to CENTCOM Weather Staff AARs; note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 1 Jul 92; Campbell Intvw (U), p 9.

[81]CENTAF SWO AAR (U), Sec K-2; ARCENT SWO AAR (U), pp 62-63 (Sec VII-2a); Conley Intvw (U), p 16.

CHAPTER V

WEATHER SUPPORT FORCE OPERATIONS

The Air Weather Service on-the-scene participation in Operation DESERT SHIELD/DESERT STORM began on 8 August 1990 when the first few AWS deployees arrived in Saudi Arabia. For the next seven months AWS's WSF in the Persian Gulf theater provided meteorological support to the US Air Force, Army, and Special Operations components of USCENTCOM and, to a limited extent, also to the US Navy, US Marine, and several foreign military forces taking part in the operation. From their very small beginning on 8 August, weather support operations swiftly expanded geographically and functionally as DESERT SHIELD rapidly grew in size and scope.

When the operation began in early August the weather in the Persian Gulf region was hot and sunny every day. As the weather people would say, there was very little, if any, "weather," i.e., there were few if any major weather systems moving through the area and little change in weather conditions from day to day. The weather, therefore, seemingly posed little or no threat to military operations. Consequently, many military leaders including General Powell, Chairman of the Joint Chiefs of Staff; General Schwarzkopf, CINCCENT; and AWS's immediate "boss," General Johnson; CINCMAC, as well as some deployed unit commanders, questioned the need for weather support to DESERT SHIELD and wondered if it was really necessary to have as many weather personnel present as had been deployed. The Headquarters CENTCOM staff seemingly also did not initially have a high regard for weather support. On the whole, this attitude was more prevalent among Air Force commanders than among Army commanders, who were used to having AWS weather teams training in the field as integral parts of Army corps, divisions, and aviation brigades.[1]

Given the skepticism about the value of weather support, many AWS SWOs, in the US as well as in the DESERT SHIELD theater, found it necessary, as one of their first tasks, to convice the commanders they supported of the importance, indeed, the necessity, of weather support even in the "benign" Southwest Asia environment. Thus, they informed their commanders that the weather would not always remain hot and sunny, that in a few months it would change dramatically, and if the operation continued into late fall, the region would begin to have a lot of "weather" that could impact military operations. But they also pointed out that even when the weather was hot and sunny every day, there were still weather factors present that could affect not only operations, but also equipment and weapons--e.g., winds could raise sand and dust which would reduce visibility and degrade the performance of weapons, vehicles, and aircraft. Also, atmospheric conditions could have a negative impact on radar operations. Most were soon convinced. It took General Kelly about a month to turn General Johnson into a strong supporter of weather support. Those not immediately persuaded became converts by the time DESERT SHIELD turned into DESERT STORM. As predicted, the hot and sunny days of August began to give way to the cooler, but still warm and sunny days of September

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[1]AWS DS/DS Rprt #2 (S), p 75 (Sec 4.1), info used (U); Kelly Intvw (U), pp 2-3; Frederick Intvw (U), p 9; Koenemann Intvw (U), p 7; atch 5 (U), Weaving DS/DS AAR, to CENTCOM Weather Staff AARs (U).

and October. Then came the cool, increasingly cloudy days of November and December, and finally, the cloudy, blustery, wet days of January and February.[2]

Weather Observations

Weather operations begin with weather observations, whether by human beings or by sophisticated automated sensors. Weather databases are built on observation data from around the world. Accurate forecasts depend on accurate observations. In DESERT SHIELD, AWS depended upon both US military (primarily AWS) and host nation observers for its in-theater weather observations. Initially, host nation observers provided the official observations at almost all coalition bases. Eventually, the AWS WSF included 152 weather observers who were located at all but eight of the locations where US forces were stationed in the operational theater. Manning ceilings imposed by host nations prevented AWS observers from being used at some locations.[3]

Unfortunately, the quality of the indigenous observations varied considerably and they were not always as complete and accurate as AWS would have liked. While they were acceptable in the early period of the operation when the weather was good, later on, after the weather deteriorated, AWS found them to be less reliable, particularly in regards to visibility and cloud cover information. To a large extent, this could be explained by the fact that host nation observers used WMO criteria which were civilian, not military (and certainly not military aviation), oriented and, in general, not as stringent as AWS standards. But cultural factors played a role. For example, what was "timely" to the host nations was not necessarily so to Americans.[4]

Consequently, AWS felt that, in the interest of safety in air operations, if nothing else, it had to augment host nation observations with its own. On 31 October CENTCOM weather issued a directive allowing AWS observers located at host nation observing sites to "improve" indigenous observations by adding ceiling and visibility data which they themselves had collected. Doing this involved, potentially at least, the national sensitivities of the host nations. Thus, the AWS observers were to be careful to only supplement, not replace, the host nation observations. In spite of this caveat, diplomatic considerations hampered AWS actions to assign additional weather observers to locations for which the host nations already furnished observations.[5]

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[2]AWS DS/DS Report #2 (S), p 75 (Sec 4.1), info used (U); Dickey Intvw (U), p 7; atch 1 (U), "Deployed Weather History," to rprt, 1Lt J.A. Cotturone, Jr, OL-E, 1690WGP and 33TFW/WWO (and Det 10, 2WS), "DESERT SHIELD/STORM Weather History," 25 Jul 91, hereafter cited as Cotturone, OL-E, 1690WGP DS/DS Weather History (U).

[3]AWS DS/DS Report #2 (S), p 155 (Sec 4.4.1), info used (U).

[4]AWS DS/DS Report #2 (S), pp 155-156 (Sec 4.4.2-a), 158 (Sec 4.4.4), 237-238 (Sec 8.2), info used (U); Kelly Intvw (U), pp 14-15; Goldey Intvw (U), pp 18-19; St. Onge Intvw (U), pp 24-25; note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 7 Jul 92; Ridge Intvw (U), pp 7-8; CENTAF SWO AAR (U), Sec G-2.

[5]AWS DS/DS Report #2 (S), p 238 (Sec 8.2), info used (U); msg (S), USCINCCENT/Weather to 5WW/CAT, et al, "WSF SITREP 66 (U)," 311240Z Oct 90, info used (U).

AWS weather teams, both Air Force and Army, deployed throughout the Persian Gulf theater sent their observations via their QRCTs and Goldwings to the DSFU at Riyadh, which also received host nation observations. The DSFU passed them on to other WSF units and to AFGWC. The two Marwins borrowed from the Navy provided valuable, but limited, upper air observations. Attempts to receive upper air observations from Army units in the field through the Army Artillery Meteorological Support Section and the Forward Area Limited Observing Program were pretty much failures. The DSFU never received any significant number of observations as a result of these attempts.[6]

The deployed AWS weather teams forwarded many observations to the DSFU, but there were problems at both the sending and receiving ends of the process. The sometimes poor HF communications and the limited number of AWN terminals available hampered transmission. In addition, weather teams often made procedural, formatting, and encoding errors when sending out their observations. This made it necessary for the DSFU to "clean up" the observations before entering them into the AWN for transmission to AFGWC. Sometimes AFGWC had to manually edit them before entering them into its database. In the end, perhaps as many as 20 percent of the observations were so garbled that they had to be discarded. The relatively low experience and skill levels of the deployed observers (averaging 18 months and less than a five-skill level) were probably a major contributor to the high error rate.[7]

Forecasting Support

Centralized Support in Theater: The DESERT SHIELD/STORM Forecast Unit

The AWS tactical forecast unit for the DESERT SHIELD/STORM operation, the DSFU, played a pivotal role in weather support operations. Its basic function was to be the in-theater focal point for gathering, creating, and disseminating forecast products. As such, it collected weather data from deployed units, the DMSP van, and other available in-theater sources, received and relayed centralized products from AFGWC and other out-of-theater sources, created its own theater-tailored products based on the data it received from these varied sources, and distributed these products throughout the theater. (For a diagram of weather forecast support to DESERT SHIELD/STORM, see Figure V-1).

The process of setting up a TFU at Riyadh began before Colonel Goldey arrived on 24 August. On 18 August, the 5th Wing requested Lieutenant Colonel Riley to establish a TFU as soon as possible. When Captain Jeffrey E. Johnson from Headquarters 5th Weather Wing and Technical Sergeant James C. Parsons from the 3d Weather Squadron's Detachment 6 at Homestead AFB, Florida, arrived at Riyadh on 21 August, Colonel Riley immediately put them to work on this project. According to AWS doctrine, the DSFU would be a part of USCENTCOM Weather and, as such, collocated with Headquarters USCENTCOM. However, as pointed out earlier,[8] Colonels Goldey and Riley early on decided to keep the DSFU at CENTAF Weather because there simply was no room for it at CENTCOM Weather. On 29 August Captain John D. Murphy from the 3d Weather Squadron's Detachment 7 at

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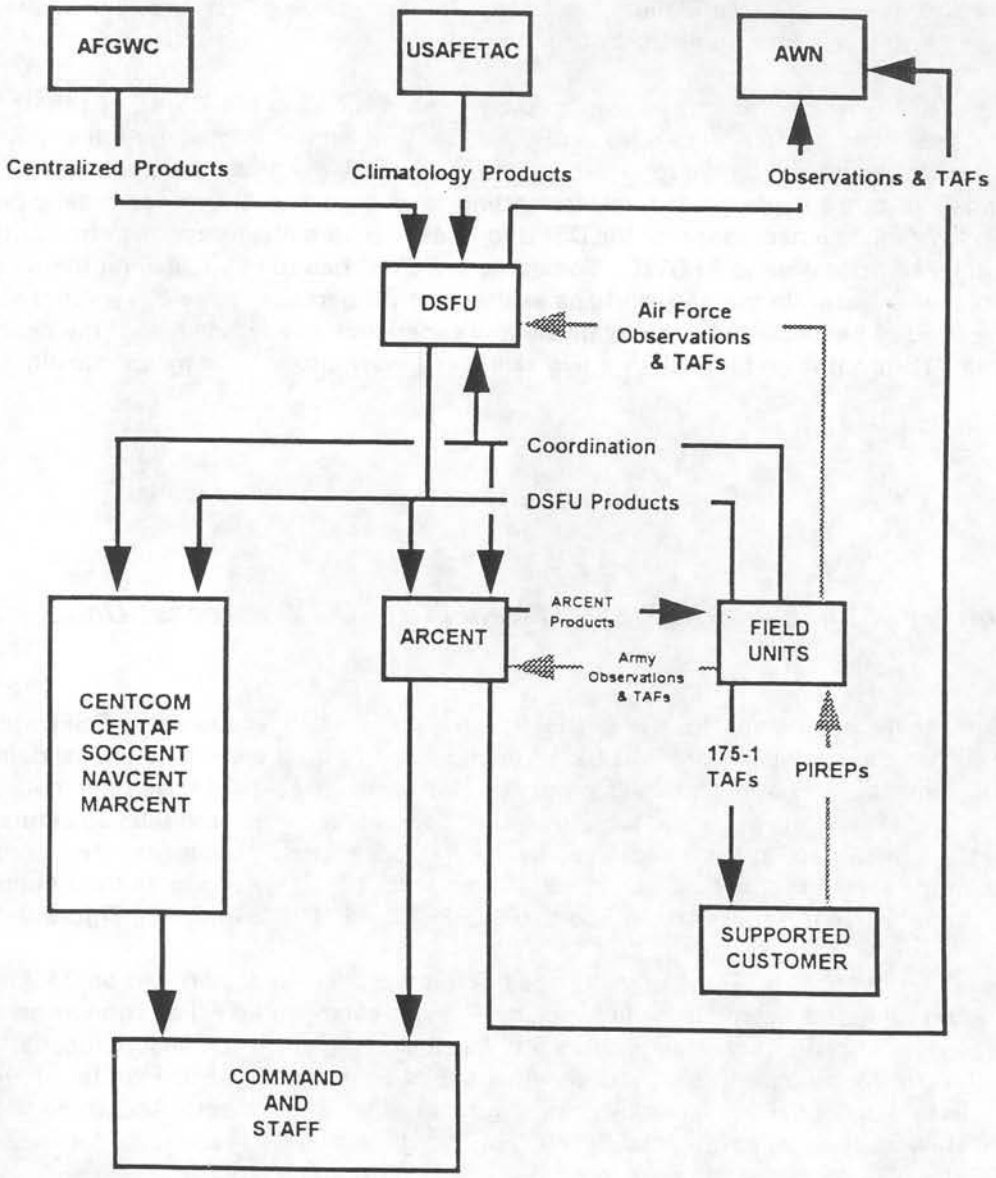
[6]AWS DS/DS Report #2 (S), pp 156 (Sec 4.4.2-b,c), 158 (Sec 4.4.3), info used (U).

[7]AWS DS/DS Report #2 (S), pp 157-158 (Secs 4.4.2-d,e, 4.4.3), info used (U).

[8]See above, Chapter II, pp 18-19.

DIAGRAM OF DESERT SHIELD/DESERT STORM FORECAST SUPPORT



The gray-colored links were the weakest, with the most problems.

SOURCE: AWS DESERT SHIELD/DESERT STORM Report #2 (S), p 76 (Atch 8), info used (U)

Figure V-1

Langley AFB, reached Riyadh to take charge of the DSFU and, a couple of days later, Master Sergeant Folk from the 25th Weather Squadron's Detachment 16 at Nellis AFB, Nevada, arrived to become the NCOIC.[9]

By 2 September the DSFU had all of its initially assigned personnel. The 5th Wing had handpicked some of them. Manning included four officers (an OIC, two team chiefs, and an electro-optical expert), eight forecasters (including the NCOIC), and six observers. Later, as part of the November-December general DESERT SHIELD force buildup, the DSFU got two additional forecasters. Four of the original eight NCO forecasters and two of the officers arrived with little or no centralized forecasting experience, which at first hampered the DSFU operations. The DSFU operated around the clock, 7 days per week with two 12-hour shifts every day. Each member of the DSFU was assigned to one of the shifts.[10]

On 27 August the newly constituted DSFU produced its first joint operational area forecast (JOAF), its most basic product. Four days later it began to send out two JOAFs per day. On 6 September it began providing a daily special support bulletin. The DSFU achieved full operational capability on 21 September.[11]

From the beginning, the DSFU operated as more than simply a tactical forecast unit. By virtue of the fact that the DSFU was collocated with CENTAF Weather, there was no clear line of delineation between it and CENTAF Weather, with the result that the DSFU wound up performing several CENTAF Weather functions--e.g., preparing briefing slides for Colonel Riley. Moreover, at the time they decided the DSFU would remain at CENTAF Weather, Colonels Goldey and Riley also made the decision to make the DSFU the Air Force's tactical weather analysis center for DESERT SHIELD, whose primary task would be to tailor general forecast products to Air Force operations. This caused more mixing of TFU and CENTAF Weather functions as well as adding to the DSFU's workload. In addition, on 31 August the DSFU became the QRCT network control station. Moreover, late in DESERT SHIELD, when the WSF began to utilize the TAC SBLC network, the DSFU received an SBLC fixed teletype terminal and DSFU personnel had to manually insert SBLC data into the AWN for further distribution.[12]

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[9]Msg (S), 5WW/Alert Staff to USCENTAF/WE, et al, "Theater Forecast Unit/Operation DESERT SHIELD (U)," 180404Z Aug 90, info used (U); Goldey Intvw (U), pp 5-6; Riley Intvw (S), p 30, info used (U); msg (S), 5WW/Alert Staff to AWS/DOJ, et al, "5WW SITREP Nbr 14/Operation DESERT SHIELD (U)," 211405Z Aug 90, info used (U); Koenemann Intvw (U), p 5.

[10]5WW DESERT SHIELD Chronology (S), p 9-6, info used (U); Koenemann Intvw (U), p 5; AWS DS/DS Report #2 (S), pp 25-26 (Sec 3.2.2), 36 (Sec 3.4), info used (U); Riley Intvw (S), pp 30-31, info used (U); Capts J.D. Murphy and J.E. Johnson in Murphy/Coe/Johnson Intvw (U), pp 12-13, 18; CENTAF SWO AAR (U), Sec G-1.

[11]5WW DESERT SHIELD Chronology (S), pp 9-5 - 9-7, info used (U); msg (S), 5WW/CAT to AWS/CAT, et al, "5WW SITREP Nbr 35/Operation DESERT SHIELD (U)," no dtg [ca 111500Z Sep 90], info used (U); AWS DS/DS Report #2 (S), p 79 (Sec 4.1.2.2), info used (U).

[12]AWS DS/DS Report #2 (S), pp 25-26 (Sec 3.2.2), 79 (Sec 4.1.2.2), info used (U); Riley Intvw (S), pp 30-31, info used (U); atch 7 (U), rprt, Capt J.D. Murphy, DSFU/OIC, to USCINCCENT/WE (1690WGP/CC), "DESERT SHIELD/STORM After-Actions Report," 21 Mar 91, w/4 atchs, hereafter cited as DSFU/OIC DS/DS AAR, pp 1, 4, to CENTCOM Weather Staff AARs (U); see above, Chapter II, p 19, and Chap III, pp 55-56.

Communications problems and shortfalls impeded DSFU operations at times. From the start the DSFU was able to receive AWN data from AFGWC, but it had no AFDIGS circuit for nearly four months. Until it obtained this circuit, it relied on HF intercept and NODDS for its facsimile data. Its access to NODDS, especially, proved to be a lifesaver for the DSFU during this time. The DSFU began to receive satellite imagery from the DMSP van on 3 September, but by hand delivery rather than electronically. Lacking meteorological data for certain specific areas in the Persian Gulf region, the DSFU relied heavily on satellite data in developing its forecasts. Already in September the DSFU put in a request for a Wraase system in order to get a looping capability, something it felt it very much needed. However, it did not get its Wraase until 1 February. In regards to transmit capabilities, the DSFU had a TIDS early on and eventually got a TACFAX circuit, but TIDS and TACFAX had to share one circuit, which hampered the operations of both.[13]

The DSFU ended up producing many more and a greater variety of products than stipulated in the O2-FY plan. It provided both area and mission-tailored forecast products. Types of products created included surface analyses, nephanalyses, and planning, tactical, and strategic horizontal weather depiction analyses and charts. The DSFU eventually produced thirteen different types of forecast bulletins. These included JOAFs, specialized support bulletins, terminal aerodrome forecasts, air refueling forecasts, electro-optical forecasts, and long-range outlooks. The JOAF was the primary forecast guidance product for weather teams. It included a synoptic discussion, sea surface data, METSAT data discussion, area forecasts, and 0- to 24-, 24- to 48-, and 48- to 72-hour outlooks. The specialized support bulletin contained forecasts for two specific cities, EOTDA and IREPS inputs, solar data, low level wind information, and a chemical downwind message.[14] (See Figure V-2.)

These products, as well as others that it received from elsewhere--such as satellite imagery and NODDS charts--the DSFU sent out to weather support units in the field. It also distributed selected products to Navy units and ships (in return, the DSFU received sea-state/surf forecasts and other bulletins from them), Marine Corps units, and to Saudi, Kuwaiti, Egyptian, British, French, and Italian forces participating in the Persian Gulf operation. It disseminated forecast bulletins by means of the AWN and AUTODIN circuits as well as the QRCT network, satellite imagery over the TIDS, and maps and charts via TACFAX, once this circuit became operational.[15]

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[13]See above, Chapter III, pp 52, 56-57, 68-69; AWS DS/DS Report #2 (S), pp 79-80, info used (U); Capts J.D. Murphy and T.E. Coe in Murphy/Coe/Johnson Intvw (U), pp 11-12, 19; atch 7 (U), DSFU/OIC DS/DS AAR, pp 2, 7, to CENTCOM Weather Staff AARs (U); atch 6 (U), rprt, SSgt T.D. Taylor, 1690WGP/METSAT Coordinator, to 1690WGP/CC, "AAR Meteorological Satellite Coordinator," 23 Mar 91, to CENTCOM Weather Staff AARs (U).

[14]AWS DS/DS Report #2 (S), pp 79-80 (Sec 4.1.2.2), 85-86 (Atch 10), info used (U); atch 7 (U), DSFU/OIC DS/DS AAR, pp 6-8, to CENTCOM Weather Staff AARs (U); Capts T.E. Coe and J.E. Johnson in Murphy/Coe/Johnson Intvw (U), pp 17-18; 5WW DESERT SHIELD Chronology (S), pp 9-6 - 9-7, info used (U). For an example of a JOAF, see AWS DS/DS Report #2 (S), pp 82-84 (Atch 9), no info used (U). For examples of the JOAF as well as other DSFU products, see atch 7 (U), DSFU/OIC DS/DS AAR (U), atchs 1-4, to CENTCOM Weather Staff AARs (U).

[15]AWS DS/DS Report #2 (S), pp 79-80 (Secs 4.1.2.1, 4.1.2.2), info used (U).

PRODUCTS ISSUED BY THE DESERT STORM FORECAST UNIT

1. JOAF (issued at 00Z and 12Z, valid through 72 hours):

    a. Synoptic discussion.
    b. Sea surface data.
    c. METSAT discussion.
    d. Area forecasts (6 areas).
    e. 24-48 hour outlook.
    f. 48-72 hour outlook.

2. SSB (issued at 00Z and 12Z, valid through 72 hours):

    a. Location specific forecasts (2 cities), 00-24 hours.
    b. Location specific forecasts (2 cities), 24-48 hours.
    c. Location specific forecasts (2 cities), 48-72 hours.
    d. EOTDA inputs (5 areas).
    e. Low-level winds (5 areas).
    f. IREPS input.
    g. HFUS bulletin (imported solar data).
    h. Chemical Downwind Message.

3. TAFS (issued at 03Z and 15Z, valid through 24 hours):

    a. In-theater TAFs (approximately 22 TAFs).
    b. CONUS TAFs (approximately 12 TAFs).
    c. European TAFs (approximately 18 TAFs).

4. MACADO (issued at 06Z, valid through 48 hours):

    a. Ceiling, visibility, and wind advisories, 00-24 hours (14 terminals).
    b. Ceiling, visibility, and wind advisories, 24-48 hours.

5. Air Refueling Forecast (issued 06Z and 18Z, valid through 24 hours):

    a. Cloud layers (10 areas).
    b. Altimeter settings and winds and temperatures.
    c. Icing.
    d. Turbulence.
    e. Thunderstorms.
    f. Contrails.

6. General EO Forecast (issued 01Z, valid through 24 hours):

    a. FLIR systems.
    b. TV/LLTV/NVG.
    c. Laser.
    d. Atmospheric conditions.

Figure V-2(1)

7. EO Forecast for Army Systems (issued 01Z, valid through 24 hours):

    a. IR.
    b. Enroute hazards (towers).
    c. TV/NVG.

8. DZ Forecast (as required, valid +/-2 hours):

    a. Cloud layers.
    b. Hazards.
    c. Winds and temperatures.
    d. Altimeter settings.

9. LZ Forecasts (as required, valid up to 24 hours):

    TAF format.

10. Wind Bulletin (issued 06Z and 18Z, valid through 24 hours):

    Surface to 35,000 feet winds for 3 areas every 6 hours.

11. Enroute Wind Bulletin (issued 03Z and 15Z, valid through 24 hours):

    Two routes, surface to 20,000.

12. Special Weather Support TOUCHE (issued 13Z, valid through 72 hours):

    a. Winds (3 areas for 00-24 hours, 24-48 hours, and 48-72 hours).
    b. Visibility and weather.
    c. Cloud layers.
    d. Altimeters settings.
    e. Hazards.
    f. Surface temperatures.

13. Long Range Outlook (issued at 14Z, valid through 14 days):

    a. Ceilings.
    b. Precipitation.
    c. Winds.
    d. Climatology data.

SOURCE: AWS DESERT SHIELD/DESERT STORM REPORT #2 (S), pp 85-86 (Atch 10), info used (U).

Figure V-2(2)

DSFU support to the WSF at first was rather shaky. However, through the hard work of its personnel, its support improved over time. In the end, users reported that DSFU products were very useful, its personnel helpful and responsive to requests, and its overall performance outstanding.[16]

During the early stages of Operation DESERT SHIELD, AFGWC served as a temporary TFU, as has been mentioned earlier,[17] but after the DSFU reached full operational capability on 21 September, AFGWC stepped down to a backup status, all the while retaining the capability to take over from the DSFU at a moment's notice. However, AWS was not satisfied with a backup TFU several thousand miles removed from the theater of operations; it felt that there should be an alternate DSFU in the theater. On 25 September it instructed the 5th Wing to develop a plan for an in-theater alternate TFU. Even though word soon came from the theater that CENTAF was not planning to fully back up its in-theater headquarters, AWS decided to press ahead anyway, but with a modified plan for what it called a "reconstituted" rather than an alternate DSFU.[18]

On 29 October Headquarters AWS approved the reconstitution plan drawn up by the 5th Wing, but later chose to site the proposed reconstituted DSFU at Taif, Saudi Arabia, rather than Thumrait, Oman, as recommended by the plan. AWS then went ahead to preposition at Taif the equipment essential for reconstitution. In January CENTCOM Weather sent a skeleton reconstituted DSFU staff to Taif. On 14 January the staff reported that it had successfully reconstituted the DSFU's capabilities and, the following day, informed CENTCOM Weather the reconstituted DSFU had reached initial operational capability. AWS now began to press toward getting it to full operational capability by 15 March. However, the rapid end to DESERT STORM negated that goal.[19]

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[16]Dickey Intvw (U), p 6; atch 2 (U), Holtgard DS/DS AAR, to CENTCOM Weather Staff AARs (U); atch 3 (U), rprt, Maj L.L. Moore, USCENTCOM/SWO Augmentee, to 1690WGP/CV, "After Action Input - DESERT SHIELD/STORM," 23 Mar 91, to CENTCOM Weather Staff AARs (U). See also, ltr (U) RADM C.C. Lautenbacher, Jr, Comdr, USNAVCENT to 1WS/CC, "Letter of Appreciation," 29 Mar 91.

[17]See above, Chapter IV, pp 71-72.

[18]AWS DS/DS Report #2 (S), pp 80-81 (Sec 4.1.2.2), info used (U); msg (U), HQ AWS/CAT to 5WW/CAT, et al, "Alternate Tactical Forecast Unit," 121841Z Oct 90; msg (S) 5WW/CAT to AWS/CAT, "Alternate TFU and DMSP Backup (U)," 142026Z Oct 90, info used (U). See also, msg (S), AWS/CAT to 5WW/CAT, "Tactical Forecast Unit Backup (U)," 250004Z Sep 90, no info used (U).

[19] AWS DS/DS Report #2 (S), p 81 (Sec 4.1.2.2), info used (U); msg (S), 5WW/CAT to AWS/CAT, "TFU Alterations [sic] (U)," 190019Z Oct 90, info used (U); msg (S) AWS/CAT to 5WW/CAT, et al, "Alternate TFU and DMSP Backup (U)," 291159Z Oct 90, info used (U); msg (S), AWS/CAT to 5WW/CAT, et al, "AWS Equipment Requirements for DESERT SHIELD (U)," 222221Z Oct 90, info used (U); msg (S), USCINCCENT/Weather to 5WW/CAT, et al, "Alternate Tactical Forecast Unit Activation Plan (U)," 271326Z Nov 90, info used (U); msg (S), USCENTAF/Weather to USCINCCENT/Weather, et al, "Test of Alternate DESERT SHIELD Forecast Unit (U)," 120543Z Jan 91, info used (U); msg (S), USCINCCENT/Weather to 5WW/CAT, et al, "RDSFU IOC (U)," 160934Z Jan 91, info used (U).

Support to US Central Command

CENTCOM Weather (officially USCENTCOM Weather Division) kept very busy providing a wide range of weather services to the CINCCENT and various CENTCOM staff agencies to assist them in their decision-making process. Colonel Goldey and his two assistant SWOs (three, beginning in mid-December) gave two formal briefings daily: in the morning to General Schwarzkopf and his senior staff, and in the evening to the general and his several component commanders. In addition to presenting standard synoptic weather information, the SWOs in their briefings categorized weather forecasts as favorable, marginal, or unfavorable for various types of operations and weapons systems (such as, e.g., close air support, reconnaissance, artillery, and helicopter operations). Later, shortly before the air offensive started, they added, at the request of the CINCCENT, the 14-day extended outlook prepared and sent to the DSFU by AFGWC.[20]

DSFU products provided the basis for all the briefings and for most of CENTCOM Weather's support services. The DSFU, although assigned to CENTCOM, was, of course, actually located with CENTAF Weather. The CENTCOM SWOs, nevertheless, in order to remain aware of the current weather situation, kept in close contact with the DSFU, usually via telephone. In order to ensure uniformity in content and consistency in forecasts, they also coordinated each briefing with their counterparts at CENTAF and ARCENT.[21]

A very important and helpful CENTCOM Weather support product was the DMSP pictures and interpretations it provided to the CENTCOM Intelligence Directorate. This imagery became particularly significant immediately before and during DESERT STORM. The CENTCOM SWOs regularly coordinated cloud-free forecasts with the CENTCOM's Strategic Reconnaissance Center in order to help CENTCOM reconnaissance planners to schedule reconnaissance missions. From September until the beginning of the war, they also furnished a written forecast for inland and coastal areas to the combined US-Arabian Coalition, Coordination, Communications, and Integration Center.[22]

Support to US Central Command Air Forces

The USCENTAF SWOs and/or deployed weather units provided weather support to all land-based air forces taking part in the DESERT SHIELD/STORM operation except for US Marine Corps airlift. CENTAF Weather support to Headquarters CENTAF consisted mostly of staff briefings and climatology for planning. During DESERT SHIELD Lieutenant Colonel Riley and his two assistant SWOs gave a daily briefing to CENTAF Commander General Horner and his staff. With the DSFU collocated with CENTAF Weather, DSFU personnel received the task of preparing the slides for the CENTAF SWO briefings. Important as these services were, CENTAF Weather's most significant task, at least during

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[20]Ltr (U), Goldey to Collens, 3 May 91; AWS DS/DS Report #2 (S), pp 77-78 (Secs 4.1.1.2, 4.1.1.3), info used (U).

[21]AWS DS/DS Report #2 (S), p 77 (Sec 4.1.1.2), info used (U).

[22]AWS DS/DS Report #2 (S), pp 77-78 (Sec 4.1.1.2), info used (U).

the war period, was to support the CENTAF Strategic Planning Cell, which planned and executed air tasking orders and included a TACC cell, a fragmentary order ("frag") shop, and a planning shop.[23]

Two weather teams subordinate to CENTAF Weather supplied vital weather services to key air operations control centers located in the Riyadh area. The TACC weather team, consisting of a SWO and three NCOs, supported the CENTAF Commander and other senior CENTAF staff members, including the Director of Operations and Director of Combat Operations, as well as the two provisional air divisions formed in the theater. It also supported the TACC Combat Plans Cell and the TACC Combat Operations Section. In addition, it provided weather services to tactical liaisons from the US Navy and Marine Corps and from British, French, Saudi Arabian, and Kuwaiti Air Forces in the theater. Another weather team composed of a SWO and an NCO furnished support to the Airlift Control Center. It briefed the Commander of Airlift Forces for DESERT SHIELD daily, not only on the weather for the theater, but also for Europe, the Atlantic Ocean, and the US east of the Mississippi River.[24]

CENTAF weather teams provided support to deployed US Air Force units, as well as a few Army and foreign aviation units engaged in various kinds of air operations, including strategic and tactical airlift, air refueling, and fighter and bomber (both tactical and strategic) practice missions. Most of the teams provided around-the-clock support. Typically, they prepared and disseminated terminal aerodrome forecasts and weather mission briefing packages ("flimsies") for aircrews four times per day. They also gave oral mass mission briefings and weather advisories and warnings as necessary. Eventually, as the weather deteriorated, the most significant support service that weather teams provided for their flying customers came to be cloud forecasting, while for their customers on the ground at the air base where they were located, it was weather advisories and warnings. The exact nature, mix, and frequency of weather support services varied from base to base depending upon the requirements of the supported units.[25]

Support to US Central Command Army Forces

AWS Army weather teams deployed to DESERT SHIELD supplied weather support to Headquarters ARCENT, VII and XVIII Army Corps, and the Army divisions, aviation brigades, and armored cavalry regiments deployed to the theater. The ARCENT SWO and his assistant SWO (a second assistant SWO arrived in early December), aided by an ARCENT enlisted weather team that reached 16 in number in December, presented daily briefings to the ARCENT Commanding General, Lieutenant General Yeosock, and his staff. ARCENT Weather provided ARCENT staff sections with daily weather packages, chemical downwind messages, information concerning weather effects on Army operations, and detailed climatological studies. It also furnished direct weather support to all Army forces in the theater who did not have dedicated AWS weather support teams assigned to them.[26]

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[23]AWS DS/DS Report #2 (S), pp 87-88 (Sec 4.1.3.2-a,b), info used (U).

[24]AWS DS/DS Report #2 (S), p 88 (Sec 4.1.3.2-c,d), info used (U).

[25]AWS DS/DS Report #2 (S), p 96 (Secs 4.1.6.1, 4.1.6.2), info used (U). For more detail on each of 20 CENTAF weather teams, see AWS DS/DS Report #2 (S), pp 96-101 (Sec 4.1.6.2-a), info all (U).

