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AD377471	
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ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96243

ACTIV-GGD

25 November 1966

SUBJECT: Letter Report of Evaluation - Large Capacity Tunnel Flushers (U)

TO: Commanding General
US Army, Vietnam
ATTN: AVHGC
APO 96307

1. (U) REFERENCES

- a. USMACV Message 03176, DTG 010510Z Feb 66, subject: Tunnel Flushing (U).
- b. DA Message 757579, DTG 2912120Z Mar 66, subject: Tunnel Flushing (U).
- c. DA Message 765093, DTG 161837Z May 66, subject: Tunnel Flushing (U).

2. (U) PURPOSE

The purpose of this evaluation was to determine which of three large capacity tunnel flushers is best suited for use in Vietnam.

3. (C) BACKGROUND

a. Tunnels serving a variety of purposes for Viet Cong insurgents are frequently encountered in Vietnam. Most tunnels discovered to date have been less than 150 meters in length and considered small. When encountered, these tunnels are usually flushed with smoke or riot control agents forced through the tunnels by a "Mighty Mite" blower which is a small, back-packed, commercial crop duster capable of delivering 450 cubic feet/minute (cfm) of air. This system works well on such tunnels but is not capable of providing enough air to use on longer and more complex systems.

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b. Within the last year, an increasing number of large tunnel systems have been discovered. Reference 1a describes this type of complex as being a network of multi-leveled tunnels interconnected with vertical shafts and cross drifts. Some tunnels have as many as six different levels, with the top level at a depth of 3 to 4 feet and bottom levels as much as 30 to 35 feet deep. Ventilation for the complexes is provided by vertical air shafts which are camouflaged and difficult to detect on the surface. The vertical interconnecting shafts between levels are frequently blocked with trap doors to avoid detection. Tunnel complexes spread underground to unknown distances. Some are known to exceed 5 kilometers in length and to contain rooms connected to tunnels by short drifts. These rooms are used for quarters, headquarters, workshops, and other such activities.

c. For such complexes, the "Mighty Mite" blower is ineffective. Therefore, Military Assistance Command, Vietnam, by reference 1a, submitted a requirement for a large capacity blower with the following characteristics and capabilities:

- 1) Capable of being sling-lifted by UH-1 aircraft
- 2) Equipped with 100 meters of collapsible air ducting
- 3) Equipped with a hopper system for introduction of micro-pulverized bulk CS into the air stream
- 4) Equipped with a device for introduction of smoke into the air stream

d. HQ Military Assistance Command Vietnam requested 33 large capacity tunnel flushers for employment by US Marine, ROK and ARVN forces.

e. The Army Concept Team in Vietnam (ACTIV) was informed by reference 1b that the Model K Buffalo Turbine and the Mars Generator met MACV requirements and were being sent to Vietnam to determine which one was best suited for use in Vietnam. Reference 1c indicated that a third blower, called Resojet, was also being sent for evaluation.

f. The first shipment arrived on 4 April 1966 accompanied by two support personnel. The support team introduced the blowers to units for a field trial and to train operators. The Buffalo Turbine was introduced to the US 173d Airborne Brigade (S O) and the Mars Generator went to the US 1st Infantry Division. The Resojet arrived about 15 July and was demonstrated to Chemical Corps personnel of the 173d Airborne Brigade, 1st Infantry Division, 25th Infantry Division and ROK Capital Division. One Resojet was left with the ROK Capital Division and one with the 25th Infantry Division.

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g. During the course of the evaluation, the Perkins Generator, a British or Australian manufactured gas turbine driven water pump, was observed in use by the Australian Task Force Vietnam. Description of the Perkins is included in this report because of its desirable feature of air removal provided by a modified exhaust extension.

