THE WARRIOR

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Free falling navigation

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Cover photo: A Marine Corps Special Operator approaches his target, finishing a High Altitude High Opening training jump in California using the Military Free Fall Navigation System. (Courtesy photo)

THE WARRIOR
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Field innovations

Group capturing Soldier ideas through installation visits

The Soldier Innovation Initiative is seeking resourceful equipment ideas from Soldiers who have served in Operation Iraqi Freedom and Operation Enduring Freedom.

The Natick Soldier Center's (NSC) Operational Forces Interface Group (OFIG) at the U.S. Army Soldier Systems Center in Natick, Mass., began the effort in January 2004 to capture Soldier-modified equipment in the field as well as identify new equipment made from materials available to Soldiers that they have creatively exploited.

The project's goal is to discover successful field ideas, prototype the best ones for further evaluation, and potentially influence the development process to field new or improved equipment. Ideas are reviewed to determine which technical area within the Natick Soldier Center or Research, Development and Engineering Command can best assess the innovation.

OFIG members, consisting primarily of active-duty and former Soldiers, visit installations throughout the year for the purpose of gathering field feedback, and the Soldier Innovation Initiative piggybacks onto these installation visits to specifically target installations with units returning from Iraq and Afghanistan.

OFIG has been in the business of collecting field feedback for 20 years and has three engineering psychologists who specialize in the development of surveys and in interpreting field feedback. The psychologists developed a survey designed to prompt Soldiers to provide their innovations, creative modifications, field solutions, and newly created or improvised items while deployed.

Soldiers are asked not only to provide information on their ideas but also to provide digital or hard copy photographs to enhance understanding of their ideas. Soldiers are also prompted for contact information so that they can be reached for further clarification.

Project officers conduct a review to determine whether the idea merits further pursuit. They are encouraged to contact the submitter and even invite him to the NSC if this will aid in the prototyping and evaluation process.

After an initial survey round with 2nd Battalion, 27th Infantry, Schofield Barracks, Hawaii, and units of the 82nd Airborne Division deployed in Afghanistan, some ideas that have emerged are:

- Map pocket sewn into the inside of a patrol cap.
- Modified sling that allows the M-4 carbine rifle to hang in a ready position.
- Commercial earpiece for Soldier Intercom for better integration with helmet.
- Golf bag straps attached to M-240B assistant machine gunner's bag to carry the weapon in a ruck configuration.

The NSC believes that the Soldier Innovation Initiative features important differences in process and scope from the Army Ideas for Excellence Program because the initiative employs OFIG to actively solicit creative ideas and solutions from returning combat veterans.

Soldiers whose ideas are determined to be fitting within the Army Ideas for Excellence Program also will be encouraged to do so through this process.

OFIG will continue to solicit ideas from returning units, providing continual new ideas for assessment and possible further development and fielding.

Courtesy photo

Sgt. 1st Class Sam Newland (far upper right corner), an enlisted liaison at OFIG, gathers feedback from Soldiers in Iraq. Survey forms are used to elicit ideas for the Soldier Innovation Initiative.

Air support

Center manages technology of inflatable composite structures

By Curt Biberdorf
Editor

Inflatable structures, also called airbeams, have swelled into a variety of products from tents on the ground to antennas in outer space, and a team of engineers at the U.S. Army Soldier Systems Center in Natick, Mass., forms the backbone of research into the technology.

Founded in 2002, the Center of Excellence for Inflatable Composite Structures headquartered at the Natick Soldier Center's Collective Protection Directorate has managed a textile technology process to create airbeams that are lightweight and compact.

For tents alone, the technology is credited with trimming up to two-thirds of the weight, shrinking into less than one-fourth the volume when packed and shedding more than half the setup time.

Army shelters were the first beneficiaries of airbeam technology, but the technology has transferred to the Air Force, Marine Corps, Navy and NASA with the assistance of industry partners Vertigo Inc. and Federal Fabrics-Fibers Inc.

"The technology was around, and people were working on inflatables, but there was no standard in the industry in design or performance, so we wanted all the expertise in one place to design (a customer's) particular composite for different applications," said Amy Soo Leighton, a chemical engineer on the Fabric Structures Team.

She along with engineers Jean Hampel, Claudia Quigley and Karen Santee contribute to the design, testing and evaluation of airbeam products for the Center of Excellence, using modeling and analysis to find the optimal design.

Interest has grown in inflatable structures as they spread the word at conferences and in publications.

