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THE THREAT OF INTENTIONAL OIL SPILLS TO
DESALINATION PLANTS IN THE MIDDLE EAST
A U.S. SECURITY THREAT

by

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A Research Report Submitted to the Faculty

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Preface

The idea for this research project came from the suggested topic list provided by the Institute for National Security Studies to the Air Command and Staff College for the 1998 academic year. The suggested topic was to study the potential for Middle East terrorists to use intentional oil spills to disrupt the operation of desalination and power facilities in that region. In order to make the topic more manageable, I have focused only on the threat of intentional spills to desalination facilities.

Prior to this effort, I was aware of desalination technology in general, but I had no comprehension of how dependent the Middle East was becoming on these facilities, how vulnerable they were, and as a result, what a threat the intentional spill scenario presents to the national security of the United States and Middle East countries. I hope readers will gain the same awareness as they go through this paper.

I would like to thank my research advisor, Maj Robert L. Fant, for his guidance throughout the year. Ms. Janet Seymour is the Air University Library's bibliographer for the "Middle East & North Africa: Natural Resources/Water Controversy" bibliography. Her bibliography was invaluable for researching water scarcity and national security issues and she also exercised great patience and spent much time answering my numerous questions.

Abstract

During the Gulf War, Iraq physically destroyed Kuwaiti desalination plants while they occupied the country. Iraq also conducted what was arguably the largest act of environmental terrorism in recent memory by releasing millions of gallons of oil into the sea, thereby threatening more desalination plants and other facilities in the region. The Institute for National Security Studies recognized the potential for this to happen again and listed this subject as one of their potential research topics for 1998. Specifically, what is the present vulnerability of Middle East desalination plants to potential acts of environmental terrorism in the form of oil spills and what can the Department of Defense (DOD) do to help? With water scarcity already an issue dividing the region's security, threats to this rapidly growing source of fresh water is a threat to the security of the region itself.

This paper first introduces the reader to this new security threat. Chapter two discusses water scarcity, the growing role of desalination, and the basics of desalination technology. Chapter three outlines the terrorist threat to Middle East water by covering both the known history and potential future threats. Chapter four examines why desalination plants are vulnerable to oil spills. Chapter five outlines spill response technologies and the DOD ability to cope with oil spills. Chapter six closes out the thesis with recommendations the U.S. can take to lessen the vulnerability of these plants to the threat of intentional oil spills and thus strengthen our national security in the region.

This paper concludes the DOD does have response measures it can take and there needs to be more comprehensive planning for a joint response. Crisis action teams need to quickly determine what resources are needed, who has them, and what current doctrine and U.S. law says about the employment of these resources overseas. This can only happen smoothly with better joint planning and exercises.

Chapter 1

A New Security Threat

On January 27, 1991, the front page of *The New York Times* introduced the world to a new security threat. Large, bold font headlining the page declared, “OIL SPILL, GROWING RAPIDLY, HEADS FOR VITAL SAUDI SITES...”¹ The first paragraph of the article got straight to the point.

Saudi officials readied barriers and dispersal chemicals today to try to contain an enormous oil slick flowing south from Kuwait, but they held out little hope of keeping the sludgy pollutant away from vital desalting plants.²

Most of the world had not yet even heard of “desalting plants” or desalination technology. Most who had certainly had not considered intentional oil spills a serious threat to their operation, much less a serious threat to the security of the Middle East. Any lingering doubts about how serious the situation was were put to rest with the next day’s headlines. “U.S. BOMBS KUWAIT OIL STATIONS SEEKING TO CUT FLOW INTO THE GULF.”³ The irony was lost to none. We were forced to strike the refineries of the nation we were going to war to liberate. However, there were few alternatives. The desalination plants supplying Riyadh were at risk and the flow of oil had to be stopped. The decision to bomb Kuwaiti refineries was made and laser guided bombs effectively stemmed the flow of oil into the Persian Gulf.⁴ The growth of the spill may

have been abated, but more work remained to control a spill already estimated to be “many times larger” than the 1989 Exxon Valdez spill in Alaska.⁵

This scenario introduced us to a new security threat that we may see again. Fresh water scarcity has caused a growing dependence upon desalination technology in the Middle East and as Iraq demonstrated so cruelly during the Gulf War, intentional oil spills are an effective way to target this dependency. Intentional spills, then, may be an effective way to influence the security balance in the Middle East. While some consider Iraq’s actions an act of war, many consider it one of the most senseless acts of terrorism demonstrated in the 20th century—an act of “ecowar” or environmental terrorism that showed complete disregard for the environment while in pursuit of one’s own objectives.

This paper examines the threat of terrorist sponsored oil spills to desalination plants and begins with this chapter’s introduction to the threat.

Chapter two outlines the water scarcity issue, the role of desalination in that issue, background information on desalination technology, and the growing importance of desalination plants to Middle East security. Since this paper focuses on the vulnerability of desalination plants to terrorist actions associated with intentional oil spills, it will not examine the water scarcity issue in great detail. The reader is urged to consult any one of a number of current books on this subject to satisfy that specific interest.

Chapter three outlines the terrorist threat to Middle East water. It covers the known history—the Iraqi oil spill during the Gulf War, Palestine Liberation Organization (PLO) attacks on Israeli water resources, and other relevant examples. It also covers organizations and methods that represent future threats to water resources in the areas.

Chapter four examines the threat of oil spills to today's desalination plants. It outlines the technical vulnerabilities of desalination plants to oil and proximity issues of desalination plants to coastal oil refineries and tanker ports.

Chapter five outlines current spill response technologies and the current state of DOD preparedness to support responses to intentional spills in the Middle East.

Chapter six closes out the paper with recommendations the U.S. can take to lessen the vulnerability of these plants to intentional spills and thus strengthen our national security in the region.

Notes

¹ R.W. Apple Jr., "Oil Spill Growing Rapidly, Heads for Vital Saudi Sites; Air-War Goals Said to Shift," *New York Times*, 27 January 1991, sec. 1.

² Ibid.

³ Philip Shenon, "U.S. Bombs Kuwait Oil Stations, Seeking to Cut Flow into Gulf; More Iraqi Planes Fly to Iran," *New York Times*, 28 January 1991, sec. 1.

