NBC Reconnaissance

—concept evaluation

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The US Army needs an NBC reconnaissance capability more responsive to the commander's needs than the present system. To reduce developer risk and better define requirements, TRADOC conducted a front-end analysis using both the US (prototype) M113-based NBC Reconnaissance System (NBCRS) and the Federal Republic of Germany's (FRG) (fielded) ABC-Spuerpanzer Fuchs.

This concept evaluation program (CEP) assessed the relative merits of the Fuchs as an NBCRS, the mobility characteristics of the NBC wheeled versus tracked reconnaissance vehicles, and gathered data to better define and refine system requirements. Better definition should shorten the acquisition cycle.

1985 HQ TRADOC-approved issues and criteria for the NBCRS were used to ensure continuity throughout the program. These issues and criteria are based on the total requirement of an NBCRS. Wheeled, tracked, and aerial recon are expected to benefit from the approach.

An additional purpose was to assess the effectiveness of the candidate NBCRSs in a tactical environment. This test was a side-by-side demonstration to enable both a program direction and possible acquisition decision.

Wheeled NBCRS

TPz-1 Fuchs is a six-wheel, amphibious, armored cargo and tactical transporter with combat wheels of a special design. The German Army uses it extensively, not only the NBC defense units, but other units as well (engineer, signal, cavalry, and Army air defense).

In its NBC configuration, the Fuchs has three onboard specialized computers, a position locator system, and special detection and identification equipment for both nuclear and chemical hazards (See table 1).

It has a cargo space slightly larger than an M113, is armed with a ring-mounted 7.62mm machinegun, and carries a crew of four. The crew is armed with light or heavy anti-tank and individual weapons.

The vehicle is also equipped with a reloadable smoke launcher for its own protection. It has a built-in electrical overpressure system as well. The system is protected against electromagnetic pulse (EMP), transient radiation effects on electronics (TREE), and electronic countermeasures (ECM).

The system remained operational in tests up to six G-force measurements. It is not degraded by the use of German decontamination material (C-8 emulsion). The communication system is the standard German FM radio (SEM 25).

Easily modified, the basic TPz-1 chassis accommodates all configurations of installation kits throughout the German Army, allowing for rapid replacement of weapon systems on the battlefield. Drivers are equipped with image intensifying night vision periscopes. The TC has night vision goggles, and weapons have night sights as well.

The German vehicle navigation system FOA 25-30 operates through a gyro with a motion sensor attached to the transmission. A control display unit in the driver's compartment can be relocated throughout the vehicle.

Vehicle location is indicated by crossbairs moving over a map, and is displayed digitally using the 13-digit universal transverse mercator (UTM) grid system (see figure 1). This unit is integrated with the radiation and chemical detection equipment. The system can accommodate maps in five different scales.

Radiac equipment (ASG-1) consists of two probes installed in exterior ports on either side of the vehicle, connected to the radiation detection, indication, and computation instrument/recorder inside.

The navigation and radiological survey system within the vehicle is integrated so that every 20, 30, or 60 seconds, the computer prints out the following information:

- Six-digit UTM grid coordinates of the vehicle's location.
- The number of minutes that the vehicle has been on a survey mission.
- The exterior dose rate in rads per hour (rad/hr), normalized to H+1 or actual dose rate.

Push the print button, and manual readings can be taken at any time. A training device is available for the ASG-1 to manipulate the radiation meter during training from either on board the system or electronically over a training area.

Chemical detection and identification equipment consists of a detection membrane probe system with an air/ground probe, and a rugged, microprocessor-controlled German mass

spectrometer (GEMS, MM-1) equipped with remote-controlled twin sampling wheels. The twin sampling wheels alternately collect samples from the ground and introduce them to the GEMS probe for evaluation.

The system utilizes gas chromatography in the probe and mass spectrometry to cover a range from 1 to 400 atomic mass units (amu), enabling it to monitor all known chemical agents. The system provides a printout of the time of detection, type of agent, relative concentration, and vehicle location, giving both a visual and audible warning upon detection.

Data regarding 900 substances are permanently stored (plus 8 substances in temporary storage). To date, six production models of the wheeled NBCRS have been constructed containing the complete sensor suite.

Nuclear/chemical/biological sampling equipment consists of:

- A sample collecting device with transport container.
- Glove protection for collecting samples.

This equipment is fixed outside the vehicle and is operated manually using the glove. The entire system is sealed in order to prevent internal contamination.

NBC marking equipment consists of an airlock through which marking buoys are dropped. The buoys are designed to return immediately to the upright position, and are heavy enough to be unaffected by wind.