4. (C) DISCUSSION

a. Description of Materiel

(1) Buffalo Turbine

The Buffalo Turbine (figure 1) is a commercial model sprayer-duster. It is equipped with a turbine blower which displaces 8,500 cfm of air and is powered by a 18-horsepower 4-cycle gasoline engine. It weighs approximately 800 pounds. The fuel tank, which can be refueled during operation, has a capacity of 3 gallons, which permits operation for 2½ hours. It has a hopper for dry agents and a pump system for liquid agents. Polyethylene "lay flat" tubing (100 meters long, 14 inches in diameter) was furnished to transport the air to the tunnel entrance.

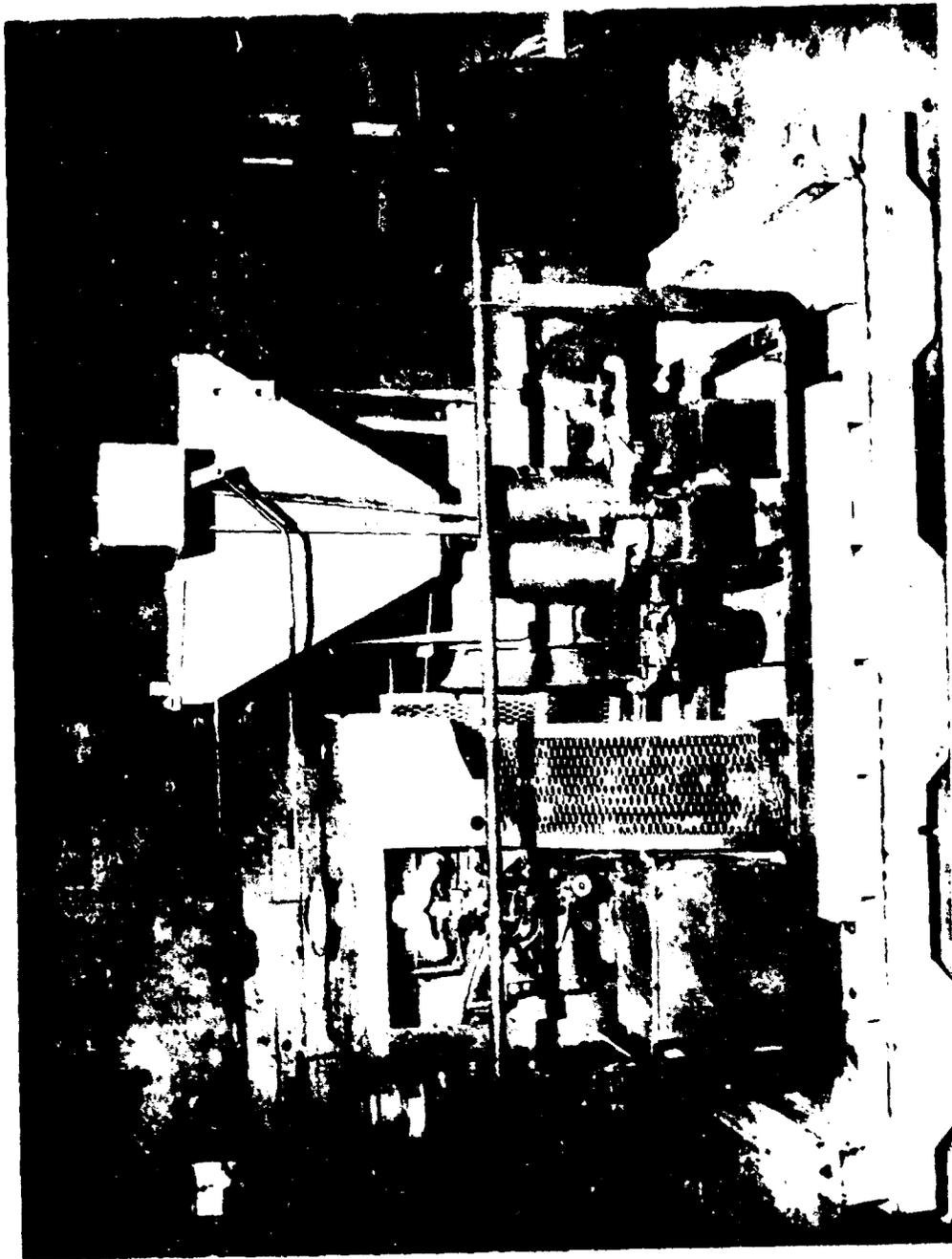
(2) Mars Generator

The Mars blower and smoke generator (figure 2) consists of a modified "Mars" gas turbine engine manufactured by Solar Aircraft Company. The engine is a single stage radial inflow turbine having a single stage centrifugal compressor and a single elbow combustor. It weighs 175 pounds and displaces 4000 cfm. The fuel tank has a 6-gallon capacity which permits about 30 minutes operating time. A 10-foot length of flexible metal tubing is provided to carry air from the blower to the tunnel. The unit does not have a hopper but dry and wet agents are introduced into the exhaust by a system of vacuum feed tubes. It can be refueled during operation and will run for extended periods.

(3) Perkins Generator

