HQ TRAC, RPD-1-88

GAP CROSSING REQUIREMENT REVIEW

MARK W. MURRAY

AUGUST 1988

QUICK-REACTION ANALYSIS

TECHNICAL CERTIFICATION

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HQ TRAC, RPD performed the Gap Crossing Requirement Review in response to a DCSCD, HQ TRADOC question on whether the BFV follow-on should be required to swim. The purpose of the study was to conduct an analysis of the European geographic factors which force or allow the Army to seek a swim capability for future infantry fighting vehicles. The analysis is based on data from a Waterways Experiment Station (WES) report, "The Evaluation of the M2 Bradley Fighting Vehicle (BFV) System Crossing Gaps in Selected Areas in the Federal Republic of Germany," the Armored Family of Vehicles draft Required Operational Capabilities (ROC) document, and telephonic input from British and German analysts. The assessment compares geographic information with vehicle limitations.

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PREFACE

HQ TRAC, RPD presented this paper to HQ TRADOC, DCSCD (MG Maddox) on 31 December 1987.

ACKNOWLEDGEMENT

HQ TRADOC, DCSCD initiated this study. HQ TRAC, Requirements and Programs Directorate (RPD) at Ft Monroe, VA performed the study.

The Deputy Chief of Staff for Combat Developments, HQ TRADOC has approved this report.

The conclusions presented in this study are those of the TRADOC Analysis Command and are based on data analyzed by HQ TRAC, RPD. Support to the study effort was provided by the U.S. Army Corps of Engineers' Waterways Experiment Station (WES), HQ TRADOC's Close Combat, Engineer, and Mine Warfare Directorate, and Federal Republic of Germany and United Kingdom analysts.

The HQ TRAC, RPD analyst was Mr. Mark W. Murray.

Support from organizations external to TRADOC was provided by Mr. James H. Robinson, WES, Mr. T. J. Stakemire, UK MOD OAD, Mr. A. F. Everett, UK MOD RARDE, and COL Pawel, FRG.

Gap Crossing Requirement Review

1. Purpose. This paper presents the findings of a HQ TRAC, RPD review of a Waterways Experiment Station (WES) report, "The Evaluation of the M2 Bradley Fighting Vehicle (BFV) System Crossing Gaps in Selected Areas in the Federal Republic of Germany", Mar 87.

2. Background. HQ TRAC, RPD did this review responding to a DCSCD, HQ TRADOC question on whether the Bradley follow-on should be required to swim.

3. Problem. The European theater river obstacles have led USAIS to state a requirement for Infantry Fighting Vehicles (IFV) to swim. HQ TRAC, RPD reviewed the WES study to assess whether European geographic factors force or allow the Army to seek a swim capability for future IFV. We did not consider other theaters.

4. Approach. This analysis is based on data in the WES study, the Armored Family of Vehicles (AFV) Draft Required Operational Capability (ROC) document, and telephonic input from British and German analysts. The analysis compares geographic information with vehicle limitations.

5. Allied Positions. Table 1 summarizes the input provided by German and British analysts. The bottom line is that they do not recognize a requirement to swim.

Table 1

NATO VIEWS ON SWIM REQUIREMENTS - INDIVIDUAL ESTIMATES

COUNTRY	STUDIES?	SWIM?	FORD?
Germany	No	No	Yes
Britain	Limited	No	Yes

Comments:

- o It is too costly to swim.
- o Fixed bridges will support river crossings. The Soviets will not destroy the bridges because they will need to use them for their own advances.
- o If a river is too deep to ford, then the currents are often too fast to swim.
- o The major river currents (Rhine, Weser, Mosel) are too fast.

o A swimming capability is a trade-off for armor protection; heavier vehicles are harder to make swim.

o There can be a trade-off in force capabilities; armies can invest in engineer force structure rather than the swim expense.

o Armored vehicles can ford approximately 80 percent of the rivers. A swim capability is only marginally necessary.

o Exiting rivers from a swim mode is often impossible due to the steepness of the river banks.