Tracked NBCRS

The tracked NBCRS is a modified M113 equipped with secure communication equipment, computer integrated chemical and nuclear detection devices, vehicle navigation system, reloadable projected smoke capability, an NBC contamination marking system, and a collective protection system.

The system has an organic decon capability with use of a mounted M13 Decon Apparatus, Portable (DAP). Automated and manually operable, mounted and dismounted chemical and radiation detectors monitor selected terrain surfaces at better than a three-minute repetition rate.

The samplers display contamination signals for surfaces with enough contamination to affect unprotected troops in the open and display a "no contamination" signal for surfaces with contamination less than the "no effects" dose to unprotected troops in the open.

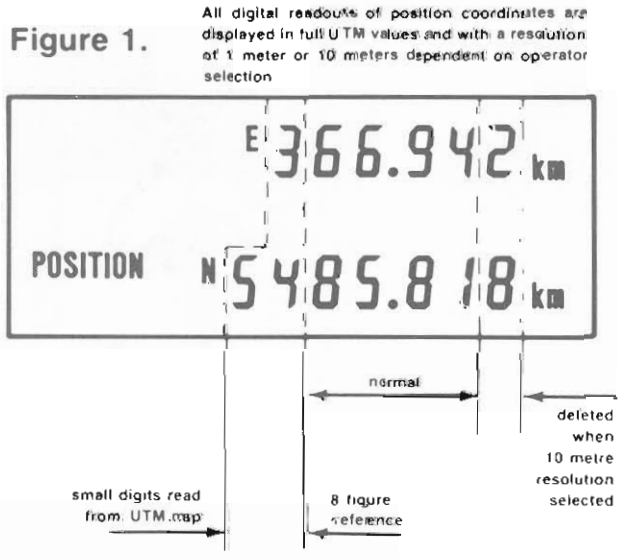
- The system is capable of mounted and dismounted NBC sampling, and is capable of storing a minimum of ten samples.
- The navigation system is capable of providing an eight-digit map coordinate of the vehicle location in a digital display.
- Terrain survey data, vehicle position, and air temperature are displayed on demand, can be edited, and may be immediately transmitted via secure radio link to a central receiving

Table 1. Wheeled NBCRS Equipment and Responsibilities

Driver	Commander	Surveyor 1	Surveyor 2
TPz-1	TPz-1	ASG-1	M43*
	FOA 25-10	GEMS	SEM 25
			CD Probe
			NBCS Kit
			NBC Markers

* The M43 alarm is used as a backup mounted and dismountable chemical agent alarm.

Figure 1.



The TPz-1A3 NBC Reconnaissance System is shown below with basic issue items.

station. A hard copy of the transmitted data is produced immediately.

• Table 2 lists the major components of the tracked NBCRS and shows who is responsible for each subsystem.

Tracked NBCRS Equipment

The Chemical Agent Monitor (CAM), a hand-held manually operated vapor agent detector, detects, identifies, and provides relative concentration data for nerve and blister agents. Securely stored externally on the vehicle, it is used when reconnaissance personnel or other accompanying forces are required to dismount and monitor the vehicle and/or terrain for chemical contamination.

The AN/VDR-2 is a small radiac set suitable for either hand-held or vehicle-mounted radiation monitoring, providing both dose-rate and total dose information from both within and outside the vehicle. It is turned on in the dose rate mode and allowed to operate throughout the NBCRS missions. Dose rate is periodically entered into the NBCRS computer.

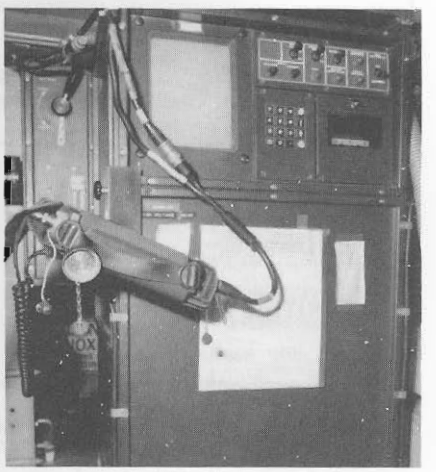
The Vehicle Navigation Aids System (VNAS) is a four-component system consisting of a vehicle reference unit (gyros), a distance measuring unit (odometer), a vehicle heading indicator, and a navigation display unit. The system is mounted on the vehicle with the odometer sensor mounted and connected into the vehicle odometer cable. The vehicle orientation unit and central processor are solidly mounted within the vehicle. The control panel/display unit is mounted to the right of the vehicle commander for ready access, without presenting a physical hazard.