(a) The Perkins Generator (figure 3) is 4 feet by 3 feet by 15 inches. As shown in figure 4 with fuel tanks mounted, the blower weighs about 350 pounds and displaces about 5500 cubic feet of air per minute. Both the Mars and the Perkins Generators use a Solar Aircraft Company gas turbine but it is not known if the turbines are the same model.

(b) The blower section or long nose in the left and center foreground of figure 3 is different from the blower section of the Mars Generator. Note the opening in the vertical section of the blower. This section provides the means to exhaust tunnels of smoke and to force fresh air through them. One end of the flexible rubber tubing in the background of figure 3 is attached to the opening and the other end is placed in the tunnel. When the turbine is started, air is sucked out of the



(U) FIGURE 1. Buffalo Turbine.



(U) FIGURE 2. Mars blower and smoke generator.



(U) FIGURE 3. The Perkins Generator.



(U) FIGURE 4. Perkins Generator with fuel tank mounted.

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tunnel.

(4) Resojet

The Resojet tunnel flusher (figure 5) consists of two man-pack units: a blower pack and a fuel pack. The 38-pound blower pack consists of a pulse jet combustor, ignition, and fuel controls, all mounted on a lightweight frame, and a heat resistant pressure cloth. The 55-pound (full of fuel) fuel pack consists of two 2½-gallon tanks (one for fuel and one for fog oil) and a hand pump for pressurizing the fuel. It displaces 3000 cfm and will operate for 15 minutes on 2½ gallons of fuel. It cannot be refueled during operation.

