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DEPARTMENT OF THE ARMY
OFFICE OF THE ADJUTANT GENERAL
WASHINGTON, D.C. 20310

IN REPLY REFER TO
AGAM-P (M) (19 Apr 68) FOR OT RD 681182 25 April 1968

SUBJECT: Operational Report - Lessons Learned, Headquarters, 93d Engineer Battalion (Const), Period Ending 31 January 1968 (U)

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2. Information contained in this report is provided to insure appropriate benefits in the future from lessons learned during current operations and may be adapted for use in developing training material.

BY ORDER OF THE SECRETARY OF THE ARMY:

Kenneth G. Wickham
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Major General, USA
The Adjutant General

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DEPARTMENT OF THE ARMY
Headquarters, 93d Engineer Battalion (Const)
APO San Francisco 96370

EGFB-XO

14 February 1968

SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 31 January 1968

THRU: Commanding Officer
34th Engineer Group (Const)
APO San Francisco 96291

Commanding General
20th Engineer Brigade
APO San Francisco 96491

Commanding General
US Army Engineer Command Vietnam (Prov)
ATTN: AVCC-P&O
APO San Francisco 96491

Commanding General
United States Army Vietnam
ATTN: AVHGC-DH
APO San Francisco 96307

Commander in Chief
United States Army, Pacific
ATTN: GPOP-OT
APO San Francisco 96588

TO: Assistant Chief of Staff for Force Development
Department of the Army (ACSFORDA)
Washington, D.C. 20310

FOR OT RD
631182

EGFB-XO 14 February 1968
SUBJECT: Operational Report - Lessons Learned
for Quarterly Period Ending 31 January 1968

SECTION 1: SIGNIFICANT ORGANIZATION OR UNIT ACTIVITIES

1. COMMAND:

a. Mission: The mission of the battalion is as follows:

(1) Construction and support of a base camp, Bear Cat, defined in five construction directives.

(2) Construction of an all-weather, C-130 capable, operational, self-supporting airfield facility and cantonment, Long Thanh North, defined in five directives.

(3) Construction of an approximately 706,700 SY MLR heliport to include 170 rotary wing aircraft revetments (CD 34-68-5MLR-93).

(4) Replacement of four tactical bridges and construction of four military standard permanent bridges for lines of communications upgrading (CD 34-67-72LOC thru 75LOC-93).

b. Command and Staff: The command of the battalion was assumed by LTC James Dorman, CE, 066844, on 14 January 1968. A majority of command and staff positions were changed as a result of directed personnel infusion and the desire to give personnel command/staff time.

(1) S-1: 1LT Michael E. Neff, CE, 0553848
Vice: 1LT Joseph L. Soczek, CE, 05535907

(2) S-4: CPT John M. Dorr, CE, 093670
Vice: CPT William T. Kirkpatrick, CE, 093790

(3) Pipeline Engr: CPT Robert M. Southworth, CE, OF103630
Vice: 1LT Richard J. Laycock, CE, 05023212

(4) Commo Off: 1LT Joseph L. Soczek, Jr., CE, 05535902
Vice: 1LT Merlyn J. Haynes, CE, 05243023

(5) PBO: CW3 Gerald J. Eichenberger, QMC, W3350260
Vice: CW2 Richard L. Watkins, QMC, W3350581

(6) CO, HHC: CPT Justice W. Edge, CE, 05418422
Vice: 1LT John M. Shank, Jr., CE, 05024227

(7) CO, Co A & Engr Equipment Maint Off: CPT William A. Miller, CE, OF102562
Vice: CPT William H.M. Brunner, CE, OF101887

(8) CO, Co C: 1LT Richard J. Laycock, CE, 05023212
Vice: CPT John M. Dorr, CE, 093790

(9) CO, TRCR Det: 1LT Ronald L. Albright, CE, 052411943

c. The battalion remains assigned to the 34th Engineer Group (Const), 20th Engineer Brigade, and the US Army Engineer Command, Vietnam (Provisional).

d. The 67th Engineer Company (DT) was detached during the period, and the US Army Engineer Detachment (Tree Crusher)(Provisional) was attached.

e. Stationing: The battalion (-) has remained in the WABTOC base camp adjacent to the Long Thanh North Airfield (presently under construction) and two kilometers southwest of Camp Martin Cox. The battalion cantonment is known locally as Camp Castle (YS 1498). An advance party from Company B displaced to a base camp location (XS 4744) of the 9th Infantry Division (Dong Tam) on 24 January 1968 with the rest of the company preparing for movement after 1 February 1968. The Second Construction Platoon of Company C displaced to a base camp location (YT 03-17) of the 199th Light Infantry Brigade near Bien Hoa on 24 January 1968. The Tree Crusher Detachment, while based at Camp Castle, operated throughout the 9th Infantry Division AO.

2. PERSONNEL, ADMINISTRATION, MORALE, DISCIPLINE:

a. Personnel:

(1) At the end of the reporting period, the battalion personnel strength was as follows:

	OFF	WO	EM	TOTAL
Authorized	31	7	867	905
Assigned	31	6	766	804

(2) The following personnel turnover has occured during the period:

	OFF	WO	EM	TOTAL
Transfer Out	5	2	119	126
Transfer In	5	1	79	85

(3) The personnel adjustments made during the period were minor for EM. However, due to the infusion program, personnel adjustments were major for officers. Transfers and the need to insure that qualified officers received needed command time accounted for most of the adjustments.

(4) The battalion currently employs 129 permanent and 103 daily hire local nationals. Skills have been developed through training. Necessary skill has not been available to fill all the requirements.

b. Administration:

(1) Reports: During the period, 636 battalion level re-occuring reports and 130 one-time reports have been submitted.

(2) Availability and timeliness of receipt of new in-country publications from USARV has improved during the period; however, requisitions continue unfilled for those USARV publications published prior to this period.

c. Morale: Morale in the unit is high as is indicated by the lowering and improving disciplinary statistics. The present time off policy allows one-half day off per week, if possible. Living conditions continue to improve. Each company and staff section improves their living and operational areas through self-help. Day rooms, volley ball courts, and an NCO club with an EM annex are now available. Five feature length films are shown per week and complete Special Services facilities are available in Bear Cat. Excellent rations contribute substantially to high morale. For the size of the base camp, the battalion has been extremely fortunate in obtaining a number of USO shows.

d. Discipline: Disciplinary actions taken during the period were as follows:

	Art 15	Summary Court	Special Court
November	63	1	7
December	43	0	2
January	34	1	3
TOTAL	140	2	12

3. INTELLIGENCE AND COUNTERINTELLIGENCE:

a. Unit Intelligence:

(1) This unit has no assigned intelligence mission. The battalion intelligence NCO does, however, provide liaison with the 9th Infantry Division G-2 and a nearby Special Forces camp to obtain information relative to base camp and job site security. Occassionally visits are also made to the US advisory team in Long Thanh. Information on enemy activities and capabilities as well as friendly activities is obtained during the liaison visits.

(2) The unit intelligence officer has also granted eight confidential security clearances, has validated eight secret security clearances, and has requested validation of one top secret security clearance during the period.

b. Long Thanh North Security: The responsibility for the Long Thanh North airfield complex security was delegated to the 210th Aviation Battalion (Combat) by the 9th Infantry Division on 2 December 1967. The 210th Aviation Battalion has in turn assigned sectors of responsibility to the various units in the Long Thanh North area. At the present time, this unit is required to provide 54 EM per night for guard duty. The number of guards increases during alerts. The following is a summary of the manhours expended for security during the period:

	Nov 67	Dec 67	Jan 68
Airfield and Base Camp Security:	73,540 MH	39,480 MH	41,355 MH
Job site security and compensatory time (Lost to construction effort):	7,800 MH	8,448 MH	7,370 MH

The number of manhours expended for airfield and base camp security dropped sharply after the arrival of the 210th Aviation Battalion (Combat) and contributed materially to higher morale and construction effectiveness within the battalion. The present compensatory time policy allows the battalion OD, the battalion SOG, and personnel selected by each sub sector commander (Company Commanders) up to 4 hours off the day following their guard duty. Usually each company will grant the third relief guards two hours off and the company charge of quarters and the company SOG four hours off.

4. PLANS, OPERATION, AND TRAINING:

a. Battalion Operations: During the reporting period, the battalion has been primarily committed to base camp and airfield construction. However, some effort was expended for LOC improvement during the last part of the reporting period. Combat support has primarily taken the form of equipment support to engineer combat battalions within the group and the employment of the tactical crushers.

b. Plans: Standard construction plans were used as often as possible during the reporting period. However, in many cases it was not possible to use a standard plan since the structures being built did not fall within the category of standard buildings. In planning and design, the battalion strived to give the customer what he desired within the costing limitations provided by higher headquarters. As units arrived at Long Thanh North airfield, almost constant revision of the airfield cantonment and operational facilities was necessary. Major drafting assistance was provided to the Base Development Boards at Bear Cat and Long Thanh North in the preparation of their semiannual base development plans. The following is a list of the plans completed during the reporting period:

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93d Engr Bn Dwg No.	Title
183-F	20' x 200' Tech Supply Electrical
184-F	Tech Supply for 75' x 202' Hangar
185-F	Camp Castle Dispensary
186-F	Steel Clamp for lifting WF beams
187-F	Covered Storage
188-F	General's Mess
189-F	Loading Ramp
190-F	USASSG ACSI DA Electrical Plan
191-G	Avn Bn Chapel
192-G	Tech Supply for 177' x 192' Hangar
193-G	Admin Bldg
194-G	LTN Layout (Revised)
195-G	Drainage South Cant. LTN Airfield
196-G	Brigade Headquarters Floor Plan and Electrical Details
197-G	Fill Stand #5
198-G	LTN South Cant. (Revised)
199-G	Bear Cat Control Tower
200-H	Dispensary
201-H	Standard Dog Kennels
202-H	Dong Tam Revetments (UH-1D)
203-H	Dong Tam Revetments (CH-47)
204-H	56th Trans Revetments Layout
205-H	Standard NCO/EM Club
206-H	Bn BOQ Electrical
207-H	Long Thanh Power Plant
208-H	Dong Tam Revetment Layouts
209-H	Revetment Layout for UH-1 B/C and UH-1D

c. Company Operations:

(1) Company A, in providing 24 hour maintenance support, completed 233 battalion maintenance jobs, 140 direct support jobs, and 186 allied trades jobs. A total of 8,207 manhours and 7,818 equipment hours was expended in completing the jobs. Company A was also responsible for prime and tack coat operations for the paving of the airfield. Four hundred and seven barrels of RC 800 were used in preparing 46,223 square yards of area for paving. The equipment platoon provided technical assistance and equipment support for the placement of 151,965 gallons of dust palliation by C and D Companies. Company A also expended 4,500 manhours in support of combat operations with the tactical tree crusher.

(2) During the period 1 November 1967 to 31 January 1968, Company B remained totally committed to the Long Thanh North airfield.

Their most important and time consuming project was the construction of 30 each 12 foot high aircraft revetments to house the U-21 aircraft of the 210th Aviation Battalion (Combat). The electrical work on the 210th Aviation Battalion tech supply building, and the LTN control tower was also completed. The facilities completed during this period on the north side of the airfield include a 20' x 96' tech supply building, a 50' x 100' concrete wash rack, a 75' x 215' pre-engineered aircraft hangar with a 20' x 215' framed tech supply area attached to the back wall, two 40' x 100' Pascoe prefabricated metal storage buildings, a company headquarters building, a water tower, and four guard bunkers. Four 40' x 100' Pascoe prefabricated metal storage buildings, various sized aircraft revetments, and an avionics repair building are the major items started but not completed during the period. The earthwork accomplished during the period consisted of a 10,000 square foot laterite pad for an open storage area, bringing a 80' x 250' runway extension to laterite grade, raising a runway overrun area 80' x 500' to laterite grade, filling a 200' x 1200' section and a 100' x 900' section of the north ramp to laterite grade, and bringing two 40' x 325' connecting taxiways to laterite grade. A 40' x 2500' parallel taxiway is 57.8% complete to laterite grade and a 7,800 square yard warmup pad is 37.2% complete to laterite grade. The 56th Transportation Company berm, drainage system, and cantonment roads were also completed during the period. B Company also operated a laterite pit and a batch plant during the period. The following is a summary of B Company's construction effort during the reporting period:

(a) Total manhours expended on projects: 84,740

(b) Total equipment hours expended: 15,850

(c) Cubic yards of concrete placed: 1,087

(d) Cubic yards of concrete produced: 2,920

(e) Cubic yards of laterite hauled: 92,617

(f) Square feet of:

1. Revetments constructed: 11,590

2. Buildings constructed: 34,490

(3) Company C had the two construction platoons primarily committed to vertical construction in Bear Cat. The earthmoving platoon was committed to the Long Thanh North roads and airfield. Structures completed during the period were living facilities for the women stationed at Bear Cat, a 28' x 132' field ration mess capable of seating approximately 80 officers, three 40' x 100' general purpose Pascoe warehouses,

a service club latrine facility, a water well fill stand with mounted 500 bbl bolted steel tank, four 20' x 150' Pascoe open storage sheds, a 75' x 215' hangar, and a 40' x 70' general's mess. The earthmoving platoon completed approximately four miles of 40' width roads with supporting drainage ditches and also placed base course material on a 80' x 250' runway extension, a 80' x 1,250' runway extension, two 40' x 325' connecting taxiways, a 20' x 950' section of the north parking ramp, and a 250' x 400' section of the south parking ramp. The EM platoon also maintained 7.1 km of local roads. Company C continued to operate a batch plant, prefab yard, and a pit (laterite). The following is a summary of C Company's construction effort for the reporting period:

(a) Total manhours expended on projects: 85,050

(b) Total equipment hours expended: 16,407

(c) Cubic yards of concrete placed: 1,394

(d) Cubic yards of laterite hauled: 55,959

(e) Square feet of buildings constructed: 51,972

(f) Cubic yards of base course hauled: 17,500

(g) Cubic yards of base course spread: 16,670

(h) Tons of plant mix asphalt hauled: 10,670

(4) During the reporting period, D Company phased out of the construction effort in Bear Cat and committed total effort to the Long Thanh North airfield. Before leaving Bear Cat, D Company completed a 40' x 100' Pascoe medical warehouse, a water well fill stnad with 500 bbl bolted steel tank and 30 miles of primary and secondary electrical distribution system for the Thai cantonment area. Horizontal construction began on the south ramp of the Long Thanh airfield while vertical construction began in support of the 210th Aviation Battalion (Combat), 12,000 meters of concertina entanglement were emplaced, 2,600 meters of earth berm were constructed, and 12 tactical bunkers were constructed. Construction was completed on a 500 man mess hall, a 1,900 square foot battalion headquarters building, a 20' x 100' S-4 warehouse, a 23' x 72' maintenance shed, two 20' x 48' administration buildings, and a water tower with a 250 bbl bolted steel tank. Projects started but not completed at the Long Thanh North airfield are the VIP terminal, a fire and crash station, closed storage warehouse, and a 175' x 190' aircraft hangar. Company D also became involved in the LOC upgrade program. A 60' standard MACV bridge was constructed at Cau Dong Mon (YS 130899) replacing the existing bailey bridge. The following is a summary of D Company's construction effort during the period:

(a) Total manhours expended: 84,105

(b) Total equipment hours expended: 15,204

(c) Total cubic yards of concrete placed: 604

(d) Total cubic yards of laterite hauled: 61,198

(e) Square feet of buildings constructed: 34,836

d. Base Development Operations:

(1) Bear Cat (Camp Martin Cox) and the Long Thanh North base development projects have been progressing very rapidly. The present base development office consists of two NCOs and one EM. An officer from the S-3 section has been appointed to supervise and coordinate activities. Construction has been cyclically hampered due to the lack of such materials as plywood, masonite, convienence outlets, and weatherheads.

(2) The Bear Cat - Long Thanh North power distribution system has been designed and is now in the initial construction stages. By the time the distribution system is completed, all existing electrical deficiencies (material shortage) should be corrected thus allowing all facilities to be connected to the system.

(3) With the help of engineer technical supervision, units have completed the following facilities in the Bear Cat and Long Thanh North areas:

Bear Cat:

DESCRIPTION	FAC CODE	AUTH SF	SF CONSTRUCTED THIS PERIOD	SF CONSTRUCTED TO DATE
Mtr Rep	214.10	102,822	9,470	21,590
EM Housing	722.10	1,077,720	102,118	454,388
BOQ	724.10	135,850	42,036	76,416
Hq/Unit Sply	610.16	111,360	34,536	68,608
Chapel	740.18	3,200		2,280
Chap/Theater	740.77	33,262	2,280	2,280
Bn Hq	610.14	24,480		27,840
Bg Hq	610.17	5,760		2,700
EM Club	740.68	31,376		13,170
NCO Club	740.47	17,864		4,750

Long Thanh North

EM Housing	722.10	59,780	11,520	44,160
BOQ	724.10	21,600	14,160	18,480

(4) The Base Development Office has turned over to the sub area real estate branch 480 buildings, has in the process of turn over 161, and has 138 additional under construction (Bear Cat and Long Thanh North).

e. The 67th Engineer Company (DT) was detached from the 93d Engineer Battalion (Const) on 26 November 1967 and attached to the 36th Engineer Battalion (Const). During the less than one month with the battalion, the company continued to operate the Ba Ria blast rock quarry and to haul blast rock to raise the grade fo the Co May Causeway (Coordinates YS 3754) and to widen QL 15 south of Ba Ria.

f. Tree Crusher Detachment:

(1) The United States Army Engineer Detachment (Tree Crusher)(Provisional) was attached to the 93d Engineer Battalion (Const) for evaluation on 1 November 1967 with operational control assigned to the 9th Infantry Division. Immediate action was taken to bring the detachment up to strength and to submit a proposed Table of Distribution and Allowance for the detachment. Since that time, the battalion has had the mission of performing engineer evaluations of the tree crushers in different types of terrain and under various conditions. A copy of the evaluation and a supplementary report are enclosed (See Annex A). The tree crushers have cleared a total of 1,290 acres of wooded area since being attached to the 93d Engineer Battalion (Const). Overall, the tree crushers have proven to be very effective in clearing areas in the 9th Infantry Division AO that had been enemy strongholds for many years.

(2) On 28 January 1968, authority to request weapons for the detachment was received. No other equipment has been authorized.

g. Training:

(1) OJT/MOS training has, as in the past, been continuous and daily.

(2) Religious training in the form of services and character guidance continued on a regular basis for those personnel in the base camp and, as far as possible, for troops on outlying operations.

(3) A class on SPOTREPS and casualty reporting was given to selected headquarters personnel.

(4) A daily program was initiated with help of the 9th Infantry Division's Old Reliable Academy whereby five personnel from the battalion received training on the M-16 rifle. The scope of the class included zeroing the weapon, care and cleaning of the rifle, nomenclature, and a quick reaction course.

(5) The battalion continued emphasis on a daily job site safety talks on safety problems peculiar to that job on that particular day and safety discussions with drivers during the scheduled preoperation maintenance period.

(6) All incoming personnel now receive a one day orientation on such selected subjects as mines and booby traps, Viet Cong tactics and techniques, security, and sentry duty, POW and detainee handling, convoy procedures, and immediate action drills.

(7) A formal program for training NCOs is now part of the battalion training schedule. Any NCO or prospective NCO desiring to obtain the training is sent to a one week course conducted by the 9th Infantry Division's Old Reliable Academy. The NCO course covers such subjects as leadership, mines and booby traps, tactics, and patrolling. The final phase of training is a 24 hour reconnaissance patrol in the vicinity of Bear Cat. Eight personnel have volunteered and participated as time permitted.

(8) The current battalion training includes a mandatory training program covering the Geneva Convention, military justice (Off and WO), psychological warfare, safety, Code of Conduct, civil affairs, SAEDA, safeguarding defense information, counterinsurgency, and counterguerilla training, survival, escape and evasion, armed forces censorship, CBR training and gas chamber exercise, clandestine surveillance and listening devices, field sanitation, material readiness, supply economy, Vietnam relations, sentry duty, preventing heat injuries, and map reading, adjustment of artillary fire (Officers and NCOs) and M-16 training. Commanders time is available each week for the conduct of training. Only the gas chamber exercise and M-16 training is controlled at battalion level. Command information is given weekly.

h. The Long Thanh North airfield is probably one of the outstanding examples of quality earthwork in Vietnam. Constant moisture sampling, grade control, and regulation of lift thickness assured proper compaction of the laterite sub-base material. Both California Bearing Ratio and Modified AASHO testing were conducted constantly during the compaction of the sub-base. During the compaction of base course, quality was insured by constant control of grade, moisture, modified AASHO density, smoothness, and porosity. One survey and one soil team was employed full time on the control of the airfield earthwork.

5. LOGISTICS:

a. S-4 Operations: During the period, the volume of construction materials handled continued to increase. On peak days, over 250,000 board feet of lumber were issued to self-help and battalion projects.

The availability of some items remained critical; however, as the battalion completed its first half year in country, the results of prior planning began to be felt. Items ordered soon after arrival, which were not available at that time, have begun to arrive. Stockage levels of many items are such that projects can proceed smoothly despite the cyclic availability of re-stockage materials. Project programming has not allowed for material procurement lead time.

b. LOC Program: During the month of November, the battalion received the mission to design and construct five bridges over the next six months. Stockage levels of bridge materials such as steel stringers and large timbers available in depot were not sufficient to meet the needs of the LOC upgrade programs. Many problems were encountered because of insufficient quantities of materials. Stringers for the Cau Dong Mon bridge had to be shipped from Vung Tau. Availability of other materials has barely kept ahead of scheduled construction.

c. CM-SH: The effectiveness of the CM-SH (Construction Material - Special Handling) method of obtaining critically short materials began to be felt during the period. Experience to date indicates that the system is not effective for ordering common items. In most cases, the common items become available in the supply system before the CM-SH shipment arrives. The system, however, is an extremely effective means of getting construction materials which are not stocked in the Army Supply System. Items such as refined electrical equipment would have to be individually procurred if the CM-SH system was not in effect.

d. Transportation Support: The increase in the quantity of construction materials used by the battalion has made it necessary to rely on transportation from outside sources. Support by the 573d Float Bridge Company has been excellent. Without outside support, the battalion would not have been able to meet its commitments.

e. Vietnamese Laborers: The S-4 section employs 14 local nationals. Eleven (11) are used as common labor, nine (9), assisting in the handling of materials in the class IV yard and five (5), in the warehouse. Three (3), personnel have received on-the-job training, one as a sign painter and two as clerk-typists. Utilization of local nationals has greatly increased the capability of the S-4 section.

6. FORCE DEVELOPMENT: A proposed Table of Distribution and Allowances for the United States Army Engineer Detachment (Tree Crusher)(Provisional) was submitted during the period and was enclosed as part of the tactical crusher evaluation (See Annex A).

7. COMMAND MANAGEMENT:

a. The battalion's command management inspections continued to provide not only a means of analyzing and comparing the areas of mess, supply operations, maintenance operations, construction management, and administration, savings program, safety program, and reenlistment but provided an incentive for company competition for Best Company of the Month as well.

b. Roadside technical inspections of vehicles provided an accurate indicator of the battalion's maintenance program and pointed out those maintenance areas requiring command attention and correction.

c. Competition for Engineer Soldier, Mechanic, Operator, Soldier, and Specialist Five of the month provided an incentive for MOS proficiency and knowledge of general military subjects.

d. In addition to the scheduled monthly inspections, the Battalion Commander and staff choose selected areas for spot checks to insure the efficient functioning of the organization.

