10 to 80:
Refocused Approach to Mobile Gun System Maintenance for Stryker Brigade Combat Teams

by LTC Rafael J. Morrison, MAJ Nicholas G. Barry and 1LT John D. Formica

Stryker brigade combat teams (SBCTs) across the Army struggle with maintaining the readiness of the Mobile Gun System (MGS). While plagued by difficulties in diagnosing faults, a training shortfall for operators and maintainers and a long lead-time for parts, MGS offers a unique long-range direct-fire capability unmatched in a SBCT and critical to the formation.

In June 2019, 4th Squadron (Longknife), 3rd Cavalry Regiment, recognized that a fundamental shift in how we maintained the MGS fleet was needed. We developed a new three-pronged approach to MGS maintenance by focusing on training our maintainers on MGS-specific processes, pulling turrets to reset wiring and teaching operators more advanced maintenance. Through this new methodology, Longknife Squadron increased readiness from 10-percent fully mission capable (FMC) to 80-percent FMC in just six months. We also recognized particular issues pertaining to Multiple Integrated Laser Engagement System (MILES) use on the MGS and institutional challenges SBCTs face that may prove valuable to our sister SBCTs throughout the Army.

Lessons-learned

Misdiagnosis or no diagnosis: importance of MGS-specific training for 91Ss. The first issue identified was a platform-specific training shortfall among the military-occupation specialty (MOS) 91S population responsible for maintaining the fleet as well as the MOS 19D vehicle operators. Thus the initial solution focused on training both the maintainers and operators. Field-support representatives (FSRs) from private industry traveled to Fort Hood, TX, with the purpose of training the 91S population on diagnosing MGS faults.

Most faults that historically stymied our 91S team related to MGS-unique computer systems (line-replaceable units or LRUs) and their associated wiring harnesses. The knowledge gap on the MGS fleet produced long trouble-shooting times and often-incorrect diagnoses. This led to even longer down times and unnecessary spending due to incorrect-parts purchasing. Only upon installation of the incorrect part and persistence of the fault would the mechanics realize the error of their initial diagnosis and move onto another diagnosis.

FSRs were able to help familiarize our 91S with the function of each LRU, the pinout chart on the wiring harnesses that led to that LRU and how to trace a fault across the complex architecture of the MGS firing system. While this training helped improve our diagnostic effectiveness, it alone was not the solution to MGS readiness, and it did nothing to address operator training.

Pulling turrets: an accelerant in operational readiness (OR). In September 2019, the squadron brought in two FSRs from private industry at Joint Base Lewis McChord, WA, to support our gunnery. These contractors initially supported instructors from Fort Lee (VA)'s Ordnance School who were part of the Unit Diagnostic Immersion Program (UDIP). This team continued the focus on maintainer education (fault identification and troubleshooting) and then expanded to include operator education. This FSR team astutely observed that nearly all the turrets had misaligned, incorrectly routed, broken or outright incorrect cables inside and around the turret. Time-consuming (manhours and long lead times) and expensive to replace, these non-mission-capable cables were crippling the fleet. Over the years, untrained mechanics and unfamiliar operators moved and replaced cables, slowly creating this problem.

Compounding the issue in Longknife Squadron is the fact that ever since the MGS refit in 2017, our MGS fleet is mixed – meaning that seven MGSs have improved turrets and five have unimproved turrets. While the differences in operating MGSs are indistinguishable, the wiring disparities are significantly more nuanced. LRUs are interchangeable between improved and unimproved turrets, but their associated wiring harnesses are either shorter or longer depending on the turret type. Installation of the wrong cable for the turret type usually results in the cable being broken.

Based on the FSR's recommendation, the squadron conducted a fleet-wide turret pull and reset – something never completed in 3rd Cavalry Regiment because the turret pull is not a task included in the MGS services plan. It typically takes about five working days with two mechanics and a three-person crew supporting the operation to remove, rewire and reattach an MGS turret. With one 91S noncommissioned officer (NCO) supervising, the squadron maintenance team performed up to two turret pulls simultaneously.

Second benefit to turret pulls: training made easy for mechanics and operators. Not only did the turret rewiring accomplish the goal of reducing the number of broken cables, it also provided an invaluable training opportunity for our mechanics. The squadron's 91S NCOs built on training provided by the UDIP and FSRs to train new 91Ss on the more detailed issues of the MGS platform. The ease of training with a turret removed cannot be overstated. Rather than working with about eight inches on either side to find cables as the turret rotates, the turret is now accessible from every angle and cable routing is significantly easier to understand. Not to mention the ease in which we were able to install LRUs, reducing the install times significantly.