b. Technique of Employment

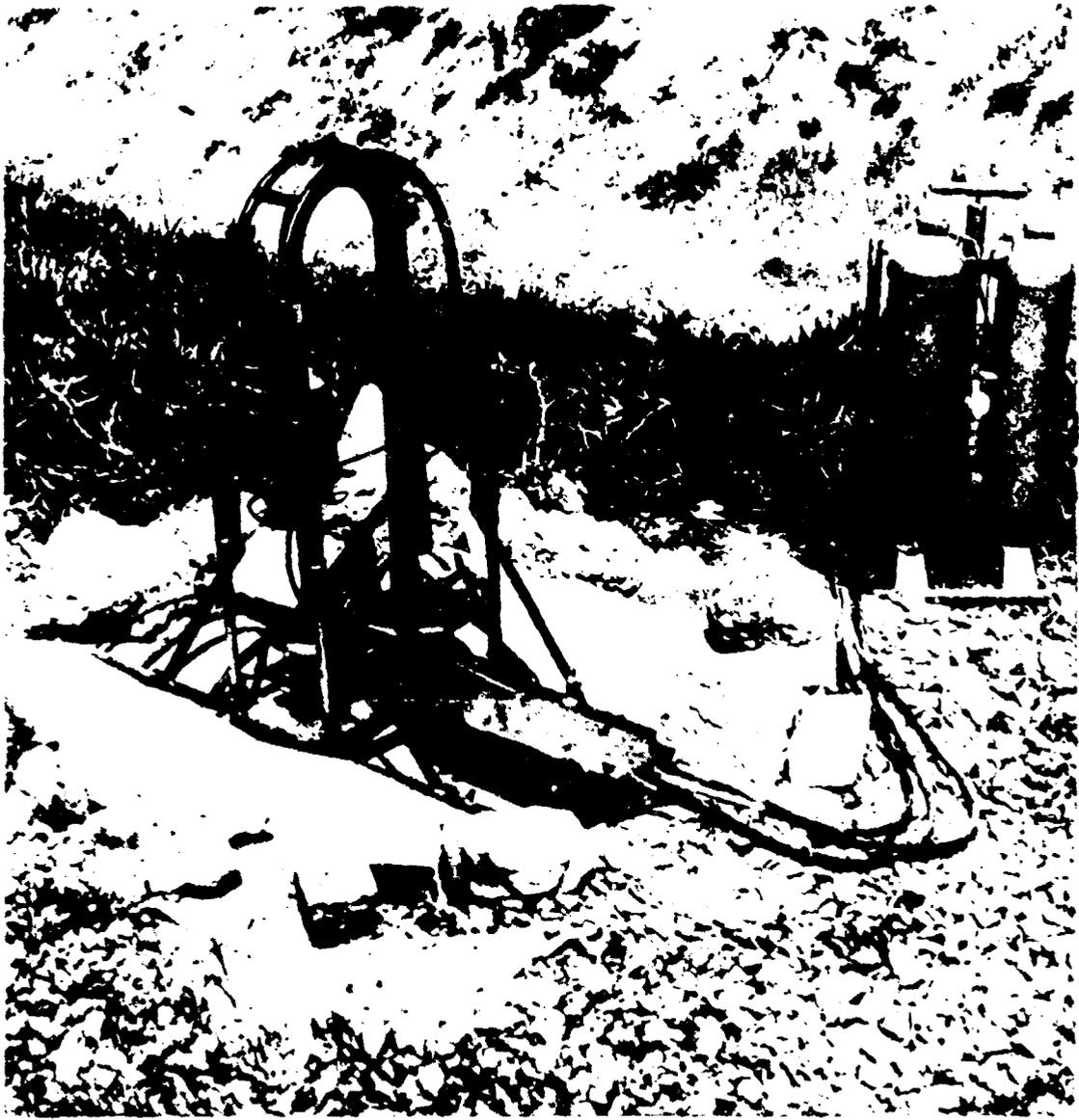
(1) Within the US divisions and separate brigades, the mission of tunnel flushing has been given to the Chemical Officer. Each unit maintains a tunnel team who flush, plot, and search tunnels. The large capacity blowers were placed in the hands of the tunnel teams for use during their operations.

(2) The technique for employing blowers was found to be fairly consistent among units, with only minor differences noted. When a tunnel was located, the blower was first used to flush out any Viet Cong present. The agent used was normally smoke. During smoking out operations, an attempt was made to locate all exits and ventilation shafts. When smoking out was completed, the tunnel was exhausted to remove the smoke and supply fresh air if possible. It was highly desirable to have fresh air pumped during search of the tunnel because there was one case of asphyxiation when the first large tunnel was found. The tunnel was searched for documents, materiel, etc, and plotted. When searching was completed, the tunnel was either filled with CS and sealed or destroyed with explosives.

(3) It was found that the blower must be light enough to be man-handled for short distances. In one case, a blower was set up at a false tunnel entrance. The next entrance was greater than 100 meters away and the blower had to be moved. Tunnels are known to contain water locks and trap doors but, during the evaluation, none were encountered. It is doubtful if the air pressure generated in the tunnel would be sufficient to overcome these. In such a case, the blower would have to be moved to the other side of the obstacle. In two instances the terrain permitted the blower to be vehicular-mounted.

(4) In operations by the ROK Capitol Division 20 to 30 km north of Qui Nhon, many tunnels and caves were discovered in rocky areas of mountain sides. Entrances to these tunnels could only be approached on foot after a difficult climb.

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(U) FIGURE 5. The Resojet tunnel flusher.