[26]AWS DS/DS Report #2 (S), pp 90-91 (Secs 4.1.4.2, 4.1.4.3), info used (U); ARCENT SWO AAR (U), p 1 (Sec I-2).

On 12 October ARCENT Weather became, in effect, a limited TFU when it took on the function of Goldwing network control station. In this capacity it dispensed and received weather data to and from Army weather teams deployed in the theater. It became even more of a TFU on 12 January 1991 when it began to produce a daily centralized support product, the tactical operational area forecast (TOAF), for the deployed Army weather teams. The TOAF was essentially the DSFU's JOAF tailored to the specific needs of Army weather support teams with the help of weather data supplied by the teams. Prior to 12 January the XVIII Corps weather team produced the TOAF, since all Army weather units in the theater were part of the XVIII Corps. However, the arrival of the VII Corps in the theater late in 1990, the positioning of the two corps in close proximity to each other, and the expectation that if and when offensive ground operations began the headquarters of both corps, along with their weather support teams, would be moving frequently, led the ARCENT SWO to conclude that it made more sense for ARCENT Weather to assume responsibility for the TOAF and issue one TOAF for the use of the weather teams of both corps. This new arrangement worked well.[27]

ARCENT weather teams in the field provided a number of important weather services to their commanding officers and their staffs. These included the usual daily briefings and weather flimsies, with additional assistance and updates as required or requested. They provided surface observations; 24-, 48-, and, sometimes, 72-hour forecasts; chemical downwind messages; and weather effects information. In addition, they issued weather warnings and advisories. Forecasts pertaining to winds, visibility, and precipitation was probably the weather information of greatest interest to their commanders. Prior to November the commanders were also concerned about possible heat stress on equipment. The teams sometimes had an input into planning future operations by briefing and analyzing climatological data. They also contributed to current decisionmaking by indicating, usually through a red-yellow-green format, the general weather impact on a particular operation. The ARCENT Weather product of greatest value to the Army weather teams in providing weather support to their customers was the TOAF.[28]

Support to US Central Command Special Operations Forces

During DESERT SHIELD the SOCCENT weather team (which eventually totaled approximately 35 people) provided support to General Lindsay, Commander, SOCCENT, and his staff, and to the commanders of AFSOC, ARSOC, and the Navy Special Warfare Task Group, all components of SOCCENT. Special operations activities during DESERT SHIELD were relatively limited; consequently, so were those of the SOCCENT weather team.[29]

The SOCCENT SWO gave three briefings daily--one to the SOCCENT commander and his staff and two to the SOCCENT Joint Operations/Intelligence Center when new shifts came on duty. The

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[27]AWS DS/DS Report #2 (S), p 90 (Sec 4.1.4.2), info used (U); ARCENT SWO AAR (U), pp 1 (Sec I-2), 3 (Sec I-3a(1)), 5 (Sec I-3a(2)); Weaving Intvw (U), pp 13-14; Campbell Intvw (U), pp 5-6; Boyle Intvw (U), pp 3-4, 6-7; Conley Intvw (U), pp 3-4.

[28]AWS DS/DS Report #2 (S), pp 96 (4.1.6.2), 101 (Sec 4.1.6.2-b), info used (U); Campbell Intvw (U), pp 19-20; Conley Intvw (U), pp 6-7. For additional detail on each of 10 Army weather support teams, see AWS DS/DS Report #2 (S), pp 101-103 (Sec 4.1.6.2-b), no info used (U).

[29]AWS DS/DS Report #2 (S), pp 94-95 (Secs 4.1.5.1, 4.1.5.3), info used (U); SOCCENT SWO AAR (U), p 1.

SWO also provided Headquarters SOCCENT with wind forecasts to assist chemical downwind predictions and furnished climatology packages to the SOCCENT Operations and Plans Directorates as part of weather annexes to the SOCCENT Operational Plan. In addition, he prepared operational forecasts for the Navy Special Warfare Task Group on an "as required" basis and made arrangements for it to receive sea state and surf forecasts via AFGWC. Like the Army weather teams, the SOCCENT SWO and the SOCCENT component SWOs depended heavily on the ARCENT TOAF in preparing weather support products.[30]

The AFSOC weather team developed an IREPS-based refractive effects product for use by the 1st Special Operations Wing and two other customers. This product depended heavily upon upper air soundings. Unfortunately, the unreliability of the IREPS product greatly reduced its value. One of the missions of the ARSOC team was to provide support to 5th Special Forces Group teams serving in an advisory and training capacity to Saudi Arabian, Kuwaiti, and Egyptian tank battalions participating in DESERT SHIELD.[31]

Joint and Combined Operational Relationships and Cooperation

Joint Coordination and Cooperation

Under Joint Chiefs of Staff Memorandum of Policy Number 5, the Air Force, through Air Weather Service, had responsibility for providing weather support to CENTCOM. The CENTCOM SWO, as head of the weather office supporting CENTCOM, had the task of coordinating joint weather support requirements and responsibilities with the CENTCOM component commands, which included not only CENTAF, ARCENT, and SOCCENT, but also CENTCOM's Naval and Marine Forces (NAVCENT and MARCENT, respectively). This was easier said than done. Planning documents called for coordinated weather support, but the coordination process broke down in practice, i.e., during actual DESERT SHIELD/STORM operations--especially between AWS and the Navy and Marine weather components and between the Navy and Marine weather forces. Indeed, a true joint weather support concept never emerged in AWS relationships with the Navy and Marine weather elements. Although coordination among CENTCOM's Air Force, Army, and special operations forces weather forces was better, it was not perfect here either. One reason was that each of these, while organizationally and administratively part of AWS, was under the operational control of its own component headquarters.[32]

This is not to say there was no cooperation between AWS and the Navy and Marine Corps. There was. CENTCOM Weather certainly wanted to work with the weather components of the other two services. Shortly after arriving in theater Colonel Goldey sent out a message via AUTODIN to the Navy and Marine SWOs announcing that CENTCOM weather and a tactical forecast unit were

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[30]AWS DS/DS Report #2 (S), p 94 (Sec 4.1.5.2), info used (U); SOCCENT SWO AAR (U), pp 1-2, 5.

[31]AWS DS/DS Report #2 (S), p 94 (Sec 4.1.5.2), info used (U); SOCCENT SWO AAR (U), p 5; Weaving Intvw (U), p 21.

[32]AWS DS/DS Report #2 (S), p 242 (Secs 9.1-a, 9.2-a), info used (U); atch 5 (U), Weaving DS/DS AAR, to CENTCOM Weather Staff AARs (U).

operational, informing them of the types of services and products the TFU was producing, and offering to make these services available to them. No direct reply came from a Navy source. However, the person in charge of the MARCENT weather element, Chief Warrant Officer Davis, who was with the 1st Marine Expeditionary Force at Al Jubayl, Saudi Arabia, responded to the messages and informed CENTCOM Weather of his weather support needs. Later in February, as the Marines were preparing for their land assault on Kuwait, he left his post in Jubayl and came to the USCENTCOM weather office in Riyadh where he used the CENTCOM SWO's field telephone to relay weather information to the Marines.[33]

Unfortunately, communications difficulties made it virtually impossible for the MARCENT weather element to receive DSFU products and, for that matter, to communicate with its own six deployed Marine squadrons. CENTAF Weather was able, however, by utilizing the expertise of the NCOIC of the Air Force DMSP van, to help the Marine weather people get one of their DMSP vans operational (they had deployed with four, none of which was operational when they arrived in theater). ETAC provided valuable assistance to the Marines by sending them copies of its climatological studies which included the Persian Gulf area. In return, the Marine weather unit at Al Jubayl sent surface and upper air observations to the CENTAF QRCT net control station via either the MAC airlift control element command and control or QRCT communications networks. But, in general, the relationship of AWS to the Marine weather units was one-sided. AWS did more for them than they did for AWS.[34]

On the whole, NAVCENT weather support personnel pretty much operated autonomously and paid little attention to the AWS weather support organizations in the DESERT SHIELD theater. For a short time the Navy did assign two enlisted persons to the AWS DSFU. Weather support to the Navy was a matter of concern to AWS WSF leaders, but other more pressing issues kept them from making this a high priority. Still, on the operational level several interchanges of weather products and services occurred. These were probably of greater benefit to AWS than to the Navy, perhaps because AWS was more interested in Navy products than the Navy was in AWS products. Mention was made earlier[35] of the great value that being able to access the Navy's NODDS was to the DSFU and of the importance of the Navy's IREPS to the WSF in its attempts to predict weather refractive effects. In addition, the DSFU received and used weather bulletins generated by Navy weather organizations which covered water areas adjacent to the Arabian Peninsula. In return, the DSFU transmitted the JOAF and other products to NAVCENT, but it was never very sure how much the Navy actually used them. Intratheater contact with Navy units was inhibited by difficulty in communication.[36]

Although AWS-Navy interfaces involving the DSFU were the most important, others also occurred. During the early weeks of DESERT SHIELD, the 5th Weather Wing coordinated with Navy officials at the neighboring Norfolk, Virginia, Naval Base on weather products that AWS was producing for the Persian Gulf theater. AFGWC and Navy weather agencies interchanged various weather

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[33]AWS DS/DS Report #2 (S), p 243 (Sec 9.2-a), info used (U); Goldey Intvw (U), p 27; note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

[34]AWS DS/DS Report #2 (S), p 243 (Sec 9.2-b), info used (U); Goldey Intvw (U), pp 227-28; Riley Intvw (S), p 27, info used (U); Mr K.W. Walters in Tuttle/Walters Intvw (U), 14 Aug 91, p 6; note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 7 Jul 92.

[35]See above, Chapter III, pp 56-57 and Chap IV, p 95.

[36]AWS DS/DS Report #2 (S), pp 244 (Sec 9.2-a), 245 (Sec 9.4-2), info used (U); atch 5 (U), Weaving DS/DS AAR, to CENTCOM Weather Staff AARs (U); Koenemann Intvw (U), pp 34-37.

products. ETAC provided climatological documents to Navy organizations--including aircraft carriers and battleships operating in southwest Asian waters.[37]

Relationships with the Saudi Arabian Meteorological and Environmental Protection Association

Since most US and coalition forces deployed to the Persian Gulf were based primarily in Saudi Arabia, and since coalition forces had to use that country as a staging area to gain access to Kuwait and Iraq, the US considered amicable relations with Saudi Arabia to be crucial to the success of DESERT SHIELD/STORM. At the same time, Saudi Arabia, as the nation most threatened by Saddam Hussein and whose defense depended upon the coalition forces, also had a vital interest in maintaining good relationships with the US, by far the most important member of the coalition.

By the same token, AWS, although on a much lower level and in a much more proscribed arena, recognized that friendly relations and cooperation with its Saudi counterpart, MEPA, were vital to the success of its operations in support of DESERT SHIELD. By and large the relations between the AWS WSF and MEPA officials during the operation were, in fact, very cordial and AWS received "great cooperation and support" from MEPA. Basically, AWS got everything from the Saudis in the way of support that it asked for, although not necessarily as quickly as it would have preferred.[38]

On 14 August, only a few days after he arrived in Riyadh, Colonel Riley, then the acting OIC of the AWS WSF, at the initiative of the RSAF Director for Air Traffic Services, met for the first time with MEPA officials. Informal contacts between AWS and Saudi weather personnel had already occurred. The high-level meeting took place in Riyadh although MEPA headquarters was in Jeddah. Lasting several hours, it was both friendly and productive. Colonel Riley had as one of his main objectives to obtain access to Saudi weather data for AWS weather teams. The two MEPA officials present, Mr Nowailaty, the agency's Coordinator for the Armed Forces, and Mr Robert Hamilton, a retired US Air Force Reserve colonel, who was serving as a technical advisor to MEPA under a US Government contract, readily agreed to permit AWS personnel to utilize Saudi weather offices and data as desired. But in return, they requested AWS help in obtaining a chemical downwind forecast capability. In keeping with the agreement, AWS weather teams thereafter had almost unlimited access to Saudi weather products.[39]

During the first week of September, Colonel Goldey, who by this time had become the OIC of the AWS WSF, met twice with MEPA officials. In these meetings the Saudis agreed to install a drop-off teletype circuit from King Khalid International Airport near Riyadh to the DSFU at CENTAF Weather, and repeated their request for a chemical downwind dispersion model to assist them in defending against possible Iraqi chemical attacks. MEPA reiterated that it had no objection to person-to-person

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[37]Koenemann Intvw (U), pp 34-37 ; Stokes Intvw (U), p 3; Mr K.W. Walters in Tuttle/Walters Intvw (U), pp 6, 8-9.

[38]AWS DS/DS Report #2 (S), pp 238 (Sec 8.2-a), 240 (Sec 8.3), 242 (Sec 9.2-e), info used (U); Riley Intvw (S), pp 41-42, info used (U); ltr (U), Goldey to Collens, 3 May 91.

[39]AWS DS/DS Report #2 (S), p 239 (Sec 8.2-b), info used (U); Riley Intvw (S), p 41, info used (U); msg (S), COMUSCENTAF Fwd/WE to COMUSCINCCENT/CCJ3-W, et al, "USCENTAF Fwd Weather SITREP 05 (U)," 140000Z Aug 90, info used (U).

transfers of Saudi weather observations from MEPA to AWS, but stressed that AWS should keep complete Saudi observations out of WMO channels because it was afraid Iraq might then be able to use them in planning chemical attacks. By "complete" they meant observations that contained wind and atmospheric pressure data. MEPA had, as a matter of fact, been taking wind and pressure data out of the weather observations it transmitted over WMO circuits ever since Iraq invaded Kuwait on 2 August. For the remainder of DESERT SHIELD/STORM, Saudi Arabia remained adamant in not permitting the transmission of Saudi wind and pressure data in such a way that Iraq might obtain it.[40]

The CENTCOM and CENTAF SWOs thereafter met frequently with Nowailaty, Hamilton, and other MEPA officials to discuss various issues. In a meeting held on 12 October, MEPA approved the use of the partially completed, long-range, dedicated weather circuit from MEPA in Jeddah to the US National Weather Service's NMC at Suitland, Maryland, as a way for AFGWC to obtain the complete Saudi weather observations. The approval came after several weeks of negotiation on the subject.[41]

At the request of the Saudi Government, the AWS WSF provided several forms of weather support to Saudi military organizations. As noted before,[42] the CENTCOM SWOs provided a written forecast for inland and coastal areas to the Coalition, Coordination, Communications and Integration Center (the combined Saudi-US and coalition operations center) from September until the outbreak of hostilities. After the war began, they supplied it with a horizontal weather depiction forecast and a one-paragraph script in support of the air and ground campaigns. CENTAF Weather furnished the RSAF with copies of DSFU, AFGWC, and ETAC weather products. It also coached RSAF briefers, prepared slides for the morning RSAF general staff meetings, and occasionally briefed the RSAF command post. The RSAF Commander, Lieutenant General Ahmed I. Behery, and other high RSAF officers generally attended briefings presented by the CENTAF SWO to General Horner and the CENTAF Battle Staff. Meanwhile, the DFSU provided satellite imagery, copies of the JOAF, and slides for the evening RSAF staff meeting. It also furnished the RSAF forces with chemical downwind messages, forecasts tailored to their particular requirements, and a monthly climatological briefing.[43]

AWS relations with MEPA were, on the whole, amiable and cooperative, and AWS was appreciative of the meteorological services Saudi Arabia provided. It, nevertheless, had reservations over the reliability of some Saudi weather observations. It was also concerned over the long time it took MEPA to implement the King Khalid International Airport-DSFU and MEPA-NMC weather data circuits. The two issues were interrelated in that if and when the circuits finally became operational, their usefulness to the DSFU and AFGWC would be reduced if the observations they transmitted were inaccurate. As it was, inaccurate Saudi observations hampered rapid movement of the Army's XVIII Corps to forward positions in preparation for the ground war and contributed to the crash of an Air Force F-4 fighter at King Khalid Military City on 19 January. Following the crash, General Horner

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[40]AWS DS/DS Report #2 (S), pp 238-239 (Secs 8.2-a,c), info used (U); Goldey Intvw (U), p 17; Millard Intvw (U), p 12; ltr (U), Goldey to Collens, 3 May 91; msg (S), 5WW/CAT to AWS/CAT, et al, "Saudi Wind Data," 201744Z Aug 90, info used (U).

[41]See above, Chapter IV, p 78; AWS DS/DS Report #2 (S), pp 237 (Sec 8.2); 239-240 (Sec 8.2-c), 245 (Sec 9.2-e), info used (U).

[42]See above, this chapter, p 110.

[43]Atch 11, Brod DS/DS AAR, p 1, to CENTCOM Weather Staff AARs (U); AWS DS/DS Report #2 (S), p 242 (Sec 9.2-d), info used (U); CENTAF SWO AAR (U), Sec F; 5WW DESERT SHIELD Chronology (S), p 9-8, info used (U).

directed that in the future Air Force traffic controllers should always have AWS observations available to them.[44]

AWS was eager to get the two promised circuits operational. As matters stood, AFGWC and the DSFU--especially AFGWC, because of its distance from Saudi weather stations--could not get any wind and pressure data from locations where MEPA personnel made the weather observations. The lack of this data skewed the DSFU and AFGWC databases which, in turn, resulted in some degradation in their products. Consequently, AWS worked with MEPA to get the two circuits installed and operational as soon as possible. However, neither came on line until January 1991. MEPA activated the DSFU circuit on 16 January. Two days later the MEPA-NMC circuit finally became operational.[45]

There were several reasons why it took so long for MEPA to implement the two circuits. Saudi Arabia's culturally-determined perception of timeliness was obviously one. There were also some factors at work beyond the control of MEPA, such as the foot-dragging by commercial communications companies mentioned earlier.[46] But there may also well have been another reason--one for which the US, more specifically, the Air Force, was to blame. In the early meetings between AWS and MEPA in which the latter agreed to install the two circuits, the MEPA officials, it will be recalled, in turn asked for Air Force assistance in obtaining a chemical downwind dispersion model. The Air Force was as slow in responding to the Saudi request as MEPA was to AWS's request to implement the circuits. Coincidentally or not, AWS got its circuits about the same time that MEPA received its chemical downwind dispersion model.[47]

At least two reasons figured in why it took the Air Force so long to get a chemical downwind dispersion model to Saudi Arabia. Apparently, soon after the early CENTAF Weather-MEPA meetings, CENTAF asked CENTCOM to work the Saudi request. CENTCOM later said it never received the CENTAF request. The loss of the CENTAF request resulted in a 60-day delay in the process of obtaining the model the Saudis wanted. Eventually, on 10 November CENTAF formally asked CENTCOM to approve the Saudi request. Meanwhile, CENTCOM nuclear-biological-chemical warfare experts decided that the particular model requested by the Saudis would not be the best for use in Saudi Arabia and recommended another instead. This led to further delays. Finally, on 1 January, with CENTCOM approval, CENTAF Weather requested AFSC to provide the Saudis with a copy of a model developed by the Armstrong Aeromedical Research Laboratory at Wright-Patterson AFB, Ohio. On 15 January, AFSC approved disclosure of the model to Saudi Arabia, but informed CENTAF Weather that the Armstrong Laboratory was in the process of modifying the model to include Saudi Arabian parameters. The laboratory would, it added, ship the model to CENTAF as soon as it was ready, which should be only a few days. On 22 January the chemical dispersion model was finally on its way to MEPA.[48]

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[44]AWS DS/DS Report #2 (S), pp 237-238 (Sec 8.2), info used (U); Kelly Intvw, pp 14-15; CENTAF SWO AAR, Sec G-2.

[45]See above, Chapter IV, pp 78-79; AWS DS/DS Report #2 (S), p 240 (Sec 8.2-d), info used (U).

[46]See above, Chapter IV, pp 79-80.

[47]AWS DS/DS Report #2 (S), p 240 (Sec 8.2-d), info used (U); Goldey Intvw (U), p 17.

[48]AWS DS/DS Report #2 (S), p 240 (Sec 8.2-d), info used (U); note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 7 Jul 92; Goldey Intvw (U), p 17; msg (S), USCENTAF/CS to USCINCCENT/CS, et al, [classified title], 101000Z Nov 90, info used (U); msg (C), USCENTAF/Weather/CS to HQ AFSC/CS, et al, "Request for Assistance - Chemical Dispersion Model

Support to Coalition Forces

Nations participating in DESERT SHIELD/STORM had no prior agreements concerning weather support in theater. Coalition forces (except for those of the US) deployed to the Persian Gulf had little, if anything, in the way of weather support with them. Moreover, the senior coalition headquarters--the Coalition, Coordination, Communications, and Integration Center--had no provisions whatsoever for weather support. The coalition headquarters and field units, therefore, turned to AWS and its deployed WSF for assistance. Even though there were no formal agreements, AWS responded by providing them with substantial, albeit limited, support--necessarily limited because of its finite personnel resources in the operational theater and its primary responsibility to support US forces. Nevertheless, CENTAF Weather, in particular, provided considerable support to the British, French, Italian, and Saudi Air Forces through its TACC weather team and the DSFU. Much of it took the form of copies of DSFU, AFGWC, and ETAC products, but it also included briefings, target forecasts, and weather information packages, all of which created a greater workload for the TACC weather team and the DSFU.[49]

The DESERT SHIELD/STORM WSF provided more support to the British air forces than it did to any other coalition military force except for the RSAF. The TACC team prepared slides for morning briefings to the Royal Air Force staff. But for the British there, too, were limits and CENTAF Weather found it necessary to decline a request to brief the combined British military staff at its nightly meeting.[50]

Cooperation between AWS and the British during DESERT SHIELD/STORM was not limited to the Persian Gulf theater. In early November, the Meteorological Office of the United Kingdom's Strike Command asked AWS for satellite imagery directly from AFGWC. Strike Command, based in the United Kingdom, managed British participation in DESERT SHIELD and its meteorological office served as the primary forecast unit for the British forces deployed to DESERT SHIELD. AWS agreed to the request, but it was February before AWS and AFGWC were successful in arranging transmission of the imagery to the command. Meanwhile, however, AWS provided the Strike Command Meteorological Office with access to weather data originating with the AWS WSF in the DESERT SHIELD theater, including the JOAF and KQ observations and forecasts.[51]

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for Royal Saudi Air Force (U)," 010900Z Jan 91, info used (U); msg (C), HQ AFSC/CS to USCENTAF/Weather/CS, et al, "Request for Assistance - Chemical Dispersion Model for Royal Saudi Air Force (U)," 152350Z Jan 91, info used (U).

[49]AWS DS/DS Report #2 (S), pp 242 (Sec 9.1-c), 245 (Sec 9.2-d), info used (U); CENTAF SWO AAR (U), Sec F; msg (U), AFGWC/DOO to AWS/DOJ, et al, "Joint Duty Credit for Air Force Positions," 291510Z May 91.

[50]AWS DS/DS Report #2 (S), p 245 (Sec 9.2-d), info used (U).

[51]Waite Intvw (U), pp 10-11; msg (S), 2WW/CAT to AFGWC/CAT, et al, "British Request for Satellite Imagery from AOR (U)," 091352Z Nov 90, info used (U); msg (U), AFGWC/CAT to 2WW/CAT, et al, "British Request for Satellite Imagery," 092211Z Nov 90; msg (U), AFGWC/CAT to AWS/CAT, et al, "AFGWC SITREP #45 for 13 Nov 90," 131817Z Nov 90; msg (S), AWS/CAT to 2WW/CAT, "British Request for Satellite Imagery from AOR (U)," 142207Z Nov 90, info used (U); atch 1 (U), bullet background paper, 5WW/DON, "UKMO and HQSTC Support During DESERT SHIELD/STORM," 12 Apr 91, to ltr (U), HQ 2WW/CC to AWS/CC, "Allied Weather Assistance for

The benefits of cooperation did not flow only in one direction. Both the Strike Command Meteorological Office and the United Kingdom Meteorological Office extended themselves to provide AWS with products that it could use to support DESERT SHIELD/STORM. The former, for example, based on data that it had at its disposal, faxed wind analyses and forecasts as well as precipitation and fog forecasts applicable to southwest Asia to CENTCOM Weather. In January the United Kingdom Meteorological Office began to forward to AFGWC meteorological products which AFGWC needed to produce its medium-range forecast and 15-day extended outlook for the Persian Gulf theater. In addition, it transmitted 24-hour forecast upper level wind and temperature charts to MEPA, some of which, at least, MEPA passed on to CENTAF Weather.[52]

Operation DESERT SHIELD/STORM," 1 May 91, w/1 atch.

[52]Ltr (U), HQ 2WW/CC to AWS/CC, "Allied Weather Assistance for Operation DESERT SHIELD/STORM," 1 May 91, w/1 atch: bullet background paper (U), 2WW/DON, "UKMO and HQSTC Support during DESERT SHIELD/STORM," 12 Apr 91; Albrecht Intvw (U), pp 3-4; note (U), Col G.F. Riley, Chief, AWS/DOT, to W.E. Nawyn, AWS/HO, 7 Jul 92; see above, Chap IV, p 74.

CHAPTER VI

WEATHER SUPPORT TO DESERT STORM

The Storm

The US and its coalition partners commenced offensive operations against Iraq on 17 January, local time. This action followed upon Saddam Hussein's failure to comply with the UN Security Council resolution of 29 November 1990 ordering him to withdraw from Kuwait by 15 January 1991 or face possible military action by the UN coalition.[1] Having decided to begin with an air campaign, the coalition partners launched their first air attack at 0050, 17 January (1650, 16 January, Eastern Standard Time). With the onset of hostilities, DESERT SHIELD became DESERT STORM. For the next 6 weeks the US Air Force, assisted by British, French, Saudi Arabian, and Kuwaiti air forces, conducted an aggressive air campaign against Iraq, usually flying more than 2,000 sorties per day. In less than 2 weeks they removed any significant threat from Iraqi air forces. Ground anti-aircraft batteries, however, continued to pose a threat for any aircraft flying below 10,000 feet. Meanwhile, in retaliation, Iraq committed two acts of "environmental terrorism." On 22 January it set on fire the first of what eventually became more than 500 oil wells and, on 25 January, began to release millions of gallons of Kuwaiti-owned oil into the Persian Gulf.[2]

Once they gained air supremacy, the coalition air forces turned their attention primarily to Iraqi ground forces, communication lines, and Scud missile sites. Indeed, destroying the Scuds became their top priority objective since Iraq was frequently launching the missiles against Saudi and Israeli cities. In February, in anticipation of a possible ground campaign, CENTAF began to devote much of its attention to destroying Iraqi frontline positions, equipment, and military forces. By 23 February, the combined air forces had flown a total of 95,000 sorties--59,000 by the US Air Force alone. By the same date, total US forces in the Persian Gulf theater had reached 537,000, including 55,000 CENTAF personnel.[3]

Meanwhile, in early February, after Iraq was no longer capable of finding out what was going on in northern Saudi Arabia, CENTCOM began to move US and coalition forces northward in Saudi Arabia from their original positions into forward assembly and staffing areas along the Kuwaiti and Iraqi borders. This included, unknown to Iraq, moving more than 150,000 US, British, and French troops

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[1]See above, Chapter II, p 35.

[2]Art (U), "So Far, So Good," Time, 28 Jan 91, pp 18-24, 29; USAF/CAFH DS/DS Chronology (S/WN/NF), pp 252-253, 264, info used (U); TAC DS/DS Chronology (U), pp 70, 72; Title V Report (U), p 168; Information Please Almanac, Atlas, and Yearbook, 1992, p 974.

[3]USAF/CAFH DS/DS Chronology (S/WN/NF), pp 246, 249, 272, 345, 366-367, info used (U); Title V Report (U), pp 168, 176, 221; TAC DS/DS Chronology (U), p 86; AWS DS/DS Report #2 (S), p 60 (Atch 3), info used (U).

by air to positions along the Iraqi border well to the west of the other coalition forces (mostly located immediately south of the Kuwaiti border) from which they could strike deep into Iraq. All major combat units were in place for a ground offensive by 13 February.[4]

The ground war began at 0400, 24 February (2000, 23 February, Eastern Standard Time). It was over in four days--100 hours to be exact. By the 27th, coalition forces had fought their way into Kuwait City and, to the west, US, British, and French armies sweeping northward across the desert almost without opposition had reached the Euphrates River and accomplished their two main objectives of hitting the Iraqi forces in Kuwait and southeastern Iraq on their right (western) flank and sealing off their escape routes to Baghdad and central Iraq. Meanwhile, coalition air forces continued to pound Iraq and its military forces in and around Kuwait pushing their total DESERT STORM sorties to 100,000, including 66,000 by the US Air Force. Before the day (27 February) was over, Saddam Hussein agreed to accept the terms of a cease-fire offered by the UN coalition. That evening (Eastern Standard Time), President Bush, declaring Kuwait liberated and the Iraqi armies defeated, ordered a halt to military operations, effective at 2400, (0800, 28 February, in the operational theater). Hostilities never resumed.[5]

DESERT STORM Weather

By the time DESERT STORM began in mid-January, the hot, dry, sunny days of summer and fall were long past in the Persian Gulf theater. The weather gradually cooled during the fall and in late November and December the weather degenerated considerably both in terms of temperatures (lower) and cloud cover (increasing). January and February turned out to be generally cold and cloudy, sometimes rainy, causing weather to have an impact on combat operations. High temperatures in the theater varied from 4 to 25 degrees Celsius; lows ranged from minus 4 to 16. More significant for air operations, many days during the two months were cloudy. The air campaign began in the early hours of 17 January with clear skies, but thereafter, clouds frequently affected, and sometimes impeded, air operations. Indeed, target areas in Iraq had ceilings below 10,000 feet about one-third of the time during the air campaign. More particularly, ceilings over Baghdad were less than 10,000 feet 32 percent of the time in January and 22 percent in February; over Kuwait City they were below 10,000 feet 52 percent of the time in January and 29 percent in February. Once Iraq began to torch the Kuwaiti oil wells, smoke also sometimes obscured targets.[6] (For a DMSP satellite visual on 17 January, see Figure VI-1.)

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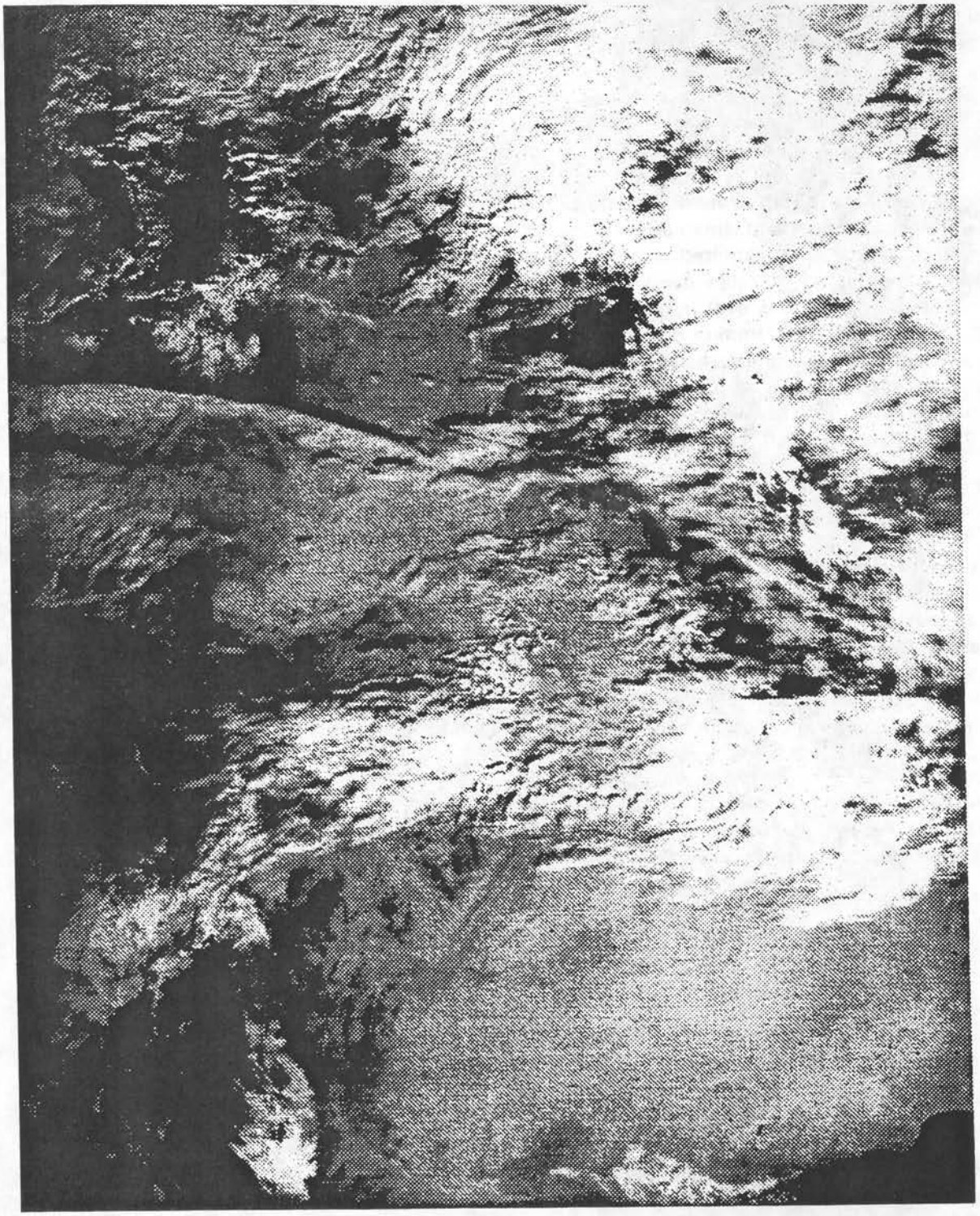
[4]HQ USAF/CAFH DS/DS Chronology (S/WN/NF), pp 313, 330, info used (U); Title V Report (U), pp 176, 341-343, art (U), "Five Decisive Moments," Time, 11 Mar 91, p 32.