8. INSPECTOR GENERAL:

a. The AGI of the 93d Engineer Battalion (Const) is scheduled for 16 April 1968.

b. A courtesy inspection was conducted by 34th Engineer Group (Const) from 22 to 26 January 1968. The team felt that the battalion was well prepared for the forthcoming AGI.

9. INFORMATION: During the reporting period, a total of sixty-two (62) public information stories were written and a total of four hundred eighty-seven (487) Home Town News Releases, most of them with pictures, were turned into higher headquarters. About twenty (20) taped personnel interviews were made for home town radio release. One area of the battalion activities that received particular attention was the operation of the tactical tree crushers. Many articles have appeared in local military newspapers. Representatives from Life Magazine and all three major TV/radio networks gathered material for stories on the tree crushers.

10. CIVIC ACTION:

a. Civic action projects during the period included an addition to the dispensary in Long Thanh, a concrete pad for the Thai Loc classroom, and approximately 8,000 board feet of scrap lumber gathered for the Long Thanh area. Over 1,700 pounds of clothing, soap, and candy were delivered to needy families in Long Thanh. Also, sewing sets have been delivered to two schools in Long Thanh.

b. Medical civic action in the form of weekly MEDCAP visits to outlying villages has provided treatment for over 1,000 citizens. The battalion dispensary continues to provide treatment to 4 or 5 civilions each day. The batt lion surgeon has initiated a bi-weekly sick call in the addition to the dispensary in Long Thanh.

11. MAINTENANCE:

a. The battalion continues to enjoy a low deadline rate. The 1½ hours of supervised daily maintenance, monthly inspections, roadside spot checks and above all, dedicated maintenance personnel make this possible.

b. An inordinate amount of maintenance personnel time is spent on parts procurement. Continued liaison with supporting maintenance units has gleaned the maximum support available. The major source of parts is the cannibalization point and friends. Continued command emphasis is placed on proper utilization of the parts request system before obtaining parts from other sources.

SECTION 2. PART I: OBSERVATIONS (LESSONS LEARNED)

1. PERSONNEL: None

2. OPERATIONS:

a. Item: Laterite boulders.

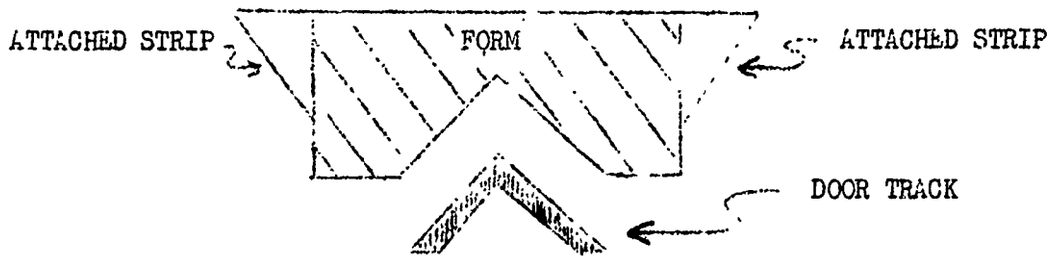
Discussion: One obstacle in the efficient operation of a laterite pit was the presence of laterite boulders. They were so hard that the cutting edge of a scraper tended to slide over them. Ripping them with a ripper dozer proved to be unsatisfactory because the boulders would just roll out of the ground.

Observation: The back ripper teeth on a dozer blade were lowered and used to rip the boulders. The blade tended to hold the boulder in the ground causing it to crumble instead of rolling out of the ground.

b. Item: Finishing and placing concrete around door tracks.

Discussion: When placing door tracks for large hangar doors or any large sliding doors, there is always the problem of edging the concrete around each track. Since both sides of each track have to be edged, many manhours are required to accomplish the task.

Observation: The solution to the problem is to attach small triangular shaped strips of lumber directly to the form that is placed over the track. The strips can be cut on a Dewalt saw and put in place with small finishing nails.



c. Item: Impact considerations in revetment design.

Discussion: Often in the design of revetments, one important strength factor is not given enough consideration. The factor is impact. The revetments are designed to withstand the soil pressure, but are not designed to withstand the impact of the initial filling.

Observation: The solution to the impact problem while filling revetments is first to slightly over-design the revetment and secondly, provide simple, temporary braces during filling operations. Additionally, the filling should be well supervised and controlled to minimize large quantities of fill from being dumped in at one time.

d. Item: Methods to aid hauling large volumes of concrete long distances.

Discussion: It has been found that hauling concrete approximately 8 kilometers from a batch plant in 5 ton dump trucks created problems of segregation and concrete sticking to the inside of the truck beds.

Observation: To avoid segregation of concrete over long haul distances, instruct drivers to drive slowly over bumps and to shut off their engine at forced stops. The concrete can be kept from sticking to the sides of the truck by lining the truck bed with T-17 membrane or scrap canvas. Lining the dump bed also overcomes the effect of segregation by allowing the entire load to be dumped at one time.

e. Item: Utilizing 290M scrapers to place base course material.

Discussion: When the job of placing base course first began, the base course material was hauled by five ton dump trucks, dumped, and then graded. A problem resulted when the fines in the base course material began to separate from the larger material. Segregation became an even bigger problem when the material was graded.

Observation: The problem was solved by placing the base course material with a 290M scraper. A uniform layer was placed thus requiring a minimum amount of grading. The fines did not separate because the material did not require as much handling. Decreasing the segregation of the fine material made it easier to obtain the required densities and CBR values.

f. Item: Soils sample.

Discussion: Wide fluctuations in AASHO Modified density in a section of fill which was compacted at the same moisture content with the same compactive effort presented problems to the soils analysts.

Observation: One possible answer is that even from one material source or pit considerable variation in material is to be expected. It is mandatory that representative samples of all materials used are tested for maximum dry unit weight and optimum moisture. A portion of each sample should be placed in a glass jar and OMC and maximum dry unit weight indicated for field comparison with the in situ material so that proper compaction control can be maintained.

g. Item: Plumbing a 40' x 96' Pascoe building.

Discussion: Two 40' x 96' Pascoe buildings were erected side by side for use as a warehouse. If handled properly, the Pascoe type warehouse is easily constructed. The most important phase in the construction is making sure the building is plumb. Otherwise, the parts will not fit properly causing trouble throughout the construction.

Observation: By installing the sway braces and plumbing two end beams on each end of the building, it was possible to plumb the rest of the building by putting on the purlins. Once the purlins were in place, the rest of the building was plumb.

h. Item: Construction of towers.

Discussion: A 45' high control tower was completely assembled on its side on the ground rather than employing normal vertical construction. The entire structure was then hoisted into its position on concrete footers.

Observation: The main advantages to constructing a 45' tower on its side on the ground and then raising it into place were the number of manhours saved, the ease of construction, and the absence of hazardous climbing and overhead work. This method of construction halved the effort expended on a similar tower erected in the conventional manner.

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SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 31 January 1968

i. Item: Storing of steel.

Discussion: Steel members placed in open storage for long periods of time have a tendency to warp if not stored properly. The warped members cause many problems when they are put into place.

Observation: When storing large steel members in the open, special consideration should be given to the location, surface, and length of the storage area. The storage area should be as level as possible. Differently shaped steel members should not be stacked together, otherwise the steel will warp.

j. Item: An improved method for the development of a laterite pit.

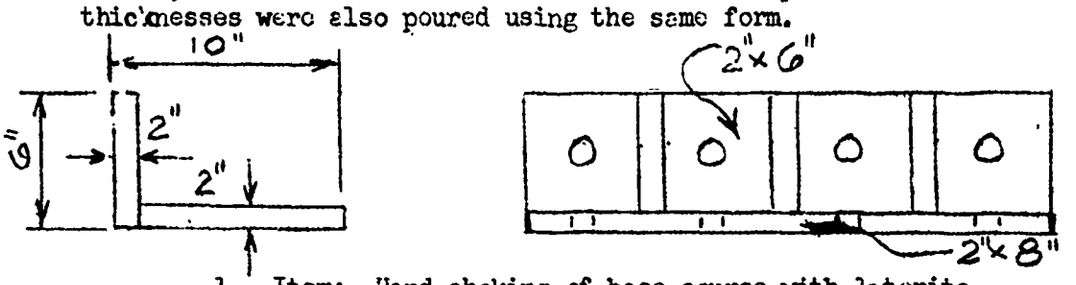
Discussion: Due to the irregularities of laterite deposits, the use of the earth auger to drill random test holes and mass overburden stripping on the basis of the test holes often results in an inefficient development of a laterite pit.

Observation: With an intelligent evaluation of small, stripped sections and a grid of test holes, an efficient laterite pit can be opened without wasting man and equipment hours stripping non-profitable areas. The proper steps in the development of a laterite pit are as follows: First, drill test holes in the laterite from the grid pattern and strip a small area down to the laterite. After a small area is stripped, drill another test hole to determine the depth of the laterite layer. Thirdly, when an area of good thick laterite is encountered, expand the area by small strips following the pattern indicated by the test grid. When the laterite layer extends below the overburden far enough so it is not profitable to continue stripping, begin a search for laterite closer to the surface. When laterite is found close to the surface, start the stripping procedure again (small areas at a time).

k. Item: Forms for concrete pads.

Discussion: Using metal forms to pour concrete pads sometimes proved to be unsatisfactory because of the weight of the forms and because the standard depth of the forms was not sufficient. The problem was solved by using forms built from 2" x 6"s and 2" x 8"s braced with a triangular block. Holes were drilled through the bottom plate and large bolts or drift pins were driven through the holes to hold the form in place. The holes in the side of the form that was not placed against the ground were used as receptacles for reinforcing bars used in construction joints. Different thicknesses were also obtained depending on which side of the form was placed against the ground.

Observation: Concrete forms made from two different sizes of lumber have proven to be more satisfactory than metal forms. The wooden forms were completely reusable, weighed much less than metal forms, and were much easier to level and line up. Pads of different thicknesses were also poured using the same form.



l. Item: Hand choking of base course with laterite.

Discussion: Specifications for base course material require that the material size be 1½" minus. The actual 1½" minus material contained many long pieces that were bigger than 1½" thus making it difficult to grade the material. During final grading, many small areas that did not have any fines were created. The areas where the fines separated from the larger material were hand choked with laterite and then compacted. Care had to be exercised so that too much laterite was not used. Any excess laterite dried out and became unsuitable to receive paving and also changed the grade of the base course.

Observation: In laying base course material, small areas where segregation occurs can be fixed by hand choking with laterite or some other suitable material. Hand choking requires much less time than trying to re-do an entire area in order to eliminate small areas where fines have segregated. This method should not be used during the monsoon season due to laterite's propensity to "bulk" when saturated.

m. Item: Curing period for a RC 800 and diesel mixture.

Discussion: In preparing an area covered with base course for asphalt, a mixture of RC 800 and diesel of varying proportions was used as a prime coat. Once the prime coat was laid, it had to cure for at least 24 hours. If asphalt was placed before the prime coat cured, the diesel in the RC 800 and diesel mixture penetrated the asphalt and broke it down. In cases where RC 800 was used without diesel, the curing period was increased to 72 hours.

Observation: Allow sufficient curing time for the prime coat in asphalt operations to cure so that the prime coat won't bleed through the asphalt causing it to be broken down.

n. Item: Placing pipes in concrete.

Discussion: A recent requirement called for eight foot vertical lengths of 2" cast iron pipe to be placed in a concrete pad. A major problem developed when it came time to put the pipes in, plumb them, and keep them plumb while the pad was being poured.

Observation: The problem of setting eight foot lengths of pipe in a concrete pad and keeping them plumb while pouring the pad was solved by placing a 4" nipple connected to a 2" coupling in the pad. The eight foot sections were then screwed into the couplings. Grease was placed inside the coupling to prevent concrete from getting into the threads.

o. Item: Preparation of an existing pavement for new pavement.

Discussion: When preparing an existing pavement for a new extension, the old pavement had to be first cut off and then cleaned up. An air compressor was originally used to cut off the existing pavement. However, then an air compressor was not available, it became necessary to develop a new method for trimming the existing pavement.

Observation: An expedient method for trimming off the end of an existing pavement was to first remove all but one of the teeth from a grader and then use the remaining tooth to trim off the pavement. The job was completed by using the edge of the drum of a 10 ton roller to trim away any loose ends.

p. Item: Utilization of a string line for determination of final grade on base course.

Discussion: The tolerance on the final grade of a compacted base material was plus or minus .015 feet. Excessive survey stakes complicated working the already difficult-to-work base material. It was, therefore, necessary to establish a procedure whereby the tolerance could be met.

Observation: Survey stakes were placed at 50' intervals and a mark 4" above grade was placed on each stake. The final grade was checked by stretching a string between survey stakes and measuring the distance from the mark on the stake to the base course. When the distance between the mark on the stake and base course equalled 4", the base course was at the proper grade.

q. Item: Base course test strips.

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Discussion: Prior to beginning the actual placement of base course material on an airfield complex, three 40' x 100' test strips were placed. The purpose of the test strips was to determine such items as the optimum moisture content of the base course material, proper placing methods, and the best compaction methods. The required density was determined to be the critical factor in getting the finished base course material to meet specifications. Once the correct density was obtained, it was easy to get the required CBR value.

Observation: By utilizing test strips to determine the best compactive methods for base course material and the optimum moisture content of the base course, many manhours and equipment hours were saved during the placing of the base course on the airfield. Laboratory results were confirmed or adjusted as required. The trial and error method for determining proper placement techniques did not have to be used where the base course material had to meet specifications. Instead, the trial and error method was used on the test strips. This also was an excellent training vehicle for grader and roller operators.

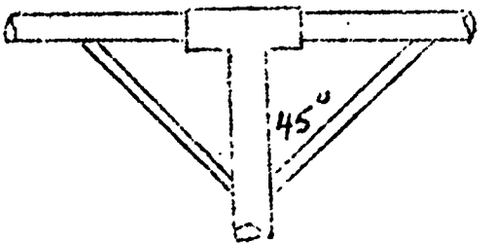
r. Item: Concrete slab at water points.

Discussion: Despite constant reminders, customers and operators at fill stands would not properly close the shut-off valves. This excess water plus the traffic heavily rutted the roadway and, as water accumulated, sub-base failure occured underneath each fill stand.

Observation: A 20' x 30' x 4" concrete pad sloped to drain was placed underneath the fill stands at water points. The concrete pad kept the area from becoming muddy and eventually impassable due to excess water from the fill tank.

s. Item: Bracing on fill stands.

Discussion: The horizontal pipe on fill stands has been found to receive an undue amount of abuse by personnel using the fill stand. In several instances, the problem was solved by welding a pipe as a 45° brace between the vertical pipe and the horizontal pipe.



3. TRAINING AND ORGANIZATION:

a. Item: Refresher course on M-16 rifle.

Discussion: Although most replacements receive some training on the M-16 rifle, it has been noted that a refresher course is both helpful and in some cases very necessary. The refresher course covers such things as zeroing and care and cleaning of the M-16.

Observation: Refresher courses on the M-16 rifle have proven to be worthwhile for replacements. The courses have also been beneficial to troops who deployed with the unit, but did not have extensive M-16 training.

b. Item: Equipment for Tactical Crusher Detachment.

Discussion: After preliminary work with a rough terrain and normal 20 ton truck-mounted crane, it was felt that a 40 ton crane would be required for the dismantling and reassembly of the tactical crushers. However, it was obvious that a 40 ton crane could not readily be moved into the areas where the crushers would be employed.

Observation: A M-88 tank retriever proved the ideal combination of lifting capability and mobility for efficient employment to dismantle, resssemble, and repair the tactical crushers.

4. INTELLIGENCE:

a. Item: Presence of Viet Cong.

Discussion: It has been noted that there is a definate correlation between the number of women and children observed in a village and the presence of VC guerillas in the village or surrounding area. Generally speaking, the presence of many women and children indicates that VC troops are not deployed in the area.

Observation: Whenever on a trip anywhere in Vietnam, be especially cautious of villages that appear to be deserted. A deserted village is a good indication that VC troops are nearby.

b. Item: Getting the word.

Discussion: In a coordinated defense with several units providing defensive efforts, there were continual problems in assuring that all items of friendly and enemy intelligence get to all elements of the defense. This problem is particularly acute where all elements are not combat units and have underdeveloped S-2 sections.

Observation: No complete solution is possible. However, problems can be minimized by the overall responsible commander insuring that all information is disseminated through a daily briefing and by constant contact amoung elements between meetings. Particularly important is a constant update on the location of friendly patrols.

5. LOGISTICS: None

6. MAINTENANCE:

a. Item: Bumper assembly on UD 69 entrenching machine.

Discussion: The bumper assembly on the UD 69 entrenching machine has been torn away from the main frame when trying to extract the machine from inundated or soft soil. Damage to the machine is a direct result of trying to extract it by attaching a tow hook to the hook on top of the bumper.

Observation: The UD 69 entrenching machine should be extracted from soft soil by attaching a tow hook and cable to the tie down brackets on the frame behind the bumper. Never attach the tow hook to the top of the bumper.

b. Item: Push beams on D7E tractor.

Discussion: During quarry operations, it was noted that push beams on D7E tractors were being excessively worn. The cause of the damage was the continuous scraping action of the push beams against the blast rock while clearing quarry shelves.

Observation: The wearing of the push beams was greatly reduced by welding salvage cutting edges from a motor grader to the sides and bottom of the push beam.

c. Item: Lunette assembly on towed bituminous distributor (Littleford Mfg.).

Discussion: When the Littleford towed bituminous distributor was received, it was equipped with a 1/4 to 3/4 ton lunette assembly. Due to the weight of the loaded distributor, it was necessary to pull it with a 2½ ton truck. It was, therefore, necessary to modify the lunette assembly so that it would fit a 2½ ton truck.

Observation: A heavy duty lunette assembly (2½ to 5 ton capability) should be used in place of the stock lunette. The lunette should also be positioned approximately 4 inches higher than the stock lunette to allow for the difference to the pintle of the towing vehicle.

d. Item: Thrust bearing on 5 ton dump truck.

Discussion: Experience has shown that the thrust bearing on 5 ton dump trucks has not been receiving the proper lubrication at depot or when it is disassembled. Insufficient lubrication has caused damage to the thrust bearing and eventually loss of the clutch.

Observation: A yearly check of the thrust bearing is needed to preclude damage to the bearing because of insufficient lubrication.

e. Item: 5 ton flat tires.

Discussion: Using twelve 5 ton dump trucks, the average number of flat tires per day was five. Changing a flat tire required on the average of 2 hours. The down time for the trucks during tire changing was decreased by setting up a tire changing station. A 2 to 3 man detail did nothing but change tires. The only time lost when a truck had a flat tire was the time required to take one tire off and put another on.

f. Item: Tilt hydraulic ram on D7E tractor blade.

Discussion: The hydraulic lines on the tilt hydraulic cylinder are easily damaged when operating in a quarry or under heavy brush in jungle conditions.

Observation: Rotate the hydraulic ram 180° from the normal position to minimize damage caused by heavy brush and rock quarry operations.

g. Item: Winch cross bar on D7E tractor.

Discussion: Attempting to tow a heavy object or vehicle by fastening a cable or chain to the winch cross bar bends thecross bar and in some cases may damage the winch frame itself.

Observation: Do not attempt to tow vehicles or heavy objects with the winch cross bar on the D7E tractor. Towing should be done with the towing pintle since the cross bar was designed as a stabilization bar and does not have significant strength to withstand heavy loads.

h. Item: Removal of winterization kit batteries from D7E tractors in tropical climate.

Discussion: Two 12 volt batteries are part of the D7E winterization kit used to boost starting capability in cold climates. The auxiliary power source is not required in tropical climates.

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SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 31 January 1968

Observation: By removing the two auxiliary batteries from the battery box prior to shipment of the D7Es to a tropical climate, the cost of the two unnecessary batteries can be saved (approximately $174.00 savings). The empty battery box can then be utilized as a tool box or accessory container.

i. Item: Engine mounting bolts, 5 ton dump truck.

Discussion: The left, front and rear engine mounting bolts on 5 ton dump trucks have been found to be loose and in most cases, excessively worn. Loose mounting bolts cause cracked bell housings and/or bolt shear within the engine block. The main causes of the loose mounting bolts are the vibrations of the engine and from operating on rough roads.

Observation: The engine mounting bolts are not easily seen or reached and often are not checked for looseness by drivers. A pointed check of these bolts should be made on a weekly basis to prevent damage to the vehicle engine.

j. Item: Clark 290M tractor hood.

Discussion: The hood mounting bolts on the 290M tractor continuously work loose causing damage to the hood. The cause of the problem is the intense vibration created through normal operation of the engine.

Observation: Damage to 290M tractor hoods caused by the hood mounting bolts becoming loose can be reduced by welding a 1½" x 4" x 1/8" metal strap to the hood and then bolting it to the radiator guard.

SECTION 2. PART II: RECOMMENDATIONS: None

James Dorman
JAMES DORMAN
LTC, CE
Commanding

2 Incl
1. Transphibian Tactical Crusher Evaluation
2. Supplemental Rpt #1 to Transphib. Evaluation

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4-CG, 20th Engr Bde, ATTN: AVBI-OPN, APO 96491
5-CO, 34th Engr Gp (Const), APO 96291 (Courier)

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EGF-OP (14 Feb 68) 1st Ind MAJ Dorris/mrd/VT 2987
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 31 January 1968

HQ, 34th Engineer Group (Const), APO 96291 21 Feb 68

TO: Commanding General, 20th Engr Bde, ATTN: AVBI-OPN, APO 96491

This headquarters concurs with the 93d Engineer Battalion's ORLL subject to the following comment: Section I, paragraph 5c: Generally the CM-SH procedure for obtaining materials has proven adequate. Frequently this HQ has not received a copy of 14th ICC MILSTRIP numbers of CM-SH items; therefore, identification of the particular item, when it arrives in-country, with the right project, has, in some instances been difficult.

FOR THE COMMANDER:

W C TOMSEN
Major, CE
Adjutant

Copies furnished:
2-ACSFOR DA
1-CO, 93d Engr Bn

AVBI-OS (14 Feb 68) 2nd Ind
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 31 January 1968

DA, Headquarters, 20th Engineer Brigade, APO 96491 2 March 1968

TO: Commanding General, USAECV(P), ATTN: AVCC-P&O, APO 96491

1. Forwarded for your information and action IAW USAECV(P) Reg 1-19, dated 15 April 1967.

2. This headquarters concurs with the ORLL submitted by the 93rd Engineer Battalion and the comment in the first indorsement.

FOR THE COMMANDER:

CECIL D. CLARK
Major, CE
Adjutant

AVCC-F&O (27 Feb 68) 3d Ind
SUBJECT: Operational Report-Lessons Learned for Quarterly Period Ending 31 January 1968

HEADQUARTERS, UNITED STATES ARMY ENGINEER COMMAND VIETNAM (PROV), APO 96491

15 MAR 1968

TO: Commanding General, United States Army Vietnam, ATTN: AVHGC-DST, APO 96375

The attached ORLL, submitted by the 93rd Engr Bn (Const), has been reviewed by this headquarters and is considered adequate except as follows:

Item concerning removal of winterization kit, Section 2, Part I, para 6h, page 23. Nonconcur. The batteries provide the extra amperage for starting. The five part TM for the D7E tractor does not list these batteries as part of the winterization kit.