We finally had the capacity to develop our own organic MGS-focused 91S maintenance team. Also, with a complete rerouting of all the cables in the turret, mechanics could eliminate bad cables during the troubleshooting process. The decrease in troubleshooting time, coupled with a decrease in incorrectly ordered long-lead-time cables, helped contribute to the overall improvement in the MGS fleet OR rate.

In addition to diagnostic training, operator training and the turret rewiring, the squadron fundamentally relooked the alignment of the maintenance personnel to better support the MGS fleet. Mechanics with advanced diagnostic training and turret-pull experience became habitually associated with the MGS platoons. This not only increased the depth of their knowledge, but over time they developed buy-in on the MGS problem. Also, when going to the field for training or gunnery, these mechanics were task-organized to the troop.

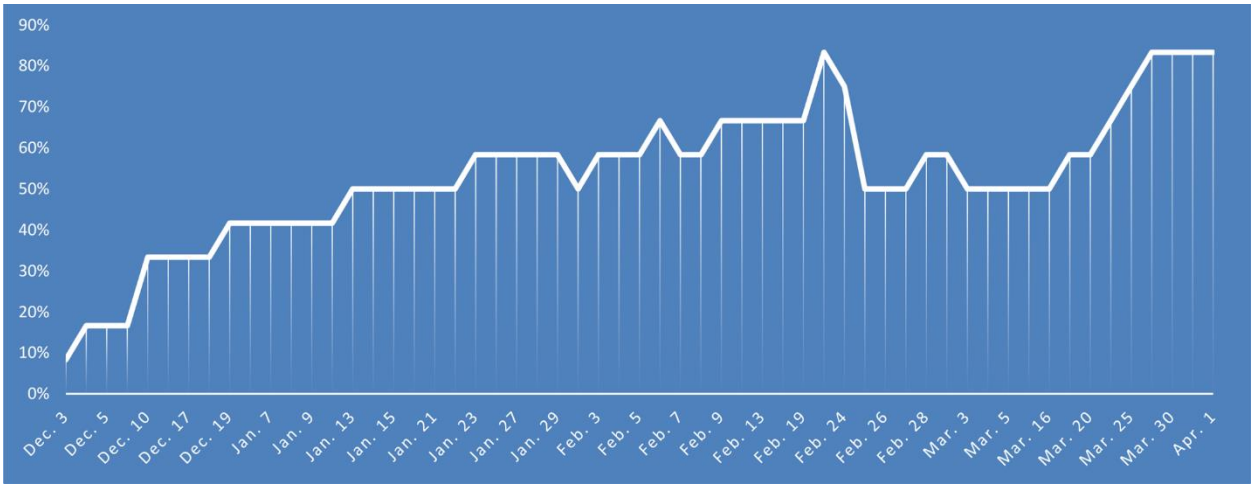

Figure 1. MGS OR in Longknife Squadron, Dec. 3, 2019-April 1, 2020.

Results come to fruition: 80-percent MGS OR. This three-pronged strategy of training, turret rewiring and alignment of mechanics worked incredibly well. After returning from National Training Center (NTC) Rotation 20-02, the MGS fleet's OR stood at 10 percent. Before the NTC rotation, the average MGS OR for the year stood at 25 percent. By the start of holiday leave, the squadron maintenance team brought the OR up to 40 percent.

In January 2020, the squadron implemented the MGS turret pulls, and the OR steadily climbed to more than 80 percent, reaching that mark for the first time since fielding the vehicles. In early March, the weapons troop conducted gunnery, putting the newly rewired vehicles through their paces. While the OR dipped to 50 percent during gunnery, constant field maintenance kept the vehicles participating in the gunnery. And, significantly, there were no new wiring-related faults during gunnery, thanks to the team's excellent work during the previous two months.

Coming out of gunnery, the OR rate climbed back to 80 percent as replacement parts arrived and mechanics installed them.

MILES: an MGS Achilles heel? In addition to miswired turrets causing deadlined MGSs, the squadron also observed a strong correlation between the use of MILES gear and the failure of MGS systems, specifically the turret electrical components. Initially, noticing a high failure rate of these components during training events involving MILES gear, we began to keep track of those faults more closely. Our maintenance team used a multimeter to see if installing MILES gear caused irregularities with the turret electronics. They took many samplings of voltage at key nodes throughout the turret and noticed that with MILES gear installed, there were extreme voltage irregularities.