"We can think of a lot of applications at Natick, but others think of areas that we never expected," Leighton said, recalling one inquiry on an airbeam design to quickly move a generator off a vehicle. "We know the technology well enough to meet their standards and have the capability in-house to design (the structures) taking into consideration safety and failure methods."

Airbeams are manufactured by continuous braiding or weaving of a high-strength 3-D fabric sleeve to provide structural strength over an air-holding bladder. What results is a smooth, durable and seamless tube anywhere from 2-40 inches in diameter set at different pressures, depending on the support needed. Each collapsible tube has a built-in valve for a fill-up from a commercial air compressor modified with an automatic shut-off.

Courtesy photo

A 4,200-pound sport utility vehicle hangs from a large shelter airbeam in a display of the structure's strength.

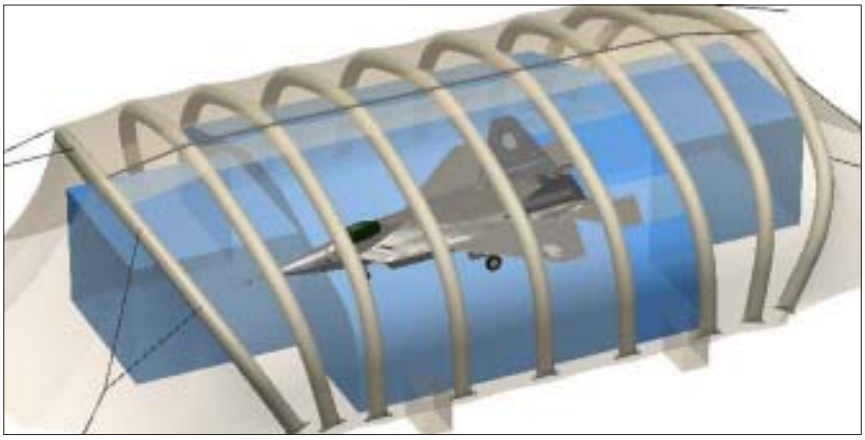
By changing design parameters, the airbeam shape can be modified for different products. The team guided and matured two weaving and braiding capabilities into a reliable technology with unlimited potential, according to Leighton, and in the process created an economical manufacturing base.

A project on a large shelter called the Transportable Helicopter Enclosure led to the Chemically and Biologically Protected Shelter System, which was fielded in 2003. The low-pressure system deploys connected to a Humvee and is equipped to treat contaminated patients.

Other medical shelters in development are the Future Medical Shelter System and 21st Century Military Hospital System, both designed for pre-operative and post-operative care in an environment protected against chemical and biological agents.

After a successful demonstration of the Future Medical Shelter System, the Future Combat System Medical Vehicle Treatment will be demonstrated, according to Leighton.

"Unlike how the (Chemically and Biologically Protected Shelter) is connected to a Humvee, the new system could be self-sustaining so it can be separated from



The Large Shelter System is illustrated with an Air Force fighter airplane. The shelter will serve as a hangar as part of an expeditionary base.

the vehicle," she said. "With photovoltaics, it could provide its own generator power to fill up with the air compressor."

Units from Fort Riley, Kan., and Fort Bliss, Texas, are helping evaluate another type of shelter, the Small Tactical Airbeam Tent, for rapid transition of airbeam-supported shelters to the field. The Standard Integrated Command Post System also could become an airbeam-supported tent.

Similar designs were used in an exercise by the Departments of Homeland Security and Defense to protect people and unmanned aerial vehicles used by the Border Patrol, Leighton said.

The larger the scale, the larger the payoff over conventional structures, she said. The Air Force has cashed in by awarding a contract to Vertigo last June to develop the Large Shelter System, which will serve as an aircraft hangar as part of an expeditionary base.

Although shelters remain a major market for inflatable structures, airbeams are spreading into ship fenders, ejection seat stabilizers, high-glide deployable parachute wings, inflatable ladders, pollution containment booms and fuel bladders.

Miles above, NASA has applied the technology for a 60-foot inflatable airbeam extension boom for a shuttle remote manipulator system to enable astronauts to perform external in-orbit inspection and repair. The agency also is interested in inflatable antennas.

Spin-offs from the manufacturing technology include low-cost rigid composite nose cones for missiles and the next-generation chemical and biological agent-resistant laminated fabric.

For their efforts, the engineers won a 2005 Federal Laboratory Consortium Award for Excellence in Technology Transfer, which will be presented in May.

