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3rd Edition, March 2010
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TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

*Department of Defense
Combat Feeding*
**FOOD SERVICE EQUIPMENT
& FIELD FEEDING SYSTEMS**

**DoD Combat Feeding
Food Service Equipment & Field Feeding Systems**

**3rd Edition
March 2010**

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Proponents of this pamphlet are the DoD Combat Feeding Directorate (CFD; Natick Soldier Research Development & Engineering Center) and Product Manager – Force Sustainment Systems (PM-FSS) located at the U.S. Army Natick Soldier Systems Center.

This pamphlet is posted on the DoD Combat Feeding website address given on the back cover. For the most current information regarding food service equipment and field food service items prior to the publication of an updated pamphlet, please consult the website. General comments and suggested improvements from readers and customers are most welcome. Please send or email them to the CFD or PM-FSS addresses listed on the last page of this pamphlet.

The U.S. Government and the DoD Combat Feeding Directorate make no endorsements of any commercial items contained, whether written or photographed, within this pamphlet. A commercial product or name is only mentioned in cases where a contract has been awarded or where a particular piece of equipment is dependent on a sole-source that meets military performance specifications.

The U.S. Army Natick Soldier RD&E Center's DoD Combat Feeding Directorate and the Product-Manager - Force Sustainment Systems will continue to invest in advanced food service equipment science, technology, and development in order to provide world-class combat feeding field food service systems to the United States Armed Forces.



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LIST OF ACRONYMS.....2

HOW TO USE THIS BOOKLET 3

FOREWORD5

EQUIPMENT & SYSTEMS ILLUSTRATION.....6-7

ARMY FIELD FEEDING EQUIPMENT 9-18

 Introduction..... 9

 Ration & Food Product Preparation10-13

 Mobile Kitchen Trailer (MKT)..... 10

 Containerized Kitchen (CK) 11

 Modern Burner Unit (MBU)..... 12

 Ration Maintenance, Stabilization,
& Distribution.....13-14

 Multi-Temperature Refrigerated Container
(MTRCS) 13

 Refrigerator Container System (RCS) 14

 Heating & Serving Rations for
Remote Feeding15-17

 Assault Kitchen (AK) 15

 Kitchen, Company Level Field Feeding
(KCLFF)..... 16

 Medical Field Feeding Cart (MFFC)..... 17

 Sanitizing Field Feeding Equipment and
Remediating Waste 18

 Food Sanitation Center (FSC) 18

MARINE CORPS FIELD FEEDING EQUIPMENT ... 19-25

 Introduction..... 19

 Expeditionary Field Kitchen (EFK) 20

 Enhanced – Tray Ration Heater System
(E-TRHS)..... 21

 8×8×10 ISO Refrigerated Container System
(RCS) 22

 Small Field Refrigeration System (SFRS)..... 23

 Tray Ration Heating System (TRHS) 24

NAVY FIELD FEEDING EQUIPMENT26-38

 Introduction..... 27

 Future Navy Galleys & Sub-Hatchable
Programs 28

 AccuSteam Griddle™ 28

 AccuTemp Steam ‘N Hold™ 29

 Blodgett Double Stack Combi Oven 30

 Market Forge Sub-Hatchable Electric
Convection Oven 31

 Legion Skittle..... 32

 Market Forge Eco-Steamer..... 33

 Hot Food Counter w/ Warming Cabinets
and Griddle w/ Refrigerated Drawers 34

 Vegetable Sink 35

 Automated Cardboard Shredder 36

Smart Process Control System 37

COMM-Z Kitchen Upgrade 38

AIR FORCE FIELD FEEDING EQUIPMENT 39-44

 Introduction..... 39

 Basic Expeditionary Airfield Resources
(BEAR)..... 40

 Single Expeditionary Kitchen (SPEK) 41

 Electric – Single Pallet Expeditionary Kitchen
(E-SPEK) 42

 Advanced Design Refrigerator (ADR-300)..... 43

 Containerized Deployment Kitchen (CDK) ... 44

ALL SERVICES45-47

 Insulated Food Container (IFC)..... 46

 Optimized Insulated Food Container (OIFC).. 46

 Insulated Beverage Container (IBC) 47

 Thermo Electric Water Chiller & Heater
(TEWCH) 47

COMING TO A THEATER NEAR YOU®48-58

 Introduction..... 49

 Battlefield Kitchen (BK) 50

 Self-Powered Tray Ration Heater (SPTRH) ... 51

 High-Efficiency Solar-Powered MTRCS 52

 Water Cooling 53

 Beverage Cooling Unit (BCU)..... 54

 Waste to Energy Converter (WEC) 55

 Automated Shipboard Dishwashing System
(ASDS) 56

 Naval Refrigeration Project..... 57

CONTACT INFORMATION..... 59

FOOD SERVICE EQUIPMENT & FIELD FEEDING SYSTEMS

ACRONYM LIST

Advanced Design Refrigerator-300	ADR-300	Medical Field Feeding Cart	MFFC
Advanced Food Sanitation Center.....	AFSC	Mobile Kitchen Trailer	MKT
Air Force	AF	Modern Burner Unit	MBU
Air Expeditionary Forces	AEF	Modified Atmosphere Packaging System	MAPS
Army Field Feeding System	AFFS	Mounted Water Ration Heater.....	MWRH
Assault Kitchen	AK	Multi-Temperature Refrigerator Container System.....	MTRCS
Automated Cardboard Shredder	ACS	Natick Soldier Research Development & Engineering Center	NSRDEC
Automated Shipboard Dishwashing System	ASDS	National Sanitation Foundation.....	NSF
Battlefield Kitchen	BK	National Stock Number.....	NSN
Basic Expeditionary Airfield Resources.....	BEAR	Naval Sea System Command	NAVSEA
Beverage Cooling Unit.....	BCU	Naval Supply Systems Command.....	NAVSUP
Combined Arms Support Command	CASCOM	Navy Standard Core Menu	NSCM
Containerized Deployment Kitchen	CDK	Optimized Insulated Food Container.....	OIFC
Combat Feeding Directorate.....	CFD	Product Manager – Force Sustainment Systems.....	PM-FSS
Commander, Naval Air Systems Command	COMNAVAIR	Product Manager – Infantry Combat Equipment.....	PM-ICE
Commercial-off-the-Shelf	COTS	Pre-Planned Product Improvement.....	P3I
Communication Zone Kitchen	COMM-Z	Tactical Quiet Generator	TQG
Containerized Kitchen	CK	Thermoelectric Water Chiller/Heater.....	TEWCH
Continuous Operations	CONOPS	TriContainer.....	TriCon
Culinary Specialist	CS	Refrigerated Container System.....	RCS
Defense Logistics Agency	DLA	Refrigeration Unit	RU
Department of Defense	DoD	Research & Development.....	R&D
Expeditionary Field Kitchen	EFK	Shipboard Modular Refrigerator	SMR
Electric Single Palletized Expeditionary Kitchen	ESPEK	Single Palletized Expeditionary Kitchen	SPEK
Enhanced – Tray Ration Heater System ...	E-TRHS	Self-Powered Tray Ration Heater.....	SPTRH
Field Food Service System	FFSS	Smart Process Control System	SPCS
Family of Medium Tactical Vehicles	FMTV	Subsistence Platoon.....	SP
Food Sanitation Center	FSC	Thermoelectric Water Chiller/Heater.....	TEWCH
Force Provider.....	FP	Tray Ration Heater.....	TRH
Individual Beverage Container.....	IBC	Enhance - Tray Ration Heater System.....	E-TRHS
Insulated Food Container	IFC	Unitized Group Ration – Heat & Serve™.....	UGR-H&S™
International Standards Organization	ISO	Unitized Group Ration – A™	UGR-A™
Kitchen, Company Level Field Feeding	KCLFF	Unitized Group Ration – B™	UGR-B™
Logistics Civilian Augmentation Program.....	LOGCAP	United States Marine Corps.....	USMC
Marine Corps Systems Command	MARCORSYSCOM	Volts Alternating Current	VAC
Meal, Ready-to-Eat	MRE™	Waste to Energy Converter	WEC

This purpose of this book is to communicate the CFD mission when it comes to researching, engineering, and developing new materials and technologies for military field feeding equipment and systems. As seen in the table of contents, each equipment item or field feeding system is grouped with the service by which it is primarily (or exclusively, in some cases) used. While it is important to know which service uses various equipment items or systems, it is also important to understand that there is often some crossover between services and the equipment they utilize to feed their units, since the services do not always operate independently from one another. Additionally, greater understanding of a particular item or system, a kitchen, for example, can be gained when one is aware of the environment in which it that kitchen is used and how it compares to another type of kitchen used by a different service in the same type of environment. As you will note on pages 6-7, there is an "Equipment and Systems Illustration" that demonstrates the operational scenarios in which the major equipment items and systems described in this book are used. Keep this illustration in mind as you read through the book, understanding that each item has been carefully researched, engineered, and tested by the CFD to ensure that it is effective, efficient, sustainable, and maintainable in the operational environment for which it is intended.

Additionally, this book is divided into five sections: Army, Marine Corps, Navy, Air Force, and Coming to a Theater Near You®. Within each section is a brief introduction to the major technology thrust areas being pursued for each service, followed by a listing of the primary pieces of equipment or field food service systems that fall within those thrust areas. The Coming to a Theater Near You® section specifically focuses on future technologies being investigated to further improve field food service systems on the battlefield. In addition, it is important to understand the relationship between the equipment and field food service systems described in this book and the family of combat rations which they support. The types of operational rations mentioned in this book are as follows:

INDIVIDUAL RATIONS:

Meal, Ready to Eat™ (MRE™), First Strike Ration®, and Meal Cold Weather/Long Range Patrol (MCW/LRP): Each of these is an individual ration utilized by Warfighters in various environments when field food service equipment is not available. The MRE™ is the cornerstone

of individual rations, sustaining a Warfighter for up to 21 days of deployment while being nutritionally adequate for longer periods if necessary. The FSR® enhances Warfighter consumption and is designed as a compact, eat-on-the-move assault ration to be utilized during the first 72 hours of intense conflict by forward deployed Warfighters. The MCW/LRP is a restricted calorie ration with a long shelf life than can be used during initial assault, special operations, and long-range reconnaissance missions.

UNITIZED GROUP RATIONS (UGR):

UGR-H&S™: Is generally the first group ration made available to Warfighters in theater. During early deployment when only field kitchens without refrigeration capability are available, the UGR-H&S™ provides a high quality, hot group meal for 50 Warfighters with easy to prepare, heat, and serve food that is pre-cooked and shelf stable, hermetically sealed in polymeric trays

UGR-A™: Provides high quality, fresh-like food components for 50 Warfighters and is the most highly accepted ration in the UGR™ family. The UGR-A™ is the only military ration that contains frozen food components; it is therefore based on a build-to-order assembly process that requires refrigerated/frozen storage and a field kitchen for preparation.

UGR-B™: Is used primarily by the Marine Corps. This ration is designed to meet requirements for providing 50 Marines with high quality group rations that do not require refrigeration and are quick and easy to prepare. All ingredients in the ration are shelf stable, with an emphasis placed on including commercial products in all menus. There are 5 breakfast and 14 lunch/dinner menus.

Navy Standard Core Menu (NSCM): Is designed to standardize food service throughout the Navy fleet while providing a high amount of variety and nutritious choices to Sailors. The NSCM is based upon a 21 day cycle that includes a different breakfast, lunch, and dinner menu for each day of the cycle. NSCM menus require preparation by a culinary specialist in a navy galley.

Additional technical information and nutritional data about these and other operational rations, components, and accessories can be found in the Operational Rations of the Department of Defense booklet at nsrdec.natick.army.mil/media/print/OP_Rations.pdf.







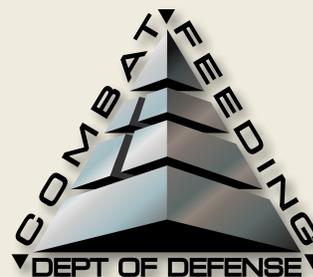
The single most important weapons platform of the U.S. Department of Defense (DoD) is the individual Warfighter. It is imperative, therefore, that Warfighters maintain optimum cognitive and physical performance in order to constantly transition between peacekeeping missions, combat preparation, and intense combat operations. Fueling the Warfighter is essential to these activities, and coupled with that need is the requirement for resource efficient, modular, and globally compatible equipment that enhances mobility and increases agility, enabling Warfighters to be more effective in their missions. In order to create and enhance these capabilities, there needs to be continual technological breakthroughs in combat food service equipment.

The DoD Combat Feeding Directorate (CFD) is part of the U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) located in Natick, Massachusetts. CFD manages the Combat Feeding Research and Engineering Program (CFREP), a joint service program that is a single source, world-class provider of science, technology & materiel systems dedicated to the research, development, integration, testing, and engineering for combat rations, field food service equipment technologies and combat feeding systems. This includes the total life cycle development and management of all science and technology programs for Marine Corps, Navy, and Air Force field food service equipment. The CFD also fosters a partnership with the Product Manager – Force Sustainment Systems (PM-FSS). The PM effectively manages advanced and full scale development for Army field food service equipment.

CFD advocates and practices a total life cycle business approach, with continuous product improvement and planned technology transitions in order to put quality field feeding equipment and systems into the hands of Warfighters around the world. Through its intense focus on utilizing the most state-of-the-art science and technology available, in conjunction with leveraging industry, the CFD provides food service equipment and systems for Warfighters that are essential for them to operate effectively and efficiently on the battlefield, regardless of location, environmental extremes, or mission requirements.

This book highlights CFD and PM-FSS combat food service equipment and systems and selected science and technology initiatives that are transforming the way the DoD sustains Warfighters. Revolutionary advances in field feeding systems are continually being made and are becoming key contributors in the DoD's efforts to create and promote a more strategically adept military. The DoD CFD and PM-FSS are responsible for ensuring that Warfighters are supplied with the best equipment so that they are the best fed in the world. CFD continues to invest in high risk, high payoff science and technology and continuous product improvement to provide revolutionary combat feeding capabilities for our Warfighters.

The DoD Combat Feeding Program mission is to ensure that United States Warfighters are the best fed in the world.



GARRISON:
Refrigeration Systems for
receiving & transporting
perishables to FOBs and
Outposts (RCS, MTRCS,
SFRS)

**FORWARD
OPERATING BASE (FOB):**
MKT, CK , FSC, MFC,
RCS, MTRCS



Field Feeding for Joint Operations in an AOR

OUTPOSTS:
KCLFF, AK, EFK, TRH/E-
TRHS, SFRS, BK (future)

NAVY GALLEY
EQUIPMENT FOR SHIPS,
CARRIERS & SUBS

AIRFIELD:
SPEK, ESPEK, CDK, BEAR,
ADR-300







INTRODUCTION TO ARMY FIELD FEEDING EQUIPMENT

As important as it is to consistently deliver high quality, highly acceptable rations to Soldiers, it is equally as imperative for troops to have the equipment they need to prepare and serve those rations. The mission of the CFD Food Systems and Equipment Team (FSET) is to engineer and design food service equipment that consistently provides Soldiers the capability to enjoy hot group meals in combat or training environments. The FSET operates under the purview of the Product Manager – Force Sustainment Systems (PM-FSS), who ensures that new equipment and food service systems are able to transition smoothly and expeditiously to Soldiers in the field.

Providing the right equipment for a specific operational scenario is highly dependent not only on developing novel equipment configuration concepts with cutting edge technologies, but also on ensuring that the resulting equipment can be integrated into the total life cycle support of already existing field food service systems. This is why the FSET operates under the purview of PM-FSS and in collaboration with Combined Arms Support Command (CASCOM) and the Integrated Logistics Support Center. PM-FSS enhances the combat effectiveness and quality of life for Soldiers by providing equipment, systems, and technical support to sustain and improve the environments in which they live, train, and operate. These programs provide direct and indirect life cycle support to Soldiers in virtually any environment, including training, contingency, and combat operations. PM-FSS provides a broad range of Soldier sustainment capability that ensures Soldiers have the proper living conditions, nutrition, supply, hygiene, and clean clothing, resulting in improved combat effectiveness.

When it comes to the specific mission of field feeding equipment for proper nutrition, food supply, and sanitation, CFD is responsible for identifying, leveraging, and integrating maturing technology from the S&T community with verified requirements from the user community (CASCOM/Army Center of Excellence, Subsistence) into acquisition programs of record for material solutions. PM-FSS ensures that initial concept engineering solutions are managed with a total life cycle mentality and are smoothly transitioned to full scale production and sustainment. The outcomes of these activities are well-planned and executed acquisition programs that field robust, efficient, and proven equipment and systems for field feeding, ration storage, and sanitation. These programs feature collaborative transition plans for equipment sustainment; increased Soldier safety, efficiency and comfort; conservation of battlefield resources such as fuel, water, and electricity; systems with smaller footprints requiring less resupply and support; and lower operations and sustainment costs.

The following pages on Army equipment are organized in order of the four functional areas in which the FSET operates and categorizes its equipment programs: Prepare Rations and Food Products; Maintain, Stabilize, and Distribute Rations; Heat and Serve Rations for Remote Feeding; and Sanitize Field Feeding Equipment and Remediate Waste. Additional descriptions of Army equipment currently undergoing preliminary S&T development and testing can be found in the "Coming to a Theater Near You®" section in the back of this book. These projects are equipment systems that utilize emerging technologies that are expected to provide a high return on investment once they are fielded.



ARMY FIELD FEEDING EQUIPMENT

MOBILE KITCHEN TRAILER (MKT)

PURPOSE:

A proven, durable asset for the Army's field feeding operation for 30-plus years, the MKT is an expandable, self-contained, trailer-mounted field kitchen used for the preparation of UGR-A™ and UGR-H&S™ rations for approximately 250-300 Warfighters per meal. The MKT was first fielded in the 1970s, and there are now approximately 3500 in use throughout the Army.

Throughout the past 30 years, the MKT has undergone various improvements such as implementation of a cold weather kit, electrical power and lighting, improved griddle, and upgraded fabric. An ongoing RESET program restores used MKTs to like-new condition and incorporates all of the latest improvements.

CHARACTERISTICS:

The MKT collapses down into an easily transportable trailer-mounted system and can be towed behind several types of military tactical vehicles. Certain models may be externally air transported by a CH47 helicopter. The MKT system consists of military standard field cooking equipment packaged in a configuration to allow efficient preparation of rations. The cooking equipment includes the M59 range, stock pot locations, griddle, field burners, tables, and insulated food/beverage containers. The expandable work platform is mounted on the trailer and contains preparation counters, cooking areas, and a serving line. The kitchen is covered by a manually raised structural roof and fabric sides for environmental protection.