⁴ Ibid.

⁵ Ibid.

Chapter 2

Water Scarcity and the Growing Importance of Desalination in the Middle East

When discussing water issues, it is important to note there are three sources of fresh water that produce amounts sufficient enough to warrant conflict. There are above ground systems (fresh water lakes and rivers), below ground aquifers, and desalination facilities; the focus of this paper.

Mary E. Morris most succinctly describes the basic water issues in her paper, “Water and Conflict in the Middle East: Threats and Opportunities.”

Three separate sets of water problems persist in the Middle East, each with different players and different issues: The first set involves the Jordan and Yarmuk River systems, as well as the West Bank and Gaza aquifers. Countries involved include Jordan, Israel, Syria, Lebanon, and the Palestinians of the Occupied Territories, and the major issues are water flow and diversion and ownership of water sources. Israel and Jordan are at imminent risk, because of full utilization by both parties of available water resources. The situation is complicated by occasional drought situations that exacerbate the resource problem. The second set of problems involves the Tigris and Euphrates River systems, with Syria, Turkey, and Iraq playing roles in issues as diverse as reduced water flow, salinization, constraints on irrigation, and hydropower. The third problem area is the Nile region, comprising Egypt, Ethiopia, and Sudan. Here the issues are flooding siltation, water flow, and diversion. Associated problems for all areas are pollution, especially for downstream riparians, water borne disease, and degradation of the soil through irrigation and fertilization.¹

Excluded from Mary Morris’ description of the problem, but no less important, are the countries on the Arabian peninsula—Saudi Arabia, Kuwait, Qatar, United Arab

Emirates, Oman, and Yemen. While these countries have no major river systems or aquifers causing disputes with neighboring countries, their scarcity issues are perhaps even more striking as a result.

Basic Scarcity Facts

Three problems are driving current and future water scarcity concerns. These include a growing population, a resulting growing need for increased irrigation, and the geographic/hydrologic realities of the Middle East environment.

Population Growth

Like most areas of the world, the Middle East is in the midst of a dramatic population growth. The 1989 population of the area was 314 million and with an average 2.8 percent increase, 423 million are expected by the year 2000.² Many demographers expect the total population to double in the next 20–25 years and this means heavy crowding in the areas surrounding rivers, where most people in this arid region already congregate.³

Increased Irrigation Needs

Population growth is rapidly driving increased irrigation requirements for farming. Agriculture already accounts for 75 to 90 percent of all water used in the Middle East and as Mary Morris notes, “Land reform has generally been ineffective, while outdated and ineffective irrigation systems, such as open canals and surface irrigation, are prevalent.”⁴ The population increases described above combined with the effective, though wasteful, irrigation techniques will further strain already scarce supplies.

Middle East Hydrologic Realities

We can not ignore the reality that this is, after all, the Middle East. As Natasha Beschorner notes, “annual water supply in the region is neither reliable nor plentiful; the climate is largely arid or semi-arid with average annual rainfall levels of less than (9.8 in/yr), except on the Mediterranean coast and upland areas of Lebanon, Syria, and Iraq. Only Turkey and Iran enjoy a relative water surplus.”⁵

National Security Issues

Water is becoming so important in the Middle East that the Secretary-General of the United Nations has noted it “may soon become a more precious resource than oil.”⁶ There are many national security issues at stake. Israel has already fought one war (the 1967 June War) largely in response to the Arab declaration that they planned to divert and use the Jordan headwaters.⁷ Chapter one shows that Saudi Arabia is already so dependent upon desalination facilities that the U.S. was forced to strike Kuwaiti refineries to stem the growing oil spill in the Gulf War. Iraq, Syria, and Turkey are constantly quarreling over Turkish water policies. Turkish accusations of Syrian sponsored terrorist and guerrilla activities (largely over water issues) continue to be a security concern for these countries.⁸ Many other examples could be given and specific acts of violence due to water conflicts will be covered later. The point should be clear; however, water scarcity has been and remains a major national security issue for regional powers. The historical and growing importance of water as a source of Middle East stability also makes this a major national security concern for the United States as well.

Growing Role of Desalination

Much debate exists over the viability of desalination technologies as a solution to the growing Middle East water crisis. Some argue it is too expensive and too energy dependent. Some argue in favor of regional water import schemes such as long pipelines, fresh water tankers, and even towing large plastic “baggies” of water to the region from other water rich countries. Others, such as Israeli Amikam Nachmani, offer desalination as “the only realistic hope.”⁹ While the debate continues, one thing is clear. For those that can afford it (as many of the oil rich countries in the Middle East can), desalination facilities offer a fresh water solution when few other options are feasible.

“Israel’s official view, as presented in January 1992 to the Moscow multilateral water summit of the Arab-Israeli peace conference, sees desalination as the only long term remedy for water poor areas like the Middle East.”¹⁰ Saudi Arabia (the largest country in the world without a river¹¹) already has nearly 27 percent of the world’s desalination capacity installed with more plants under construction.¹² The United Arab Emirates is executing plans to double existing production and is also accepting bids for two new facilities.¹³ Oman has “high priority plans to build more desalination plants.”¹⁴ Kuwait and Qatar are almost entirely dependant on desalination plants already for their drinking water and with Qatar’s only aquifer estimated to run dry by 2000, reliance on desalination plants will be even more complete.¹⁵

The key point here remains that while debate continues about the affordability and long term energy demands of desalination facilities, countries are increasing their dependence on this alternative and as long as this remains the case, desalination will have a correspondingly larger role in national security concerns.

One final note here is interesting. Dan Zaslavsky, Israel's water controller, has said,

If one wishes to make peace and bring prosperity to these countries, one must make sure that in the next decade 500 million to 600 million cubic meters (132–158 trillion gallons) of water will be desalinated. The investment needed for such a project is about \$2.5 billion, less than the cost of a small war.”¹⁶

Middle East nations clearly understand the economics of this quote and the wealthy ones are stepping in line with an ever-increasing number of desalination facilities.