The award recognizes laboratory employees who have accomplished outstanding work in the process of transferring federally-developed technology to the marketplace. A panel of experts from industry, state and local government, academia and federal laboratory system judge nominations.

Fenders air up for High Speed Vessel

Bumping will become a lot simpler with this fender.

Diverse applications for airbeam technology include the Deployable Airbeam Fender System, the latest undertaking by the Fabric Structures Team and its first Navy project, adding to its focus so far on developing more efficient military shelters.

"That's what was new for us—learning about the Navy, their systems, what's been done and what you need to do to make them better," said Amy Soo Leighton, a chemical engineer on the Fabric Structures Team. "It's a different environment, and we have to figure out what materials, pressure and size will be durable."

The fender system is intended to protect the hull of the Navy's new High Speed Connector during ship-to-ship and ship-to-causeway docking operations, but she said it could transition to other ships.

Current fenders consist of large foam-filled cylinders that are heavy, bulky and difficult to deploy given the inaccessibility of the hull, and low-pressure inflatable rubber bumpers, according to Leighton.

The plan is to install three self-deploying, self-retracting airbeams positioned perpendicular to the water and spread along each side of the vessel that would drop down when needed to provide protection.

"The goal is to increase the performance while cutting the logistics," Leighton said. "We hope to make the operation seamless to the crew, as simple as pressing a button."

She said the one-year-old project finished Phase I testing and will begin more extensive Phase II in Norfolk, Va., this year. Fielding could begin in 2008.

Courtesy photo

Airbeam technology has a variety of applications, including this prototype ladder.

Squeezed

High-pressure processing kills bacteria, saves food quality

By Curt Biberdorf
Editor

Pressed inside a vessel exerting 70,000 pounds per square inch or more, food can be processed so that it retains its fresh appearance, flavor, texture and nutrients while disabling harmful microorganisms and slowing spoilage.

High-pressure processing, an idea more than a century old, was resurrected in the past decade under the joint leadership of Patrick Dunne, a senior research chemist at the Department of Defense Combat Feeding Directorate at the U.S. Army Soldier Systems Center in Natick, Mass., and Edmund Ting of Avure Technologies Inc., in Kent, Wash.

Its potential is now being realized in the commercial market and in the future may lead to a wide array of appealing shelf-stable combat rations for warfighters.

"(High-pressure processing) has been quoted as being the best innovation in food processing in 50 years," Dunne said, who's also the senior adviser for advanced processing and nutritional biochemistry at Combat Feeding. "It's another dimension of food processing that gives a cleaner (ingredient) label with fewer additives and in some cases improves texture."

Although first discovered in the 1890s, high-pressure processing was dormant technology until the late 1980s, according to Dunne. His expertise in understanding microbial inactivation by high pressure and benefits of minimizing chemical changes in foods during and after processing was teamed with Ting and engineers from Avure, who developed the equipment to produce high-pressure processed foods.

Using hydrostatic pressure, water is pumped into a sturdy closeable steel vessel. Foods of any shape or size are equally squeezed around its surface area without crushing the food particles. It's effective on most moist foods, such as fruits, vegetables, sauces and ready-to-eat meats. It can even shell whole uncooked lobster.

Patrick Dunne holds a steel tube that is placed into the high pressure vessel for processing (above). Plastic tubes are used for pouch food while a metal tube is designed for foods in a can. Processing time is much faster using high pressure. (Warrior/ Underhill)

"It rapidly and uniformly inactivates bacteria by injuring the protein and other key cellular structures that would be necessary for growth and function of bacteria. It also inactivates viruses," Dunne said.

The high pressure cycle takes no longer than six minutes, compared to traditional high-temperature processing that takes an hour or longer, without causing chemical changes that degrade food quality.

The process is the only Food and Drug Administration and U.S. Department of Agriculture-approved technology that can kill E. coli, Salmonella and Listeria pathogens inside packaged food products without additives or additional heat processing, according to Dunne, but there's one pathogen still to overcome.

"Clostridium botulinum has been a stumbling block to commercialization of low-acid, shelf-stable foods," Dunne said. "It still has to be demonstrated on a prototype unit before the next step of full-scale research for a bigger production rate."

A family of acidified shelf-stable items—including seafood jambalaya, oriental chicken and Southwestern pasta—was initially demonstrated at

Warrior/Underhill

Patrick Dunne shows the control panel for a pilot-size high pressure processer in a Combat Feeding food lab used for research.

