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ABSTRACT

Wartime water needs for all geographic locations were analyzed with emphasis placed on living within the JCS planning factors. We found that present planning factors are well documented and supported, but not contained in Air Force publications. We also developed some logistics only planning factors not previously considered. Our review encompassed fixed plant and mobile water purification systems. In reviewing waterless decontamination procedures, we discovered a commercially developed dry cleaning system which offers great promise for decontaminating without water. The report offers four recommendations: (1) include newly developed "logistics only" water needs in the JCS planning factors, (2) include JCS planning factors in Air Force WMP 1, (3) continue to investigate a Freon-based decontamination unit, (4) ensure a newly developed NBC detection kit enters the Air Force without delay.

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EXECUTIVE SUMMARY

Water is basic to the daily operation of any base, but it becomes even more critical during conflict. When a base is involved in contingency operations more drinking, firefighting and industrial water will be required. Concurrent with this increased usage the chances of reduced water supply multiply. The water source may be interdicted, contaminated, or destroyed.

HQ USAF/LEX tasked the AFLMC to analyze the absolute water needs for all locations with emphasis on living within the JCS planning factors. We were to address the JCS planning factor of 21.5 gallons per day per person for arid environments as well as the 50.1 gallons per day for all other theaters. Fixed plant and mobile water purification systems were to be considered. In addition, the Air Force Reserves (AFRES/LG) asked that the AFLMC investigate sources other than water for decontamination.

The analysis included contact with all major commands, AFESC, Air Force Office of Survivability, Army, Navy, Marines, civilian federal agencies, and private firms. Our literature search involved Army publications such as "**Expedient Water Conservation Techniques**" and "**Minutes of the Water Resources Management Action Group (WRMAG)**"

We reviewed the Air Force's water use throughout the world and what actions had been taken to insure water availability. Various water factors were reviewed and some Air Force-unique logistics water factors were developed.

We recommend present JCS planning factors be changed to include the logistics water factors we developed, and all water planning factors should be included in an Air Force WMP-1. Additionally, as a result of our project, the Army changed the requirements for the new nuclear, biological, chemical detection kit and identified a commercially developed product for decontaminating without water.

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CHAPTER 1

THE PROBLEM

Project Background. Historically, water has presented significant challenges to the military. During World War II, forces in North Africa suffered heavy casualties due to heat fatigue. The 1967 Arab-Israeli war produced over 20,000 heat-related casualties. Later research indicates many of these heat-related casualties were caused by improper use of water.

It is not just human consumption of water which causes problems. Water is required for other tasks. Most decontamination operations involve using water. Although firefighting uses other agents, water is still a basic firefighting material. Water is used for hygiene purposes, thus helping prevent the spread of illness, which can rapidly debilitate a fighting force. In addition, water is required for numerous, sometimes forgotten areas, such as metal working and battery shop operations.

PROBLEM STATEMENT

As a result of general concern about the water problem, the AFLMC's Survivability Panel suggested we analyze specific logistics water requirements for base-level contingency operations. Fixed plant and mobile water purification systems were to be considered. HQ USAF/LEX, in approving the study, expanded the tasking to include the absolute water needs for all geographic locations with emphasis placed on living within the JCS planning factors. The JCS planning factors are 21.5 gallons per man per day for arid environments (Atch 1) and 50.1 gallons per man per day for all other theaters, including the United States. (Atch 2)

During the initial planning phase of the project, we were asked to look at two other water related issues. AFRES/LG requested other decontamination methods be investigated to decrease dependence upon water. Strategic Air Command (SAC) asked us to review portable demineralizers because they were dissatisfied with them. They were physically awkward to handle and operationally unreliable.

CHAPTER 2

RESEARCH AND DEVELOPMENT

APPROACH: We conducted a literature search of military and civilian sources. Additionally, major commands were queried about their water requirements for traditional logistics functions of supply, transportation, and maintenance. We visited several units to discuss their water requirements and the efforts taken to ensure their requirements were met. We visited the Army's Mobility Equipment Research and Development Command Headquarters at Ft Belvoir and the Office of the Department of the Army, Deputy Chief of Staff for Logistics at the Pentagon. We also visited the Air Force's Survivability System Management Office at Eglin AFB and the Engineering and Services Center at Tyndall AFB. We met with the Water Resources Management Action Group (WRMAG) at Ft McPherson and reviewed minutes from some of their meetings.