Desalination Basics

“A desalting device essentially separates saline water into two streams: one with a low concentration of dissolved salts (the fresh water stream) and the other containing the remaining dissolved salts (the concentrate or brine stream).”¹⁷ There are two processes that represent the vast majority of desalination processes in use in the world and the Middle East.¹⁸ These are the thermal process of multi-stage flash distillation and the membrane process of reverse osmosis.

Multi-Stage Flash (MSF) Distillation

MSF distillation is similar in theory to methods used to desalinate water for thousands of years. Saltwater is taken in, heated, and the vaporized (desalinated) water is then condensed in cooled coils and collected for use. “Typical MSF systems consist of many evaporation chambers arranged in series, each with successively lower pressures and temperatures that cause sudden (flash) evaporation of hot brine, followed by condensation on tubes in the upper portion of each chamber.”¹⁹

Reverse Osmosis (RO)

The RO process is much like a modern camper's water purifier, executed on a much larger scale. Saline water is passed through a membrane which separates it from the salts and other foreign matter. O.K. Buross describes the process in his pamphlet, "The ABC's of Desalting."

In practice, the saline feed water is pumped into a closed vessel where it is pressurized against the membrane....A portion of the water passes through the membrane (the desalinated portion which is collected for use), the remaining feed water increases in salt content (and is discharged without passing through the membrane).... Pretreatment is important in RO because the feed water must pass through very narrow passages during the process. Therefore, suspended solids must be removed and the water pre-treated so that salt precipitation or microorganism growth does not occur on the membranes.²⁰

Unlike MSF distillation, RO requires no heating; however, it does obviously require energy for pressurizing the feed water.²¹ The Watermakers, Inc. figure below further details the reverse osmosis process.²²

Figure 1. How Reverse Osmosis Works

Other Common Features of Desalination

No matter what process is used to separate the salts from sea water, both methods require large intake ports moving large volumes of sea water into the facilities. (Note that desalination facilities also can be used for brackish or inland saline water, but the focus of this paper remains on the large coastal facilities dedicated to production of fresh water from sea water sources.) Intake ports will be discussed in more detail later with respect to specific vulnerabilities of desalination facilities to oil spills.

Both the MSF and RO desalination processes require a relatively large amount of energy, though the RO requirement is about half of the MSF process.²³ In the Middle East, some of this energy requirement has been eased by combining desalination facilities with electric power facilities; a practice referred to as “cogeneration.” A typical scenario would see the same steam being generated to turn electric turbines also being used to heat the saline water in a MSF distillation process.²⁴ “The main advantage of a cogeneration system is that it can significantly reduce the consumption of fuel when compared to the fuel needed if two separate plants were required.”²⁵

The key point here is the same arrangement that allows for cheaper operation also means a more lucrative target in wartime or for terrorist operations. Using oil to foul the intake of these cogeneration facilities will simultaneously knock out both power and fresh water facilities—a terrorist’s version of “more bang for the buck.”

Notes

¹ Mary E. Morris, “Water and Conflict in the Middle East: Threats and Opportunities,” *Studies in Conflict and Terrorism*, no. 1, (1997): 3.

² John Bulloch and Adel Darwish, *Water Wars*: (London, Gollancz, 1993), 19.

³ Morris, 5.

⁴ *Ibid.*, 4.

⁵ Natasha Beschorner, “Water and Instability in the Middle East” in *The Adelphi Papers*, no. 273, (London, Brassey’s for the International Institute for Strategic Studies, 1992), 3.

⁶ Chris Cragg, “Water Resources in the Middle East and North Africa,” in *The Middle East and North Africa, 1997*, (London, England: Europa Publications Limited, 1997), 159.

⁷ Peter H. Gleick, ed, *Water in Crisis: A Guide to the World’s Fresh Water Resources*: (New York, Oxford, Oxford University Press, 1993), 9.

⁸ Beschorner, 37.

⁹ Amikam Nachmani, “Water Jitters in the Middle East,” *Studies in Conflict and Terrorism*, no. 1, (1997): 84.

¹⁰ *Ibid.*, 84.

¹¹ Bulloch and Darwish, 143.

¹² Nachmani, 85.

Notes

¹³ “United Arab Emirates,” Janes Geopolitical, 1997, on-line, CD ROM Database, 5 November 1997, available at AU library until discontinued in January, 1998.

¹⁴ “Oman,” Janes Geopolitical, 1997, on-line, CD ROM Database, 5 November 1997, available at AU library until discontinued in January, 1998.

¹⁵ “Qatar,” Janes Geopolitical, 1997, on-line, CD ROM Database, 5 November 1997, available at AU library until discontinued in January, 1998.

¹⁶ Bulloch and Darwish, 145.

¹⁷ O.K. Buros, “ABC’s of Desalting,” *International Desalting Association Publication List*, 22 September 1997, 13, on-line, Internet, 5 November 1997, available from <http://www.ida.bm.html.abc.htm>.

¹⁸ Gleick, 69.

¹⁹ *Ibid.*, 70.

²⁰ Buros, 8.

²¹ *Ibid.*, 7.

²² “How Reverse Osmosis and Desalination Works,” 1, on-line, Internet, 5 November 1997, available from <http://www.watermakers.com/how.htm>

²³ Gleick, 70.

²⁴ Buros, 10.

²⁵ *Ibid.*, 10.

Chapter 3

Terrorist Threats to Mid-East Water

In today's environment, it is hard to imagine even a single day going by without hearing of some type of terrorist act in the Middle East. One might even wonder about the necessity to include a section on potential terrorist threats here. The principle reason is to emphasize that water resources have been a major source of conflict in the recent past and to show that the future potential for similar acts is very great. In addition, as long as the security interests of the United States are dependent upon the stability of the Middle East, it is important to understand recent and future threats to regional stability.

Recent History

The reader should note that when covering recent history, "acts of war," terrorist actions, and guerilla actions are treated here equally. In dealing with Middle East conflict, it quickly becomes apparent that any action can be described a number of ways depending on one's perspective. For the purposes of this paper, it is more important to understand where and when water resources were targeted than to engage in a debate about the nature and intent of the attack.