FOR THE COMMANDER:

John V Matonis 1LT, AGC
for RICHARD B. BIRD
Captain, AGC
Assistant Adjutant General

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AVHGC-DST (27 Feb 68) 4th Ind
SUBJECT: Operational Report - Lessons Learned for Quarterly Period Ending 31 January 1968

HEADQUARTERS, US ARMY VIETNAM, APO San Francisco 96375 19 MAR 1968

TO: Commander in Chief, United States Army, Pacific, ATTN: GPOP-DT, APO 96558

1. This headquarters has reviewed the Operational Report-Lessons Learned for the quarterly period ending 31 January 1968 from Headquarters, 93d Engineer Battalion (Const) (WD3WAA) as indorsed.

2. Concur with report as indorsed. Report is considered adequate.

3. A copy of this indorsement will be furnished to the reporting unit through channels.

FOR THE COMMANDER:

CHARLES A. BYRD
Major, AGC
Assistant Adjutant General

Copy furnished:
HQ, USAECV (P)
HQ, 93d Engr Bn

GPOP-DT (27 Feb 68) 5th Ind
SUBJECT: Operational Report of HQ, 93d Engr Bn (Const) for period Ending 31 January 1968 (RCS CSFOR-65)

HQ, US Army, Pacific, APO San Francisco 96558 29 MAR 1968

TO: Assistant Chief of Staff for Force Development, Department of the Army, Washington, D. C. 20310

This headquarters has evaluated subject report and forwarding indorsements and concurs in the report as indorsed.

FOR THE COMMANDER IN CHIEF:

K. F. OSBOURN
MAJ, AGC
Asst AG

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DEPARTMENT OF THE ARMY
HEADQUARTERS, 93D ENGINEER BATTALION (CONST)
APO San Francisco 96370

TRANSPHIBIAN TACTICAL CRUSHER EVALUATION

Incl 1

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I N D E X

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I. INTRODUCTION

The Le Tourneau transphibian tactical crushers arrived in Viet Nam on 27 July 1967 and were initially assigned to the 1st Logistical Command for test and evaluation. The transphibian crusher is a highly mobile vehicle approximately 60 feet long, 25 feet tall, 32 feet wide and weighing 97½ tons. The mission of the machine is to traverse and clear difficult terrain. Photograph number 1 shows the tree crusher with the amphibian drums and photograph number 2 shows the land drum configuration.

On 9 November 1967, the Tree Crushing Detachment was attached to the 93rd Engineer Battalion (Const) for tactical employment and further evaluation. Operational control during this period was given to the 9th Infantry Division, while the responsibility for the technical and engineering evaluation rested with the 93rd Engineer Battalion (Const).

The remaining sections and annexes of this report are the engineer evaluation of the entire scope of tree crusher operations in Viet Nam and consolidates the observations and opinions of the commanders and staff officers involved in the employment of the transphibian tactical crusher in a tactical situation.

Photograph #1 - (perimeter of Bearcat) Transphibian tactical tree crushers with water and wat land drums.

Photograph #2 - (Long Thanh North) Transphibian tactical tree crusher with land drums.

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II. PARAMETERS OF EVALUATION.

A. Scope of Operation

1. Personnel and Equipment: The personnel and equipment of the Tree Crusher Detachment were initially established under 1st Logistical Command and subsequently transferred to 20th Engineer Brigade. Upon their assignment to the 93d Engineer Battalion (Const), the detachment was augmented by eight personnel to bring its present strength to 23 EM and one officer (plus three civilian technical representatives). This augmentation was made to insure that sufficient operation, maintenance and administrative personnel were present to enable the detachment to conduct sustained operations. The proposed TDA is included in this report under Annex A. The Tree Crusher Detachment was attached to Company A, the Engineer Equipment and Maintenance Company for the battalion, to insure that it was adequately supported. One officer of the Battalion S-3 section provided staff supervision of the detachment to handle logistical, security, and operational problems and the reporting system involved in the detachment operation and evaluation.

2. Test Areas: Test areas were chosen to afford the maximum number of environments for the employment of the tactical tree crushers while providing support to the 9th Infantry Division who excercised operational control of the machines. A trace of the work areas is found on the following page. Under the 1st Logistical Command, the TCD cleared 2,083 acres in the vicinity of Long Binh. While under the 93d Engineer Battalion (Const), the crushers operated in the following areas: Long Thanh North (550 acres cleared), An Loi Woods (450 acres cleared), and the Nhon Trach (215 acres cleared).

3. Equipment Hours: Total operational equipment hours for both machines during the period 31 July 1967 to 15 December 1967 were 1565.3.

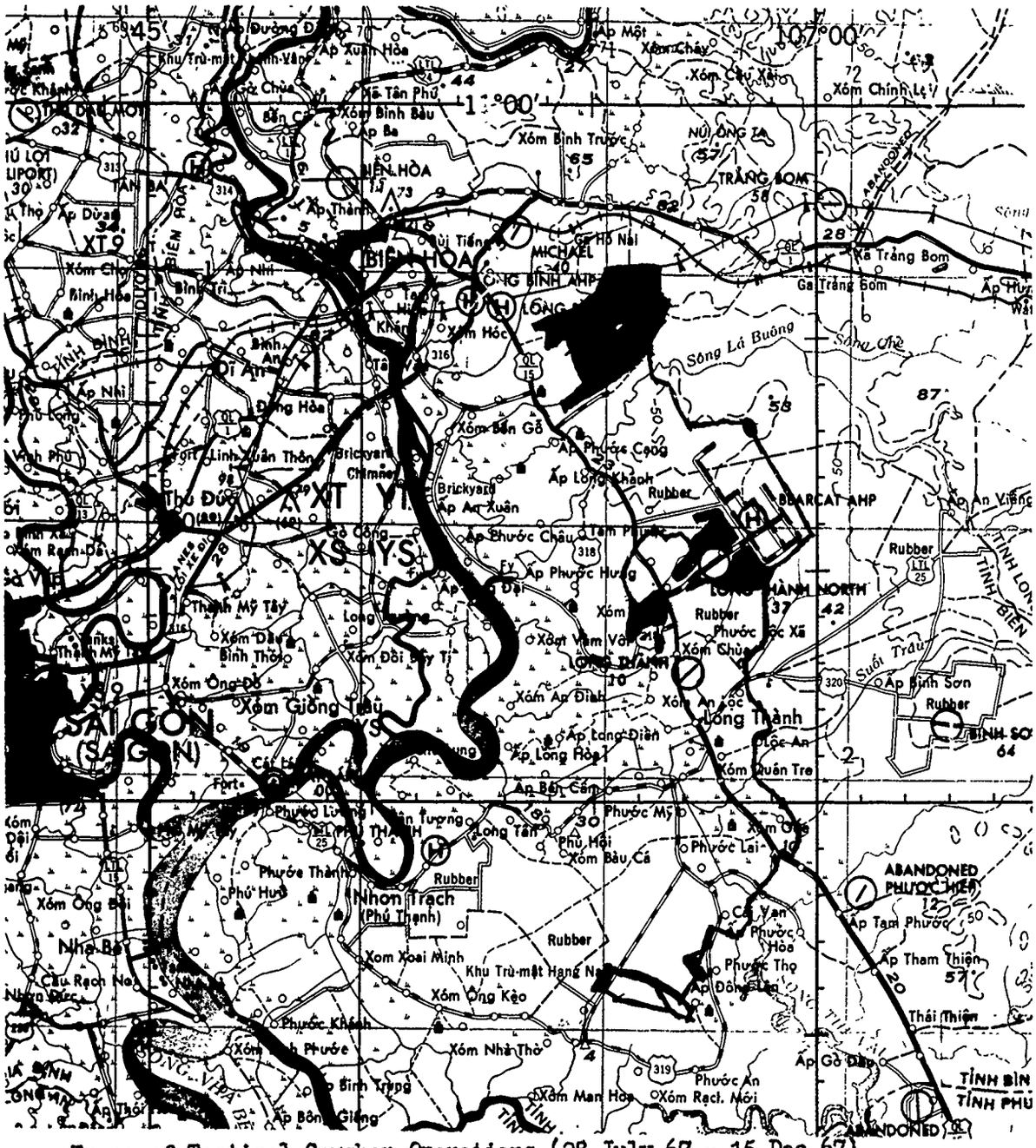
4. Maintenance Hours: Total maintenance hours of scheduled maintenance, unscheduled maintenance, and field modifications amounted to 4485. A detailed breakdown is contained in Annex C.

5. Instructional Hours: Total instructional hours amounted to 5816, with 622 of these devoted to classroom instruction, giving each man approximately 31 hours.

B. Evaluation of Performance

1. Foliage Types vs Rates of Clearing:

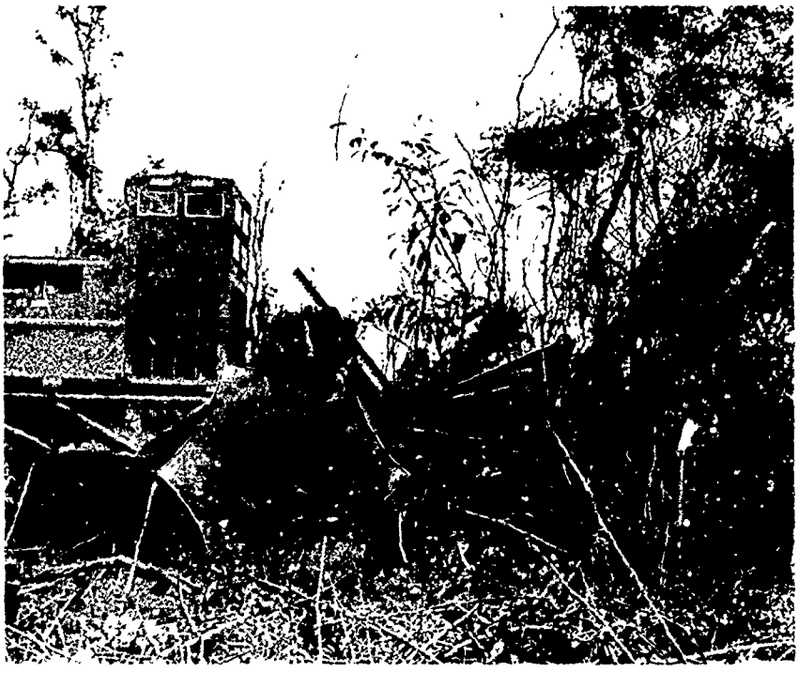
a. Heavy: Extremely heavy or dense foliage was not encoutered during the evaluation. Trees up to three feet in diameter which ranged up to 50 feet in height were sparsely distributed in the operational area, but presented little obstacle to the tree crusher. The boom is used to push against the tree truck approximately twenty feet off the ground while one drum walks up the trunk and forces the tree down to the ground. The use of the bumper is shown in photograph number 3. Trees of larger diameter probably require a larger bumper apparatus. Many such large trees closely spaced together would pose a serious obstacle to the machines and force them to attack one tree at a time materially reducing the crushing rate.



Trace of Tactical Crusher Operations (28 July 67 - 15 Dec 67)

Ref: Map. Joint Operations Graphic (Air) NC 48-7 Scale 1:250,000

1.	Long Binh	-	2083 acres
2.	Long Thanh North	-	550 acres
3.	An Loi Woods	-	450 acres
4.	Nhon Trach	-	215 acres
		Total:	3298 acres



Photograph #3 - (Bear Cat perimeter) Bumper assembly used to push over small trees.

b. Medium: Medium foliage is overcome by the tree crushers with excellent results. No hesitation is perceptible in the motion of the machines through tall brush, thickets, and trees up to 12 inches in diameter. Both the dry land drums and the amphibian drums work well in this foliage although the land drums chop the material into shorter lengths. The clearing rate for dry land drums was approximately four acres per machine-hour while the amphibian drums produced approximately three acres per machine-hour. Trees 6 to 8 inches in diameter are crushed and broken into lengths of approximately six feet by the transphibian drums. Less complete cutting action is achieved by the land drums unless the ground is very hard. Trees over eight inches are either left on top of the ground or are pushed into the ground by the weight of the machine, depending upon the soil conditions. Photograph 4 shows the machines moving through medium terrain.

c. Light: Light foliage was cleared at essentially the same rate as medium foliage. Crushing in light foliage creates a mat of grass and brush underneath the machine as shown in photograph 5. Though insufficient observation time was available to permit an absolute judgement, decomposition of this material may in fact accelerate further growth. Fair results were obtained by burning light foliage after it was crushed but before decomposition had set in (See photograph 6 and 7). The grass and brush mat was effectively destroyed, but branches thicker than two inches were untouched. The actual deterrent value of the burning in terms of future growth could not be evaluated within the time frame of the test period.

2. Surface Conditions vs Rate of Clearing.

a. Tidal swamp regions: Evaluation of tidal swamp performance was obtained in the tidal silt deposits of the Nhon Trach. The soil is a highly saturated silt. During high tide much of the area is awash. The crusher cannot operate effectively in those areas, even with amphibian drums. Water must be forced from the saturated soil up under the machine to float it forward until it mires down again. Then the process must be repeated. The clearing results are negligible as there is no real surface against which the drums can work to destroy the foliage. With a determined effort, a machine could clear only 2 to 3 acres per day. Very high fuel consumption rates were encountered, approximately twice the rate experienced on other terrain. In open water the machine can move by paddling with its drums; although it is not readily maneuverable due to the offset steering mechanism. Pictures 8-11 show the machines in this swamp area.

b. Wet ground or marsh: Wet ground conditions pose no real problem to the tree crushers unless the subsoil is unstable or highly saturated. A marsh, or vegetated soft wet earth with surface water, can be traversed by the crusher. The more vegetation that is present, the better the trafficability. Most wet ground areas can be traversed or cleared with little difficulty. One problem, however, lies in the inability to accurately determine the condition of the subsoil prior to employing the machines due to the wide variation in soils found in areas of operation. In the areas tested, visual inspection was not sufficient. As an example, photograph 12 shows the effect of the crushers in an area which by visual inspection appeared to be firm and solid. However, the ground had a four inch, densely-compacted crust over a highly-saturated, low-shear-strength soil. The results are graphically portrayed in photograph 13.

Photograph #4 - (Bearcat perimter) Tree crushers in echelon. Machines work best in a staggered formation which also allows a back-up if one machine gets into a difficult area.

Photograph #5 - (Long Thanh North) Land drum configuration clearing light foliage. Dirt clinging to land drums does not cause a problem on hard ground.

Photograph #6 - (Long Thanh North) Area crushed by transphibian drums further defoliated by burning. Burning took place two weeks after clearing.

Photograph #7 - (Long Thanh North) Area cleared by land drums after burning.

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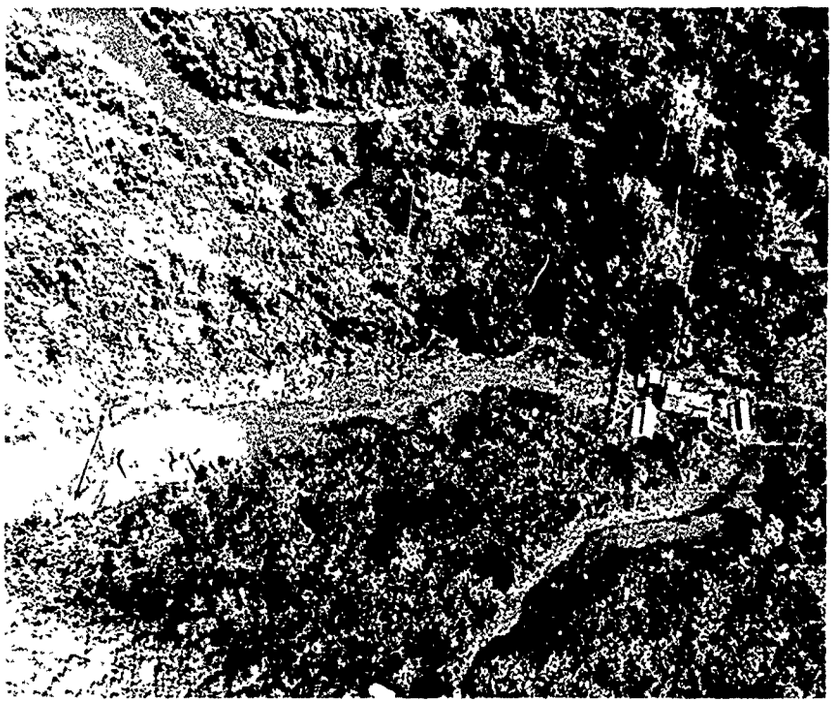
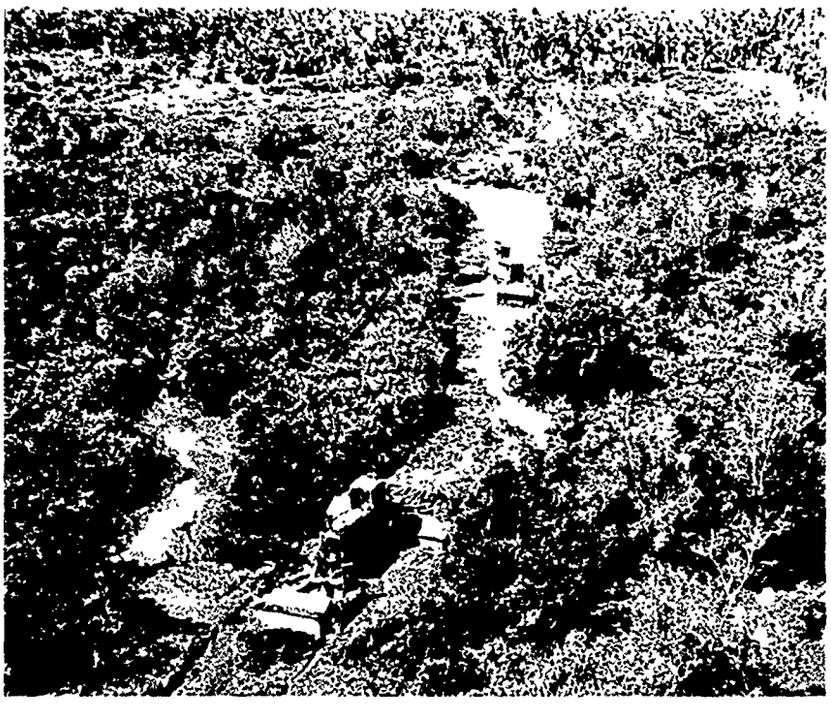


Photograph #8 - (Nhon Trach) Tactical tree crusher in tidal flat region.



Photograph #9 - Swamp channel at low tide. Tree crushers are moving toward banana grove in background.

Photograph #10-(Nhon Trach) TTC maneuvering in channel. Crusher cleared swath on the side of channel.

Photograph #11 - (Nhon Trach) Resupply in swamp area. Note tow cable on rear deck.

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Photograph #12 - (Ap Thanh Nguyen - NW of Camp Castle) Crust failure (Note marsh area in background).

Photograph #13 - (Ap Thanh Nguyen) Soil failure continued until crusher worked up on firmer soil.

The crust sheared due to the weight of the machine, and until dry soil started to be pushed under the drums, the machine was unable to get a good bite with its drums. A similar failure is shown in photograph 14. Even under fairly saturated conditions, a clearing rate of 1.5 acres per machine-hour can be maintained. The dry land drums are not feasible for operation in or near wet ground; the blades on the drum become packed with mud and spin helplessly. This situation is aggrevated by the tail-heavy weight distribution.

c. Dry Hardstand: Dry hardstand comprised the majority of the operational areas. The crushers operated in an impressive manner and cleared 32-foot swaths through the landscape in a steady manner. Land drums can be used to advantage in this type of terrain, but are not feasible if wet areas might be encountered. The contrast in design is shown on photograph 15. The tree crushers effectively destroy the foliage on one pass, and it is not necessary to re-do or overlap previously cleared areas. The full rate of clearing is developed and maintained on this type of soil (3 acres/machine-hour with amphibian drums and 4 acres/machine-hour with dry land drums).

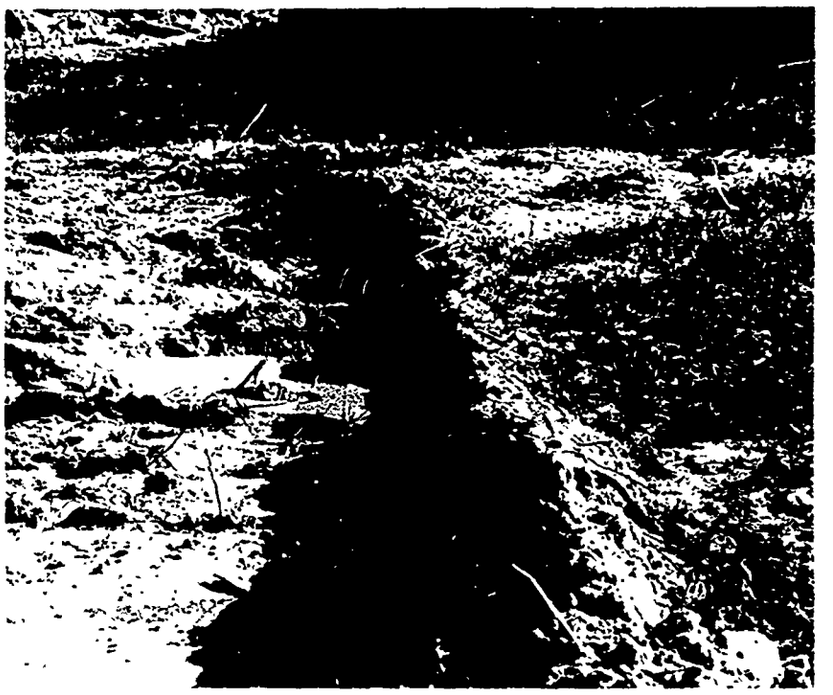
3. Techniques of Using Equipment in Varied Terrain.

a. Ravines: Ravines were encountered with slopes up to forty degrees in the An Loi Woods operational area. The best methods of tackling such areas is to cut along the bottom of the ravine with the first cut. Once the deepest part of the "V" has been pinpointed, the machines work up and down the sides of the "V". The machine is capable of climbing slopes up to forty degrees based on operations in this area. Tests were not made on steeper slopes.

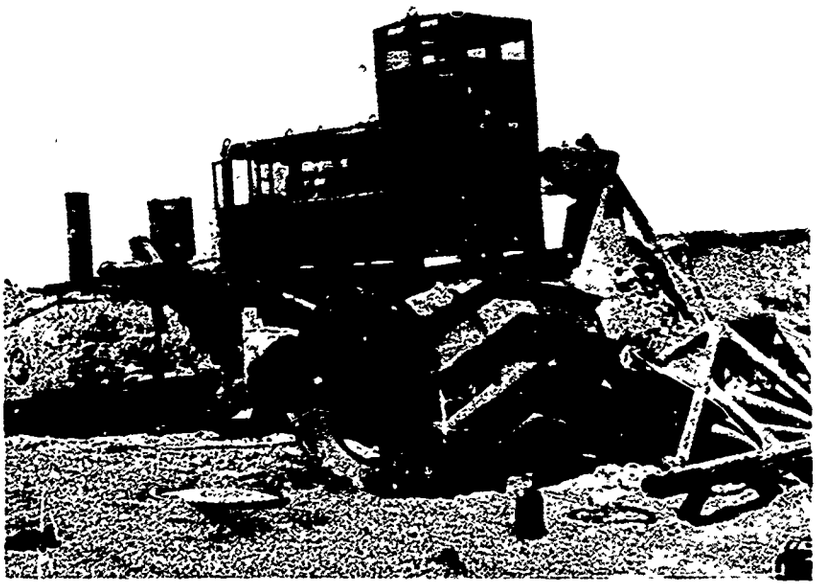
b. River Banks: River banks require careful entry and exit techniques. The best method is to enter the river with one drum first, then drive in the machine and swim to the opposite side. In most cases, it is best to exit with the rear drum first, as the tug assembly gives good traction on the river bank. Problems are encountered here if the soil has little shear resistance and crumbles away under the drum (see picture 14). Generally, if this occurs, another approach must be found which offers a firmer footing.

c. Hardstand Areas: Hardstand areas lend themselves to a block or triangle cut where the machines cut an outline of the work area and then operate within this cut, with one machine following the other at a distance of approximately 50 meters. An "L" shaped cut with one machine working each leg is also effective if security is not a problem.