GEMS is a chemical agent sensor developed for the German military for the detection of chemical warfare agents. This sensor was used on-board the tracked NBCRS as the primary chemical sensor. GEMS determines the presence of chemical agent vapors and residual ground contamination, and interfaces with an on-board computer. All electronic operations are performed on an externally mounted control panel by either keyboard entries or moving low voltage toggle switches. These operations isolate the operator from any potentially hazardous internal electronics. The calibration process is automatic and utilizes a closed loop sampling mode to prevent any of the calibrant gas (tri[pentafluoroethyl]-s-triazine) from escaping. The probe is operated from an insulated tube, thus limiting the potential for a skin burn.

The AN/VRC-46/47, components of the AN/VRC-12-series radio, is a standard military radio used in tracked vehicles. The AN/VRC-12-series radios provide short-range, two-way radiotelephone communication in the 30.00 to 75.95 MH_Z range, using frequency modulated (FM) transmission and reception. The AN/VRC-46/47 is used to demonstrate the effectiveness of digitally transmitting data and sending NBC

Table 2. Tracked NBCRS Equipment and Responsibilities

Driver	Commander	NBCRS Operator
M113	M113	M113
M13	AN/VRC 46/47 radios	M13
	IPECS	MET System
	VNAS	AN/VDR-2
		GEMS
		Ramp Cowling System
		DCT
		CAM



M113 NBCRS is shown at left with basic issue items. Both it and the TPz-1A3 were equipped with the programmable German Mass Spectrometer. Rear view shows GEMS placement.

messages under a simulated Threat environment.

To enable ready access to the ground (surface) from within the M113 a cowling was designed to provide a five-square-foot area where a sampling mechanism, a glove port, and a marker drop port are installed.

The glove port in the bottom of the cowling is a standard nine-inch glove retained with protective covers on both the interior and exterior of the cowling. A vision block allows the glove user to see the earth below the glove port.

The marker drop is a five-inch tube with a threaded cover on the interior side of the rear ramp, and permits the operator to drop a weighted contamination or clear-lane marker flag outside the vehicle.

To use the marker drop tube, the operator assembles the appropriate marker configuration (biological, radiological, chemical, or clear-lane), inserts the marker, weighted end first, into the drop tube and pushes it through. To use the glove port and take samples for retention, the operator lies on his stomach, opens both the top and bottom covers, and inserts his arm into the glove. With the help of the vision block, a covered sample storage container is filled with a sample. He then places the container back into its storage place.

The M13 DAP was designed as a one-man portable DS2 decontamination capability. It consists of a 14-liter container with a 10-foot hose and wand brush assembly, with a hand-operated pump at the container end of the wand. The pump forces fluid from the container and through the wand to the brush, where it may be applied to the contaminated surface. This device is designed to be mounted on the fuel/water can mounts on military vehicles. In the event of contamination, the crew must decontaminate itself and components of the NBCRS, using the M13.

The AN/TMQ-30 Automatic Meteorological Station (MET) measures atmospheric pressure, wind speed and direction, relative humidity, and temperature, automatically transmitting data to the digital communications terminal (DCT). The AN/TMQ-30 sensor is mounted on the rear of the M113, allowing the stopped vehicle to collect and process real-time meteorological data. Mounted at the top of a telescoping mast, the wind speed and direction sensor extends approximately 3.5 meters above the top of the M113. During transit, the mast-mounted system is lowered.

The AN/PSC-2 Digital Communications Terminal (DCT) is a small, lightweight, hand-held communications message processor (computer). It is firmly mounted near the NBCRS operator in the rear of the vehicle. The DCT, operable from vehicle power, formats and controls the acquisition and transmission of all data from the NBCRS, and employs touch pads instead of keys and a touch display for manual data entry. Through preprogrammed read-only memory (ROM) and automatic or manual entry, data is entered into the NBC report format and, at the press of a button, can be transmitted by the on-board radio. The DCT automatically acquires data, formats it, and provides the NBC operator with transmission options.

Integrated Power and Environmental Control System (IPECS) is the vehicle's auxiliary power and air filtration system. The IPECS uses a turbine engine to provide the vehicle with additional electrical power and filtered air to maintain positive pressure (overpressure) and provide temperature control of the filtered air. The components are behind panels on the right side of the vehicle. The control panel is at the vehicle commander's station. The air intake, filter access door, and exhaust port are on top of the vehicle on the right side.