Natick under a contract to Oregon State University led by Professor Daniel Farkas in the 1990s with a longer than two-year shelf-life, he said, but processing equipment was too expensive for commercial application.

By 2001, Avure developed highly-reliable equipment to meet demand for a variety of extended shelf-life refrigerated products. Food companies are using the process for products ranging from orange juice to guacamole to deli meats, which are sold at major stores across the country.

Dunne said the next step for the Army is to develop a high-pressure-assisted thermal sterilization process in low-acid foods, which is expected to be approved by regulatory agencies this year.

Working with industry and academia, Combat Feeding food technologists want to investigate making shelf-stable acidified and low-acid foods, such as potatoes, pasta, rice, whole-muscle meats, seafood and eggs, Dunne said.

Mashed potatoes processed with a new high-pressure sterilization unit might be ready for field testing by the end of the year, he said. Egg products are a longer-term goal. Both degrade in quality during traditional processing.

"It's a new era where industry is collaborating in funding equipment and research on the inactivation of pathogens," Dunne said. "Maybe in another three years, there will be a large enough commercial base to produce pressure-sterilized shelf-stable foods, and we hope beginning with the military."

Beyond the food industry, high-pressure technology could lead to the processing of biological pharmaceutical products and specialized intravenous solutions, or lead to development of a human vaccine from pressure-inactivated viruses serving as antigens for inoculation.

High-pressure processing won a 2005 Federal Laboratory Consortium Award for Excellence in Technology Transfer, which will be presented to Dunne and Ting in May.

The award recognizes laboratory employees who have accomplished outstanding work in the process of transferring federally-developed technology to the marketplace. A panel of experts from industry, state and local government, academia and federal laboratory system judge nominations.

Food companies are using high pressure processing for products such as guacamole (above) to whole meats (right), which are sold at major stores across the country. (Courtesy photos)

Guided jumps

Navigation aid takes uncertainty out of drop zone from high altitudes

By Curt Biberdorf
Editor

Heavy fog, cloud cover, and even rain or blowing snow are all the better for Special Operation Forces parachuting from high in the sky toward their intended infiltration point aided by a navigation system.

Three prototype Military Free Fall (MFF) navigation systems are being evaluated by the Natick Soldier Center's (NSC) Airdrop Technology Team at the U.S. Army Soldier Systems Center in Natick, Mass., to safely, accurately and covertly insert forces into unfriendly places.

Like pilots relying on their instruments to guide their aircraft when visual cues are unavailable, Special Operations warfighters can rely on the navigation system on MFF missions.

Jumping from altitudes of 25,000 feet or higher, they can steer their Ram Air parachutes to pre-selected impact points even after exiting the aircraft from miles away in miserable weather. This infiltration technique is called High Altitude High Opening (HAHO).

"The best conditions are the worst conditions," said Daniel Shedd, project officer for the MFF Navigation System. "Ideally, you don't want to see the ground until just prior to landing, because (the enemy) can see you."

While precision airdrop programs at the Airdrop/Aerial Delivery Directorate at Natick are working on ways to accurately deliver cargo to a planned drop zone, the MFF navigation system guides warfighters flying under canopy. In both cases, the intent is to minimize exposure of Air Force aircraft and their crews to enemy threats.

"We just want to get them close. Once they are on final approach within a kilometer, they should be able to identify their target," Shedd said. "The Global Positioning System (GPS) is accurate to within about 10 meters, but unfortunately the altitude is not yet accurate enough considering the timing necessary of the canopy flair maneuver, which slows the forward speed and vertical descent rate for a soft and safe landing."

Courtesy photo

The Military Free Fall Navigation System for the Marine Corps mounts a Global Positioning System (GPS) onto the parachutist helmet. The system is wired to a TV-like display attached to the goggles to give users directions on where to steer the canopy.

Primitive attempts

He said HAHO operations are not commonly considered because commanders don't have enough confidence to risk failure of the larger mission and possible loss of life.

Bad winds, missed release points, inaccurate release altitudes and human directional errors frequently result in missed targets. Adequate training is another concern because of airspace restrictions, aircraft limitations and logistics involved in operating in such a hazardous environment.

These infiltrations, when successfully performed, are ideal for small units requiring the highest level of security, he said.

When coupled with precision bundle capabilities and future improved personnel parachute systems, large amounts of equipment and vehicles will be able to be inserted with the unit, greatly increasing its mission capabilities.