4. Performance in Insecure Areas: Performance in insecure areas does not materially effect the clearing rate of the tree crushers if adequate security and resupply means are available. For distant or undeveloped areas, a helicopter is essential to effect timely resupply of Class I, III and to rotate personnel. If the security or resupply means are less than adequate, the clearing rate of the tree crushers is correspondingly decreased. During the testing period, several hours were lost each week as a result of requirements of the particular security force. It was found necessary to dig emplacements in the daylight; or that a larger force would have been required in order to continue movement after dark through some areas. Employment of security is discussed in paragraph C 2.



Photograph #14 - (Edge of Long Thanh North rubber plantation) Soil failure prevented drums from obtaining sufficient bite to climb out of stream.



Photograph #15 - (Camp Castle) Tree crusher undergoing change from amphibian drums to land drums. Change-over takes from 18-24 hours.

5. Performance as Affected by Extended Operations: Extended operations have little effect on the clearing rate of the tree crushers unless tactical or terrain conditions prevented maintenance equipment from reaching the machines for the weekly maintenance periods. Additionally, cross-country navigation presents a problem in extended operations, but this can be solved by using smoke or flares to guide the machines. The installation of a shock-resistant compass might be advisable if extended operations in remote, unpopulated areas are anticipated. The basic design of the machine and the simplicity of its operation lend themselves to trouble-free operation at long distances from home base. The testing period with the 93d Engineer Battalion (Const) has shown the many advantages to be found when working with machines that have no hydraulic lines to fail or transmissions and power trains to be overstressed. Initially problems were encountered with the drive pinions and the cooling of the generators, but no recent problems have been experienced. Specific problems are covered in detail in the maintenance annex.

6. Additional Equipment: The rake attachment was not evaluated as it could only be used in conjunction with the land drums. Based on in-country conditions, this accessory does not appear to be useful, especially since it can be mounted only with land drums.

C. Security and Control

1. The effects of enemy action upon the tactical crushers cannot be fully evaluated. Up to this point only seven rounds of small arms fire have struck the machines, although one attempt was made to hit it with an RPG round which detonated prematurely on a tree. Six rounds of a small caliber struck the drums and left only small nicks, and one round chipped the resistent glass on the driver's compartment but did not penetrate. Enemy bunkers and tunnels have been effectively destroyed by the tactical crushers as a result of the action of the drums and the machine's weight.

2. Type of Security for Various Types of Foliage and Surface Conditions: The inherent mission of the tree crusher to clear wilderness makes the problem of security a difficult one. Regardless of the conditions, there is a definite need for both passive and active security if full protection is to be afforded. Merely posting security in the immediate vicinity of the crushers is inadequate. Area clearing presents less of a problem than trace clearing in that a defensive perimeter can be established and manned, whereas clearing a trace requires everyone to be on the move. The best method of securing an area to be cleared is to have the machines make an initial cut outlining the area or a portion of the area in which they plan to work. Security can be posted at the corners of this area, while the crushers work on the inside of the perimeter trace. The security can either pull in with the decreasing area to be cleared, or remain on the outermost edges of the cut. Heavy or automatic weapons are placed along the trace in those positions offering the best fields of fire, while infantry or APC's are used to fill in any gaps. Photograph 16 shows a tree crusher working with armor protection.

a. Dense: Dense foliage has mixed blessings in that the security has a difficult job moving with the machines, but the enemy has at least as difficult time in locating the machines. For dense areas, both mounted and foot

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Photograph #16 - (Long Thanh North) Tank securing corner of the trace while tree crusher increases fieles of fire.

patrols are needed as the tracked units generally are forced to follow the crushers while the infantry patrols to the front and sides. If the machines are making subsequent passes through the same area, the tracked vehicle can precede the crushers along the previously crushed path. A helicopter can be used to a limited extent for patrolling although the dense foliage reduces its effectivness in this role.

b. Medium to Light: Medium to light foliage requires the security to spread out over a wider area (up to a kilometer in open areas) since the high silouette makes the machines more susceptible to RPG or recoilless rifle fire as seen on photograph 17. Helicopters offer a real advantage in the role of an active patrol to spot enemy activities in these areas.

c. Swamp Areas: Swampy areas present the greatest obstacle for security forces in that it is generally very difficult for either tracked or foot security to follow and keep up with the crushers through such areas. A boat or helicopter is a necessity in these areas. Some security can ride the machines through this area, as well as through other types of terrain, but this force cannot be relied on to provide adequate protection for the equipment. Even on wet ground, APC's and M38A3's following the crushers along a trace have become stuck on numerous occasions and had to be extracted which resulted in lost time.

3. Radio Control from Ground and Air: Radio control from the ground and air is an effective means of maintaining control over the detachment. The detachment was augmented with radios drawn from the battalion to insure constant communication and to help solve the problem of monitoring the tree crusher frequency, and the security force frequency. Each vehicle was equipped with an AN/VRC 46 which proved satisfactory although maintenance problems were experienced with the crusher radios due to the constant shock action to which they are subjected. Air control was employed to a very limited extent as no aircraft were available for this purpose on a continuing basis. The aircraft has the additional advantages of being able to guide the machine along its path and provide security. Regular access to a light observation helicopter would greatly increase the control of the detachment.

4. Staff Supervision: Staff control consumed an inordinate amount of time. The S-3 section found it necessary to have the staff officer work almost full time to effect the necessary coordination for movement planning, security, recovery of stuck vehicles, fuel re-supply, and to arrange for visits and evaluation of the tree crushers. In view of the staff experience and coordination requirements, it appears preferable to attach the crushers to a combat engineer battalion.

D. Maintenance

1. Repair Parts Usage and PLL-ASL: Repair parts usage factors were quite low considering the developmental nature of the machines. What parts were needed were supplied promptly from on-hand stock or obtained through Philco-Ford in Saigon. Fuel and oil elements have to be changed at every other 60 hour maintenance periods. PLL is maintained by detachment personnel and is carried

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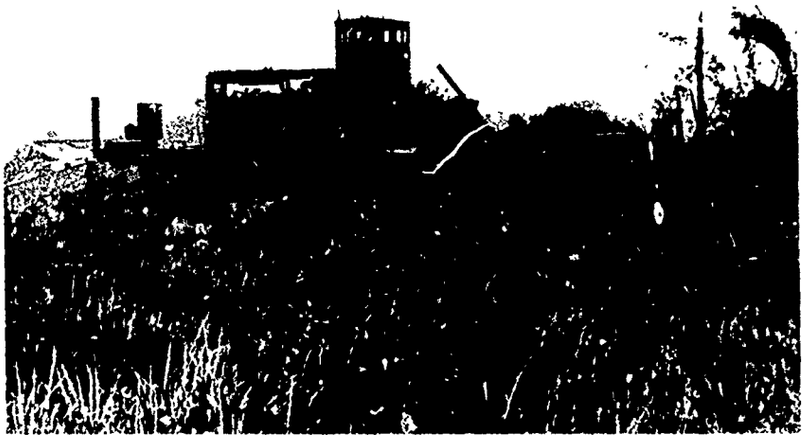


Photograph #17 - (Long Thanh North) Tree Crusher operating in light foliage.

in the shop van. PLL should include all frequently changed components and an adequate supply of parts for drum or pinion driver change. The ASL maintained at Philco-Ford is sufficient to supply parts for each of the machines for a period of one year. A more detailed discussion of maintenance problems encountered is found in Annex C.

2. Maintenance Program: The established maintenance program appears to be satisfactory. Normal preventive maintenance of one hour before and after operation has so far been adequate. The stand-down time of one day per seven (or after every 60 hours of operation) is not excessive and is sufficient to detect any situations that might develop into problems. Terrain presents a problem only in so far as being able to get the support equipment to the machines. An M88 VTR, rather than the currently available rough terrain crane, would increase the capabilities of the detachment greatly by its increased mobility and greater applicability to work in conjunction with the tree crushers. Sustained operations have not caused any additional problems. The test situation of changing from one set of drums to another has caused some problems with drum bolts, but this is apparently as much a matter of mechanics' training as anything else.

E. Support

1. Additional Maintenance Support Required: Additional maintenance support is not required unless special factory or depot-shipped parts must be ordered. If the machine is to be disassembled, a 40 ton crane is necessary for lifting the center assembly.

2. POL Support Including Methods of Supply: POL support does not present as great a problem as might be thought as each tank holds a 16-20 hour operational load. One 600 gallon fuel pod can resupply both machines. Where possible, the machines are fueled from a 2½ ton fuel tanker. If that is not feasible, a trailer-mounted fuel pod is hauled to the site for POL resupply. If the area is inaccessible, fuel can be resupplied by air as has been done on several occasions. Water, oil and grease have not constituted a problem in resupply operations.

3. Movement and Support Requirements:

a. Overland: Problems arise when attempting to move the machines overland for any distance. Basically, it is best to keep such moves to a minimum by employing the detachment on large-scale rather than numerous small-scale operations. Extensive route reconnaissance and coordination with local officials is necessary to minimize damage to civilian property and secure clearances when moving through populated areas. The security must be consulted as to their ability to travel with the machines. Additionally, 6 each 2½ ton trucks and 7 each tractor-trailer rigs are necessary if the entire detachment is to be moved with all its equipment and PLL-ASL.

b. Disassembly and Reassembly: Disassembly was not tested during this period, but would probably only be feasible if the move were over 50 miles. Based on the experience of assembling the machines when they arrived in country,

it is estimated that the disassembly and assembly time would be at least one week. This would require a 40 ton crane and 19 tractor-trailers to move both machines. A thorough road reconnaissance would also have to be made to determine if the route could handle a class 60 load.

F. Training

1. Evaluation of Classroom Training vs OJT: Based on the experience gained during this testing period, there is a definite need for formal classroom training to achieve maximum effectiveness on the part of the machine operators. The operation of the machine itself is very simple, and some OJT is necessary to learn proper technique, but it is felt that all personnel, especially those in a supervisory position, should attend the 80 hour block of instruction provided by the Le Tourneau engineers. This instruction covers nomenclature, theory of operation, repair and operational techniques.

2. Evaluation of Mechanics Training vs OJT: OJT value for mechanics was limited due to the unique nature of the equipment and the low density of tree crushers available for training. 622 hours had to be spent on classroom instruction covering theory and basic concepts of the machines. A thorough training program involving work on a machine would have to be set up before the mechanics could be considered fully qualified.

G. Suggested Factory Modifications

1. Provision for radio installation: The crushers should be modified to accomodate radio installation for proper control of the detachment. Special care should be taken to provide a mounting location for the radio to minimize shock, and to provide for the mounting of the antenna assembly in a protected location. The AN/VRC 46 would be suitable for this installation. A more detailed discussion of the field modification accomplished is provided in Operational Report Number 1.

2. Provision of limited infrared/white light capability: Night tests made in the vicinity of Long Thanh North indicate the feasibility of night operations of the machines in relatively secure areas. Field modifications included the mounting of lights on top of the driver's compartment, facing forward, 2 lights inside the engine compartment to illuminate the sides, and 2 lights also within the engine compartment facing to the rear. The concept proved highly satisfactory, but the illumination cast by the 200 M wheeled tractor lights used was not sufficient to cover the entire area. More powerful lights should be incorporated into the modification.

3. A tow cable should be mounted on each machine to replace the winches. The best diameter has been found to be 1-3/4 inches. The top of the rear drive assembly offers a surface upon which the tow cable could be mounted for transport. The winch assembly has not proven to be worthwhile as it is not of sufficient strength to be used as a tow cable and adds 10,000 pounds of weight to the rear of the machine, which is already too heavy. A thirty foot tow cable used by itself or in combination with another cable would give the machine the best capability to retrieve a disabled crusher without adding excessive weight to the equipment.

4. Design a universal drum to replace the water and land drums, which would incorporate the best features of both drums. One manner in which this could be accomplished is shown in Figures 5 and 6. Modifying each drum to twelve points instead of six contact points would result in one point contacting the ground every 3 feet rather than every 6 feet as occurs on the present amphibian drum seen in photograph 18. This would provide a smoother ride, less shock to the machine, and reduce the possibility of breaking through an upper crust of earth. This universal drum would still give maximum flotation for water conditions. It should also reduce maintenance problems of the driver unit since less effort would be required to turn the wheel. An extreme example of the track left by the present amphibian drums is shown in photograph 19.

5. The present bumper was designed for trees with an average diameter of eight inches. In actuality, the equipment encountered trees in the operational area in excess of three feet in diameter. By the addition of baffle plates to the main support bars and to the pintle assembly, coupled with the installation of bumper braces and stops, this problem was solved in the field. The firm presently manufactures larger bumper beams. A suggested factory modification is shown in Figure 4. (See operational reports 10 and 16 for a more detailed description of field modification).

6. Replace the 12 point head bolts used to secure the drum cover plate with a standard 6 point bolt head (maintain the double fine thread and seat). This would be done in the interests of standardization and eliminate the need for special 12 point socket tools.

7. Reverse electrical system from a positive ground to a negative ground system. This would allow such accessories as lights and radios to be used without the installation of additional batteries.

8. Redesign the tug structure to reduce weight on rear end of machine. The present configuration seen on photograph 20 results in a ground pressure of 4 psi on the front drums and 7½ psi on the rear drum. This could be achieved by modifying the rear tug structure as shown in figures 3 and 7. The lightening of the rear assembly by 10 or more tons would greatly increase the trafficability of the machine without affecting the machine's crushing capabilities.

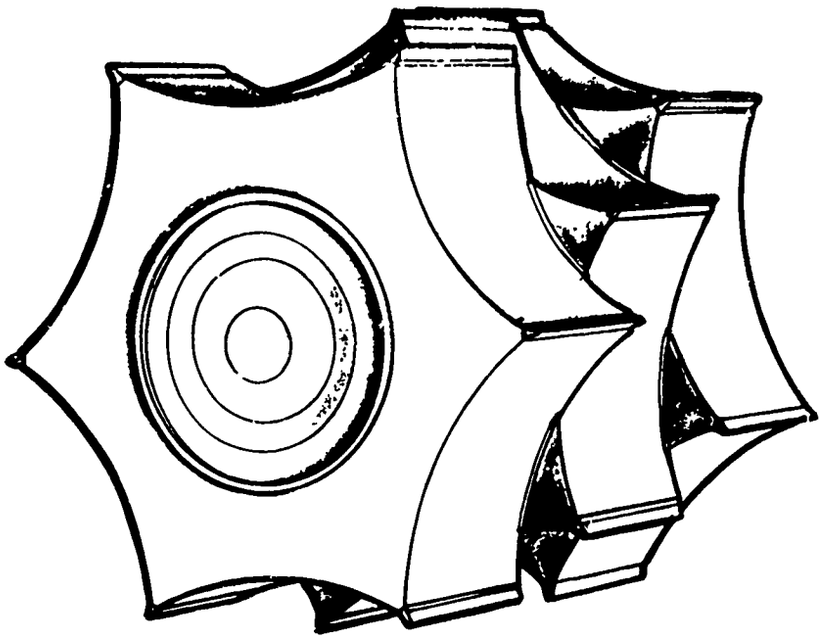


FIG. 6 POSSIBLE DRUM DESIGN – 18 POINT
(ARTIST CONCEPT)

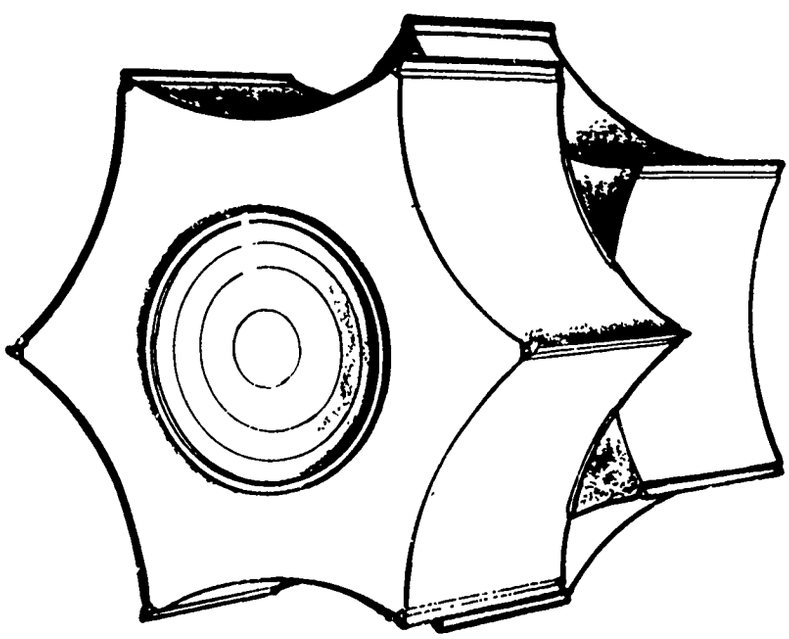
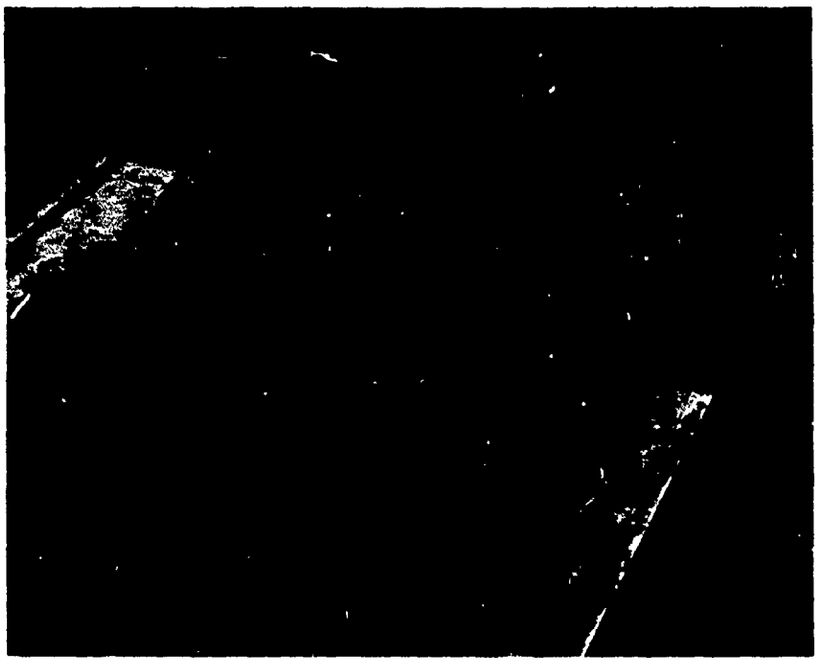


FIG. 5 POSSIBLE DRUM DESIGN 12 POINT
(ARTIST CONCEPT)



Photograph #18 (Bearcat) Transphibian drum show three of the six points. Height of drum is 12 feet and distance between points measures 6 feet.

Photograph #19 - (Long Thanh) Extreme example of characteristic pattern left by present amphibian drums. Driving a light wheeled vehicle over this terrain is very difficult.

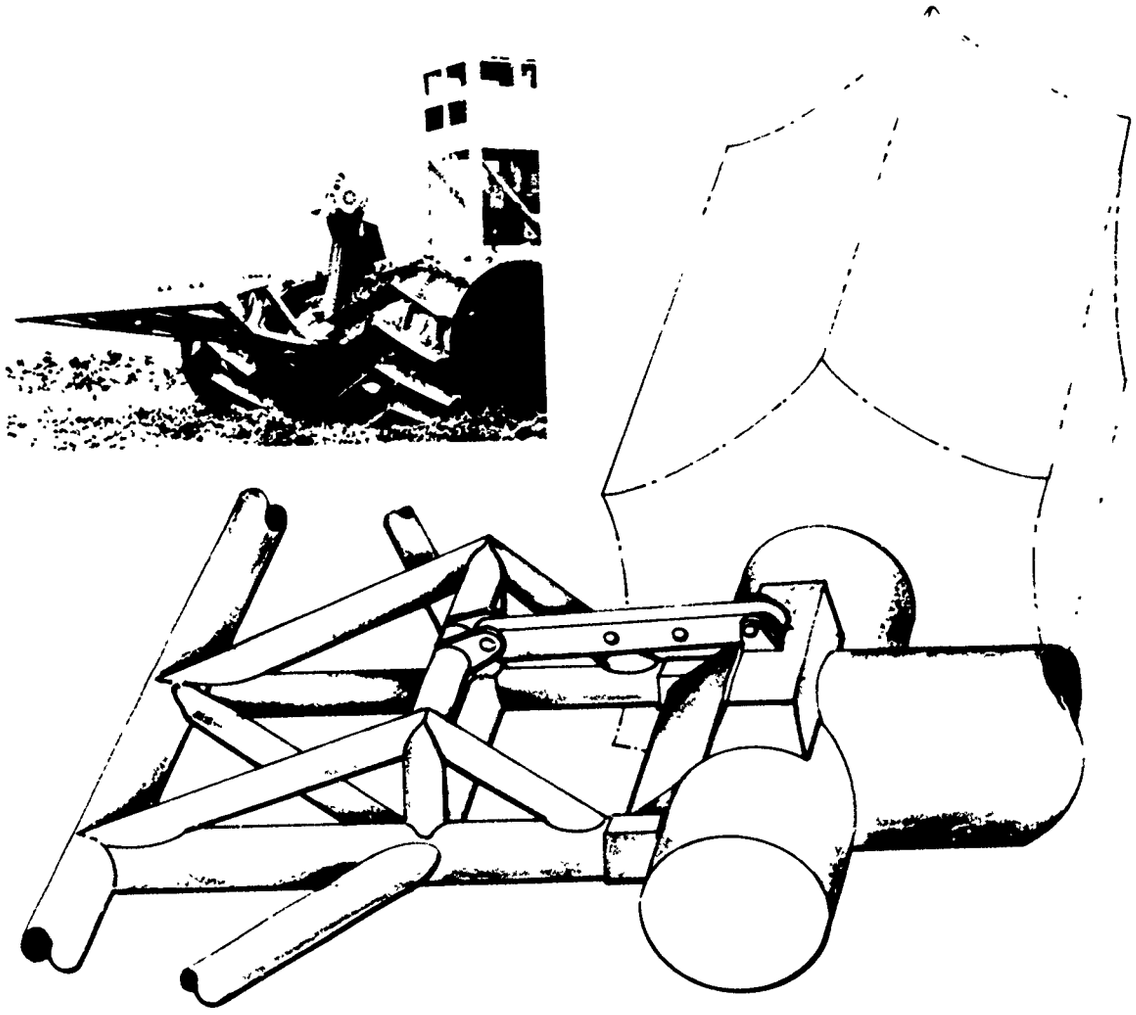


FIG. 4 PROPOSED PUSH BEAM MODIFICATION
(ARTIST CONCEPT)

Photograph #20 - (Secret) Side view of tactical crusher. Although the majority of the weight is forward, the single drum in the rear causes the machine to behave as if it were tail heavy.

