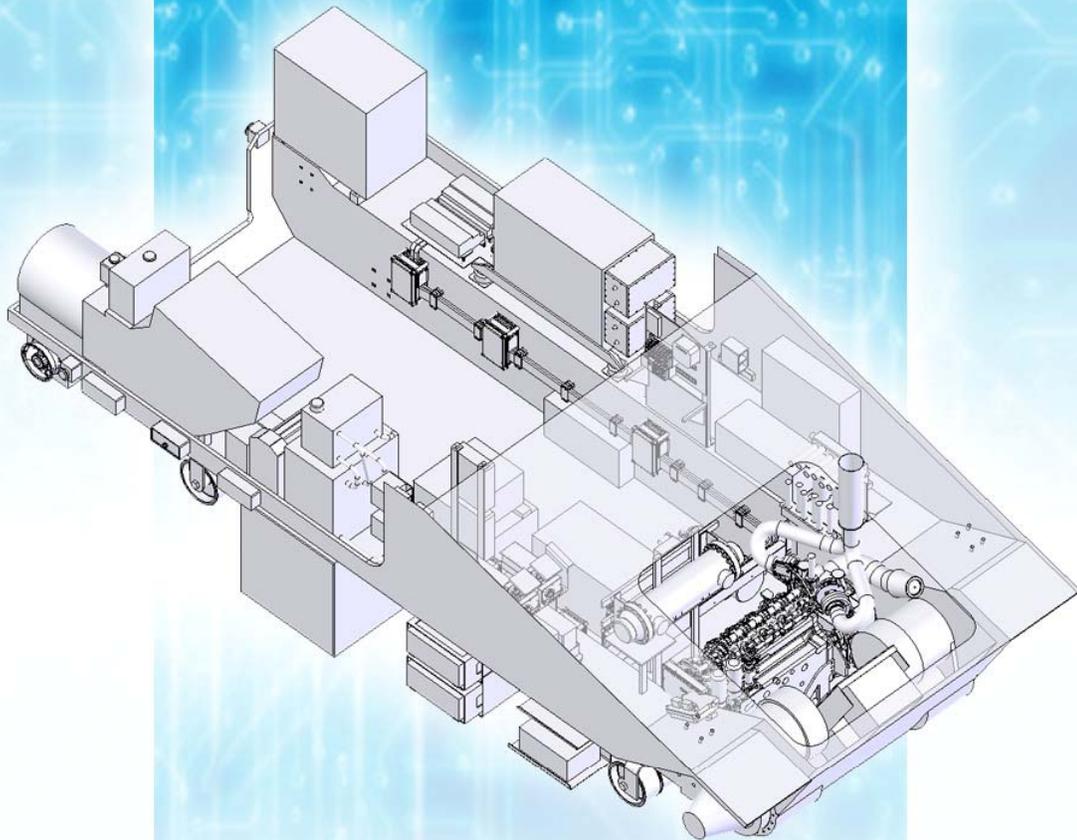


HERMIT

*Hybrid Electric Reconfigurable
Movable Integration Testbed*

INSTRUCTION GUIDE



SAIC Science Applications
From Science to Solutions™ International Corporation

News Release

SAIC HERMIT Instructional Manual

CART Completes Instructional Manual for SAIC

Even the title of the task—producing an instructional guide capable of explaining how to operate a Hybrid Energy Reconfigurable Movable Integration Test-bed (HERMIT) —sounds complicated. However, the Center for Applied Research and Technology, Inc. (CART) completed the project, and the result is a practical document supporting critical testing of Hybrid Electric Vehicle (HEV) component integration and subsystems in a cost-effective laboratory environment that saves development time and improves quality.

“The Scientific Applications International Corporation (SAIC), a Fortune 500® company and a leading provider of systems integration to the U.S. military and intelligence community, requested proposals from their small business partners to help them develop the instructional guide that organized and formatted a vast amount of technical data and instructions related to testing HEV components and subsystems,” explained Bruce Mutter, CART CEO. “SAIC wanted to provide an overview of the subsystems and reference drawings, detail proper startup and shutdown procedures, caution operators about the high-voltage power distribution onboard, and bring exact sequence to processes, while explaining appropriate practices and safeguards to maximize safety.”