Testing was sufficiently adequate to analyze identified issues and criteria within the scope of the evaluation. However, test limitations precluded anything but indications being drawn from the data. Required DT data to support operational issues has either not been collected at this time or, in the case of the German system, translated and accepted by the Test and Evaluation Command for use during this evaluation.

The CEP was conducted during the period 3 February through 31 May 1986 in five phases including training.

Training

Training was conducted on both systems simultaneously: Fuchs NBCRS training was conducted at the ABC-und-Selbstchutzschule (ABC/SeS) from 3 February to 27 March 1986 in Sonthofen, Germany. M113 NBCRS training was conducted from 3 March through 27 March 1986 in Nuernberg-Schwabach, Germany. The additional time for training on the Fuchs was used for driver training. All drivers of the M113 NBCRS were previously licensed on the M113.

Fuchs NBCRS operation and maintenance training was performed by military and civilian instructors from the ABC/SeS and industry representatives, while the M113 NBCRS operation and maintenance training was conducted by military personnel from the US Army Chemical School (USACMLS) and civilian personnel from the Chemical Research, Development, and Engineering Center (CRDEC).

Phase I: A total of 16 reconnaissance missions were conducted at the German Infantry School (Hammelburg) under field conditions. Twelve missions, using doctrine proposed by the USACMLS, and four missions, using German Army Chemical School doctrine were performed.

Phase II: A field training exercise (FTX) was conducted at the Hohenfels Training Area with the NBCRSs operationally controlled by B Troop, 1/1 Cavalry Squadron. The purpose of the FTX was to assess the command, control, and communication (C^3) of the NBCRSs when task-organized

with a reconnaissance or maneuver unit, while conducting operations in scenarios developed for the forward area of the air-land battlefield.

Phase III: A command post exercise (CPX) was conducted at Hammelburg with the NBCRSs operating as a platoon. The 1st Armored Division chemical officer provided the operations orders (OPORDs) using rear area scenarios. The purpose of the CPX was to assess the C^3 of the NBCRSs when operating under rear battle scenarios.

Phase IV: A mobility/land navigation course was conducted from 15 through 25 May 1986 at Hammelburg. The NBCRSs negotiated a course consisting of approximately 27 kilometers (16.7+ miles) of primary and secondary roads and cross-country terrain. An M3 Bradley fighting vehicle and M151A2 utility truck were used as comparison vehicles (see figure 2). Crews operated in mission-oriented protective posture (MOPP) MOPP Zero and MOPP4.

CEP Observations

• The wheeled NBCRS is a fully matured system presently being fielded by the German Army. The tracked NBCRS is considered more of a concept vehicle than a prototype for an NBCRS. The different levels of maturation must be understood to

TPz-1A3's twin-propeller propulsion system and sample wheel assembly are shown below. Middle photo shows the German vehicle swimming the Danube River. The two systems are shown side by side in bottom photo.

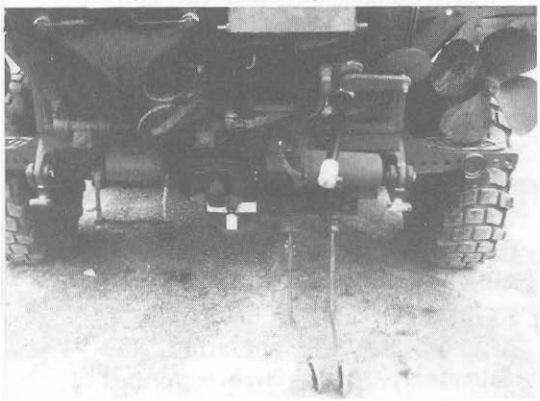
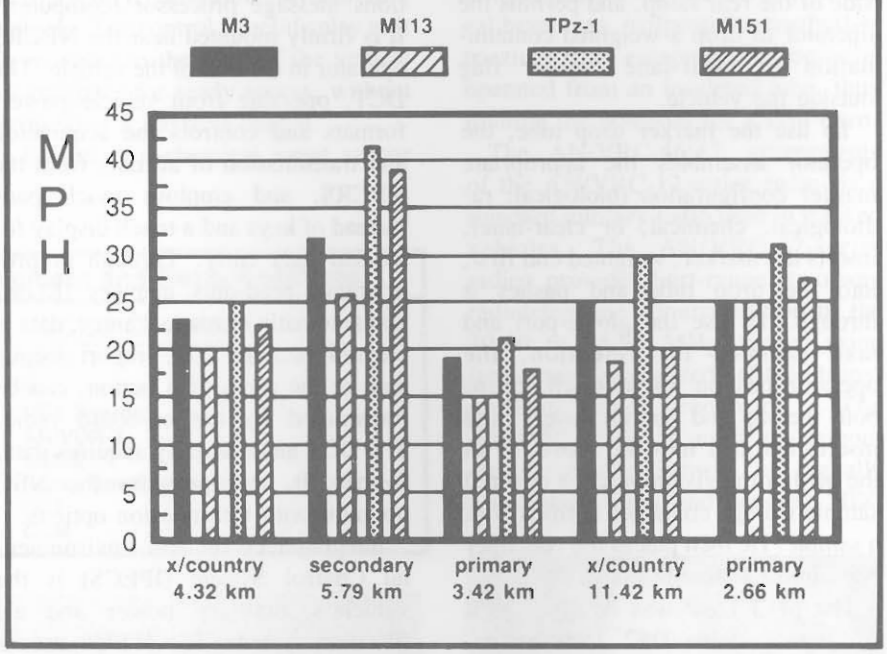