FINDINGS: The WRMAG consists of representatives from several DoD agencies (including all military services) with an interest in the water support program. They provide a forum for the planning, coordinating and tasking of water actions and assure water issues continue to receive a high level of attention. The Army, however, is the DoD's lead agency for water matters. The Air Force has several of its own programs, but all agencies use the WRMAG as a coordinating organization. The Air Force is aggressively represented, and the WRMAG is responsive to Air Force needs. In addition, Air Force members are quick to respond to any tasking assigned to them. The WRMAG appears to be a model working group. Each meeting results in many action items which are assigned OPRs and rapidly accomplished.

The joint planning factors for arid environments (Atch 1), as well as the joint planning factors for theaters other than arid environments (Atch 2) were reviewed. The wide disparity between 21.5 gallons per man per day for arid environments versus 50.1 for all other theaters caused initial concern. However, the 50.1 figure is based upon the assured availability of water in other than arid regions which allows for less restrictive water consumption planning factors. We also reviewed critiques conducted by both DOD and consulting agencies to determine the accuracy and applicability of the figures. We found the figures are well researched and reviewed often. However, we could find no Air Force document which included the planning factors.

Although the planning factors currently used appear reasonable, "**logistics only**" requirements had not been included. This subject had not been addressed by any Air Force unit prior to AFLMC involvement. To develop these new factors we requested information concerning "**logistics only**" water requirements during periods of heavy tasking (e.g. war plan execution) from the MAJCOMs. We divided the raw figures received from the MAJCOMs by the number of people expected to be deployed for a unit (1700) and arrived at a gallons per person per day factor. The results were used to develop a "**logistics only**" figure included in Attachment 3.

We are concerned with applying gallons per person per day figures to such items as vehicles, aircraft wash, and construction. However, we are aware

these applications make the figures easier to apply, and therefore serve a valid need. Using the "**gallons of water to number of people**" philosophy, we reduced our "**logistics only**" figures to gallons per person per day. While reviewing consumption factors, we also reviewed sources of water.

Both fixed and mobile sources of water were reviewed. All services have some involvement in such projects, but the Army is the most deeply involved. The Army is the primary agency testing drilling equipment, etc., and is pressing ahead with its efforts to satisfy all service needs.

The Air Force involvement included testing and adapting the Reverse Osmosis Water Purification Unit (ROWPU) to Air Force needs. The ROWPU is a machine using a membrane process in which the input water is pressurized to a value above the osmatic pressure. Water passes through the membrane, leaving most soluble salts behind. At the same time, essentially all particulate matter, including microorganisms and suspended celloids, is removed. The ROWPU is a significant improvement over water purification units previously used.

While researching Air Force water needs and sources, three other issues were investigated: (1) nuclear, biological, chemical (NBC) detection kits, (2) water substitutes for decontamination purposes, and (3) portable demineralizers.

Nuclear, Biological, Chemical Detection (NBC) Kits:

While reviewing nuclear, biological and chemical (NBC) decontamination, we discovered the NBC detection kit requirements made no mention of detecting agents in chlorinated water. Lack of this ability would impact the Army and could significantly impact the Air Force which tends to use more permanent facilities with a central water treatment plant. The Army agreed, and the kit requirements were changed to reflect the need to detect agents in chlorinated water. Discussions with TAC bioenvironmental people indicate the Air Force intends to adopt the kit (NSN 6665-01-134-0885) for Air Force use.

Water Substitutes for Decontamination:

We also addressed the AFRES request for research into non-water decontamination. A promising alternative to using water to decontaminate clothing appears to be a Freon-based dry cleaning system developed by Honeywell. The system uses only a small amount of Freon, since most can be recycled. The technique has been used successfully in the nuclear field for some time. Honeywell believes they can adapt their unit to military needs with only a small effort. It appears the unit is capable of decontaminating and cleaning not only clothing, but also small aircraft components. The company has expressed an interest in expanding the concept to include larger items of Air Force hardware. The Aeronautical Systems Division at AFSC has accomplished significant research on this system and believe with further development the concept may offer a real additive to Air Force decontamination. The AFESC was informed of Honeywell's activities and has expressed an interest.