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c. Operational Usage

(1) The Mars Generator was used twice. The 1st Infantry Division used it in early April on a 400-meter, single story tunnel system. The blower was airlifted to the general area and then carried to the tunnel by vehicle. At this time, the flexible tubing had not arrived and the blower had to be tilted down so that the exhaust blew into the tunnel shaft. The entrance was covered with an asbestos blanket under which was thrown a red smoke grenade at two minute intervals. Good results were obtained except at other entrances, which were exceptionally large. Sufficient material was not on hand to seal them to prevent loss of air flow.

(2) The second operation took place near Cu Chi in early August. What appeared to be a large tunnel system was located in typical jungle terrain. The blower was airlifted to a landing zone about 150 meters from the known tunnel entrance and was man-carried to the tunnel. The blower was used in conjunction with violet smoke grenades. The tunnel was discovered to have a length of 800 meters. Smoke completely filled the tunnel in less than 10 minutes and was instrumental in the discovery of 12 well-camouflaged entrances.

(3) The 173d Airborne Brigade used the Buffalo Turbine in late June on a single story tunnel of about 1000 meters in length. Thirty-pound smoke pots were used for the flushing operation. Locating ventilation shafts and entrances proved difficult because of heavy underbrush and the lack of an aerial observer. The primary use of the blower in this instance was to supply fresh, cool air to the searchers who worked in the tunnel for the better part of 2 days. This blower was refueled during operation and ran for extended periods. The blower had been airlifted to the general area and then transferred to an armored personnel carrier. In order for the blower to fit inside, the hopper had to be removed.

(4) A Resojet blower was given to the ROK Tiger Division in September. They had requested a tunnel flusher for caves and tunnels found in operations north of Qui Nhon. The asbestos pressure cloth and blower unit could not be fitted to the irregular, boulder strewn, steep approaches to tunnel entrances. It was tried on an accessible tunnel entrance in a deserted village but would not start in a heavy rain.

5. (C) FINDINGS

a. The Buffalo Turbine is air-transportable into jungle terrain by UH-1 under favorable atmospheric conditions. Its weight, however, prevents it from being man-handled in difficult terrain.

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b. The Mars Generator meets all of the MACV requirements except it does not have a hopper. It is man-portable, but cannot furnish fresh air. The products of combustion are exhausted into a tunnel at about 1000 degrees Fahrenheit. This is considered to be unsafe if friendly personnel are in the tunnel.

c. The Resojet blower has no hopper for micropulverized CS nor air ducting, both MACV requirements. Neither does it have the capability of extended operation nor can it provide fresh air. The discharge is considered safe due to the efficiency of combustion, but heat output is 20,000 BTU per pound of fuel. The Resojet could not be fitted to the irregular tunnel entrances found in rocky mountains.

d. In order to be effectively employed in the manner required, an acceptable blower must possess the following capabilities in addition to those indicated by MACV:

- 1) Be man-portable so that it can be moved on site as necessary.
- 2) Be capable of extended running time (up to 2 hours) so that air pressure can be maintained.
- 3) Be capable of blowing fresh air into the tunnel and exhausting smoke and fumes from the tunnel.

6. (U) CONCLUSIONS

It is concluded that:

- a. The Buffalo Turbine is unsuitable because of its excessive weight.
- b. The Resojet is unsuitable because it can not operate for extended periods and cannot be "fitted" to all tunnel entrances.
- c. The Mars Generator with modified blower section similar to that of the Perkins generator is best suited for used in Vietnam.

7. (U) RECOMMENDATIONS

Its recommended that:

- a. The "Mars" Generator with blower section similar to the Perkins generator be procured.

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b. Coordination be made with OCRD on US Army Limited War Lab Task 06-B-66, Tunnel Denial (U) to investigate the possibility of using the modified Mars generator to fulfill the requirement for a disseminator of an agent solution as a part of LWL Task 06-B-66.

c. Recommend basis of issue be determined by HQ, USARV, on the basis of specific recommendations by unit commanders.

Merrill G. Hatch

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Colonel, Artillery
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