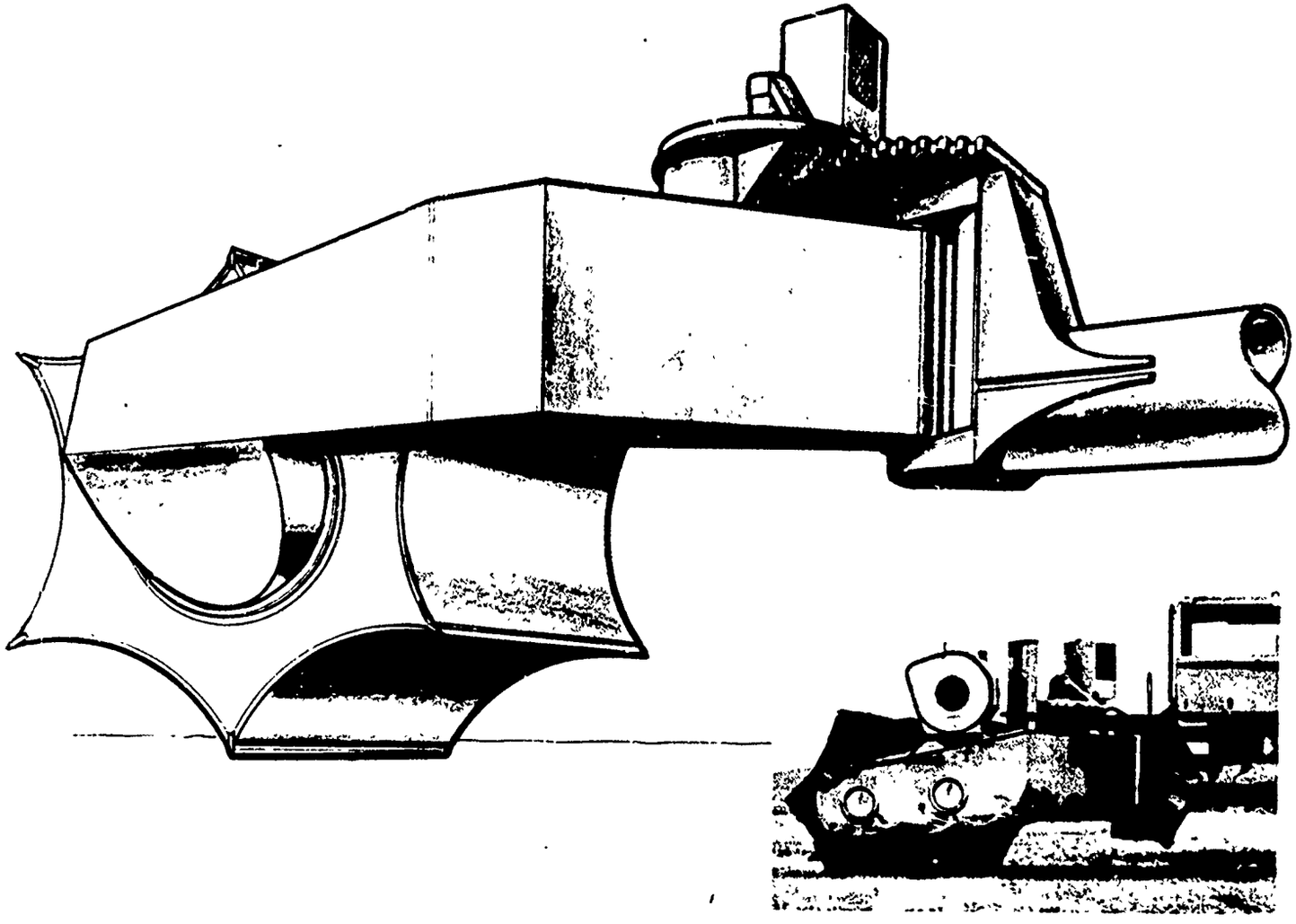


FIG. 3 PROPOSED TUG STRUCTURE MODIFICATION (ARTIST CONCEPT)

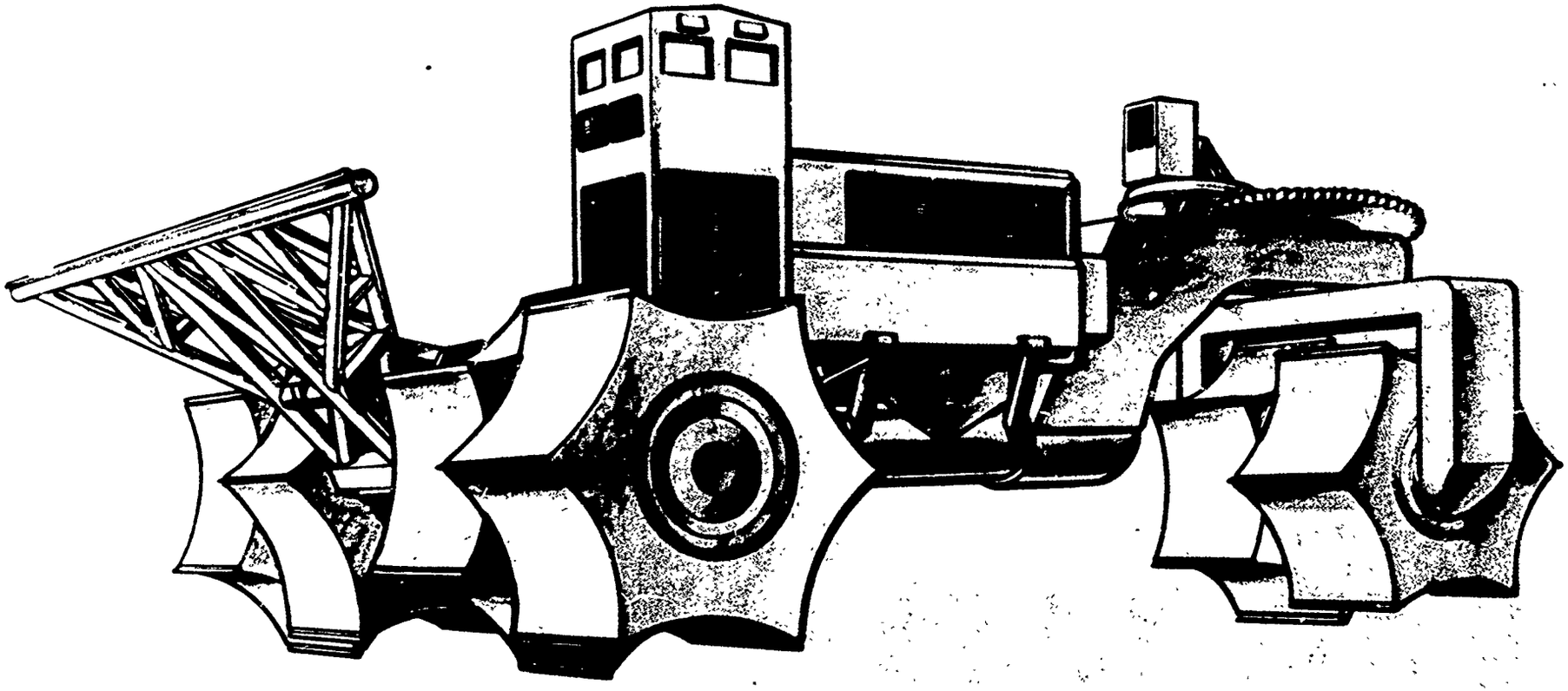


FIG. 7 POSSIBLE TUG STRUCTURE DESIGN CENTER STEERING
(ARTIST CONCEPT)

III. COMPARISON WITH ROME PLOWS

TACTICAL TREE CRUSHERS vs ROME PLOWS

	Cost of Clearing Devices	Fuel Consup. Per Day	Clearing Per Detachment Per Hour On Firm Ground	Initial Modification Required	Capability		Maintenance Support Required	Maintenance Problems	Stand Down Time / Week / Machine
					Swamp	Soft Wet Ground			
Tree Crushers	*1 2@ $250,00= $500,000	300 gal	6.6 acres	No	Marginal	Yes	None	Bolts On Driver Pinions	10
Rome Plows	*2 22@ $34,074= $749,628	1540-2200 gal.	1.7 acres	Yes	None	No	Air Comp 3rd Echelon	Turbochargers Fractured Oil Pans Cooling syst.	14.2

*1 Will probably be reduced by increased procurement.

*2 The eight bull blades are not counted in this comparison as they follow up on the same area that is cleared by the Rome plows. If a completely cleared area were desired, a group could be used in conjunction with the tactical tree crushers.

*3 Data based on information received from 86th Engr Bn (C)(A) and Jungle Clearing Operation Report, 65th Engr Bn.

IV. CONCLUSIONS

A. The tactical crusher in its present configuration is a worthwhile complement to the Rome plow on firm, hard ground and supplement to the Rome plow in soft, wet areas.

B. The transphibian tactical crusher offers an effective and economical means of clearing large areas.

C. There are modifications that could make the present configuration a better machine for the particular environment found in the areas of Vietnam where it has been tested.

D. Utilizing the amphibian drums, the tree crusher can negotiate almost any terrain, but is not adapted to clearing tidal mud flats.

E. The land drums are feasible only for use in dry areas where the soil has a high bearing capacity and a low water table.

F. Due to the excessive time required for disassembly and the extensive coordination required to move the crushers overland through built-up areas, the machines are best employed clearing large tracts or crushing traces through tactical areas.

V. RECOMMENDATIONS

A. That the present two machines be leased six additional months for use in further land clearing operations. Also retained should be the present PLI-AGI stock go. At least one technical representative should remain in country to assist in further modifications and training.

B. That the acquisition of additional machines be considered if the modifications suggested in paragraph G, section II, can be satisfactorily incorporated into the design.

C. That further research be made to develop a drum which sheds soil like the amphibian drum yet provides the crushing rate of the dry land drums. If such a drum is developed, it should be tested on one of the tactical tree crushers in-country.

D. That the rake attachment not be retained for use.

E. That the TDA outlined in ANNEX A be adopted.

ANNEX A: PROPOSED TDA

GENERAL

ORGANIZATION

1. MISSION: To clear wooded or jungle areas for fields of fire, tactical operations, construction projects, and selected civic action projects.

2. ASSIGNMENT: Attached to the Engineer Combat Battalion, Army, TO&E 5-36 or the Engineer Construction Battalion, TO&E 5-115.

3. CAPABILITIES:

a. This unit:

(1) Levels selected areas of heavy vegetation, jungle, or woods.

(2) Clears vegetation and trees by leveling any type of vegetation, by crushing trees up to 8" diameter into sections and by selective burning. Vegetation over relatively hard ground is crushed to a height of 2 or 3 feet.

(3) Operates on a two-shift basis.

b. This unit has a limited capability of providing its own administration and supply but must be provided mess.

c. This unit is capable of providing limited organizational maintenance of ordance-automotive equipment. It is capable of direct support level maintenance on engineer and tree crushing equipment.

d. This unit is not adaptable to a type B organization.

e. This unit is not adaptable to a reduced strength organization.

f. Individuals of this organization can assist in the close-in defense of the crushing equipment only. Primary security must be provided from external sources.

4. BASIS OF ALLOCATION: One per Engineer Combat Battalion, Army, TO&E 5-36 or Engineer Construction Battalion TO&E 5-115 engaged in large scale land clearing operations.

5. CATEGORY: This unit is designated a category II unit. (Reference unit categories, AR 320-5)

6. MOBILITY: The primary mechanical components of the detachment, the two crushers, are land mobile only over selected routes due to their excessive weight and destructive nature. The crushers when dismantled are not transportable on organizational vehicles. No evaluation of air transportability has been made.

7. This table is in accordance with AR 310-series and, together with documents listed in paragraph 10, is the authority to requisition and issue, in accordance with pertinent Department of the Army directives, all items listed herein unless otherwise indicated.

8. In accordance with pertinent Department of the Army and/or theater documents, units are authorized the following (definition of terms in accordance with AR 320-5 as amplified by SB 38-26):

a. Basic load

b. Prescribed load

c. Mission load

9. When there appears to be a discrepancy between the allowances shown in section III (Equipment Allowances) level column and the basis of distribution as indicated in the "Remarks" column, the amount shown in the level column will govern.

10. Items of clothing, equipment, components of sets and kits, repair parts, accessories, special tools and allowances of expendable items, as contained in the following publications, are authorized so far as they pertain to the allowances for the organization and/or individuals covered by this table.

a. Tables of Allowances (TA).

TA 8-100, Allowances of Army Medical Service Expendable Supplies.

TA 10-100, Allowances of Expendable Supplies.

TA 10-100-40, Allowances of Quartermaster Expendable Stationery and Office Supplies.

TA 50-971, Allowances of Expendable Supplies for the Army National Guard.

TA 50-973, Allowances of Expendable Supplies for U.S. Army Reserve.

TA 50-986, Allowances of Expendable Supplies to Supplement Equipment for Food Service Facilities Serving Field Installation, Troop and Hospital Trains and Army Vessels.

b. Army Regulations (AR)

AR 11-14, Army Programs - Material Readiness.
AR 135-8, Reserve Component Unit Readiness.
AR 140-1, Army Reserve - Mission, Organization and Training.
AR 220-1, Unit Readiness.

AR 310-1, Military Publications - General Policies.
AR 310-31, Organization and Equipment Authorization Tables; Tables of Organization and Equipment.
AR 310-32, Organization and Equipment Authorization Tables; Personnel.
AR 310-34, Organization and Equipment Authorization Tables; Equipment.
AR 310-44, New Army Authorization Documents System (NAADS) Policies, Responsibilities, Manpower Standards and Criteria, and Priority Control Schedules.
AR 385-32, Protective Clothing and Equipment.
AR 420-76, Entomology Services.
AR 622-5, Qualification in Arms - Qualification and Familiarzation.
AR 700-4, Supply and Maintenance Technical Assistance Program.
AR 700-11, Reduction of Equipment Requirements.
AR 700-20, Type Classification and Reclassification of Material.
AR 700-8400-1, Issue and Sale of Personal Clothing.
AR 711-16, DSU/Installation Stock Control and Supply Procedures (Army Field Stock Control System).
AR 715-30, Local Purchase of Civilian-Type Items.
AR 725-50, Requisitioning, Receipt and Issue System.
AR 725-500, Local Purchase and Requisitioning of Ordance Expendable Items (Except for Ammunition and Guided Missles).
AR 735-5, Property Accountability - General Principles and Policies and Basic Procedures.
AR 735-11, Accounting for Lost, Damaged and Destroyed Property.
AR 735-35, Supply Procedures for TOE and TDA Units or Activities.
AR 735-7600-1, Library Books.
AR 750-1, Maintenance Concepts.
AR 750-3, The Army Integrated Equipment Records Maintenance and Management System (TAERS).
AR 750-5, Organization, Policies and Responsibilities for Maintenance Operation.
AR 750-6, Maintenance Support Planning.
AR 750-8, Command Maintenance Management Inspections.
AR 750-10, Material Readiness (Serviceability of Unit Equipment).
AR 750-50, Use of Controlled Cannibalization as a Source of Low Mortality Repair Parts Supply.

c. Other applicable CTA.

TA 20-2, Equipment for Training Purposes.
TA 20-92, Army Education Center Activities.
TA 23, Targets and Target Equipment.
TA 23-100-1, Ammunition, Rockets and Missiles for Basic and Advanced Individual Training (by MOS).
TA 23-100-2, Ammunition, Rockets and Missiles for CONUS Service School Training.

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TA 23-100-3, Ammunition for Training in Overseas Theaters.
TA 23-100-4, Ammunition for Training, USAR Schools.
TA 23-100-5, Ammunition for Training - USMA, ROTC Schools and ROTC Summer Camps.
TA 23-100-6, Ammunition, Rockets and Missiles for Unit Training - Active Army and Reserve Components.
TA 23-101, Miscellaneous Ammunition and Explosives.
TA 23-103, Dummy, Drill and Inert Ammunition.
TA 45-8, United States Army Troop Information Activities.
TA 50-901, Clothing and Equipment (PEACE).
TA 50-902, Clothing and Equipment (MOBILIZATION).
TA 50-903, Clothing and Equipment for Army National Guard.
TA 50-905, Clothing and Equipment for Army Reserve.
TA 50-911, Equipment for Food Service Facilities Serving Field Installations, Troop and Hospital Trains and Army Vessels.
TA 50-913, Office Type Furniture and Equipment.
TA 50-914, Individual Safety and Protective Clothing and Equipment.
TA 50-915, Allowances for Flags, Tentage, Sewing Machines and Equipment for Civilian Guards.
TA 50-918, Dayroom Furnishings.
TA 50-919, Furnishings for Government Controlled Nonhousekeeping Personnel Quarters and All Types bachelor Officers Quarters.
TA 50-920, Furniture, Furnishings and Moveable Equipment for Government Controlled Family Housing.

d. Other publications.

DA Pam 108-1, Filmstrips, Slides, Tapes, and Phono-Recordings.
DA Pam 310-3, Index of Doctrinal, Training and Organizational Publications (Field Manuals, Reserve Officers Training Corps Manuals, Training Circulars, Army Training Programs, Army Subject Schedules, Army Training Tests, Firing Tables and Trajectory Charts, Tables of Organization and Equipment, Type Tables of Distribution and Tables of Allowances).
DA Pam 310-4, Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, Lubrication Orders and Modification Work Orders.
DA Pam 310-6, Index of Supply Catalogs and Supply Manuals (Excluding Types 7, 8, and 9).
DA Pam 750-1, Preventive Maintenance Guide for Commanders.
SB 3-40, Pesticides and Herbicides.
(C) SB 38-26, Ammunition Supply Rates (U).
SB 700-20, Army Adopted Items of Equipment.
TM 38-750, Army Equipment Record Procedures.

11. The abbreviations used herein are in accordance with AR 320-50.

12. Unless otherwise indicated, items of equipment authorized herein are the latest adopted type articles. Priorities of issue and/or issue of substitute items, pending availability of later models or in lieu thereof until exhausted, are established by current supply directives.

13. This table contains the minimum essential quantities and types of equipment necessary to accomplish the mission of the unit. Additional special tools and equipment contained in publications as supplemental to TOE for maintenance within scope of mission of the unit may be authorized by local commander, provided the items requested are determined to be essential for the successful performance of the assigned supply and maintenance mission. When any other additional equipment is required and is not covered by pertinent equipment authorization documents, approval must be obtained in accordance with procedures established by AR 310-31, AR 310-34 and AR 310-49.

14. Allowances of equipment authorized herein may be decreased or omitted at the direction of the commanders of major commands. Units will requisition only the authorized items which they are able to receive, store, maintain, and utilize unless otherwise directed by Headquarters, Department of the Army.

15. When assigned military personnel exceeds that authorized in section II (Personnel Allowances), items of equipment authorized on an individual basis are increased accordingly.

16. Approval for authorization of arms and items of individual equipment for issue to non-military personnel must be obtained through command channels from the theater army commander or the Department of the Army.

17. In accordance with AR 310-31 and AR 310-44, recommendations for changes to sections I, II and III may be submitted directly to Headquarters, United States Army Combat Developments Command, through command channels. Emphasis will be placed on recommending changes designed to accomplish the most efficient and economical use of personnel and equipment. Recommended changes to or inquiries on section IV should be addressed to Headquarters, United States Army Materiel Command.

TABLE OF DISTRIBUTION AND ALLOWANCES

SECTION II - ORGANIZATION

DESIGNATION US Army Engineer Det (JC) TDA XX MTDA

INDEX PAR a	INDEX LINE b	DESCRIPTION c	GRADE d	MOS e	BR f	ID g	REQ h
01	01	Det Cmdr	LT	01331	CE	O	1
01	02	Det Sgt	E7	62E40	EC	E	1
01	03	Sup Sgt	E5	76Y40	NC	E	1
01	04	Det Clk	E5	71H20		E	1
01	05	Repair Parts Sp	E4	76Q20		E	1
02		Tree Crusher Sect					
02	01	Const Mach Supv	E6	62E40	NC	E	1
02	02	Crusher Operator	E5	62E20		E	4
02	03	Asst Crusher Operator	E4	62E20		E	4
03		Maint Sect					
03	01	Engr Maint Tech	WO	62A10			1
	02	Engr Equip Repair Foreman	E6	62B40	NC	E	1
	03	Mechinist	E5	44E20		E	1
	04	Power Equip Rpmn	E5	52D20		E	1
	05	Sr Engr Equip Rpmn	E5	62B20		E	2
	06	Tank Retriever Op	E5	11E20		E	2
	07	Welder	E4	44C20		E	1
	08	Engr Equip Rpmn	E4	62B20		E	2
	09	Gen Veh Rpmn	E4	63B20		E	1
	10	Maint Data Sp	E3	70A10		E	1

a	b	c	d	e	f	g	h

JUSTIFICATIONS

Detachment Sergeant
Para 01 Line 02

Recommend an E-7 be authorized for this position. Due to the nature of this detachment's duties and responsibilities it is inconceivable that an E-6 could run this complicated organization. This NCO will have the added responsibilities of an operations sergeant and coordination with higher headquarters, He will be responsible for all unit administrative and operative functions except for the operation of a mess section.

Const Mach Supv
Para 02 Line 01

Recommend that the Const Mach Foreman be graded E-6 as an exception to line 14, page 637, AR 611-201. The nature of the duties and responsibilities of the incumbent of this position are far greater than those of an individual supervising a section comprising of 16 or more personnel. The mere cost of the equipment and its complicated operations is far greater than that of an entire Engineer Platoon of a Construction Engineer Company.

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DETACHMENT HEADQUARTERS

Par	Line	Description	Qty	Remarks
01	A72660	Antenna Group RC-292	1 ea	
01	D64865	Case Field Office Machine	2 ea	
01	E63317	Compass Magnetic Lensatic	2 ea	
01	F97915	Desk Field 2 Folding Stools	2 ea	
01	H73666	Flashlight, Plastic RT Angle	1 ea	
01	J71304	Goggles Sun, Wind & Dust	4 ea	
01	N55650	Panel Marker Aerial Liaison	2 ea	
01	Q54618	Radio Set AN/VRC-47 Mtd in ¼ ton Trk	1 ea	
01	Q54618	Radio Set AN/VRC-47 Mtd in 3/4 ton Trk	1 ea	
01	R94967	Rifle 5.56mm M-16	4 ea	
01	S27405	Safe 2 Shelves 1 Drawer	1 ea	
01	U11152	Sprayer Insecticide 2 Gal Hand	1 ea	
01	U93888	Table Folding Portable	2 ea	
01	V48921	Tent GP Med	5 ea	
01	V49058	Tent GP Small	1 ea	
01	W95487	Trailer Cargo ¼ ton 2W	1 ea	
01	W95537	Trailer Cargo 3.4 ton 2W	1 ea	
01	W98962	Trailer Tank Water 400 Gal 2W	1 ea	
01	X39461	Truck Cargo 4 x 4 (¼ ton)	1 ea	
01	X39735	Truck Cargo 4 x 4 (3/4 ton)	1 ea	
01	X40009	Truck Cargo 6 x 6 (2½ ton)	1 ea	
01	X80211	Typewriter Non-Port 15" Carr	2 ea	
01	Y34027	Watch Wrist	3 ea	

JUNGLE CRUSHER SECT

Par	Line	Description	Qty	Remarks
02	B67081	Binoculars 6 x 30 Mil Reticle	2 ea	
02	E62803	Compass Gyro Miniature 115V 400 or 60CY 70Watts Mark 27	2 ea	
02	L44575	Launcher Grenade 40mm	2 ea	
02	Q53186	Radio Set AN/VRC-46 Mtd in Tree Crusher	2 ea	
02	R94967	Rifle 5.56mm M-16	9 ea	
02		Transphibious Tactical Jungle Crusher	2 ea	

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MAINTENANCE SECT

Par	Line	Description	Qty	Remarks
03	B98994	Book Set Machinist Weld & Elect Repair	1 ea	
03	D11048	Carrier Cargo 6 Ton M548	1 ea	
03	D80299	Chain Assy Sgl leg w/pear Link	14 ea	
03	E72393	Compressor Rty Pwr Drvn Skid Mtd Gas Drvn, 125 CFM 100 PSI	1 ea	
03	NVEL	Tank Retriever, M88	1 ea	
03	H19221	Floodlight Set Elect Ptbl 6 Floodlights, Mast Mtd	1 ea	
03	H47082	File Visible Index Book Unit	2 ea	
03	J43849	Generator Set Gas Eng 1.5 KW 60Cy 1 Phase 2 Wire AC	1 ea	
03	J45699	Generator Set Gas Eng 3 KW 60Cy Skid Mtd, 1-3 Ph AC	1 ea	
03	J71304	Goggles Sun, Wind & Dust	2 ea	
03	L10505	Jack Hydr Hand 100 Ton	2 ea	
03	L44575	Launcher Grenade 40mm	2 ea	
03	L92386	Machine Gun 7.62mm Lt Flex	2 ea	
03	N96741	Pistol Cal .45 Auto	1 ea	
03	Q54618	Radio Set AN/VRC-47 Mtd in Carrier Cargo M548	1 ea	
03	R94967	Rifle 5.56mm M-16	12 ea	
03	T13152	Shop Eqpt Organizational Repair Light Trk Mtd	1 ea	
03	V19950	Tank Unit Liquid Disp	1 ea	
03	V48441	Tent Frame Type Maint	1 ea	
03	W32456	Tool Kit Auto Fuel & Elect System	3 ea	

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MAINTENANCE SECT CONT'D

Par	Line	Description	Qty	Remarks
03	W33004	Tool Kit Auto Mech	8 ea	
03	W33552	Tool Kit Body & Fender Repair	1 ea	
03	W67706	Torch Outfit Cutting & Welding	1 ea	
03	W95081	Trailer Cargo 1½ Ton 2W	1 ea	
03	YA8255	Welding Shop Cargo Trl Mtd 300Amp	1 ea	

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JUSTIFICATION

Q54470 RADIO SET AN/VRC-46. One per 97½ ton amphibious jungle crusher for maintaining radio communications between the crusher jobsite and the detachment headquarters, between the two crushers and any ground support tactical forces in the vicinity of the jobsite.