Iraqi Actions During the Gulf War

Even though Saddam Hussein denied causing the largest deliberate oil spill in history, today there is little doubt about his intentions. It wasn't the first time. In 1983 during the Iran/Iraq war, Iraqi forces "destroyed Iranian offshore oil wells and, through repeated attacks, prevented engineers from capping the wells...(causing) more than 2 million barrels of oil" to escape into the Persian Gulf.¹

In January, 1991; however, the process was far more direct. *Science News* had the most concise report.

On or about Jan 20, five oil super-tankers berthed at the Kuwaiti port of Mina al Ahmadi began discharging an estimated 3 million barrels of crude oil into the Persian Gulf. At about the same time, an underwater pipeline carrying crude oil from storage tanks there to Sea Island, a tanker-loading terminal about 10 miles offshore, also began spewing oil into the Gulf.... The two releases created the largest oil spill in history, sending a total of 10 to 11 million barrels of crude into the Gulf's shallow and relatively contained waters.²

This spill caused the closure of most of Saudi Arabia's desalination plants in the area as a precautionary measure even though the spill never reached the shoreline in the area of the operating plants.³ The spill would have impacted the Saudi desalination plant at Khafji, except that it had been shut down months earlier as a result of its closer proximity to Kuwait.⁴ The other Saudi plants were able to be back online within days.⁵ This was fortunate, because Riyadh had only 3 to 4 days of potable water on hand at the time and the same facilities which supplied Riyadh also supplied about half the drinking water for the country—the impact, had these facilities stayed offline, would have been enormous.⁶

Focus on Israel

Israel has a long history of water conflict. Most infamous, the June 1967 war was caused, in part, by the increasing tensions resulting from Syria's attempts at diverting the

headwaters of the Jordan River and Israel's air attacks on the diversion facilities in the months prior to June.⁷ Israel continued to shell Jordan's East Ghor Canal, damaging it four times after the war,⁸ and attacked the canal by air again in 1969 in retaliation for PLO attacks.⁹ "Syria further utilized the Palestinian guerilla organization al-Fatah, which carried out subwar activities in Israel often aimed at National Carrier Project (water project) installations."¹⁰ Still other reports indicate Israel's invasion of Lebanon in 1978 and 1982 were motivated not only by a need to stop "PLO operations against northern Israel, but also by water security needs."¹¹

Focus on the Tigris/Euphrates Region

Perhaps the most effective way to document recent water conflicts in this region is to simply list them. A list of many of the major water-related security incidents since the early 1970s follows.

1. 1974—Iraq threatens to bomb Syria's al-Thawra dam claiming it has reduced the flow of the Euphrates River into Iraq.¹²
2. 1990—Turkey "impounds" the flow of the Euphrates to fill its Ataturk dam reservoir. Syria and Iraq join forces and a "water war" is nervously avoided.¹³
3. 1991—Coalition forces destroy or severely damage the Iraqi Darbandikhan, Dokan, Haditha, Samarra, and Saddam dams as well as the Ramadi barrage.¹⁴
4. 1991—A captured Iraqi police memo indicates their intention to poison Kurdish marshwater, and to "drain the marshes and divert the water through massive dikes into a huge canal."¹⁵
5. Various times—The Kurds, in response to Iraqi water aggression outlined above, declare a "hydro-jihad" against Iraq.¹⁶
6. Various times—"The PKK (Kurds) has made actual threats against Turkey's hydraulic installations, especially the Ataturk dam."¹⁷

It should be clear that nations in this region clearly understand the importance of water to national security and are not afraid to target it in order to meet their own national security objectives.

Focus on the Nile Region

The conflicts here have been fewer, but still demonstrate the willingness of governments and other organizations to target water projects. In 1983, the Sudan Peoples' Liberation Army began a series of attacks that successfully stopped French Canal builders from diverting water from the Nile across the desert to Southern Sudan.¹⁸ In the early 80's, after Libya had conducted extensive planning to divert a large aquifer also believed to supply Egyptian water reserves, Egyptian commandos rehearsed raids aimed at disabling or gaining control of "key (Libyan) water pumping installations."¹⁹ Although the raids were never carried out, they indicate Egypt's willingness to consider water projects a valid target.

Current Threats

There are two types of terrorist threats that might threaten desalination facilities with intentional oil spills. The first is the more traditional threat of organizations carrying out bombing attacks on related facilities. The second type of threat is less realized in today's "modern" environment. Piracy on the high seas, specifically the threat of oil tanker hijacking, is another threat that is still being carried out in ways very similar to those used in the 16th century.

More "Traditional" Terrorist Threats

According to the U.S. State Department's "1996 Patterns of Global Terrorism" report, there were over 16 distinct terrorist organizations operating within the Middle East during 1996.²⁰ In addition, seven of thirteen Middle East countries had terrorist actions within their borders in 1996.²¹ The table below provides a good summary of the State Department's 1996 data.

Table 1. Middle East Countries Experiencing Terrorist Acts in 1996 and Number of Known Terrorist Organizations Within Their Borders

Country	# of Terrorist Org's	Incident(s) in 1996?
Bahrain	2	Yes
Egypt	2	Yes
Iraq	5+	Yes
Israel and the Occupied Territories	5	Yes
Jordan	6	No
Kuwait	2	Yes
Lebanon	5	No
Qatar	Not listed	No
Saudi Arabia	4	Yes
Syria	6+	No
Turkey	2	Yes
United Arab Emirates	Not listed	No
Yemen	2	Yes

Source: U.S. Department of State, *Patterns of Global Terrorism, 1996* (Internet, <http://www.milnet.com/milnet/state/1996/middle.htm>), 1-8.

While the State Department report does not indicate any specific acts of terrorism that targeted desalination facilities or other water related targets in 1996, it should be clear that terrorist activities are as numerous as ever, and it is a small step to move the focus of the attacks to water facilities.

Piracy on the High Seas

Vantage Security, a piracy consulting firm, confirms 142 attacks on shipping from January to September of 1997.²² Many of these attacks were on large ships. More to the point, on October 27, 1997, the Thai Navy reported that a Thai and Honduran registered oil tanker, the *Oriental City*, was seized near Malaysia by 11 men.²³ It was not an isolated instance. On November 11, 1996, a Malaysian registered tanker was pirated within 100 miles of Singapore and other tanker attacks have been reported.²⁴ The Regional Piracy Center released the following in a report in 1995.