CAPABILITIES & BENEFITS:

- Has high mobility and versatility.
- Can be utilized as either a forward operated or rear operated field kitchen.
- Is durable and diverse enough to be towed over both highways and cross country terrain.
- Two MKTs may be placed side by side as in the picture shown in order to double the feeding capacity.

COMMENTS:

There is an ongoing effort to develop a MKT RESET Kit, which consists of new equipment to increase the kitchen's ability to prepare a wider variety of operational rations. The MKT RESET Kit will not alter the basic form of the current MKT platform. Kit components will fit inside the current platform with minimal changes to the MKT structure and layout of cooking and preparation areas. The effort will investigate alternative power sources that are quiet and more reliable. The prototype kit includes an oven to replace one M59 range and a tilt-skillet to replace the standard griddle. These new appliances add variety in how rations are prepared, thus improving the quality of rations and troop morale. Temperature control of appliances is aimed at saving on labor, fuel, and power costs. Overall, the project will improve sustainment capability through the reduction in power/fuel consumption and updated food preparation equipment.



AT A GLANCE:

- **FEEDING CAPACITY:**
250-300 Warfighters per meal
- **DIMENSIONS:**
Travel: 93"H x 92"W x 171"L
(236cm x 234cm x 434cm)
Operational: 132"H x 152"W x 201"L
(335cm x 386cm x 1,102cm)
- **WEIGHT:**
 - Approx 6,000 lbs (2,721 kg) dry (without fuel & water)
 - Approx 6,700 lbs (3,039 kg) wet (with fuel & water)
- **POWER:**
Electrically powered with a 2 kW generator
- **TRANSPORTATION:**
Can be towed behind LMTV, stowed on board C130 aircraft; some models are certified for external airlift by CH47 Helicopter.

CONTAINERIZED KITCHEN (CK)

PURPOSE:

The CK is used for preparing and serving both UGR-H&S™ and UGR-A™ meals, but can prepare any type of food as it has a full complement of appliances, including refrigeration capabilities. This provides Warfighters with high quality, fresh rations in a controlled environment. Capable of supporting up to 800 Warfighters with three hot cook-prepared or heat and serve rations per day, the CK is designed for use at battalion-level meal preparation sites but can also be used by other selected units in remote locations.

CHARACTERISTICS:

The CK is a self-contained system for food preparation, cooking, and warming that consists of a combination of existing military kitchen equipment and COTS items together in an expandable 8×8×20 ISO container. The kitchen is mounted on a tactical trailer and towed by the latest Family of Medium Tactical Vehicle (MTV) 5-ton truck. Once in the field, it remains on the trailer. The electrical needs of the CK are provided by an on-board 10 kW TQG. In garrison, the kitchen can also be placed on the ground and be operated from an external electrical source. The CK is the first fielded system that uses the MBU as the primary heat source. The six MBUs can generate approximately 100 kW of heat energy. The CK improvements over other field kitchens include hot and cold running water for food preparation and clean up, environmental controls for heating and cooling, integrated ventilation for cooking and burner by-products, and two refrigerators for 60 cu ft (1.7 cu m) of refrigerated storage. Additionally, equipment is



interchangeable on four of the CK’s burners, giving cooks maximum flexibility in utilizing a griddle and multiple steam pans and cook pots. The remaining two burners heat the oven and heater tank assembly. A Soldier’s serving line inside the kitchen separates the cooks and Soldiers while the 10 kW TQG and major utilities are located in a separated room.

CAPABILITIES & BENEFITS:

- Has same food preparation capabilities as two MKTs, a decreased footprint, and a reduction in personnel requirement for assembly and operation.
- Is expandable to full operation in less than 40 min.
- Is trailer or ground operable and easily transportable by land, sea, and air.
- Has portable and fixed water source connections for obtaining hot and cold potable water.
- Is highly durable and able to operate in temperatures ranging from -25°F (-32°C) to 120°F (49°C).

COMMENTS:

The CK was initially fielded in 1998 and is the largest of the Army fielded kitchens. It is nearing production completion in FY10. The CK is currently undergoing a PrePlanned Product Improvement Program (P3I) aimed at making improvements to the sustainability and operational capability of the kitchen. In order to reduce heat stress for workers, new prototype systems are being developed that eliminate the ineffective air conditioners and replace them with fans. Removal of the AC units will decrease the weight of the CK by at least 436 pounds (196 kg) and reduce the power consumption by 5.6 kW, allowing for an increase in the power of the airflow in the vent hood. The CK has been fitted with ducts that make it compatible with the Military Environmental Control Unit system so that cooling will still be available during meal prep and service. Additional goals of the P3I program include integrating sanitation within the CK while also developing appliances that are compatible with the future Battlefield Kitchen.

AT A GLANCE:

- **FEEDING CAPACITY:**
800 Warfighters, 3 times per day
- **DIMENSIONS:**
8 ft H×8 ft W×20 ft L (2.4×2.4×6.1m)
- **WEIGHT:**
19,800 lbs (8,910 kg) including 5,500 lb (2,475 kg) trailer
- **POWER:**
Internal 10 kW TQG or external power compatible
- **HEAT SOURCE:**
Six MBUs with independent fuel supply
- **REFRIGERATION:**
Two refrigerators with 60 cu. ft. (1.7 cubic meters) of refrigeration capacity and non ozone depleting R-404A refrigerant
- **ENVIRONMENTAL CONTROL:**
Internal 48,000 BTU/hr air conditioner and 4 kW space heater
- **LIGHTING:**
Light system has blackout capability



MODERN BURNER UNIT (MBU)

PURPOSE:

The Modern Burner Unit is the backbone of the food service equipment in the field. It is utilized as the sole heating component in the MKT and CK and is a component of the Assault Kitchen. The MB is also the heat source for the Food Sanitation Center. The MBU was first fielded in 1999 as a replacement to the older M2 burner. The MBU uses JP-8, a kerosene-based fuel that burns more cleanly and is less volatile than gasoline used by the M2, thereby increasing safety and preventing pollution. The MBU tank also takes less time to fill than the M2 tank.

CHARACTERISTICS:

The MBU can be inserted beneath cooking racks in MKTs and CKs to prepare meals. It features a closed-circuit fuel system, which reduces the safety hazard of the M2 Burner by eliminating possible fuel spillage and reduces maintenance. The MBU has an integral pump that draws fuel through a quick disconnect fitting located on the front of the unit. It is self-priming and can fill its 2-gal tank in 2 min. The unit ignites with the touch of button, and shuts down just as easily, with a firing range comparable to the M2. Because the new MBU can be lit in place within an MKT, there is no need for Warfighters to carry the burner (as they did with the M2 burner), thus eliminating the chance of fuel spillage. Additionally, the MBU produces fewer emissions than the M2 burner.

CAPABILITIES & BENEFITS:

- Has same dimensions as M2 with lightweight construction and modular assembly.
- Has infra-red burner capabilities.
- Generates 18,000 to 60,000 BTU/hr operating in -25°F (-32°C) to 125°F (52°C) in remote locations.
- Operates approximately 4 hrs on full tank of fuel.
- Has powered ignition and powered refueling.
- Has fully adjustable burner temperature.
- Has fault detection and fuel level indicators.

COMMENTS:

Warfighters in the field are able to perform three key maintenance procedures on the MBU: controller assembly, compressor assembly, and fuel delivery block assembly. They can replace these components in the field instead of turning the unserviceable unit in to unit level maintenance or having to order a new one. With the user performing these limited replacements, the MBU can be placed back in service quickly, thus improving the MBU mission-capability rates. To aid in these repairs, an MBU tool kit consisting of common hand tools was developed to allow operators to successfully perform these maintenance functions. PM-FSS purchased an initial amount of tool kits to support already fielded CKs and MKTs.



AT A GLANCE:

- **WEIGHT:**
58 lbs (26 kg) fully fueled; 41.5 lbs (19 kg) without fuel
- **DIMENSIONS:**
Height 9.75 inches (25 cm); Depth 23 inches (58 cm); Width 19 inches (48 cm)
- **FUEL CAPACITY (Usable):**
2 gallons (7.6 lt)
- **FUEL CONSUMPTION:**
Operating at maximum firing rate: 2.8 lbs (1.27 kg)/hr; Operating at minimum firing rate is 1.2 lbs (.54 kg)/hr
- **OPERATION TIME:**
(Full fuel tank) up to 4 hrs
- **OUTPUTS:**
 - Heat (setting dependent) 18,000 to 60,000 BTU/hr
 - Carbon monoxide (setting dependent) .50 to 120 ppm
- **FUEL REQUIREMENTS:**
JP-8
- **ELECTRICAL REQUIREMENTS:**
22 to 29.5 V DC
- **OPERATING TEMPERATURES:**
-25°F to 125°F (-32°C to +52°C) w/operating elevations up to 10,000 ft (3,048 m) above sea level
- **BATTERY PACK:**
Two sealed lead acid batteries w/input voltage range 22 to 29.5 V





MULTI-TEMPERATURE REFRIGERATED CONTAINER (MTRCS)

PURPOSE:

The Multi-Temperature Refrigerated Container System (MTRCS) provides a flexible, rapidly deployable, resource efficient, multi-fueled, refrigerated, food distribution capability that enables meal preparation in multiple environments and operational scenarios. The MTRCS supports the Future Modular Force Concept by providing 3 days of rations for 800 Soldiers when utilized in conjunction with the Container Roll-in/out Platform (CROP). The system is designed to be used primarily by Army Subsistence Platoons (SPs) and Brigade Combat Teams' maneuver elements in field feeding operations across the battle space. It will also be used by medical units for the transportation and refrigerated storage of medical supplies, including blood products and vaccines.

CHARACTERISTICS:

MTRCS is a highly mobile multi-temperature partitioned refrigerated container system that provides simultaneous transport of frozen and chilled semi-perishable rations on a single platform directly to the field kitchen site. MTRCS is the follow-on generation of refrigeration systems, intended to replace the Refrigerated Container System (RCS). MTRCS can transport and store both refrigerated and frozen products in a single container. The system consists of an insulated 8x8x20 ISO container that can operate on the move with an integral engine-driven Refrigeration Unit complete with custom selectable/individually controlled compartments with setpoints ranging from -5° F (-21°C) to 60° F (16°C). The two compartments are separated by a removable partition, which allows for varied proportions of refrigerated and frozen storage; this also allows for use as a single temperature container. A double set of end wall doors and a side door can be used to optimize loading and unloading of separate compartments. An integral bale bar and rail system enables it to be transported via the PLS or HEMTT-LHS. An auxiliary fuel tank and a commercially available transport refrigeration unit keep chilled and frozen cargo at the optimum temperatures during transport via aircraft, ship, rail or truck.

CAPABILITIES & BENEFITS:

- Can be located directly at the field kitchen site.
- Operation on the move provides increased operational flexibility and logistics capability while decreasing operational and transportation costs.
- Eliminates the need for a forward area Ration Break Point.
- Compartment temperatures operate independently, allowing internal temperatures to be controlled from -5° F (-21°C) to 60° F (16°C) in ambient temperatures ranging from -25°F (-32°C) to 120°F (49°C).
- Multi-powered operation includes integral JP-8/ diesel engine drive, 440 VAC shipboard operations and 220 VAC land based operation.
- Integral bale bar and rail system makes the MTRCS land, sea, and air transportable on any military or commercial conveyance capable of transporting either ISO based or PLS/LHS assets.
- Both perishable and semi-perishable rations move on the same asset, allowing the SPs to accomplish their mission more efficiently.

COMMENTS:

Initial production for the MTRCS began in FY09, and a Full Materiel Release Decision for MTRCS is planned to be completed by July 2010.

AT A GLANCE:

- **DIMENSIONS:**
8 ft H × 8 ft W × 20 ft L (2.4 × 2.4 × 6.1 m)
- **REFRIGERATION SYSTEM:**
Integral, multi-fueled commercial Carrier Genesis R-90 CT3-69 TriVortex Diesel Engine Drive
- **REFRIGERANT:**
Non-ozone depleting R-404A
- **STANDBY OPERATION:**
208VAC/230VAC 3 phase 50/60 Hz or 440 VAC 3 phase 50/60 Hz shipboard power
- **COOLING/HEATING CAPACITY:**
20,500 BTU/hour and 16,000 BTU/hour
- **WEIGHT:**
 - Tare: 13,180 lbs (5,931 kg)
 - Gross: 52,900 lbs (23,805 kg)



REFRIGERATOR CONTAINER SYSTEM (RCS)

PURPOSE:

The Refrigerated Container System (RCS) provides for the safe transport and storage of perishable food items. It is an ISO-based container designed to be transportable by land, sea and air and can operate in ambient temperatures ranging from -40°F (-40°C) to 125°F (52°C). The container is designed to operate on the ground at a fixed site location. The container is also able to receive power from an external electrical source, provided that the container is located within 20 feet of the electrical source. The RCS is durable and robust, designed for use in extreme hot, cold, humid, and dry environments.

CHARACTERISTICS:

The RCS is dual powered and can be operated either through the use of the onboard 10 kW JP-8 or diesel powered tactically quiet generator (TQG) or through an external 208 V 3-phase 50/60 Hz AC power source. Either source allows for complete cooling or heating of the RCS to include, but not limited to, the Refrigeration Unit (RU). All of the walls, the ceiling, and the floor are fully insulated to minimize the heat transfer. The ribbed floor and wall spacer strips allow conditioned air to properly circulate around the cargo and provide for sufficient structure to load the container up to a maximum gross of 52,900 lbs (23,805 kg). An end-wall set of double doors provides full access to the container's interior and seals tightly against the container frame when closed. The right access door also contains an emergency escape door to prevent entrapment of personnel and can only be removed from inside the container. Floor drains are located at each corner of the ribbed floor to prevent water buildup within the RCS.

CAPABILITIES & BENEFITS:

- Is easily transportable on a military/commercial flatbed truck, railway car, ship or any other ISO transportable conveyance; 8 foot (2.44 m) height allows for transport by C-130 and larger aircraft.
- Can be stacked up to 9 high and connected in tandem for transporting or storage.
- Operates from on-board 10 kW TQG or external electrical power sources.
- The generator is mounted on roller slides to allow the users to access the back of the generator to perform maintenance.
- Has operator controlled internal lighting.
- Escape hatch permits emergency exit from container interior.
- Is equipped with a self-contained RU to provide both cooling and heating capabilities; can maintain internal temperatures of between 0°F to 40°F (-18°C to 4.5°C) in ambient temperature from -40°F to 125°F .
- Provides 798 cu ft (22.6 cu m) of single temperature storage capacity.

COMMENTS:

The RCS has been fielded since 31 July 1998.



AT A GLANCE:

- **DIMENSIONS:**
8 ft H x 20 ft L x 8 ft W (6.1x2.44x2.44 m)
- **WEIGHT:**
 - Container: 9,237 lbs (4,197 kg) empty or 52,900 lbs. (24,471 kg) maximum gross
 - Generator: 1000 lbs (454 kg)
- **SHIPPING CUBE:**
1,280 cu ft (35.84 cu m)
- **CARGO WEIGHT CAPACITY:**
43,663 lbs (19,823 kg)
- **POWER REQUIREMENTS:**
10 kW TQG or external 208 V, 3-phase, 60 Hz
- **COOLING CAPACITY:**
9,000 BTU/hour
- **HEATING CAPACITY:**
7,000 BTU/hour
- **REFRIGERANT:** Non-ozone depleting 134A



ASSAULT KITCHEN (AK)



AT A GLANCE:

■ FEEDING CAPACITY:

Daily feeding for 250 Soldiers in one location or 500 Soldiers in multiple locations

■ OPERATIONAL DIMENSIONS:

Height - 8 ft (2.44 m)
Width - 15 ft (4.57 m)
Length - 22 ft (6.71 m)

■ WEIGHT:

1500 lbs (675 kg) without weight of fuel and water

■ FUEL REQUIREMENTS:

JP-8

■ ELECTRICAL REQUIREMENTS:

120V-AC from HMMWV power system and routed through an inverter

■ KEY FEATURES:

Heat on the move capability utilizing the Tray Ration Heater System (TRHS)

PURPOSE:

Fielded beginning in 2008, the Assault Kitchen (AK) is the replacement for the Kitchen, Company Level Field Feeding (KCLFF). While maintaining a smaller logistical footprint than the KCLFF, the AK is a highly mobile field feeding platform capable of sustaining a Company-sized unit of Soldiers with a high quality, hot UGR-H&S™ meal while minimizing time at the feeding site.

CHARACTERISTICS:

The AK consists of key components packed in an M1101 or M1102 Light Tactical Trailer (LTT) that is pulled by a HMMWV. Every component has a designated location on the mobile platform. The LTT holds a Tray Ration Heater (TRH) to heat UGR-H&S™ components, as well as a power inverter, IFCs, IBCs, side loading pan carriers, tools required for system maintenance, utensils, and three serving tables. The HMMWV is utilized to carry supporting items including extra water and rations, an ice chest, a stockpot cradle assembly, and an MBU for warming beverages. This integrated AK solution replaces the KCLFF's loose collection of items packed on a 5-ton. The primary feature of the AK is the TRH. It offers a "heat-on-the-move" capability that leads to minimal meal preparation time at forward or remote feeding sites. This capability is not available in the KCLFF. The TRH contains a stainless steel water tank that heats up to 24 tray packs, 15 number ten food service cans, or a combination of the two in 30 to 45 min. Safety features include thermostatic control to ensure the water temperature stays below the boiling point, a liquid level sensor that shuts off the burner if the water depth in the tank falls below 4 inches (10.2 cm), and a tilt switch to shut the burner off at an excessive operational angle. Power for the AK TRH is provided through a connection to the HMMWV routed through an on-board power inverter.

CAPABILITIES & BENEFITS:

- Provides heat-on-the-move field feeding; mobility allows feeding without interrupting the battle rhythm.
- Feeds 250 UGH-H&S™ meals at a feeding site within 90 minutes or 500 meals a day at multiple sites; hot meals lead to improved Soldier morale.
- Requires minimal setup time (10 min) at a remote site and near instantaneous feeding.
- Leverages and uses same key components as USMC TRHS; comprised almost entirely of non-developmental items (NDI) and commercial components.
- Enables 60% reduction in time at fielding site, 33% reduction in fuel usage, and 80% reduction in ration heater water usage when compared to the KCLFF.
- Integrates into HMMWV with attached LTT; components can be removed from HMMWV and LTT and used statically.