Portable Demineralizers:

While reviewing demineralized water requirements, we discovered SAC needed an improved (more portable, supportable, and reliable) water demineralizer. Since a significant number of B-52 and KC-135 aircraft require demineralized water, a good portable demineralizer is extremely important to the war effort. We supported SAC's request to AFLC, and an improved demineralizer was obtained. The HB 785 is a state-of-the-art machine which satisfies SAC's requirements. They are continuing to investigate the reverse osmosis method of water purification which may provide more capability for demineralizing water. Since the National Guard units are receiving reengined KC-135's which will eliminate the need for demineralized water for those aircraft, and the only B-52s in the inventory which currently require water are the G models, the demineralized water problem is getting smaller. Adoption of a reverse osmosis system may not be required.

CHAPTER 3

CONCLUSIONS

Water support research, development, and implementation are effectively accomplished by many units within the DOD. The WRMAG acts as an efficient coordination center.

Water needs are well addressed by the WRMAG as are the mobile and fixed purification systems. Our review of JCS consumption planning factors indicates the factors accurately reflect most Air Force needs. However, we believe Air Force should also consider those "logistics unique" factors developed under this study. We further believe the Air Force should publish all water planning factors in an appropriate Air Force document.

The new decontamination detection kit (M-272) should soon be entering the Air Force inventory.

The Freon-based decontamination and dry cleaning unit discussed in this report provides great potential for decontamination without water.

CHAPTER 4

RECOMMENDATIONS

1. "Logistics unique" planning factors should be included in the Air Force portion of the JCS planning factors. (OPR: AF/LEXX)

2. JCS planning factors should be included in the USAF War and Mobilization Plan, Volume 1, Annex 5. (OPR: AF/LEXX, OCR: AF/XOXIC)

3. Air Force Systems Command should continue evaluation of the Freon based decontamination and dry cleaning unit for Air Force use. (OPR: ASD/AESD, OCR: AFESC/CC)

4. Headquarters Tactical Air Command should ensure no delays are encountered in introducing the M-272 detection kit into the inventory. This new kit (NSN 6665-01-134-0885) should immediately be identified in TAs 889, 896 and 916. (OPR: HQ TAC/SEPB, OCR: Warner Robins ALC/MM).

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Regulations and Pamphlets

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Joint Planning Factors for Arid Environment

ACTIVITY	GALLONS PER DAY PER MAN
DRINKING	4.0
PERSONAL HYGIENE	2.7
SHOWERS	1.3
FOOD PREPARATION	3.0
VEHICLES	.3
HOSPITALS	1.0
HEAT TREATMENT	1.0
GRAVES REGISTRATION	.2
LAUNDRY	2.0
CONSTRUCTION	1.5
AIRCRAFT WASH	2.5
SUB TOTAL	19.5
WASTE AND EVAPORATION	2.0
TOTAL	21.5

Attachment 1

Joint Planning Factors For Other Than an Arid Environment

ACTIVITY	GALLONS PER DAY PER MAN
DRINKING	3.0
PERSONAL HYGIENE	2.7
SHOWERS	10.0
SEWAGE	10.0
FOOD PREPARATION	7.0
VEHICLES	1.0
HOSPITALS	1.0
GRAVES REGISTRATION	.2
LAUNDRY	4.5
CONSTRUCTION	4.5
AIRCRAFT WASH	2.5
SUB TOTAL	46.4
WASTE AND EVAPORATION	3.7
TOTAL	50.1

NOTE: In recognition of increased water availability several areas (e.g., showers, sewage) are allocated more water than they are in an arid environment.

Attachment 2

LOGISTICS Only WATER REQUIREMENTS*

ACTIVITY	GALLONS PER DAY PER MAN
NDI	.24
MUNITIONS HANDLING	.005
BATTERY SHOP	.12
METAL PROCESSING	.03
TOTAL	.395

* Beyond those specified in the joint planning factors.

Attachment 3