[5]Art (U), "The 100 Hours," Time, 11 Mar 91, pp 22-32; USAF/CAFH DS/DS Chronology (S/WN/NF), pp 369, 382, 385, 386, info used (U); art (U), "Free at Last! Free at Last!," Time, 11 Mar 91, pp 38-39; art (U), "Five Decisive Moments," Time, 11 Mar 91, p 33; TAC DS/DS Chronology (U), pp 86-88; Information Please Almanac, Atlas, and Yearbook, 1992, p 974.

[6]Campbell Intvw, p 10; rprt (S), HQ AWS, "Operation DESERT STORM/DESERT SHIELD Report #1: Air Weather Service Contribution to Winning the War--The Value of Weather Support," 23 May 91, hereafter cited as AWS DS/DS Report #1 (S), p i (Exec Sum), info used (U); art (U), Tim Downey, American Forces Information Service, AWS Observer, "AWS Keeps Vigilant Eye on Desert Storm," Mar 91; AWS DS/DS Report #2 (S), p 125 (Atch 13), info used (U).

SATELLITE IMAGERY (DMSP VISUAL) OF DESERT THEATER 17 JAN 91, 0555Z

Fog and low clouds are visible in east central Saudi Arabia and the United Arab Emirates. The leading edge of the approaching frontal system can be seen over the Northern Red Sea.



SOURCE: Rprt (U), K. R. Walters, Sr, et al, Gulf War Weather, USAFETAC/TN-92/003, Mar 92, p 3-3.

Figure VI-1

Closer to the surface of the earth, the 2 months were marked by frequent gusty winds, blowing sand, rain, and thundershowers. Tactical assembly areas in northeastern Saudi Arabia received as much as four inches of rain during January alone. Fog was prevalent along the northwestern Persian Gulf and sometimes penetrated as much as 100-150 miles inland during the night hours and sometimes well into the following mornings. Depending on wind direction, the smoke from the burning oil wells also sometimes restricted surface visibility.[7]

The weather during the 4 days of the ground war was, if anything, worse than the average weather of the preceding 6-week air campaign. When the coalition forces began their offensive early on the morning of 24 February, the skies in southern Iraq and Kuwait were broken to overcast. However, at the time, a low pressure system was bearing down on the operational area (Kuwait Theater of Operations [KTO]) from the west. It reached the area late in the morning, bringing with it extensive low cloud cover and isolated rain showers. Winds blew out of the east-southeast at 15 to 20 knots, raising dust that restricted visibility. But the wind also drove the smoke from the oil well fires up the Tigris-Euphrates Valley deep into Iraq, keeping it away from the advancing ground forces (but hampering air operations over Iraq). Moreover, the southeasterly winds prevented the Iraqis, if they had any such intention, from using chemical weapons against the advancing coalition forces. By the end of the day the low pressure system had moved through the theater, but it was soon followed by an upper-air disturbance that brought in more clouds and rain. Temperatures on the 24th ranged from 1 to 21 degrees Celsius, which turned out to be both the low and high temperatures for the four days of the ground campaign.[8] (For a DMSP satellite visual on 24 February, see Figure VI-2.)

Over the next 3 days the weather did not improve a great deal, but General Schwarzkopf called it "great infantryman's weather." The 25th was not only cloudy and rainy, but also windy--gusts reached 40 knots per hour in the afternoon. The cloud cover continued over the battle area during the 26th. Intermittent rainshowers and thunderstorms occurred and the winds remained southeasterly. The weather finally began to improve late on 27 February. During the morning of the 27th parts of the operational theater still had cloud cover and along with it rainshowers and thunderstorms, but by early evening the entire area was clear. Winds had shifted back to the more prevailing westerly and northwesterly direction. With the shift in the wind, a smoke layer moved over much of central and southern Kuwait. Broken clouds covered the battle area on 28 February, the last day of the war. By early evening the skies were clear or had only scattered clouds. But by then the ground war was over and the cease-fire in effect.[9]

AWS knew all along, of course, that the weather would deteriorate when winter came along, and SWOs had frequently warned their customers of this fact. But the weather in the Persian Gulf region during January and February 1991 was worse than anticipated on the basis of climatology. Around the time the ground war began, General Merrill E. McPeak, Chief of Staff of the Air Force, asked AWS whether DESERT STORM weather was better or worse than climatology had led it to

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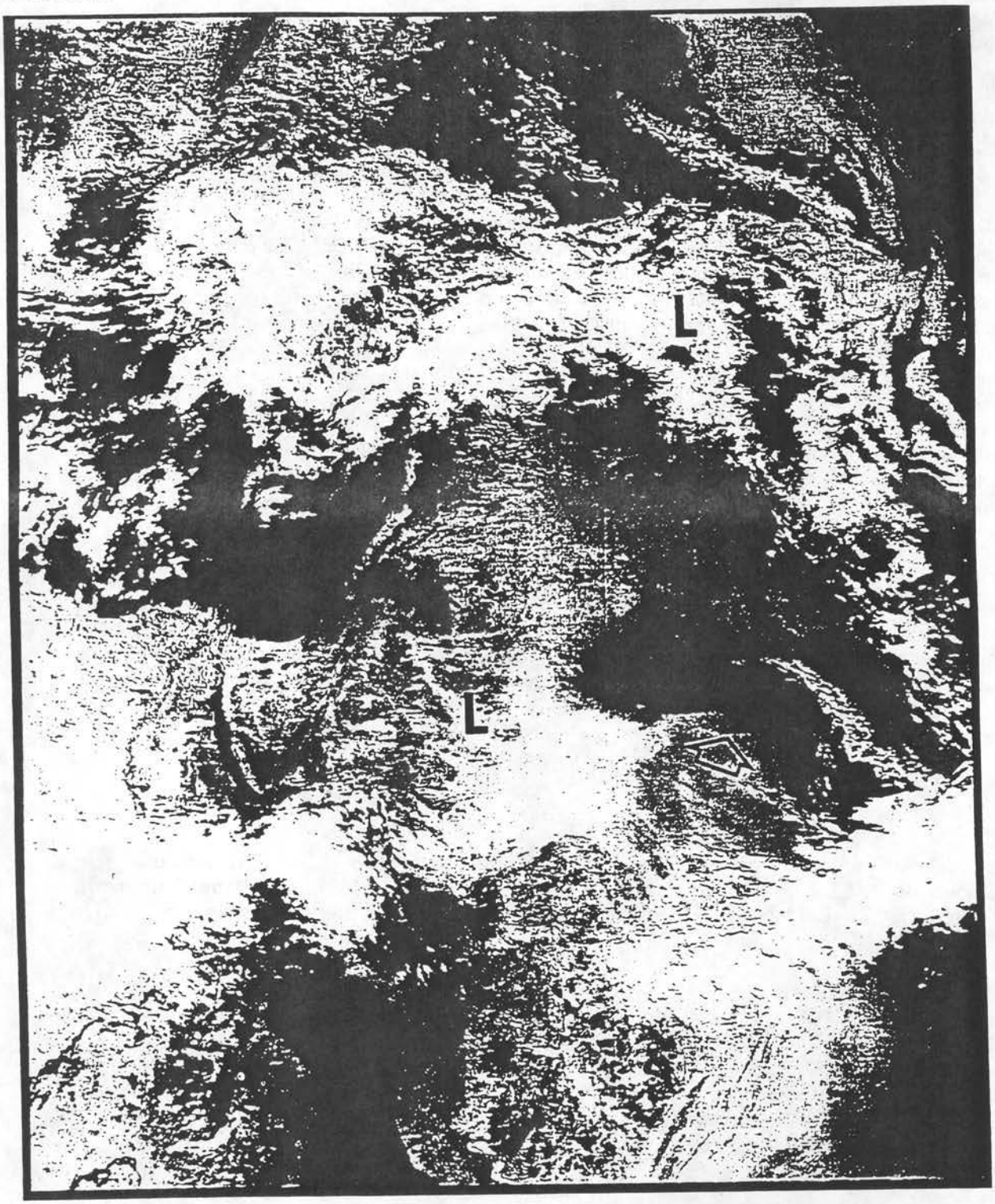
[7]Rprt (U), K.R. Walters, Sr, et al, Gulf War Weather, USAFETAC/TN--92/003, Mar 92, pp 3-2 - 3-102; Cotturone, OL-E, 1690WGP DS/DS Weather History (U); AWS DS/DS Report #2 (S), p 126 (Atch 13), info used (U); Campbell Intvw (U), p 10.

[8]Rprt (U), K.R. Walters, Sr, et al, Gulf War Weather, USAFETAC/TN--92/003, Mar 92, pp 3-87 - 3-89; Cotturone, OL-E, 1690WGP DS/DS Weather History (U); ltr (U), LTC W.S. Weaving, 1690WGP/CV, to 5WW/DO, "Weather Support to DESERT SHIELD/STORM," 6 Mar 91, hereafter cited as ltr, Weaving to 5WW/DO, 6 Mar 91; Weaving Intvw (U), p 30.

[9]Rprt (U), K.R. Walters, Sr, et al, Gulf War Weather, USAFETAC//TN--92/003, Mar 92, pp 3-90 - 3-102.; Cotturone OL-E, 1690WGP Weather History (U); ltr (U), Weaving to 5WW/DO, 6 Mar 91.

SATELLITE IMAGERY (DMSP VISUAL) OF DESERT THEATER 24 FEB 91, 1123Z

Smoke (arrow) spreads from Kuwait to central Iraq. The upper-air disturbance that affected Kuwait in the morning is now over the Persian Gulf, and the disturbance affecting it in the evening is now over the Red Sea.



SOURCE: Rprt (U), K. R. Walters, Sr, et al, Gulf War Weather, USAFETAC/TN-92/003, Mar 92, p 3-3.

Figure VI-2

expect. In response, AWS directed ETAC to conduct an exhaustive analysis of the actual weather during all of DESERT SHIELD and STORM compared to climatology. ETAC concluded, based on the 14 years' worth of weather data that it had from Southwest Asia, that the weather in the Persian Gulf area was approximately twice as bad (i.e., twice as much time with cloud cover and/or ceilings below 10,000 feet) as climatology suggested and was worse in January and February 1991 than it had been in the same 2 months of any of the preceding 14 years.[10]

More specifically, ETAC found that, overall, the operational area had ceilings below 10,000 feet about 35 percent of the time. It also determined that in January 1991 the mean cloud cover over Baghdad was 3.4 eighths and in February 2.5 eighths compared to the 14-year climatological mean of 1.7 and 1.5, respectively. Similarly, Kuwait City had a mean of 2.5 and 2.2 eighths of cloud cover in the two DESERT STORM months compared to the 1.0 and 0.8 indicated by climatology. It also discovered that low cloud cover over Baghdad in January and February 1991 was 231 percent of normal (i.e, the mean over the last 15 years, including 1991), over Kuwait City 290 percent of normal. In addition, ETAC, using statistical techniques, estimated the probability of the DESERT STORM weather actually occurring was 2.5 percent for January and 5 percent for February for Baghdad and less than 1 percent for both months for Kuwait City.[11] (See Figures VI-3 and VI-4.)

An assistant CENTCOM SWO, Major Joseph D. Brod, also analyzed the weather over Baghdad and Kuwait City in January and February 1991. Using nephanalysis charts prepared by the DSFU, satellite imagery, and Navy climatology (Summary of Meteorological Observations, Surface), he concluded that Baghdad ceilings were below 10,000 feet 32 percent of the time in January and 22 percent of the time in February compared to the 21 and 17 percent, respectively, suggested by the climatology. For Kuwait City, he found the percentages for the same categories to be 52 and 29 compared to 24 and 21.[12]

The discrepancy between the actual weather and climatology was perhaps due in part to limited and inaccurate climatological data. The database used to develop the climatology covered only the last 14 years. Moreover, incomplete and inaccurate observations over these years may have biased the climatology. Local observations were not always reliable, many cloud cover observations were missing, and changes in WMO observing practices occurred during the 14 years. In short, the quantity and quality of the observations were less than might be desired. However, the shortcomings

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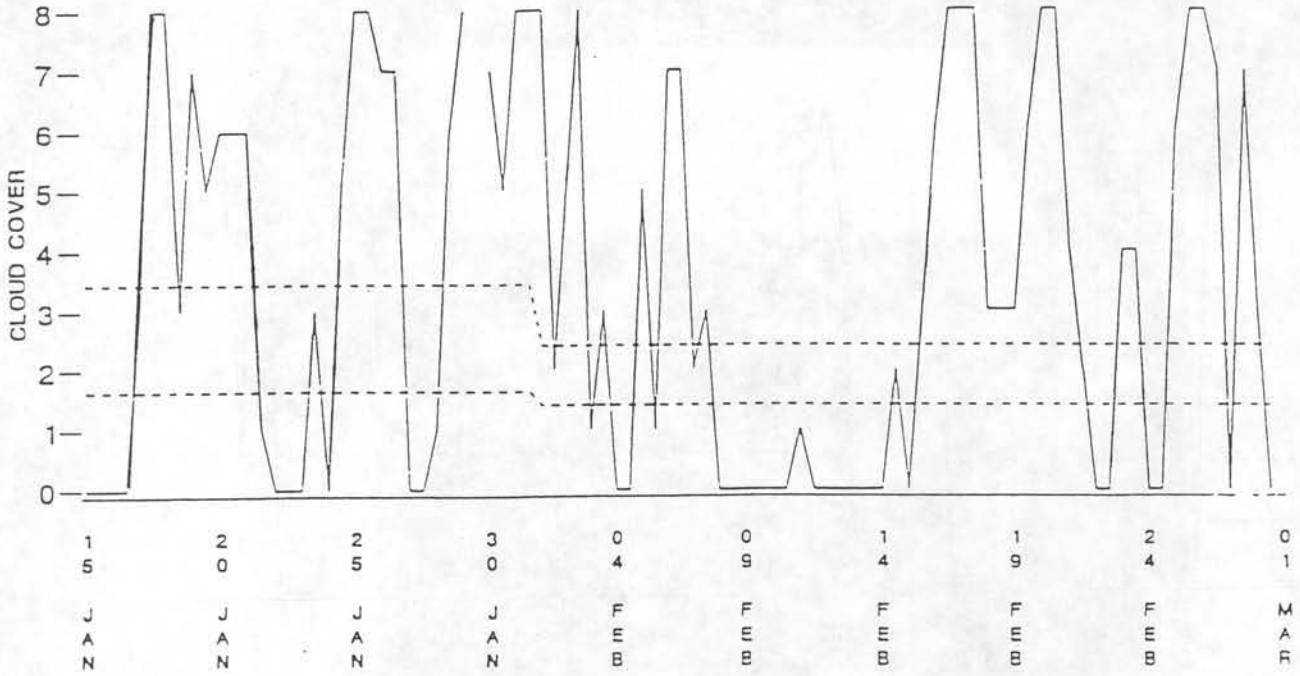
[10]LTC R.R. Wall in AWTB Intvw (U), p 41; AWS DS/DS Report #1, p 1 (Sec 3.1), info used (U); AWS DS/DS Report #2 (S), p 125 (Atch 13), info used (U); atch 5 (U), "Summary Paper," to ltr (U), LTC D.J. Pace, Det 2, HQ AWS, to AFGWC/CC, "DESERT STORM Weather Comparison for CSAF," 28 Feb 91.

[11]Brfg (S), Majs A.R. Shaffer, 5WW/DOS, and R.W. Keefer, AWS/DOJ, to Brig Gen J.J. Kelly, Jr, USAF/XOW, [DESERT STORM Analysis and Lessons Learned Briefing (U),] 12 Apr 91, hereafter cited as Shaffer/Keefer DESERT STORM Analysis Brfg (S), slides (paper) 4,5, info used (U); AWS DS/DS Report #2 (S), pp 125, 127, 128 (Atchs 13,14,15), info used (U); AWS DS/DS Report #1 (S), pp 1-2 (Sec 3.1), 4-5 (Figs 1,2), info used (U); atch 3 (U), "Explanatory Paper," to ltr (U), LTC D.J. Pace, Det 2, HQ AWS, "DESERT STORM Weather Comparison for CSAF," 8 Mar 91, w/3 atchs. See also ltr (U), AFGWC/DO to Det 2, HQ AWS, "Actual Weather for DESERT SHIELD/DESERT STORM vs Climo," 26 Feb 91, w/3 atchs.

[12]AWS DS/DS Report #2 (S), pp 125 (Atch 13), 129 (Atch 16), info used (U).

BAGHDAD WEATHER VERSUS CLIMATOLOGY
15 JAN - 1 MAR 91



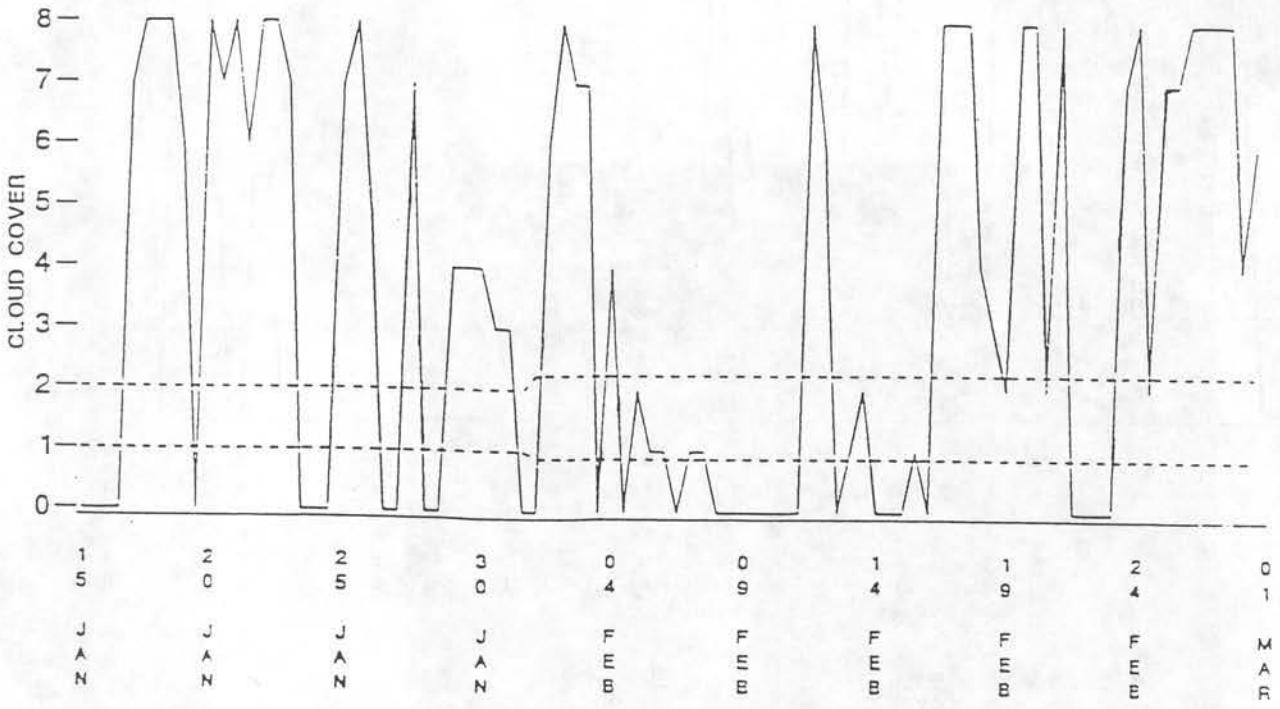
OBSERVED CLIMATOLOGY: 1991 Monthly Mean Cloud Cover below 10,000 feet.

BAGHDAD CLIMATOLOGY: The daily variation (thin solid line) of eighths of cloud cover, monthly mean cloud cover for the 14-year period of record (botton dashed line), and the 1991 monthly average cloud cover below 10,000 feet (top dashed line) for Baghdad.

SOURCE: AWS DESERT SHIELD/DESERT STORM, Report #2 (S), p 127 (Atch 14), info used (U).

Figure VI-3

KUWAIT THEATER OF OPERATIONS
WEATHER VERSUS CLIMATOLOGY
15 JAN - 1 MAR 91



OBSERVED CLIMATOLOGY: 1991 Monthly Mean Cloud Cover below 10,000 feet.

KUWAIT CLIMATOLOGY. The daily variation (thin solid line) of eighths of cloud cover, monthly mean cloud cover for the 14-year period of record (botton dashed line), and the 1991 monthly average cloud cover below 10,000 feet (top dashed line) for Kuwait Theater of Operations.

SOURCE: AWS DESERT SHIELD/DESERT STORM Report #2 (S), p 128 (Atch 15), info used (U).

Figure VI-4

of the climatology did not significantly threaten the correctness of the basic conclusion that the weather during DESERT STORM was indeed unusual.[13]

Weather Support Operations

By the time DESERT STORM began, the AWS WSF was "ready to support any operation directed by the president." Not that every last piece of equipment or communications systems was in place and operational or that the force could not further hone its skills and expand its capabilities, but essentially it was able and ready to go. DESERT STORM brought a great increase in workload for the WSF, but for the most part the nature of its weather support operations did not change a great deal. In other words, the force worked harder and more intensely, but basically continued to provide its customers with the same types of weather information, although frequently more of it.[14]

Overall, weather and weather support proved to be more critical to and had more of an impact upon combat operations during DESERT STORM than commanders originally anticipated. This was due to at least two reasons. First, the weather was worse than expected. Secondly, when anti-aircraft weapons replaced ground-to-air missiles and counter air operations as the chief Iraqi threat to the US and coalition air forces after they gained air supremacy over Iraq, CENTAF mission planners established a 10,000 feet operational threshold. This, in turn, led to a greater concern for cloud cover and ceilings.[15]

Centralized Support to the WSF from the DESERT STORM Tactical Forecast Unit

During DESERT STORM the DSFU, like the WSF in general, basically continued to operate much as it had during DESERT SHIELD and to provide the same products. Its workload increased and its personnel worked through DESERT STORM without getting a day off. The DSFU deactivated on 18 March 1991, 18 days after the cease-fire ending hostilities and 178 days after it began full operations on 21 September. At this point, AFGWC again assumed the tactical forecast unit functions.[16]

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[13]AWS DS/DS Report #2 (S), pp 125, 126 (Atch 13), info used (U); AWS DS/DS Report #1 (S), p 3 (Sec 3.2), info used (U); Goldey Intvw (U), p 21; memo (U), "Update," 19 Mar 91, to memo (U), AWS/DO to AWS/CC/CV/CC, [DS/DS Weather vs Climo,] 18 Mar 91.

[14]Frederick Intvw (U), p 12; msg (S), 5WW/CAT to AWS/CAT, et al, "Operational Readiness of the DESERT SHIELD WSF," 041308Z Jan 91, info used (U).

[15]AWS DS/DS Report #1 (S), p 32 (Sec 6.3), info used (U).

[16]Riley Intvw (S), p 31, info used (U); AWS DS/DS Report #2 (S), pp 79 (Sec 4.1.2.2), 111 (Sec 4.2), info used (U). See also, msg (S), [USCENTAF Weather to WSF,] et al, "TFU Deactivation (U)," no dtg [18 Mar 91], no info used (U).

The CENTCOM staff required twice as much weather data from CENTCOM Weather during the war period as before. The number of daily briefings increased from two to four as CENTCOM added briefings to the Joint Intelligence and Joint Operations Centers to the morning and evening CINCCENT briefings. Moreover, the number of slides briefed rose from four to nine and the scope of each briefing expanded from a simple 0- to 24-hour to a 0- to 72-hour forecast that categorized weather forecasts as favorable, marginal, or unfavorable for various types of operations and weapons systems (e.g., closeair support, reconnaissance, artillery, helicopter operations). After the war started the CENTCOM SWOs began to issue a daily horizontal weather depiction graphic forecast and a one-paragraph script for the air and ground campaigns. They also continued to brief the 14-day extended outlook for the DESERT SHIELD theater.[17]

On 29 January CENTCOM Special Plans asked CENTCOM Weather to provide, as an additional project, a 3-week, day-by-day, cloud cover outlook (clear, partly cloudy, cloudy) for western Iraq and the KTO. The purpose of this effort was to demonstrate to General Schwarzkopf the weather trands, with emphasis on cloud-free days. Its value was that it pointed out for the general the cyclical weather trends. The forecasts showed that there were frequently 3 days of clear to scattered clouds in the two areas between each weather system. A later refinement of the forecast indicated that there would be 3 clear to scattered cloud days from 21 to 24 February, which, along with other factors such as illumination data and tides, led the general to decide to start the ground offensive on 22 February. However, logistical problems caused him to delay the attack until 24 February. Overall, the 21-day forecast for the two areas combined verified at 71.4 percent.[18]

During DESERT STORM DMSP satellite imagery became even more significant than it had been before hostilities began. Consequently, General Schwarzkopf directed that DMSP transparencies be included in his daily briefings. The satellite imagery not only provided CENTCOM leaders with decision-making assistance, but also helped CENTCOM Intelligence to determine the number and location of oil well fires, the extent and direction of the resultant smoke plume, and to assess the impact of the fires and smoke. The CENTCOM Intelligence and Operations staffs frequently requested and received satellite data updates.[19]

DMSP satellite imagery provided General Schwarzkopf with the first battle damage assessment of the war. Following the air raids on Baghdad on the first night of the war, the general remarked that he wasn't getting assessments of the damage caused by the raids fast enough. Hearing of General Schwarzkopf's remark, Lieutenant Colonel Riley took two DMSP visuals covering Baghdad taken on the nights of January 16 and 17 to Brigadier General Buster C. Glosson, the Director of the CENTAF Strategic Planning Cell, who quickly passed them on to General Schwarzkopf. The one taken

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[17]AWS DS/DS Report #1 (S), p 8 (Sec 5.1.1), info used (U); AWS DS/DS Report #2 (S), p 77 (Sec 4.1.1.2), info used (U); ltr (U), Weaving to 5WW/DO, 6 Mar 91.

[18]Note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

[19]AWS DS/DS Report #2 (S), pp 77-78 (Sec 4.1.1.2), info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "WSF SITREP 150 (U)," 231000Z Jan 91, info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "WSF SITREP 153 (U)," 261130Z Jan 91, info used (U); msg (S), 5WW/CAT to AWS/CAT, "DESERT STORM Weather Impacts (U)," 211459Z Jan 91, info used (U).

the night of the 16th clearly showed lights on in the city; the one taken the following night depicted nothing but darkness. The visuals thus clearly indicated that the raids had accomplished their chief objective, to knock out Baghdad's electrical systems and network.[20]

CENTCOM Weather's primary responsibility was to provide planning support to the CENTCOM staff, but it also furnished direct operational support to theater reconnaissance missions, using forecasts supplied by the DSFU and SAC's Directorate of Weather for Strategic Reconnaissance at Offutt AFB, Nebraska.[21]

Support to US Central Command Air Forces

CENTAF Weather also experienced a considerable increase in its workload during DESERT STORM. It now briefed General Horner and his staff twice daily instead of once, gave target area weather assessments, and provided General Horner and Brigadier General Buster C. Glosson, the Director of the CENTAF Strategic Planning Cell, with frequent weather updates. Like General Schwarzkopf, General Horner placed great value on satellite imagery and, therefore, directed that he receive a copy of the latest imagery as soon as it became available. He also ordered CENTAF Weather to provide and display in the TACC a continuously updated nephanalysis of the satellite imagery to help him and the TACC directors interpret it. In addition, he instructed CENTAF Weather to put together and display an air terminal weather board containing up-to-date weather information for all CENTAF bases in the theater. When CENTAF shifted its air campaign tactics, CENTAF Weather tailored its support to meet the new forecast requirements resulting from the consequent concern for cloud cover below 10,000 feet.[22]

CENTAF Weather's support to the Strategic Planning Cell became both more extensive and more critical during DESERT STORM. Particularly important was the support provided to the Planning Cell's Plans shop, (or Guidance Allocation Tasking Cell), usually referred to as the "black hole," which planned air tasking orders. The support included briefing General Glosson and his staff twice daily, posting in the black hole a daily 2-day horizontal weather depiction of the operational theater and the latest satellite imagery, and presenting numerous "on-call" briefings. In addition, Lieutenant Colonel Riley, in coordination with the Commander of CENTAF's Electronic Warfare Division, developed a new, structured planning support product. It consisted of a three page, 3-day (72-hour) weather forecast for four areas: Baghdad, Mosul (in northern Iraq), the KTO, and western Iraq. Beginning on 29 January, it issued the forecast three times daily. Black hole planners particularly wanted to know if, or which, potential target areas would be cloud free below 10,000 feet 2 days later. Indeed, the cloud forecast for target areas was the single most important weather product CENTAF Weather provided.[23]

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[20]Note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

[21]AWS DS/DS Report #1 (S), pp 8, 10 (Sec 5.1.2), info used (U).

[22]AWS DS/DS Report #2 (S), p 87 (Sec 4.1.3.2), info used (U); AWS DS/DS Report #1 (S), p 1 (Sec 2), info used (U).

[23]AWS DS/DS Report #2 (S), pp 87-88 (Sec 4.1.3.2), info used (U); AWS DS/DS Report # 1 (S), pp 10-14 (Sec 5.2.1, Figs 5-7), info used (U); Shaffer/Keefer DESERT STORM Analysis Brfg (S), slide (paper) 11, info used (U).

CENTAF Weather also provided weather support to the Strategic Planning Cell's frag shop and TACC cell. The CENTAF SWOs provided the frag shop with a daily verbal briefing and a written horizontal weather depiction forecast to help it in building the next day's air tasking order. The CENTAF SWOs, together with the TACC SWO, furnished the TACC cell with detailed weather inputs that assisted it in executing the current day's air tasking order. Up-to-date forecasts of cloud cover over targets, for example, enabled the TACC, if necessary, to redirect attack missions, even those already underway, from targets with low ceilings to other targets with acceptable weather.[24]

CENTAF Weather provided weather inputs at four points in the planning and executing process for an air tasking order. Fifty hours prior to the planned execution time for a particular air tasking order (2400 local time) it briefed the theater weather to General Glosson, who then decided on potential targets to be "fragged" the following day. Exactly 24 hours later, 26 hours before execution, it briefed a 26-hour forecast to the black hole to assist it in selecting the final list of targets that the planners would release to the frag shop. Eighteen hours before execution (at 0800 local time), it briefed the fraggers building the next night's air tasking order. Finally, 12 hours before execution (1400 local time) it briefed the weather for a final time to General Glosson, who then made a final decision on the targets for the coming night. This was the last opportunity to change the formal air tasking order, although it did not formally close until 1800 local time, 8 hours before execution, at which time the TACC weather team provided yet another weather input.[25] (See Figure VI-5.)