6. AFV System Requirements. Table 2 lists the requirements which the BFV Follow-on (FO) must meet to satisfy the draft ROC. Note that "self-span" is defined in this analysis to mean the vehicle can cross a gap without going down into the gap; at some point the vehicle will touch the tops of both banks simultaneously.

Table 2

BFV FOLLOW-ON "GO" CRITERIA FROM ROC

o Vehicle Self Span Distance < 7 feet

o Bank Angle < 60 degrees

o Bank Height < 3.5 feet

o Water Depth < 60 inches (for fording)

o Water Velocity < 3 mph (4 ft per second)

7. Land Areas Considered. Each of the five areas of West Germany studied covered an area about 21 km wide divided into 3 km strips within which the vehicle could seek an unobstructed path. Lengths of the strips for the first four areas were 23 km long, the fifth area traversed the width of the southern section of the Federal Republic of Germany (about 300 km). The areas considered were:

a. V Corps sector, Lauterbach and Hunfeld.

b. VII Corps sector, Nabburg.

c. III Corps sector, Burgdorf, a northern sector which has about three times more water crossings than the others.

d. An area north of Nabburg and extending from the East German border to the French border, which was analyzed in an earlier WES study and included in the Mar 87 report.

8. Geographic Traits. Displays 1 - 4 (encl 1-4) chart the characteristics of the natural obstacles any IFV is likely to encounter in the areas considered. Indicated on the charts are the critical vehicle characteristics which delineate the crossover points where a vehicle's operating mode will change. Based on WES's analytical approach, no attempt was made to operationally plan maneuver routes through an area based on known river obstacles.

9. Analysis. Table 3 summarizes the options available for a successful gap crossing given the set of environmental factors involved. The charts and tables for the high, mean, and low water levels show that:

a. The BFV FO should be able to "self-span" at least half the gaps.

b. The BFV FO should be able to ford at least three-fourths of the gaps at all water levels and more than 90% of them at mean or low water levels.

c. In most areas, less than half of the gaps have a slow enough water current to allow swimming at the high stage. Although current speed allows more swimming at the mean and low stages, the water depth at those stages usually allows fording.

d. Bank height and angle pose the most significant obstacles at any water level. Swimming onto a high or steep bank exacerbates the problem.

e. The analysis does not consider combinations which may further restrict the crossing options, e.g. low banks but swift currents or slow currents but high banks.

Table 3

GAP CROSSING OPTIONS

Water Level	Depth	Current	Bank	Generally Recommended Approach
	Sw-F-Sp*	Sw-F-Sp	Sw-F-Sp	
High	Y-N-N	N-N-N	N-?-?	NO GO
Mean	Y-Y-N	Y-Y-N	?-?-?	FORD
Low	N-Y-Y	Y-Y-Y	Y-Y-Y	FORD

*Sw-F-Sp: Swim - Ford - Span

10. Summary. Although the WES analysis did not consider the impact of pre-planning routes through an operational corridor, we can draw the following conclusions:

a. The BFV FO should be able to cross most gaps without swimming.

b. If the water depth prevents the BFV FO from fording, the current will often prevent it from swimming.

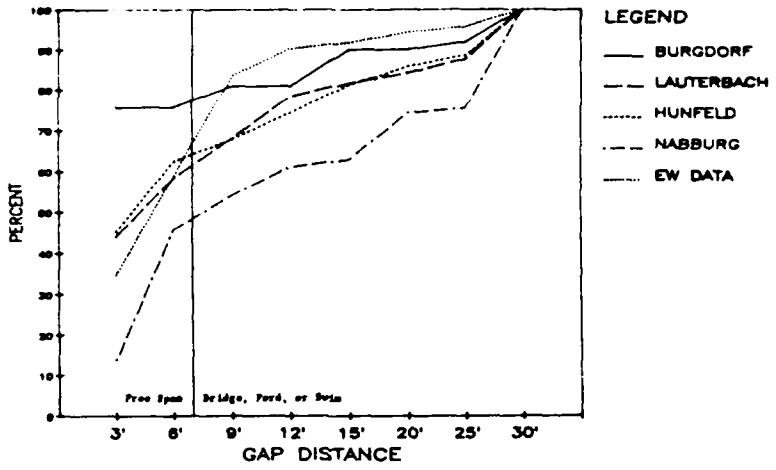
c. Where water current is slow enough for swimming, it is likely to be shallow enough to ford.

d. GE and UK do not have a requirement to swim and consider their fording and spanning capabilities to be adequate.