"When the opportunity arises to train for this type of infiltration technique, the jumpers need the best tools available to ensure success and demonstrate the viability of the mission," Shedd said.

The user-community has long sought this type of capability but has had no choice but to purchase their own handheld GPS units and attempt to mount them in places where they could be useful.

GPS-based airborne guidance units mounted on the chest or wrist were primitive attempts to navigate from under canopy, said Shedd, but the problem is that they are too dif-

ficult to view while wearing all the necessary equipment for high-altitude jumps, such as oxygen masks.

Started two years ago and funded by Special Operations Command's Special Operations Special Technology, Shedd said the project has gained significant momentum, in addition to the participation of all of the Special Operations services.

Systems now in development consist of a Gentex high-altitude parachutist helmet with a heads-up display, a processor unit and GPS. A laptop-based or Personal Digital Assistant (PDA) mission planner along with a map overlay, alternative target designation features and predicted release cones based on wind estimates entered into the computer before the jump are all options being evaluated.

The Marine Corps, engineers from the Navy's Coastal Systems Station in Panama City, Fla., and the NSC have produced a prototype scheduled for fielding in 2006.

It will give Marine Corps Special Operators the first MFF navigation aid to work with until an upgraded system is available, according to Shedd.

"These guys are really excited. I have no shortage of people who want to know more and eventually try it," Shedd said, who has tested the systems as an airborne-qualified civilian employee. "Experience has shown that jumpers need a couple of jumps just to get used to it, but once they do, they all become believers."

From altitudes as high as 35,000 feet, the system must function at minus 35 degrees F and for as long as a 20-mile offset in calm winds with MC-4 or MC-5 parachute systems. Offsets of 3-1, which is a ratio of 3 feet of forward motion for every 1 foot of descent, will increase to 5-1 or 6-1 with a future canopy, and help to provide extra protection to aircraft, according to Shedd.

Multi-mission capable

Future real-time wind information will be delivered to the mission planning computer by the Joint Precision Aerial Delivery System (JPADS) for cargo delivery, a current Advanced Concept Technology Demonstration program also being managed by NSC. This will further enhance mission accuracy since inaccurate winds are the most significant contributor to missed targets, Shedd said.

Courtesy photo

A parachutist helmet with a heads-up display is shown next to a Personal Digital Assistant (PDA) containing a Global Positioning System (GPS) and mission planning software. An eventual goal is to have a wireless connection between the display and PDA. Longer-term, the hope is that the navigation aid will become the base for an electronics package that will be considered multi-mission capable.

The Marine Corps system integrates a GPS wired to a tiny TV-like display mounted to one side of the goggle. Shedd said the system is assembled with commercial components, and the technology is relatively mature, but there is limited follow-on capability, the display is obtrusive and the helmet is of little use on the ground.

Another prototype, developed by European Aeronautic Defence and Space Co. for German Special Forces, uses a handheld GPS with airborne guidance wired to the helmet display.

A display driver and antenna integrated into the helmet are fine, but the liquid crystal display begins to fail at high altitudes due to the low temperatures, and the cables restrict movement and are sensitive to damage, according to Shedd.

On the upside, he said the mission planning software is "fantastic." It knows how to fly the mission and determine the approach, making 3-D adjustments from the sky. Also, its GPS can be used on the ground.

Shedd said the next-generation prototype should be ready within the next six months.

The eventual goal is to carry a PDA containing mission-planning software and an encrypted GPS in the rucksack that wirelessly communicates to a heads-up display.

The display is expected to be unaffected by low temperature, legible in bright light and attached to a ballistic helmet instead of a parachutist helmet.

It is hoped that the navigation aid will become the base for an electronics package that will be considered multi-mission capable, which streamlines many computer-based capabilities now expected of Special Operations, such as calling in close air support, and enabling many communications functions, according to Shedd.

"The system must be reliable and easy to use, and programming should not overly burden planning of the long-term mission," he said. "We have to keep in mind that HAHO jumps are just a way of getting Special Operations Forces to the job."

Speed scratch

Navy menu adopts food industry advances to increase efficiency

Story and photos by Curt Biberdorf

Nydia Ekstrom, a chef for Unilever Food Solutions, speaks to Combat Feeding food technologists before they try items that may become part of the Navy's 21-day advanced operational menu.