...of concern is the number of tankers, chemical tankers, LPG (liquefied petroleum gas) and LNG (liquefied natural gas) vessels attacked The potential for environmental disaster should not be underestimated, as a significant number of attacked vessels drift unsupervised during and after the piratical incidents.

It is an irrefutable fact that the seizure of an oil tanker on the high seas is not only a possibility, but one that has been demonstrated very recently.

Notes

¹ Fred Pearce, "Gulf War Could Mean Largest oil Spill Ever," *New Scientist*, vol. 129 (19 January 1991): 18.

² J. Raloff and R. Monoastersky, "Gulf Oil Threatens Ecology, Maybe Climate," *Science News*, vol. 139 (2 February 1991): 71.

³ John Bulloch and Adel Darwish, *Water Wars*: (London, Gollancz, 1993), 143.

⁴ Philip Shenon, "U.S. Bombs Kuwait Oil Stations, Seeking to Cut Flow into Gulf; More Iraqi Planes Fly to Iran," *New York Times*, 28 January 1991, sec. 1.

⁵ Bulloch and Darwish, 143.

⁶ Shenon, sec. 1.

⁷ Sean M. Lynn-Jones and Steven E. Miller, ed, *Global Dangers: Changing Dimensions of International Security*: (Cambridge, MA, MIT Press, 1995), 92.

⁸ J.A. Allan, ed, *Water, Peace, and the Middle East: Negotiating Resources in the Jordan Basin*: (London, New York, Tauris Academic Studies, St. Martins [distributor], 1996), 180.

⁹ Helena Lindholm, "Water and the Arab-Israeli Conflict," in *Hydropolitics: Conflicts over Water as a Development Constraint*, ed. Lief Ohlsson, (London, University Press Limited, 1995), 72.

¹⁰ *Ibid.*, 69.

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¹¹ Ibid., 75.

¹² Lynn-Jones and Miller, 93.

¹³ Natasha Beschorner, "Water and Instability in the Middle East" in *The Adelphi Papers*, no.273, (London, Brassey's for the International Institute for Strategic Studies, 1992), 41.

¹⁴ Ibid., 36.

¹⁵ Joyce Shira Starr, *Covenant over Middle Eastern Waters: Key to World Survival*: (New York, H. Holt, 1995), 152.

¹⁶ Michael Shulz, "Turkey, Syria and Iraq: A Hydropolitical Security Complex," in *Hydropolitics: Conflicts over Water as a Development Constraint*, ed. Lief Ohlsson, (London, University Press Limited, 1995), 110.

¹⁷ Beschorner, 68.

¹⁸ Bulloch and Darwish, 120.

¹⁹ Ibid., 128.

²⁰ "Middle East Overview," *Patterns of Global Terrorism, 1996, 1997*, 8, on-line, Internet, 5 November 1997, available from <http://www.milnet.com/milnet/state/1996/middle.htm>

²¹ Ibid.

²² "World Piracy Violence Up, Attacks Down," *World Piracy Update, 1997*, 6, on-line, Internet, 5 November 1997, available from <http://www.vantage-security.com/piracya.htm>, 1.

²³ Ibid., 2.

²⁴ John Grissim, "Yo-Ho-Ho, A Ski Mask and a Gun: Modern-Day Pirates are Terrorizing the High Seas," *The Washington Post*, 22 June 1997, sec. C01.

Chapter 4

Specific Threat of Oil to Desalination Plants

This chapter briefly outlines the reasons accounting for our growing awareness of the vulnerability of desalination facilities. Specifically, it will address why oil is a physical threat to desalination facilities and how the proximity of coastal oil refineries and tanker ports to desalination facilities add to Middle East security concerns.

Growing Awareness of Desalination Vulnerability

The New York Times articles discussed in chapter one best indicate the growing awareness of the vulnerability of desalination plants to oil. However, there are some other interesting indications that should be noted.

Perhaps most dramatic are recent statements by former deputy assistant secretary for energy emergencies and the U.S. Department of Energy, Edward Badolato. He said the “U.S. government ‘is doing nothing’ to anticipate sabotage of pumping stations, treatment plants, pipelines, or dams in the Middle East.”¹ When commenting on U.S. plans to defend international water facilities, Badolato said, “We’re not equipped to deal with it. We haven’t focused on the water problem. We’re barely capable of focusing on oil.”²

John Bullock and Adel Darwish, in their book *Water Wars*, are also very clear about how vulnerable they see desalination facilities.

Every desalination plant built is a hostage to fortune; they are easily sabotaged; they can be attacked from the air or by shelling from off-shore; and their intake ports have to be kept clear, giving another simple way of preventing their operation.³

Why is Oil a Threat?

Oil is a threat for two primary reasons. First, it contains pollutants not normally found in sea water that the desalination facilities do not normally have to remove. For instance, benzene is a human carcinogen contained in oil that can not exceed 5 parts per billion in potable water.⁴ Continued operation of desalination plants with even a small amount of processed benzene could pose a threat to public health.

Second and perhaps the most obvious reason oil threatens desalination plants is the damage it can do to sea water intake filters and heat exchangers. Oil in sea water can take the form of the well recognized slick, but it can also form large tarballs and “sunken oil globs” that can be drawn into intake filters.⁵ Obviously, the oil can then foul the filters limiting the amount of water intake as well as foul internal membranes disrupting the reverse osmosis process if affecting a reverse osmosis facility.