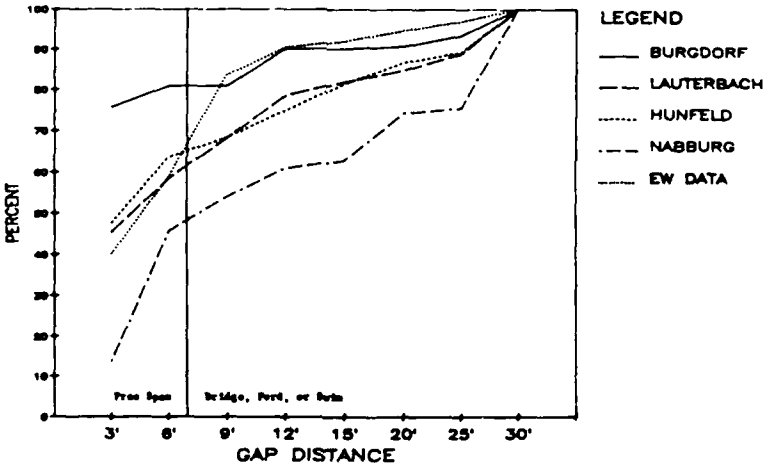
11. Conclusion. This analysis indicates that the BFV FO does not have a hard requirement to swim in Europe.

DISPLAY 1

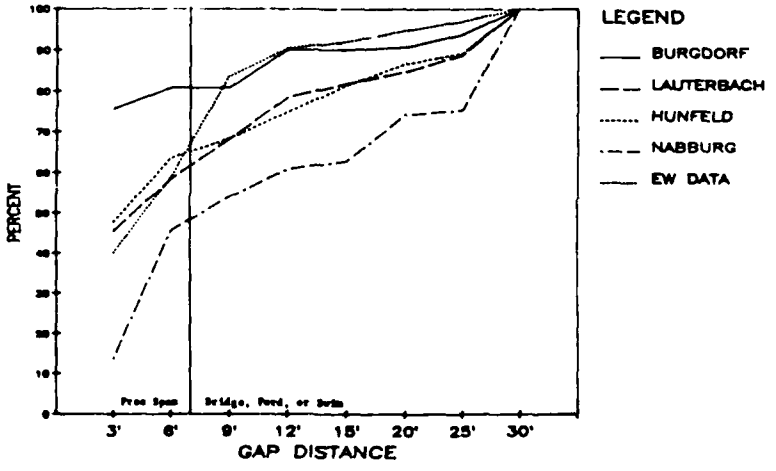
GAP DISTANCE
CUMULATIVE PERCENTAGES
HIGH STAGE