CENTAF force-level and unit-level weather teams provided primarily execution support to their customers during DESERT STORM. In addition to the weather support it furnished to the Strategic Planning Cell referred to in the preceding two paragraphs, the TACC weather team, using DMSP and NOAA satellite imagery, constantly updated cloud conditions over the DESERT STORM theater. It also developed a process to continuously update current observations at, and 12-hour forecasts for, all recovery bases so that it would have available the information General Horner wanted displayed on the terminal weather board he had directed it to provide. The Airlift Control Center weather team supported General Schwarzkopf's hugely successful "Hail Mary" play, the sudden and clandestine shift of coalition ground forces by air to the Saudi Arabian-Iraqi border well to the west of Kuwait. The SWO sent an observing team to Rafha, where the aircraft transporting the troops were landing, and briefed the Commander of Airlift Forces hourly on weather forecasts for the landing zone. The amount of support required by CENTAF units in the field varied from one base to another, but typically the support consisted of oral, stand-up mission briefings and weather flimsies which pilots could use to brief themselves. Unit teams also provided EOTDAs for situational awareness to deep interdiction and close air support missions.[26]

While most CENTAF Air Force weather teams supported CENTAF's air campaign against Iraq from bases located on the Arabian Peninsula, one four-person (five after 24 January 1991) weather team provided support to a provisional SAC B-52 bomb wing stationed on the island of Diego Garcia. This wing, although removed by 2,000 miles from the Persian Gulf theater, participated in the air campaign against Iraq. The weather team furnished various kinds of weather information to wing operational planners, including wind and electro-optical data, astronomical information such as sun rising and setting times, lunar illumination, and warnings concerning weather hazards and possible

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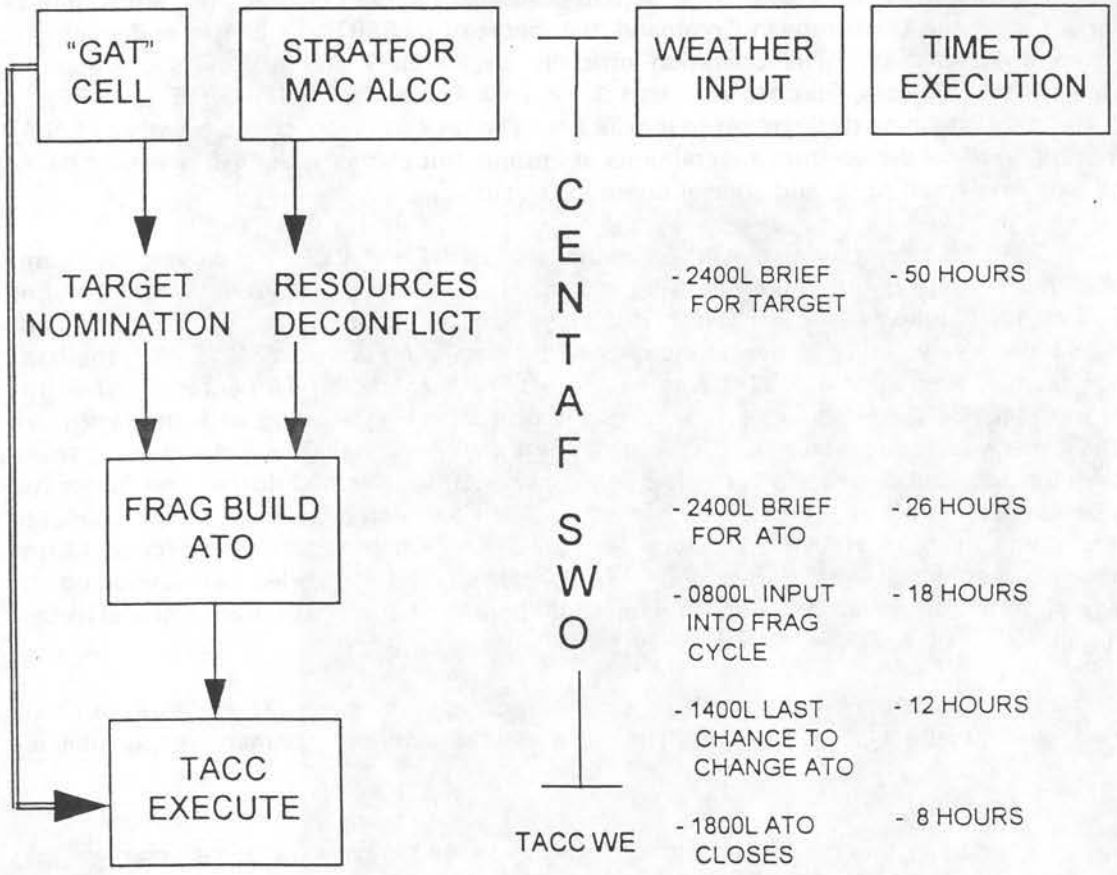
[24]AWS DS/DS Report #2 (S), pp 87-88 (Sec 4.1.3.2-b), info used (U).

[25]AWS DS/DS Report #1 (S), pp 14-15 (Sec 5.2.1, Fig 8), info used (U).

[26]AWS DS/DS Report #1 (S), pp 19, 22 (Secs 5.2.2, 5.2.2.2.1, 5.2.2.2.2, 5.2.2.2.3), info used (U); AWS DS/DS Report #2 (S), p 88 (Sec 4.1.3.3-d), info used (U).

CENTAF PLANNING CYCLE

Schematic of the target nomination, planning, and execution cycle with key weather input points.



SOURCE: AWS DESERT SHIELD/DESERT STORM Report #1 (S), p 15 (Fig 8), info used (U).

Figure VI-5

radar ducting. The team also briefed the wing battle staff daily, presented from two to four take-off briefings each day, and operated the TPS-68 tactical radar AWS had sent to the island.[27]

Support to Operation PROVEN FORCE

AWS also supported DESERT STORM from outside of the Persian Gulf theater by providing weather support for Operation PROVEN FORCE, a joint operation directed by the US Joint Chiefs of Staff and conducted by the US European Command in support of DESERT STORM from Turkey and the eastern Mediterranean Sea. The operation officially began on 7 January, 1991, when the Commander in Chief, US Forces, Europe, activated Joint Task Force, PROVEN FORCE (JTF-PF), at Ramstein AB, Germany, pending deployment to Incirlik AB. The task force consisted mostly of US Air Force aircraft and personnel drawn from several units in Europe, but also included Navy carrier-based planes as well as a few small Army and special operations units.[28]

A total of 23 AWS personnel deployed to Turkey for PROVEN FORCE. All except four came from the 2d Weather Wing (three from the 5th Wing's 5th Squadron, one from the 3d Wing). The first seven deployed on 14 January; all except two had deployed by 18 January. The 2d Wing regularly operated a peacetime base weather station at Incirlik. At the beginning of PROVEN FORCE, the base weather station team (Detachment 19, 31st Weather Squadron) consisted of 14 persons. When the JTF-PF deployed to Incirlik, the wing appointed one of the officers it was sending with the task force to augment the base weather station staff. Eleven of the other 2d Wing JTF-PF deployees (seven officers, four forecasters) supported the Air Force component of the joint task force; one forecaster (the 3d Wing deployee) directly supported SAC operations. The remaining ten weather personnel (4 officers, 5 forecasters, one observer) who deployed with the JTF-PF supported the Air Force and Army special operations forces which were part of the JTF-PF. Half stayed at Incirlik, half (including the three deployees from the 5th Squadron) went to a forward operating base. Lieutenant Colonel Robert Allen served as the OIC of the JTF-PF WSF.[29]

The OICWSF monitored the Incirlik base weather station as well as the JTF-PF WSF, but tried to keep their functions distinct and separate. The base weather station's primary responsibilities

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[27]Msg (S), OL-D, 1690WGP/OIC to CENTAF Weather, et al, "DESERT SHIELD/DESERT STORM AAR," 8 parts, 210801Z-210808Z Mar 91, info used (U).

[28]Msg (S), Ops Support Ctr/JTF PROVEN FORCE/J6 to USEUCOM/ECJ6 DT, et al, "Activation of Joint Task Force PROVEN FORCE J6 Staff (U)," 081147Z Jan 91, info used (U); msg (S), Ops Support Ctr/JTF PROVEN FORCE JTFCS to USCINCEUR ECJ6/SPACUS, et al, "JTF PROVEN FORCE SITREP 001 8 Jan 91 (U)," 081800Z Jan 91, info used (U); msg (S), 2WW/CAT to USCINCCENT Weather, et al, "PROVEN FORCE Issues (U)," 091830Z Jan 91, info used (U); msg (S), CJCS to USCINCEUR, et al, "PROVEN FORCE Support (C)," 170418Z Jan 91, info used (U); msg (S), 2WW/DOX to AWS/DOJ, et al, "PROVEN FORCE After Action Report (U)," 230800Z Apr 91, hereafter cited as 2WW PROVEN FORCE AAR (S), Sec 1 (p 1), info used (U).

[29]2WW PROVEN FORCE AAR (S), Sec 2 (pp 1-2), info used (U). For the names of all except two of the 23 AWS persons who deployed to JTF-PF, see msg (S), 2WW/CAT to HQ AWS/CAT, et al, "PROVEN FORCE Deployed Personnel Status #2 (U)," 202000Z Jan 91, no info used; and 2WW/CAT to HQ AWS/CAT, et al, "2WW PROVEN FORCE SITREP #20 as of 041800Z Feb 91 (U)," 041800Z Feb 91, no info used.

continued to be providing support for the base itself, local missions, and transient aircraft. The JTF-PF WSF, on the other hand, provided support mostly to the composite air wing (provisional) formed at Incirlik for PROVEN FORCE and the special operations units at Incirlik and the forward operating base. The weather team at the composite wing provided weather support for the planning, enroute, and execution stages of the wing's combat missions.[30]

The JTF-PF WSF regularly briefed the JTF-PF and the JTF-PF Air Force staffs--at first daily, but later 3 and 5 days a week, respectively. It also furnished a number of weather products, including a twice-daily planning flimsy, a daily 0- to 72-hour planning weather forecast for JTF Operations and the TACC's Air Tasking Order shop, a daily nephanalysis, a mission flimsy for each aircraft launch, and terminal aerodrome forecasts for the special operations forward operating base four times daily. To assist it in developing these products, the WSF was able to utilize centralized products it obtained from AFGWC, the DSFU, and from a few non-AWS sources. Probably the WSFs single most useful product was forecast wind profiles. The JTF-PF special operations weather team gave daily briefings to the JTF-PF special operations staff and personnel at the Army special forces operating base at Incirlik and forward operating location. It also provided various kinds of weather products tailored to the needs of its customers.[31]

The PROVEN FORCE WSF began redeployment to home stations a few days after DESERT STORM hostilities ended on 28 February. The first of its members to depart, two officers and two forecasters, left Incirlik on 5 March. All 23 USAF personnel had redeployed by 18 March.[32]

Support to the US Central Command Army Forces

Deteriorating weather, the movement of US Army forces into offensive positions, and eventually the ground war itself dramatically increased the demands upon the ARCENT WSF for weather products and forecasts in January and February 1991. ARCENT Weather's briefing requirement rose from two to four per day on 23 January: one for General Yeosock and his staff in the morning, two for intelligence support, and one for target assessment. Three days later the ARCENT SWOs began to brief the Operations and Intelligence Center at the twice-daily shift change times. ARCENT Weather's briefing load reached its peak of seven per day on 24 February when General Yeosock began to require an early evening (1700 local time) weather update in addition to the morning briefing. All the briefings included a synoptic discussion, a 24-hour plain language forecast for the operational theater, a light data slide portraying the periods of high and low risk for using night vision

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[30]2WW PROVEN FORCE AAR (S), Sec 1 (pp 1-2), info used (U).

[31]2WW PROVEN FORCE AAR (S), Sec I (pp 2-3), Sec II, (p 4), Sec III (pp 1-2), info used (U); msg (S), 2WW/CAT to HQ AWS/CAT, et al, "2WW PROVEN FORCE SITREP #31 as of 151730Z Feb 91 (U)," 151830Z Feb 91, info used (U); msg (S), 2WW/CAT to AWS/CAT, et al, "PROVEN FORCE Strike Products Verification (U)," 272130Z Feb 91, info used (U).

[32]Msg (U), 2WW/CAT to HQ AWS/CAT, et al, "2WW PROVEN FORCE SITREP 47 as of 051730Z Mar 91," 061730Z Mar 91; msg (U), 2WW/CAT to HQ AWS/CAT, et al, "2WW PROVEN FORCE SITREP 53 as of 181600Z Mar 91," 181600Z Mar 91.

goggles, and, beginning 17 February, a weather effects matrix (including a red-yellow-green forecast) for the theater.[33]

ARCENT Weather also provided other types of support to the Headquarters ARCENT staff during DESERT STORM. For instance, it supplied a detailed climatological analysis of the KTO to the Army's 513th Intelligence Brigade. The brigade used the analysis in developing a detailed Intelligence Preparation of the Battlefield document as part of the planning for the ground war. It also issued a 72-hour plain-language forecast for Riyadh, Dhahran, and King Khalid Military City twice every day, and a 72-hour plain-language forecast for southern Iraq and the KTO once each day. In addition, ARCENT Weather advised the ARCENT staff as to the weather impacts on electro-optical reconnaissance operations, which at times persuaded intelligence collection managers to change to collection systems that were not dependent upon weather.[34]

ARCENT Weather's responsibilities included not only planning support to Headquarters ARCENT, but also direct support to subordinate weather teams. Most importantly, it supplied them with the TOAF, but it also sent them the weather packages and chemical downwind messages it provided to the ARCENT staff and issued military weather advisories for specific points in the Army's area of operations. Providing this support, not to mention retaining operational control over the teams, became a major challenge during DESERT STORM. Indeed, maintaining any contact with them at all became difficult, especially after the ground war began. This was because in late January the teams began to "jump" with their customers. When their units jumped, the weather teams had to dismantle their weather station, pack up their weather gear and stow it aboard trucks and other vehicles, and reestablish their station at the new location. Weather teams assigned to Army divisions rapidly advancing into Iraq during the ground war--eleven teams were in Iraq by 25 February--had a hard time keeping up with their units, not to mention finding time to set up their weather equipment before jumping again. Therefore, jumping weather teams usually had to suspend operations for shorter or longer periods of time. During such times they missed out on weather being sent to the field by their corps weather team or ARCENT Weather and could not take and transmit their own weather observations.[35]

To assist weather teams in this situation, the ARCENT Weather NCOIC, Master Sergeant William J. Boyle, developed a special contingency weather package tailored for jumping weather teams. This new product was designed to bring a team back "up to speed" as soon as possible by filling its data gap and apprising it of current and forecast weather conditions. It consisted of the past weather picture, the current and forecast synoptic situation, a 12-hour forecast for the team's new location, and the latest position of all weather teams in the ARCENT operational area. Having prepared as much of the package as it could in advance, ARCENT Weather had it ready to send out as soon as a team

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[33]AWS DS/DS Report #1 (S), p 24 (Sec 5.3.1), info used (U); ARCENT SWO AAR (U), pp 7-8 (Sec I-3c), Atch I-2-3.

[34]AWS DS/DS Report #1 (S), p 24 (Secs 5.3, 5.3.1), info used (U); AWS DS/DS Report #2 (S), p 90 (Sec 4.1.4.2), info used (U).

[35]AWS DS/DS Report #2 (S), p 90 (Sec 4.1.4.2), info used (U); ARCENT SWO AAR (U), pp 7-8 (Sec I-3c); Weaving Intvw (U), pp 24-25; Campbell Intvw (U), pp 21-22, 26. For an account of weather team operations during the jumping process from the perspective of a jumping weather team, see Bridges/Bullard Intvw (U), pp 13-19; and McDonald/Spendley Intvw (C), pp 25-27, no info used (U).

reestablished communication. This proved to be of real help to the jumping weather teams. ARCENT Weather issued its first contingency weather package on 26 January.[36]

In return, jumping weather teams took weather observations whenever possible and did their best to get them to their corps team or to ARCENT Weather. Their efforts to transmit the observations were hampered not only by the disruption in communications capability caused by the jumps, but also by the radio silence frequently imposed by ARCENT. In some cases, however, the Army Signal Corps helped them out by providing access to corps, division, and regimental AUTODIN circuits. In spite of the handicaps under which its weather teams worked, ARCENT Weather received 812 observations during the 4 days of the ground war (the first on 24 February from the weather team of the 101st Air Assault Division), 84 percent of which came from jumping teams.[37]

Meanwhile, both jumping and stationary weather teams performed to the best of their ability their first responsibility, which was to support the commander of the Army unit to which they were attached. For this they normally relied primarily on the TOAF. Jumping weather teams, however, blended the information they received in the contingency weather package with the data they got in the TOAF. Army weather teams continued to support their units with the usual weather briefings and weather flimsies as well as 24-, 48-, and 72-hour forecasts. They kept their commanders apprised of current and changing weather conditions and most also informed them of weather impacts on upcoming operations, generally in a graphic form using the red/yellow/green format. Teams with aviation brigades also provided EOTDA support.[38]

On occasion, especially during the ground war, Army weather teams were able to provide their commanders with weather "windows of opportunity" that would help them to accomplish their objectives. For example, the 101st Air Assault Division's weather team informed its commander that weather would be favorable for a helicopter assault into the Tigris-Euphrates Valley deep inside Iraq from early afternoon on 26 February until 0000 local time on the 27th, at which time fog would begin to form. This came after the commander had postponed the operation both in the evening of the 25th and the morning of the 26th based on the team's predictions of unfavorable weather. Relying on the new forecast with its predicted window, the division launched its assault at 1430 on the 26th and successfully completed it before the weather again deteriorated.[39]

The XVIII Corps also successfully used a window of opportunity to which it was alerted by its weather team. On 25 February the corps wanted to immediately launch a helicopter mission to rescue a long-range surveillance team deployed in Iraq beyond the front lines which, because its position was compromised, requested extraction. The XVIII Corps SWO, Major Conley, and a forecaster, Technical Sergeant Paul A. Strickler, however, advised delaying the search and rescue effort because of cloud cover, high winds, and poor visibility at the team's location. The front containing the clouds, they

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[36]AWS DS/DS Report #2 (S), pp 90-91 (Secs 4.1.4.2, 4.1.4.4), info used (U); AWS DS/DS Report #1 (S), p 25 (Sec 5.3.2), atch 3, info used (U); ARCENT SWO AAR (U), pp 7-8 (Sec I-3c), Atch I-2-3; Frederick Intvw (U), p 15.

[37]AWS DS/DS Report #1 (S), p 25 (Sec 5.3.2), info used (U); ARCENT SWO AAR (U), p 7 (Sec I-3c), Atch I-2-3.

[38]AWS DS/DS Report #1 (S), p 25 (Sec 5.3.2), info used (U); ARCENT SWO AAR (U), p 8 (Sec I-3c); Campbell Intvw (U), p 19.

[39]AWS DS/DS Report # 1 (S), p 31 (Sec 6.3-d), info used (U); ARCENT SWO AAR (U), p 8 (Sec I-3c); Capt M.H. McDonald in McDonald/Spendley Intvw (C), pp 27-30, info used (U).

predicted, would move to the east in a few hours (it turned out to be four) and as it did so, the sky would clear and the winds would die down. When the front passed, the helicopters could fly due north and approach the team's position from the west while using the trailing edge of the cloud bank associated with the receding front as cover for the infiltration and extraction. The forecast was exactly accurate and the mission was successful. When the mission pilots returned, they made it a point to come to the corps weather station and state, "You guys get credit for that save."[40]

Both ARCENT Weather and Army weather teams in the field furnished their customers with weather information applicable to what were perhaps their three primary, weather-related concerns--chemical warfare, trafficability, and flying weather. All during DESERT STORM coalition ground forces lived with the fear that Iraq might launch a chemical attack against them. As it turned out, Iraq never did, if only because the weather, meaning primarily the prevailing northwest winds, made it risky. Not knowing this, Army units were always eager to receive the daily chemical downwind messages provided by their weather support teams predicting, based on wind and temperature data, the likely dispersion characteristics of chemical agents for the next day. They also wanted to know terrain features and weather conditions that would impede movements of tanks, vehicles, and personnel since the outcome of battle might well hinge on these factors. Weather teams provided vital support to Army combat engineers in this area. Given the Army's dependence on helicopter support, Army units, aviation brigades in particular, needed information concerning weather effects on helicopter operations. Here again, their supporting weather teams were able to help them.[41]

Support to US Central Command Special Operations Forces

SOCCENT Weather's support to the SOCCENT staff did not change with the coming of DESERT STORM. It continued to provide briefings and planning forecasts. The AFSOC weather team's work, however, increased during DESERT STORM as it began to prepare two alert packages each day in support of combat search and rescue missions. The package contained a horizontal weather depiction for the area, a plain language forecast, and forecasts for bases of interest. The AFSOC team also supplied wind forecasts for 17 leaflet drops conducted by AFSOC's Psychological Operations Section. The leaflets tried to persuade Iraqi troops to surrender. In addition, an AFSOC forecaster accompanied a psychological operations team to the Iraqi border to observe wind readings, using a Marwin upper air sounding system which he took with him, and make short-term forecasts to enhance the accuracy of the leaflet drops. During January and February 1991 the AFSOC weather team provided a total of 994 flight support briefings. Meanwhile, the weather team of ARSOC's 5th Special Forces Group furnished support for the wartime operations of its unit.[42]

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[40]AWS DS/DS Report #1 (S), pp 31-32 (Sec 6.3-e), info used (U); Frederick Intvw (U), p 15; Weaving Intvw (U), p 29; Conley Intvw (U), pp 10-11.

[41]Conley Intvw (U), pp 4-6; AWS DS/DS Report #2 (S), p 90 (Sec 4.1.4.2), info used (U); Weaving Intvw (U), p 30.

[42]AWS DS/S Report #1 (S), p 25 (Secs 5.4, 5.4.1, 5.4.2), info used (U); AWS DS/S Report #2 (S), p 94 (Sec 4.1.5.2), info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Impacts on Leaflet Drops--DESERT STORM (U)," 121250Z Mar 91, info used (U); Capt W.J. Spendley in McDonald/Spendley Intvw (C), pp 8-9, info used (U).

An AWS special operations weather team tactical element deployed by AWS to the Persian Gulf during DESERT SHIELD also played a small role in the Gulf War. It began DESERT STORM under the operational control of the 1723d Special Tactics Squadron with the responsibility of providing weather support to combat search and rescue missions from forward operating locations. However, since there were few aircraft losses during the air campaign and, consequently, little need for search and rescue missions, SOCCENT changed the tactical element's focus. In early February it directed the element to deploy with the 1723d Squadron to airfields occupied by coalition ground forces during the anticipated ground campaign and provide the initial weather support from these airfields. On 28 February, the tactical element arrived with elements of the 1723d at Kuwait City International Airport, liberated by US Marines two days earlier, and immediately began taking weather observations and passing them back to AFSOC via SOCCENT.[43]

Wartime Experiences

Living Conditions

Most CENTAF weather support teams continued to work and live in the same facilities and under the same conditions during DESERT STORM that they had during DESERT SHIELD. For most Army support weather teams, however, it was a different story, especially in respect to living conditions. Their living conditions, very austere to begin with, became worse when their Army units moved into tactical assembly areas in northern Saudi Arabia along the Kuwait and Iraq borders during the air campaign phase. Each person now received a "shelter half," or half-tent. Two of these together created a tent of sorts which was big enough for only one person to sleep in--the idea being that two people would share the tent and sleep in shifts. The tents blew down easily and did little to shelter an individual from rain or blowing sand and dust. Many persons just tried to get by with their shelter half or slept out in the open covered only by a poncho. In short, most Army weather teams lived out in the open without much in the way of shelter.[44]

For the Army weather teams rapidly advancing into Iraq with their units during the four-day ground campaign, conditions only got worse. For the most part they lived out of vehicles and slept on the ground. It now even became difficult to find time to rest and sleep. The teams carried their weather equipment in their vehicles or on their backs, and usually had to set it up out in the open--on those occasions when their units stopped long enough for them to even unlimber their equipment. The 1st Infantry Division (Mechanized)-Main (i.e., headquarters) team, however, operated out of a mini-weather station it had set up in its 5-ton van.[45]

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[43]AWS DS/DS Report #2 (S), pp 94-95 (Sec 4.1.5.2-b), info used (U); atch 6 (U), "TE Events in Planning and Executing Ground Campaign Support," to ARCENT SWO AAR (U).

[44]Capt M.H. McDonald in McDonald/Spendley Intvw (C), pp 18-21, info used (U).

[45]Capt M.H. McDonald in McDonald/Spendley Intvw (C), pp 30-31, info used (U); Weaving Intvw (U), p 32; see above, Chapter II, pp 30-31. For an account of conditions with the 1st ID(M) during the 4 days of the war, see Bridges/Bullard Intvw (U), pp 17-29.

Exposure to Wartime Dangers

CENTAF weather support teams, for the most part, did not experience additional danger as a result of the war. Many were stationed at air bases far from the combat area and generally did not have to fear enemy attack. CENTAF Weather, as well as the other two headquarters weather units and any weather teams located in and around Riyadh, along with the teams near Dhahran, however, were exposed to Iraqi Scud missile attacks. Twenty-six of the missiles fell on Riyadh alone. The attacks occurred most often during the first two or three weeks of the air campaign and usually during the night, thereby disrupting both work and sleep. When Scud alerts sounded, personnel had to don chemical protective gear and proceed to bomb shelters. Once a Scud shot down by a US Patriot anti-missile battery landed a block away from the RSAF Building in Riyadh where CENTAF Weather was located, knocking plaster from the ceiling of the DSFU room on to the head of the QRCT operator. At another time a Patriot battery intercepted a Scud right over the building. Captain Dickey, OIC of the weather team at Dhahran International Airport, estimated that her team experienced 10 to 12 Scud alerts. On one of these occasions an intercepted Scud plunged to earth only about 50 yards from the hardened F-15 alert hangar where the base weather station was located. It shook the whole facility but did not cause any damage.[46]

On the other hand, most ARCENT weather teams entered dangerous combat areas during the DESERT STORM ground campaign as they advanced into Iraq and Kuwait with the units they supported. The 24th Infantry Division weather team jumped a total of approximately 200 miles in the 100 hours of the ground war as the division swung in a wide arc through Iraq from the Saudi border, around the west and north of Kuwait to the vicinity of Basrah, the Iraqi port city near the head of the Persian Gulf. A member of the 101st Air Assault Division's weather team, Sergeant Charles W. Lindstrom, volunteered to serve as door gunner on the CH-47 helicopter transporting an initial three-man element of the team to the forward operating base the division was establishing approximately 70 miles inside of Iraq. The element was part of the second wave the 101st deployed to the base by helicopter. Although at the time the division had not yet fully secured the base, the sergeant did not have to use his weapon.[47]

The 1st Infantry Division (Mechanized) showed great confidence in Captain F. Paul Bridges, the OIC of the weather team, when during the ground offensive it chose him to lead its entire support element convoy of about 167 vehicles into "the eye of the storm" in chase of the division's tanks and Division-Main rapidly advancing into Iraq. At one point, when the convoy got trapped in cross fire from enemy tanks, the captain quickly circled his convoy and brought them to safer ground. The division commander, Major General Thomas G. Rhame, later was lavish in his praise of the soldiering skills shown by the division's weathermen, saying that "his" Air Force weathermen "out-soldiered" his own soldiers.[48]

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[46]Riley Intvw (S), p 14, info used (U); Campbell Intvw (U), pp 27-28; Capts J.D. Murphy and T.E. Coe in Murphy/Coe/Johnson Intvw (U), pp 20-21; Conley Intvw (U), pp 8-9; Dickey Intvw (U), pp 12-15.

[47]5WW DS/DS Summary Brfg (S), slide (paper copy) 49, info used (U); Capt M.H. McDonald in McDonald/Spendley Intvw (C), pp 25, 31, info used (U); map (U), "The 100-Hour War, Feb. 24-28," Time, p 18.

[48]Note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

Captain Bridges, along with one of the members of his 1st Infantry Division weather team, was also involved in what was perhaps the most unique wartime incident involving AWS weather teams. The episode occurred in western Iraq on the last day of the war. Shortly after midday, while his 1st Infantry Division weather team was traveling across the desert with the division's Division-Main following the rapidly advancing main forces of the division, the captain was forced to stop the vehicle in which he and Airman First Class Charles M. Limbaugh were riding because of a broken fuel filter. Captain Bridges ordered the rest of his weather team to continue with the Division-Main convoy while he and Airman Limbaugh attempted to repair their vehicle. Before they could decide what to do, 25 Iraqi soldiers emerged from a nearby bunker, initially causing the two men to fear for their lives. It soon became apparent, however, that the Iraqis merely wanted to surrender. Captain Bridges and Airman Limbaugh accepted their surrender and, after fixing their vehicle by installing a usable fuel filter they found in an abandoned vehicle nearby, told the Iraqis to wait near the road until someone came to get them. Proceeding on, the weathermen reached the Division Main, which had come to a halt about 1600, where they immediately reported the "capture" to the military police. The police then went back and picked up the "prisoners." In a similar incident, two other Iraqi soldiers surrendered to the weather team of the 1st Infantry's aviation brigade.[49]

The day before they "captured" the 25 Iraqi solders, Captain Bridges and Airman Limbaugh, along with two other men of the Division-Main weather support element, Staff Sergeant Duane P. Bullard and Airman Mark V. Thompson, experienced a momentary scare when temporarily stranded in Iraq a short distance west of Kuwait due to a battery fire in the 5-ton van that served as the team's weather station. The weathermen managed to put out the fire, caused by bouncing across the roadless desert at speeds up to 50 miles per hour as part of the Division-Main convoy trying to catch up with the rapidly advancing main forces of the division, and get the batteries working again. However, while they worked on the van two US Air Force F-15 jet fighters returning from a mission over Iraq spotted the men and their vehicles (the van and Captain Bridges' vehicle) and circled overhead. One of the F-15s then began what appeared to be a strafing run, but at the last moment veered off when apparently the pilot recognized the vehicles as American. During this same time one of two Apache helicopters flying over also seemed ready to launch an attack, but it, too, left without doing so.[50]

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[49]Rprt (U), Capt F.P. Bridges, Det 19, 1690WGP/OIC, to ARCENT SWO, "Initial After Actions Report," 6 Mar 91, para 7 (also found in atch 5 (U), excerpts from rprt, Det 19, 1690WGP to ARCENT SWO, "Initial After Actions Report," 6 Mar 91, to ltr (U), Weaving to Collens, 15 Apr 91, w/6 atchs); Capt F.P. Bridges in Bridges/Bullard Intvw (U), pp 25-27; ltr (U), 1690WGP/CV to 5WW/DO, "Weather Support To DESERT SHIELD/STORM," 6 Mar 91.

[50]Rprt (U), Capt F.P. Bridges, Det 19, 1690WGP/CC, to ARCENT SWO, "Initial After Actions Report," 6 Mar 91, para 6 (also found in atch 5 (U), excerpts from rprt, Det 19, 1690WGP to ARCENT SWO, "Initial After Actions Report," 6 Mar 91, to ltr, Weaving to Collens, 15 Apr 91); SSgt D.P. Bullard in Bridges/Bullard Intvw (U), pp 20-21.

Technical Accuracy of Forecasts

Accuracy of Initial DESERT STORM Forecasts

The forecast that CENTAF Weather provided General Horner on the afternoon of 16 January for the start of the air campaign, scheduled to begin less than twelve hours later, was very accurate. It predicted there would be no significant weather (scattered clouds at 8,000 feet and light southwest winds at 3 knots), except for some fog in low-lying river areas. Based on pilot reports, the forecast verified except for the formation of some patchy fog west of Baghdad toward morning that prevented attacking aircraft from hitting a few primary targets during the last wave of air strikes for the night.[51]

The initial forecast for the ground war, however, was less accurate. The weather proved to be considerably worse than forecasted. The latest JOAF prior to the attack (issued at 1500 local time on 23 February) predicted an 8,000 foot ceiling, 5 knot southeast winds with gusts up to 15 knots, and 2 miles visibility with smoke and haze until 0800 local time, 3 miles thereafter, for the KTO on 24 February. It also indicated the possibility of thunderstorms and rainshowers "in the vicinity" until 0700 local time. In actuality, the ceiling was 1,000 feet, the winds strong at 15-20 knots with gusts as high as 35 knots, and visibility only one-half mile in blowing sand. Isolated rainshowers occurred. Clearly, however, even if CENTCOM decisionmakers had known what the weather was actually going to be in the operational theater on 24 February, they would not, on that account, have postponed the beginning of the ground war. The weather still would not have been bad enough to cause delay and, in any event, weather was only one factor weighed in deciding when to attack. Other factors such as political considerations and troop readiness probably carried more weight.[52]

As it turned out, the weather did not impede the advance into Kuwait and Iraq. Indeed, in retrospect, it probably helped the offensive. For example, if the coalition ground forces had moved on clear calm days, they would have lost the element of surprise because the Iraqis could have seen the dust plumes created by the advancing tanks from perhaps as far away as 100 miles over the flat terrain. This would have given them at least a 2-hour warning. Instead, strong winds stirred up the dust, causing, as captured Iraqi tank commanders later confessed, the Iraqis to be unaware of the approach of coalition forces until they heard the tank engines or saw explosions. Moreover, since they would quickly disperse the chemical agents, the strong winds greatly reduced the likelihood of the Iraqis launching a chemical attack, a constant worry of General Schwarzkopf during the ground campaign.[53]

Nevertheless, the question naturally arose as to why the flawed forecast. One answer came from AFGWC. It concluded that an intense cyclogenesis--the first seen in the KTO since the beginning

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[51]Riley Intvw (S), p 32, info used (U); Shaffer/Keefer DESERT STORM Analysis Brfg (S), brfg script, slide (paper) 26, info used (U); memo (U), HQ 5WW to AWS/DO, "Answers to AWS/CC Questions on OPVER Briefing," 13 Mar 91; 5WW DS/DS Summary Brfg (S), slide (paper) 37, info used (U).

[52]Shaffer/Keefer DESERT STORM Analysis Brfg (S), brfg script, slide (paper) 27, info used (U); memo (U), HQ 5WW to AWS/DO, "Answers to AWS/CC Questions on OPVER Briefing," 13 Mar 91; 5WW DS/DS Summary Brfg (S), slide (paper) 48, info used (U); Frederick Intvw (U), p 15; Riley Intvw (S), pp 32-33, info used (U).