Figure 2. Average speed (Dry terrain)



preclude direct comparisons being made, with the exception of the issue of mobility. It is not expected that further development of the M113-based NBCRS will affect the mobility characteristics of the base vehicle. The differing levels of maturation were also evidenced in the quality of the technical manuals and training.

- The tracked NBCRS did not have formatted manuals but used, instead, operator checklists at each crew station. Training consisted more of hands-on instruction for prototype subsystems and had tasks, conditions, and standards for the equipment which is currently being fielded, that is, the CAM, the AN/VDR-2, and the M113.
- As stated, the wheeled system did have draft manuals, but translation of these manuals was time-consuming and resulted, in most cases, in their distribution after training.
- Training presented by the ABC/SeS on the wheeled system was professional and well planned. Training aids greatly enhanced the soldiers' understanding of the equipment. Translators were available during classes conducted at the ABC/SeS which allowed language difficulties to be humorous rather than training distractors.
- Both systems provided a quantum improvement over current NBC reconnaissance capabilities. Data generated and observations made during the CEP indicate that while the need to further refine doctrine and maneuver techniques exists, current doctrine is sufficient for use as a base document.
- Both NBCRSs experienced difficulty sustaining operations cross-country in rugged terrain, particularly in muddy conditions, due to mud build-up on the external chemical sensor equipment. The tracked NBCRS took on mud and water through the aperture where the sampling rod mechanisms protrude through the floor of the vehicle to touch the ground. The sampling arms on the wheeled NBCRS were easily bent or became misaligned with the GEMS probe face during operations in rugged terrain.
- The digital communications terminal (DCT) and integrated central data processing unit (CDPU) in the tracked NBCRS were quick, accurate, and convenient in passing all types of message traffic.
- Additional training on leadership and the fundamentals of reconnaissance are needed for future NBCRS crews.
- The navigation system on the wheeled NBCRS was accurate and easy to operate, both stationary and on the move, during daylight and darkness.
- The tracked system requires the driver and TC to operate in the closed hatch mode to benefit from the collective protection. For safety reasons, the tracked vehicle driver was not required to mask or operate closed hatch during most missions.

Fundamental Requirements Met

The NBC Reconnaissance CEP has been successful in meeting the fundamental requirement of the program. On 1 August 1985 the decision to test was made and the CEP was completed in the FRG on 31 May 1986. Major objectives of the CEP: to assess the relative merits of the German NBCRS, examine the capabilities of a wheeled and tracked system, and gather data to better define equipment, doctrine, and training requirements.

Each system provides a quantum increase over current NBC reconnaissance capabilities. Since neither system was specifically developed against the same requirement document, direct correlation between the systems' capabilities and the IEP issues and criteria must, in most cases, be evaluated based upon subjective data rather than supported by statistical data.

In the area of mission performance, both systems demonstrated a significant improvement over currently fielded methods of NBC reconnaissance in that they were mobile, had the capability to detect and quantify simulated chemical agents, and could communicate their findings.

Additionally, both systems had a navigation device that exceeded the criteria of plus or minus 50 meters, with the wheeled system being more accurate at an average of 19.38 meters versus 29.31 meters for the tracked system error over a 27-kilometer course.

Testing determined that the US M113-based system could sustain only five hours of operation because of the high fuel consumption of the IPECS, which was the collective protection system for the vehicle. The tracked system had a CDPU that allowed sensor integration and, when coupled to the AN/VRC-46, automatically formatted and transmitted NBC reports or other operational reports.