COMMENTS:

The Army's acquisition objective for the AK is approximately 1,900, with initial fieldings targeted to Stryker Brigade Combat Teams (SBCTs) and Special Forces units. It is being fielded as a one-for-one replacement for the KCLFF. The AK is compatible with the evolutionary Army field feeding concept for the Current, Modular, and Future Force that requires improved mobility, survivability, deployability, and offers a field feeding sustainment capability that is quickly operational with minimal staffing.

ARMY FIELD FEEDING EQUIPMENT

KITCHEN, COMPANY LEVEL, FIELD FEEDING (KCLFF)

PURPOSE:

The KCLFF provides a flexible and rapidly deployable field feeding capability to company remote feeding sites. It is designed as a collection of field feeding equipment and appliances to provide limited capability for cooking, preparing, and serving hot meals for up to 200 Warfighters once a day at remote sites as the tactical and logistical situation permits.

CHARACTERISTICS:

The major components of the KCLFF are a heater cabinet, cook pot cradle, M59 Field Range Cabinet, ice chest, griddle, 3 modern burner units, 2 work and serving tables, 4 beverage dispensers, 16 insulated food containers (IFC), and assorted utensils. Two personnel (92G Food Service Specialists) are required to operate the KCLFF, with assistance from the unit being supported. Hot meals may be delivered to Warfighters in dispersed units or remote sites by using the IFCs. Prime movers for the KCLFF are the HMMWV or larger vehicle.

CAPABILITIES & BENEFITS:

- Provides capability to prepare UGR-B™ meals and limited UGR-A™ meals (i.e. roast, bake, boil, grill, and fry).
- Provides support for company- size units.
- IFCs are used to hold pre-cooked hot or pre-chilled cold prepared items to dispersed squad-size units or to hold pre-cooked items for mass feeding; Provides flexibility of serving precooked and field cooked meals.
- Utilizing the M59 field range cabinet, field range outfit, griddle assembly, and ice chest, one 92G Food Service Specialist can prepare limited UGR-A™ meals for up to 50 Warfighters.
- Additional IFCs provide ample storage and transport capabilities.

COMMENTS:

The KCLFF functions as a collection of field feeding equipment that is highly modular and can be used in field feeding scenarios where an MKT or CK are not applicable or available. While the KCLFF does not provide as many capabilities as the MKT or CK, it nonetheless enables deployed Warfighters the ability to enjoy a group ration as opposed to an individual ration, such as an MRE™.



AT A GLANCE:

- **FEEDING CAPACITY:**
200 Warfighters once per day
- **WEIGHT:**
900 lbs (405 kg)
- **FUEL CONSUMPTION:**
1.5 gallons of JP-8 per hour of operation
- **TRANSPORTATION:**
HMMWV or larger vehicle
- **NUMBER OF OPERATORS:**
2 personnel (92Gs)
- **HEAT SOURCE:**
3 MBUs with JP-8 fuel

MEDICAL FIELD FEEDING CART (MFFC)



AT A GLANCE:

- **LOAD CAPACITY:**
200 lbs (90 kg)
- **DIMENSIONS:**
Height - 36 inches (91.44 cm)
Width - 28 inches (71.12 cm)
Length - 50 inches (127 cm)
- **WEIGHT:**
75 lbs (33.75 kg)
- **MATERIAL:**
Aluminum
- **MAINTENANCE:**
The MFFC will feature pneumatic tires that may require repair or inflation

PURPOSE:

The Army Medical Department (AMEDD) is undertaking a Force Design Update for the new Combat Support Hospital, which includes improved hospitalization technologies and field standing operational procedures and tactics, techniques and procedures of conducting health care. This demands improvements in medical field feeding speed, safety, temperature maintenance, ergonomics and sanitation. The Medical Field Feeding Cart (MFFC) replaces the use of the two-wheeled patient gurney as the transporter of food in field hospitals. The current gurney method poses patient meal service and ergonomic problems, resulting in time and food lost during transportation.

CHARACTERISTICS:

The cart is designed to hold two insulated food containers (IFCs) that have a rail system compatible with a full sized sheet pan. These food carriers have the capacity of 16 half sized sheet pans or six full-size deep food pans. The MFFC is also capable of transporting 5-gal (18.95 liter) beverage containers. The cart is fielded with two wheel sets, one for predominately hard surfaces (dirt, concrete, etc.) and the other for soft surfaces (sand, snow, etc.). The MFFC provides the dual use of transporting food to and from food storage areas to the kitchen and then from the kitchen to patient care areas. The cart has a flat top that can be used as for transporting food, as a work surface or serving surface. All food contact surfaces meet NSF requirements.

CAPABILITIES & BENEFITS:

- Is compatible with current inventory of Insulated Food Containers (IFCs), including Optimized IFCs.
- Provides transport of patient food, beverages, and bulk food.
- Can negotiate uneven terrain.
- Maintains serving temperature for 30-45 min.
- Enables easy food distribution and has easy to clean and sanitize surfaces.

COMMENTS:

The goal of the Medical Field Feeding Cart development is not to change the current method for food delivery to patients but rather to do a better job in serving its function within the Food Preparation and Service Set issued to Combat Support Hospitals. The MFFC improves ergonomics of current system, allowing for improved mobility during one-person operation and more efficient cart loading. It also provides a reduction of cart tipping and injuries.

The production goal for the MFFC is 380. An improved version has been completed and includes such improvements as removable beverage trays that can hold up to two 5-gal (18.95 L) beverage containers without straps. The trays are spaced to provide better visibility during transport and room for holding cups and containers. Other improvements to the MFFC include an added lip to the top of the cart to better contain items; the lip also has holes for placement of elastic cords to secure containers.

FOOD SANITATION CENTER (FSC)

PURPOSE:

The Food Sanitation Center (FSC) consists of equipment required to clean and sanitize food service equipment in the field. The FSC is essential to maintain the safety and health of Warfighters in the field who are utilizing field food service equipment, whether as cooks or consumers. The responsibility of managing and upgrading the FSC falls under the Army (PM-FSS), but the FSC is used by multiple services. The FSC replaces the antiquated and unsafe mess kit laundry line, which uses garbage cans and gasoline-fired M67 immersion heaters.

CHARACTERISTICS:

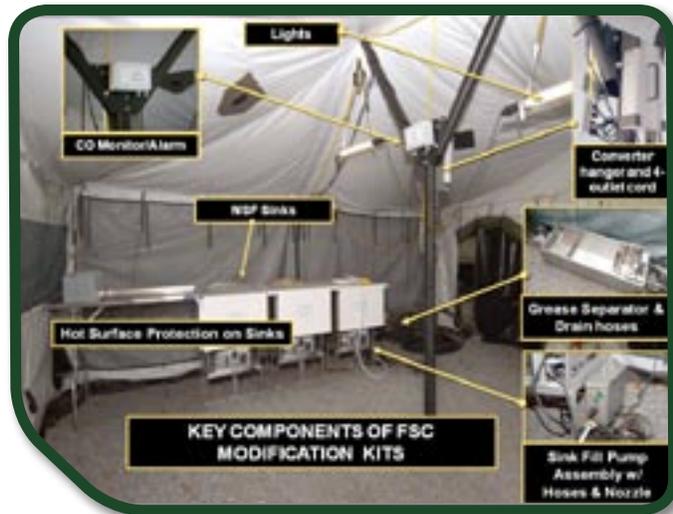
There are two models of the FSC in the field: the original is the FSC-90, and the most recent is the FSC-2. Both models consist of three sink assemblies, trash barrels, sink drain table, work tables, and a tent shelter. Three burner units are included to provide hot water for a 3-step sanitation process. The FSC-2 model offers improvement over the FSC-90 through addition of a grease separator, sink fill pump, carbon monoxide (CO) monitor, NSF-compliant sinks, and more efficient layout of electrical connections.

CAPABILITIES & BENEFITS:

- Provides a clean, safe environment for sanitizing food service equipment.
- Maintains food safety in the field feeding environment.
- Offers nesting of components for easy transport.

COMMENTS:

The FSC-90 was fielded from 1990-2005, and the FSC-2 fielding has been in process since 2006. In addition to fielding complete FSC-2 systems, PM-FSS is performing a modernization effort whereby modification kits are being produced to upgrade the FSC-90 model to the FSC-2 configuration. For improved safety, reduced environmental impact and workload reduction, a CO monitor, insulation of hot surfaces, sink-fill pump, NSF compliant sinks, and grease separator will be incorporated into fielded FSC-90s as part of a basic modification kit. Fielding of modification kits to units that have FSC-90s is scheduled to commence in 2010. Development is ongoing for additional improvements to the FSC. Future improvements may include a sink exhaust system to improve air quality; automatic controls to regulate sink water temperature; and a gray water reuse pump assembly to reduce water consumption.



AT A GLANCE:

■ DIMENSIONS:

Fits within one 16x20 ft (4.9 x 6.1 m) extendible modular utility tent or one 19x19 ft (5.8x5.8 m) Modular General Purpose Tent.

■ WATER USE:

250 gal (946 L) per day, when serving two meals per day

■ HEAT SOURCE:

3 MBUs

■ POWER:

Shares one 2 kW generator with the Mobile Kitchen Trailer or connects to Containerized Kitchen power.

■ TRANSPORT:

Is packed as cargo in the back of the kitchen's tow vehicle.



INTRODUCTION TO U.S. MARINE CORPS FIELD FEEDING EQUIPMENT

Field feeding requirements for the USMC must satisfy extreme environments in both land and sea forward operations. Like the other Services, the U.S. Marine Corps Field Feeding Program is designed to keep Marines satisfied both nutritionally and psychologically with a balanced mix of operational rations, which are supported by trained food service personnel and effective field food service equipment. The equipment and field food service kitchens must be adaptable from platoon size up to Marine Air-Ground Task Force operations in all operational environments.



Deployed Marines subsist on a mix of rations that include individual rations such as the Meal, Ready to Eat™ (MRE™) and Meal Cold Weather/Long Range Patrol (MCW/LRP), and group rations, primarily the UGR-H&S™, and the UGR-B™. For preparing, cooking, and serving those group rations, which can sometimes include the UGR-A™, the CFD Systems Equipment and Engineering Team (SEET) is charged with the mission of developing and supporting best value, technologically advanced food service field feeding equipment and systems to enhance the quality of life and performance for Marines. The SEET works closely with the Marine Corps Systems Command (MARCORSYSCOM) and Product Manager Infantry Combat Equipment (PM-ICE), providing engineering services to aid in the development and procurement of equipment to support the Field Food Service System.



To accomplish this mission, the SEET continually integrates and adapts leading edge technology into food service equipment and systems for the USMC, including developing and modifying system specifications for new, improved, or existing food service equipment and providing procurement and engineering support for adopted fielded items and systems. In order to promote joint needs among the services, the SEET also investigates, plans, and conducts acquisition alternatives such as PrePlanned Product Improvement (P3I) and adoption of COTS items or non-developmental items, which are often leveraged from the other Services.

The major equipment items developed by the SEET that satisfy the USMC's unique field feeding requirement are the Expeditionary Field Kitchen (EFK), Tray Ration Heater, (TRH) Enhanced - Tray Ration Heating System (ETRHS), and the 8x8x10 Refrigerated Container System (RCS). Each of these is described on the following pages. Also included is a description of the Small Field Refrigeration System (SFRS), which is a commercial item that has recently been procured by the USMC.

EXPEDITIONARY FIELD KITCHEN (EFK)

PURPOSE:

The Expeditionary Field Kitchen (EFK) is intended to fill the gap between the Tray Ration Heating System (TRHS) and the Field Food Service System (FFSS) or Logistics Civil Augmentation Program (LOGCAP) feeding sites. The EFK is a containerized, rapidly deployable, mobile kitchen and sanitation center designed to support a minimum of 500 Warfighters in a tactical environment. The system is designed to be able to service remote areas using USMC transportation assets, eliminating the need to transport hot food over long distances.

CHARACTERISTICS:

The EFK is designed to prepare and serve the full range of group rations (UGR-B™, UGR-H&S™ and UGR-A™). The kitchen is contained within an 8'x8'x20' (2.4x2.4x6.1 m) ISO container that is towed on an MCC 20 trailer by the USMC 7-ton Medium Tactical Vehicle Replacement (MTVR) series truck. Once the kitchen is onsite, it can be set up and ready for cooking in 45 minutes by four personnel and supervisor. The kitchen is comprised of modified commercial and military cooking appliances that are thermostatically controlled and meet NSF cleanliness standards. These appliances will roast, grill, boil, braise, pan fry, and bake foods to cover any combination of food preparation requirements. An onboard sanitation center allows personnel to clean the pots and wares required to feed 500 Warfighters. The kitchen makes use of the USMC single accepted field burner, the Airtronic™, as the appliances' heat source, minimizing training and logistic requirements. All appliances are fuel fired and operate on JP-8 fuel while required electric power is supplied by a 10kW TQG for ventilation, lights, pumping fresh water, and refrigeration. The EFK has 46 cubic feet (1.3 cubic meters) of refrigerated space to maintain rations. The kitchen is complete with fire extinguishers, convenience electrical outlets and all serving and preparatory pans and silverware. All of the combustion products are vented out of the kitchen and sanitation work areas to assure a safe and comfortable work environment.

CAPABILITIES & BENEFITS:

- The EFK is simple to operate using modified commercial equipment all located within one container.
- Rapid deployment and employment (45 min by requirement) of the EFK ensures that it keeps pace with unit operations.
- Is capable of supporting 500 Warfighters in a static location (within 3 hr prep and cleanup time).
- The EFK uses the Airtronic™ burner, already embedded in the Marine Corps supply chain, minimizing logistical and maintenance support required by using already established supply infrastructure and maintenance skill sets.

COMMENTS:

This item supports the Ground Combat Element of the Marine Air-Ground Task Force. The EFK is currently in transition from an R&D to a production contract, with the First Unit Equipped planned for FY11. The total USMC acquisition objective is 104 kitchens.



AT A GLANCE:

- **FEEDING CAPACITY:**
Minimum of 500 personnel within 3 hours, including cleanup
- **DIMENSIONS:**
8 ft H x 8 ft W x 20 ft L (2.4 x 2.4 x 6.1 m)
- **WEIGHT:**
14,000 lbs (6,300 kg)
- **ELECTRICAL REQUIREMENTS:**
10 kW; required electric power can be supplied by MEP TQG or shore power connections
- **REFRIGERATION:**
Two refrigerators with 46 cu ft (1.3 cu m) of refrigeration capacity and non ozone depleting R-404A refrigerant
- **FUEL REQUIREMENTS:**
JP-8 or diesel fuel
- **LIGHTING:**
Blackout capability for nighttime operation in a tactical zone





The E-TRHS is housed in the Small Field Refrigeration System Container (top), which holds all of the components needed to set up a field kitchen as (shown packed out at left).

AT A GLANCE:

- **DIMENSIONS:**
8 ft L x 6-5.5 ft W x 8 ft H (2.4 x 1.9 x 2.4 m)
- **WEIGHT:**
 - Max. Gross Weight: 15,000 lbs (6,750 kg)
 - Tare Weight (including RU): 3520 lbs (1,584 kg)
 - Max Payload Weight: 11,480 lbs (5.166 kg)
- **VOLUME:**
300 cubic feet (8.5 cubic meters)
- **COOLING CAPACITY:**
 - 10,500 BTU/hr @ 35°F-110° (1.7°C – 44°C)
 - 5200 BTU/hr @ 0°F-110°F (-18°C – 44°C)
- **UTILITIES/POWER:**
208/230 VAC, 3-Phase, 50-60 Hz, 10-14 A Nominal Current Rating
- **TRANSPORTATION:**
Transportable by USMC MTRV or LVS

ENHANCED – TRAY RATION HEATER SYSTEM (E-TRHS)

PURPOSE:

The Enhanced - Tray Ration Heating System (E-TRHS) is a USMC group field feeding platform designed to feed 250 Warfighters. It fills a logistical gap that exists between providing Marines individual rations (MRE™, MCW/LRP) and utilizing USMC or Army Logistics Civilian Augmentation Program (LOGCAP) to serve UGR-A™ menu items (or the 14 or 21-day CONOPS A-Ration Menu). UGR-H&S™, UGR-A™, and UGR-B™ menu items can be stored, prepared and served by the E-TRHS.

CHARACTERISTICS:

The E-TRHS uses the kitchen-in-a-box concept. All of the required cooking appliances, utensils, and serving wares are packed in an easily transportable container. The container also carries a military standard refrigeration system. When a suitable cooking and serving site is found, the box is opened up, the kitchen is set up outside the container, the refrigeration is turned on and the container is filled with semi-perishable or perishable food. The container is the Small Field Refrigeration System (SFRS) and uses a Thermo King VM405 PBBD2 Refrigeration Unit (RU; already supported in the field). The cooking appliances consist of a tray ration heater, which can boil 20 gal (76 L) of water in less than 20 min, and two M-59 field ranges. All of the associated equipment, such as tentage, tables, pan carriers, and spatulas, are also contained within the SFRS. The E-TRHS provides cooking flexibility, allowing the cook to boil, simmer, pan fry, grill or roast available rations. The kitchen uses the USMC single fielded burner, reducing supportability risks for the program. The kitchen requires power and fuel (JP-8 or approved diesel) to operate.

CAPABILITIES & BENEFITS

- Is capable of supporting forward feeding with multiple deployment scenarios.
- Supports preparation of complete UGR-H&S™, UGR-A™, and UGR-B™ menus.
- SFRS enables easy transportation and then converts to refrigerated storage for rations at temperatures from 33°F to 40°F (.56°C to 4.4°C) and frozen rations at temperatures from -5°F to 32°F (-21°C to 0°C) in ambient environments up to 122°F (50°C).

COMMENTS:

The E-TRHS fielding requires integration of separately procured parts. The First Unit Equipped is planned for March 2010.

The system was originally developed around a smaller refrigerated container called the Quadcon Refrigerated Container System (QRCS). Because the SFRS is more easily supported, this larger container was selected as the ETRHS container. The larger volume of the SFRS may allow for additional components (sanitizing sinks) to be added to the system as follow on efforts.

8×8×10 ISO REFRIGERATED CONTAINER SYSTEM (RCS)

PURPOSE:

The Refrigerated Container System (RCS) provides for the safe transport and storage of perishable food items. It is an ISO-based container designed to be transportable by land, sea, and air and to operate in ambient temperatures ranging from -40°F (-40°C) to 125°F (52°C). The container is designed to operate on the ground at a fixed site location. The container is also able to receive power from an external electrical source, provided that the container is located within 20 feet of the electrical source. The RCS is durable and robust, designed for use in extreme hot, cold, humid, and dry environments.