[53]Note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

of DESERT SHIELD, which forecasters could not have predicted more than twelve hours in advance, was an important factor. It ascribed the cyclogenesis to the conjunction of subtropical moisture streaming into the theater from Africa and an upper air level diffluence of two jetstreams over Saudi Arabia. Colonel Goldey basically agreed with AFGWC, but theorized that the burning oil wells in Kuwait might have contributed to the intensity of the cyclogenesis, not only due possibly to the heat released by the fires, but also the tremendous local increase in condensation nuclei due to the high concentration of smoke from the oil fires.[54]

Operational Verification Policy

AWS did not establish a formal operational verification program in the DESERT SHIELD theater. Indeed, it decided early on in the operation not to require deployed units to verify their forecast products. Important considerations driving this decision were the barely adequate size of the deployed weather teams and, particularly, an earlier decision not to deploy station chiefs. Nevertheless, after the air campaign began, Headquarters AWS, with an eye to documenting the value of weather support after DESERT STORM was over, instructed the 5th Weather Wing to ascertain what deployed units were doing to verify their products. The wing discovered that they were doing very little by way of formally collecting and storing verification statistics, as might be expected given the absence of an operational verification program, and consequently little or no verification data was available. Deployed units, however, often informally obtained a sense of the accuracy of their products by getting feedback from their customers and talking to pilots.[55]

In view of Headquarters AWS's interest in obtaining verification data, the CENTCOM, CENTAF, and ARCENT SWOs, in conjunction with the 5th Wing, now set up a WSF operational verification program applicable to both the headquarters and field levels. Most units, however, did not implement the program, primarily because they had neither the manpower nor the experience to do so while the war was going on and the workload was heavy. The headquarters weather units, however, during DESERT STORM managed to compile accuracy statistics for six types of forecast products: the DSFU JOAF, CENTAF three-day Strategic Planning Cell forecast, ARCENT TOAF, unit-level terminal aerodrome forecasts, EOTDA forecasts, and Operation PROVEN FORCE forecasts.[56]

Verification Statistics for Selected DESERT STORM Forecast Products

The verification statistics collected during DESERT STORM showed forecast accuracy to be generally above 75 percent for forecasts of up to 72 hours. Thus forecasts issued by the WSF were considerably better than "no-skill" or mere "persistence" (i.e., tomorrow's weather will be just like today's) forecasts would have been--about 15 percent better. Moreover, the statistics indicated that

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[54]Shaffer/Keefer DESERT STORM Analysis Brfg (S), brfg script, slide (paper) 27, info used (U); note (U), Col W.S. Weaving, USAF (Ret), to W.E. Nawyn, 10 Jan 95.

[55]AWS DS/DS Report # 2 (S), p 105 (Sec 4.1.7.1), info used (U); ltr (S), 5WW/CAT to AWS/CAT, "DESERT STORM OPVER (U)," 13 Feb 91, w/3 atchs, info used (U).

[56]AWS DS/DS Report #2 (S), p 105 (Sec 4.1.7.2), info used (U).

accuracy improved as the operation went on. Accuracy was more like 85 percent by the end of the war.[57]

The JOAF produced by the DSFU had an overall accuracy rate of 81 percent during DESERT STORM. This far exceeded persistence forecasts, which would have been about 62 percent accurate. DSFU cloud cover forecasts for February alone verified at 87 percent for 20,000 feet ceilings and at 78 percent for 10,000 feet ceilings. CENTCOM Weather planning forecasts provided to the CENTCOM staff were approximately 77 percent accurate for Baghdad, but somewhat less, 70 percent, for the KTO. Persistence forecasts for Baghdad and the operational theater would have been right slightly more than 60 percent of the time. Forecasts that CENTCOM Weather issued for weather reconnaissance missions verified at a high 91 percent.[58]

In the aggregate, the very important 3-day (72-hour), 10,000 feet ceiling forecasts which CENTAF Weather provided for the CENTAF Strategic Planning Cell from 29 January through 28 February were correct 70 percent of the time. Forecast accuracy for the first and second days (24- and 48-hour forecasts), however, increased to 76 and 74 percent, respectively, compared to a persistence forecast accuracy during the same period of 71, 59, and 56 percent for the first, second, and third days. Obviously, the accuracy of CENTAF Weather forecasts for the second and third days far exceeded that of persistence forecasts. (See Figure VI-6.) The 24-, 48-, and 72-hour forecasts for Baghdad specifically were, respectively, 76, 79, and 75 percent accurate. At 67, 70, and 68 percent, respectively, they were somewhat less accurate for the KTO.[59]

From 8 through 28 February, ARCENT Weather verified the TOAF it produced for its Army weather teams both in respect to the two separate versions it issued for the VII Corps and XVIII Corps operational areas (i.e., east and west of 47 degrees east longitude) and to four information categories: ceilings below 3,000 feet, visibility below 4,800 meters, precipitation (yes or no), and thunderstorms (yes or no). The TOAF forecasts for the eastern operational area were approximately 83 percent accurate for 0-12 hours, 82 percent for 12-24 hours, 75 percent for 24-36 hours, and 52 percent for 36-48 hours. For the area to the west of 47 degrees east longitude, the TOAF 12-, 24-, 36-, and 48-hour forecasts verified somewhat better at 82, 71, 71, and 68 percent respectively. Overall, the 24-, 36-, and 48-hour forecasts were well ahead of persistence in accuracy. In terms of specific categories, the TOAF 12-hour forecasts verified at l00 percent for ceilings, 100 percent for visibility, 90 percent for precipitation, and 76 percent for thunderstorms, while its 12- to 24-hour forecasts were 100 percent accurate for ceilings and visibility, 74 percent for precipitation, and 86 percent for thunderstorms. These forecasts, too, exceeded persistence except for ceilings in both time periods and for thunderstorms in the 0-to 12-hour forecasts.[60] (See Figures VI-7 and VI-8.)

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[57]AWS DS/DS Report #1 (S), p i (Exec Sum), info used (U); Frederick Intvw (U), p 14.

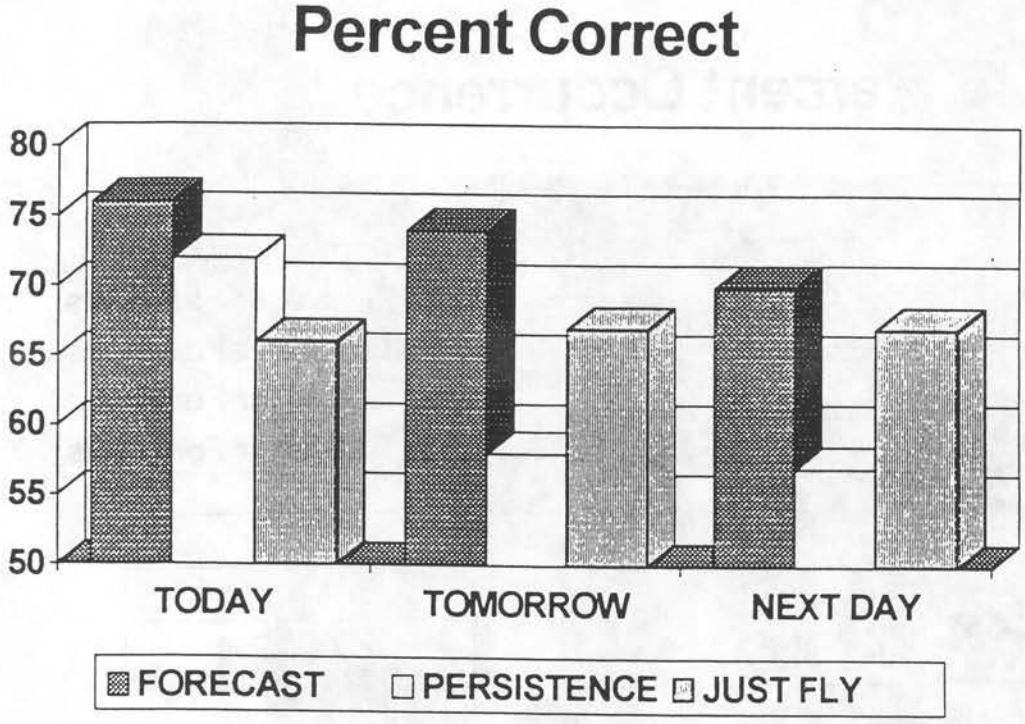
[58]AWS DS/DS Report #1 (S), pp 8-10 (Secs 5.1.1, 5.1.2, Fig 4), info used (U); AWS DS/DS Report #2 (S), p 105 (Sec 4.1.7.2-a), info used (U); brfg (S), 5WW/CAT for HQ AWS, "DESERT STORM Operational Verification," [28 Feb 91], slide (paper) 4, info used (U).

[59]AWS DS/DS Report #1 (S), pp 14, 16-18 (Secs 5.2.1.1, 5.2.1.2, 5.2.1.3, Figs 9,10,11), info used (U); AWS DS/DS Report #2 (S), pp 105-106 (Sec 4.1.7.2-b), info used (U); msg (C), CENTAF Weather to USCINCCENT Weather and 5WW/CAT, "February Operational Verification Results (U)," 041800Z Mar 91, info used (U).

[60]AWS DS/DS Report #1 (S), pp 24-27 (Sec 5.3.2, Figs 15, 16), info used (U); AWS DS/DS Report #2 (S), p 106 (Sec 4.1.7.2-c), info used (U).

AGGREGATE CENTAF PLANNING FORECAST ACCURACY

CENTAF planning forecast accuracy for all locations and all forecast issue times. Forecast is compared to persistence and "just fly" case of always assuming good weather.

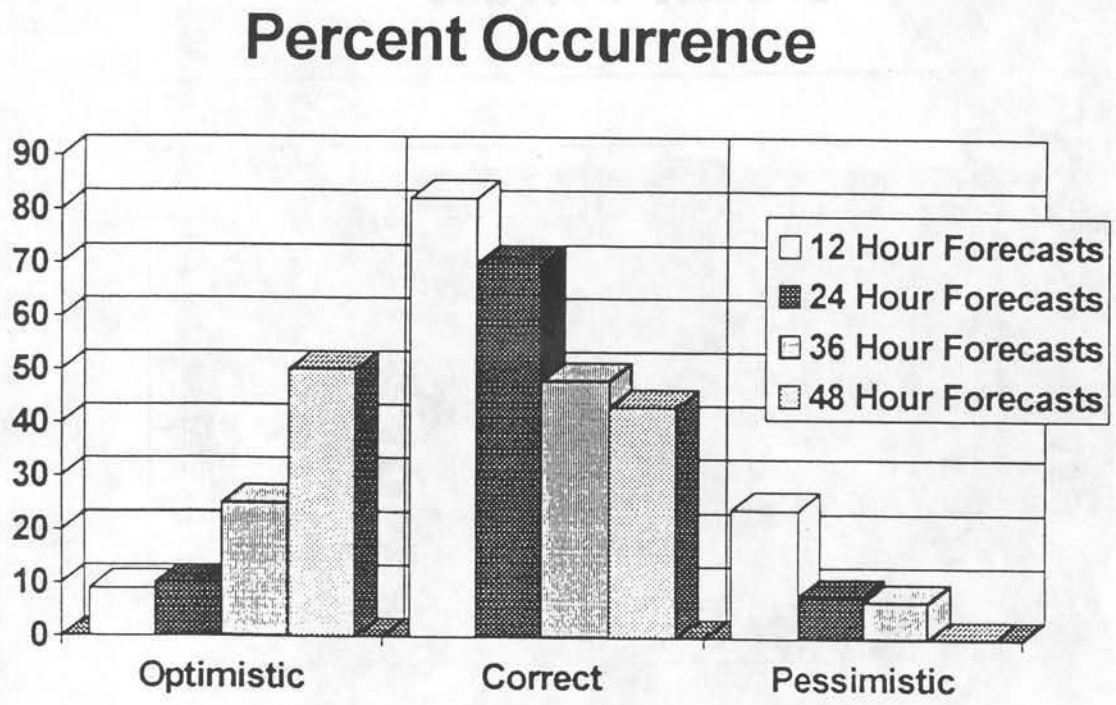


SOURCE: AWS DESERT SHIELD/DESERT STORM Report #1 (S), p 26 (Fig 11), info used (U).

Figure VI-6

ARCENT TOAF
FORECAST ACCURACY - EAST

ARCENT TOAF Forecast Accuracy east of 47° E longitude.

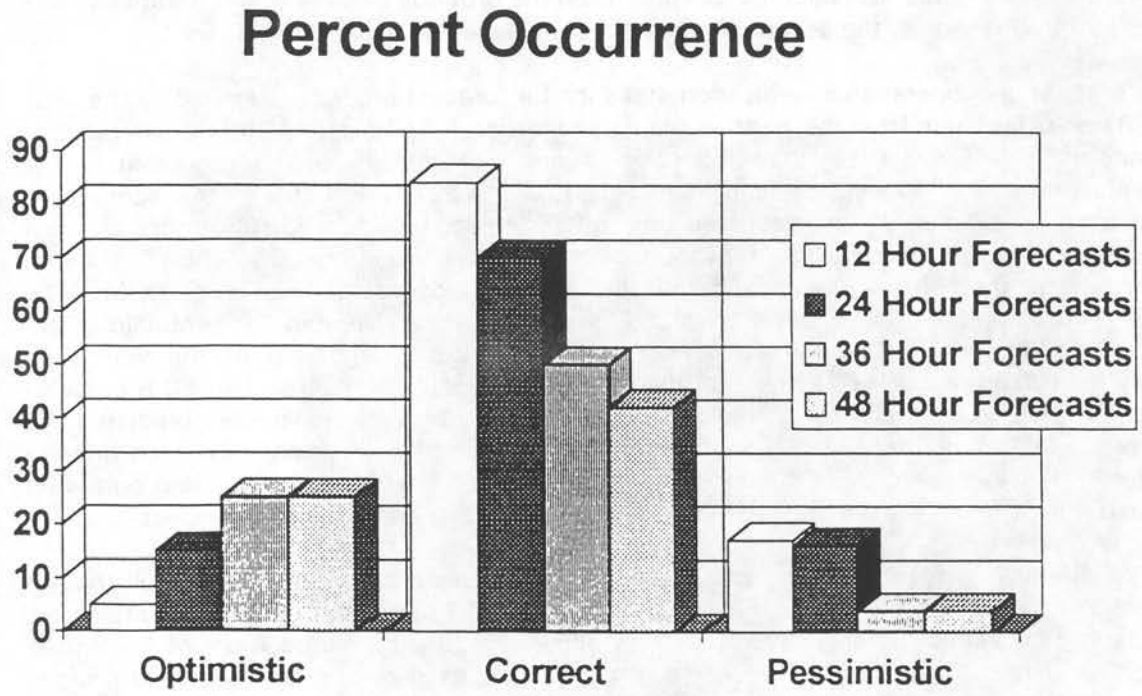


SOURCE: AWS DESERT SHIELD/DESERT STORM Report #1 (S), p 27 (Fig 16), info used (U).

Figure VI-7

ARCENT TOAF
FORECAST ACCURACY - WEST

ARCENT TOAF Forecast Accuracy west of 47° E longitude.



SOURCE: AWS DESERT SHIELD/DESERT STORM Report #1 (S), p 26 (Fig 15), info used (U).

Figure VI-8

The forecast accuracies for the remaining three types of products for which the headquarters weather units in Riyadh collected statistics varied from 76 to 100 percent. CENTAF unit-level terminal aerodrome forecasts verified at 90 percent, as did weather warnings and advisories when the weather teams had enough lead time. Weather warnings and advisories issued by ARCENT weather teams were 83 percent accurate in cases where they had sufficient lead time. Verification statistics for EOTDA forecasts were sparse since demand for mission-specific EOTDAs was very limited. CENTAF weather units verified only 32 EOTDA forecasts (31 for F-111 missions, one for an F-15 mission), all at the beginning of the air war before customers requested the more generic, situational awareness EOTDAs. All 32 were correct. Mission forecasts issued by the PROVEN FORCE WSF from 28 January through 28 February predicting favorable, marginal, or unfavorable weather conditions were correct 76 percent of the time. If, however, forecasts predicting favorable weather conditions when observed conditions were marginal were also counted as correct, on the grounds that marginal conditions were still above go/no go thresholds, the accuracy percentage increased to nearly 87 percent.[61]

Two other sets of operational verification statistics for forecast products supplied by the WSF during DESERT STORM came from the weather teams supporting F-117 "stealth" fighter aircraft and AFSOC. Since the F-117 was a new, high interest weapons system being tested in combat for the first time, the six-person F-117 support team (one officer, two NCOs, and two airmen) recorded its forecasts for each F-117 mission and debriefed the crew after each. Consequently, more forecast verification data existed for this weapons system than any other employed in DESERT STORM. Mission forecasts for the F-117 improved dramatically during the course of DESERT STORM. The coordinated products of the F-117 SWO, First Lieutenant Norman R. Modlin, and Lieutenant Colonel Riley at CENTAF Weather, the forecasts at the beginning of the war were approximately 60 percent accurate; by the end their cumulative accuracy had reached 80.5 percent. Put differently, in their joint forecasts, Lieutenant Modlin and Lieutenant Colonel Riley predicted the weather correctly in 103 of the 122 weather briefings delivered by the former, with each briefing covering 8 to 10 missions. The AFSOC support team ascertained that its wind direction and wind speed forecasts for SOCCENT's leaflet drop missions verified at 94 and 98 percent respectively.[62]

AFGWC's analysis of the medium- and extended-range forecasts for the Persian Gulf theater it issued from 24 December through 28 February also provided operational verification statistics. These forecasts, as indicated before,[63] were not very accurate. For the period from 24 December 1990 through January 1991, AFGWC's 4- to 7-day weather charts put weather fronts and troughs within 3 degrees of their actual locations only one-third of the time and pressure centers only one-fourth of the time. During the same period, however, cloud cover predictions in discussion bulletins were 67 percent accurate.[64]

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[61]AWS DS/DS Report #2 (S), p 106 (Sec 4.1.7.2-d,e,f), info used (U); brfg (S), 5WW/CAT for HQ AWS, "DESERT STORM Operational Verification (U)," [28 Feb 91], slides (paper) 8,13, info used (U); AWS DS/DS Report #1 (S), pp 22-24 (Secs 5.2.2.2.2, 5.2.2.2.4, Fig 23), info used (U).

[62]AWS DS/DS Report #2 (S), pp 62 (Atch 4), 73 (Atch 7), info used (U); AWS DS/DS Report #1 (S), pp 19-21 (Sec 5.2.2.2.1, Figs 12, 13), 25 (Sec 5.4.2), info used (U); memo (U), [HQ 5WW/CAT] to AWS/DO, "Answers to AWS/CC Questions on OPVER Briefing," 13 Mar 91; telecon (U), W.E Nawyn with Col G.F. Riley, AWS/XO, 31 Jan 95. Lieutenant Modlin was from Det 8, 25WS.

[63]See above, Chapter IV, p 75.

[64]Atch 1 (U), "Initial Verification Package," to ltr (U), AFGWC/CAT to AWS/CAT, "Extended MRF Verification," 6 Feb 91, w/ 1 atch.

In its analysis of statistics for 1-15 February, AFGWC included its 7- to 10-day extended medium-range as well as its 4-to -7 day medium-range forecast. During this period the forecast accuracy for fronts and troughs was 45 percent and for pressure centers 34 percent. Cloud cover forecasts were 47 percent accurate for the 4- to 7-day period and 32 percent for the 7- to 10-day period. Precipitation forecasts were accurate 20 percent of the time in the medium-range forecasts, only eleven percent in the extended medium-range forecasts. AFGWC added statistics for the 11- to 15-day extended outlook to its analysis of the last half of February. In general, accuracy percentages declined for this period. Predicted front and trough locations were within 3 degrees of actual locations only 18 percent of the time, pressure centers only 15 percent. Cloud cover accuracy slipped to 21 percent overall (23 for 4- to 7-day, 28 for 7- to 10-day, 16 for 11- to 15-day). Precipitation forecasts overall were 11 percent accurate (18, 5, and 10 percent for the three forecast periods).[66]

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[66]Atch 1 (U), "MRF Verification," to ltr (U), AFGWC/DO to AWS/CAT, "February 1991 MRF Verification," 4 Mar 91, w/1 atch.

CHAPTER VII

POST-HOSTILITIES OPERATIONS AND REDEPLOYMENT

After the Storm

President Bush's declaration of a provisional cease-fire on 27 February (28 February in the DESERT STORM theater) stopped offensive operations against Iraq by coalition military forces, but several weeks elapsed before the Gulf War officially ended. Three days after the President's declaration, General Schwarzkopf and other top coalition commanders met with Iraqi military officials to discuss the terms of the cease-fire. The Iraqis accepted all of the coalition's conditions, which included the immediate release of all prisoners of war and all Kuwaiti civilians held by Iraq and compliance by Iraq with all relevant UN resolutions. In keeping with a demand found in one of these resolutions, Saddam Hussein on 5 March rescinded his annexation of Kuwait.[1]

On 3 April the UN Security Council adopted a resolution proposed by the US and Britain to establish a permanent cease-fire. By so doing, it, in effect, voted to officially end the Gulf War if and when Iraq accepted the terms of the resolution. These terms included requirements that Iraq recognize the previous border between Iraq and Kuwait, "unconditionally" accept the destruction or removal of its nuclear weapons and facilities, chemical and biological weapons and facilities, and ballistic missiles with a range greater than 150 miles. The resolution also reaffirmed an earlier UN resolution stating that Iraq was liable for all losses and damage associated with its invasion and occupation of Kuwait. Although protesting that the terms were unjust, three days later Iraq agreed to accept them. The permanent cease-fire went into effect on 11 April 1991 (12 April in the Persian Gulf), the day Iraq officially accepted the resolution).[2]

Meanwhile, the coalition kept the pressure on Iraq by continuing air patrols and reconnaissance missions over the country and keeping ground forces in southern Iraq. Indeed, at one point (14 March), CENTCOM moved elements of a few Army units back to the cease-fire line as a show of force. However, at the same time the US began to reduce its forces in the Persian Gulf area. The redeployment phase of DESERT STORM officially began on 10 March, although small, symbolic troop withdrawals started on 5 March. By the time the UN adopted the permanent cease-fire resolution on 3 April, US forces in the Persian Gulf theater had already declined from their peak strength of 541,000 to about 370,000 and troops were leaving the theater at the rate of approximately 5,000 per day. By the end of April all Army forces had left Iraq and by mid-June had also departed Saudi Arabia. However, in a small counter-movement, the Army, during late May and early June, deployed a small

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[1]USAF/CAFH DS/DS Chronology (S/WN/NF), p 396, info used (U); art (U), "Bush's Demands," Time, 11 Mar 91, p 25.

[2]USAF/CAFH DS/DS Chronology (SWN/NF), pp 417, 429-430, 433, info used (U); Information Please Almanac, Atlas, and Yearbook, 1992, p 980; AWS DS/DS Report #2 (S), p 281 (App C), info used (U).

force to Kuwait to maintain a temporary American presence there. Meanwhile, as aircraft and personnel redeployed, CENTAF closed most of its bases in the theater; by late June only a few were still in operation.[3]

Neither the Air Force nor the Army had done much advance planning for redeployment; there was no overall redeployment plan. However, some action in this direction began as the end of DESERT STORM loomed. On 1 March, the day after the initial cease-fire went into effect, the CENTAF Commander, General Horner, issued a redeployment concept of operations which expressed the hope that redeployment would occur "in the same professional manner we deployed," announced the establishment of a CENTAF planning cadre, and directed deployed units to establish planning teams "to ensure an orderly...redeployment of your people and resources." The document also laid down "first in, first out" as the general redeployment principle for units to follow.[4]

In actual fact, however, redeployment,although to a large extent adhering to the first in, first out principle, was attended with a good deal of confusion. Units and personnel left at a much more rapid pace than originally envisioned. Most redeployed within three months of the end of hostilities. TAC initially attempted to establish and follow an Air Force redeployment TPFDD, but the TPFDD collapsed under the pressures of the redeployment flood which followed the permanent cease-fire.[5]

Post-War Weather Support Operations

The "combat" experiences of the 1st Infantry Division weather team did not end with the provisional cease-fire. The day it began, Staff Sergeant Bullard, Staff Sergeant John A. Walsh, Sergeant Rodney D. Swirk, and Airman Thompson came under hostile fire from a bunker occupied by Iraqi soldiers who were flying a white flag and presumably waiting to surrender. At the time the three men were on their way in a team vehicle to the 1st Division Aviation Brigade to drop off some mail and obtain some forms. Sergeant Swick, who was driving, immediately began to zigzag across the desert at high speed while the other men locked and loaded their weapons. However, they were soon out of range and neither the men nor the vehicle were hit.[6]

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[3]USAF/CAFH DS/DS Chronology (S/WN/NF), pp 395, 406, 424, info used (U); AWS DS/DS Report #2 (S), p 60 (Atch 3), info used (U); TAC DS/DS Chronology (U), pp 90,95; Capt F.P. Bridges in Bridges/Bullard Intvw (U), p 32; msg (U), USCENTAF/CC to 1TFW Deployed/CC, et al, "Redeployment Concept of Operations," 011255Z Mar 91; msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP #216 (U)," 291100Z Mar 91, info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP #224 (U)," 070930Z Apr 91, info used (U); note (U), Maj J.A. White, AWS/DO, to W.E. Nawyn, AWS/HO, ca 30 Sep 92; atch 1 (S), "List of Units Still Active (U)," 25 Jun 91, info used (U), to ltr (U), AWS/DO to HQ MAC/XPMO, "Deactivation of Provisional Units," 1 Jul 91, w/2 atchs.

[4]Goldey Intvw (U), p 33; msg (U), USCENTAF/CC to 1TFW Deployed/CC, et al, "Redeployment Concept of Operations," 011255Z Mar 91.

[5]Tkach Intvw (U), pp 19, 21.

[6]SSgt D.P. Bullard in Bridges/Bullard Intvw (U), pp 29-30; rprt (U), Capt F.P. Bridges, Det 19, 1690WGP/CC, to ARCENT SWO, "Initial After Actions Report," 6 Mar 91, Sec 1, Para 9.

The 3d Special Forces Group weather team was among the first Americans to arrive in Kuwait City after its liberation. The team, which had not been directly involved in DESERT STORM operations before, entered Kuwait City with an American military convoy on 28 February. On 2 March four of its members had the honor of participating at the first post-liberation flag-raising ceremony at the American embassy in Kuwait City. Also on 28 February another weather support team deployed with a MAC airlift control element to Kuwait City International Airport.[7]

The AWS WSF continued to provide weather support to its customers as long as they remained operational regardless of where they were. But the quick redeployment pace resulted in a rapid reduction in weather support requirements and, consequently, operations. CENTAF Weather shut down the QRCT network on 15 March and turned over responsibility for transmitting weather data to the weather teams in the theater to the base weather station at Incirlik AB with its "QRCT Plus." The DSFU ceased operations and passed its tactical forecast unit and JOAF responsibilities to AFGWC on 18 March. Two days later the TACC weather team began to function as CENTAF Weather. ARCENT Weather handed off production of the TOAF to the VII Corps weather team on 26 March. By mid-April no more weather teams remained in Iraq; except for the 3d Armored Division team in Kuwait, all were now in Saudi Arabia. CENTCOM Weather shut down following the closure of CENTCOM's headquarters in Riyadh; it sent out its last situation report on 18 April. Two days later CENTCOM redeployed the DMSP van. Colonel Goldey had already wanted it redeployed it in late March, but General Moore, CENTCOM's Director of Operations, would not consent to doing so at that time on the grounds that General Schwarzkopf wanted to continue to receive satellite imagery as long as he remained in the theater. ARCENT Weather closed down on 11 May, following the departure of the VII Corps and the redeployment of Headquarters ARCENT.[8]

Air Weather Service Redeployment and Deactivations

On 8 March Colonel Goldey instructed WSF units to obtain permission to redeploy from him as OICWSF and Commander, 1690th WGP through CENTCOM channels--i.e., through the weather units at CENTAF, ARCENT, or SOCCOM headquarters, and notify 1690th WGP headquarters when

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[7]Weaving Intvw (U), p 34; msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP 191 (U)," 051000Z Mar 91, info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, "Weather Support Force SITREP 187 (U)," 011330Z Mar 91, info used (U). The four members of the 3d SFG weather team taking part in the flag-raising ceremony were TSgt Frank J. Hall III, SSgt Robert D. Patterson, SSgt Garth A. McCulloch, and A1C Aaron M. Otte.

[8]Msg (S), 5WW/CAT to AWS/CAT, et al, "5WW DESERT STORM SITREP #86--as of 18/2000Z Apr 91 (U)," 182000Z Apr 91, info used (U); Riley Intvw (S), p 34, info used (U); msg (S), USCENTAF/Weather to AIG 571, et al, "Deactivation of CENTAF QRCT Net Control Station and KQ List Freeze (U)," 131200Z Mar 91, info used (U); AWS DS/DS Report #2 (S), p 281 (App C), info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, "Weather Support Force SITREP 191 (U)," 051000Z Mar 91, info used (U); msg (U), CENTAF Weather to 1690WGP BWS/WE, et al, "Weather Support Force Drawdown and Redeployment Information," 200800Z Mar 91; msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP #211 (U)," 250746Z Mar 91, info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP #235 (U)," 181030Z Apr 91, info used (U); msg (S), 5WW/CAT to AWS/CAT, et al, "5WW DESERT STORM SITREP #85--as of 17/2000Z Apr 91 (U)," 172000Z Apr 91, info used (U); Kelly Intvw (U), p 29; Goldey Intvw (U), p 26; Campbell Intvw (U), p 30.

they would deploy. But this policy was easier stated than implemented and the headquarters sometimes lost track, at least temporarily, of what was going on in the field relative to redeployment. Back in the US, the 5th Wing also did its best to keep track of redeployments, but with the breakdown of the TPFDD process and with decisions as to who redeployed and when they redeployed essentially being made in the theater, it found this, to say the least, very difficult.[9]

Basically, AWS weather teams redeployed when their customers did--Army weather teams redeployed with the units they supported; Air Force weather teams redeployed after the last aircraft stationed at their base returned to its home station. WSF leaders honored the first in, first out principle whenever possible, but sometimes, mostly because of mission commitments, they were unable to do so. On some occasions, however, they reassigned recent deployees to other units so that individuals in those units who had been in the theater for a long period of time could redeploy. AWS also deployed 13 additional people to the Persian Gulf theater in March and early April to replace redeploying personnel or support residual missions.[10]

The redeployment of the DESERT STORM WSF began on 7 March. On this date two weathermen--one a member of a CENTAF weather team, the other of an ARCENT weather team--left the theater as part of the early, small "symbolic" redeployment arranged by CENTCOM.[11] Once begun, the WSF's redeployment, like that of all the other DESERT STORM forces, went extremely fast. Air Force support personnel started returning to the US in significant numbers about mid-March and continued to redeploy on into July. The XVIII Corps weather teams began to leave the theater in the last week of March; the last Army team (a VII Corps team) redeployed in early June. All members of SOCCENT weather teams except one had redeployed by 20 April. By 1 April the WSF had declined from its peak strength of 475 persons to approximately 300. One month later its size had decreased to about 120 and by the beginning of June, less than 50 AWS personnel remained in the Persian Gulf theater. The last person who had served in the WSF prior to the 28 February cease-fire redeployed on 26 July 1991.[12] (See Figure VII-1.)

Lieutenant Colonel Riley, the first top leader of the WSF to arrive in theater, was also the first to redeploy, leaving on 27 March. Major Curtis A. Reutner, who had deployed to the Persian Gulf

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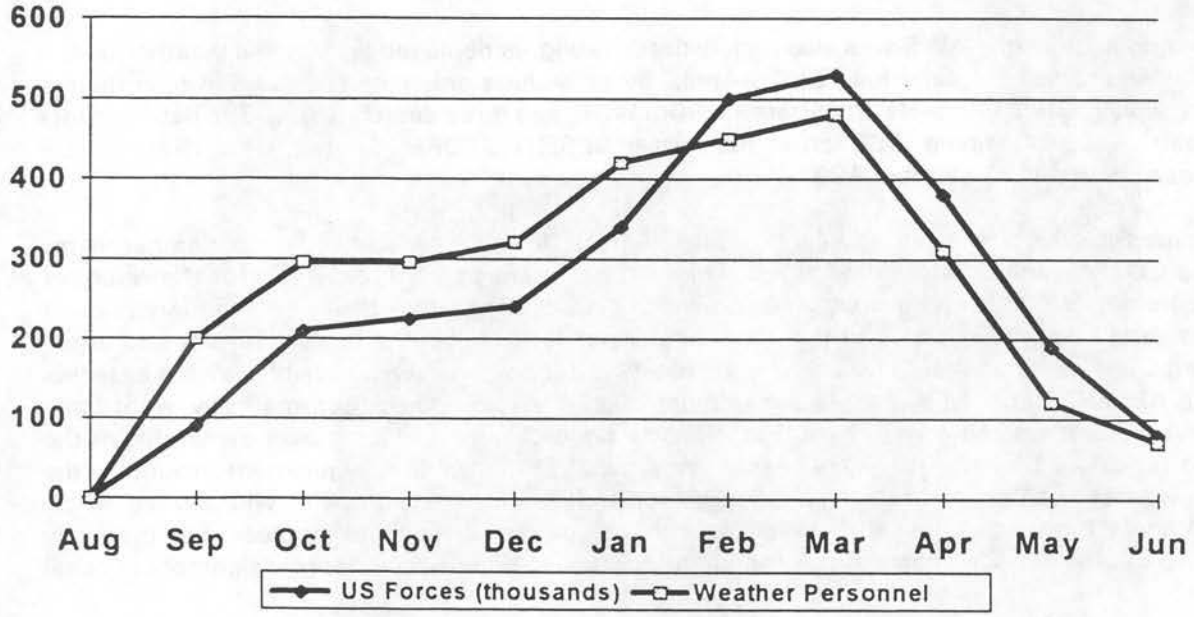
[9]Msg (U), USCINCCENT Weather to COMSOCCENT/J2-SWO, et al, "1690th Weather Group (P) Redeployment Procedures," 081200Z Mar 91; St Onge Intvw (U), p 27; Tkach Intvw (U), p 19; msg (S), 5WW/CAT to 1WW/CAT, et al, "Tentative DESERT STORM Redeployment Plans (U)," 071300Z Mar 91, info used (U).