The wheeled system required the operator to gather the data from both the ASG-1 radiac and the GEMS and verbally transmit the report. As previously mentioned, both NBCRSs experienced difficulty sustaining operations cross-country in rugged terrain, particularly in muddy conditions.

The differing levels of maturity between the systems were most obvious in the area of logistics. The tracked system had a logistic support concept for the vehicle itself but lacked a defined and approved support concept for the sensor suite onboard.

Technical manuals were available for those subsystems already type-classified, but because of the early level of development and expected changes to requirements of the integrated system, formatted manuals were not economical to produce.

Operator checklists and simplified troubleshooting guides were provided to the crew, and maintenance parts availability was dependent upon contractor support.

The wheeled NBCRS had a multi-echelon maintenance allocation plan which was followed and presented no

problems. It must be noted, however, that the German maintenance plan depends heavily on manufacturer/contractor support warranty service on the individual subsystems.

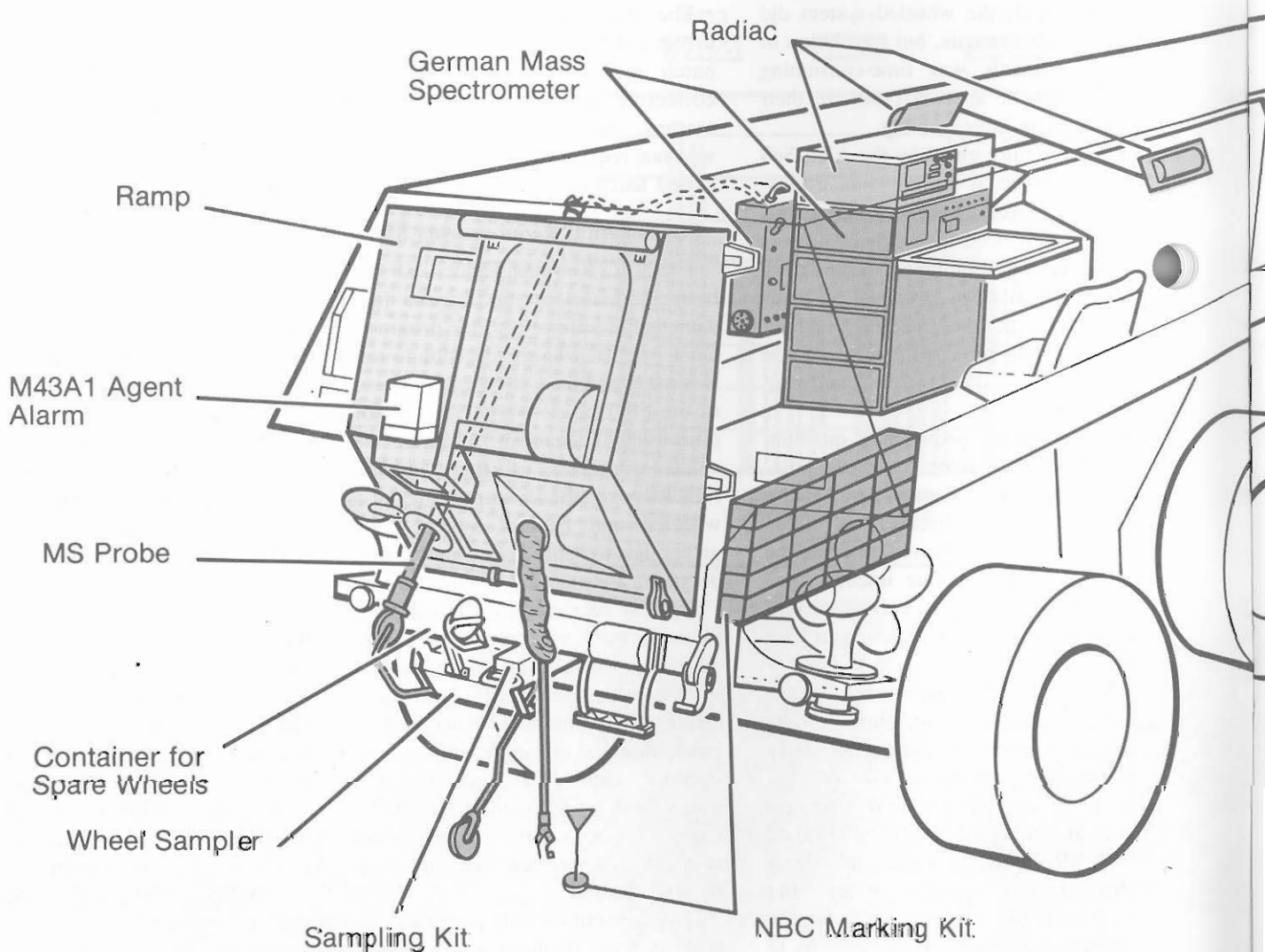
Training for the wheeled system was complete and supported by training simulators. While German training techniques differ slightly from US training, no major philosophical differences were noted. The training plan for the wheeled system could readily be incorporated in US service schools.