The required clean-up and problems caused by oil affecting a multi-stage flash facility are no less troublesome. “If oil enters a (multi-stage flash) desalination plant it may be necessary to first use a solvent to loosen the oil particles. Next, the plant should be flushed with soap and water and finally it should be flushed with fresh water. Oil clings to heat transfer surfaces, disrupting the heat transfer process.”⁶

Proximity Concerns

The Middle East is the one place in the world uniquely positioned to have the highest concentration of both desalination and oil facilities, thus providing many opportunities

for the terrorist scenario suggested by this paper. The Central Intelligence Agency's "Middle East Area Oil and Gas Map" shows a stunning concentration of oil facilities in the region. The Persian Gulf has 29 major tanker ports and 16 major shore-based refineries.⁷ Kuwait alone accounts for 4 tanker ports and 4 coastal refineries⁸ while the International Desalination Association's plant inventory indicates Kuwait had 23 major desalination facilities operational by 1997.⁹ Considering its north/south coastline is only approximately 100 miles long, Kuwait clearly has a concentration of facilities that makes another Gulf War spill scenario very possible. The United Arab Emirates is another example of how concentrated the desalination and oil facilities are. Ten tanker ports and three coastal refineries¹⁰ share approximately 300 miles of coastline with 40 major desalination plants.¹¹

Other Middle East countries share a similar story, so the point to be made here is an obvious one; many desalination plants share limited coastal areas with many oil facilities. Thus, proximity alone presents another threat to desalination plants in the Middle East.

Notes

¹ Joyce Shira Starr, *Covenant over Middle Eastern Waters: Key to World Survival*: (New York, H. Holt, 1995), 55.

² *Ibid*, 56.

³ John Bulloch and Adel Darwish, *Water Wars*: (London, Gollancz, 1993), 147.

⁴ J.W. Doerffer, *Oil Spill Response in the Marine Environment*: (New York, NY, Pergamon Press, 1992), 261.

⁵ *Ibid*, 261.

⁶ *Ibid*, 262.

⁷ *Middle East Area Oil and Gas Map*, Central Intelligence Agency map #801357, June 1990.

⁸ *Ibid*.

⁹ Klaus Wangnick, ed., 1990 IDA Worldwide Desalting Plants Inventory Report No. 11 (Gnattenburg, Germany: Wangnick Consulting, 1989), appendices 6 & 7.

¹⁰ *Middle East Area Oil and Gas Map*.

¹¹ Wangnick, appendices 6 & 7.

Chapter 5

Coping with the Threat of Intentional Spills

It may have been the environmental movement in the eighties that first focused the U.S. on oil spill technologies, but it was the 1989 Exxon Valdez spill of 11 million gallons that demanded national attention on the issue. The press was relentless in hounding both Exxon and the government for years on details of the clean-up and its legacy has been a myriad of new agencies and technologies focused on improving our ability to handle spills. From a physical standpoint, crews can attack spills directly with chemical or mechanical devices, desalination plants can take preventive measures, and other means to predict and survey oil spills can be employed. From an organizational standpoint, how the government and commercial entities cooperate, organize, and prepare can mean the difference between success and failure in dealing with spills.

Chemical Response Technology

In addition to allowing oil to degrade naturally, there are a number of chemical responses to enhance oil spill clean-up. Chemicals can be added to either disperse the surface oil from high value places or to collect it in thicker densities, thus making it more combustible or more easily dealt with by mechanical means.¹ Absorbents can be sprayed or foamed on the spill that absorb the oil allowing for their later collection by mechanical

means. In addition, burning is a viable means of chemical response when the spill is still concentrated enough and when risk to plant and animal life is not a factor.²

Mechanical Response Technology

Floating booms are one of the most common mechanical devices for spill containment. They consist of a long floating element with an oil “skirt” that hangs vertically in the water to contain the oil while other means to collect or disperse the oil is employed. Despite the simplicity of the concept, the employment of booms may be difficult due to other debris in the water, waves, wind, the size of the spill, and the nature of the equipment deploying the booms.³

Once booms have been deployed to contain and increase the density of the oil in the water, the oil can be burned (provided the situation allows for this and a fireproof boom is in use) or mechanical skimmers can be employed to skim the oil from the surface.

Finally, there are a number of different types of oil recovery vessels specifically designed for spill clean-up efforts. These are large container type ships with built in skimmers and collection tanks. In addition, there are portable skimmers, boom systems, and collection tanks that can be utilized by normal ships to convert them into ad hoc oil containment or collection vessels.⁴

Desalination Plant Options

The desalination facilities themselves can do some things to help prevent oil fouling beyond merely shutting down to prohibit the intake of oil. Booms can be maintained near the intake ports for use when required. J.W. Doerffer, in his book *Oil Spill Response in*

the Maritime Environment, lists a number of other design features to help prevent oil intake.

Intakes should be located well below the water surface.... Fishnets are strung over the openings to catch large tarballs and sunken oil globs. Another technique has been to surround the intake with hoses releasing air, which form a bubble screen. The rising bubbles cause a vertical motion in the water column, which lifts tarballs to the surface.⁵

Other Response Measures

There are more oil response measures than can be covered here. However, a few have been singled out where the U.S. might be able to provide support in the advent of an intentional spill in the Middle East.

Oil Spill Modeling

Computer modeling and simulation can be used for both spill contingency applications and for spill-response activities.⁶ For contingency applications, models are “used to identify which resources are at risk if a spill should occur, and to evaluate the effectiveness of proposed response plans.”⁷ These models can be used to help predict where spills from specific Middle East locations might impact which desalination facilities. Models used for spill response activities can “forecast the transport and fate of spilled oil to provide information useful in directing and optimizing clean-up equipment use.”⁸

Miscellaneous Aviation Support

Adequate air traffic control support is perhaps one of the least expected necessities of an oil spill. For example, prior to the Exxon Valdez spill, the airstrip in Valdez, Alaska averaged 10-15 takeoffs and landings per day.⁹ Within weeks, this airstrip was averaging

400-500 operations a day with a high of 687, causing the “U.S. Coast Guard and the FAA to take joint action to maintain the safe flow of traffic over Prince William Sound and nearby airports.”¹⁰ Air traffic control support could play a key role again in future spill scenarios.

Aviation played other key roles in the Gulf War and Valdez spills. Air Force C-5s and C-141s airlifted spill clean-up equipment to the areas. For the Valdez spill, U.S. Coast Guard C-130s and helicopters flew hundreds of observation, supply, and general support missions.¹¹ The Coast Guard also flew numerous missions in a HU-25B Falcon jet equipped with side-looking airborne radar (SLAR) to image the spill and closely track its spread.¹² Finally, U.S. Army CH-54 Skycranes were used to lift oversized “6,000-lb. pumps and other equipment to the stricken tanker.”¹³

Air operations were a major aspect of both the Gulf War and Valdez spill clean-up efforts and no future contingency planning would be complete without air operations planning.