[10]Tkach Intvw (U), p 20; Campbell Intvw (U), pp 30-31; msg (U), CENTAF Weather to 1690WGP/WE, et al, "Weather Support Force Drawdown and Redeployment Information," 200800Z Mar 91; Goldey Intvw (U), p 34; Riley Intvw (S), pp 34-35, info used (U); Tkach, List of Deployed AWS Personnel (U), Sep 91.

[11]The two weathermen were Staff Sergeant Carl H. Campbell of the base weather station at Dhahran International Airport supporting the 1st Tactical Fighter Wing and Technical Sergeant Richard L. Foster Jr., of the weather team supporting the VII Corps' 1st Armored Division. Tkach, List of Deployed AWS Personnel (U), Sep 91.

[12]AWS DS/DS Report #2 (S), pp 60 (Atch 3), 281 (App C), info used (U); Tkach, List of Deployed AWS Personnel (U), Sep 91; Campbell Intvw (U), pp 30-31. The last pre-March deployee to redeploy was A1C Jerry D. Owen, a member of the residual 1690th WGP weather detachment at Riyadh when he redeployed, but initially part of the weather team supporting SAC operations out of Cairo West AB, Egypt.

NUMBER OF U.S. FORCES AND AWS PERSONNEL DEPLOYED TO DESERT SHIELD/DESERT STORM THEATER 1 AUG 90 - 1 JUN 91



SOURCE: DESERT SHIELD/DESERT STORM Report #2 (S), p 60 (Atch 3), info used (U).

Figure VII-1

theater on 16 March and was currently the TACC SWO, succeeded him as CENTAF SWO and OIC of the CENTAF weather support element and, nominally, CENTAF Weather (it had no personnel left). Colonel Goldey departed only a few hours after Colonel Riley. Command of the 1690th Weather Group and what remained of the WSF now devolved upon several officers in rapid succession. Lieutenant Colonel Weaving, the 1690th's Deputy Commander, took Colonel Goldey's place. Three weeks later, when he redeployed with the main body of Headquarters ARCENT, Lieutenant Colonel Campbell, the OIC of ARCENT Weather and the ARCENT weather support element, replaced him. Upon Colonel Campbell's departure with part of Headquarters ARCENT on 1 May, Lieutenant Colonel Thornberry, the VII Corps SWO, took over until 12 May, when he, too, left. At this point, Major Reutner became the Commander of the 1690th WGP and OIC of the small residual WSF set up to remain in the Persian Gulf indefinitely, a position he kept until he returned to the US on 3 October 1991.[13]

During all this time AWS was also rapidly deactivating its deployed provisional weather units--four by 18 March; 18, or nearly half, by 16 April. By early June only nine remained in operation; a month later only four were left--Headquarters, 1690th WGP, and three detachments. The detachments became part of the sustaining WSF left in the former DESERT STORM theater. The 1690th WGP officially deactivated on 1 October 1991.[14]

Immediately upon the cessation of hostilities, CENTCOM Weather told deployed weather teams supporting CENTAF units that before they redeployed they were to make provision for the return of their meteorological and communications equipment to the US, specifically their home stations, where it could be sorted out and returned to the units that owned it. The 5th Wing went further and urged redeploying CENTAF personnel to take their equipment with them whenever possible. Weather teams supporting ARCENT did not need these admonitions since their equipment automatically went back with their Army unit's equipment. There was initially a good deal of confusion over ownership of the equipment redeployed by the Air Force teams since the WSF had shifted equipment around in the theater to wherever it was most needed, thereby making it hard to keep track of who owned what. The 5th Wing's logistics people, however, took charge of the sorting out process and gradually straightened out the mess, sometimes resorting to the exchange of equipment or reassignment of serial numbers.[15]

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[13]Riley Intvw (S), pp 34-35, info used (U); AWS DS/DS Report #2 (S), p 65 (Atch 7), info used (U); Goldey Intvw (U), pp 32-33, info used (U); Campbell Intvw (U), pp 29-30; note (U), Maj J.A. White, AWS/DOO, to W.E. Nawyn, AWS/HO, ca 30 Sep 92.

[14]Msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP 204 (U)," 180800Z Mar 91, info used (U); msg (S), USCINCCENT Weather to 5WW/CAT, et al, "Weather Support Force SITREP #233 (U)," 160915Z Apr 91, info used (U); msg (S), 5WW/CAT to AWS/CAT, et al, "Provisional Weather Unit Deactivations (U)," 072000Z Jun 91, info used (U); ltr (U), AWS/DOO to HQ MAC/XPMO, "Deactivation of Provisional Units," 11 Jun 91, w/2 atchs; atch 2 (S), "List of Units Still Active," 25 Jun 91, info used (U), to ltr (U), AWS/DDO to HQ MAC/XPMO, "Deactivation of Provisional Units," 1 Jul 91, w/2 atchs; msg (S), 5WW/CAT to AWS/CAT, et al, "Final 5WW DESERT STORM SITREP #39--12/1700Z Sep 91 (U)," 121747Z Sep 91, info used (U); note (U), Maj J.A. White, AWS/DOO, to W.E. Nawyn, AWS/HO, ca 30 Sep 92.

[15]Msg (U), USCINCCENT Weather to CENTAF Weather, et al, "TACMET and TACCOM Redeployment Policy," 280911Z Feb 91; Grizzle/Brothers Intvw (U), pp 16-17.

The Sustaining Weather Support Force

Although the US rapidly removed its forces from the Persian Gulf theater following the cease-fire, it nevertheless intended to keep a small residual military presence in the region for an indefinite, but presumably limited, period of time. Consequently, CENTCOM and its component commands began almost immediately after the end of the war to make plans for a "sustaining force." AWS, in turn, began to plan for providing weather support to the sustaining force. On 10 May, and again in early June, CENTAF Weather sent the 5th Weather Wing several proposals to serve as a basis for a sustaining WSF concept of operations. On 20 June the 5th Wing issued a concept of operations that provided for a small force of 30-35 persons consisting of eight units (Headquarters 1690th WGP, CENTAF Weather Support Unit, AFSOC weather team, and five detachments) stationed at five locations. The CENTAF SWO would serve as both the OIC of the sustaining force and the in-theater Commander of the 1690th WGP.[16]

The transition from a temporary WSF intended to serve only for the duration of DESERT SHIELD/STORM to a semi-permanent sustaining force occurred largely during June 1991. CENTAF Weather shifted its operations from Riyadh to Dhahran on 22 June. The sustaining force continued to operate at as many as ten locations and its manning remained in the 40s during all of June, somewhat above the planned figures. By mid-July, however, the number of locations and personnel had both settled down to their projected levels.[17]

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[16]Msg (S), USCINCCENT Weather to 5WW/CAT, et al, "DESERT STORM Residual Forces Weather Support Force (U), 061326Z Mar 91, info used (U); msg (S), CENTAF Weather to 5WW/CAT, et al, "Weather Support Concept of Operations (U)," 101145Z May 91, info used (U); msg (S), CENTAF Fwd Weather to Det 30, 1690WGP, et al, [Proposed Manning Movements and Positions,] 041400Z Jun 91, info used (U); msg (S), CENTAF Fwd Weather to Det 30, 1690WGP/WE, et al, "Change One to Manning Movements and Positions (U)," 060800Z Jun 91, info used (U); msg (S), 5WW/CAT to USCENTAF Fwd/WE, "5WW Concept of Operations/Operation DS (Rotation) (U)," 202000Z Jun 91, info used (U).

[17]Msg (S), 5WW/CAT to AWS/CAT, et al, "5WW DS (Rotation) (DESERT CALM) SITREP #3 18/2000Z June 91 (U)," 182100Z Jun 91, info used (U); msg (U), USCENTAF Forward/Weather to USS Nimitz, et al, "Office Relocation," 220830Z Jun 91; msg (U), CENTAF Forward/Weather to 5WW/CAT, et al, "Weather Support Cell Relocation," 261100Z Jun 91; msg (S), 5WW/CAT to AWS/CAT, et al, "5WW DS (Rotation) SITREP #21 15/2000Z July 91 (U)," 152000Z Jul 91, info used (U). For June and July manning figures, see 5WW DESERT STORM SITREPS #117 through #125 (S), 1-13 June 1991; and 5WW DS (Rotation) SITREPs # 1 through #27 (S), 14 June-30 July 1991, no info used.

CHAPTER VIII

LESSONS AND CONCLUSIONS

DESERT SHIELD/STORM stretched and tested AWS in its ability to perform its mission more than any military operation in which it participated since the Vietnam War, which had ended nearly 20 years before. The challenges of the Grenada and Panama contingencies of 1983 and 1989, respectively, paled in comparison. It is not surprising, therefore, that the operation exposed a number of AWS weaknesses and problem areas, and that AWS could have done some things better than it did. But, on the positive side, from the inadequacies it discovered, the problems it struggled with, and the mistakes it made, AWS learned a large number of lessons, lessons it could use to upgrade its capabilities for and improve its performance in future contingencies.

The Value of Weather Support

During DESERT SHIELD/STORM, and particularly the DESERT STORM phase, AWS learned anew that important as weather support was in peacetime, it was far more critical during wartime. Weather support clearly was of value during DESERT SHIELD/STORM. This value, however, was not immediately apparent. Indeed, at the beginning of DESERT SHIELD leaders of the operation were skeptical of the need for weather support. By the end of DESERT STORM, however, they no longer had any doubts about its necessity. The bad weather in January and February 1991 made weather support particularly important for DESERT STORM. Now AWS no longer had to convince Air Force and Army commanders that it had value, they could see this on a day-to-day basis. During DESERT STORM General Horner, the CENTAF Commander, kept a copy of CENTAF Weather's latest day-by-day, long-range forecast in his pocket and the latest satellite imagery always prominently displayed in his warroom. After the operation was over, Brigadier General John F. Stewart, Jr., ARCENT's Director of Intelligence, remarked that weather support was a critical function that had made a major contribution to Army combat power. Weather support functioned as a force multiplier. Forecasts were a key factor in both air and ground war decisions and helped both Air Force and Army commanders to maximize the use of their weapons systems. In short, weather support made a substantial contribution to the war effort.[1]

Satellite imagery was probably the single most valuable weather support product. Providing virtually real time pictures of cloud cover, it was particularly important for air operations. Satellite data helped the CENTAF operations staff to plan the air war and to redirect strike missions to targets with more favorable weather. It also helped Army commanders by, for example, depicting areas of precipitation and blowing sand, and assisted Army terrain analysts in their work. In addition, satellite

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[1]AWS DS/DS Report #2 (S), p 107 (Secs 4.1.7.3, 4.1.7.4), info used (U); Kelly Intvw (U), pp 2-3, 29-30; Goldey Intvw (U), p 31; Riley Intvw (S), pp 35-37, 41, info used (U); Campbell Intvw (U), pp 20, 25-26; Koenemann Intvw (U), pp 29-30; 5WW DS/DS Summary Brfg (S), slide (paper) 53, info used (U); ltr (U), Weaving to 5WW/DO, 6 Mar 91; msg (S), 5WW/CAT to AWS/CAT, "DESERT STORM Weather Impacts (U)," 211459Z Jan 91, info used (U).

imagery enabled CENTCOM leaders to almost immediately find the locations of new oil well fires and determine the direction and speed their smoke was moving and increased the ability of CENTCOM's Intelligence Directorate to select the correct aircraft for reconnaissance (e.g., Scud-hunting) missions.[2]

One of the most important contributions, perhaps the most important, made by weather support was enhancing the effectiveness of air operations. Accurate weather forecasts helped air operations planners to reduce the number of sorties lost to weather by redirecting aircraft from originally planned targets to substitute targets with better weather. Weather forecasts also sometimes prompted operators to switch from guided to unguided weapons systems. An AWS quantitative analysis of weather support value concluded that weather support increased the success rate of both F-117 and F-111 missions, which translated into additional mission effective days for both weapons systems. The analysis also found that with weather support, the Air Force was able to direct more precision-guided missiles against Iraqi targets in the 43 days of the air campaign than it could have without weather support.[3]

Weather support was also a key input into decisions regarding the pace of MAC's successful airlift during the deployment phases of DESERT SHIELD and helped MAC to avoid weather aborts when airlifting the XVIII Corps from near Dhahran to Rafha. Another example of the value of weather support to air operations is found in the assistance weather teams supporting deployed SAC B-52 units provided to their customers in incorporating wind forecasts into flight plans so that B-52 missions could achieve correct time over target and increase their bombing accuracy.[4]

As previously noted,[5] Army commanders on more than one occasion took advantage of weather "windows of opportunity" (openings in low cloud cover or fog) predicted by their weather teams. Army helicopter operations, in general, benefited from weather support. Weather support also was an important factor in the success of several special operations missions.[6]

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[2]AWS DS/DS Report #2 (S), p 161 (Sec 4.5.2-a(7)), info used (U); Weaving Intvw (U), pp 12, 17-18, 26-27; point paper (U), DESERT STORM Satellite Support Lessons Learned, Mar 91; msg (S), USCINCCENT/Weather to 5WW/CAT, et al, "5WW/CAT AI #12-13, DMSP Feedback (U)," 060930Z Jan 91, info used (U).

[3] AWS DS/DS Report #1 (S), pp i (Exec Sum), 28-30 (Figs 17, 18, Secs 6.1, 6.2), 32 (Sec 7), info used (U); Frederick Intvw (U), p 13; Riley Intvw (S), p 33, info used (U); Col T.C. Tarbell in AWTB Intvw (U), p 38.

[4] Telefax (U), USAF/XOWP to AWS/CV, "AWS DESERT STORM Involvement," 13 Jun 91; AWS DS/DS Report #1 (S), pp 30-31 (Sec 6.3), info used (U); msg (S), 5WW/CAT to AWS/CAT, "DESERT STORM Weather Impacts (U)," 211459Z Jan 91, info used (U); telefax memo (U), AWS/CAT to USAF/XOW, [Value of Weather Support,] 28 Feb 91; ltr (S), 3WW/DOJ to AWS/DOJ, "3WW Input to AWS Contributions," 21 Jun 91, info used (U).

[5] See above Chapter VI, pp 137-138.

[6]AWS DS/DS Report #1 (S), p 31 (Sec 6.3), info used (U); Campbell Intvw (U), p 19; ltr (U), 1690WGP/CV to 5WW/DO, "Weather Support to DESERT SHIELD/STORM," Weaving to 5WW/DO, 6 Mar 91; telefax (U); USAF/XOWP to AWS/CV, "AWS DESERT STORM involvement," 13 Jun 91.

Lessons Learned

DESERT SHIELD/STORM may have confirmed AWS's conviction that weather forecasting had value for its customers, but it also taught AWS that there were operational and capabilities areas that needed reassessment and improvement. Taking this basic lesson to heart, AWS began immediately, even before DESERT STORM ended, to take action to ensure that it would not in the future cause or encounter the situations which gave rise to the lessons learned from DESERT SHIELD/STORM.

One of the early problems AWS encountered was the persistence of a "peacetime mentality" among AWS personnel in general and, perhaps more importantly, some senior AWS officers. There was, frequently, a feeling that DESERT SHIELD was basically only a show of force to intimidate Saddam Hussein and that it would be of short duration. Some initial uncertainty as to what the total mission of the deploying DESERT SHIELD force really was contributed to the problem. Consequently, a sense of urgency was sometimes lacking. Some time elapsed before the gravity of the situation became generally apparent and the realization fully dawned that DESERT SHIELD was not just another exercise or peacetime contingency and that herculean efforts in many areas were required. The lesson here, obviously, was that AWS personnel, leaders especially, had to sense more quickly when something was not just "business as usual."[7]

DESERT SHIELD/STORM again validated the lead wing concept, but problems emerged in executing it. While the 5th Wing effectively sourced, deployed, equipped, and sustained the WSF, the lack of a clear delineation between lead wing and Headquarters AWS functions led to a certain amount of overlapping and duplication of effort and a degree of friction between the two levels. According to doctrine, the lead wing was to take the initiative in fielding a functioning WSF and Headquarters AWS was to assist and support it in this effort; in actuality headquarters frequently led and the 5th Wing helped it. This was at least partly because as the operation rapidly expanded the wing became swamped with work and had difficulty in just keeping up with the day-to-day tasks that it had to perform. All this suggested that, first, the responsibilities of Headquarters AWS and the lead wing should be more clearly spelled out and, second, taking full responsibility for a weather support operation in support of a contingency the size of DESERT SHIELD/STORM was beyond the capability of a wing-level organization.[8]

The operation reaffirmed AWS's belief that it was important, indeed essential, to develop plans for responding to possible contingencies long before they happened. But it also reminded AWS that no pre-developed plan could fully anticipate the exigencies of a specific contingency, least of all a massive one such as DESERT SHIELD/STORM. AWS learned anew, therefore, that it had to be flexible in implementing plans, meaning it had to be ready to modify and adapt them to meet the particular circumstances of the contingency. However, it also found that its plans for manning, equipping, and operating a WSF were basically sound, although they could have been better, and that at the very least they provided a good starting point. It should not, therefore, be too quick to jettison "key building blocks"--e.g., basic manning and equipping stipulations--contained in the plans and part of AWS's

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[7]Kelly Intvw (U), pp 3, 5-6; Frederick Intvw (U), p 13.

[8]Kelly Intvw (U), p 4; Frederick Intvw (U), pp 2-4; AWS DS/DS Report #2 (S), pp ii (Exec Sum), 8 (Sec 2.1.3), 16 (Sec 2.2.4), 247 (Sec 10.0-a), 263 (App B), info used (U); 5WW/DO DS/DS Lessons Learned Brfg (U); JULLS Long Report No 32028-47974 (7400040)(U), SAC/DOWXP, "Partial Success of AWS Lead Wing Force Structure Concept," 29 Mar 91, in JEMP Report (S), 29 Mar 91; msg (U), 7WW/CAT to AWS/DOJ, "7WW Lessons Learned," 222125Z Mar 91.

weather support doctrine. Some AWS officials concluded that in DESERT SHIELD/STORM AWS had, perhaps, discarded too much of the original plans and that it would have been better in the long run if AWS had stuck closer to them than it did.[9]

Several weeks into DESERT SHIELD, as the size, scope, and probable duration of the operation became more evident, AWS came to realize that it had deployed too many junior officers and NCOs--wing weather officers instead of detachment commanders, buck and staff sergeants instead of master and senior master sergeants. In other words, it began to see that the experience level of the WSF was too low. But by this time, due to a large extent to the personnel ceilings imposed by USCINCCENT, AWS could no longer do much about it. Fortunately, the force had a few months to train and practice before DESERT STORM began. The green troops learned a lot during that time and were ready for the storm when it came. Nevertheless, the lesson was clear: in future contingencies AWS had to deploy a more experienced WSF.[10]

AWS also derived other lessons from the personnel deployment process. One was that it needed a better system, perhaps a database containing the names of all AWS personnel with their areas of expertise and experience, to identify persons who had skills in certain functional areas so that AWS could deploy people with the particular skills required in the theater by the WSF. Another was that it would have been better to form weather support units in the operational theater from persons deployed from the same home units rather than creating composite units comprised of individuals deployed from various stateside units. The reasoning here was that deployed units would operate more efficiently, at least initially, if they were made up of persons familiar with each other and used to working together.[11]

In addition, AWS found that while the overall manning of the WSF was adequate, if only barely, there were several areas where real shortages existed. AWS did not at first deploy enough persons to man the CENTCOM, CENTAF, and ARCENT SWO staffs, especially the former two. This was due in part to initial miscalculation of manning needs by leaders in the theater, but also by the reluctance of Headquarters AWS to deploy more personnel, even when requested to do so by Colonel Goldey. The imposition of DESERT SHIELD manning ceilings soon made it too late, at least for the time being, for AWS to augment the three staffs. The manning shortage was particularly acute at CENTCOM Weather since the CENTCOM SWO also served as the OIC of the entire WSF. Given the necessity of scrubbing manpower requirements to the minimum, AWS deployment planners had also shortchanged the management area. In order to operate more efficiently, larger units very much needed an NCO with

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[9]Kelly Intvw (U), pp 4, 26-28, 33; AWS DS/DS Report #2 (S), pp 36 (Sec 3.4), 225-226 (Secs 5.3.3, 5.3.4), 264 (App B), info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 38-39; Tkach Intvw (U), p 24; 5WW/DOX Lessons Learned Listing (U).

[10]Kelly Intvw (U), pp 32-33; AWS DS/DS Report #2 (S), pp ii (Exec Sum), 35-36 (Sec 3.4), 248 (Sec 10.0), 264 (App B), info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 29-30 (U); Koenemann Intvw (U), pp 9-10; Tkach Intvw (U), p 25; 5WW/DO DS/DS Lessons Learned Briefing (U); JULLS Long Report No 32049-34676 (00049)(U), SAC/DOWXP, "Deployable Detcos," 29 Mar 91, in JEMP Report (S), 29 Mar 91.

[11] AWS DS/DS Report #2 (S), p 232 (Sec 6.4), info used (U); Ridge Intvw (U), pp 3-4; atch 1 (U), "Consolidated List of All Lessons Learned--DESERT SHIELD/STORM," to ltr (U), HQ AFGWC/DO to AWS/DOJ, "AFGWC Lessons Learned," 22 Mar 91; JULLS Long Report No 31231-04449 (00005)(C), SAC/DOWXP, "Weather Experience Data Base Requirement (U)," 29 Mar 91, info used (U), in JEMP Report (S), 29 Mar 91; msg (U), 4WW to AWS, et al, "4WW DESERT SHIELD/DESERT STORM Lessons Learned," 222025Z Mar 91; Frederick Intvw (U), p 16; Koenemann Intvw (U), p 9.

management skills assigned to them. The WSF could also have used several people with special expertise in tactical communications and benefitted from a few individuals trained in the supply area. CENTCOM Weather, especially, needed a supply person. Moreover, minimal manning at most deployed units in the field precluded them from assigning someone to work on operational verification.[12]

AWS concluded that the centralized command concept it used for the WSF (one officer in charge of the entire force) in DESERT SHIELD/STORM was valid and that the provisional organization it created had been sufficiently flexible to accommodate itself to the rapid growth which the WSF experienced. It recognized, however, that structurally, especially in regards to its chain of command, the 1690th WGP had some shortcomings. There were also some persons in AWS who felt that the weather group concept violated organizational principles such as span of control.[13]

DESERT SHIELD/STORM showed AWS that the training of its personnel had been deficient in several areas. First of all, the training received during exercises was not realistic enough. Exercises had to better match conditions AWS personnel would encounter when deploying to a bare base environment and having to set up weather support operations from scratch. Further, weather teams needed more practice in operating autonomously. In addition, the operation demonstrated that AWS personnel were frequently insufficiently prepared for deployment and that AWS had to provide a greater percentage of its people with more than merely the lowest level (Phase I) of mobility training. The operation also taught AWS that it needed to provide its leadership with more training in organizing and fielding a WSF for contingency operations.[14]

A glaring training deficiency that became apparent at the very beginning of DESERT SHIELD, and probably the one with the most serious adverse effect on AWS weather support, at least in the initial stages of the operation, was the inadequate or sometimes even total lack of training that deploying personnel had on the QRCT. While this could be, to a certain extent, rationalized by the fact that the QRCT was a new system that some AWS units had not yet received or, at best, had not possessed for a very long period of time, there, nevertheless, appears to have been a general lack of urgency in getting personnel qualified in operating the system. Again, fortunately, deployed personnel had a few months to train on the QRCT and become proficient in using it before DESERT STORM began in mid-January. The lesson to be learned here was clear and urgent: it was vitally important that

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[12]Kelly Intvw (U), pp 14, 24; Frederick Intvw (U), pp 4, 7; AWS DS/DS Report #2 (S), pp 11 (Exec Sum), 20 (Sec 2.4.3), 36 (Sec 3.4), 107 (Sec 4.1.7.4), 235 (Sec 7.3), 247 (Sec 10.0-b), info used (U); telecon (U), W.E. Nawyn with Col G.F. Riley, AWS/XO, 31 Jan 95; note (U), Col C.J. Bjerkaas, Act AWS/CV, to W.E. Nawyn, AWS/HO, ca 2 Oct 92; LTC R.R. Wall in AWTB Intvw (U), p 18; Tkach Intvw (U), pp 8-9, 24; 5WW/DO DS/DS Lessons Learned Brfg (U).

[13]5WW/DO DS/DS Lessons Learned Brfg (U); JULLS Long Rprt No. 31430-44500 (00002)(U), AWS/DO, "Centralized WSF Management," n.d. [probably Mar 91]; ARCENT SWO AAR (U), p 77, (Sec VII-4h).

[14]Kelly Intvw (U), pp 3, 16-17, 32; Frederick Intvw (U), p 16; AWS DS/DS Report #2 (S), pp iii (Exec Sum), 104 (Sec 4.1.6.4), 231-232 (Sec 6.4), 248 (Sec 10.0-g), 277 (App B), info used (U); atch 9 (U), rprt, 1690WGP/CV to 1690WGP/CC, "Weather Support Lessons Learned - Operations DESERT SHIELD/STORM," 20 Mar 91, hereafter cited as 1690WGP/CV DS/DS Lessons Learned, to CENTCOM Weather Staff AARs(U); rprt (U), 1WW/DO to AWS/DO, "DESERT SHIELD/STORM Lessons Learned," 19 Mar 91; JULLS Long Report No 32033-42507 (00042)(U), SAC/DOWXP, "Mobility Responsibilities," 29 Mar 91, in JEMP Report (S), 29 Mar 91; 5WW/DOX Lessons Learned Listing (U); msg (U), 7WW/CAT to AWS/DOJ, "7WW Lessons Learned," 222125Z Mar 91.

weather personnel be thoroughly familiar with tactical communications equipment and, indeed, with tactical communications in general.[15]

Other problems also emerged in the weather communications arena during DESERT SHIELD/STORM. Many have been noted in the earlier discussion of long-range and tactical communications.[16] Some led to additional lessons learned; some served to reinforce old lessons. In the long-range area, for instance, the operation forcefully reminded AWS that it depended heavily upon a reliable intertheater communications capability, especially for a contingency operation conducted far away from the US. Moreover, it taught AWS that its units in the field should have a dial-in capability whereby they could directly access AFGWC data in a way similar to how the DSFU accessed the Navy's NODDS during DESERT SHIELD/STORM.[17]

In addition, AWS met several problems in connection with using AFDIGS and AUTODIN that it needed to address after the operation was over. For instance, the multiple analog-to-digital conversions on the AFDIGS circuits often degraded signal quality to the point where weather graphic products received were almost unusable. These and other problems plaguing the weather facsimile circuits made many work-arounds necessary. Although AWS found AUTODIN useful for both Air Force and Army weather teams, particularly the latter, it discovered that weather data flowing from the AWN to AUTODIN frequently saturated in-theater AUTODIN communications centers.[18]

However, AWS experienced its chief problems and learned the most lessons in the tactical communications area. It came to see it needed a formal concept of operations for first-in HF communications. DESERT SHIELD/STORM powerfully reinforced what AWS already knew--that tactical communications systems had to be easily transportable, that "smaller is better." AWS found that in the QRCT/Goldwing it had a first-in HF tactical communications system superior to any it had ever had before (thanks to a lesson learned in the Grenada operation) and one which also worked better than any of its predecessors. But it also discovered that the QRCTs still had shortcomings that it had to rectify before the next contingency occurred. Moreover, it found, too, as it was already aware, that as good as the QRCT/Goldwings were as a first-in system, they did not work out well for long-term use, which was understandable because they were not designed for that. The basic lesson here was that fixed tactical communications should somehow be brought on line much quicker than it was during DESERT SHIELD/STORM and that AWS should work with AFCC and/or other communications agencies to ensure that this would happen.[19]

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[15]Kelly Intvw (U), pp 17-19; AWS DS/DS Report #2 (S), pp 181 (Sec 5.1.1.4), 273 (App B), info used (U); atch 9 (U), 1690WGP/CV DS/DS Lessons Learned, to CENTCOM Weather Staff AARs (U); ARCENT SWO AAR (U), p 42 (Sec VII-1f); 5WW/DOX Lessons Learned Listing (U).

[16]See above, Chapter III, pp 52-59, 61-68.

[17]Frederick Intvw (U), p 10; 5WW/DO DS/DS Lessons Learned Brfg (U); atch 1 (U), "Consolidated List of All Lessons Learned--DESERT SHIELD/STORM," to rprt (U), HQ AFGWC/DO to AWS/DOJ, "AFGWC Lessons Learned," 22 Mar 91, w/1 atch.

[18]AWS DS/DS Report #2 (S), pp 206 (Sec 5.1.2.4), 210 (Secs 5.1.3.3, 5.1.3.4), 213 (Sec 5.1.4.4), 248 (Sec 10.0-e), 274-275 (App B), info used (U).

[19]Kelly Intvw (U), pp 19-20, 25, 32, 33; AWS DS/DS Report #2 (S), pp iii (Exec Sum), 180-181 (Sec 5.1.1.4), 247-248 (Sec 10.0-e), info used (U); atch 9 (U), 1690WGP/CV DS/DS Lessons Learned, to CENTCOM Weather Staff AARs (U); JULLS Long Report No 31952-76384 (00039)(S), SAC/DOWXP, "QRCT Training and Taskings (U)," 29 Mar 91, p 33, info used (U), in JEMP Report (S),

The operation showed AWS that it very much needed a dedicated, in-theater maintenance capability for both its communications and meteorological equipment, perhaps its own deployable maintenance element. The existing QRCT maintenance concept was "woefully deficient." Indeed, for all practical purposes, there was none for contingency operations. The TACMET maintenance concept was little better--AWS found it to be "totally unsatisfactory." The absence of a workable, dedicated in-theater TACCOM and TACMET maintenance capability created serious mission-threatening problems for the deployed WSF, pointing up the urgency in rectifying this situation before another contingency operation occurred.[20]

AWS's experience with TACMET in DESERT SHIELD/STORM, like its experience with TACCOM, strongly underscored its growing conviction that smaller was better. It almost immediately saw, for example, that its GMD-5 Upper Air Measuring Set, supposedly transportable, was, in fact, too big and bulky for AWS to easily deploy (consequently, it never deployed the system). On the other hand, it found that the much smaller Marwin upper air sounding systems that it procured on an emergency basis during the course of the operation were very mobile, and, in addition, provided a valuable new capability. AWS also learned that its new TMQ-34 Tactical Meteorological Observing Set could be unreliable, at least in the hot desert environment, and that it would have to make several improvements in the system if it was to operate satisfactorily. On the whole, though, the TACMET equipment performed reasonably well.[21]

An extremely significant lesson AWS learned from the operation, especially the DESERT STORM phase, was that meteorological satellite imagery was the single most important weather support product it supplied to its customers, a key tool for all weather forecasting. Moreover, satellite imagery was valuable to the Air Force for in-theater mission planning and the Army in determining trafficability; it provided a means for obtaining weather data from over enemy territory; and it was very helpful to AFGWC in producing its weather support products. In short, satellite imagery was indispensable. AWS also discovered that the Mark IV DMSP satellite readout van was a very reliable piece of equipment; it performed almost flawlessly.[22]

All of which is not to say that AWS did not find shortcomings, and, therefore, room for improvement, in the meteorological satellite area. Early in the operation, for instance, AWS realized

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29 Mar 91; rprt (S), 4WW/CAT to AWS, et al, "4WW DESERT SHIELD/STORM After Action Report (U)," 172222Z Apr 91, info used (U); 5WW/DO DS/DS Lessons Learned Brfg (U).

[20]AWS DS/DS Report #2 (S), pp iii (Exec Sum), 181 (Sec 5.1.1.4), 221 (Sec 5.2.4), 247-248 (Sec 10.0-e,f), 274 (App B), info used (U); Weaving Intvw (U), p 36; Koenemann Intvw (U), p 31; Atch 9 (U), 1690WGP/CV DS/DS Lessons Learned, to CENTCOM Weather Staff AARs (U); ARCENT SWO AAR (U), p 64 (Sec VII-2c); 5WW/DOX Lessons Learned Listing (U).

[21]Kelly Intvw (U), pp 25, 32; AWS DS/DS Report #2 (S), pp iii (Exec Sum), 158 (Sec 4.4.4), 221 (Sec 5.2.4), 248 (Sec 10.0-f), info used (U); 5WW/DOX Lessons Learned Listing (U).