CHARACTERISTICS:

The RCS is dual powered and can be operated either through the use of the stand alone 10 kW JP-8 or diesel powered Tactically Quiet Generator (TQG) or through an external 208 V 3-phase 50/60 Hz power source. Either source allows for complete operation of the RCS to include, but not limited to the refrigeration unit (RU), TQG, interior lighting, and all associated control systems. All of the walls, the ceiling and the floor are fully insulated to minimize the heat transfer between the container interior and ambient conditions, with a heat leakage rate no greater than 48 BTU/hr/°F. The ribbed floor and wall spacer strips allow conditioned air to properly circulate around the cargo and provide for sufficient structure to load the container up to a maximum gross of 52,900 pounds (23,805 kg). An end-wall set of double doors provides full access to the container's interior and seals tightly against the container frame when closed. The right access door also contains an emergency escape door to prevent entrapment of personnel and can only be removed from inside the container. Floor drains are located at each corner of the ribbed floor to prevent water buildup within the RCS.

CAPABILITIES & BENEFITS:

- Is easily transportable on military/commercial flatbed truck, railway car, ship, or any other ISO transportable conveyance; 8 foot (2.44 m) height allows for transport by C-130 and larger aircraft.
- Can be stacked up to 9 high and connected in tandem for transporting or storage.
- Operates from on-board 10 kW TQG or external electrical power sources.
- Has operator controlled internal lighting.
- Escape hatch permits emergency exit from container interior.
- Is equipped with a self-contained RU to provide both cooling and heating capabilities; can maintain internal temperatures of between 0°F to 40°F (-18°C to 4.5°C) in ambient temperature from -40°F to 125°F.
- Provides 798 cu ft (22.6 cu m) of single temperature storage capacity.

COMMENTS:

The RCS has been fielded since 31 July 1998.



AT A GLANCE:

- **CUBIC CAPACITY:**
385 cu ft (11 cu m)
- **COOLING CAPACITY:**
10,500 BTU/hr @ 35°F-110°F (1.67°C - 43°C) and 5200 BTU/hr @ 0°F-110°F (-17°C - 43°C)
- **DIMENSIONS:**
96 in W × 96 in H × 117 in L (244 x 244 x 297 cm)
- **WEIGHT:**
 - Max. Gross Weight: 22,400 lbs (10,160 kg)
 - Tare Weight: 5,200 lbs (2,359 kg) (including refrigeration unit)
- **MAX PAYLOAD WEIGHT:**
4,800 lbs (2,177 kg)
- **UTILITIES/POWER:**
208/230 VAC, 3-Phase, 50-60 Hz
- **TRANSPORTATION:**
Transportable by USMC MTRV or LVS
- 10-14 amps Nominal Current Rating
- Non-ozone depleting refrigerant (R-404A)

SMALL FIELD REFRIGERATION SYSTEM (SFRS)



PURPOSE:

The Small Field Refrigeration System brings together the transportation benefits of the TriContainer (TriCon) and the refrigeration capabilities of traditional refrigeration units (RUs) that normally require their own transportation to field feeding sites. The SFRS is known commercially as the TriCold®.

CHARACTERISTICS:

The SFRS is designed with a three-into-one concept. Like a regular TriCon, it offers the advantages of functionally or organizationally segregated cargo with the ease of handling of a standard 20 ft container. Additionally, however, the SFRS has the added capability of refrigerated or frozen storage of perishable and semi-perishable food items once the system has reach its destination site. One SFRS unit is structurally compatible to be mixed and matched with other traditional TriCons or other SFRS units to form larger units that are equivalent to ISO 20 foot containers. The SFRS is thermally efficient, with steel-foam-steel construction. Four-way lift pockets are integrated into the design.

CAPABILITIES & BENEFITS:

- All SFRS units have a single side door full-width access, offering a wide range of options for food service equipment storage, foodstuffs, and medical supplies.
- Can store perishable and semi-perishable foods, as well as whole blood for medical needs.
- Has four-way fork-lift pockets.
- Has thermally efficient, steel-foam-steel panel construction (stainless steel interior).
- Can be simply and quickly secured together using SeaLock connectors.

COMMENTS:

The SFRS is one of the main components of the E-TRHS. The use of the SFRS for shipping the E-TRHS allows it to be combined with other mission essential cargo (when combined with other SFRS units or TriCons) while providing the refrigeration and freezer capability necessary for storing perishable food items at forward field feeding sites.



AT A GLANCE:

■ DIMENSIONS:

- Container: 8 ft L × 6-5.5 ft W × 8 ft H (2.4 × 1.9 × 2.4 m)
- Doors: 5 ft 9 inches W × 6 ft 10 inches H (1.8 × 2.1 m)

■ VOLUME/INTERNAL CAPACITY:

270 cu ft (7.5 cu m)

■ WEIGHT:

- Maximum gross: 24,460 lbs (12,000 kg)
- Tare (including RU): 4,410 lbs (2,000 kg)
- Payload: 22,050 lbs (10,000 kg)

TRAY RATION HEATER SYSTEM (TRHS)

PURPOSE:

The Tray Ration Heater System (TRHS) is a fully-mobile system with heat-on-the-move capability to feed up to 250 Marines with UGR-H&S™ rations in a single, remote location. The system also provides the flexible capability for feeding up to 500 Marines in three different locations. The TRHS can be utilized to support non-mobile field feeding requirements as well.

CHARACTERISTICS:

The TRHS is designed to be mounted on a HMMWV for heating UGR-H&S™ rations while on the move from one field feeding site to another. The TRHS can also operate in a static location when it is plugged into any 120 VAC, 60 Hz electrical source. The primary component of the TRHS is the Tray Ration Heater (TRH), a stainless steel, 30 gal (114 L) hot-water tank with a burner that operates from its own 5 gallon (19 L) can fuel source. In theater use of the TRH has shown that 20 gal of water can be heated to between 180°F (83°C) to 200°F (94°C) in 20 min. The burner in the TRH is powered by a small 75-watt motor with a double-shafted design that provides combustion air, a simple compressor to supply atomizing air, and a self-priming fuel pump to deliver fuel to the atomizers.

Once the TRH is filled with potable water and connected to the fuel and electrical power it is ready for operation. The TRH is supported by other system components to aid in the serving of rations, including 3 serving tables, 5 insulated beverage containers, side-loading pan carriers, multiple serving utensils, can opener, and rain cover kit. When the HMMWV arrives at the feeding location, serving tables and equipment are deployed, and a serving line is established. Hot tray packs are taken from the heater or side loading pan carriers, opened, and served. As hot tray packs are taken from the heater, they are replaced with cold ones, which will then be ready to serve at the next feeding site. When serving is completed, tables and equipment are put back on the HMMWV and secured for travel.

CAPABILITIES & BENEFITS:

- System can support both mobile and non-mobile field feeding requirements utilizing the UGR-H&S™.
- Designed for feeding 250 Marines in one location, or 500 Marines in three locations.
- Able to heat 18 tray packs for serving in 40 min.
- Thermostatically controlled burner is the only required heat source for the TRH tank; burner can burn continuously for 10 hrs on 5 gal (19 L) of fuel.
- Burner features an automatic safety off-switch if the vehicle rolls over; a 30° tilt on either side or a 60° tilt front to back causes the burner to shut off automatically.
- Able to operate in ambient temperatures as low as -65°F (-54°C) and as high as 125°F (52°C).



COMMENTS:

The TRH, the main component of the complete TRHS is an integral part of the soon-to-be-fielded Expeditionary Field Kitchen. A modified TRH is also a component being leveraged by the Army for use in Containerized Kitchen as part of the Pre-Planned Product Improvement project.

A TRH maintenance kit is included with the TRHS. It is encased in a 14 cu in (229 cu cm) stainless steel box with assembly tray and contains a spare burner, test box, burner power test cord, and various spare parts.

AT A GLANCE:

- **FEEDING CAPACITY:**
250 Marines in one remote site; up to 500 Marines in 3 remote sites per day
- **WEIGHT:**
TRH tank is 285 lbs (128 kg) empty and 400 lbs (180 kg) when loaded with trays and water
- **OPERATING TEMPERATURE:**
Ambient temperatures of -65°F to 125°F (-54°C to 52°C)
- **FUEL CAPACITY:**
Provides at least 10 hrs of continuous operation
- **FUEL REQUIREMENTS:**
Diesel or JP-8; burner achieves temperature of 2,000 degrees and high heat capacity results in no emissions
- **ELECTRICAL REQUIREMENTS:**
120 VAC, 60 Hz









INTRODUCTION TO NAVY FIELD FEEDING EQUIPMENT

The CFD Systems Equipment and Engineering Team (SEET) is responsible for supporting the Navy’s Food Service Requirement for developing a single, coherent food service strategy that satisfies emerging operational requirements, leverages technology and commercial best practices, optimizes financial resources, and meets stakeholder expectations. SEET project officers’ efforts provide commonality of food service equipment fleet-wide, resulting in purchase cost reductions and decreased repair and maintenance costs. They employ a total systems approach to consolidate food service spaces and functions to optimize resources, diminish galley tasks, and minimize total life cycle costs. Additional efforts performed by SEET project officers include recommending modern efficient equipment and systems to support galleys on all naval platforms and evaluating galley equipment to support the Navy Standard Core Menu (NSCM).

The major umbrella program for SEET’s projects is the Future Navy Galleys project. Mandated reductions in Culinary Specialist (CS) crewing and maintenance and support personnel will necessitate that future Navy crews require additional skills and duties. By working with the Naval Supply Systems Command (NAVSUP), Naval Sea Systems Command (NAVSEA) and the Commander Naval Air Forces (COMNAVAIR), the CFD SEET provides a comprehensive recommendation to the Navy to transform the galley operations of their ships, carriers, and subs with reduced operation and support costs resulting in a significant reduction in the overall Navy budget. Therefore, the Future Navy Galleys project encompasses many different equipment items and equipment systems described on the following pages that utilize the latest technologically advanced commercial-off-the-shelf (COTS) designs and equipment, support future state-of-the-art naval vessel designs and the NSCM, enable production of quality food products, and save time and labor with reduced manning levels. Overall, the program results in improved equipment configuration, standardization, and interchangeability across platforms for the current Navy fleet. Additionally, these Navy transformation efforts will also provide new Navy ships, carriers, and submarines of the future with the latest technologically advanced modular food service systems and newly designed ergonomically enhanced galleys.

In support of Navy transformation efforts, CFD SEET is involved in various integrating planning teams in the DDG & CG Modernization programs, and the DD(X), LCS, & LHA-R programs in relation to galley design and equipment recommendations. SEET project officers have tested various food service equipment items for future platforms including the DD(X), LCS, LPD-17, and CG(X), and make continual recommendations to NAVSEA and NAVSUP and ship builders on galley design and equipment.

The following pages in this section describe various equipment items, systems, and designs that utilize such technologies as automation, modularity, dual functionality, smart process controls, extended food preservation, and human systems based ergonomic designs. CFD’s continuous research, evaluation, engineering, and testing of food service equipment and related emerging technologies is consistently coordinated with NAVSUP, NAVSEA, and COMNAVAIR to ensure that Naval Food Service Operation is optimized across the fleet and enhances the quality of life of Sailors. Additional information on these equipment items described on the following pages can be found via the links and addresses found on the “Contacts” page in this book, under “Navy Contacts”.

ACCUSTEAM GRIDDLE™

PURPOSE:

The AccuSteam Griddle™ replaces traditional grills aboard ships with advanced technology that reduces cooking and cleaning times. The Accu-Steam Griddle™ provides uniform grill temperatures with no heat recovery time.

CHARACTERISTICS:

The AccuSteam Griddle™ is a stainless steel, electric grill for use aboard ship. The griddle uses steam in a closed chamber to evenly transfer heat to a stainless steel cooking surface. Just below the cooking surface, heating elements are permanently sealed within the chamber. This unique process of heating the grill eliminates the problems of uneven heating on the griddle surface and the recovery time associated with the traditional grills. The grill surface temperature varies less than 2°F from edge to edge and has the capability, for example, to uniformly cook a full load of hamburgers in just 4 min. Ice water is used to lift food particles from the surface, reducing the time to clean a griddle from approximately 35 min to less than 15 min. The griddle is ship hatchable (one model hatchable for submarines) and is available in several different sizes.

CAPABILITIES & BENEFITS:

- Cooking time is reduced by 50% in comparison to a standard grill.
- Provides uniform grill temperature.
- Is low maintenance; does not require recalibrating.
- Reduces labor costs and has an easy-to-clean stainless steel grill surface.
- Reduces capital equipment costs.
- Can be placed directly on a serving line.

COMMENTS:

When installed on a ship or sub, this item must be placed under a grease extraction hood.

The AccuSteam Griddle™ is available for procurement and is managed by the Naval Surface Warfare Center, Philadelphia Naval Business Center.



AT A GLANCE:

- **CAPACITY:**
Ranges from 558 sq inches to 1,119 sq inches
- **DIMENSIONS:**
Varies depending on model; averages are 38 inches W × 29 inches D × 9 inches H (97 x 74 x 23 cm)
- **WEIGHT:**
Varies depending on model; average is 312 lbs (142 kg)
- **UTILITIES:**
440 Volts for all models and ranges from 17 kW to 17.14 kW across models
- **MAXIMUM GRILL LOAD:**
For 4 inch (10 cm) wide food items, ranges from 30 to 60 depending on model

ACCUTEMP STEAM 'N' HOLD™



PURPOSE:

The AccuTemp Steam 'N' Hold™ is a countertop pressureless steamer that does not require water and drain connections. This item replaces previous pressure steamers that required dedicated plumbing and necessitated constant de-liming. With its two capabilities, cooking and holding food, the Steam 'N' Hold™ saves space aboard ships.

CHARACTERISTICS:

The primary improvement of the Steam 'N' Hold™ over previous pressure steamers is that it is able to cook different types of food in the same compartment and hold those foods after cooking is complete without the transfer of flavors between them. Steam is created by manually pouring water into the unit reservoir. The steamer uses an adjustable vacuum pump to lower the temperature at which water turns to steam from 140°F to the usual 212°F. The lower temperature helps preserve the color and texture of vegetables such as broccoli. Once cooking is complete, the unit automatically holds food at a safe serving temperature without compromising quality. This piece of equipment is easily cleaned and maintained.

CAPABILITIES & BENEFITS:

- Simple installation requires no water or drain connection.
- Unit operates with 2 gal of water.
- Is low maintenance and easy to clean.
- Steamer can be used safely tilted at 15° without water leaking.
- Multiple foods may be steamed simultaneously without flavor transfer.

COMMENTS:

The Steam 'N' Hold is available for procurement and is managed by the Naval Surface Warfare Center, Philadelphia Naval Business Center.

The Evolution, pictured on left below the Steam 'N' Hold, is a new pressureless steamer from AccuTemp. This piece of equipment features AccuTemp's Steam Vector Technology (SVT), which utilizes no moving parts. It delivers steam to each individual pan evenly, which results in more even pan-to-pan temperatures, improved product quality, and faster cook times. Since there are no moving parts, reliability is much improved and simple-to-operate digital controls means fewer parts overall, less maintenance, and less downtime.



AT A GLANCE:

- **CAPACITY:**
Depending on pan sizes, no less than 4 or no more than 6 pans
- **DIMENSIONS:**
 - Exterior Cabinet:
30 inches H × 23 inches W × 28 inches D (76 x 58 x 71 cm)
 - Interior Cabinet: 21 inches H × 13 inches W × 17 inches D (53 x 33 x 43 cm)
- **WEIGHT:** 188 lbs (85 kg)
- **UTILITIES/POWER:**
1.4 amps @ 440 Volts, 9.5 kW

BLODGETT DOUBLE STACK COMBI-OVEN™

PURPOSE:

The Blodgett Double Stack Combi-Oven™ is a double stack combination oven that features three cook modes: steam, convection air, or a combination of both. The Combi-Oven™ was designed to replace traditional ovens aboard ships with a multifunctional oven that reduces time and labor required for cleaning while also saving space aboard ships. A single Combi-Oven™ can be used to replace one standard convection oven, a deep fat fryer, and two high-pressure steamers.

CHARACTERISTICS:

The Combi-Oven™ is a versatile piece of equipment that combines three modes of cooking in one oven, using steam, circulated hot air, or a combination of both. The combi mode is used to re-heat foods, roast, bake and oven fry. When the combi mode is used for oven frying, food develops a crisp texture and taste similar to deep fat fried items. This supports the Navy Standard Core Menu, which includes lower fat, oven fried foods that have traditionally been deep fat fried, such as French fries and fried chicken. In addition, the combi mode decreases overall cook times, reduces product shrinkage and eliminates flavor transfer when multiple items are cooked simultaneously. Meanwhile, the steam mode is ideal for rapid cooking of vegetables, fish and shellfish, and the hot air mode operates as a convection oven for baking cookies, cakes, pastries and other baked items. The Combi-Oven™ is extremely easy to clean. The steps required to clean involve spraying the interior cavity with an oven cleaner, setting oven to the steam mode for five to ten minutes and then rinsing. Cleaning time and labor is reduced by 50 to 60 percent in comparison to a traditional convection oven.

The Blodgett Combi-Oven™ is also hatchable, engineered in modular sections that fit through a 26 x 66 inch (66 x 168 cm) hatch. Installation of the oven requires an exhaust hood, drain, ¾ inch (1.9 cm) cold water connection, and .45 PSI maximum water pressure.

CAPABILITIES & BENEFITS:

- Foods cook in less time, resulting in increased product yield.
- Multiple foods may be steamed simultaneously without flavor transfer.
- Easy to clean oven reduces labor costs and workload.
- Multifunctional oven reduces capital equipment costs.
- "Oven frying" in the combi mode improves nutrition and eliminates the hazard of operating a deep fat fryer.

COMMENTS:

The Combi-Oven™ is available for procurement and is managed by the Naval Surface Warfare Center, Philadelphia Naval Business Center.



AT A GLANCE:

- **CAPACITY:**
Six full size steam-table pans (12 inches W x 20 inches L x 4 inches H; 30 x 61 x 10 cm)
- **DIMENSIONS:**
38 inches W x 44 inches D x 65 inches H (97 x 112 x 165 cm) base
- **WEIGHT:**
1250 lbs (567 kg)
- **UTILITIES/POWER:**
440 Volts, 44 kW



TOP:
Sub-hatchable oven w/compatible AccuTemp griddle mounted on top

BOTTOM:
Sub-hatchable oven being lowered through 28" submarine hatch

MARKET FORGE SUB-HATCHABLE ELECTRIC CONVECTION OVEN™

PURPOSE:

The Market Forge Sub-Hatchable Convection Oven™ replaces traditional convection ovens on board submarines and ships with a stainless steel lined oven that is both modular and easy to clean. It is designed for use aboard both ships and submarines.