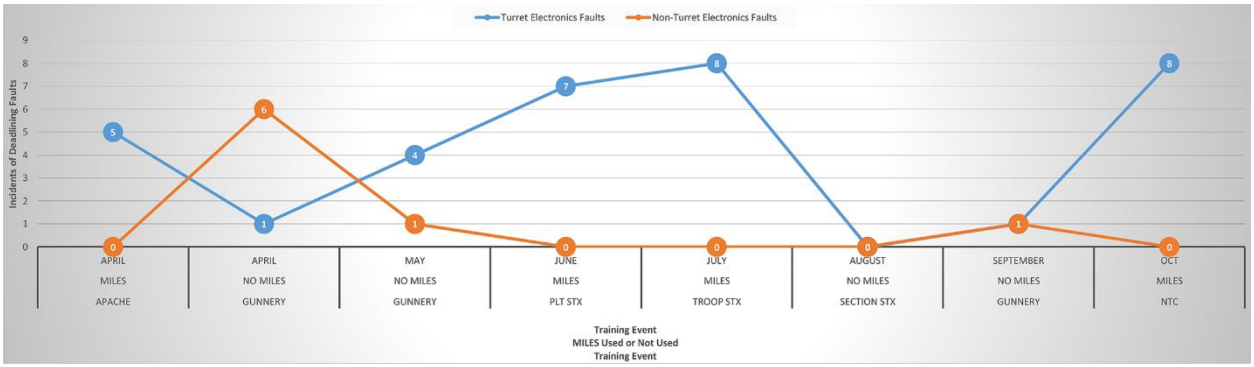

Figure 2. Longknife's sampling of turret electrical vs. non-turret electrical faults during MILES use April-October 2019.

Over the course of an entire training cycle, the weapons-troop executive officer and maintenance team tracked faults diligently and broke them into the training periods. Figure 2 demonstrates that during periods of training where MILES gear was used, the MGS fleet suffered a significantly higher number of faults related to components that ran purely off turret power than during periods of similar training without MILES gear.

The team attempted to strengthen the validity of their initial hypothesis by comparing training events (featuring similar times and types of movement and turret use), reducing the difference to the presence or absence of MILES. While no two training events are identical, Figure 2 clearly shows a higher incidences of turret electronic faults with MILES installed.

Key among the turret electrical faults was an irregular number of thermal optic burnouts, LRU failures and associated wiring harnesses shorting. Also, in some vehicles the entire slip ring shorted out, causing electrical arcing within mere hours of MILES gear installation. MGSs that performed perfectly for months of training before MILES use would inexplicably be deadlined almost as soon as MILES gear was installed.

To combat the issue, after a troop situational-training exercise (STX), the regimental commander decided to no longer use MILES gear on MGSs until NTC. This was when the correlation became painfully clear. During pre-deployment operations at the rotational-unit bivouac area, the weapons troop screened (zeroing of the MGS main weapon) seven out of the nine MGSs with no issues. At the completion of force-on-force operations, two had shorted slip rings (a very rare deadline), two had burned-out commander's thermals, one had a burned-out gunner's thermal and three had either LRUs or wiring harnesses shorted. Leading up to the NTC rotation, turret electrical faults were observed 28 times during periods of MILES use, as opposed to only nine times during periods when MILES was not used.

While correlation often does not equal causation, this specific instance of correlation, coupled with voltage irregularities observed by mechanics, certainly suggests that MILES gear induces faults in the MGS turret electronics. Therefore, Longknife Squadron attempted to determine if this was an Army-wide issue; many sister weapons troops reported they had the same experience -- also stating they did not have operational MGS MILES equipment, which raised the question of whether MILES itself is inherently faulted or if the problem is degraded MILES equipment causing issues. It is without question that this topic needs further exploration and could be an article unto itself, but Longknife mitigated the issue by only using MILES when absolutely necessary (mainly combat-training-center rotations), disconnecting it as soon as possible and using observer-controllers to adjudicate whenever possible.

Institutional MGS issues (and thoughts on overcoming them)

There are several institutional challenges facing the MGS outside of the discussion about its pending obsolescence. There is no specific MOS for MGS operators; 19D troopers operate the MGS in Longknife Squadron and most other SBCTs. These same troopers, with the same training, serve as dismounted scouts in our line cavalry troops. Most 19Ds we receive for the MGS platoons have absolutely no MGS experience and, at best, minimal time on a Bradley Fighting Vehicle (BFV).

Being entirely new to the platform with little to no experience operating a turret presents a tremendous challenge for understanding the proper operation and maintenance of such a complicated piece of equipment. Even if Soldiers have previous experience on the Stryker platform, the MGS is almost an entirely different system. We recommend that the Army either institutes an additional-skill identifier (ASI) for 19Ds who have turret experience, either on a BFV or MGS, or adjust the modified table of organization and equipment for MGS operators back to MOS 19K. While having a specific MOS for MGS vehicles would be the most preferred course of action, this isn't likely feasible due to the minimal number of MGS platforms vs. armor platforms in an armor BCT.