Q54692 RADIO SET AN/VRC-47 MTD IN TRK CARGO 3/4-Ton M-37, To include Trk ¼ Ton and APC To maintain communications between the detachment headquarters and the isolated crusher jobsite. Receiver needed for higher Hqs.

E72393 COMPRESSOR RTY PWR DRVN: AIR 5KW GAS DRVN 125CFM 100PSI. Required to support the prescribed weekly preventive maintenance for the two jungle crushers, to clean the generator units exciter generators, drive motors, motor line switches, electric control compartments, wheel reversing switches.

J45699 GENERATOR SET GAS ENG 3KW SKID. Required to provide power to light the detachment Headquarters and Supply Section command post tent and the Maintenance and Shop Section maintenance tent.

L63994 LIGHT SET GEN ILLIUM 25 OUTLET. Required to provide lights to the command post and maintenance tent.

T13152 SHOP EQUIPMENT ORGANIZATIONAL REP 5-TON TRK MTD. Required to provide equipment for the machinist to make small repair parts and any parts required for field modifications of the two developmental tree crushers.

W95400 TRAILER CARGO ¼-TON. Required to haul supplies from support facilities to the detachment and to haul Detachment Headquarters materials and equipment between areas of operation. To be towed by the Detachment Headquarters ¼-ton truck.

W95811 TRAILER CARGO 1½-TON. Required to haul Supply Section materials and equipment between areas of operation. To be towed by the Maintenance and Shop Section truck mounted shop equipment vehicle.

X39735 TRUCK CARGO 3/4-TON M-37. Required to hold the detachment control net AN/VRC-47 radio repair parts and other Detachment Headquarters material and equipment between areas of operation.

X60833 TRUCK UTILITY ¼-TON. Required to provide transportation for the Detachment Commander and to make supply and mail runs for the detachment.

D11048 CARRIER CARGO FULL TRACKED 13-TON AMPHIBIOUS MODEL M-548. Required as a contact maintenance vehicle to support the two jungle crushers, precludes the use of a standard 3/4-ton contact maintenance truck. The armored personnel carrier can carry the oxyacetylene welding and cutting torch set, the 400-AMP arc welding machine and/or the lubrication and service units plus repair parts and fuel from the Maintenance and Shop Section to the isolated crusher jobsite.

JUSTIFICATION CONT'D

N96741 PISTOL CAL .45 SEMIAUTOMATIC. One for the Detachment Commander.

R95319 RIFLE 5.56mm M-16 SEMIAUTOMATIC. Individual weapons. One per enlisted man in the detachment.

W32456 TOOL KIT AUTMV FUEL AND ELEC SYS REPAIR. Required to provide tools for the two general vehicle repairmen to perform organizational maintenance on the 4 detachment trucks and the 13-ton armored personnel carrier.

_____ M-88 TANK RETRIEVER. The deletion of the 20-ton RT crane and the addition of an M-88 VTR would provide the detachment with the following capabilities over and above the RT crane: Greater maneuverability with access to varied terrain conditions; capability to make temporary roads to work sites which would allow the 5-ton shop set, POL truck, or personnel to reach work sites in the shortest time; also it would help prepare a work site for making repairs on the crushers. The boom height and the recovery cable could be used to lift the drum (24,200 lbs) and remove it to allow the drive to be worked on or removed. In performing these services it would be more effective than the 20-ton RT crane. In addition, it would provide the detachment with an organic recovery capability.

L445575 LAUNCHER, GRENADE 40mm, M-79. Required for tactical support while tree crushers are on the jobsite.

L92386 MACHINE GUN 7.62mm, Lt Flex M-60. To be mounted on each tree crusher for tactical support and fire cover while the crushers are operating in an isolated area.

W98962 TRAILER TANK WTR 400 gal 2 WHL POTABLE WTR. Required for use in isolated areas where men can't get potable water is not available.

X40009 TRUCK, CARGO 6x6 ½ TON M35A2. Required to haul men and equipment to and from the jobsite where the crushers are located.

Y34027 WATCH WRIST. One for the Detachment Commander, XO, and Detachment 1SG.

H470829 FILE VISIBLE INDEX, BOOK UNIT. One for the Detachment Supply PLL and one for the Detachment Maintenance PLL.

B98994 BOOK SET, MACHINIST, WELD AND ELEC REPAIRS. To be used by the machinist and repairmen.

E63317 COMPASS, MAGNETIC, UNMTD, LENSATIC, 1.58" Dia0-360 Grad. One for the Detachment Commander and one for the Detachment NCOIC.

J43849 GEN SET, GAS ENG, 1.5KW, 60CPS SKD MTD. To be used on the jobsite for lights while crushers are being operated.

JUSTIFICATION CONT'D

Y48255 WELDING SHOP CARGO TRI MTD 300AMP. Required for the use by the detachment welder.

H73666 FLASHLIGHT, PLASTIC, RT ANGLE, 2 CELL MIN LAMP, WTRTGHT. For use by the detachment CQ.

L10505 JACK, HYDR, HAND, 100-TON 19½" CLOSED H 29½" EXT. One for each tree crusher, for maintenance on the tree crushers.

W67706 TORCH OUTFIT CUTTING & WELDING OXY-ACCETYLENE. Required for cutting and welding on the tree crushers by the welder.

W95537 TRAILER, CARGO 3/4-TON, 2WHL, W/E. To be used with 3/4-ton truck to haul supplies and equipment from jobsite to Detachment Headquarters.

D64865 CASE, FIELD OFFICE MACHINE. Required for carrying typewriters when a base camp is required.

F97915 DESK, FIELD, 2 FOLDING STOOLS. One for the detachment orderly room and supply room.

J71304 GOGGLES, SUN WIND & DUST, SINGLE APRTR, PLASTIC LENS. For use by by the vehical operators.

N55650 PANEL MARKER, AERIAL LIAISON. Required for each crusher when in an isolated area.

S27405 SAFE, 2 SHLF, 1 DRWR, 2 COMP 26"x17"x17½". Required for classified documents and for use by the Detachment Commander.

U11152 SPRAYER, INSEC, HAND 2 GAL. For use while detachment is in an isolated area.

U93888 TABLE, FIELD PTBL. One for the Detachment Orderly Room, and one for the supply room.

V48441 TENT, GP MED LT WT OG 107 FMWWR W/COMP. Required for the detachment while out in the field.

V49058 TENT, GP SMALL, LT WT, OG107 FMWWR W/COMP. Required for use by the Detachment Commander while in the field.

W33004 TOOL KIT, AUTOMOTIVE GEN MECH. One for each auto mechanic for maintenance on the vehicles.

X80211 TYPEWRITER, NPTBL, 15" CARRIAGE. One for the clerk typist and one for the supply room.

V19950 TANK UNIT LIQUID DISPENSING. Required for refueling of the crushers and support vehicles while located in an isolated area.

JUSTIFICATION CONT'D

A72260 ANTENNA GP, RC 292. Required for base camp for communications between the crushers and Detachment Headquarters.

D80299 CHAIN ASSY, SGL LEG, W/FEAR LINK AND GRAB HOOK, 5/8. Required for each vehicle.

E62803 COMPASS, GYRO, MINIATURE, 115V 400 OR FOR MOUNTING 60CPS 70 WATT MARK 27. Required for each tree crusher in navigation.

B67081 BINOCULARS 6x30 MIL RETICLE. Required for aerial and land reconnaissance. One for the Detachment Commander and one for the Detachment NCOIC.

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ANNEX B --- PREDICTION OF TRAFFICABILITY

1. An attempt was made to correlate, after the fact, cone penetrometer readings with the trafficability of the tactical transphibian crushers. No definite conclusions could be reached; though the following generalities appear valid:

a. There is an apparent correlation between CBR readings obtained with a cone penetrometer and the trafficability of the tree crushers.

b. On firm, dry ground or wet soil which is not saturated, a CBR of 5-10 will apparently allow the crusher to operate.

c. Soil failure will occur in areas with a CBR of less than 5 when loaded by the crusher drums.

d. The worst situation occurs when the soil conditions provide inadequate bearing capacity for the drums, yet there is insufficient water to take advantage of the flotation capability.

2. When examining crusted silt, it is extremely important that the crust be removed prior to testing with the penetrometer or false readings will occur. The crusher, particularly if turning, will break through any crust up to eight inches.

ANNEX B

ANNEX C: MAINTENANCE CONSIDERATIONS

1. Equipment hours (15 July 1967 - 15 December 1967).

a. Total tree crusher hours		1565.3
b. Support equipment hours		1197
	Total	2762.3

(1) Rough terrain crane

(2) Armored personnel carrier

(3) 5 ton shop truck

2. POL consumption

a. Diesel	26,854 gal
b. Oil	2,621 qts
c. Grease	388 lbs
d. Approximate consumption in gal/hr/machine:	17.0 gal/hr/machine

3. Total manhours (operations only):	5,772 mh
4. Maintenance manhours:	4,485 mh
a. Preventive maintenance	1,325 mh
b. Special problems and field modifications:	3,160 mh

5. Special problems.

a. Main DC Generator Burn Out: The high ambient generator temperature was believed to be one of the causes. Another cause was the fact that the drive belts were too loose on the exciter generator. Blower units were installed on the generators. The generator continued to overheat but did not result in any additional damage to the system indicating that the blower did make some contribution. Also, a vent was cut through the armor plate under the generator to allow outside air to enter between the power house unit and the top of the fuel tank. The output voltage of the variable voltage main DC generator was regulated and the DC driving motors were rewired from a paralled to series circuit. There were no futher instances of excessive temperature and the problem was apparently solved.

ANNEX C

b. Commutator: Several copper bars in the commutator of the main DC generator expanded causing irregularities in the diameter of that section of the armature and caused the commutator brushes to chip and break. The alternate overheating and cooling of the main DC generator probably caused this. The commutators were cut down a few thousandths of an inch to extablish a uniform diameter. On another occasion, the armature of the main DC generator was damaged beyond repair. The overheating caused by a continuous period of work had caused one of the bars in the commutator to raise up, crack, and break off in a piece approximately three inches long. In turn, this had caused some of the commutator brushes to be chewed up. The damages required a replacement of the armature and the commutator brushes. There have been no recurring instances of this problem.

c. Right Front Driver Unit Malfunction: Malfunction was caused by a series field jumper (electrical lead) in the right front drive motor arced loose. The jumper was silver-soldered back into place and the connection taped. This was apparently an isolated problem and has not recurred.

d. Cracked Roller Bearing Assemblies: The Senior Le Tourneau Service Engineer in Longvies, Texas conducted a detailed investigation and shipped a different type for installation in the driver unit. The new bearings have a self aliging feature which should compensate for the forces which have caused the previous failure in the roller bearing assemblies. As of this report there has been no problem with the new bearings.

e. Gear Tooth: A counter-shaft pinion cog (which holds the roller bearing assemblies) cracked and a small piece broke off in the driver unit causing damage to some of the other internal gears in the driver unit. Some generator brushes had to be replaced and the damaged driver unit was replaced with one that had been built with spare parts. The Le Tourneau Engineers have forwarded the metal teeth to the Le Tourneau plant for an analysis.

f. Bumper Beam Support Failure: Welding on both sides and top of the pindle broke loose causing the brackets to partially collapse. Field modifications were (1) weld a plate under the pindle bar; (2) weld a baffle plate between the main support bars to the plate structure and; (3) weld small baffle plates to the pindle assembly to the main baffle plate. Additionally, the bumper braces and stops were added to provide three points of contact instead of one. This has allowed a larger diameter tree to be crushed without causing bumper failure.

g. Counter-shaft Pinions: The pinions in the right driver sheared in two. The pinion was one which had been reheated and machined to fit the new self-aligning bearings. The reheating may have caused the metal to become brittle and shear. Later, two more pinions in the left driver failed. As of this report no solution to the problem has been found but the situation has not reoccured.

h. Right Rear Exciter Bearing: The right rear exciter bearing in the exciter generator burned out twice. The Le Tourneau Service Engineer found that the bearing shaft had increased and the bearing could not slip the required distance. This problem was solved by turning the shaft down to the specified size. Evaluation has not continued for a sufficient time to determine if problem is finally solved.

i. Drums Shipping Water: It was found that two of the drums shipped some water and mud. This caused a loss of mobility and steering. The condition was apparently caused by improperly tigntened bolts. As of this report there has been no additional water leakage into the drums.

j. Exhaust Vents: When traveling through deep water, both machines shipped water through the exhaust vents located two feet above flotation line. This is believed to have been caused by wave action. Damage to electrical wiring by the salt water has not yet been evaluated. This occured after the close of the reporting period and no corrective action has been taken as of yet.

5. Repair Parts Usage:

a. Preventative maintenance

(1) 20 ea fuel filters

(2) 8 ea air cleaners

(3) 4 ea fan belts

(4) 8 ea oil filters

b. Special maintenance

(1) 1 ea DC generator

(2) 1 ea driver unit

(3) 11 ea roller bearings

(4) 48 ea brushes

(5) 20 ea brush springs

(6) 35 ea snap rings

(7) 3 ea gears

(8) 10 ea pinions

(9) 1 ea armature

(10) 57 ea screws

(11) 13 ea washers

(12) 24 ea W grids

(13) 2 ea shunts

(14) 12 ea ammeters

(15) 160 ft electrical wire

(16) 2 ea rubber baffles

6. Summary: As with any developmental model, various problems developed in the initial stages of testing in Vietnam. The majority of the problems have been solved, however, and for the last month and a half with the 93d Engineer Battalion (Const), few maintenance problems have been encountered. It should be kept in mind that a thorough training program was not possible for the operation and maintenance of tree crushers. A good percentage of the time, the machines were operated and maintained by relatively inexperienced military personnel with general supervision and OJT being taught by representatives from the manufacturer. Also, to enable maximum evaluation, operations were conducted in extremely rough terrain. These factors tended to increase maintenance difficulties and lower machine production. Once the field modifications have been perfected and the military personnel operating and maintaining the machines have received proper training, very few maintenance problems are expected to arise.

ANNEX D, PLL - ASL

STOCK NUMBER AND NOUN		UNIT OF ISSUE	AUTHORIZED QUANTITY
B-81	SV-Belt	EA	4
C-177	Bearing	EA	1
C-315	Grease Fitting	EA	5
CD-3426	W-Grid Plate	EA	12
CF-7945	Nylon Plug	EA	2
CF-42	Capscrew	EA	4
CF-7954	Oil Seal	EA	1
CF-7769	Primary Gear	EA	1
CF-2132	Liner	EA	2
CF-7782	Final Drive Gear	EA	1
CF-9361	Final Gear	EA	1
CF 6250	Copper Washer	EA	18
CG-7472	Capscrew	EA	3
CG-7474	Capscrew	EA	2
CG-7479	Capscrew	EA	5
CG-7957	Capscrew	EA	9
CG-2424	Bearing	EA	1
CH-1950	Capscrew	EA	9
CH-6245	Primary Gear	EA	1
CJ-1053	15/16"x2½ 2St	EA	168
CL-6248	Ring	EA	2
CL-8738	Spacer	EA	1
CL-8740	Oil Seal	EA	1
CM-3978	Micro Switch	EA	3
DC-5636	Primer Switch	EA	1
DF-5869	Hose Clamp	EA	2
DG-8379	Point	EA	1
DG-8380	Point	EA	2
HC-902	Hose Clamp	EA	2
HF-5115	Hose Clamp	EA	2
HF-2179	Exciter Gen Brush	EA	12
HF-1367	Wheel Moter Bearing	EA	4
HF-6972	Ammeter	EA	1
HF-5318	Bearing	EA	1
HF-5319	Bearing	EA	1
HF-5227	Exciter Gen Bearing	EA	1
HF-3993	Capaciter	EA	1
HF-8375	Countershaft Locknut	EA	1
HH-5415	Rubber Seal	EA	2
HH-4913	Water Sending Unit	EA	1
HH-4914	Oil Sending Unit	EA	1
HH-3302	Water Temp Gauge	EA	1
HH-3303	Oil Pressure Gauge	EA	1
HK-1513	Bearing	EA	1
HJ-752	Clamp	EA	2
HJ-7013	Contact Strip	EA	2
HJ-3862	38 Plate Rectifier	EA	1

ANNEX D

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ANNEX D, PLL - ASL

STOCK NUMBER AND NOUN		UNIT OF ISSUE	AUTHORIZED QUANTITY
HL-1111	2 Point Terminal	EA	2
HL-9457	Coil	EA	1
HL-8495	Grease Fitting	EA	2
HL-7920	Housing Coil Assembly	EA	1
HL-7809	Capscrew	EA	1
HM-7346	Bolt Block	EA	4
HM-7357	17 Pinion	EA	1
HM-9278	Capscrew	EA	17
HM-9739	Exciter Gen Armature	EA	1
HM-2739	Bearing	EA	1
HM-5838	Capscrew	EA	4
HM-9744	Bracket Power Switch	EA	1
HM-3208	Cap Screw	EA	2
HM-2207	Bearing	EA	1
HO-979	Grease Hose	EA	2
HO-909	Tacker	EA	1
HO-7259	Point Housing	EA	2
HO-7210	3/8 inch Bolt Block	EA	44
HO-6940	Cap Screw	EA	4
HO-6803	Cap Screw	EA	10
HO-6457	Starter	EA	1
HO-6110	Point	EA	10
HO-4500	DC Main Switch	EA	2
HO-4532	Transformer (Contr)	EA	1
HO-4630	Control Switch	EA	2
HO-4007	Cap Screw	EA	10
HO-4037	Coil	EA	1
HO-8831	Mag T Arm. Assy	EA	1
HO-9879	30 Plate Rectifier	EA	1
HO-3402	Spring Lifter	EA	2
HO-3049	6 Plate Rectifier	EA	1
HP-3459	Steel Brake Disk	EA	18
HP-2983	Point R. H.	EA	1
HP-2979	Point Support L.H.	EA	1
HP-2978	Point Support R.H.	EA	1
HP-2988	Stationary Point L.H.	EA	2
HP-2990	Stationary Point R.H.	EA	2
HP-2984	Point L.H.	EA	1
HP-1074	Seal	EA	1
HP-559	Steering Motor Stator	EA	1
HP-3460	Brake Disk	EA	17
HP-3370	C-9 Brush Ring Assy	EA	1
HR-2871	Oil Seal	EA	3
HR-1759	AC Generator Brush	EA	8
HR-7037	A55S Fan Belt	EA	6
HR-9474	Capscrew	EA	2

ANNEX D, PLL - ASL

STOCK NUMBER AND NOUN		UNIT OF ISSUE	AUTHORIZED QUANTITY
5111340	Rocker Arm	EA	6
5111343	Rocker Arm	EA	6
5111422	Bearing	EA	2
5111424	Washer	EA	4
5111526	Pipe Assy	EA	1
5111527	Pipe	EA	1
5113953	Cylinder Liner	EA	1
5114335	Seal	EA	3
5115037	Cam Follower	EA	9
5115454	Seal	EA	2
5116476	Seal	EA	4
5117003	Bolt	EA	8
5117005	Washer	EA	4
5117016	Gasket	EA	4
5117023	Bolts	EA	4
5117269	Gasket	EA	2
5117369	Connector	EA	1
5117404	Gasket	EA	1
5117629	Nut	EA	4
5117962	Ring	EA	2
5117976	Gasket	EA	2
5117984	Bearing	EA	2
5119826	Thermostat	EA	6
5121963	Gasket	EA	2
5124519	Ring	EA	2
5125108	Washer	EA	4
5126327	Spring	EA	1
5128640	Push Rod	EA	9
5130959	Seal	EA	1
5133767	Bolt Set	EA	1
5135756	Rod	EA	2
5150013	Nut	EA	2
5150193	Gasket	EA	4
5150303	Retainer	EA	6
5150322	Rocker Arm Shaft	EA	2
5150329	Gasket	EA	2
5150325	Brackets	EA	8
5151601	Lock Nut	EA	4
5152149	Bearing Cap	EA	1
5152944	Gasket	EA	1
5153284	Retainer	EA	4
5153286	Screen	EA	1
5154637	Ring	EA	1
5169319	Shell Set	EA	7
5172874	Nozzle	EA	1
5175846	Gasket	EA	1
5176228	Screw	EA	2

87

ANNEX D, PLL - ASL

STOCK NUMBER AND NOUN		UNIT OF ISSUE	AUTHORIZED QUANTITY
5111340	Rocker Arm	EA	6
5111343	Rocker Arm	EA	6
5111422	Bearing	EA	2
5111424	Washer	EA	4
5111526	Pipe Assy	EA	1
5111527	Pipe	EA	1
5113953	Cylinder Liner	EA	1
5114335	Seal	EA	3
5115037	Cam Follower	EA	9
5115454	Seal	EA	2
5116476	Seal	EA	4
5117003	Bolt	EA	8
5117005	Washer	EA	4
5117016	Gasket	EA	4
5117023	Bolts	EA	4
5117269	Gasket	EA	2
5117369	Connector	EA	1
5117404	Gasket	EA	1
5117629	Nut	EA	4
5117962	Ring	EA	2
5117976	Gasket	EA	2
5117984	Bearing	EA	2
5119826	Thermostat	EA	6
5121963	Gasket	EA	2
5124519	Ring	EA	2
5125108	Washer	EA	4
5126327	Spring	EA	1
5126640	Push Rod	EA	9
5130959	Seal	EA	1
5133767	Bolt Set	EA	1
5135756	Rod	EA	2
5150013	Nut	EA	2
5150193	Gasket	EA	4
5150303	Retainer	EA	6
5150322	Rocker Arm Shaft	EA	2
5150329	Gasket	EA	2
5150825	Brackets	EA	8
5151601	Lock Nut	EA	4
5152149	Bearing Cap	EA	1
5152944	Gasket	EA	1
5153284	Retainer	EA	4
5153286	Screen	EA	1
5154537	Ring	EA	1
5169319	Shell Set	EA	7
5172874	Nozzle	EA	1
5175846	Gasket	EA	1
5176228	Screw	EA	2

ANNEX D, PLL - ASL

STOCK NUMBER AND AND NOUN		UNIT OF ISSUE	AUTHORIZED QUANTITY
5177764	Damper	EA.	1
5177773	Gasket	EA.	2
5177777	Valve	EA.	1
5179954	Rocker Arm	EA.	6
5184484	Insert	EA.	2
5186858	Spring	EA.	6
5188405	Retainer	EA.	6
5188506	Pin	EA.	1
5195167	Valve	EA.	16
5196026	Bearing Set	EA.	10
5196320	Rod Shell Set	EA.	24
5196375	Gasket Kit	EA.	2
5196382	Gasket Kit	EA.	2
5196383	Blower Repair Kit	EA.	2
5196386	Blower Kit	EA.	4
5196938	Fuel Pump Kit	EA.	2
5197939	Ring Set	EA.	2
5198465	Cylinder Kit	EA.	12
5228765	Injector	EA.	12
5230007	Seal	EA.	4
5373014	Elements	EA.	60
5564980	Elements	EA.	20
5575086	Gasket	EA.	2
5575087	Spring	EA.	1
6436719	Elements	EA.	20
6437298	Gasket	EA.	4
8137404	Connector	EA.	2
8524267	Cooler	EA.	1

ANNEX E. OBSERVATIONS OF LE TOURNEAU SERVICE ENGINEERS.