CHARACTERISTICS:

The Market Forge Sub-Hatchable Electric Oven™ is a stainless steel convection oven engineered in modular sections that fit through a 28-inch (71 cm) diameter submarine hatch. This is a commercially available item that has been modified with a stainless steel interior to reduce time and labor required for cleaning. The stainless steel oven interior can be easily cleaned with oven cleaner and a water spray hose. Cleaning time is reduced by 50 to 60 percent in comparison to a traditional convection oven. This item is "hatchable," meaning that it is assembled on location and no welding is required. (Conventional ovens had to be cut in half to get through the hatch and then welded back together in the galley.)

CAPABILITIES & BENEFITS:

- Is easy to clean, with stainless steel interior and exterior.
- Modular oven sections fit through a 28-inch (71 cm) diameter submarine hatch.
- Has economical and simple oven assembly.
- Oven unit completely is serviceable from the front.
- Can be used on surface ships in single or double stacked configuration.

COMMENTS:

The oven top of this item is designed to be compatible with the Accutemp Griddle™ (Model EGF4403B3602-00). This item must be installed under a grease extracting ventilation hood. This item is available for procurement and is managed by the Naval Surface Warfare Center, Philadelphia Naval Business Center.

AT A GLANCE:

- **CAPACITY:**
Can accommodate full-size sheet pans or four-inch steam table pans
- **DIMENSIONS:**
Varies depending on model; ranges from 24-49 W × 27-29 D × 5-9 H inches
- **WEIGHT:**
450 lbs (204 kg)
- **UTILITIES/POWER:**
440 Volts, 50/60 Hz, 3-phase, 11 kW

LEGION SKITTLE™

PURPOSE:

The Legion Skittle™ is a multifunctional piece of equipment that can be used as a steamer, tilting skillet, griddle, kettle, holding cabinet and roaster. The item is available in several different sizes and models, providing Navy galleys with multifunctional equipment that increases efficiency and includes savings in capital investments.

CHARACTERISTICS:

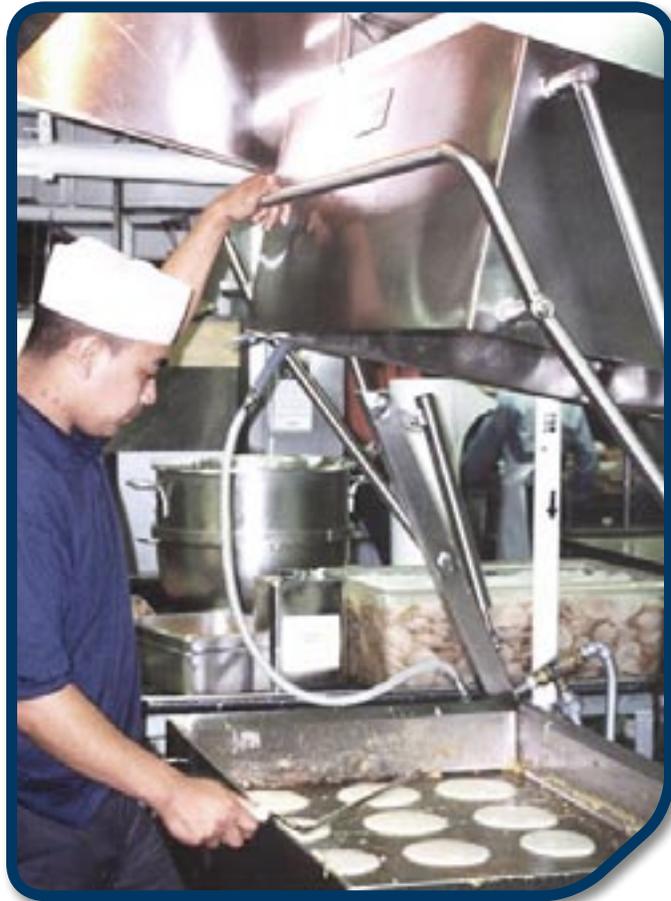
The versatile Skittle™ can grill, steam, roast and braise food. Different types of food can be steamed together in the Skittle™ without transferring flavors. It also functions as a holding cabinet and a small-capacity kettle. The Legion Skittle™ is constructed of stainless steel with a fully insulated tilting pan and a vertical lift capsule lid. A flexible spray hose is attached to the unit for filling the body with water needed for cooking. The stainless steel surface is easily cleaned using the attached spray hose. The unit requires minimal maintenance with no de-liming or gaskets to replace. The Skittle™ is available in a "hatchable" version for easy access through a surface ship hatch and can replace 2 pressure steamers and a holding cabinet, providing great versatility in the galley.

CAPABILITIES & BENEFITS:

- Multifunctional cooking increases galley efficiency.
- The replacement of traditional equipment with the Skittle™ reduces capital equipment and maintenance costs.
- Easy cleaning reduces labor costs.

COMMENTS:

The Legion Skittle is available for procurement and is managed by the Naval Surface Warfare Center, Philadelphia Naval Business Center.



AT A GLANCE:

- **CAPACITY:**
Two pan racks hold 6 full size steam table pans
- **GRIDDLE AREA:**
Depending on model, either 703 sq inches (4,535 sq cm) or 1029 sq inches (6,639 sq cm)
- **KETTLE CAPACITY:**
 - Filled at Brim: 15, 27, 33, or 49 gal (57, 102, 125, or 185 L) depending on model
 - At 15° Tilt: 5, 16, 22, or 25 gal (19, 61, 83, or 95 L) depending on model
- **WEIGHT:**
395, 578, 435, or 688 pounds (179, 262, 197, 312 kg) depending on model
- **UTILITIES:**
440 Volts, 14.4 kW standard or 19.2 kW (high heat); also available 440 Volts, 20.9 kW standard or 27.6 (high heat)
- **TRANSPORTATION:**
For shipboard use; normal transport delivery



MARKET FORGE ECO-STEAMER™

PURPOSE:

The Market Forge Eco-Steamer™, Model ET-5E, is a countertop, pressureless steamer that is multi-functional as a steamer and a holding cabinet. The Market Forge Eco-Steamer™ was designed to replace pressure steamers with pressureless steamers that do not require dedicated plumbing, or de-liming and are low maintenance.

CHARACTERISTICS:

The Market Forge Eco-Steamer™ is constructed of stainless steel and does not require water or drain connections. Steam is created by manually pouring water into the unit reservoir. Additional features include automatic shut off with a beep sound to alert low water level and the ability to hold food at 160°F (71°C) until ready to serve.

CAPABILITIES & BENEFITS:

- Simple installation requires no water or drain connection.
- Unit operates with 2 gal (7.6 L) of water.
- Is low maintenance and easy to clean.
- Steamer can be safely opened at 15° tilt.
- Multiple foods may be steamed simultaneously without flavor transfer.

COMMENTS:

The Eco-Steamer is available for procurement and is managed by the Naval Surface Warfare Center, Philadelphia Naval Business Center.

AT A GLANCE:

■ CAPACITY:

Five full size steam table pans (12 in × 20 in × 2.5 in; 30 × 51 × 6.3 cm) or three 12 in × 20 in × 4 in (30 × 51 × 10 cm)

■ DIMENSIONS:

- Exterior Cabinet: 34 in H × 24 in W × 30 in D (86 × 61 × 76 cm) with legs
- Interior Cabinet: 21 in H × 14.75 in W × 23 in D (53 × 37 × 58 cm)

■ WEIGHT:

198 lbs (90 kg)

■ UTILITIES/POWER:

480 Volts, 11 kW

■ TRANSPORTATION:

For shipboard use; normal transport delivery



HOT FOOD COUNTER W/ WARMING CABINETS and GRIDDLE W/ REFRIGERATED DRAWERS

PURPOSE:

The hot food counter with warming cabinets and the griddle with refrigerated drawers both support consolidated galley designs by offering dual function pieces of equipment that cut down on space requirements onboard ships. Each piece of equipment uses advanced technologies that support the Navy's efforts to optimize crew sizes so that they maintain efficiency while operating with reduced costs.

CHARACTERISTICS:

Hot Food Counter w/Warming Cabinets:

- Has five hot food wells that can be run dry or wet.
- Has four warming cabinets capable of holding twelve 20 inch x 12 inch (51 x 30 cm) full hotel pans.
- Power Requirement is 115 V, 60 Hz, 1Ph/ 208 V, 60 Hz, 440 V, 60 Hz, 3 Ph.
- Disassembles into three section to pass through a 26 x 66 inch (66 x 168 cm) surface ship hatch.
- Is a commercially available equipment item.

Griddle w/ Refrigerated Drawers:

- Provides same benefits of reduced cooking and recovery time and uniform grill temperature as the AccuSteam Griddle™ since it utilizes the same griddle design and technology.
- Disassembles into two pieces to pass through a 26 x 66 inch (66 x 168 cm) surface ship hatch.
- Refrigerated food-holding drawers are located under the griddle and are capable of holding six 20 inch x 12 inch (51 x 30 cm) full hotel pans.
- Power requirement is 115 V, 60 Hz, 1 Ph.
- Is a commercially available equipment item.

COMMENTS:

CFD SEET performed evaluation and testing on the Hot Food Counter w/Warming Cabinets prototype in FY08. Test results indicated that the item meets requirements for transition to the Navy and Air Force. The Hot Food Counter w/Warming Cabinets specifications documents have been provided to the Naval Surface Warfare Center.



TOP & INSET:
Hot Food Counter w/Warming Cabinets
BOTTOM:
Griddle w/ Refrigerated Drawers



AUTOMATED VEGETABLE WASH & SANITIZING SINK (X-GREEN)

PURPOSE:

Currently, Navy personnel must hand wash Fresh Fruits & Vegetables (FF&V) during meal preparation in Navy galleys. This process is labor intensive, time-consuming and doesn't kill all pathogens on FF&V effectively. The Automated Vegetable Wash & Sanitizing Sink is a newly developed and recently tested piece of equipment that has been designed to effectively sanitize FF&V while increasing safety of the produce and reducing the amount of shipboard labor.

CHARACTERISTICS:

The Automated Vegetable Wash & Sanitizing Sink, known commercially as the X-Green Produce Sanitation System, is a versatile piece of equipment that can provide labor savings by reducing the overall time to wash/sanitize produce. The use of the automated system allows food service personnel to complete other tasks while the produce is being washed/sanitized. The X-Green can be fabricated with one, two, or three compartments depending on the application needed and provides automated injection of two products to provide safe and effective cleaning of the FF&V: a vegetable wash and a defoamer. The vegetable wash is made from all natural products, including citric acid and grapefruit oil. The de-foaming agent is a food grade silicone solution that is injected in small quantities to minimize foaming.

The X-Green saves time and increases food safety by effectively reducing bacteria and microbes that cause food-borne illness. It also reduces shipboard labor costs and provides an ergonomic design application of human systems integration principles that support optimized galley crew sizes. Additionally, this item maximizes performance effectiveness when washing and sanitizing FF&V overseas. According to NAVMED P5010-1, when produce is purchased overseas, the produce must be sanitized in a 100 PPM chlorine solution. Chlorine is a hazardous chemical, and if not measured correctly, is either not effective or leaves an unpleasant taste on food. Since the vegetable wash is citrus based, it is completely safe and leaves no aftertaste. The X-Green also eliminates errors in chemical measurements because the computer maintains proper pH levels based on input from an onboard sensor.

AT A GLANCE:

- **MAJOR COMPONENTS:**
Refrigeration, agitation, and chemical injection systems that are all automated and controlled by a touch screen interface.
- **POWER REQUIREMENTS:**
 - Current Prototype requires 220 Volts, 60 Hz, single phase.
 - Can be made into a 115 V or possibly a 440 V unit according to the manufacturer; Navy requires equipment to be either 440 V or 115 V.
- **OPTIMAL EFFECTIVE OPERATING TEMPERATURE:** 70°F (21°C)

CAPABILITIES & BENEFITS:

- Reduces amount of labor needed for vegetable preparation by utilizing a semi-automated process.
- Supports "green initiatives" by utilizing a citric based vegetable wash that is environmentally friendly.
- Elimination of chlorine used to wash produce purchased overseas results in better tasting FF&V.

COMMENTS:

This item has been tested by the SEET and has been found to produce cleaner, safer FF&V while providing a labor savings as well. Currently undergoing further test and evaluation.

AUTOMATED CARDBOARD SHREDDER

PURPOSE:

The NAVSEA approved method for the management of paper and cardboard consists of source segregation of paper and cardboard from other waste streams, moving this waste to a central processing area, and pulping it for overboard discharge or incineration. Studies have shown that cardboard and paper waste make up the second largest portion of total waste generated aboard ships and submarines. It takes two Sailors up 32 hours to break down cardboard boxes for a pulper to accept them for processing; the process of breaking down cardboard is cumbersome and labor intensive. The WEIMA WLK 4 automated cardboard shredder, as evaluated by the CFD SEET, is an effective piece of automated equipment for breaking down and shredding cardboard and paper waste products while reducing shipboard labor time and costs. The design of the unit allows the operator to shred any size piece of cardboard that can fit into the feed. This means Sailors only need to remove non paper products (tape, plastic and staples) from packaging before inserting it into the shredder. The design also allows for minimal operator participation; the operator can simply turn the unit on, place cardboard in the feed, and remove the collection bin when full.

CHARACTERISTICS:

The WEIMA WLK 4 unit is a single shaft shredder that weighs 3300 pounds (1,485 kg) and has the capability to shred cardboard, plastic and other food waste based streams. The WLK 4 unit can be configured to different screen sizes, in order to reduce the diameter of the shredded waste. The throughput and ability to shred waste, depends upon the screen size and the kind of waste. The WLK 4 shredder feed consists of a 44 in H x 31 in W x 24 in D (112 x 79 x 61 cm) funnel, a hydraulic arm and the shredding knives. The unit functions by the hydraulic arm that feeds cardboard into the bottom 7 in (18 cm) of the 44 in (104 cm) tall funnel and into the shredding knives to be shredded. When placed on a ship or sub, the WLK 4 will require a space foot print area of 5 ft x 5 ft (1.52 x 1.52 m).

Any type of collection container can be used to collect the shredded material as it exits the shredder, as long as it is larger than the 24 in x 8 in (61 x 20 cm) opening container should be monitored when shredding to avoid unnecessary overflow).

CAPABILITIES & BENEFITS:

- Reduces labor costs for breaking down paper waste.
- Varying screen sizes allow optimum material intake.
- Has low power consumption, yet high output.

COMMENTS:

Sailors have the choice to use this piece of equipment in two ways: breaking down cardboard into any size that fits into the feed (least labor intensive) or breaking it down into sheet sizes (18 in x 20 in; 46 x 51 cm) that can lie in the bottom 7 in (18 cm) of the shredder (more labor intensive). While extra initial effort is required with

the second option, it allows for the shredder to shred up to six pounds of heavy cardboard with one pass of the hydraulic arm (less than 30 seconds). This results in a drastic decrease in the overall breakdown and shredding time of the cardboard and therefore reduces the total man hours required.

This item has been tested and evaluated by the SEET and has been found to reduce man hours and labor costs for cardboard breakdown. It has not yet been placed aboard a ship or carrier for further evaluation.



WLK 4 shredder unit with hydraulic arm shown at inset

AT A GLANCE:

- **UNIT TYPE:**
Single Shaft Shredder
- **THROUGHPUT CAPABILITY:**
Varies depending on waste type and screen size
- **MAJOR COMPONENTS:**
Shredder feed with a 44 in H x 31 in W x 24 in D (112 x 79 x 61 cm) funnel, hydraulic arm, and shredding knives
- **SPACE REQUIREMENT:**
Requires a 5 ft x 5 ft (1.52 x 1.52 m) footprint on ships or subs
- **WEIGHT:**
3300 lbs (1,485 kg)

SMART PROCESS CONTROL SYSTEM

PURPOSE:

The Smart Process Control System is an automated system designed to provide operational monitoring, supervisory control, and data acquisition of Navy food service equipment. The system was developed by leveraging existing commercial technologies available in food service automation. Smart Process Control has the ability to minimize the amount of labor required to perform maintenance, prepare food products, and perform management functions, which leads to greater efficiencies in meal production processes and minimized maintenance requirements. The Smart Process Control System will reduce overall life-cycle costs associated with shipboard maintenance, repair and equipment down time.

CHARACTERISTICS:

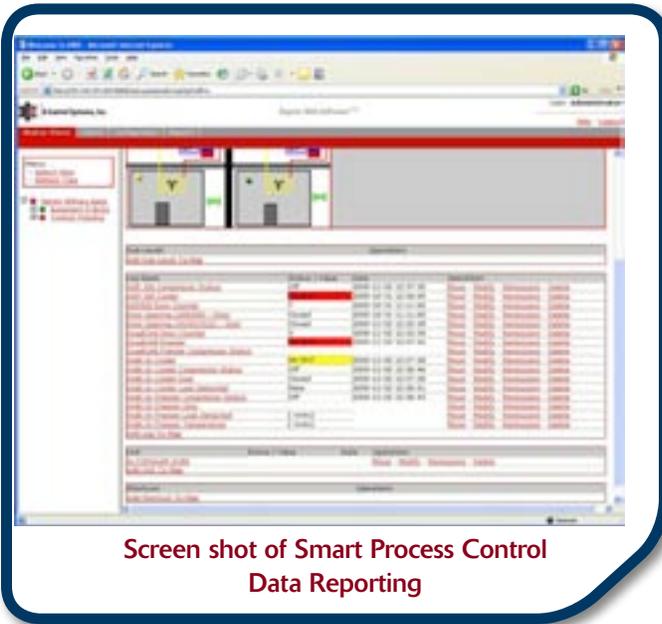
The Smart Process Control System provides equipment visibility from remote locations and a streamlined approach to food service equipment automation in the galley. Operators can quickly web-enable equipment, allowing for greatly enhanced food quality, safety, production, equipment asset management, and operations monitoring and control. Food Service equipment is embedded with smart hardware modules and linked to a gateway network to provide an online management, internet-based communication system. This system enables galley operators to monitor and manage their food service equipment and operations both locally and remotely by collecting equipment performance data, configuring shipboard recipes, uploading diagnostics and prognostics information, and establishing requirements for initiating condition-based maintenance schedules for remote access and query of equipment.