[22]AWS DS/DS Report #2 (S), pp ii (Exec Sum), 89 (Sec 4.1.3.4), 168 (Sec 4.5.4-a), 247 (Sec 10.0-c), 270-271 (App B), info used (U); ARCENT SWO AAR (U), p 57 (Sec VII-1v); 5WW/DO DS/DS Lessons Learned Brfg (U); JULLS Long Report No 32031-9176 (00001)(U), CENTCOM Weather, "Weather Satellite," 20 Mar 91, in Atch 1 (U), CENTCOM Weather, JEMP Report, 25 Mar 91, p 1, to CENTCOM Weather Staff AARs (U); Atch 2 (U), Holtgard DS/DS AAR, to CENTCOM Weather Staff AARs (U); memo (U), AFGWC/WF to AFGWC/DOO, "Lessons Learned--DESERT STORM/SHIELD," 21 Mar 91; point paper (U), HQ AWS/XTRR/DOOF, "Environmental Satellite Support to DESERT STORM--Lessons Learned," 5 Mar 91.

that it needed a first-in meteorological satellite capability, in other words, a small tactical satellite readout terminal, for Air Force units. Army weather teams deployed with the Wraase tactical terminal which they already owned--and which, incidentally, turned out to be another very reliable, perhaps the best, piece of tactical weather equipment deployed to DESERT SHIELD/STORM. Air Force weather support units, on the other hand, had no access to meteorological satellite imagery until the DMSP van arrived about 4 weeks after the operation began. As mentioned earlier,[23] AWS managed to procure and deploy a few interim small tactical terminals before the end of DESERT STORM. They worked well, but they did not arrive in theater until very late in the operation. AWS also found that the DMSP van should, for maximum efficiency, be collocated with the tactical forecast unit and had a refresh rate that was too slow.[24]

DESERT SHIELD/STORM taught AWS the important lesson that a deployed WSF had to be flexible in doing its job. The operation demonstrated that in a real-world contingency things frequently, probably most of the time, did not go "by the book." Thus leaders and members of a WSF had to be open to new concepts of weather support and ways of doing things and be able to adapt to new, strange, and unexpected circumstances and requirements.[25]

DESERT SHIELD/STORM again proved the value of centralized weather support. The out-of-theater support provided to the WSF by AFGWC and its subordinate organization, USAFETAC, was, on the whole, excellent. ETAC's descriptive climatologies for the Middle East were essential for planning purposes, and the climatological data it provided was very useful to weather forecasters. On the negative side, AWS determined that AFGWC's ability to handle and incorporate classified data needed improvement and its data processing system had to be more flexible in tailoring point and gridded products for specific points in the world on short notice. It also saw that ETAC had to take care that inaccurate weather observations did not adversely affect its climatology database and that the climatological data in the SWO kits provided for deploying personnel was in a usable format.[26]

But the operation also revealed the importance of in-theater centralized weather support. Both the JOAF and TOAF concepts worked well. The JOAF, in addition to being a vital product for CENTAF

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[23]See above, Chapter IV, pp 90-92.

[24]AWS DS/DS Report #2 (S), pp iii (Exec Sum), 78 (Sec 4.1.1.4), 168-169 (Sec 4.5.4), 247 (Sec 10.0-c), 272 (App B), info used (U); Kelly Intvw (U), p 25; ARCENT SWO AAR (U), pp 56-57 (Sec VII-1v); JULLS Long Report No.32031-91676 (00001)(U), CENTCOM Weather, "Weather Satellite," 20 Mar 91, and JULLS Report No. 32032-97913 (00003) (U), CENTCOM Weather, "Defense Military Satellite Program Van," 20 Mar 91, both in atch 1 (U), CENTCOM Weather, JEMP Report, 25 Mar 91, pp 1,3, to CENTCOM Weather Staff AARs (U); 5WW/DO DS/DS Lessons Learned Brfg (U); 5WW/DOX Lessons Learned Listing (U); point paper (U), HQ AWS/XTRR/DOOF, "Environmental Satellite Support to DESERT STORM--Lessons Learned," 5 Mar 91; atch 1 (U), CAC/CALL, Newsletter, "Space Support to the Army: Lessons from Operations DESERT SHIELD and STORM," (Chap 2, Section A), Oct 91, to rprt (U), USAIC SWO to TRADOC SWO, "Unit Activity Report - November/December 91," 16 Jan 92.

[25]Goldey Intvw (U), p 35; Col T.C. Tarbell in AWTB Intvw (U), pp 38-39; SOCCENT SWO AAR (U), p 6.

[26]AWS DS/DS Report #2 (S), pp ii (Exec Sum), 109 (Sec 4.1.8.4), 113-114 (Secs 4.2.1.2-d(3), 4.2.1.3, 4.2.1.4), 123-124 (Sec 4.2.2.4), 228 (Sec 5.4.4), 247 (Sec 10.0-c), 267-268 (App B), info used (U); Koenemann Intvw (U), p 31; 5WW/DOX Lessons Learned Listing (U).

weather units, was also helpful for the Navy and Marine components of CENTCOM. AWS quickly recognized that the contingency weather package developed by ARCENT Weather late in the operation was a valuable new centralized product for mobile weather teams and should be incorporated into Army support doctrine.[27]

From its experience in DESERT SHIELD/STORM, AWS concluded that it should, in the future, have a pre-formed and pre-manned tactical forecast unit, probably at AFGWC, ready to deploy as a unit in the event of a contingency operation. In DESERT SHIELD, AWS had manned the DSFU, so critical to WSF operations, with mostly inexperienced personnel drawn from various AWS units, which had severely hampered its operational efficiency in the early stages of the operation. AWS reasoned that it could overcome this problem by deploying a ready-made core TFU comprised of individuals who were already used to working together as a team and proficient in TFU operations. It could later augment the unit with additional personnel if the need arose. AWS also learned that it was best not to collocate the TFU, a joint command headquarters organization, with a component command headquarters such as CENTAF, as it had done in DESERT SHIELD/STORM.[28]

In DESERT SHIELD/STORM, AWS found that it took the DSFU and weather teams too much time to produce EOTDAs. But more importantly, the operation taught AWS that EOTDA support had to be flexible and adaptable to different types of operational tactics. During the operation the demand from customers was primarily for "situational awareness" EOTDAs rather than the type it had expected. AWS concluded that the EOTDA concept was valid and EOTDAs were, and would continue to be, essential, but perhaps not in the way it had anticipated. It decided, therefore, that it should reevaluate the future role of EOTDAs and the type that customers would find most valuable. [29]

AWS found the weather services provided by host nations during DESERT SHIELD/STORM valuable for the operations of its deployed WSF. It also came to the conclusion, primarily as a result of its dealings with MEPA, that its personnel should know something about the culture of any foreign nation or nations they might have to deal with in the future and, thus, be more prepared for the cultural differences they might encounter and how these, in turn, would affect the nature and quality of the weather data provided by these nations. AWS also came to see that it would be a good idea to provide its personnel with some prior assessment of indigenous weather support they might some day use and perhaps have an advance plan as to how it would use this data.[30]

DESERT SHIELD/STORM exposed several shortcomings in the joint operations arena impacting weather support operations. For example, there was no clear cut joint doctrine to cover weather support to unified and specified commanders, nor was there a focal point for environmental support

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[27]AWS DS/DS Report #2 (S), pp 81 (Sec 4.1.2.4), 91 (Sec 4.1.4.4), 247 (Sec 10.0-c), 265-266 (App B), info used (U).

[28]Kelly Intvw (U), p 32; Frederick Intvw (U), p 11; AWS DS/DS Report #2 (U), pp 36 (Sec 3.4), 265 (App B), info used (U); Koenemann Intvw (U), p 5; CENTAF SWO AAR (U), Sec J; 5WW/DO DS/DS Lessons Learned Brfg (U).

[29]Kelly Intvw (U), p 30; Frederick Intvw (U), pp 16-17; AWS DS/DS Report #2 (S), pp ii (Exec Sum), 81 (Sec 4.1.2.4), 89 (Sec 4.1.3.4), 150-151 (Secs 4.3.1.3, 4.3.1.4), 247 (Sec 10.0-c), info used (U); 5WW/DO DS/DS Lessons Learned Brfg (U).

[30]AWS DS/DS Report #2 (S), pp ii, iv (Exec Sum), 241 (Sec 8.4), 270 (App B), 278 (App B), info used (U); Ridge Intvw (U), pp 8-9. See also AWS DS/DS Report #2 (S), pp 158 (Sec 4.1.3.4), 247 (Sec 10.0-d), info used (U).

issues on the joint level. Furthermore, the degree of coordination and cooperation among the military services in weather support operations was insufficient, an important negative result of which was a general lack of interoperability among their weather communications systems. These situations needed attention from the military agencies involved, but there was little AWS could do by itself.[31]

Conclusion

The many problems and shortcomings and the many instances of needed improvements discussed in the previous paragraphs should not obscure the fact that in every major area AWS's positive accomplishments outweighed the negatives. Sooner or later, AWS, through the efforts of its people at home and in the field, either resolved or worked-around the problems and in a relatively short time put together a large functioning WSF deployed thousands of miles from the US. In the process AWS successfully adapted itself to situations and circumstances it had never encountered before and did things it had never done before. The result was that by the time DESERT STORM began AWS had a WSF in the field that was ready to fully support the operation and do its job of providing weather support to its customers.[32]

Weather support to DESERT SHIELD/STORM was, on the whole, a success story--a "real shining moment," General Kelly called it. The credit for that success belonged primarily to the young officers and enlisted persons, both men and women, of the WSF. Working hard and long, they not only did their job, they did it outstandingly. General Kelly was strong in his praise for the members of the WSF. They put forth, he said, "a herculean effort and did a very fine job....Overall, they did great." Confirmation of the high quality of weather support came from the WSF's customers, who frequently expressed satisfaction with and appreciation for the support they received. The 5th Wing headquarters and Headquarters AWS personnel, through the support they extended to the WSF, also played a vital role. Indeed, everywhere the members of AWS--officers, enlisted, and civilians alike--worked extra hard in support of DESERT SHIELD/STORM weather operations. [33]

Weather support was not a decisive factor in winning the war, but it made a significant contribution to the military's success; it made a difference. Perhaps the main contribution of weather support to the Air Force was in the overall prosecution of the air war, particularly in the mission planning area--e.g., assisting planners in how to use weather to their advantage and how to select

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[31]Kelly Intvw (U), p 32; AWS DS/DS Report #2 (S), pp iv (Exec Sum), 246 (Sec 9.4), 247 (Sec 10.0-b), 278 (App B), info used (U); JULLS Long Report No. 31358-57600 (00001)(U), AWS/DO, "Incompatible High Frequency Weather Communication Systems," n.d. [probably mid-Mar 91].

[32]Kelly Intvw (U), pp 26, 30, 34; Frederick Intvw (U), p 14; AWS DS/DS Report #2 (S), p iv (Exec Sum), info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 34-35; Goldey Intvw (U), p 35.

[33]Kelly Intvw (U), pp 2, 29, 34; Frederick Intvw (U), p 12, 18, 19; AWS DS/DS Report #2 (S), pp 78 (Sec 4.1.1.4), 104 (Sec 4.1.6.3), info used (U); Col T.C. Tarbell in AWTB Intvw (U), pp 34-35; Goldey Intvw (U), pp 14-15; Riley Intvw (S), p 41, info used (U); Weaving Intvw (U), pp 26-27; Campbell Intvw (U), pp 19, 25-26, 29; Koenemann Intvw (U), p 24; msg (U), AWS/CC to AIG 8148/CC, [Appreciation for AWS Personnel Performance in DS/DS,] 011800Z Mar 91.

targets, while to the Army it was in the tactical arena--assisting Army commanders in tactical decision-making.[34]

Even though it faced many problems and challenges, could have done some things better than it did, and experienced shortcomings in several areas, AWS, overall, did well in DESERT SHIELD/STORM--due, in no small part, to "leadership foresight, years of preparation, and the commitment and sacrifice of every member of the weather community."[35] At the end of the operation AWS could, with justifiable pride, report, "Mission accomplished."

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[34]Kelly Intvw (U), p 30; Frederick Intvw (U), pp 12, 14-15; AWS DS/DS Report #2 (S), p iv (Exec Sum), info used (U); Col T.C. Tarbell in AWTB Intvw (U), p 34; Riley Intvw (S), p 40, info used (U); Campbell Intvw (U), pp 25-26; CENTAF SWO AAR (U), Sec K-3; 5WW DS/DS Summary Brfg (S), slide (paper) #53, info used (U); msg (U), AWS/CC to AIG 8148, [Appreciation for AWS Personnel Performance in DS/DS,] 011800Z Mar 91.

[35]AWS DS/DS Report #2 (S), p 248 (Sec 10.0-i), info used (U).

APPENDIX I

AWS PERSONNEL DEPLOYED TO DESERT SHIELD/DESERT STORM

RANK	NAME	DT DPLYD	DT RDPLYD
A1C	ACEVEDO, FRANK III	08/20/90	11/18/90
AMN	ADAMS, BENJAMIN D.	09/29/90	04/07/91
SRA	ADAMS, CLIFFORD G.	08/09/90	03/31/91
SSG	ADAMS, JON D.	08/25/90	03/15/91
TSG	ADAMS, STEVEN R.	04/07/91	05/11/91
A1C	ALDRIDGE, TIMOTHY A.	08/19/90	03/23/91
TSG	ALEXANDER, LAWRENCE J.	08/08/90	03/21/91
SRA	ALLEN, MARC E.	08/20/90	04/17/91
SGT	AMRHEIN, EDWARD T.	10/11/90	04/17/91
SGT	ANDERSEN, PETER	01/19/91	06/03/91
A1C	ANDERSON, DAVID W.	08/09/90	03/19/91
SSG	ANDERSON, JAMES M.	01/20/91	05/28/91
SRA	ANDERSON, STEVEN E.	02/07/91	03/21/91
TSG	ANDERSON, WILLIAM M.	11/29/90	03/27/91
SSG	APPLE, ERIC G.	08/09/90	03/19/91
SSG	ARCHER, NAOMI L.	12/18/90	06/24/91
CPT	ASATO, BLAINE A.	12/06/90	04/14/91
TSG	ASHTON, PATRICK L.	01/20/91	06/03/91
AMN	ATKINSON, STEVEN L.	02/07/91	03/19/91
SGT	AUSTIN, LORI A.	01/17/91	05/24/91
A1C	AVENARIUS, STEVEN R.	08/08/90	03/24/91
SSG	AVERY, TERRY L.	08/10/90	02/23/91
TSG	BABCOCK, BRUCE J.	08/20/90	03/14/91
SSG	BAGBY, JAMES B.	12/13/90	04/17/91
A1C	BAILEY, KIRK D.	08/11/90	04/12/91
SSG	BAKER, JOHN P.	09/19/90	04/10/91
SSG	BALSOMA, THOMAS C.	12/07/90	03/24/91
MSG	BARBER, RAYMOND A.	12/23/90	04/29/91
SSG	BARGER, TRAVIS L.	01/14/91	03/13/91
2LT	BASS, RANDALL G.	08/27/90	04/10/91
A1C	BATSON, TIMOTHY D.	08/11/90	04/04/91
SSG	BAWEK, SCOTT A.	09/02/90	04/07/91
SRA	BELL, STEVEN R.	09/09/90	04/10/91
SGT	BENEFIELD, JEFFERY S.	01/20/91	04/10/91
1LT	BERTHA, JOHN C.	08/09/90	12/31/90
1LT	BISHOP, THYRA A.	01/20/91	07/25/91
TSG	BLACKFORD, BRIK A.	11/29/90	06/03/91
TSG	BLAY, JAMES E.	12/07/90	06/13/91
SSG	BLOMQUIST, MICHAEL P.	10/01/90	03/30/91

TSG	BLUME, RICHARD A.	12/29/90	02/28/91
SSG	BLUNDELL, WARREN L.	03/16/91	06/29/91
SSG	BOBERG, THOMAS J.	12/31/90	07/04/91
SSG	BOND, GREGORY A.	12/25/90	05/24/91
A1C	BOS, PAUL P.	11/18/90	03/23/91
A1C	BOURNE, KEVIN M.	08/27/90	03/29/91
SSG	BOWDEN, TIMOTHY P.	08/27/90	05/05/91
SGT	BOWMAN, VINCE B.	08/07/90	03/10/91
MSG	BOYLE, WILLIAM J.	08/31/90	04/30/91
SMS	BRADLEY, PAUL D.	08/13/90	04/30/91
CPT	BREES, DANIEL J.	08/25/90	10/05/90
CPT	BRIDGES, FREEMAN P.	12/29/90	04/25/91
MAJ	BROD, JOSEPH D.	08/23/90	04/20/91
SSG	BROOKS, MICHAEL G.	08/31/90	03/21/91
SSG	BROWN, WILLIAM R.	08/19/90	03/23/91
TSG	BUECHER, MICHAEL M.	08/31/90	04/12/91
SSG	BULLARD, DUANE P.	12/29/90	05/12/91
CPT	BUNNAG, FREDERIC J.	10/12/90	04/29/91
SSG	BURKHALTER, RONALD J.	08/20/90	03/20/91
SSG	BUSSEY, JESSIE E.	08/08/90	02/25/91
SGT	BUSTANY, BRADY M.	12/13/90	04/28/91
A1C	BYARS, MICHAEL S.	08/11/90	04/03/91
A1C	CALDERON, DONALD M.	08/22/90	03/31/91
SSG	CAMPBELL, CARL H.	08/08/90	03/07/91
LTC	CAMPBELL, WILLIAM H.	11/15/90	04/30/91
A1C	CARDENAS, RICHARD N., JR.	09/29/90	04/07/91
CPT	CARROLL, LINDA L.	08/09/90	03/09/91
SRA	CARROLL, JOHN A.	08/21/90	04/02/91
SGT	CASTLE, SHANE P.	09/27/90	04/17/91
SGT	CEPEK, JASON J.	12/31/90	03/27/91
SSG	CERONE, JOHN J., JR.	08/25/90	03/20/91
SSG	CHAMBERS, NANCY M.	08/10/90	03/15/91
A1C	CHANEY, JEFFERY L.	08/17/90	03/30/91
AMN	CHAPMAN, ROBERT E.	12/23/90	04/29/91
AMN	CHERNAY, EDWARD S., JR.	08/27/90	03/21/91
SSG	CHESEBRO, KEVIN L.	12/11/90	06/13/91
SSG	CHOPLICK, DANIEL E., JR.	08/11/90	04/03/91
2LT	CHORNEY, DAVID L.	12/28/90	07/01/91
SSG	CHRISTIANSEN, DIRK W.	08/08/90	02/13/91
SRA	CHRISTIANSON, CARL C.	09/28/90	04/13/91
CPT	CHRISTY, STEVEN R.	01/17/91	05/15/91
AMN	CHUMNEY, WALTER L.	12/01/90	04/17/91
A1C	CLARK, MATTHEW A.	12/06/90	04/23/91
CPT	CLARK, RAY M.	12/06/90	04/23/91
1LT	CLEMENT, PETER C.	08/08/90	04/02/91
A1C	COBB, GREG	09/09/90	03/17/91
CPT	COE, THOMAS E.	08/25/90	03/24/91
A1C	COLEMAN, JOANN	08/09/90	03/09/91
CPT	COLLISON, BRYAN W.	10/11/90	04/13/91
SSG	COMTE, CHRISTOPHER A.	08/09/90	03/19/91
CPT	CONANT, PHILIP A.	12/13/90	04/28/91
1LT	CONANT, ROBERT W. JR.	08/13/90	04/07/91
MAJ	CONLEY, JOHN R.	09/22/90	03/28/91
2LT	CONNORS, MARK J.	01/24/91	03/27/91

SSG	COOK, JOHN P.	08/27/90	10/03/90
SSG	COOK, RONALD L.	12/03/90	05/11/91
SGT	COOKERLY, FRED S.	10/29/90	05/13/91
SGT	COOPER, JAMES M.	08/25/90	03/23/91
SSG	CORRIVEAU, KEVIN S.	01/17/91	05/20/91
1LT	COTTURONE, JAMES A.	09/04/90	04/15/91
CMS	COUGHRAN, BENJAMIN L.	08/27/90	03/26/91
2LT	COX, JEFFERY M.	02/14/91	03/21/91
SGT	COX, JOHN D. JR.	08/28/90	10/24/90
SGT	CRUTCHFIELD, SCOTT E.	08/14/90	03/31/91
SSG	CRUZ, JOSEPH K.	08/27/90	04/08/91
A1C	CUMBO, RICHARD A.	11/15/90	03/14/91
TSG	CUMMINGS, KEVIN J.	01/31/91	04/08/91
A1C	CUPIL, RONALD A.	08/13/90	03/18/91
TSG	CURRIN, ROBERT J.	01/08/91	05/20/91
SGT	CVITKO, KEVIN J.	08/09/90	03/31/91
A1C	DAHL, MARK A.	08/27/90	10/13/90
TSG	DANIELS, KEITH E.	08/07/90	03/08/91
A1C	DAVENPORT, DEBBIE M.	10/17/90	03/24/91
SRA	DAVIDSON, WAYNE A.	08/10/90	03/15/91
CPT	DAVISON, MICHEL	08/13/90	04/30/91
SSG	DEATHRAGE, MICHAEL A.	10/27/90	05/01/91
SSG	DEBORD, JOSHUA P.	09/12/90	03/20/91
SSG	DEELY, TIMOTHY E.	09/09/90	03/20/91
SGT	DEJEAN, GARRIGUES A.	01/08/91	04/19/91
A1C	DELMARCELLE, MICHAEL L.	08/17/90	03/30/91
AMN	DEMEYER, JEFFREY D.	08/22/90	03/25/91
TSG	DEMPSEY, ROBERT L. JR.	08/11/90	03/23/91
SSG	DENNIS, WILLIAM H. JR.	12/23/90	04/29/91
TSG	DEOLIVERA, KENNETH D.	08/10/90	03/15/91
SSG	DEROJAS, FERNANDO A.	11/20/90	03/17/91
SSG	DETRAFFORD, RICHARD J.	12/18/90	07/01/91
CPT	DICKEY, JUDITH E.	08/07/90	03/20/91
TSG	DICKINSON, DAVID C.	09/15/90	03/23/91
SSG	DISTLER JOHN S.	08/25/90	03/22/91
SGT	DIXON, JAMES S.	12/13/90	04/28/91
CPT	DOBRY, EUGENE W. JR.	12/23/90	04/29/91
MSG	DOUGHERTY, MICHAEL D.	08/24/90	09/25/90
SSG	DOUGLAS, DAVID J.	12/30/90	07/03/91
TSG	DRUMMOND, KARL E.	10/11/90	04/07/91
1LT	DUFFY, KEITH J.	08/16/90	03/21/91
TSG	DUFRANE, ROBERT F.	12/31/90	04/20/91
SSG	DUNCAN, THOMAS A.	08/11/90	03/22/91
SRA	DUNN, JAMES F.	10/17/90	03/29/91
1LT	DWYER, MICHAEL J.	01/02/91	07/04/91
AMN	EICHENBERGER, JOSEPH W.	08/31/90	03/20/91
SSG	EIERMANN, MICHAEL P.	11/24/90	05/24/91
SSG	ELFORD, CHARLES H.	12/26/90	07/01/91
SSG	ERSKINE, MICHAEL S.	11/23/90	03/18/91
TSG	ERWIN, GLYNN	08/12/90	10/12/90
SSG	ESPARZA, DAVID C.	08/28/90	03/14/91
SSG	ESPINOSA, CARLOS A.	08/11/90	04/04/91
SRA	FAHEY, DUKE E.	08/10/90	03/15/91
MSG	FARIAS, RICHARD S. JR.	01/03/91	07/08/91

SGT	FARLEY, JOHN F.	08/27/90	03/23/91
SGT	FASHING, JAMES M.	08/27/90	01/08/91
1LT	FASKING, TODD M.	08/07/90	10/14/90
SSG	FEDERICO, JOSEPH J.	08/08/90	03/24/91
MSG	FENTON, WILLIAM J.	09/09/90	11/19/90
SSG	FINCHER, DAVID A.	01/11/91	07/12/91
1LT	FIORINO, STEVEN T.	unknown	unknown
TSG	FISHER, MARK S.	12/13/90	04/28/91
MSG	FISKE, RICHARD A.	12/13/90	04/28/91
SSG	FITZGERALD, DENNIS W.	01/05/91	07/08/91
SSG	FJELLIN, KIM T.	08/31/90	04/04/91
SSG	FLANAGAN, DENNIS B.	08/30/90	04/04/91
1LT	FLEISHAUER, ROBERT	08/11/90	03/26/91
AMN	FLORES, JOE A. JR.	12/05/90	04/12/91
MSG	FOLK, BRYAN J.	08/30/90	03/26/91
2LT	FORTMEYER, ERIK J.	01/02/91	07/02/91
TSG	FOSTER, RICHARD L. JR.	12/23/90	03/07/91
A1C	FOURNIER, ROBERT G. JR.	09/05/90	04/03/91
SGT	FRAME, CHARLES E.	08/23/90	02/17/91
A1C	FROST, SUSAN L.	08/09/90	03/19./91
TSG	FULLER, ROBERT L.	08/26/90	04/10/91
SGT	FULLER, STEPHEN C.	12/04/90	04/30/91
A1C	GAMBINO, RANDALL R.	01/17/91	03/30/91
SSG	GANLEY, GIRARD R. JR.	09/01/90	04/09/91
SRA	GARCIA, GALO JR.	10/11/90	04/17/91
1LT	GARRETT, ANDREW W.	02/10/91	05/30/91
TSG	GATTO, GEORGE A. JR.	12/23/90	04/29/91
SSG	GATZ, GEOFF A.	01/12/91	07/12/91
TSG	GEIS, DANIEL J.	12/01/90	06/07/91
SGT	GEORGE, RUSSELL C.	08/16/90	03/30/91
TSG	GIBSON, KENNETH R.	08/16/90	03/23/91
TSG	GILBERT, MICHAEL P.	10/16/90	04/15/91
TSG	GOFORTH, BRYAN, K.	01/02/91	03/12/91
A1C	GOLD, LARRY D.	08/17/90	04/03/91
COL	GOLDEY, JAMES W.	08/23/90	03/27/91
1LT	GONZALES, NORMAN W.	09/01/90	04/09/91
TSG	GOODE, RONALD C. JR.	08/09/90	03/09/91
SSG	GOULD, JEFFREY M.	08/11/90	04/04/91
A1C	GRAY, DAVID	01/20/91	03/29/91
TSG	GREEN, STEPHEN G.	08/08/90	11/09/90
SGT	GRIFFITH, KEVIN R. JR.	03/27/91	07/01/91
CPT	GRIGORIAN, GARY C.	08/10/90	03/15/91
SSG	GROSS, THOMAS P.	08/14/90	03/11/91
TSG	GUNNING, DONALD D.	08/31/90	04/15/91
A1C	GURLEY, DERRICH D.	08/09/90	04/02/91
A1C	HAAVISTO, JAMES K.	12/23/90	04/29/91
TSG	HALL, CHARLES JR.	03/09/91	05/24/91
TSG	HALL, FRANK J. III	01/25/91	04/18/91
SSG	HALSEY, LANCE D.	08/13/90	03/09/91
SGT	HAM, LINDA R.	01/20/91	05/28/91
A1C	HAMLING, ROBERT J.	08/25/90	03/23/91
TSG	HANCOCK, JOHN K.	08/25/90	11/02/90
SSG	HAND, TERRY R.	09/27/90	04/21/91
1LT	HARPER, DON S. III	08/10/90	05/19/91

SSG	HARRIS, EDWARD C.	02/14/91	04/16/91
2LT	HARRIS, GETTYS N. JR.	08/14/90	03/26/91
TSG	HART, JOEL D.	01/29/91	03/24/91
SSG	HAWK, ROBERT B.	12/19/90	03/08/91
A1C	HAYES, RANDALL W.	09/10/90	04/04/91
SGT	HENDERSON, ANDREW C.	09/15/90	03/23/91
SGT	HENDERSON, ROBERT J.	unknown	unknown
TSG	HIATT, DAVID D.	12/29/90	04/23/91
A1C	HICKCOX, DAVID B.	12/19/90	05/24/91
TSG	HILDEBRAND, MARK Z.	08/10/90	03/07/91
SRA	HILL, DALE L.	08/10/90	10/05/90
SGT	HILL, DALE M.	08/10/90	03/06/91
SSG	HILL, STEVE G.	09/01/90	03/24/91
SSG	HILSDORF, DAVID M.	12/23/90	04/29/91
TSG	HINE, GILBERT C.	08/28/90	02/15/91
AMN	HINSBERGER, JOHN A.	12/05/90	06/10/91
1LT	HINSON, FRANKLIN J.	08/18/90	03/19/91
SSG	HIRL, ROBERT L.	08/18/90	03/24/91
MAJ	HOFMANN, KARAN T.	03/21/91	06/17/91
MAJ	HOLTGARD, NANCY E.	08/23/90	04/20/91
SSG	HOPKINS, BRADLEY N.	08/27/90	04/05/91
A1C	HORGAN, MICHAEL A.	03/01/91	07/01/91
A1C	HORNING, KENNETH L. II	09/19/90	04/07/91
MSG	HOSEIN, FIZAL	12/30/90	07/03/91
SGT	HOWELL, DON N. JR.	12/01/90	05/01/91
SSG	HUEBNER, VINCENT S.	08/30/90	03/30/91
SSG	HUNTER, GERALD L.	08/13/90	04/04/91
SRA	IRESON, KIRK J.	12/23/90	04/29/91
SSG	ISOM, JEFFERY L.	08/27/90	03/24/91
A1C	JACOBI, BRIAN W.	08/30/90	04/03/91
TSG	JACOBS, MICHAEL .	09/28/90	04/13/91
TSG	JANKITE, JOHN	09/13/90	03/23/91
A1C	JENSEN, FREDERICK W. JR.	12/23/90	04/29/91
TSG	JOHNSON, CARL J.	08/08/90	02/13/91
CPT	JOHNSON, JEFFREY E.	08/20/90	03/15/91
SSG	JOHNSON, JEFFREY E.	08/08/90	10/11/90
CPT	JOHNSON, STEVEN C.	08/29/90	03/24/91
CPT	JOHNSTON, KEVIN	08/12/90	11/04/90
CPT	JOHNSTON (first name unknown)	01/18/91	03/23/91
SSG	JORDAN, OLIVER L. JR	01/21/91	05/20/91
SRA	JOSEPHSON, KEVIN A.	12/06/90	04/17/91
A1C	KAHMER, ROBERT A. JR.	09/15/90	03/23/91
TSG	KALB, TIMOTHY A.	08/20/90	03/19/91
A1C	KEATON, WILLIAM B.	08/20/90	03/19/91
A1C	KEEL, PAUL J.	12/23/90	06/24/91
SSG	KEENAN, THOMAS J.	08/12/90	03/30/91
SRA	KELLER, RICHARD A.	12/06/90	04/23/91
TSG	KELLERMAN, RONALD H.	08/10/90	03/29/91
1LT	KELLY, ANDREW R.	11/01/90	05/03/91
MAJ	KENDRICK, FRANK L.	08/07/90	03/26/91
AMN	KEUP, BRYAN C.	08/30/90	04/10/91
CPT	KINCAID, LARRY W.	12/13/90	05/12/91
SSG	KING, EUGENE J. JR	09/19/90	04/10/91
SSG	KING, MICHAEL E.	01/06/91	04/02/91

SSG	KLEINBECK, KARL N.	09/27/90	04/21/91
A1C	KLINZMANN, DWAYNE E. J.	09/11/90	04/10/91
TSG	KNOWLES, CORY W.	02/21/91	03/14/91
SSG	KOCH, JEROME P. JR.	12/01/90	05/11/91
1LT	KODAMA, KEVIN R.	12/28/90	07/01/91
SSG	KOGUT, MICHEL J.	12/30/90	07/04/91
MSG	KOWALSKI, ERIC J.	12/19/90	05/24/91
SSG	KRAETSCH, ROBERT C. A.	02/07/91	03/17/91
CPT	KRASNER, RICHARD D.	08/30/90	03/27/91
2LT	KRATZER, JAMES A.	01/19/91	04/15/91
TSG	KUREK, DANIEL R.	11/01/90	03/14/91
SSG	LACOSSE, WAYNE R.	08/18/90	03/30/91
SSG	LACROIX, EDDIE P. JR.	08/28/90	03/15/91
SSG	LAMMERS, KLAUS P.	08/12/90	03/30/91
SRA	LAND, GARY W.	08/09/90	03/09/91
A1C	LATHAM, JOSEPH E.	11/16/90	05/24/91
CPT	LAUTEN, JOHN T.	01/31/91	03/28/91
A1C	LAWSON, BABE A.	08/20/90	04/03/91
A1C	LEARY, DAVID T. JR.	12/26/90	06/27/91
SGT	LEBRUN, STEPHEN A.	10/11/90	04/13/91
SGT	LEGAULT, JOHN B.	09/27/90	04/15/91
TSG	LEHR, LAWRENCE W. JR.	12/26/90	07/01/91
A1C	LEMARR, BILLY R.	08/13/90	12/10/90
2LT	LEWIS, JOHN M.	12/29/90	05/01/91
A1C	LIMBAUGH, DICK A.	12/29/90	05/12/91
SGT	LINDSTROM, CHARLES W.	09/19/90	04/04/91
TSG	LOFTON, EUGENE	08/11/90	03/15/91
TSG	LONG, JIMMY W.	08/09/90	03/09/91
MSG	LORD, STEPHEN A.	08/08/90	03/10/91
SGT	LUCIA, JUANITA A.	08/30/90	04/03/91
CPT	LUM, ROY H.	01/05/91	03/20/91
1LT	LUNSFORD, TOM D.	08/26/90	04/03/91
1LT	LUTERMAN, RICHARD H.	12/28/90	06/27/91
2LT	MAES, WILLIAM C.	10/22/90	05/05/91
SSG	MAHLER, ROBERT D.	10/23/90	04/14/91
CPT	MAHOOD, ROBERT W.	12/23/90	04/29/91
SGT	MALCHOSE, KERRY R.	08/08/90	03/20/91
SSG	MALCOMB, WILLIAM D.	01/26/91	04/18/91
SSG	MALLARD, SIDNEY D.	08/29/90	03/23/91
CPT	MALONE, EMMETT C.	08/14/90	04/02/91
TSG	MARCI, ANTHONY C.	08/08/90	03/21/91
AMN	MARSHALL (first name unknown)	08/29/90	09/24/90
SSG	MARTIN, WILLIAM J.	08/12/90	03/30/91
A1C	MATHIAS, WESLEY D.	12/25/90	05/24/91
1LT	MATTHEWS, LAILLA R.	08/18/90	04/17/91
TSG	MAVIS, TERRY W.	08/30/90	03/11/91
A1C	MAYNOR, STEPHANIE M.	08/25/90	03/24/91
MAJ	MCATEE, MICHAEL D.	12/25/90	05/24/91
A1C	MCATTEE, RACHELLE J.	10/11/90	04/17/91
TSG	MCCARTHY, THOMAS M.	08/11/90	04/03/91
SSG	MCCLELLAN, JOHN W.	08/22/90	03/31/91
SSG	MCCOY, COLIN W.	08/14/90	03/23/91
SSG	MCCULLOCH, GARTH A.	01/26/91	04/18/91
CPT	MCDONALD, MICHAEL H.	09/19/90	04/03/91