A. Recommended Basic Modifications of Present Crusher.

1. Redesign rear end of main frame and redesign tug structure for better ground clearance. This should markedly improve performance in swamps.

2. Replace both the star drums and round drums with a universal drum. We propose a drum made basically as the star drums now are but made in two 7 foot sections revolved ½ turn in realation to each other. This would give the effect of rolling on a drum with points three (3) feet apart instead of the present six (6), thus making for smoother rolling on firm ground.

NOTE: In the event the army decided on new modified machines there are further recommendations concerning weight reduction and distribution, to which it would be premature to attempt to propose at this time.

B. Support Equipment: Be sure the necessary support equipment is properly maintained, available, and accessable to the crushers. This applies to everything from hand tools to an adequate crane.

NOTE: The RT crane has proven quite limited in its lifting capabilities and the type of terrain it can traverse.

C. Training Program: Recommend all officers and NCO's directly connected with the Tree Crushers should attend the Le Tourneau Service Training School. They in turn should give the on-the-job training to operators and mechanics.

ANNEX E

94

AVBI-OS (19 Dec 67) 2d Ind
SUBJECT: Transphibian Tactical Crusher Evaluation

DA, Headquarters, 20th Engineer Brigade, APO 96491 26 December 1967

TO: Commanding General, US Army Engineer Command Vietnam (Prov)
APO 96491

1. The Transphibian Tactical Tree Crusher evaluation is forwarded in accordance with instructions contained in your General Order 443, 1 November 1967 and your message AVCC-P&O UX 4372, 12 November 1967.

2. With respect to the recommendations contained in paragraph V of the report, this headquarters agrees that further research is needed to develop a land drum which will shed soil like an amphibian drum, that the rake attachment not be retained for future use, and that the TDA, Annex A of report, be adopted. This headquarters does not concur in the recommendation to extend the contract 6 months. However, it is recommended that the present PLL-ASL stockage be retained, that one technical representative remain with the detachment, and that the contract, with modifications, be extended for 3 months until 30 April 1968. This headquarters considers that a 3 month extension on the contract will allow sufficient additional time to observe and evaluate the tree crusher under varying conditions and to reach essential conclusions not possible at the present time. Observations, to date, are based on limited conditions of jungle, terrain, and hostile attack.

**3. This headquarters concurs in the comments in paragraph 3, 1st Indorsement. The observations made thus far, in the limited time available, have been insufficient to conclude that the tree crusher is an economical and efficient means of clearing jungle under combat conditions. Therefore, action to order into production or purchase additional tree crushers is not appropriate at this time.

4. The comparison of tree crushers with Rome Plows, paragraph III of the report, provides useful information. However, in order to determine the more economical means of clearing, the operating unit costs must be compared, i.e., personnel costs, repair parts and POL costs, and costs of other support requirements.

5. Particularly noteworthy is the fact that the machines experienced few mechanical problems until the end of the test period when the electrical systems failed on both machines. Serious breakdown of the electrical systems indicates further observations are necessary before it can be concluded that the machines are relatively maintenance free.

**NO ADDITIONAL INDORSEMENTS RECEIVED, HQS, DA

AVBI-OS 26 December 1967
SUBJECT: Transphibian Tactical Crusher Evaluation

6. Little experience was gained with respect to the tree crusher's ability to survive in a hostile environment. The degree of incapacitation that might be caused by an anti-tank mine or a direct hit with an RPG round is unknown. The machine operates in very difficult terrain where support and maintenance equipment would experience great difficulty in making major repairs to damage as a result of hostile action. This same terrain makes the security of operations a difficult task, and increases the probability of VC-inflicted damage in more active hostile areas than those experienced thus far.

FOR THE COMMANDER:

t/ROBERT F. JONES
Captain CE
Assistant Adjutant

93

DEPARTMENT OF THE ARMY
HEADQUARTERS, 93D ENGINEER BATTALION (CONST)
APO San Francisco 96370

SUPPLEMENTAL REPORT NO. 1
TO
TRANSPHIBIAN TACTICAL CRUSHER EVALUATION

Incl 2

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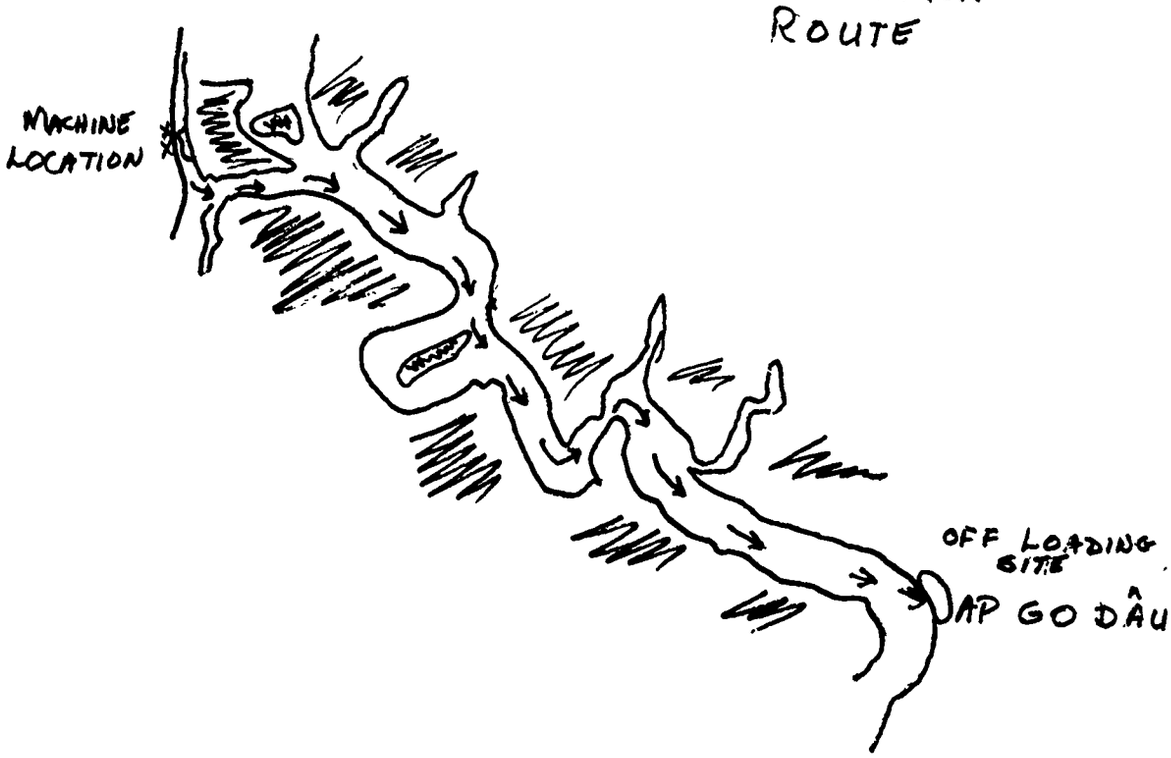
95

21
+ 84

TRACE OF
EXTRACTION
ROUTE



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I. INTRODUCTION

Following the close of the transphibian tactical crusher evaluation period on 15 December, the crushers encountered difficulties in a waterway of the Nhon Trach and could not be driven out under their own power. This mechanical failure and the subsequent removal and disassembly of the machines is judged to be of sufficient importance to warrant a short supplement to the original evaluation. This report is compiled from interviews conducted with individuals involved with the tactical crushers during the period 16 December to 24 December 1967.

A channel in the Nhon Trach near high tide (Thi Vai River, Coordinates YS 160817).

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II. PARAMETERS OF EVALUATION

A. Scope of Operation

1. Personnel and Equipment: The personnel and equipment assigned to the Tree Crusher Detachment remained unchanged during this period with the exception of the addition of various boats for security and transportation. Assisting in the operation during this period were four bridge boats; three from the 100th FB Co and one from the 573d FB Co. The 15th Engrs also supplied five air boats and three 12-ton bridge float assemblies. The Battalion Executive Officer supervised the extraction, removal, and teardown operation.

2. Test Area: The entire period was spent in the Thi Vai River which is the main stream flowing through the Nhon Trach tidal swamp. The area is composed of island-like deposits of tidal silt interlaced with water channels of varying widths. High tide occurs twice each day, the first tide rises approximately three feet and the second about eleven feet. The current velocity varies from three to five feet per second.

B. Evaluation of Performance

1. Problems Encountered in Deep Water: On 16 December 1967, the machines were to swim up the Thi Vai River to their original point of entry into the Nhon Trach, which was the first leg of the trip back to Bearcat. Both machines crossed the soft ground shown in photograph 2 to reach the main water channel. As crusher number 2 reached the deep water of the main channel and started in, number 1 paused on the mud bank to watch the progress. Number 2 entered the deep water during the receding tide and was swept about fifty meters downstream. The operator had difficulty controlling the machine which tipped from side to side. Although the water was relatively calm on the surface, there was apparently a whirlpool or eddy current acting underneath the surface. After twenty or thirty minutes, number 2 reached the far bank and paused for number 1 to move out. Number 1 then entered the water and encountered the same difficulty with the current. The machine started dipping from side to side despite the operator's efforts to control it against the current. Suddenly the operator of number 1 could hear the machine taking on water. It sounded as if it was pouring into the front axle and very soon thereafter smoke started to enter the driver's compartment from the ventilating port. The machine behaved erratically and the right front drum locked. At this point the operator of number 2 saw the smoke coming from number 1 and moved accross the stream to assist the other crusher. The operator swam number 2 downstream to turn around, and when he did so, the machine tilted and the operator thought he heard water running into the frame. Crusher 2 continued to operate however, and moved back upstream to put a tow cable on the first machine. As he approached the stranded machine, the operator noticed that his right front drum would not move, so he shut down number 2 immediately. A small amount of smoke from machine number 2 was noticed by the people on machine number 1. A detailed discussion of the mechanical difficulties is covered in section D.

2. Extraction: By late afternoon of the 16th, the situation looked bleak. Both crushers were disabled in the middle of the Nhon Trach tidal

#2 — Marsh leading from Phuoc Tho into the Nhon Trach Swamp during the rising tide (Coordinates YS153823).

swamp. Neither would run nor float. How do you extract 195 tons of steel and wire? The machines were highly vulnerable to enemy action in that only limited security could be afforded with the equipment on hand. At least there was no problem of the machines floating away; the operators had beached them as soon as they had run into difficulty. The machines were spaced approximately 150 feet apart and did not float away even at high tide (see photograph 3). The two immediate problems were the removal of the water from the inside of the axle, and the securing of the machines from enemy action. On the 17th, a land and air reconnaissance was made to fix the location of the crushers and to locate a suitable extraction site. The only feasible site - firm shore and cleared bank with land access - was located eight kilometers downstream at the destroyed village of Ap Go Dau. Photograph 4 shows the bank at that location. During the day mechanics and tools were lowered from helicopters to the machines to determine the extent of the damage. A pump was also taken out to the crushers to begin pumping out the water. Lengths of hose were used in conjunction with the pumps to siphon the water from the front axles, but these devices could only be employed at low tide since the remainder of the time the access plate to the front axle was under water. Boats were the only means of getting to the crushers as well as defending them and maximum effort was made to obtain a sufficient number. On 18 December, four bridge erection boats were placed in the water near the stranded crusher with the aid of a Chinook. Five airboats were assembled on 19 December. The airboats provided security and a ferry service between the landing site at Ap Go Dau, code name Point Zulu, and the crushers. Two of the airboats mounted .50 caliber machine guns and the remainder were equipped with 7.62 mm machine guns. Photograph number 5 shows one of these airboats with Thai security elements. On 19 December, machine number 1 had been pumped out and was pulled from its mud berth by the four bridge erection boats. The first attempt was made against the current for maximum control, but little headway was made. Moving with the current proved easier, although it was much more difficult to maneuver the machine in the swift water (see photograph 6). Many combinations of the four boats pulling and pushing were attempted. The crushers were not designed for this manuever. Most effective was found to be four boats tied together pulling the machine broadside against the rising tide; the maximum speed was .75 km/hr. The tide does not rise long enough to make the trip; therefore it was necessary to ride the tide out. Riding the tide with full power provided what was considered to be marginal power for control. The trip for the first crusher required 6 hours and 10 minutes. By 2200 hrs, with floodlights the two M-88's had pulled the 97½ ton crusher from the water over the relatively firm bank (see photograph 7). By now a fairly sizeable force was concentrated at Point Zulu which had been secured by the 3/5 Cav on the evening of the 19th. A dozer was used to establish a protective berm around the area. The second crusher posed a somewhat greater problem in that the suction caused by the mud bank kept the front drums from floating even after the front axle had been pumped clear of water (see photograph 8). Three 24-ton bridge pontoons were assembled at Point Zulu, loaded with bridge timbers, and moved upstream to the crushers as shown in photograph 9. Their purpose was to add to the floatation of the front end of the crusher and thus help break it loose from the mud bank. The floats could be maneuvered only during a period of several hours each day, since at low tide the mud offered no foothold (photograph 10) and high tide covered the drums. Between the fall and rise of tide on 21 December two complete floats were wedged under the bumper assembly and were lashed to the bumper (picture 11). C4 explosive was also buried in the mud alongside the drums to be

#3 — Tactical crusher #1 at high tide. The water in the main axle coupled with the suction afforded by the mud prevented the machine from floating away. The Thai security element encamped on the cab.

#4 — Bank of river at Ap Go Dau (coord YS 213788) (note laterite rocks along the shore)

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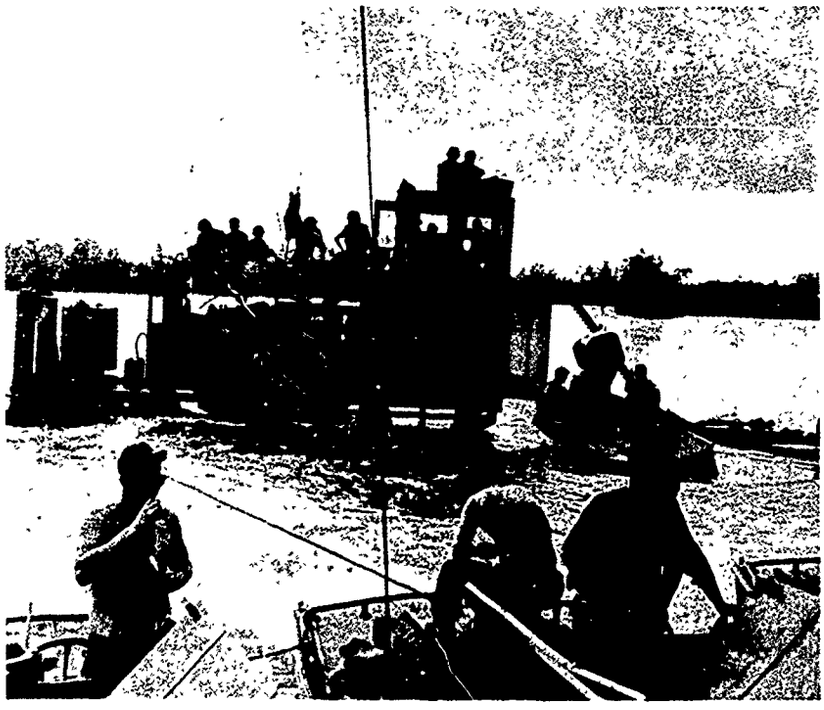
#5 — Airboat supplied by 15th Engr Bn (C) with Thai security. In addition to providing security, airboats were used to move personnel and supplies to the crushers.

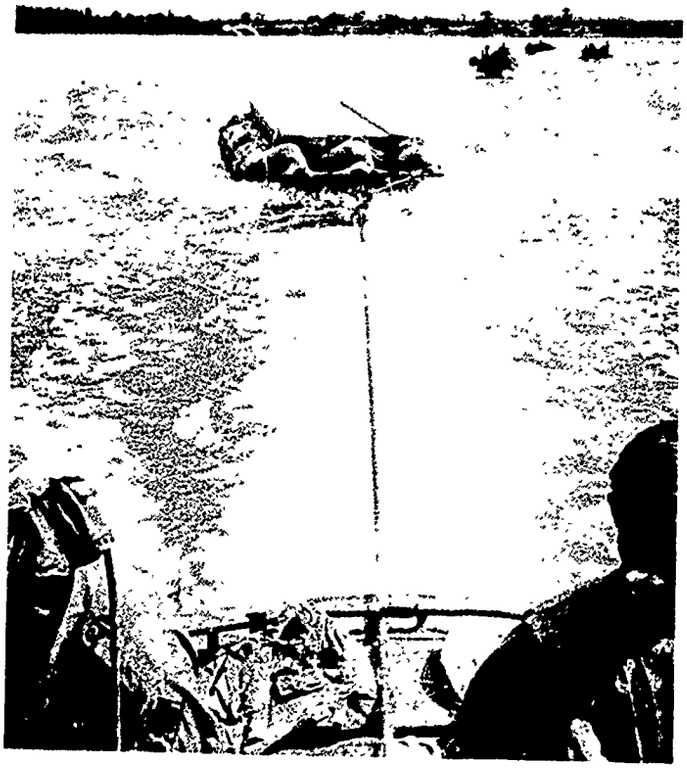


#6 — Bridge erection boats towing crusher downstream to Poi Zulu. Four boats were used. The boats were tied together to form one power unit. Two boats were tied to tug section (rear) and two boats tied to front end of crusher. Max speed .75 km/hr against tide.

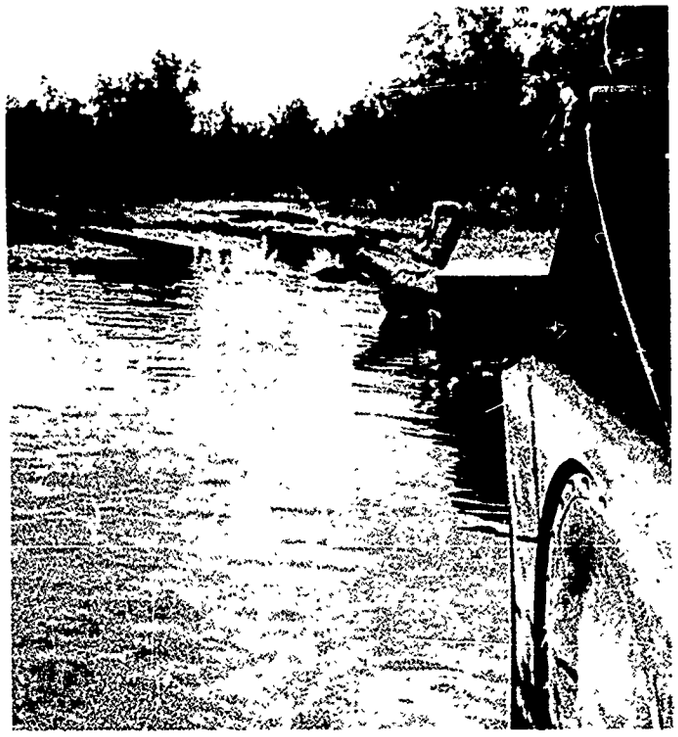
#7 — Extraction of tree crusher at Zulu. The crusher would move with a single line until floatation was lost. A change to a double line is in progress. Tracks of the first nights extraction are visible.

#8 — Tactical crusher #2 stuck in the mud at high tide. Branches were helpful in keeping burning sun from security troops.

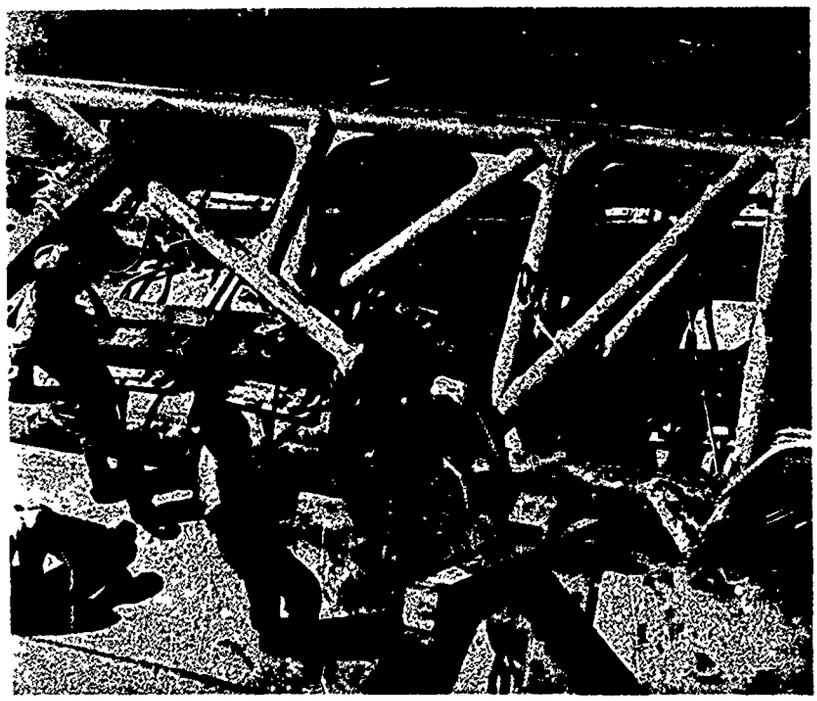
103



#9 — Movement of the pontoons upstream to aid crusher #2.



#10 — Wedging the floats underneath the bumper assembly of crusher #2. Maneuvering floats was difficult: bottomless mud at low tide and water at high tide.