CAPABILITIES & BENEFITS:

- Provides enhanced utilization of equipment assets.
- Optimizes performance and reliability of equipment.
- Improves crew productivity and labor efficiency.
- Reduces costs associated with periodic maintenance.
- Reduces equipment downtime.
- Replaces manual operations with automated food service techniques.
- Automated notifications of refrigeration status are both prognostic and diagnostic, allowing for corrective actions to be taken, which helps to reduce food spoilage.

COMMENTS:

This system meets the Future Navy Galley Systems project and Air Force Base Expeditionary Air Readiness base camp objectives to provide food service equipment monitoring, food safety, automatic alerting, and production management.



Screen shot of Smart Process Control Data Reporting



Typical Network Diagram



Potential Sensor Units

COMM-Z KITCHEN UPGRADE

PURPOSE:

The Navy Expeditionary Medical Support Command (NEMSCOM) has a requirement to modernize the COMM-Z Field Hospital Feeding Complex. The original COMM-Z consisted of three expandable ISO containers: a kitchen, a bakery, and a sanitation unit. These units were designed and developed in the 1980s and were powered by a combination of electricity, fuel, and steam. In order to modernize and extend the life of legacy COMM-Zs, the kitchen upgrade project was undertaken to modernize major components of the kitchen, including converting the multi-fuel ovens, griddles, and steam-driven food service equipment to all-electric equipment. The use of new technologies in all-electric food service equipment will enhance the effective operation and reliability of these field kitchens. By upgrading the existing systems, the Navy will save thousands of dollars by not having to procure entire new kitchens. This project supports Navy Expeditionary Medical Support Command requirements for preparation of UGR-A™, UGR-H&S™, and UGR-B™ rations.

CHARACTERISTICS:

The upgraded COMM-Z is self-contained in one two-sided expandable ISO shelter (8'W × 8'H × 20'L; 2.4W × 2.4H × 6.1L m) that expands to 8' × 24' × 20' (2.4W × 7.3H × 6.1L m). The entire kitchen is supported by one external tactical quiet generator that provides electric power to the unit. Only a source of water is required to make the kitchen fully operational. Contained within the ISO shelter is a variety of commercial food service equipment, including: 4 convection ovens, 3 tilt griddles, 2 tilt kettles, 2 pressureless steamers, 1 steam griddle, 4 refrigerators, a 5-well steam table, a three-well sanitation sink with water heaters, an ice machine, coffee urn, work tables, water pump, and onboard hot water heater

CAPABILITIES & BENEFITS:

- Is capable of preparing UGR-H&S™, UGR-A™, and UGR-B™ meals for 250 patients and a staff of 550 medical personnel over a 24-hr period.
- Four personnel can complete preparation and begin serving meals within two hours of set-up.
- Can be set up or taken down and packed for transport by two personnel in 45 min.
- All-electric equipment improves safety by eliminating the need for fuel-fired burners (supports environmental cleanliness initiatives).
- Adapts to external heat and air conditioning units, allowing it to operate in temperatures ranging from -25°F (-32°C) to 120°F (49°C).
- Can be transported by sea, air (C-130) and land (M1022A1 Dolly Mobilizers).



COMMENTS:

The COMM-Z is managed by NEMSCOM. Completion of the first COMM-Z conversion occurred in September 2009.



AT A GLANCE:

- **FEEDING CAPACITY:**
Up to 800 personnel (250 patients, 550 medical staff) per 24 hour meal period
- **DIMENSIONS:**
 - Contained: 8 ft W × 8 ft H × 20 ft L (2.4 × 2.4 × 6.1 m)
 - Operational: 8 ft W × 24 ft H × 20 ft L (2.4 × 7.3 × 6.1 m)
- **POWER:**
Electrically powered with TQG
- **HEAT SOURCE:**
All-electric
- **REFRIGERATION:**
4 refrigerators utilizing non-ozone depleting R-404A and R-134A



INTRODUCTION TO AIR FORCE FIELD FEEDING EQUIPMENT

The cornerstone of Air Force Field Feeding is the Air Force Basic Force Module Phasing Plan for Air Expeditionary Force (AEF) deployments. The phasing plan of the AEF requires field feeding support for increments of 550 Warfighters. The following pages describe equipment items and systems that have been engineered and tested by the CFD System Equipment Engineering Team (SEET) to ensure that AF requirements under this phasing plan are met. To meet such AEF requirements, SEET engineers identify and leverage the most advanced technologies for food service equipment. SEET engineers also identify Commercial-off-the-Shelf (COTS) items that can either be used as is or in modified form and perform testing on them to ensure that they meet military requirements.

Upon forward deployment with only initial operating capabilities, AF personnel utilize individual rations, MREs™, for the first six days. On days 6-15, either the Single Palletized Expeditionary Kitchen (SPEK) or Electric Single Palletized Expeditionary Kitchen (ESPEK) are set up and utilized to serve the full requirement of 550 UGR-H&S™ meals. The ESPEK is also able to serve a limited number (350) of UGR-A™ meals. The Containerized Deployment Kitchen (CDK) is another all-electric kitchen that is also utilized to meet phasing plan requirements during this time frame. The phasing plan then provides for the transport and set up of the Basic Expeditionary Airfield Resources (BEAR) sets on day 15, which supports the full UGR-A™ ration capability for feeding 550 to 3300 personnel for the sustainment of the entire air wing. In addition to these kitchens and equipment systems, this section also describes AF refrigeration capabilities, specifically, the Advanced Design Refrigerator-300 and its utilization as the premier refrigerated container system used by the AF.

The SEET works closely with materiel developers within the Air Force Materiel Command to ensure that the most effective equipment and field feeding systems are transitioned smoothly to the Air Force. The equipment and field food service systems contained in this section include some of the most recent and current efforts being performed to achieve this goal. Additionally, other items described have already been utilized in the field for an extended period of time and have proven effective as part of the AEF.



BASIC EXPEDITIONARY AIRFIELD RESOURCES (BEAR)

PURPOSE:

The BEAR is an electric field feeding system outfitted with approved commercial food service equipment for field use. It is a vital part of the Air Force Basic Force Module Phasing Plan.

The phasing plan calls for initial operating capability (days 1-6) to be based on MREs™ to feed Airmen. On days 6-15, the SPEK provides UGR-H&S™ rations. On day 15, BEAR sets are operational to support UGR-A™ rations and the ability to feed 550 to 3300 personnel for the sustainment of the entire wing. Ultimately, the BEAR is a front line initiative for a joint, all-electric modular field feeding system.

CHARACTERISTICS:

The BEAR System consists of two units: the BEAR (i) (initial) and the BEAR (f) (follow-on). Each unit has a slightly different inventory of food service equipment to support the build of personnel in increments of 550 (up to 3300). Both units are completely integrated, tent-based modular field kitchens.

The BEAR (i) consists of four standard 40 ft (12 m) CAMSS20EX Shelters integrated to form 3200 sq ft (297 sq m) of kitchen, dining, and storage areas. The following food service equipment is included: 2 warming cabinets, 2 tilt grills, 1 double stack convection oven, 2 reach-in refrigerators, 5 stainless steel work tables, 1 three compartment sanitation sink, 1 pressureless steamer, 1 steam kettle, 1 hot food serving counter, 1 cold food serving counter, 2 coffee makers, 2 toasters, 1 M-80 water heater, 22 tables and 44 benches for the dining facility.

The BEAR (f) consists of two additional standard 40 ft (12 m) CAMSS20EX Shelters integrated into the BEAR (i) System adding 1600 sq ft (149 sq m) of dining area. Additionally, the following food service equipment is included to increase the feeding capacity for 1,100 personnel: 2 warming cabinets, 1 tilt grill, 1 grill, 1 double stack convection oven, 2 reach-in refrigerators, 3 stainless steel work tables, 1 pressureless steamer, 1 steam kettle, 1 hot food serving counter, 1 cold food serving counter, 2 coffee makers, 2 toasters, 1 food mixer, 1 meat slicer, 1 M-80 water heater, and 22 tables and 44 benches for the dining facility.

CAPABILITIES & BENEFITS:

- Able to prepare (roast, bake, grill, boil, braise, steam and stew) the entire family of Unitized Group Rations with enhancements and supplements as well as fresh foods.
- All appliances are all-electric COTS items wired for plug and play use.
- Provides climate controlled dining areas to support meal consumption during sustainment periods.
- A field kitchen exhaust system is provided to safely remove grease laden air from the shelter.
- BEAR generators operate from a single battlefield fuel (JP-8).



AT A GLANCE:

■ FEEDING CAPACITY:

550 to 3300 Air field personnel; to feed a force of the following sizes, the BEARS needed are:

- 1650 – 2 BEAR (i) and 1 BEAR (f)
- 2200 – 2 BEAR (i) and 2 BEAR (f)
- 2750 – 3 BEAR (i) and 2 BEAR (f)
- 3300 – 3 BEAR (i) and 3 BEAR (f)

■ INTERIOR SQUARE FOOTAGE:

3200 sq ft (297 sq m) for the BEAR (i) and 4800 sq ft (446 sq m) for the BEAR (f)

■ PACKED VOLUME:

240 cu ft (6.8 cu m) when packed

■ UTILITIES/POWER:

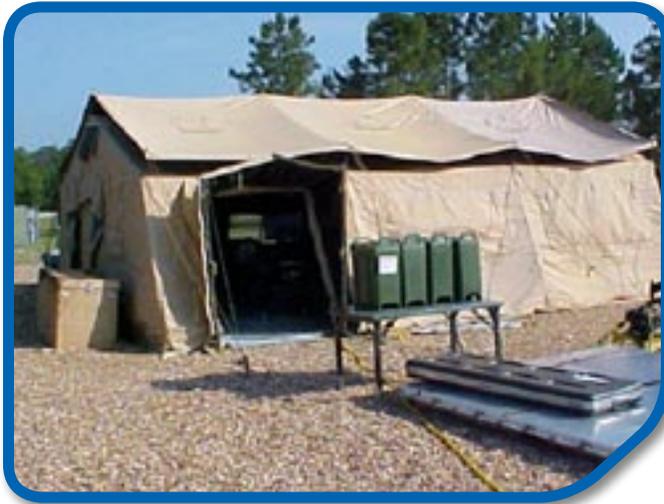
Generators operation from a single battlefield fuel (JP-8)

- BEAR (i) shelter system can be fully assembled in less than 4 hrs by a crew of four personnel; tentage can be stacked and shipped on one 463L pallet.
- Performs well in extreme environments, and has excellent climate control due to its unique rugged liner system; CAMSS20EX meets a 20 lb (9 kg) snow load and 100 mph wind load.
- Weighs 20% less than current BEAR tentage.

COMMENTS:

Current plans call for transitioning the BEAR (i) and (f) to the Air Force in FY11.

SINGLE PALLET EXPEDITIONARY KITCHEN (SPEK)



PURPOSE:

The Single Pallet Expeditionary Kitchen (SPEK) is utilized to provide the AF the capability to rapidly feed Warfighters for a up to 30 days. Under the phasing stages of the Air Force Basic Force Module Phasing Plan, the SPEK is used to prepare and serve UGR-H&S™ rations until an expanded Air Force BEAR kitchen can be set up.

CHARACTERISTICS:

The SPEK is highly mobile. It is used in remote and undeveloped areas to prepare and serve up to 300 UGR-H&S™ meals per day. When deployed, the entire kitchen can be set-up by a minimum of 4 Warfighters in less than 2 hrs. The kitchen includes the Tray Ration Heater (TRH), which is used for preparing UGR-H&S™ rations, and the Sanitation System, which is used for cleaning, washing, and sanitizing utensils. Both items have been designed to operate at temperatures ranging from -20°F to 120°F (-29°C to 49°C) and relative humidity ranging from 20 to 80%. The SPEK also shelters the operators and equipment from the environment in a 3-section TEMPER tent, including 480 sq ft (45 sq m) of specialized flooring that is tough, lightweight, weatherproof, and maintenance free, providing easy sanitation after serving. The entire system is powered by a 2kW generator and comes complete with all required kitchen accessories, including multiple insulated food and beverage containers. The SPEK is logistically transportable in a C-130 with all of its equipment fitting onto a single 463L air cargo pallet.

CAPABILITIES & BENEFITS:

- Is highly mobile for early entry in remote locations.
- Fits on a single 463L air cargo pallet for transportation.
- Is easily unpacked and assembled.
- Shelters operators and equipment from environmental conditions.
- Requires only four food service personnel to operate.

COMMENTS:

Current plans call for the SPEK to be replaced by an all-electric version called the E-SPEK. Development of the E-SPEK is scheduled to be completed and transitioned to the Air Force in FY11.

AT A GLANCE:

- **FEEDING CAPACITY:**
Up to 300 people in 2 hrs twice per day
- **DIMENSIONS:**
One 3 section TEMPER tent, with 20 ft x 24 ft (6.1 x 7.3 m) weather proof flooring
- **WEIGHT:**
 - Basic Level SPEK (one three-section TEMPER Tent) "Individual Bases": 3,655 lbs (1,645 kg)
 - BEAR SPEK (ESAMS hard Shelter System) "Expeditionary Forces": 7,330 lbs (3,299 kg)
- **UTILITIES/POWER:**
One military tactical 2 kW diesel generator
- **TRANSPORTATION:**
Fits onto a C-130, 463L air cargo pallet



ELECTRIC – SINGLE PALLET EXPEDITIONARY KITCHEN (E-SPEK)

PURPOSE:

The E-SPEK replaces the fuel fired SPEKs that are currently used by the AF, providing the new capability of an all electric initial hot meal feeding capability to Expeditionary Air Force (AEF) deployments in austere locations. The ESPEK can prepare 550 UGR-H&S™ rations and 350 UGR-A™ rations (with additional power and refrigeration) in less than two hours. It is a compact, quick response kitchen system consisting of a tent based kitchen and optional dining areas, all electric appliances, and a sanitation system transported in standard ISO shipping containers (TriCons or BiCons) or on 463L air cargo pallets to support air, land, and ocean transport.

CHARACTERISTICS:

The E-SPEK can provide hot meals within 4 hrs after rations arrive. It is best utilized for Prime Readiness in Base Service units at austere contingency locations for periods of 30 days or less. The E-SPEK consists of one 24 ft (7.3 m) CAMSS20EX Shelter integrated to form 480 sq ft (45 sq m) of kitchen, food preparation, sanitation, storage and serving line areas. The following food service equipment is included: 1 manual tilt braising pan (i.e. tilt grill), 1 convection oven, 2 pressureless steamers, portable flooring system, 5 lightweight food preparation work tables, 1 three compartment sanitation sink, 5 insulated food and beverage containers, portable drying and storage racks, utensils, hotel pans, and other miscellaneous food service equipment items. The kitchen's sanitation system and potable water hose system are designed to pump water from a separate water truck, water buffalo, or bladder. The system also has an integrated sump pump for removing gray water from the sanitation unit to a separate grey water tank/bladder. A separate (optional) dining facility consists of a second CAMSS20EX shelter system coupled to one end of the kitchen shelter and all of the associated tables and chairs necessary to support in-shelter dining.

Power is supplied to the kitchen via a 60 kW MEP-806B generator through a 200 amp Class L main power cable that feeds power to a 60 KVA power distribution panel (PDP). In addition, 110VAC GFCI duplex convenience outlets are added to provide convenience power and lighting. Each commercial appliance is modified to add a 60 amp Class L box mount connector on the rear of the appliance to support field plug and operation capabilities.

The E-SPEK Kitchen can be transported and deployed on a single 463L air cargo pallet. However, the generator, water bladder, hoses, and additional dining equipment (i.e. dining shelter, tables, chairs, etc.) need to be transported on a second air cargo pallet.

CAPABILITIES & BENEFITS:

- Is designed primarily for the UGR-H&S™; UGR-A™ rations can be prepared with the addition of refrigeration and additional electrical power.
- Provides flexibility to roast, bake, grill, boil, braise, steam, and stew.



- Eliminates the hazards, burdens and costs associated with using fuel fired equipment.
- Provides a much improved shelter system (CAMSS) over the legacy TEMPER tent system.
- Is easily unpacked and assembled; requires only 4 food service personnel to operate and has on demand hot water capabilities.
- Operates from the 60 kW TQG currently used in the BEAR's inventory.
- Is designed to be the first two 463L pallet positions for the BEAR Kitchen system.

COMMENTS:

The E-SPEK is a vital part of the Air Force Basic Force Module Phasing Plan and can be augmented by the playbook option BEAR Kitchen System. It is planned for transition to the AF in FY11.

Similar to the E-SPEK is the Containerized E-SPEK (CESPEK). It provides many of the same capabilities as the E-SPEK but is contained in a unique three sided expandable (ISO) TriCon shelter. All of the components, except for those permanently mounted (tilt grill & combi ovens) are transported inside the TriCon kitchen shelter for pack out, making it "Ready for Transport" as a standard TriCon and "fully operational" when deployed as an expeditionary kitchen. Fabrication of the CESPEK is complete and will be evaluated by the BEAR and Air Force Services Agency in FY10.



ADVANCED DESIGN REFRIGERATOR-300 (ADR-300)

PURPOSE:

The Advanced Design Refrigerator (ADR-300) is a light-weight, highly durable and highly insulated refrigerated container system optimized for internal air transport by military fixed and rotary winged aircraft. It is the premier refrigerated container system used to support AF and BEAR field feeding, medical, and mortuary affairs requirements.

CHARACTERISTICS:

The ADR-300 stores chilled or frozen UGR-A™ rations and other perishables to support remote site and base camp feeding operations in austere environments. The system can be placed in any one of the five 463L pallet positions available on a C-130 aircraft, optimizing available transport space. Temperature control is provided by a modified, electrically driven, COTS refrigeration unit that provides temperature control from 80°F down to 0°F in ambient temperature as high as 125°F, and a digital thermostat provides an interior set-point temperature and manual defrost control. The item is composed of fiberglass reinforced plastic skinned composite panels that are mounted on a formed aluminum pallet base. The interior features racks with five removable/adjustable shelves on each side wall, while integrated four-way forklift pockets allow for ease of forklift transport.

CAPABILITIES & BENEFITS:

- Provides precise temperature control for refrigerated or frozen group rations in hot and arid climates.
- Extremely thermally efficient design maintains safe food temperatures during flight or loss of power.
- Is multi-modal transportable by air, land and rail.
- Is internal Cargo Aircraft Certified by the Air Transport Test Load Agency.
- Is Helicopter Sling Certified.
- Has 463L compatible cargo rails for easy Military aircraft "roll on/roll off" capabilities.
- Tie down provisions meet MIL-STD-209 requirements.
- Reduces transportation footprint and logistical footprint of other refrigeration equipment.