A1C	MCDONALD, TROY E.	08/31/90	03/20/91
CPT	MCKITO, MICHAEL L.	08/25/90	03/23/91
A1C	MCNEIL, DAVID P.	01/08/91	05/20/91
MAJ	MEADE, ARTHUR C.	08/12/90	03/12/91
SSG	MEDLIN, BRAD A.	12/06/90	04/28/91
A1C	MENDONCA, HOWARD J.	08/13/90	03/27/91
SSG	MIKISKA, STEPHEN J.	08/12/90	01/24/91
MSG	MILLER, ANDREW J.	12/25/90	05/24/91
MSG	MILLER, STEVEN V.	12/06/90	04/23/91
TSG	MINARD, STEVEN R.	01/13/91	05/25/91
TSG	MITCHELL, WILLIAM R. JR.	12/31/90	05/24/91
CPT	MITSCH (first name unknown)	08/28/90	12/19/90
SGT	MIZELL, STEPHEN A.	08/08/90	03/31/91
1LT	MODLIN, NORMAN R.	08/20/90	04/15/91
MSG	MOLL, MICHAEL J.	03/21/91	07/26/91
A1C	MONTY, KEITH J.	12/19/90	05/12/91
TSG	MOORE, GARY W.	10/27/90	05/01/91
1LT	MORLEY, FAWN L.	08/06/90	11/02/90
TSG	MORRIS, JEFFREY L.	08/13/90	03/29/91
A1C	MORRIS, TODD E.	02/19/91	04/14/91
SSG	MORTENSON, MICHAEL A.	01/05/91	03/11/91
SGT	MUNRO, MARK A.	12/26/90	07/01/91
CPT	MURPHY, JOHN D.	08/25/90	03/24/91
TSG	MURPHY, RICKEY J.	09/02/90	03/17/91
SRA	NAIRN, JOHN K.	09/19/90	10/27/90
MSG	NAPPIER, DENNIS E.	09/07/90	03/27/91
TSG	NARDI, MICHAEL G.	08/08/90	04/02/91
A1C	NAST, EARL D.	08/30/90	03/05/91
SRA	NATALLE, JON S.	12/04/90	04/30/91
CPT	NELMES, KENNETH W. J.	04/04/91	07/01/91
SSG	NELSON,RANDY E.	12/14/90	04/02/91
SSG	NIEMAN, RICHARD W.	03/07/91	07/04/91
SSG	NUNEZ, JOSE A.	08/28/90	03/12/91
MSG	O'CONNELL, NANCY L.	08/20/90	04/03/91
SSG	O'BRIEN, SCOTT M.	01/20/91	05/19/91
SSG	OETTING, DAVID W.	08/18/90	04/17/91
CPT	OGLESBY, ERIC A.	01/20/91	05/30/91
CPT	O'HEARN, MICHAEL J.	09/15/90	03/23/91
2LT	OLSON, WILLIAM A.	12/28/90	03/31/91
SGT	ORTIZ, OSCAR JR.	08/13/90	11/03/90
SRA	OSBORNE, DORIAN E. JR.	08/28/90	03/09/91
SSG	O'SHEA, AARON P.	08/27/90	10/18/90
AMN	OTTE, AARON M.	01/26/91	04/18/91
SGT	OVERTON, DELANE L.	12/16/90	06/17/91
A1C	OWEN, JERRY D.	01/26/91	07/26/91
SSG	PADILLO, STEFAN J.	09/13/90	03/23/91
TSG	PARSONS, JAMES C.	08/19/90	10/21/90
SRA	PASSANISI, GAIL M.	12/25/90	05/04/91
SGT	PATTERSON, JEFFREY W.	08/18/90	03/30/91
SSG	PATTERSON, ROBERT D.	01/26/91	04/18/91
A1C	PATTERSON, ROBERT J. JR.	08/17/90	04/03/91
TSG	PEEPLES, ADRIAN M.	01/19/91	04/17/91
SSG	PEGRAM, DARYL J.	03/03/91	06/03/91
A1C	PENTON, VICKY L.	11/26/90	03/23/91

SSG	PERKINS, BRUCE W.	08/12/90	11/04/90
A1C	PETERS, SCOTT M.	09/19/90	04/03/91
A1C	PETERSON, RUSSELL E. J.	08/14/90	04/02/91
SSG	PHELPS, KENNETH A.	02/14/91	05/30/91
A1C	PITRE, JERRY G. JR.	08/08/90	03/21/91
SSG	PITSENBARGER, LARRY A.	08/09/90	03/09/91
SSG	POOLE, JOHN N.	08/07/90	03/17/91
SGT	PORTA, SHAUN MARIE	08/11/90	03/05/91
AMN	PORTILLO, CHRISTOPHER G.	08/30/90	04/03/91
TSG	POTTS, CHARLES S.	08/30/90	12/18/90
SSG	POULTER, TIMOTHY D.	09/28/90	04/17/91
A1C	PRICE, CLINT C.	09/28/90	04/13/91
A1C	PRICE, DERRICK D.	12/29/90	05/12/91
SRA	PRICE, GREGORY M.	12/06/90	04/23/91
A1C	PRIEST, DEBORAH A.	09/03/90	09/30/90
SSG	PRITCHARD, DAVID A.	01/20/91	04/19/91
SSG	PRUETT, BILLY D.	08/31/90	11/16/90
SGT	QUILLEN, JOHN D.	10/28/90	04/27/91
A1C	RAINIER, LORI L.	08/20/90	04/17/91
TSG	RAMBALI, CHRISTOPHER M.	08/11/90	03/15/91
SRA	RAMSAY, GRANT A.	09/27/90	04/21/91
CPT	RAMSAY, GREGORY A.	08/29/90	01/14/91
TSG	RAMSEY, ROGER W.	09/10/90	04/10/91
SSG	RANDALL, DARRELL J.	12/06/90	04/14/91
MSG	REID, JAMES J.	12/01/90	05/06/91
SSG	REID, JOHN H.II	01/25/91	04/18/91
TSG	REID, ROBERT T.	08/12/90	03/27/91
MAJ	REUTNER, CURTIS A.	03/16/91	10/03/91
1LT	RICH, COSMO A. JR.	08/08/90	12/13/90
A1C	RICHARDSON, KENNETH M.	08/27/90	03/15/91
CPT	RIES, VINCENT T.	12/04/90	05/11/91
SSG	RIGDON, JEFFREY R.	08/31/90	03/21/91
LTC	RILEY, GERALD F. JR.	08/07/90	03/27/91
A1C	RITER, RICHARD J.	08/10/90	03/15/91
MAJ	RIVA, LOUIS J.	08/30/90	03/30/91
A1C	ROBERTS, KENNETH A. JR.	08/25/90	03/23/91
SRA	ROBERTS, MARTHA A.	08/30/90	03/05/91
CPT	ROBERTSON, BRIAN D.	12/20/90	06/18/91
SGT	ROBERTSON, JOHN D.	12/20/90	05/01/91
CPT	ROBINSON, ALAN D.	08/09/90	03/28/91
SGT	ROBINSON, LAURIE L.	12/19/90	05/24/91
1LT	ROBISON, RONALD M.	01/04/91	05/01/91
SRA	ROCCONI, JOSEPH A.	12/25/90	05/24/91
A1C	RODGERS, MATHEW W.	12/23/90	04/29/91
SGT	RODRIQUEZ, RANDOLPH	08/10/90	03/20/91
MSG	ROGERS, ALAN M.	08/29/90	03/23/91
TSG	ROGERS, FRED D. JR.	02/16/91	03/22/91
MSG	ROLL, NEAL R.	08/10/90	03/23/91
SRA	ROMERO, KAREN S.	10/11/90	04/07/91
SSG	ROSBACH, JEFFREY A.	02/07/91	03/19/91
1LT	ROSE, STEPHEN A.	01/25/91	04/18/91
AMN	ROSS, TIMOTHY R.	12/23/90	04/29/91
A1C	ROYCE, CHRISTOPHER C.	08/16/90	03/30/91
TSG	ROZICH, DOUGLAS M.	12/07/90	03/24/91

SGT	RUDD, LOREN L.	09/03/90	09/30/90
SGT	SAFREED, KEVIN L.	09/15/90	03/23/91
TSG	SAMUEL, JEREMY L.	12/06/90	04/23/91
SRA	SAND, HOWARD L.	08/20/90	03/15/91
A1C	SANTOS, FRANCISCO R.	09/01/90	04/09/91
A1C	SCARBOROUGH, STEVEN L.	08/20/90	04/17/91
SRA	SCHAFF, LORI M.	02/13/91	03/23/91
CPT	SCHMID, VALERIE J.	03/07/91	06/07/91
SGT	SCHMIDT, GREGORY A.	10/01/90	04/03/91
TSG	SCHMIDT, JEFFREY A.	12/29/90	04/23/91
TSG	SCOTT, MICHAEL E.	12/19/90	05/12/91
SSG	SECESSIONS, RAYMOND	08/12/90	04/02/91
TSG	SEIBERT, DAVID P.	03/14/91	07/04/91
SSG	SHAY, MICHAEL F.	08/27/90	11/02/90
SSG	SHERIN, WILLIE C.	12/10/90	03/19/91
AMN	SIMON, WILLIAM K.	08/30/90	04/08/91
SSG	SINCORE, MICHAEL D.	08/12/90	03/25/91
1LT	SISKANENITZ, WILLIAM	08/09/90	03/19/91
CPT	SKIDMORE, STEVEN D.	08/12/90	04/20/91
SSG	SMEBY, JEFFREY D.	09/24/90	04/17/91
SRA	SMITH, CHARLES L.	09/15/90	03/17/91
CPT	SMITH, GERALD B. II	12/25/90	05/24/91
AMN	SMITH, MICHAEL R.	08/09/90	04/02/91
TSG	SMITH, ROBIN R.	08/27/90	04/08/91
AMN	SMITH, SAMUEL	12/29/90	05/12/91
1LT	SMITH, TINA M.	08/31/90	04/12/91
A1C	SNYDER, DALE R.	08/30/90	05/05/91
SGT	SOLBERG, BENNIE G.	08/27/90	01/20/91
SGT	SOMERS, OWEN	01/26/91	04/18/91
CPT	SORLIN-DAVIS, JANET	09/27/90	05/01/91
SSG	SPACK, DENISE L.	08/30/90	05/05/91
CPT	SPENDLEY, WILLIAM J.	09/09/90	03/17/91
SSG	STARRS, SHAWN P.	09/19/90	04/04/91
A1C	STEELE, MICHAEL A.	11/26/90	05/29/91
SSG	STEENBURGH, ROBERT A.	08/24/90	03/15/91
SSG	STEPHENS, JOE SR.	08/27/90	03/27/91
1LT	STEVENSON, CHRISTIN	12/17/90	03/15/91
A1C	STEVENSON, SALLY S.	12/13/90	04/28/91
CPT	STONEHOCKER, SYDNEY	09/26/90	03/30/91
A1C	STOVALL, RODNEY L.	02/28/91	07/01/91
SSG	STRACHAN, TREVOR S.	08/12/90	03/25/91
TSG	STRICKLER, PAUL A.	08/30/90	03/27/91
MSG	STRUNK, GEORGE K.	08/09/90	03/19/91
A1C	STUART, LISA G.	02/07/91	03/21/91
SSG	STUMPH, JOHN M.	08/10/90	03/15/91
SSG	SULLIVAN, JAMES A.	08/10/90	03/17/91
AMN	SUMRALL, MICHAEL S.	08/30/90	04/08/91
SSG	SUNTYCH, BRUCE A.	12/13/90	04/28/91
SGT	SWICK, RODNEY D.	12/29/90	04/25/91
AMN	TAFT, RANDY C.	08/29/90	03/23/91
TSG	TAYLOR, DAVID A.	12/01/90	04/17/91
SSG	TAYLOR, IRVING A. JR.	12/06/90	04/23/91
SSG	TAYLOR, JOSEPH M.	08/29/90	04/04/91
SSG	TAYLOR, TONY D.	08/27/90	03/24/91

SGT	TEFFT, JOHN S.	12/05/90	06/06/91
TSG	TESORI, ANTHONY J.	08/28/90	03/09/91
SSG	THOELE, THOMAS R.	01/24/91	05/09/91
TSG	THOMAS, NATHANIEL W.	12/01/90	04/17/91
CPT	THOMAS, ROBERT B.	01/13/91	03/13/91
A1C	THOMPSON, DEAN M.	08/24/90	09/15/90
AMN	THOMPSON, MARK V.	12/29/90	05/12/91
SSG	THOMPSON, MARTIN R.	12/25/90	05/24/91
SSG	THOMPSON, SCOTT C.	09/09/90	04/04/91
LTC	THORNBERRY, JERRY R.	12/01/90	05/12/91
MSG	THORNSBERRY, STEVEN J.	08/25/90	03/21/91
SSG	TINGELHOFF, RUDY B.	09/04/90	04/15/91
2LT	TOBIN, BRIDGET F.	08/10/90	03/15/91
A1C	TUCKER, DANIEL	01/20/91	05/30/91
SSG	TURKOVICH, STEPHEN H. II	09/15/90	03/23/91
A1C	TURNER, LORRENE M.	12/25/90	05/24/91
TSG	UNDERWOOD, JOHN W.	08/30/90	03/05/91
A1C	URIBE, ANGELA L.	08/08/90	03/21/91
SGT	VANBROCKLIN, JEFFREY M.	08/12/90	03/11/91
TSG	VELASCO, JUAN M.	10/11/90	04/17/91
MSG	VIOLA, CHARLES D.	10/28/90	04/29/91
SRA	VOCI, TODD D.	12/04/90	04/30/91
SGT	VOGEL, JEFFREY W.	08/30/90	03/24/91
MAJ	WAITE, LARRY J.	01/14/91	03/27/91
A1C	WALKER, CHARLES A. JR.	12/26/90	05/16/91
SSG	WALKER, CHARLES L.	08/13/90	04/04/91
CPT	WALKER, JAMES E.	08/22/90	03/11/91
SSG	WALKER, JOHN W.	10/01/90	04/03/91
SSG	WALSH, JOHN R.	12/29/90	05/12/91
MSG	WALSH, PAUL E.	02/08/91	04/03/91
A1C	WALTERS, KEVIN R.	12/23/90	04/29/91
SSG	WARD, DANIEL K.	12/23/90	04/29/91
SSG	WAYTE, KEVIN E.	08/30/90	04/03/91
LTC	WEAVING, WILLIAM S.	09/07/90	04/20/91
SGT	WEBER, CHARLES G.	01/30/91	03/14/91
SGT	WEBER, JOHN V.	12/19/90	05/24/91
SRA	WHITE, JANE E.	12/11/90	06/14/91
MAJ	WHITE, JOHN A. III	08/08/90	09/25/90
SSG	WHITTLE, ROBERT J.	02/11/91	05/30/91
MSG	WILBURN, FRED A.	08/09/90	03/09/91
MSG	WILCOX, THOMAS L.	08/09/90	11/06/90
CPT	WILDEROTTER, STEVEN	10/11/90	04/17/91
TSG	WILLIAMS, DENNIS D.	08/16/90	04/15/91
SSG	WILLIAMS, GREGORY W.	08/09/90	03/28/91
SGT	WILLIAMS, JIMMY W.	08/20/90	03/20/91
1LT	WILLIAMS, ROBERT T.	08/10/90	03/15/91
SGT	WILLIAMS, STEVEN	12/29/90	04/23/91
SSG	WILLIAMSON, DALE F.	08/25/90	03/21/91
A1C	WILLMS, ANTHONY W.	08/11/90	04/12/91
CPT	WILLSON, JAMES A.	12/17/90	05/28/91
CPT	WILZ, THEODORE R.	09/15/90	03/23/91
SSG	WINTERS, MYRON G. JR.	02/07/91	05/01/91
SSG	WISEMAN, THOMAS D. JR.	08/09/90	03/19/91
A1C	WOLF, SHANNON L.	08/11/90	04/03/91

MSG	WOLFE, DUANE M.	12/14/90	03/30/91
1LT	WOOD, DAVID R.	08/24/90	03/24/91
TSG	YELENIC, STEVEN M.	09/24/90	03/13/91
SSG	YELTON, ROBERT S. JR.	01/02/91	06/09/91
SSG	ZILKENAT, GLENN P.	12/20/90	06/20/91
MSG	ZIMMER, MICHAEL A.	12/03/90	07/01/91

SOURCE: Tkach, List of Deployed AWS Personnel (U), Sep 94

APPENDIX II

DESERT SHIELD/DESERT STORM
FINAL WEATHER SUPPORT FORCE REQUIREMENTS
(17 FEB 91)

LOCATION		OFF	FCT	OBS	IM	TOT
1690WGP	RIYADH MIL					
	CENTCOM	5	5	0	1	11
	ARCENT	4	4	6	1	15
	CENTAF	5	1	0	1	7
	ALCC	1	1	0	0	2
	TACC	1	3	0	0	4
	DSFU	4	8	6	0	18
	BWS - E8A	2	4	3	0	9
OL-D 1690WGP	DIEGO GARCIA NAF					
	SAC SPT	1	4	0	0	5
OL-E 1690WGP	TABUK					
	TAC SPT	1	2	0	0	3
OL-F 1690WGP	JUBAIL					
	ALCE	1	1	0	0	2
OL-G 1690WGP	12AVN BDE					
	12 AVN BDE	2	3	3	0	8
OL-L 1690WGP	2BDE/A10 FOB (KKMC)					
	2 BDE	1	2	3	0	6
	A10 FOB	0	2	0	0	2
DET 1 1690WGP	SOCCENT (KING FAHD)					
	SOCCENT	2	0	0	0	2
	AFSOC	1	5	0	0	6
	SOWT	0	2	1	0	3
	5SFG SFOB	1	3	0	0	4
	3SFG (KING FAHD)					
	3SFG SFOB	1	3	2	0	6
	3SFG FOB	0	2	1	0	3
	5SFG FOB	0	5	3	0	8

LOCATION		OFF	FCT	OBS	IM	TOT
DET 2 1690WGP	AL DHAFRA					
	BWS	2	4	0	0	6
OL-A DET 2 1690WGP	BATEEN					
	BWS	1	3	3	0	7
OL-J DET 2 1690WGP	ABU DHABI INTL					
	BWS	1	3	1	0	5
DET 3 1690WGP	18ABN CRP					
	18ABN MAIN	2	5	2	0	9
	18ABN AVN	1	3	3	0	7
DET 4 1690WGP	AL MINHAD					
	BWS	1	4	3	0	8
OL-B DET 4 1690WGP	SHARJAH INTL					
	BWS	1	3	0	0	4
OL-K DET 4 1690WGP	DUBAI INTL					
	BWS	1	3	0	0	4
DET 5 1690WGP	82ABN DIV					
	82ABN MAIN	1	3	4	0	8
	82ABN AVN	1	3	3	0	7
DET 6 1690WGP	DHAHRAN INTL					
	BWS	2	4	3	0	9
OL-C DET 6 1690WGP	SHAIKH ISA					
	BWS	1	3	3	0	7
DET 7 1690WGP	24ID					
	24ID MAIN	1	3	4	0	8
	24ID AVN	1	3	3	0	7
DET 8 1690WGP	KING FAHD					
	BWS	2	6	3	0	11
	MAC SPT	1	2	0	0	3
DET 9 1690WGP	101ABN DIV					
	101AD MAIN	2	4	3	0	9
	101AD 1BDE	0	3	2	0	5
	101AD 2BDE	0	3	2	0	5
	101AD 3BDE	0	3	2	0	5
	101AD AVN	0	3	3	0	6

LOCATION		OFF	FCT	OBS	IM	TOT
DET 10 1690WGP	DOHA INTL					
	BWS	1	3	3	0	7
DET 11 1690WGP	1CD					
	1CD MAIN	1	3	4	0	8
	1CD AVN	1	3	3	0	7
DET 12 1690WGP	TAIF					
	TR1	1	0	0	0	1
	U2	1	0	0	0	1
	BWS - RDSFU	1	6	4	0	11
DET 13 1690WGP	7 CRP					
	7 CRP MAIN	2	5	2	0	9
	11 AVN BDE	1	3	3	0	7
DET 14 1690WGP	KING ABDUL AZIZ INTL-JEDDAH					
	BWS	1	4	2	0	7
	B52	2	1	0	0	3
DET 15 1690WGP	1AD					
	1AD MAIN	1	3	4	0	8
	1AD AVN	1	3	3	0	7
DET 16 1690WGP	THUMRAIT					
	BWS	1	3	3	0	7
DET 17 1690WGP	3AD					
	3AD MAIN	1	3	4	0	8
	3AD AVN	1	3	3	0	7
DET 18 1690WGP	AL AIN/BURAYMI WEST					
	BWS	1	3	3	0	7
DET 19 1690WGP	1ID					
	1ID MAIN	1	3	4	0	8
	1ID AVN	1	3	3	0	7
DET 20 1690WGP	MASIRAH					
	BWS	1	4	3	0	8
	BWS	0	0	1	0	1
DET 21 1690WGP	2ACR					
	2ACR MAIN	1	2	2	0	5
	2ACR AVN	1	2	3	0	6

LOCATION		OFF	FCT	OBS	IM	TOT
DET 22 1690WGP	SEEB INTL					
	BWS	1	3	3	0	7
DET 23 1690WGP	3ACR					
	3ACR MAIN	1	2	2	0	5
	3ACR AVN	1	2	3	0	6
DET 24 1690WGP	CAIRO WEST					
	BWS	1	4	3	0	8
DET 26 1690WGP	KHAMIS MUSHAIT					
	BWS	1	4	2	0	7
DET 28 1690WGP	KING KHALID INTL-RIYADH					
	BWS	1	3	0	0	4
DET 30 1690WGP	AL KHARJ					
	BWS	2	5	3	0	10
DET 30 1690WGP	FORWARD ALCE					
		0	2	0	0	2
SAC OL'S:						
	MORON					
	BWS	1	4	3	0	8
	FAIRFORD					
	BWS	1	4	3	0	8
	MONT/DE/MARSAN					
	SAC SPT	1	2	0	0	3
	MALPENSA					
	SAC SPT	1	0	0	0	1
TOTAL COUNT		90	229	151	3	473

SOURCE: AWS DS/DS Report #2 (S), pp 42-44 (Atch 3), info used (U)

APPENDIX III

DESERT SHIELD/DESERT STORM FORCES/CUSTOMERS SUPPORTED AS OF 17 FEB 91

UNIT	AIRCRAFT	QUANTITY
BWS GP-RIYADH	E-3	11
	E-8	2
	EC-130 (ABCCC)	7
	RC-135	7
	KC-135	10
	C-21	8
	TACC	
	ALCC	
OL-D GP-DIEGO GARCIA	B-52	20
	KC-10	7
	KC-135	5
OL-E GP-TABUK	F-15C	24
OL-F GP-JUBAIL	ALCE	
DET 02-AL DHAFRA	F-16C	72
	KC-135	7
OL-A DET 2-BATEEN	C-130	16
	EC-130 (CC)	6
OL-J DET 2-ABU DHABI	KC-135	12
DET 04-AL MINHAD	F-16	72
OL-B DET 4-SHARJAH	C-130	16
OL-K DET 4-DUBAI	KC-135	12
DET 06-DHAHRAN	F-15	48
	CRC	
OL-C DET 6-SHAIKH ISA	F-4G	48
	RF-4C	18
USMC	FA-18	78
	A6-E	32
	EA-6B	12
DET 08-KING FAHD	A-10	132
	OA-10	12
	F-16C	24
	C-130	24
	EC-130 (VS)	2
	EC-130 (JACC CP)	3
	AC-130	8
SOF	HC-130	4
	MC-130	4
	MH-53	8
	MH-60	8
DET 10-DOHA	F-16	24
DET 12-TAIF	U-2	6
	TR-1	5
	F-111F	64
	EF-111	18
DET 14-JEDDAH/KAA	B-52	16
	KC-10	13
	KC-135	62
DET 16-THUMRAIT	C-130	16
DET 18 AL AIN	C-130	40
DET 20-MASIRAH	C-130	16
	KC-135	10
DET 22-SEEB	KC-10	10
	KC-135	15
DET 24 CAIRO WEST	KC-135	15
DET 26-KHAMIS MUSHAIT	F-117	42
DET 28-KG KHALID IAP KKIA	EC-135L	2
	KC-135	46
DET 30-AL KHARJ	F-15E	48
	F-15C	24
	F-16A	24
	FA-16A	18
	C-130H	16
OL-SAC FAIRFORD	B-52	8
OL-SAC MORON	B-52	22
OL-SAC MALPENSA	KC-10	6
OL-SAC MONT DE MARSON	KC-135	7
DET 03-18 ABN CORPS 18 ABN AVN	CH-47	30
	UH-1H	32
DET 05-82 ABN DIV 82 ABN AVN	AH-64	19
	AH-1	10
	OH-58	34
	UH-60	42
	EH-60	3
COSCOM	AH-64	1
	CH-47	1
	VH-1	13
	MEDEVAC	67

UNIT	AIRCRAFT	QUANTITY
DET 07-24 ID/24 ID AVN	AH-64	18
	AH-1	8
	OH-58	31
	UH-60	18
	UH-1	11
	EH-60	3
DET 09-101 ABN DIV/101 AD AVN	AH-64	37
	AH-1	34
	CH-47	45
	OH-58	69
	UH-60	106
	UH-1	35
	EH-60	3
	MEDEVAC	12
DET 11-1CD/1CD AVN	AH-64	36
	CH-47	8
	OH-58	44
	UH-60	6
	UH-1	33
	EH-60	3
DET 13-7 CORPS AND 11 AVN		
DET 15-1AD/1AD AVN		
DET 17-3 AD/3 AD AVN		
DET 19-1 ID/1 ID AVN		
DET 21-2 ACR/2 ACR AVN		
DET 23-3 ACR AVN	CH-47	26
	OH-58	27
	UH-60	18
	EH-60	3
OL-G GP-12 AVN	AH-64	36
	CH-47	8
	OH-58	28
	UH-60	21
	UH-1	5
OL-L GP-KHALID MC	A-10	FOB
SOF	UH-60	8
	CH-47	4
	160 SOAG ACFT	
-HAFR AL BATIN	ASOC/CRC/MPC	
UNKLOCK-ARMY FIXED WG	OV-1	11
	RV-1	6
	RC-1	5
	C-21	1

SOURCE: AWS DS/DS Report #2 (S), pp 61-62 (Atch 4)

APPENDIX IV

1690TH WEATHER GROUP PROVISIONAL HERALDRY

The 1690th WGP patch decribed on this page was designed by Col James W. Goldey, 1690WGP OICWSF and, although never formally approved by the Air Force, was widely accepted and issued to all members of the AWS WSF.

1. The central tri-color disk is symbolic of AWS support to the three USCENTCOM components: yellow for the desert sand of ARCENT; blue for the skies of CENTAF; black for the special operations of SOCCENT.

2. The three-cup anemometer is the traditional AWS symbol.

3. The crossed scimitars and palm are the symbol of the kingdom of Saudi Arabia. The palm itself symbolizes health, well being, and sustenance. The color green, lushness. The crossed scimitars symbolize the justice of the kingdom.

4. The red letters and outer band are symbolic of the courage of weather personnel deployed to support U.S. objectives in DESERT SHIELD.

5. The white background of the letters symbolizes the unity of effort of the joint support, as white is the union of all colors.

6. The three white stars in the blue background commemorate our three comrades who perished in the C-5 accident at Ramstein AB.

GLOSSARY

AB	Air Base
ADWS	Automatic Digital Weather Switch
AFB	Air Force Base
AFCC	Air Force Communications Command
AFDIGS	Air Force Digital Graphics System
AFGWC	Air Force Global Weather Central
AFLC	Air Force Logistics Command
AFSC	Air Force Systems Command
AFSOC	Air Force Special Operations Command
AOR	Area of Responsibility
ARCENT	Army Forces, Central Command
ARSOC	Army Special Operations Command
AT&T	American Telephone and Telegraph
AUTODIN	Automatic Digital Network
AWN	Automated Weather Network
AWS	Air Weather Service
AWSR	Air Weather Service Regulation
BOS	Back-Up Observing System
CAT	Crisis Action Team
CENTAF	Air Forces, Central Command
CENTCOM	Central Command
CINC	Commander in Chief
COMSEC	Communications Security
CONUS	Continental United States
DCS	Deputy Chief of Staff
DMSP	Defense Meteorological Satellite Program
DSFU	DESERT SHIELD/STORM Forecast Unit
EOTDA	Electro-optical Tactical Decision Aids
ETAC	Environmental Technical Applications Center
EURDIGS	European Digital Graphics System
FORSCOM	Forces Command [Army]
HF	High Frequency
IMA	Individual Mobilization Augmentee
IREPS	Integrated Refractive Effects Prediction System
JOAF	Joint Operational Area Forecast
JTF-PF	Joint Task Force-PROVEN FORCE
KTO	Kuwait Theater of Operations
MAC	Military Airlift Command
MARCENT	Marine Forces, Central Command
MEPA	Meteorological and Environmental Protection Association [Saudi Arabia]
METEOSAT	European Meteorological Satellite
MODA	Ministry of Defense and Aviation [Saudi Arabia]
NAVCENT	Naval Forces, Central Command
NCO	Noncommissioned Officer
NCOIC	Noncommissioned Officer in Charge
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NODDS	Naval Oceanographic Data Dissemination System

OIC	Officer in Charge
OICWSF	Officer in Charge Weather Support Force
OPORD	Operations Order
QRCT	Quick Reaction Communications Terminal
RAF	Royal Air Force [United Kingdom]
RDIT	Rapid Deployment Imagery Terminal
RSAF	Royal Saudi Air Force
RSLF	Royal Saudi Land Forces
SAC	Strategic Air Command
SAR	Support Assistance Request
SBLC	Standard Base Level Computer
SM-ALC	Sacramento Air Logistics Center
SOCCENT	Special Operations Command, Central Command
SOF	Special Operation Forces
SPO	System Program Office
SWO	Staff Weather Officer
TAC	Tactical Air Command
TACC	Tactical Air Control Center
TACFAX	Tactical Facsimile
TACCOM	Tactical Communications Equipment/Systems
TACMET	Tactical Meteorological Equipment/Systems
TFU	Tactical Forecast Unit
TIDS	Tactical Imagery Dissemination System
TOAF	Tactical Operational Area Forecast
TPFDD	Time-Phased Force Deployment Data
TWAC	Tactical Weather Analysis Center
TWS	Tactical Weather System
UN	United Nations
US	United States
USAFETAC	United States Air Force Environmental Technical Applications Center
USARCENT	United States Central Command, Army Forces
USCENTAF	United States Central Command, Air Forces
USCENTCOM	United States Central Command
USCINCCENT	Commander in Chief, US Central Command
UAWS	US Army, Europe, Automated Weather System
WGP	Weather Group Provisional
WMO	World Meteorological Organization
WSF	Weather Support Force

LIST OF SUPPORTING DOCUMENTS

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SSgt Duane P. Bullard, 1ID(M)/ASWO, Det 19, 1690WGP/NCOIC (and Det 8, 5WS/NCOIC), 19 Jul 91.

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Lt Col Willliam H. Campbell, ARCENT/SWO, ARCENT WSE/OIC (and 7WS/DO), 1 Jul 91.

Maj John R. Conley, XVIII Corps/SWO (and 6WS/DO), 18 Jul 91.

Capt Judith E.Dickey, Det 6, 1690WGP/CC (and Det 7, 3WS), 7 Jun 91.

Capt Steven B. Dreksler, AWS/XTX, 12 Aug 91.

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Col James W. Goldey, CENTCOM/SWO, OICWSF, and 1690WGP/CC (and 1WS/CC), 16 May 91.

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