Training for the tracked system was adequate for the conduct of the CEP. The low density of the developmental items hampered instruction but was not considered a major problem because of the number of soldiers receiving training. A standard POI was used by chemical instructors for those items currently fielded.

The individual soldier demonstrated a high learning curve and expertise at his assigned crew position in both vehicles. It was expected, and observed, that the typical 54E or 54C soldier lacked the tactical expertise in maneuver, actions on contact, and terrain driving.

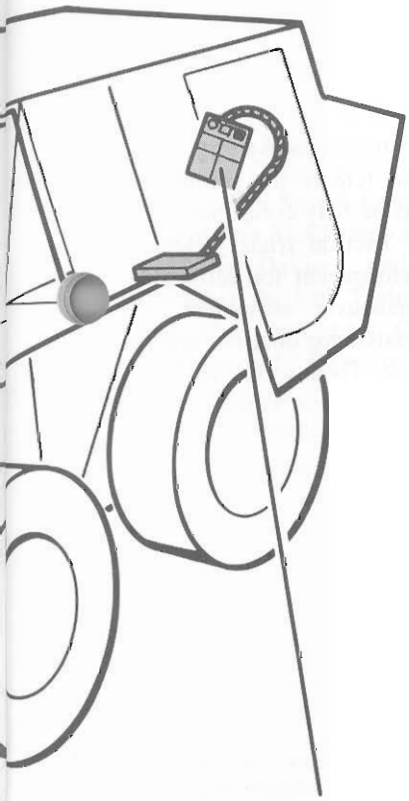
Four areas of survivability/vulnerability were addressed in the CEP:

GERMAN NBC RECON SYSTEM



operation as an integral component of a maneuver force, extended operations (12 hours), operations in MOPP4, and unique signature.

Both systems could operate with maneuver forces and did not degrade their momentum when the force was in MOPP4. Until the building of a stand-off detector, the NBCRS-equipped maneuver unit is as likely to enter contamination as the NBCRS.



Position Locator

The benefit of NBC reconnaissance is the follow-on maneuver force's ability to reduce MOPP and avoid contamination. Conduct of NBC recon required slower movement by the accompanying maneuver force when in MOPP Zero. However, when in MOPP4, the pace of maneuver slowed to that of the NBCRS conducting its recon mission.

During extended operations, the tracked systems could not exceed five hours of continuous operation because of the high fuel consumption rate of the IPECS. With the exception of the IPECS-equipped NBCRS, both systems carried enough consumables to have operated 12 or more hours.

An excursion was conducted to examine operations in MOPP4 by simulating a failure of the collective protection system. No problems were observed in either system.

Personnel distinguished no visual items producing a unique signature of military significance on either vehicle. The M113 NBCRS had recognizably thicker splash boards on the front, and fuel tanks extending to the rear of the vehicle. The TPz-1 NBCRS appeared to one soldier to look like a BRDM. None of the soldiers could quantify their observations. All vehicles were recognized as NATO vehicles due to their markings and insignias.

Both NBCRSs were deployed during this CEP without difficulty. The tracked NBCRS was transported by C5A aircraft from the US to FRG for testing, and from test site to test site by M915 truck with 40-foot trailer, and M911 truck with 40-foot trailer. The wheeled NBCRS was able to travel on all roads with no special equipment. Transportation assets were not necessary for the wheeled NBCRS during the CEP.

US and FRG Doctrine

NBC reconnaissance doctrine of both the US and German Army was examined during the CEP. Both countries utilize contamination avoidance as the mainstay for NBC reconnaissance and are in early development of employment doctrine. The largest difference between the two doctrines is in reconnaissance techniques and movement. The US, because of worldwide commitments, does not limit the conduct of NBC reconnaissance to any terrain feature or road network. The German Army, because of the extensive road network in Europe, uses predominately "road only" NBC reconnaissance. Additionally, the German Army may employ their systems singularly, whereas the US Army has traditionally employed systems in mutually supporting pairs.

Throughout phases I, II, and III (US doctrine), the NBCRSs were employed in pairs. The lead NBCRS encountered contamination (normally) and proceeded through it. The trail NBCRS turned 180 degrees and located a clean bypass around the contamination (while marking the bypass with clear lane markers). The two vehicles would rendezvous on the far side of the contamination.