COMMENTS:

Over 800 ADRs were procured and fielded by the BEAR Weapons Systems Office and CFD in 2005-2006. These are currently in use by the AF.

AT A GLANCE:

■ CAPACITY:

285 cu ft (8 cu m): 10,500 BTU/hr @ 35°F to 110°F (1.67°C to 43°C) and 5200 BTU/hr @ 0°F to 110°F (-17°C to 43°C)

■ DIMENSIONS:

- Exterior Dimensions (with airlift rails): 88 in L x 108 in W x 96 in H (224 x 274 x 244 cm)
- Exterior Dimensions (without airlift rails): 85 in L x 105 in W x 96 in H (216 x 267 x 244 cm)
- Interior Dimensions: 80 in L x 75 in W x 81 in H (203 x 191 x 206 cm)

■ WEIGHT:

- Max. Gross Weight: 10,000 lbs (4,536 kg)
- Tare Weight (Including refrigeration unit): 3,285 lbs (1,490 kg)
- Payload Weight: 6,715 lbs (3,046 kg)

■ UTILITIES/POWER:

208/230 Volt AC, 3-Phase 50-60 Hz

■ REFRIGERANT: Environmentally friendly refrigerant, R-404A

■ TRANSPORTATION:

Transported by military aircraft (C-141, C-5A, C-17 and C-130), 5-ton Family of Medium Tactical Vehicles (FMTV), rail car or by 10,000 lbs (4,536 kg) forklift.



CONTAINERIZED DEPLOYMENT KITCHEN (CDK)

PURPOSE:

The Containerized Deployment Kitchen (CDK) is a self-contained kitchen that can be deployed quickly to feed Airmen and other Warfighters in the field during the first few days of a mission until more extensive kitchen facilities are established. The CDK is all-electric and is fully outfitted with commercial food-service equipment.

CHARACTERISTICS:

The CDK is compact and efficient, able to be used in the early stages of deployment, and later transitioned to the Flight Line to better support Airfield Personnel. The CDK prepares all group rations for Airmen in the field during the opening-the-base force module phase. Capable of feeding 550 personnel up to two times per day, the CDK provides sustainment until the BEAR Kitchen System arrives. The kitchen is contained within a one-sided expandable ISO shelter and is supported by a commercial generator that provides electric power to the unit. Only fuel and a source of water are required to make it operational. It is fully outfitted with all commercial food service equipment: 2 convection ovens, 2 tilt griddles, 2 tilt kettles, 2 refrigerators, a five-well stream table, a three-well sanitation sink with water heaters, a meat slicer, an ice machine, a coffee urn, work tables, and an onboard hot water heater.

CAPABILITY & BENEFITS:

- Is an all-electric, self-contained kitchen.
- Can be set up or taken down and packed for transport by four people within 4 hrs.
- Has integrated heat and air conditioning.
- Can operate in temperatures ranging from -25°F to 120°F (-32°C to 49°).

COMMENTS:

The CDK was first procured in the 1980s. There are no new procurements anticipated.



AT A GLANCE:

■ FEEDING CAPACITY:

Up to 550 personnel within 2 hrs twice per day with 4 cooks

■ DIMENSIONS:

One-sided expandable ISO shelter (8 ft H x 8 ft W x 20 ft L; 2.4 x 2.4 x 6.1 m); expands to (8 ft H x 16 ft L x 20 ft W; 2.4 x 4.9 x 6.1 m)

■ WEIGHT:

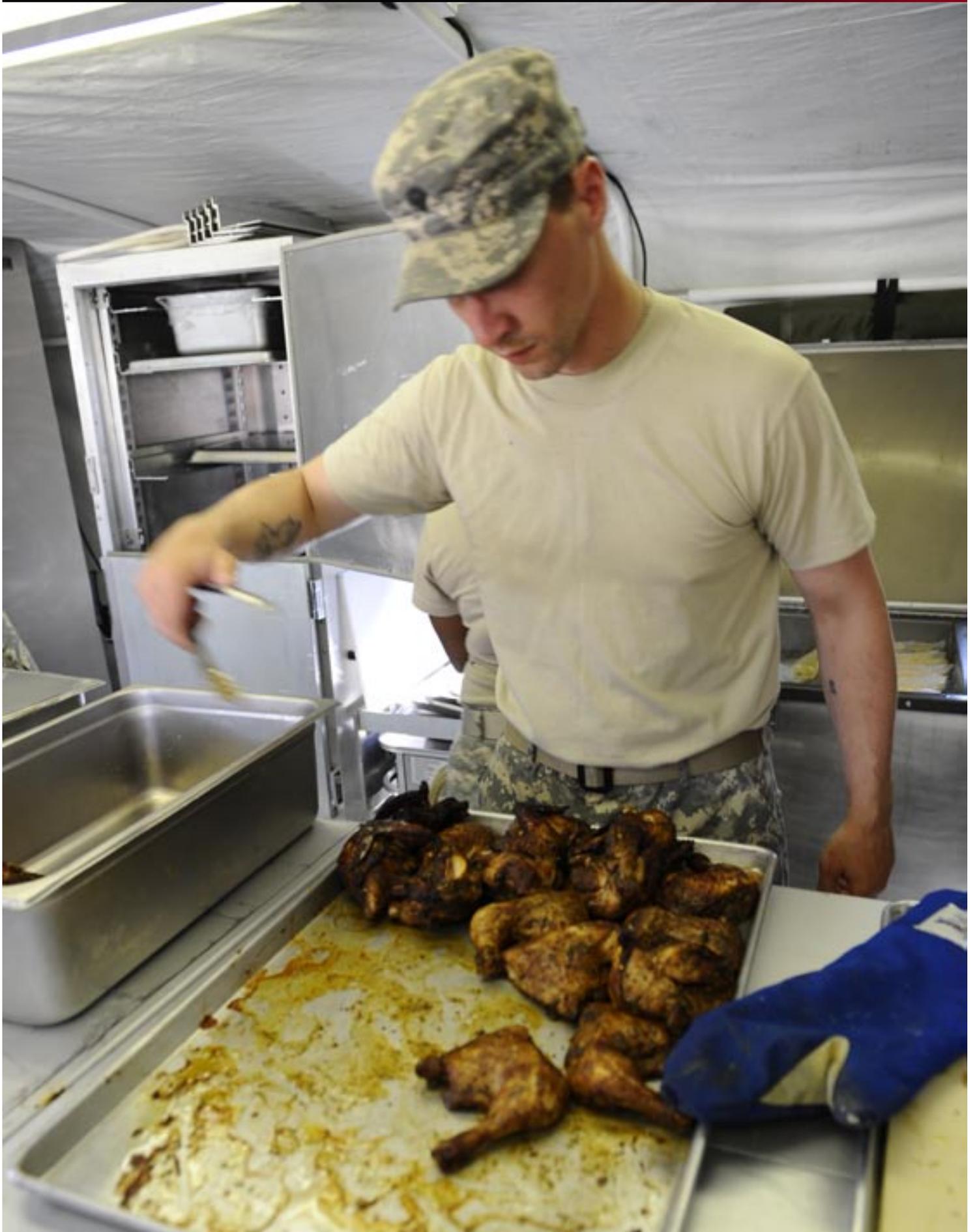
12,800 lbs (5,806 kg) /150 kW generator
8,200 lbs (3,719 kg)

■ UTILITIES/POWER:

150 kW generator, fuel and water

■ TRANSPORTATION:

Transported by sea, by air (C-130) and by land (M1022A1 Dolly Mobilizers)



INSULATED FOOD CONTAINER (IFC)

PURPOSE:

The Insulated Food Container (IFC) is a commercially available container used for storing and transporting combat rations. It is primarily utilized when field feeding requires transporting hot group rations (e.g., UGR-H&S™ or UGR-A™) to Warfighters in remote locations.

CHARACTERISTICS:

The IFC is made of sturdy, double-wall, high density, molded polyethylene for impact resistance. Each IFC is top loading and stores food in three separate inserts with lids (standard 1/3 size 6-inch deep steam table pans). It can also be utilized with any two standard 1/3-size commercial steam table pan. The pans are separated by two 13.75 in (35 cm) divider bars. The thick, foam-injected insulation assures superior thermal performance. IFCs are designed to be interlocked and stacked for easier transport and maximum storage space.

CAPABILITIES & BENEFITS:

- Food can be maintained above 140°F (60°C) or below 40°F (4.4°C) for up to 4 hrs in harsh conditions while remaining in compliance with food safety standards.
- Is impact resistant to rough handling and transportation in all environments.
- Airtight removable gasket provides a secure seal.
- Has molded-in handles for easy carrying and handling.
- Four plastic latches secure contents.
- Interlocks and stacks for transporting and storing.

OPTIMIZED INSULATED FOOD CONTAINER (OIFC)

PURPOSE:

The OIFC is a commercially available food container that can accommodate three 1/3-size 6-inch deep steam table pans or five UGR-H&S™ trays. This item is a second generation of the IFC, with a structural web-molded design that can hold and maintain serving temperatures for both the UGR-A™ and UGR-H&S™ rations while improving upon cube, weight, and transportability.

CHARACTERISTICS:

Like the IFC, the OIFC is able to maintain food at acceptable serving temperatures for up to 4 hrs in environmental extremes (-25°F to 125°F; -32°C to 52°C) during transport from field kitchens to Warfighters at remote sites. The IFC uses standard size steam table pans, allows for easy field sanitation, and is produced using a high-density polypropylene for impact resistance. The container is issued with three 1/3-size, 6-inch deep stainless steel steam table pans with covers and gaskets. The OIFC is an improvement over the IFC since it is 20% lighter and smaller, has nesting ability for further storage volume reduction, and can store one additional UGR-H&S tray (five total).

CAPABILITIES & BENEFITS:

- Is lighter and easier to handle than current IFC.
- Is smaller in cube than current IFC.
- Nestable design allows for 35% reduction in storage volume.
- Offers increased UGR-H&S™ storage capacity.

AT A GLANCE:

- **CAPACITY:**
All containers are used with three, 1/3-size, 6-inch deep stainless steel or plastic insert pans with covers and gaskets. The pans are separated by two 13.75 in (35 cm) divider bars.
- **DIMENSIONS:**
25 in L × 17 in W × 10 in or 12 in D (64 x 43 x 25 or 30 cm)
- **WEIGHT:**
18.4 lbs (8.3 kg)



AT A GLANCE:

- **CAPACITY:**
Three 1/3-size, 6-inch deep steam table pans, or five UGR-H&S™ trays.
- **DIMENSIONS:**
24.4 in L × 16.4 in W × 9 in D (62 x 42 x 23 cm)
- **WEIGHT:**
14.6 lbs (6.6 kg)

INSULATED BEVERAGE CONTAINER (IBC)

PURPOSE:

The IBC is commercially available and is used to hold, transport and serve hot and cold beverages to Warfighters in remote locations.

CHARACTERISTICS:

The IBC consists of a one piece polyethylene outer shell combined with a thick foam core that provides insulation against heat and cold for a minimum of four hours. Molded-in mounting plates prevent latches from pulling out. A drip proof recessed spigot allow for clean, easy self-serve access. Units are designed to be stacked for secure transport or service.

CAPABILITIES & BENEFITS:

- Is easily stackable & transportable.
- Allows easy self serve access.
- Sturdy plastic latches secure lids tightly and will never rust.

AT A GLANCE:

- **CAPACITY:**
4.75 gal (17.98 l)
- **DIMENSIONS:**
16.75 in L x 9 in W x 24.25 in H (42.5 x 22.9 x 61.6 cm)
- **WEIGHT:**
16 lbs (40 kg)



THERMOELECTRIC WATER CHILLER/HEATER (TEWCH)

PURPOSE:

The TEWCH enhances the operational readiness of combat vehicle crews by providing a lightweight means to heat and chill water for beverages. It improves on the existing Mounted Water Ration Heater (MWRH) by both heating and chilling water in a lighter weight unit. The MWRH was used in most combat vehicles to heat water for beverages and as an immersion heater to heat MRE™ entrées. The MWRH heats about a half gal (about 1.9 L) of water with electrical resistance and weighs 20 lbs (9 kg). However, the MWRH cannot chill water, which is necessary to improve crew hydration.

CHARACTERISTICS:

The TEWCH can be used for heating water for re-hydrating rations and hot beverages or for cooling water for cold beverages and to enhance operational readiness. The TEWCH has a 16 oz (.47 L) hot and cold water capacity, for 32 oz (.95 L) total. The water chiller/heater component is capable of simultaneously heating water from 40°F (4.5°C) to 140°F (60.5°C) and chilling water from 100°F (38.1°C) to 60°F (15.7°C) in 20 min or less, depending on ambient temperature. The weight of this item is 6.5 lbs (2.93 kg).

CAPABILITIES & BENEFITS:

- Heats and cools water in 20 min or less.
- Provides both hot and cold water from the same process.
- Offers 67% reduction in weight, from 20 lbs (9 kg) to 6.5 lbs (3 kg) when compared to the MWRH.
- Provides heating and cooling without pumps or moving parts.
- Enhances Warfighter morale and quality of life.







INTRODUCTION TO CONCEPTUAL FIELD FEEDING EQUIPMENT

The CFD is looking to revolutionize military operations, researching new concepts and technologies for field feeding equipment and systems that will improve the quality of life in the field for all Warfighters. CFD has created the registered trademark "Coming to a Theater Near You®" to symbolize this effort. It represents a pledge to Warfighters that new and innovative technologies are always being researched and developed in order to improve food quality while maximizing the time and energy that is put toward preparing food in the field.

The projects and equipment described in the following pages are all designated as "Coming to a Theater Near You®" because they are high risk, high payoff technology concepts that are planned for testing and/or fielding within the next few fiscal years and promise great impact on field feeding operations. Also, as more effort is put towards researching environmentally conscious technologies, so do CFD's equipment and related systems become more energy efficient and resource sustainable. While many equipment items and systems have the potential to be used by all services once their application is seen in theater, the R&D for a particular item is usually done for a specific need of one of the Services. The item listed at the top of each page is identified as either Army, All Services, or Navy.



BATTLEFIELD KITCHEN - ARMY

PURPOSE:

The Army has identified a need to replace the Mobile Kitchen Trailer (MKT) with a kitchen that reduces the problems associated with the open combustion burners used in the MKT, which produce excessive noise and heat. Versatility and mobility are the primary engineering considerations for the BK, which will result in the ability to prepare, cook, and serve meals using less fuel and labor than required for the MKT.

CHARACTERISTICS:

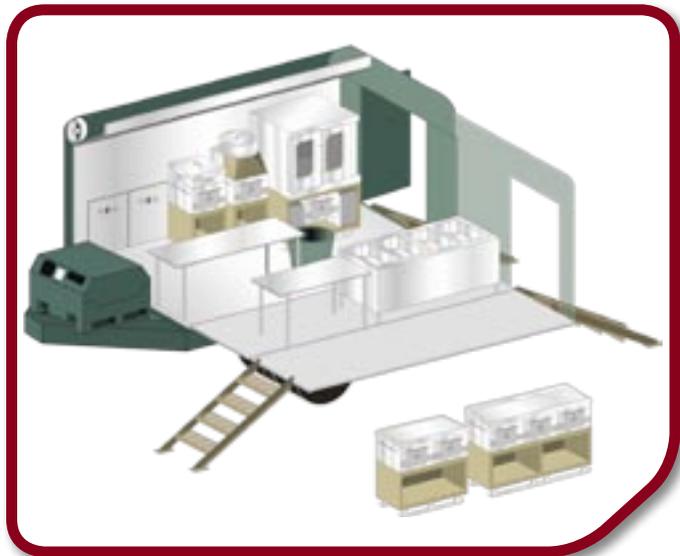
The heart of the BK will be the modular, fuel fired appliances. These will be the first appliances developed from the ground up to meet the needs of the Army. The kitchen itself will be trailer based, but the modular approach will allow the appliances and all the kitchen cabinetry to be quickly and easily removed from the mobile platform and set up in custom configurations as each mission dictates. The modular appliances will be developed with the full system of future kitchens in mind. The first application for the appliances will be the Pre-Planned Product Improvement (P³I) of the Containerized Kitchen (CK). The modular approach will allow appliances and cabinetry to be swapped seamlessly between the BK, CK and future army field kitchens of all sizes, both trailer and ground based.

CAPABILITIES & BENEFITS:

- Modularity of appliances will be the building block for the BK, CK, and all army field kitchens; they will be commercial-like but designed for the military.
- Powered ventilation and closed combustion will drastically reduce kitchen heat and noise.
- Weight control will be a primary design consideration in order to maintain the mobility of the current MKT as much as possible.
- Will provide the ability to quickly and easily off-load equipment into fixed facilities.
- Hybrid power (a battery/generator system where the generator only runs to recharge the battery) is being considered; this will reduce generator operational hours, increasing its life while reducing fuel consumption, wet stacking, and noise.
- Cogeneration (production of heat and electricity) is also being considered to further reduce fuel consumption and noise.
- The system design will allow for as many BKs to be linked together as mission requires and terrain allows; the MKT is limited to two, back to back.

COMMENTS:

The Experimental Development and Demonstration phase has been initiated on the advanced technologies being considered. Engineering Development has been initiated on the modular appliances under the CK P³I effort. Transition of advanced technologies to PM-FSS will be ongoing as technologies mature. CASCOP is currently developing a Requirements Document, and transition to procurement is currently scheduled for FY15.



Battlefield Kitchen (BK) Conceptual Renderings
TOP: Set Up In Trailer; BOTTOM: Set Up In Structure

AT A GLANCE:

- **CAPACITY:**
Up to 300 meals per day
- **FUEL:**
JP-8 and diesel
- **WEIGHT:**
Less than 10,000 lbs (4,536 kg)
- **PERSONNEL:**
Requires four cooks (same as MKT)
- **TRANSPORTATION:**
LMTV towed trailer



AT A GLANCE:

- **CAPACITY:**
18 tray packs
- **WEIGHT:**
Less than 400 lbs (180 kg)
- **UTILITIES/POWER:**
JP-8; uses a commercial DC powered 40 Watt burner
- **COMPATIBILITY:**
Compatible with Army AK, USMC TRHS, and AF SPEK

SELF-POWERED TRAY RATION HEATER (SPTRH) SYSTEM - ARMY

PURPOSE:

The SPTRH is a thermo-electric based self-powered improvement to the standard Tray Ration Heater (TRH). Operating electricity from the heat of combustion is produced by the thermoelectric modules of the SPTRH and used to power system operation. This ultimately eliminates the need for HMMWV or generator support for system operation. The SPTRH is targeted as a technology insertion into the Army Assault Kitchen (AK), the USMC Tray Ration Heating System (TRHS), and the AF Single Pallet Expeditionary Kitchen (SPEK).