MEAN STAGE



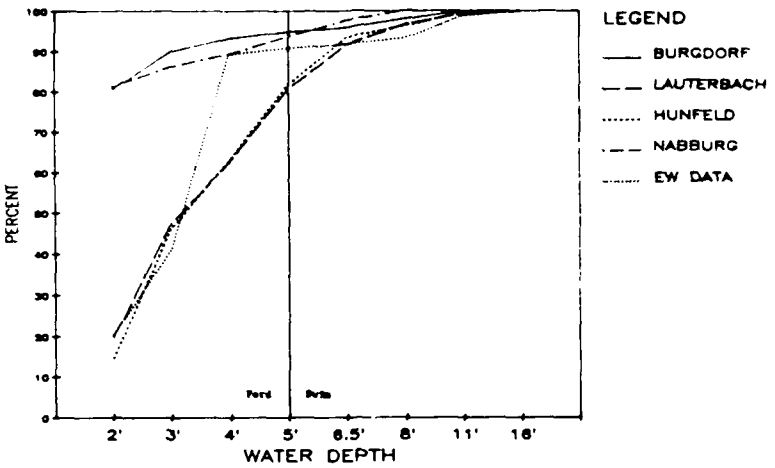
LOW STAGE



Encl 1

DISPLAY 2

WES STUDY WATER DEPTHS
CUMULATIVE PERCENTAGES
HIGH STAGE



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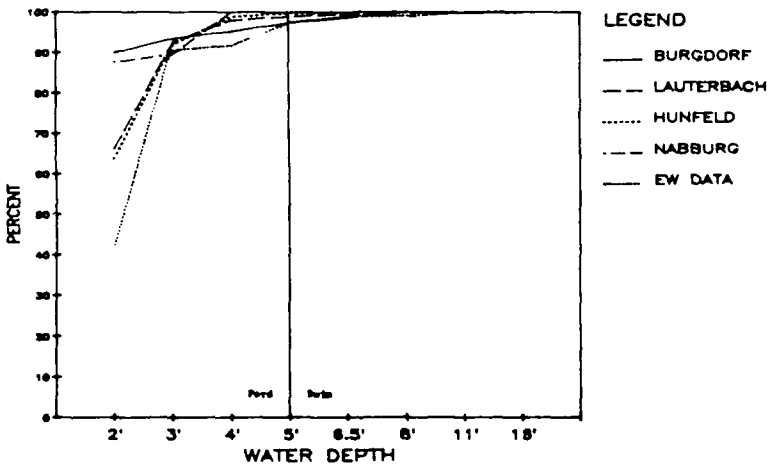

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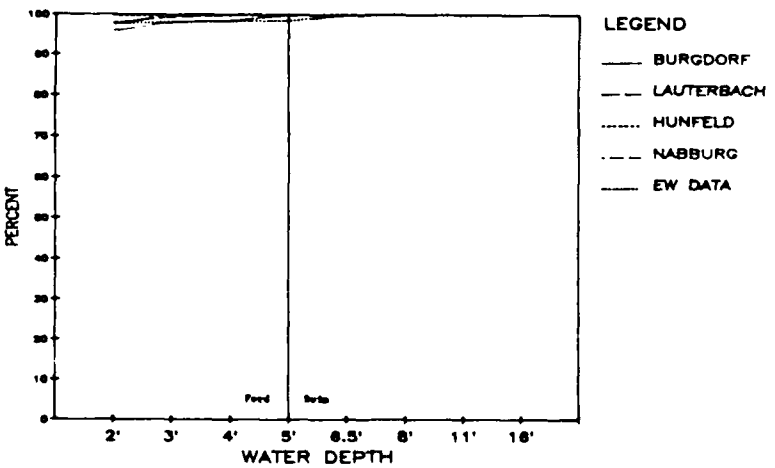

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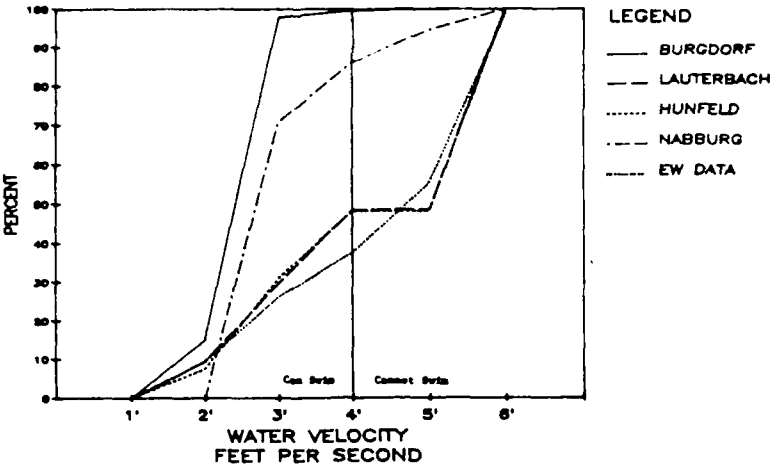
DISPLAY 3