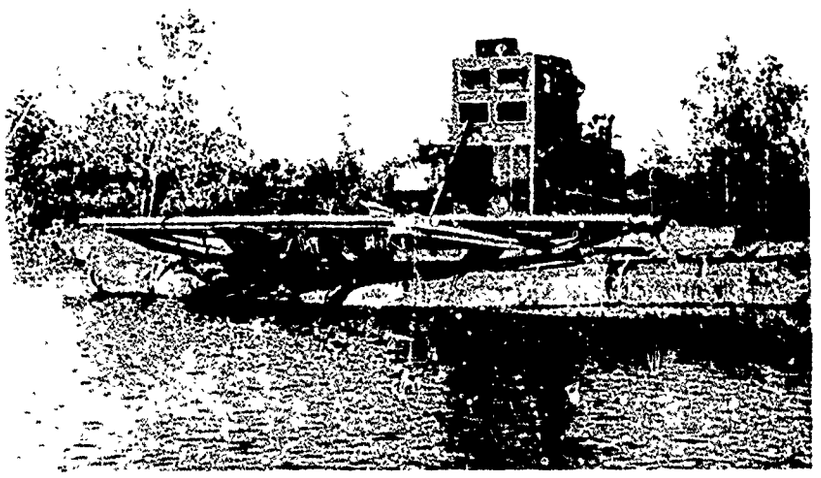
#11 — Floats in place and secured to the bumper. Timbers were wedged and lashed to insure maximum floatation and to keep floats from sliding on the sloping surface of the bumper.

used if necessary to break the suction of the mud. This was to be the last ditch attempt to free the machine. Everything stood in readiness for the high tide late in the afternoon. The tide came in slowly and the timbers placed on the top of the floats creaked and groaned as they were mashed against the bumpers by the relentless tide. Finally the machine broke loose with tide left to spare. Photograph number 12 shows crusher number 2 prior to breaking loose. Movement down to the landing site was not started until after 1930 high tide. The second trip was accomplished with 40% less power since one boat had developed transmission trouble and a second boat had lost one engine. The machine was carried by the currents of the falling tide and the boats were used to keep the machine as close as possible to the channel. The second trip lasted 3 hours and 15 minutes but to those who were aware of the lack of control over the machine it seemed much longer. Zulu was reached after 2245 that evening. The lack of control made it necessary to beach the machine, and the tree crusher was extracted with the two VTR's on the early morning tide 22 Dec 67.

3. Disassembly: Disassembly was not accomplished during the previous evaluation period. During this period however, both machines were torn down and moved twenty-five kilometers overland. The disassembly was accomplished in a much shorter time than thought possible. A strong motivational factor in the form of heavy VC action in the vicinity coupled with the anticipated loss of our security force on 24 December undoubtedly contributed to the rapid teardown. The first machine was completely disassembled in 18½ hours, and the second machine required only 11½ hours. Photographs 13 through 20 show this disassembly and point up the value of an M-88 tank retriever for this operation. It was definitely established that this piece of equipment has the most desirable combination of capabilities needed for disassembly. It has sufficient power and lifting strength to easily handle every operation including lifting of the cab assembly from the top of the crusher. The 20-ton crane, on the other hand, cannot accomplish many of the operations without being moved several times (requiring the object being moved to be set down each time). The disassembly of the machines with the M-88 proved to be practically fool-proof and no problems were encountered.

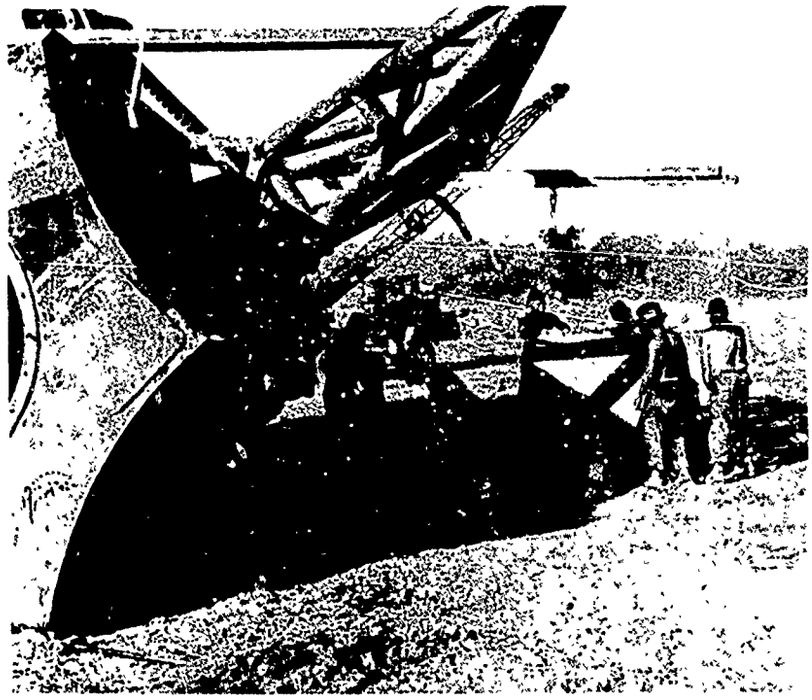
4. Movement: Each crusher was moved with six 25-ton lowbeds and no difficulties were encountered. A shuttle system was used to conserve the number of 5-ton tractors required. Care had to be excercised due to the wide loads (see photographs 21 and 22).

C. Security and Resupply: The same problems encountered during the evaluation period in trying to defend and resupply the crushers in swamp areas were encountered during the recovering period. The security force was restricted to the tops of the crushers or to boats as shown in photographs 23 and 24. Resupply was accomplished by boat or by air (see picture 25). The vegetation on the surrounding mud flats was practically impenetrable (at least for a force of any size) and apparently presented as great an obstacle to the enemy as to the friendly forces. During this period there were several Viet Cong attacks in the vicinity against the RTAVR First Rifle Company, the unit providing security up in the Nhon Trach, and later against the 3/5 Cavalry, providing security at the landing site. Despite these attacks, which ranged up to battalion strength, the crushers did not come under fire. The eight kilometers of water between the entry point and Zulu posed the greatest problem in securing the crushers.



#12 — Crusher #2 as the tide comes in. The wedged timber holds the floats under the bumper and transferred the force in a lever effect lifting the drums from the mud.

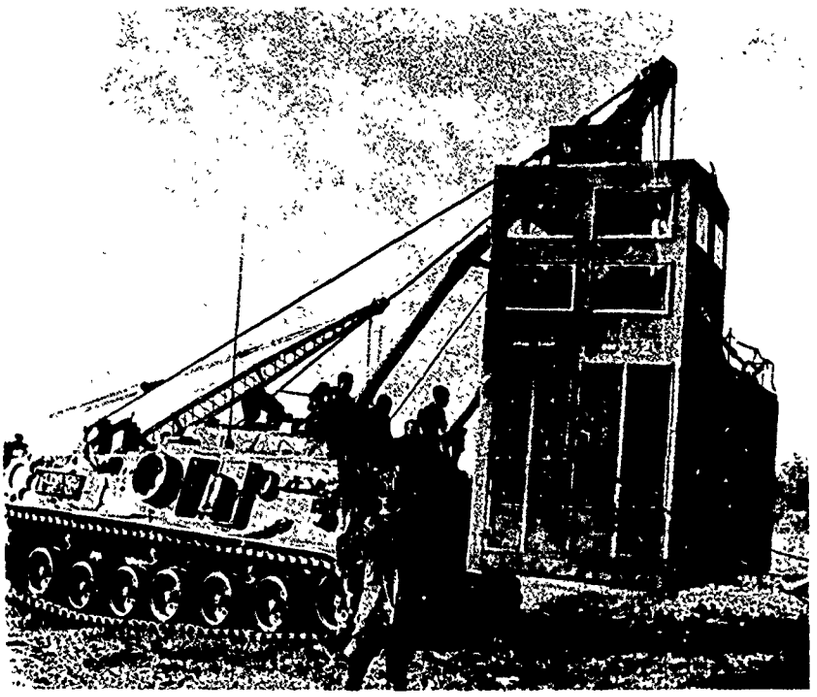
101



#13. Disassembly at Ap Go Dau. Large steel plates and jack stands must be positioned by hand under the bumper assembly.

#14. Bumper assembly is lowered on the jacks to raise the drums off the ground.

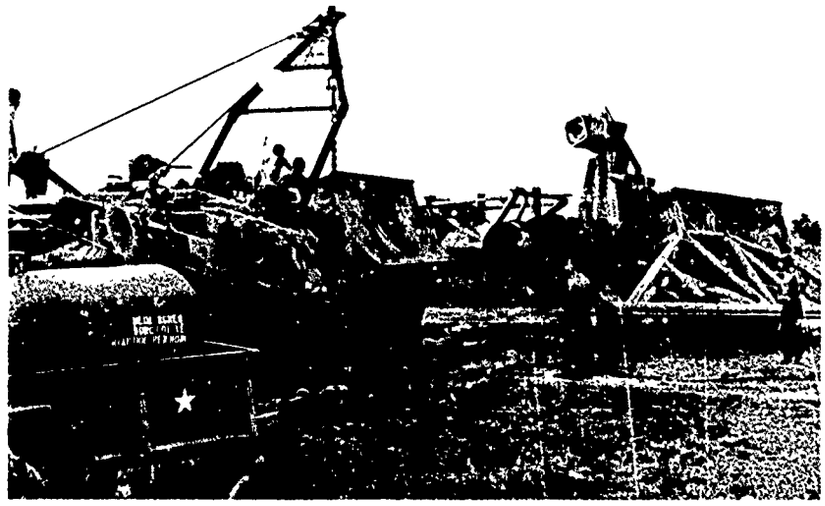
108



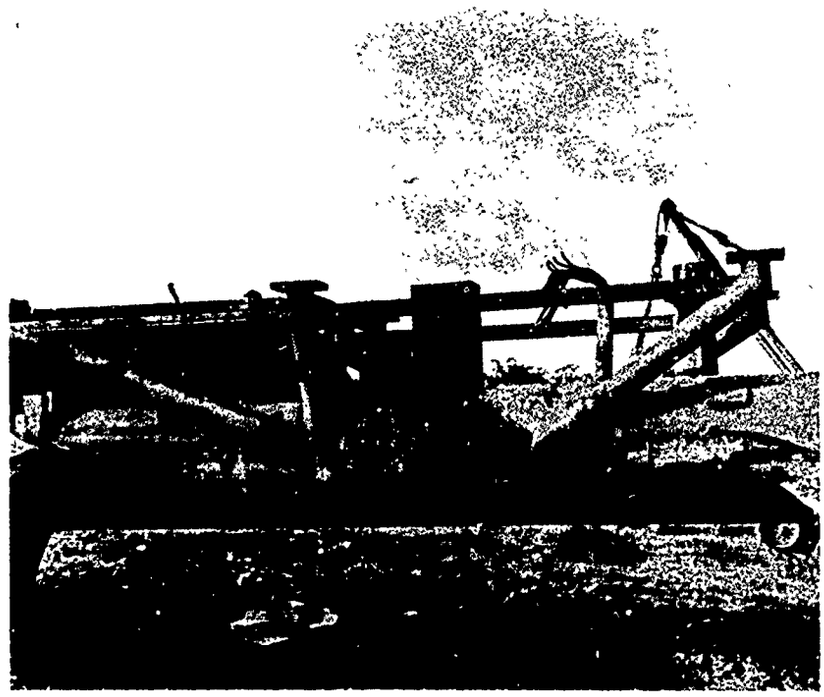
#15. The heavy lift: proof that the VTR can handle the job of lifting the 14-ton cab and power assembly.

#16. Without electric power, the electric motor had to be turned with a wrench to lower the bumper.

109

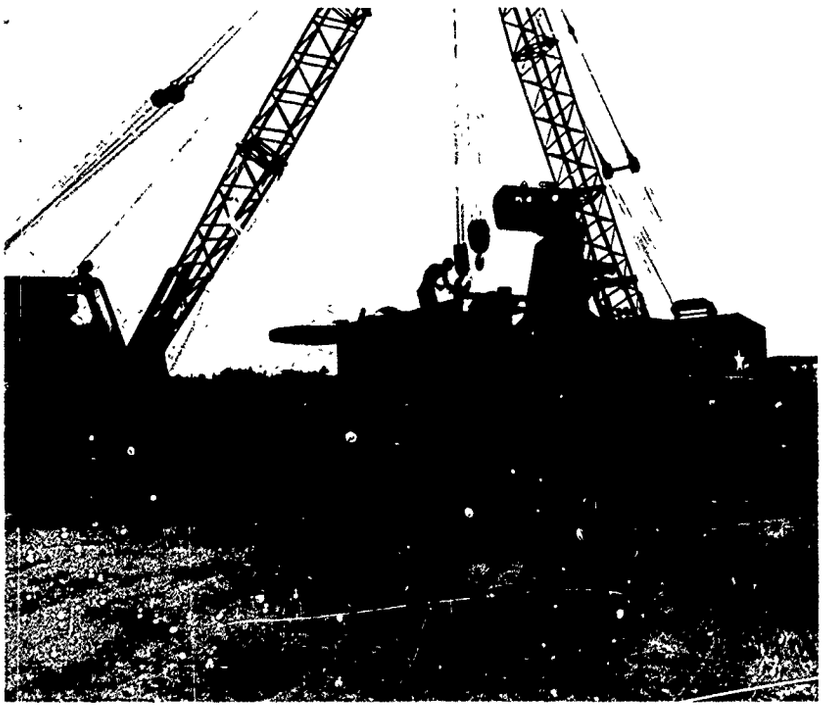


#17. VTR stripping a 24,000 pound drum from the carcass.

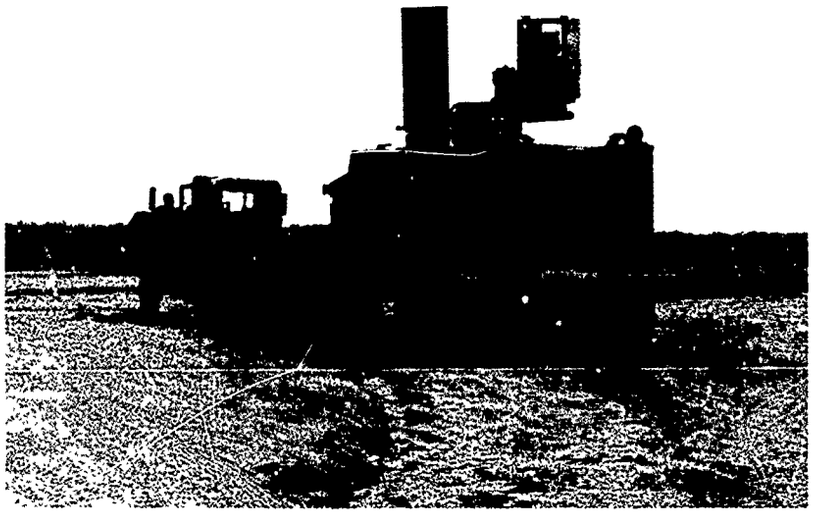


#18. Main frame assembly - the rectangular vertical tube most likely allowed water into the main frame and caused the electrical shorts.

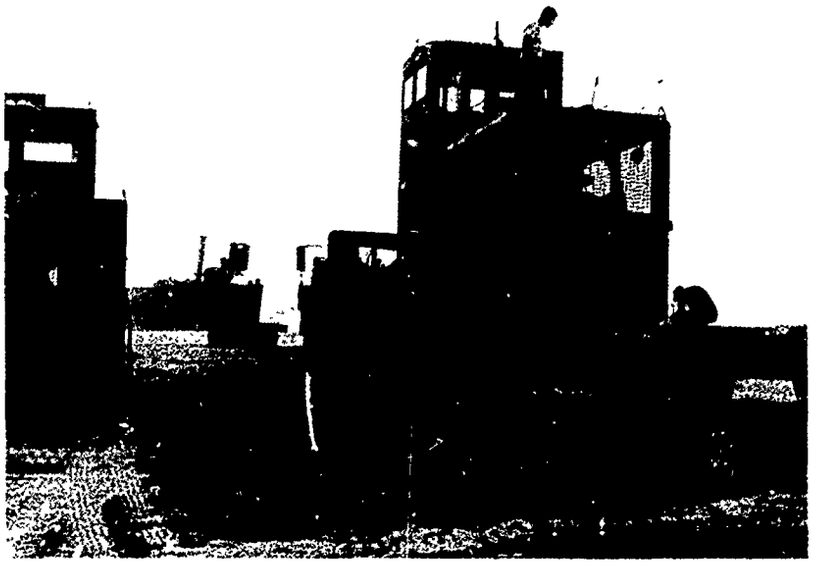
#19. The wide ones - each of the 3 drums with hubs requires a lowbed. The load width is 14 ft.



#20. The main frame being unloaded. Two 20-ton cranes must team up when a VTR is not available.

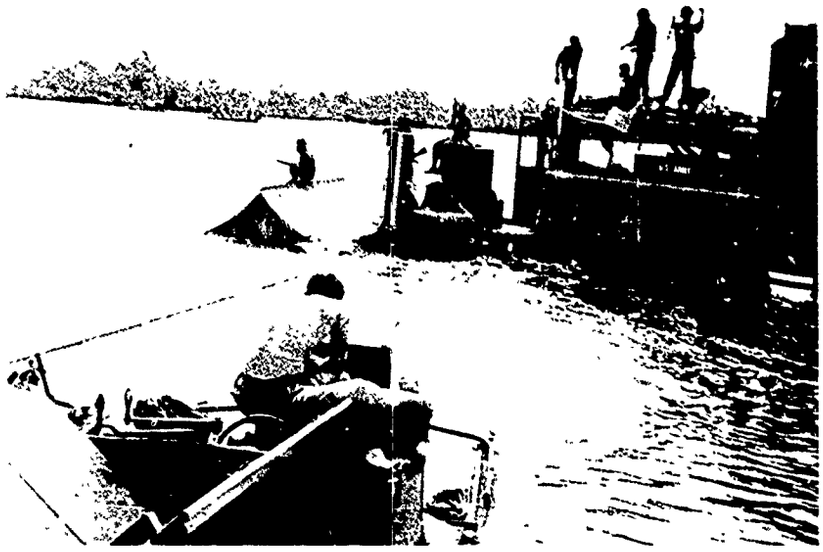


#21. The tug structure loaded for transport back to Camp Castle. The load is 14 feet wide.



#22. The cab/engine load prior to securing on lowbed.

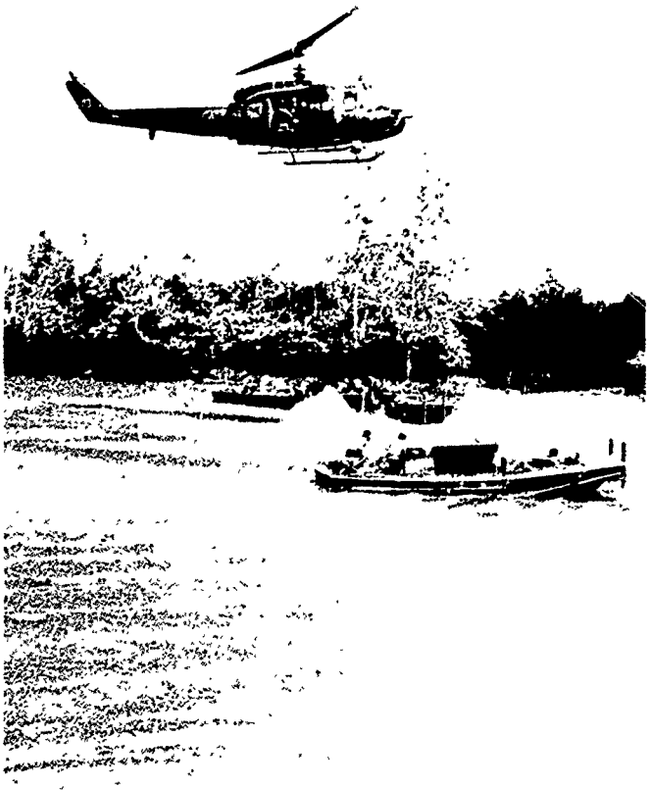
112



#23. The security deployed on top of the crushers. Note double lines from tug structure.

#24. Security force patrolling the stream. Boats covered the banks during the move.

113



#25. Resupply of C-rations by air to security forces. Those that didn't sink were recovered. There was no bank or open space to land or drop supplies. Water cans were handed from helicopter but almost sank the boats.

During movement, maximum use was made of the airboats which constantly patrolled up and down stream to discourage any would-be attackers.

D. Maintenance:

1. The major maintenance problem encountered during this period was the shipping of water by both machines and the subsequent power failure. The machines are constructed to be watertight and have operated in the water previously with little difficulty. However, in this case one machine took six to eight inches into the main axle and the other machine had its axle completely filled with water. A great deal of the wiring and a large transformer are contained in this front axle assembly which is located between the two front drums. The water caused shorts in this wiring and disabled both machines. How much additional damage the high concentration of salt in the water might have caused to the driver seals and electric wiring cannot be determined.

2. There are four possible ways for the water to have entered into the axles: 1) through the front access plate cover, 2) though the driver seals, 3) through the exhaust port located under the main frame cab assembly, and 4) through cracks in the frame. After examination during the extraction process and after disassembly of the machines, it was determined that the primary leakage occurred through the exhaust port, probably as a result of the wave action and subsequent dipping of the machines. Normally this port is two feet above the water line (the exhaust port can be seen in picture 18). After the water was pumped out of the crushers, these ports were sealed off with canvas prior to the movement downstream. Leakage around the driver seals contributed to the intake of water in at least one machine. These seals had not been changed for several months and appeared to have been adversely affected by the salt water. It is not felt that the driver seals were a significant factor as no additional leakage could be established during the 12 to 24 hours the crushers spent in the river after the water was removed, and water could not have been heard going through the seals. The possibility of leakage through the driver's access plate has been eliminated since there were no air bubbles seen around the plate on either machine and the gaskets were unbroken. Apparent leaking through a crack in the frame was observed during pumping on the 2nd machine extracted.

E. Support: The only additional material gathered concerning the support requirements of the tactical tree crushers involved the confirmation of the earlier belief that the M-88 tank retriever is a far superior vehicle to the rough terrain crane for the disassembly of the tree crushers. It was established also that there is no need for a forty-ton crane as had been thought earlier.

F. Training: Additional training for the operators of the tactical crusher in deep water is needed.

G. Modifications:

1. Exhaust Port: The design of the exhaust port is presently being modified to outlet through the engine compartment, thus raising the outlet to four feet above the floatation line, and eliminating the possibility of

water entering through this port. Future models should incorporate some modification to exhaust this outlet at an equivalent height above the water.

2. Bilge Pumps and Drain Plugs: A definite need exists for a bilge pump to prevent a power failure if water should enter the front axle or main frame. This unit has installed a drain plug in the front axle to facilitate checks after amphibian operations. A factory modification to incorporate drain plugs might prove helpful.

3. Access to the main frame and front axle while the machine was floating would have saved much time and allowed repairs and pumping and possibly prevented much of the damage. The feasibility of this as a factory modification cannot be evaluated.

III. CONCLUSIONS AND RECOMMENDATIONS

A. The activities during this period have not changed any of the original conclusions or recommendations with the exception of the problems encountered in the swiftly moving water.

B. If operations in water are anticipated, the machines should be modified to include a higher exhaust port, bilge pumps, and additional training should be afforded the operators.

C. Driver seals should be checked before amphibian operations are undertaken with the crushers.

D. Disassembly and movement of the crushers by road to another site appears feasible although it is not the preferable method of movement and should be limited to emergency situations. In most situations time and effort for reassembly of the machines is not justified unless it would take at least a week to cover the distance overland; even in that case, consideration should be given to the fact that the machine is not designed for repeated assembly and disassembly.

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