Now located in the Detroit Arsenal in Warren, MI, the HERMIT is used by the U.S. Army Tank Automotive Research, Development, and Engineering Center (TARDEC) to evaluate electrical component technologies independently, as well as integrate the technologies to see how they react when packaged with other subsystems in a vehicle platform.

“Producing the instructional manual required taking a tremendous amount of SAIC-provided data, drawings, illustrations, pictures, graphs, and tables that needed to be indexed, formatted, sequenced, and edited to eliminate information gaps, conflicting instructions, unnecessary duplication, and illustrations and tables were formatted to be more operator friendly,” Mutter added.

“It was a reiterative process that involved several drafts by the CART team and review and approval by SAIC,” he continued. “Our experience with autonomous vehicle research, design, construction, development, and testing was particularly applicable in helping us understand the complexities of systems integration and we certainly needed it to complete this project.”

SAIC is pleased with the final product, according to Bob Marinos, Principal Scientist, SAIC. “We received the instructional guides as specified, they looked great, and we delivered them to the customer, and if we have any other editing projects in the future we would come back to CART,” Marinos said. For CART, the experience was an opportunity to prove that the center at BSC could be a reliable team member for SAIC. “We really enjoyed working for SAIC and completing a small, but important, part of their TARDEC contract, and we look forward to any opportunities to work for them in the future.

CART, TARDEC, SAIC, HERMIT, U.S. Army, Detroit Arsenal, HEV

TARDEC Engineers Advance Technology and Systems

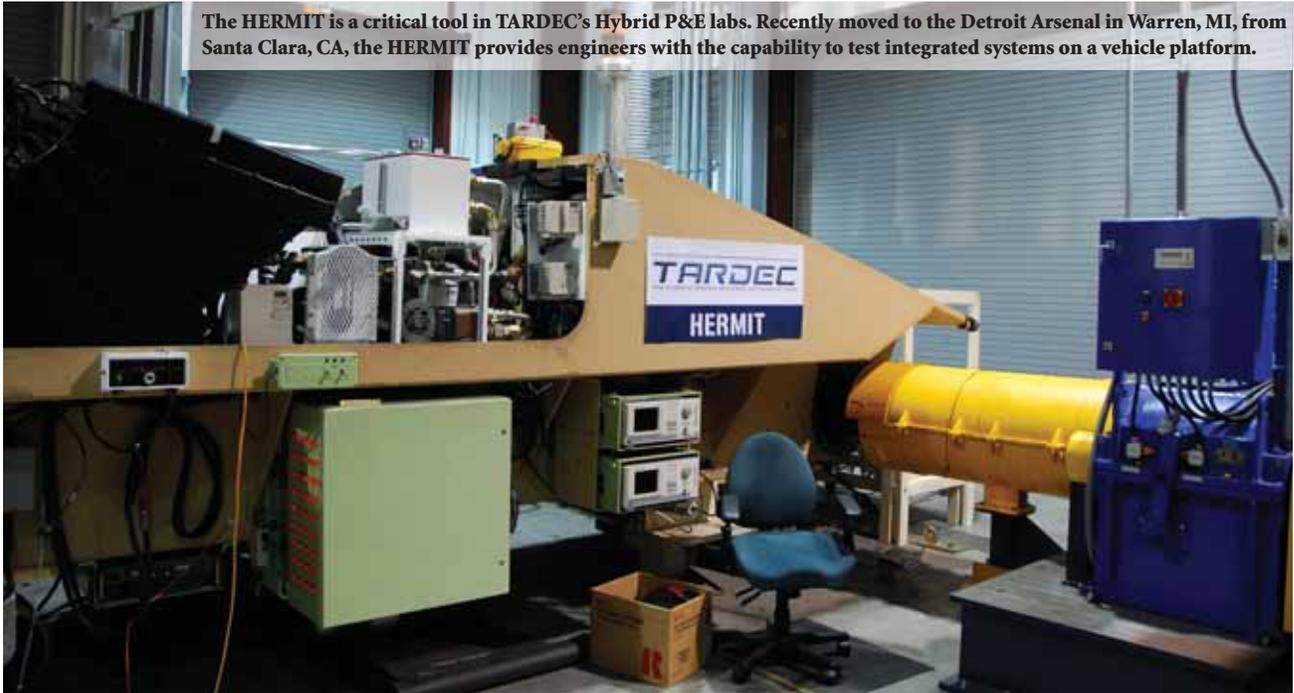
Increased fuel efficiency requirements and power demands have made HE power an integral component for developing the Army's future ground vehicle fleet. TARDEC, as the Army's ground vehicle systems integrator, tests HE components and systems for future implementation on a range of wheeled and tracked vehicles using the HE Reconfigurable Movable Integration Test (HERMIT) bed. (U.S. Army TARDEC photos provided by Ghassan Khalil.)