WATER VELOCITY
CUMULATIVE PERCENTAGES
HIGH STAGE



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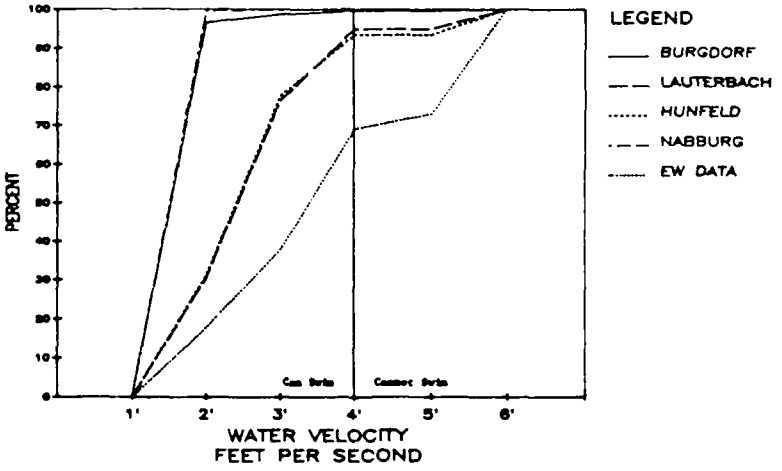

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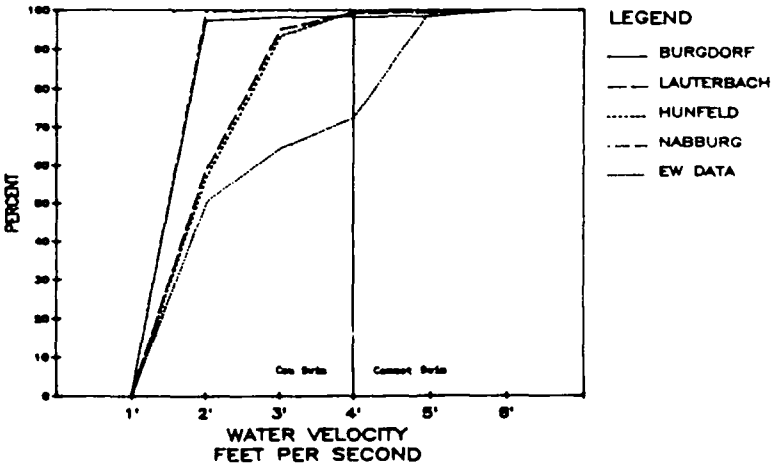

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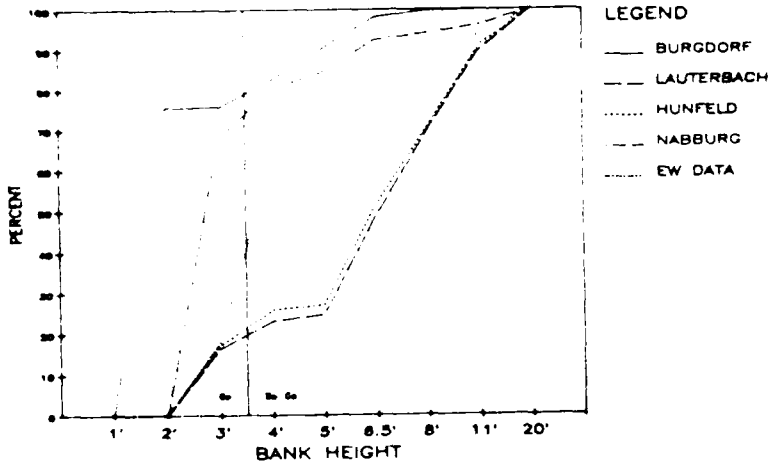
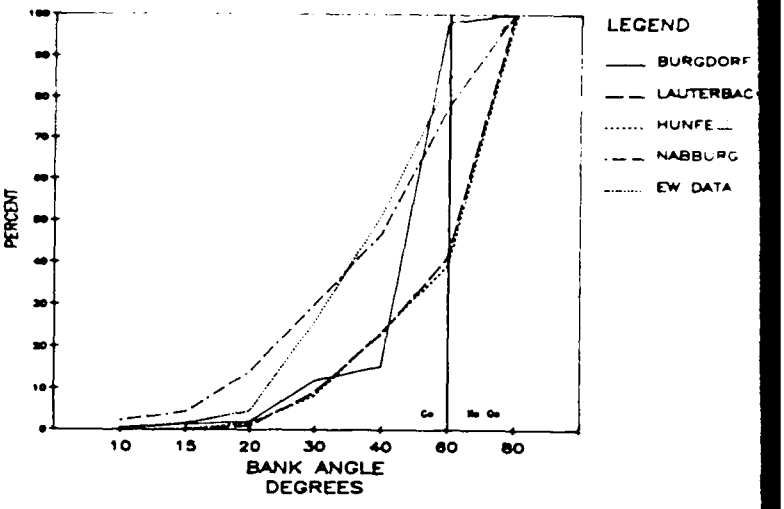
DISPLAY 4