Figure 3. A rewired MGS turret sits on a turret stand in the Longknife Squadron motorpool. *(Photo by 1LT John Formica)*

A second personnel challenge with the MGS is the lack of an ASI for the 91S community. Mechanics in MOS 91S perform maintenance on all 13 variants of Strykers. While 80 percent of Stryker components are common across each variant, the other 20 percent involve extremely complex electrical and mechanical differences. There is no way to track who has MGS experience and ensure that SBCTs are able to put those skills to use in the weapons troop. There should be a series of ASIs to support the three most complicated and unique Stryker minority variants: the MGS, the anti-tank guided-missile vehicle (known as an ATVV if it has double-V hull) and the nuclear, biological and chemical reconnaissance variant.

Creating these ASIs would allow strength managers and commanders the opportunity to put their mechanics' previous experience and knowledge to good use supporting unique protection assets as well as the platforms with the most firepower in the entire brigade.

There is also a training shortfall on the MGS for new MOS 91S Soldiers arriving to the unit from advanced individual training. Therefore we recommend members of each class take a more in-depth "elective training" on the minority Stryker variants. For the MGS, this training would include a turret pull, the discrepancies between

improved and unimproved turrets, and diagnostic/troubleshooting training to better prepare them to work on the MGS.

The other variants each have their own maintenance challenges, which the training could address. This strategy nests with the ASI assignments, which employs Army personnel systems to assign the mechanics with the proper training to the units with those variants.

The prevalence of long-lead-time parts for the MGS contributes to the historically low OR. MGSs have many unique parts, which – coupled with their low density across the Army – creates a low demand. We have three turret pulls to complete, which are paused solely to receive long-lead-time parts requiring removal of the turret for installation. Many of the LRUs, any of the main turret-wiring harnesses and the Commander's Panoramic Viewer and Hazardous Incident Response Equipment Sensor (the commander and gunner thermals, respectively) have at least three- to six-month lead times.

Also, the squadron waited nine months for an MGS Forward Unity Periscope (FUP) to arrive from the repair-part program. This vehicle remained deadlined for that entire period. It is not financially advantageous to keep an MGS FUP in the shop-stock list, and one is not included on the SBCT critical-stockage list. This is an issue with most of the MGS parts – the pending obsolescence has caused many manufacturers of MGS-specific parts to shut down new production. If they do not have a part on hand, they require that the faulty part be turned into the repair system, and then end-users must wait for it to be refurbished.

One potential solution to speed up acquisition of wiring harness for MGS is to have them locally fabricated or repaired. While the tools and knowledge are not resident in the SBCT maintenance structure, local vendors have the capability to fabricate or repair the wiring harnesses. However, we were unable to leverage these resources due to the proprietary nature of the wiring harnesses, which prevented the availability of the schematics necessary to replicate or repair them.

Conclusions

While the Army continues to assess the MGS' future, there are still best practices units can implement to bolster readiness:

- A strong training program for both operators and maintainers is the foundation to success.
- Only choose the most technically proficient and resilient troopers as MGS operators and maintainers.
- Also, every SBCT weapons troop's service plan should require turret pulls annually. If nothing else, this provides the chance to train new MOS 91S troopers and gives operators a chance to clean out the vehicles' hulls.
- MILES gear should only be used when absolutely necessary, and MILES personnel should be trained to install and troubleshoot the equipment. With that in mind, Longknife Squadron attacked the problem of essentially only one platoon's worth of MGSs FMC by using the concept outlined here.

While the OR still is not 100 percent, an air of confidence and optimism now exists as the rate steadily trends upward. In just nine months, the squadron lifted the stigma of the MGS and it is now a true force-multiplier, sought after by the other squadrons in the regiment for its lethality and direct-fire capabilities.

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Acronym Quick-Scan

ASI – additional-skill identifier
BCT – brigade combat team
BFV – Bradley Fighting Vehicle
FMC – fully mission capable
FSR – field-support representative
FUP – Forward Unity Periscope
JRTC – Joint Readiness Training Center
LRU – line-replaceable unit
MGS – Mobile Gun System
MILES – Multiple Integrated Laser-Engagement System
MOS – military-occupation specialty
NCO – noncommissioned officer
NTC – National Training Center
O/C/T – observer/coach/trainer
OR – operational readiness
SBCT – Stryker brigade combat team
STX – situational-training exercise
UDIP – Unit Diagnostic Immersion Program

Figure 4. An MGS from Longknife Squadron engages simulated enemy combat vehicles during force-on-force training under live-fire conditions during NTC Rotation 20-02. *(U.S. Army photo by 1LT John Formica)*