Hybrid-Electric (HE) Integration

Chris Williams

As automakers face new fuel-efficiency requirements and the U.S. Army develops new ways to power vehicles, the role of HE vehicles (HEVs) has become more prominent. To further the Army's development of HE technology, the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) operates two laboratories that specialize in developing, testing and optimizing HE systems.

The HERMIT is a critical tool in TARDEC's Hybrid P&E labs. Recently moved to the Detroit Arsenal in Warren, MI, from Santa Clara, CA, the HERMIT provides engineers with the capability to test integrated systems on a vehicle platform.



Electric Component Evaluation Laboratory (ECEL)

The Army's demonstrator HEVs require advancing some enabling electrical component technologies for the vehicles to meet their performance objectives. Located at the Detroit Arsenal in Warren, MI, TARDEC's ECEL technicians and engineers test and verify the performance of new HE component concepts for acceptable and safe operation.

"It's a very important capability to have because there are some technical challenges that need to be resolved before we can implement HE technologies," explained Ghassan Khalil, TARDEC HE Team Leader. "We have to mature the technology, and we do that through testing and evaluation and further development at the system level."

The ECEL includes capabilities to test all electrical components that make up an HE system, including electric motors and their controllers, power conditioning converters and advanced batteries. An alternating cur-

rent dynamometer is used to test motors and generators up to 350 kilowatts to provide an understanding of the test items' power, torque, efficiency and thermal management.

"Even though we test individual components and understand their performance, we need to gain an understanding of how they behave when they are integrated together."

The laboratory provides TARDEC associates with the ability to understand electric component capabilities prior to integrating them into a system, a crucial factor in developing vehicle systems. "The importance is to verify the component's predicted and advertised performance," stated Khalil. "When you buy a machine, it comes with certain ratings related to torque, power, speed and an advertised efficiency. Efficiency varies with speed, load, power and torque, and we need to verify that these ratings are correct and

then characterize the machine by measuring its efficiency at several points to create an efficiency map."

Power and Energy (P&E) Systems Integration Laboratory (SIL)

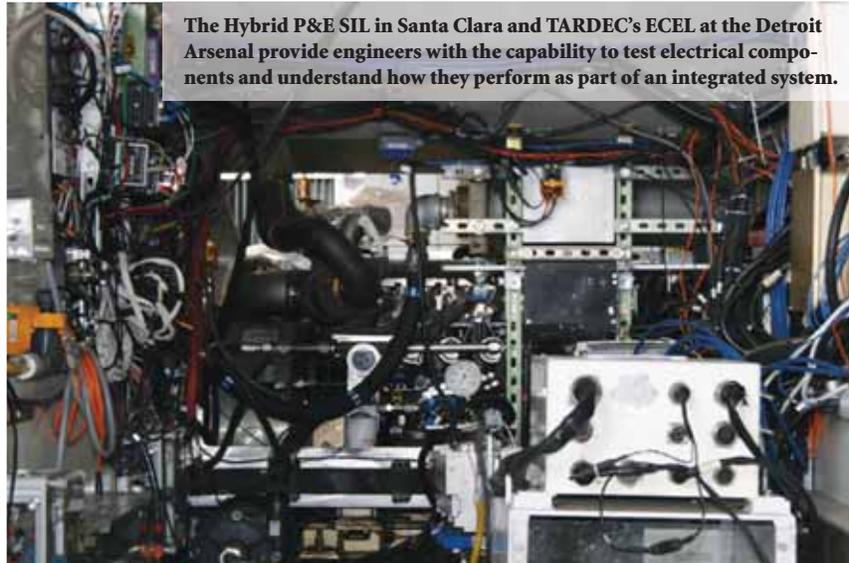
Once electrical components have been tested on their own, they must be evaluated as part of an integrated system. TARDEC's P&E SIL, initially located in Santa Clara, CA, now has a large portion of the facility's equipment moved to TARDEC. This allows on-site researchers to understand how a component's capabilities are affected when it is connected to a system. "Even though we test individual components and understand their performance, we need to gain an understanding of how they behave when they are integrated together," remarked Khalil. "How are they connected together, how does one system affect another system, what's their burden for integration purposes, how many cooling circuits will they require and what are the different temperatures that need to be maintained for each component? All of these things are



extremely critical before components are integrated into the vehicle, and the SIL gives us the capability to understand those issues,” Khalil explained.