GAP BANK HEIGHT
CUMULATIVE PERCENTAGES
HIGH STAGE



BANK ANGLE CLASSES
CUMULATIVE PERCENTAGES



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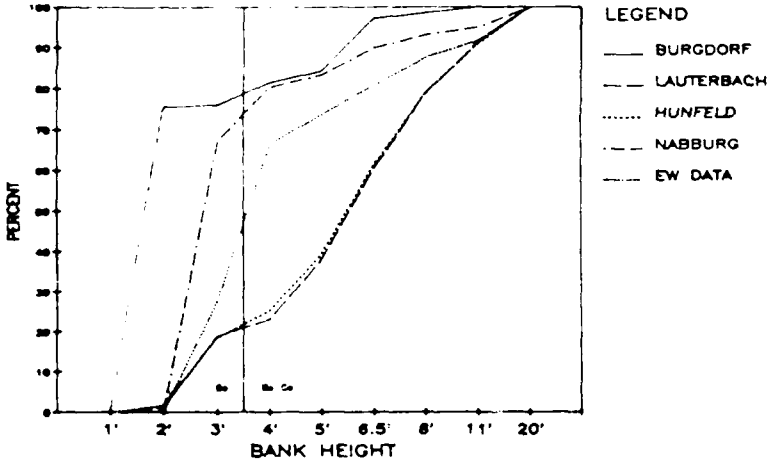

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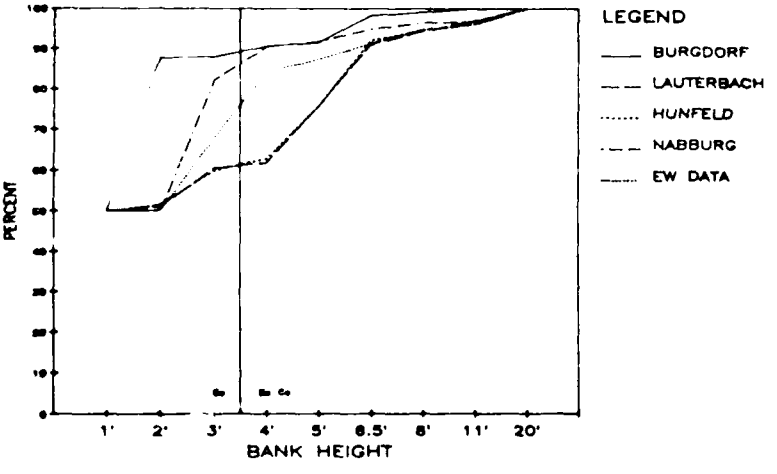

Encl 4

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Robinson, J. H., "Evaluation of the M2 Bradley Fighting Vehicle System Crossing Gaps in Selected Areas in the Federal Republic of Germany", U.S. Army Engineer Waterways Experiment Station, Corps of Engineers, Vicksburg, MS, March 1987.

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