The German doctrine was used during four missions. Due to the limited number of missions, only one aspect of German doctrine was employed. The NBCRSs were employed singularly with a notional security force conducting route reconnaissance. A system of checkpoints pre-positioned throughout the tactical operation was used to notify the operations center of the presence or absence of contamination between these checkpoints.

Both techniques presented advantages and disadvantages for US employment of NBC reconnaissance. The combination of the most advantageous techniques was found to assist in providing the commander with timely and easily understood NBC reconnaissance reports.

Human factors and safety considerations were explored during operations conducted in daylight, darkness, and in NBC protective gear to verify adequancy of operator

controls, switches, and lights. No maintenance actions had human factors engineering ramifications.

Observations indicate that the wheeled NBCRS crew members were able to operate effectively for a longer period of time due to the noticeable difference in comfort between the NBCRSs.

The tracked NBCRS vibrated the crew enough to degrade their performance, while the wheeled NBCRS crews were able to sustain effective operations due to the smoothness of the ride. However, the rear door of the wheeled NBCRS is heavy and cannot be easily closed from the inside. Often, the TC dismounts and closes it for surveyor 1 and 2. When the door opens, it springs up at about head level; anyone standing near it may be struck and possibly injured.

The tracked NBCRSs are modified M113 chassis with HFE principles incorporated with the basic vehicle. Most switches and buttons are within the operator's reach. However, the operator cannot operate the meteorological system control panel or the DCT printer from his normally seated position. He must rise and go to the opposite side of the vehicle to operate these items.

Conclusions

Both systems were noted to exceed current capabilities in mission performance. The mobility of the systems and sensor suites increased flexibility for mission accomplishment. Significant training and doctrine changes will be required to reduce operator problems and to improve NBC reconnaissance techniques.

Mission performance of the tracked NBCRS, even at its currently low level of developmental maturity, supported and improved current capabilities to conduct NBC reconnaissance. The use of currently fielded sensors enhances compatibility and ease of training.

Integration of all sensors to a computerized data processor rapidly and accurately formatted reports and presented near real-time data to the commander.

The meteorological system demonstrated that different local wind and weather conditions existed than were stated in the divisional area weather prediction. This allows more accurate prediction of downwind hazard and agent desorption. The use of the meteorological system also supports the requirement of the Integrated Meteorological System (IMETS) currently being developed by the Atmospheric Science Laboratory.

The engineering requirements to harden the sensor suite and its application to the M113 have been identified, but will require development time and additional testing to substantiate results and quantify reliability, availability, and maintainability (RAM).

The six-wheeled reconnaissance vehicle is a fielded and mature system. Operation of the system will support doctrinal employment in forward and rear area missions. The sensor suite is not integrated with a central data processor and utilizes a mixture of state-of-the-art technology (GEMS) and older, less capable (against US requirements) sensors (ASG-1, M43).

Reporting of contamination is limited to voice radio or messenger, but computer integration of the sensor suite and the communications system can be applied (currently planned by German Army). The vehicle is extremely maneuverable and can attain speeds equal to or exceeding that of the M3 Bradley.

A training program has been developed for use by the German Army and would not require major changes for US instruction. RAM and logistics supportability of the vehicle are unknown for system use in the US Army and would require additional testing to quantify. Soldier acceptance of the training and operation of the system was extremely high.

In summary, the CEP was designed to address the relative merits of the TPz-1 NBCRS for further detailed evaluation and simultaneously test the mobility capabilities of a track system and a wheeled system and explore doctrinal techniques.

The availability of the M113 NBCRS concept vehicle allowed the mobility test, different sensor suite applications, and doctrinal techniques to be combined for evaluation. The sensors and computer integration of the M113 NBCRS demonstrated a greater ability to meet the needs of the commander.

The mobility, ease of operation, and ability of the chassis interior to accept equipment changes were definite advantages of the TPz-1 NBCRS. Both systems had a common chemical agent point sensor (GEMS) and an extremely accurate navigation system.

The communications system in the TPz-1 would require the addition of US radios to be fully compatible with US forces. Tactical trials generated sufficient information for refinement of draft maneuver techniques and NBC reconnaissance doctrine regardless of vehicle. These refinements will be reflected in the next iteration of FC 3-19, NBC Reconnaissance.

Refinements in both doctrine and requirements can now be pursued based on the data collected. Equipment acquisition decisions are expected in FY87.

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