“There are many constraints in integrating a vehicle, and you never know how a system reacts to those constraints until you package the different subsystems into the vehicle platform.”

A component’s performance can be drastically affected when it’s connected to another component. A motor may operate at 97-percent efficiency on its own, but that efficiency will decrease when controllers, fans or other components are attached to it. The work conducted in the P&E SIL allows TARDEC engineers to connect the components together in one room and understand the system’s performance capabilities, allowing them to discover problems and challenges before the system is integrated into a vehicle for future fielding. The measurements gained through testing in the SIL rapidly and cost-effectively validate and transition advanced electrical technology to a vehicle and provide a cost-effective means to develop and evaluate



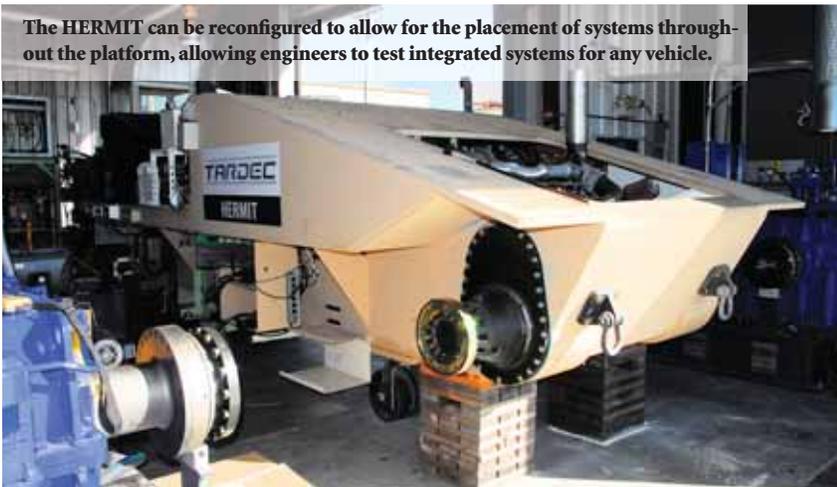
The Hybrid P&E SIL in Santa Clara and TARDEC’s ECEL at the Detroit Arsenal provide engineers with the capability to test electrical components and understand how they perform as part of an integrated system.

a combat vehicle architecture’s effectiveness. “When you test these components as part of an integrated system, things start appearing,” Khalil revealed. “You may learn that a component works fine by itself, but there’s an issue when it’s combined with other components. The SIL allows us to discover and fix these issues before the vehicle is fielded, when it would be too late.”

One key P&E SIL test tool is the HE Reconfigurable Movable Integration Test bed (HERMIT). The HERMIT provides engineers with the capability to test the integrated systems on a vehicle platform. The HERMIT allows TARDEC associates to understand how the system performs when components are connected under the

constraints of a system, where electrical interference and space and weight restrictions may affect the system’s overall capabilities.

“The idea is to see how tight the space is going to be when you put all these components together and see if you have enough space available for what you have designed,” Khalil noted. “There are many constraints in integrating a vehicle, and you never know how a system reacts to those constraints until you package the different subsystems into the vehicle platform. The SIL can operate without a vehicle platform because we can put different components in different places and fill up an entire room. With the HERMIT, we bring them all into this small space to gain an understanding of how they all work together,” Khalil concluded.



The HERMIT can be reconfigured to allow for the placement of systems throughout the platform, allowing engineers to test integrated systems for any vehicle.

Chris Williams is a Writer/Editor with BRTRC and provides contract support to TARDEC’s Strategic Communications team. He has a B.A. in communication from Wayne State University in Detroit, MI, and has previously written for *The Source* newspaper in Shelby Township, MI, and *The Macomb Daily* and C & G Newspapers in Macomb County, MI.