Available DOD Response Assets

U.S. Air Force

The Air Force has many things it can offer for potential spill response efforts. As mentioned above, the Air Force can provide the much needed airlift support. Heavy-lift jets as well as multi-purpose VIP transports like C-21s and helicopters may be required. In addition, Air Combat Command (ACC) has the preponderance of mobile air traffic control equipment and personnel. If requested by the unified command’s crisis action team, ACC headquarters can provide more air traffic control personnel for a local airfield

already possessing adequate equipment. If adequate equipment is not available at the nearest airfield, ACC headquarters can also provide the Deployable Air Traffic Control and Landing System (DATCALs). This includes equipment such as a mobile radar approach control, precision approach control radar, a TSW-7 mobile tower and other equipment.

U.S. Navy

The U.S. Navy is well prepared to deal with a number of environmental “disasters” including oil spills. The Supervisor of Salvage (SUPSALV) is the navy office responsible for providing oil spill response resources for all spills exceeding local base response capabilities.¹⁴

SUPSALV has a world-wide system in place to respond to all phases of oil pollution abatement, including containment, collection, and processing. An extensive inventory of equipment is maintained at response centers located in Williamsburg, VA; Stockton, CA; Anchorage, AK; and Pearl Harbor, HI. Large volume oil skimmers, open ocean containment booms, support craft, storage bladders, portable off-loading pumps, and related equipment are available for emergency response world-wide. All equipment is mobilized with qualified, trained operators. This unique capability is available to any DOD activity requiring response assets. All responses are conducted on a cost-reimbursable basis.¹⁵

SUPSALV also conducts a wide range of training exercises both in the U.S. and throughout the world. This will be discussed in more detail in the following chapter.

U.S. Coast Guard

Coast Guard participation in a Middle East incident is currently limited and will be discussed in the doctrine and planning discussion in Chapter 6. However, if tasked, they could provide a wide range of equipment including the SLAR-equipped Falcon Jets used in the Valdez spill, recovery vessels such as the four Keeper Class buoy tenders which

have the ability to “skim and recover surface oil pollution,”¹⁶ command and control assets, etc.... In addition, Coast Guard port security assets are highly trained and might be required to prevent secondary terrorist attacks on desalination facilities near ports.

U.S. Army

Army support would most likely be limited to VIP and heavy lift helicopter assets. However, in a hostile environment, their security forces might be required to prevent secondary terrorist attacks on shoreline targets.

Notes

¹ J.W. Doerffer, *Oil Spill Response in the Marine Environment*: (New York, NY, Pergamon Press, 1992), 90.

² *Ibid.*, 115.

³ *Ibid.*, 138-146.

⁴ *Ibid.*, 192-209.

⁵ *Ibid.*, 261-262.

⁶ Malcolm L. Spaulding, “Oil Spill Modeling in the Field and in the Laboratory,” *Oceanus*, vol. 36 (Summer, 1993): 72.

⁷ *Ibid.*, 72.

⁸ *Ibid.*, 72.

⁹ David Hughes, “Air Operations are Critical to Alaskan Oil Spill Cleanup,” *Aviation Week & Space Technology*, 10 April 1989, 16.

¹⁰ *Ibid.*, 16.

¹¹ “CH-54, C-5 Aircraft Play Key Roles in Cleanup of Alaskan Oil Spill,” *Aviation Week & Space Technology*, 1 May 1989, 73.

¹² “Coast Guard Radar Images are Key to Tracking Oil Spill,” *Aviation Week & Space Technology*, 10 April 1989, 18.

¹³ “CH-54, C-5 Aircraft Play Key Roles in Cleanup of Alaskan Oil Spill,” *Aviation Week & Space Technology*, 1 May 1989, 73.

¹⁴ *Environmental Issues Newsletter*, no.96, 10 January 1997, 1, on-line, Internet, 14 March 1998, available from <http://www.msc.navy.mil/n7/web10/096ein.htm>

¹⁵ “Pollution Abatement,” *Salvage Operations*, 20 February 1998, 1, on-line, Internet, 14 March 1998, available from <http://www.navsea.navy.mil/sea00c/pol.html>

¹⁶ Captain Richard Sharpe, RN, ed, *Janes Fighting Ships, 1997-98*: (Coulsdon, Surrey, U.K., Jane’s Information Group Limited, 1997), 856.

Chapter 6

Required DOD Spill Response Planning and Doctrine

Previous chapters have outlined the growing dependence of Middle East nations on desalination technology, the security threat of terrorism to desalination facilities, and potential means for combating intentional spills. Given U.S. security interests in the Middle East, the DOD should maintain active planning and doctrine to best utilize our available assets to aid in future responses to intentional spills. This chapter addresses the complexities involved in spill response planning, shortfalls in joint Environmental Defense Operations (EDO) doctrine, and the need for joint response planning.

Multi-National Complexities for DOD Planning Needs

The complexities surrounding DOD planning for spill response contingencies are immense. Planners must consider the fact that so many spill response assets are available in other nations, most of these assets are civilian operated, and most of these are commercially owned. The Gulf War spill provides a good example for study.

Some of the first response teams on scene were assets provided by the Oil Spill Service Center in Southampton, United Kingdom. As early as January 28th, 1991, only three days after the spill was first reported, “ninety tons of specialist oil-slick clearing equipment...was flown out from Britain en route to the Gulf.”¹ The U.S. sent a team of “oil pollution experts” from the Environmental Protection Agency, the Coast Guard, and

the National Oceanographic and Atmospheric Administration.² Saudi Arabia immediately went into action with Saudi Aramco's Oil Spill Committee holding an emergency session on January, 26th and they immediately assumed the role of lead coordinator.³ Computer simulations were used to model the spill at King Fahd University of Petroleum and Minerals and "experts and critically needed equipment came from the United States of America, Britain, France, Germany, Canada, New Zealand, the Netherlands, Norway, Japan, and the former Soviet Union."⁴

It is important to understand that in this situation, the DOD was clearly not the lead agent. The civilian and commercially-based spill response experts were better equipped to marshal the required resources. In fact, they did so in a very impressive fashion. The DOD clearly served a supporting role, but still this role needs to be planned and coordinated in order to best utilize response assets.