Prepared packaged foods are gaining a foothold in Navy food service through the 21-day advanced operational menu, a project managed by the Department of Defense Combat Feeding Directorate at the U.S. Army Soldier Systems Center in Natick, Mass., intended to reduce labor and cut costs.

Navy culinary specialists traditionally have prepared recipes with ingredients from scratch, but now the push is to find efficiencies aboard ships.

"Years ago, the military didn't look at labor as an issue. Now, the less people you put on a ship, the better," said Dave Dillon, a retired Navy master chief and project officer for the Navy's food equipment program. Besides improving galley equipment, another way to save time is through menu management. Dillon said every ship has its own six-week cycle, which could be the same or completely different, based on Armed Forces recipes or local recipes. Packaged foods were tried in 1994 during initial research into a new menu, but they were rated unacceptable in taste testing.

Beginning last year, the Navy Food Service Division revisited the idea. In Phase I of the program, the division assembled a prototype menu for the Pacific Fleet and Fleet Forces Command using "1 NSN," the name given to a fresh-food group ration similar to what's used in the Army. Each 1 NSN contains 50 servings of a protein, starch and vegetable.

Although sailors liked the food and cooks saved time while enjoying more flexibility, costs were higher than desired and storage was limited, according to Deb Sisson, a physical scientist and project officer for the advanced menu.

After demonstrating the potential of 1 NSN in Phase I, the Navy went to Combat Feeding for Phase II to provide the data to support the goals of cutting labor, costs and simplifying re-supply without compromising nutrition and taste.

Time studies with lasagna showed that a "speed scratch" recipe, one that combines at least some manufacturer-prepared ingredients, took 30 minutes vs. 90 minutes for scratch. A frozen heat and serve entrée shortens preparation time to five minutes. Alternatives to scratch recipes also rated well in sensory panels.

Judith Aylward, a senior food technologist, fills out a survey evaluating the food quality during a product demonstration at the food lab Feb. 16. A total of 43 varieties of fish, chicken and beef entrees, and soups and sauces were available to sample.

"We used lasagna and a few other entrees because we knew they were labor-intensive," Dillon said. "Every product got similar scores (to scratch recipes) in evaluations. Industry has done a good job of getting products that save time and are high quality."

In the past decade the amount of pre-packaged or heat and serve products from major food manufacturers has "exploded," said Sisson, leading to new opportunities to incorporate them into a standardized menu.

Through market surveys, Sisson learned that nearly every major chain of quick serve and quick casual restaurant was using some variety of pre-cooked protein in their menu. For instance, frozen raw chicken vs. cooked frozen chicken can taste about the same, but cooked frozen chicken requires less than half the preparation time and lowers the chance of food contamination during handling.

"I don't think the average consumer knows the difference between pre-cooked and fresh," Sisson said. "There aren't many cooks (at these restaurants) cooking from scratch."

Still, sailors and cooks don't need to fret about the end of scratch meals. The plan calls for one speed scratch or heat and serve selection to supplement a meal made from scratch.

"By using the foods Deb has researched, we're still giving culinary specialists a chance to use their skills. Instead of spending 13 hours a day just trying to get the food served, they'll have time to do training or work on a new recipe," Dillon said.

Storage is increased because precooked packaged foods occupy less space than raw foods. He said by using the new menu the Navy can easily pack a ship for up to 60 days.

How the Navy orders menu items is another way to gain efficiency, according to Sisson. One of the goals is to reduce the size of the prime vendor catalog the Navy uses to order food from more than 1,500 items to 600 items.

"The logistics to support that catalog is enormous," she said. "If everyone has spaghetti on the same day, we could reduce the logistics and cost."

Another advantage of prepared foods is reduced reliance on deep-fat fryers aboard ships, which eliminates the hazards of cooking with hot oil, fryer maintenance, and oil handling and disposal, according to Dillon.

Major food service companies have demonstrated hundreds of prepared foods for Combat Feeding scientists to evaluate, the latest demonstration offering 43 samples of fish, chicken and beef entrees, and soups and sauces.

Sisson said chefs who have come to Natick work with major chains to help develop their menus, but only the highest-rated products from the manufacturers will be selected for the 21-day operational menu scheduled to be sent to the fleet in June for evaluation.

She said the Navy will then gather comments from sailors to help Combat Feeding to improve the menu.

Dave Dillon, project officer for the Navy's food equipment program, helps prepare a dish during a demonstration of the Navy's 21-day advanced operational menu Feb. 16. All foods were prepared with Navy kitchen equipment.

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