Today, the DOD is forging ahead with some multinational planning and response exercises. In early 1997, the U.S. Navy's SUPSALV worked with Italy, Bulgaria, Romania, and Turkey "to develop a multinational Navy oil spill contingency plan for the Black Sea area."⁵ According to the Spring, 1997 issue of *The SUPSALV Skimmer*, (SUPSALV's newsletter),

Upon completion...each (country's) Navy...will have an Appendix or Annex to their own spill response plan which will detail a common approach to combating oil spills anywhere in the Black Sea. This initiative will serve to help bring the various navies in the area closer together in conducting "environmentally friendly" joint operations, and will contribute to the global and international effort to make this important body of water healthier.⁶

This type of exercise and combined planning is a great step forward; however, the Navy needs to continue this effort in other areas of the world like the Middle East. In doing so, they also need to involve all the services in their exercises and planning.

Coast Guard Response to the Gulf War

The U.S. Coast Guard, since the Gulf War, has maintained an aggressive stance with regard to Environmental Defense Operations (EDO). The need for EDO doctrine “was recognized after (the Gulf War spill)...and has been articulated in Joint Pub 3-07: Joint Doctrine for Military Operations Other Than War...⁷ As a result, “the Coast Guard is the lead federal agency charged with preventing and responding to marine pollution incidents, and as such, is equipped to command, coordinate, and provide resources to monitor and respond to major spills or environmental disasters.”⁸ However, this charge is limited to U.S. operations. There is no existing joint doctrine giving the Coast Guard (or any other service) similar lead agent responsibilities for overseas incidents. Further, there is limited experience in joint training for Coast Guard participation in overseas incidents.

The Coast Guard’s “Office of Response” has recently been tasked to “dust off” their planning for a Middle East scenario, and this will surely include joint training and response planning. However, the lack of emphasis on joint doctrine in other services with specific regard to joint spill response efforts needs to be addressed.

The Need for Joint Planning

DOD planning for spill response activities will be necessarily complex. In addition to a wide range of service assets that may be required, civil authorities, commercial companies, and a wide range of government and non-government organizations might be players in a Middle East spill crisis. The DOD needs to build and maintain basic, joint-service plans for spill response. U.S. Navy efforts, particularly those led by SUPSALV described earlier in this paper, have gone a long way to fill the planning gap since the

Gulf War. However, these plans need to be expanded and exercised in a joint environment. Any crisis action team working for any unified commander should be able to refer to existing plans. They will need to discern major contributing organizations, what equipment and personnel are available, what statutes and regulations apply, and who the key points of contact are. Planning should also include, from past exercise experience, what phasing will be required for key assets to be delivered, from where, and by whom.

It is not enough for the Navy to maintain spill response plans unique to their service or for the Coast Guard to work on EDO doctrine unique to its own service and the U.S. territorial waters. As both the Gulf War and Exxon Valdez spill responses proved, future major spills may also require the support of other services, coordination of this support with other federal agencies, and coordination of this joint support with other nations. This can only be done with deliberate joint and multinational planning and exercises of these same plans.

Notes

¹ *Gulf Crisis Chronology*: (Aylesbury, Bucks, U.K., BPC Hazell Books, 1991), 205.

² Nasser Ibrahim Rashid and Esber Ibrahim Shaheen, *Saudi Arabia and the Gulf War*: (Joplin, International Institute of Technology, Inc., 1992), 330.

³ *Ibid.*, 332.

⁴ *Ibid.*, 334.

⁵ "SUPSALV Visits Black Sea," *The SUPSALV Skimmer*, vol. 6, no.1 (Spring 1997): 8.

⁶ *Ibid.*, 8.

⁷ Lt Michael Edrington, USCG Headquarters, Office of Response, Talking Paper for staff, Office of Response, subject: "Environmental Defense Operations: G-MOR"

⁸ *Ibid.*

Glossary

ACC	Air Combat Command
ATC	Air Traffic Control
DATCAL	Deployable Air Traffic Control and Landing System
DOD	Department of Defense
EDO	Environmental Defense Operations
FAA	Federal Aviation Administration
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas
MSF	Multi-Stage Flash
PLO	Palestine Liberation Organization
RO	Reverse Osmosis
SLAR	Side-Looking Airborne Radar
SUPSALV	Supervisor of Salvage
VIP	Very Important Person

absorbent. A chemical compound that is sprayed or foamed on an oil spill in order to absorb the oil allowing it to be collected later by mechanical means.

brine. Water saturated with or containing large amounts of salt.

cogeneration. A process in which two processes (for example, both desalination and power production) are combined in the same facility in order to share power, space, money, or other resources.

desalination. The process of removing saline water from sea water in order to produce potable water.

ecowar. A new term referring to either the destruction of the environment in war or the use of environmental resources to conduct acts of war.

feedwater. The unprocessed sea water that is taken (fed) into a desalination plant for processing.

- floating boom system.** A mechanical oil spill containment system in which a floating boom with a suspended “skirt” hanging below the surface of the water is used to surround, collect, and contain spilled oil until other collection or dispersion methods are used.
- intake filter.** The screen or filter mechanism on an intake port which removes foreign particles from feedwater prior to processing at a desalination plant.
- intake port.** The passage through which feedwater is initially drawn into a desalination plant for processing.
- multistage flash distillation.** A desalination process in which sea water is taken in, heated, and the vaporized (desalinated) water is then condensed in cooled coils and collected for use.
- oil fouling.** The term used to describe oil interfering with the normal operation of mechanical processes as a result of an oil spill.
- reverse osmosis.** A desalination process in which sea water is pressurized against a membrane, which allows potable water to pass through, while the remaining saline water is removed.
- saline water.** Water with a high concentration of salt (sea water, for example).
- skimmer.** A mechanical device used to “skim” or collect spilled oil from the surface of the water.

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