CHARACTERISTICS:

The SPTRH is similar in construction and operation as the fielded TRH. It consists of a stainless steel water tank and a control panel, but has thermoelectric modules installed on the underside of the tank. When the system burner is operated, the burner off-gas heats the hot side of the modules, which transfers heat to the water in the ration heating tank. The water in the tank cools the cold side of the thermoelectric modules. The result is the production of electrical power required for operation of the system. An on-board battery is required to initiate SPTRH operation and provide power to the burner during the initial 9 min of operation. After 9 min, the thermoelectric modules provide enough power to operate the system. Safety features of the SPTRH include thermostatic control to ensure the water temperature stays below the boiling point, a low water sensor that shuts off the burner if the water depth in the tank falls below 4 inches (10.16 cm), and a tilt switch to shut the burner off at an excessive operational angle. The self-powered capability of the SPTRH improves overall system reliability, availability, and maintainability (RAM) characteristics because solid-state thermoelectrics require less maintenance than a generator or vehicle power supply. It also ensures the availability of a kitchen to produce hot meals is not eliminated if the vehicle must be taken away for a higher priority mission or if the generator fails.

CAPABILITIES & BENEFITS:

- Eliminates requirement for generator or vehicle power supply for heater tank operation.
- Reduces fuel consumption by 50% because neither a generator nor vehicle is needed to provide power.
- Ultra-reliable, with thermoelectric generator solid-state architecture that improves system RAM characteristics.
- Enables kitchen to be delivered to feeding site so HMMWV can be used for other missions.
- Offers similar performance characteristics as the TRH, including capacity, heating time, size, weight, and cube.
- Utilizes a standard commercial DC powered burner.

COMMENTS:

A User Evaluation of the SPTRH integrated into the Army AK is planned for FY10. The SPTRH may be inserted into the AK program as early as FY11 as an Engineering Change Proposal.

HIGH-EFFICIENCY SOLAR-POWERED MTRCS - ARMY

PURPOSE:

With recognition that the transport of fuel through battlefields is a significant expense and security liability, efforts are underway to use solar power for military assets. An obvious initial application is aboard the Refrigerated Container Systems (RCS) needed for transport and on-site storage of food, ice and water. The CFD Equipment and Energy Technology Team initiated a Solar-Powered Refrigerated Container (SPRC) project and is transitioning results to PM-Force Sustainment Systems (PM-FSS) Food Service Equipment Team (FSET), specifically to benefit the Multi-Temperature Refrigerated Container System (MTRCS).

CHARACTERISTICS:

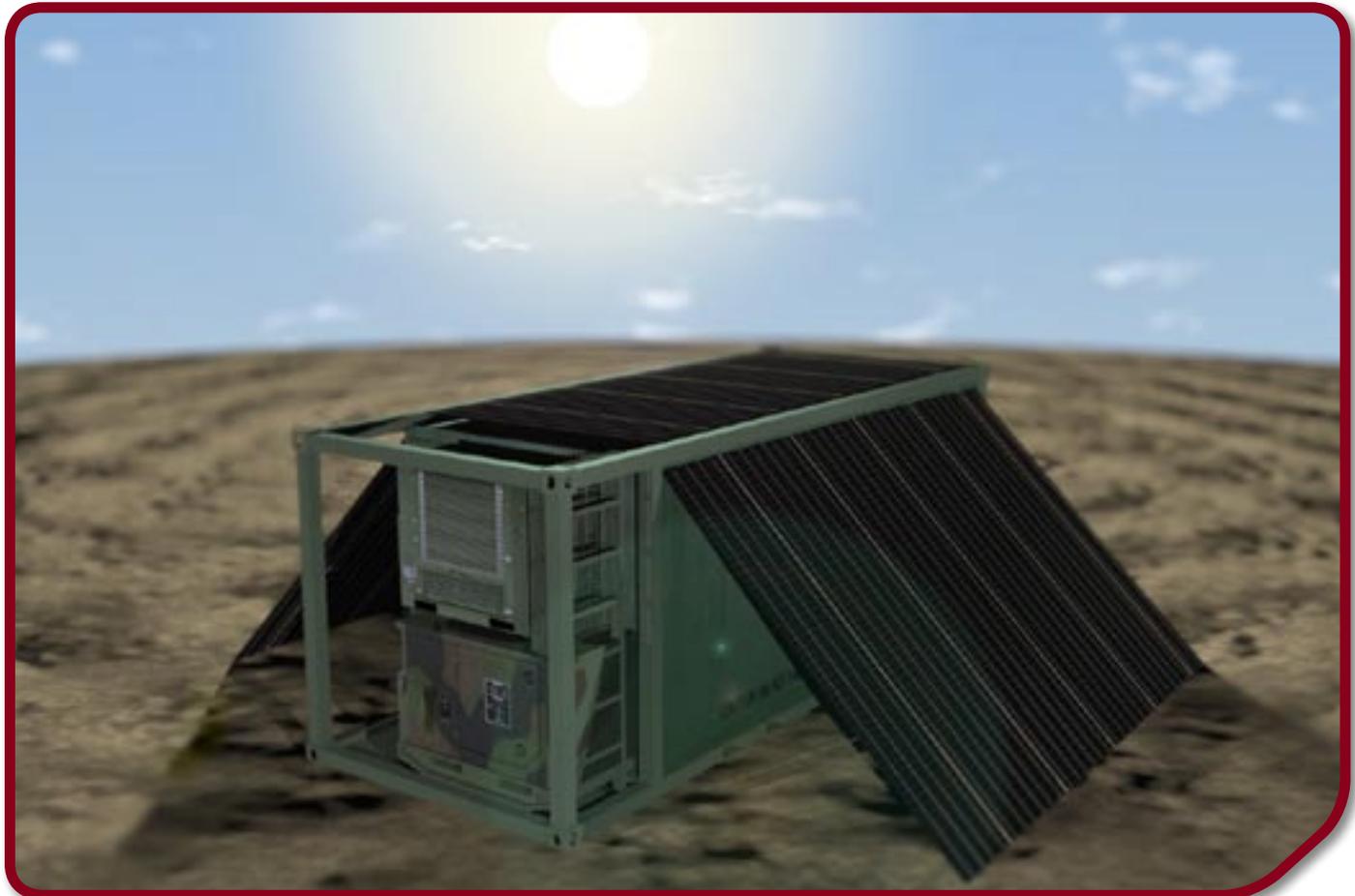
Presently, the MTRCS consumes between .8-1 gal (3-3.7 liters) per hour of JP-8 in ambient temperatures near its operational limit of approximately 120°F (50°C). To promote fuel savings, the MTRCS Operational Requirements Document (ORD) allows for alternative energy technology implementation as a Pre-Planned Product Improvement (P3I). The standard equipment relies on aged refrigeration technology, requiring far too much power and energy to practically employ the frugal output from solar photovoltaics. However, the SPRC project research has empirically demonstrated the MTRCS performance can be dramatically improved through modification, thereby enabling it for solar power.

CAPABILITIES & BENEFITS:

- Extends ambient operational temperature limit from approximately 120°F (50°C) to approximately 135°F (55°C).
- Reduces heat-soak pulldown time by 50 percent.
- Reduces fuel consumption by 50% at temperatures over approximately 100°F (40°C); results in 30% fuel savings annually.
- Has the potential to reduce the Mean Time Between Failures (MTBF) by 50 percent.
- Enables the integration of solar photovoltaic power supplies.

COMMENTS:

Upon fulfillment of predefined objectives, the technology is projected to transition from EETT to PM-FSS FSET in FY10. Meanwhile, ongoing efforts include development of the equipment, Production Qualification Testing, user testing, logistical demonstrations, and First Article Testing. Successful development and positive results from verification testing will allow for transition to production in FY13.



WATER COOLING - ARMY

PURPOSE:

It is estimated that 1.5 million bottles of water are shipped into theater daily. Due to the limited availability of refrigerated assets (refrigerated trucks, MILVANS, and CONEX primary shipping containers), the temperature of the bottled water given to the Warfighter rises due to high heat and extreme solar loading conditions. Reports from the field state that Soldiers are not consuming enough water to support proper hydration. They should be consuming water at a rate of 3 gal (11 L) per day. Therefore, with a HMMWV that carries up to four Soldiers, a requirement exists for 12 gal (45 L) of cooled water per day. To satisfy this need, Warfighters in theater are currently utilizing COTS coolers purchased from PXs that don't maintain cool temperatures for extended periods of time.

CFD FSET's current project investigating this issue is in response to a formal Request For Information (RFI) received through the Field Assistance in Science and Technology (FAST) team that identified a need for more effective COTS coolers that could effectively store chilled water bottles for vehicular mounted Warfighters. The RFI also identified a need for effective methods of securing loose water bottles within HMMWVs. In a survey with Warfighters, many reported that they pour out water due to high temperature and feel that space is available inside tactical vehicles for a water cooling unit. Many also reported that there is a need for actively chilled bottled water inside their vehicles to ensure hydration and combat effectiveness is maintained at optimal levels.

In order to provide a low-cost, immediate solution of providing chilled water to Warfighters, CFD FSET performed market research on a variety of both low-tech and low-power cooler options to determine which would be most beneficial to send to the field to meet Warfighters' immediate needs. Key aspects of the research were the structural strength of the coolers and the ability to keep contents cold. Various COTS coolers were then sent to units in theater and feedback was gathered. As a result of the RFI, the FSET identified the YETI Tundra cooler to Project Manager – Mine Resistant Ambush Protected Vehicles (PM-MRAP) as the recommended cooler for purchase by units in the field."

CHARACTERISTICS:

- Has hatches to keep cooler securely closed.
- Durable design with rugged fiberglass material will not easily break.

CAPABILITIES & BENEFITS:

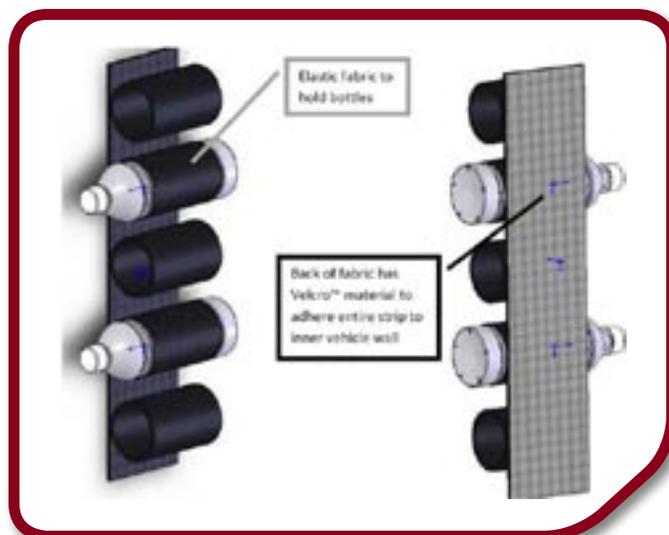
- Positive initial feedback from field:
 - Water is still palatable after 5 days in sun.
 - Increases user satisfaction.
- During event of impact, cooler is more likely than others tested to prevent water bottles from becoming projectiles, increasing user safety.
- Performance outweighs increased cost over lower-tech coolers.

COMMENTS:

An additional challenge of proving chilled bottles of water to Warfighters in the field is ensuring those bottles are



Various COTS coolers were evaluated by CFD FSET and surveyed in theater; YETI Tundra is the PM-FSS identified cooler for effective storing of chilled, bottled water .



Potential bandolier system to help keep water bottles secure & accessible in vehicle

secure from rolling around in vehicles. Warfighters have reported the problem of loose water bottles rolling around in MRAPs during Force Protection Patrols. This is a safety hazard in the event of impact and the bottles becoming projectiles. The graphic shown above depicts a bandolier system to alleviate this problem. The fabric attaches to the inner vehicle wall and holds water bottles secure while remaining within arm's reach so Warfighters do not have to constantly open coolers to retrieve the bottles.

BEVERAGE COOLING UNIT (BCU) - ALL SERVICES

PURPOSE:

The Beverage Cooling Unit (BCU) has been developed to give Warfighters the capability to rapidly cool their potable water supply. Average ambient temperatures in places such as Iraq can be anywhere between 95°F to 125°F (35°C to 52°C). In these conditions, Warfighters may be required to remain static inside their tactical vehicles from 6 to 48 hrs or mobile outside in the high ambient temperatures. Such extreme operating environments can lead to heat induced ailments such as heat exhaustion, heat stroke and dehydration. These factors can reduce the combat effectiveness of the Warfighter, which can be detrimental to mission requirements. Reports have demonstrated that troops will drink more water if it is cool and palatable. To combat the effects of extreme heat on the Warfighter, the BCU is capable of directly cooling the Warfighter's drinking water and has been independently tested and developed by the SEET team.

CHARACTERISTICS:

The tested cooling system is comprised of a micro vapor-compression refrigeration system with quick disconnect fittings which allow the system to connect to a standard 5-gal* water container. Utilizing an extremely efficient design in a small footprint, the cooling system is capable of chilling water in a standard water container a minimum difference of 40°F in 25 min in ambient temperatures up to 145°F (63°C). Cooling performance also improves as ambient temperature increases, providing quicker cool down rates at increased starting water temperatures. Based on Warfighter water consumption rates, the BCU is capable of providing a platoon sized force with consumable cold water for as long as power is available. In current configuration, the BCU is designed, but not limited to operate either inside an HMMWV cab or in the HMMWV bed. No daily maintenance is required except for a daily cleaning which requires the user to circulate a provided non-toxic food grade cleaning solution through the system. The BCU has also been vibration approved to MIL STD 810G.

The BCU is used in conjunction with one of two other newly developed items that also aid in providing cooled palatable water to Warfighters. One of these items is a newly updated Insulated Bag for the 5-gal water container (IC5; seen covering 5-gal container in top of photo) that is capable of keeping the chilled water at a palatable temperature in the container for over 24 hrs. The second item is the High Strength Collapsible Water Bag (HSCWB; seen in bottom of photo), designed to alleviate current issues with the standard 5-gal water container: poor pouring characteristics and cap design (water loss/leakage/contamination), damage during resupply airdrops, difficult cleaning requirements, and high logistical burden when carrying water into battle. The prototype HSCWB is more efficient in resupply airdrops and offers a reduction in cube storage volume inside infantry patrol vehicles.

CAPABILITIES & BENEFITS:

- The BCU is highly portable, weighing only 40 lbs (18 kg); the entire system can be quickly removed and used anywhere where a proper power receptacle can be found.



- Quick disconnect fittings on the ends of the umbilical hoses have been utilized to simplify and speed up the breakdown process.
- The IC5 utilizes integrated shoulder straps to allow for easy transport and is flexible enough to be rolled up and stored within another backpack.
- When used in conjunction with the BCU and in place of the standard 5-gal container, the HSCWB can withstand airdrop heights as high as 37 ft (11.3 m) multiple times. The HSCWB has a cover cap-sealing feature that prevents dirt from hindering the seal and contaminating the water, making the bag easier to sanitize. It also has modified handles to support cargo strap for transportation and is constructed using a 1050 denier ballistic Nylon material coated with FDA approved silicone rubber to eliminate film growth and leaching at high temperatures.

COMMENTS:

An initial prototype of the BCU has been tested and developed to function with the standard military 5-gal water container as well as the prototype HSCWB. An updated BCU prototype has been designed and is in the fabrication process. The updated prototype includes more durable quick disconnect fittings, more durable hoses and faster cool down rates.

The BCU, in conjunction with the IC5 and HSCWB, is designed for all armed services.

*5-gal = 19 L

WASTE TO ENERGY CONVERTER (WEC) - ALL SERVICES

PURPOSE:

The Waste to Energy Converter (WEC) is a solid waste remediation system with two logistical priorities: reduce the need for waste disposal and reduce the need to import fuel into forward areas. Deployed forces generate enormous amounts of solid waste that is typically disposed of by burning it in open burn pits or burn boxes, or trucking it to landfills. Any of these methods consumes fuel and has negative environmental and force protection consequences. Burning waste creates operational and maintenance burdens, operations security concerns, safety and health issues, is environmentally harmful, and wastes energy. Backhauling waste is expensive, places Warfighters in harm's way, and consumes fuel. The WEC can help the military improve force protection by keeping trucks off the road, and the reduced logistics requirement can allow for Warfighters to focus on mission related tasks.

CHARACTERISTICS:

In the course of WEC research and development, the CFD Equipment & Energy Technology Team (EETT) has explored several thermochemical conversion approaches. At this time, the most promising technology for effective and economical battalion-scale waste to energy conversion is air-blown downdraft gasification. Under this approach, raw waste feedstock is conditioned by sizing, drying, and/or densifying; the conditioned feedstock is converted into combustible gases; and the gases are burned to generate electricity in a tactical quiet generator adapted for bi-fuel operation. Initial prototypes concentrated on the 3.3-4.4 lbs (1.5-2 kg) trash per person per day generated by field food service operations, with an ultimate goal of handling most of the carbonaceous waste generated by a battalion sized camp. The systems are designed to be packaged in 20 ft (6.1 m) CONEX container(s) for compatibility with existing transportation assets.

CAPABILITES & BENEFITS:

- Helps decrease the logistical burden of waste disposal and fuel resupply.
- Reduces solid waste to non-hazardous byproducts, resulting in a 95% reduction in weight and cube of carbonaceous feedstock.
- Produces electricity and heat, innovative energy sources that displace fossil fuel.
- Improves force protection by helping reduce the size of convoys while reducing signature and environmental impacts.
- Deploys rapidly for Force Provider, field kitchens, or command outposts.
- Minimizes specialized labor and training with automated control and operation.

COMMENTS:

As a follow-up to previous WEC development, CFD EETT is upgrading a prototype WEC system for a high quality field demonstration in FY10. EETT is also investigating the development of a more capable 2-3 ton/day system.

3-4 Lbs./Person/Day

Producer Gas Displaces JP-8 in Tactical Quiet Generator

Mixed Solid Waste has 1/3 the Energy Density of Liquid Fuel, and the Wec Can Recover 50% of this Otherwise Wasted Energy..

WEC Prototype at Camp Grayling

Other potentially viable technologies are being explored under the Environmental Security Technology Certification Program as well as the Foreign Comparative Test program, under which PM-FSS is evaluating a British pyrolysis waste destruction system.

The need for a solid waste remediation system is expressed in the Force Provider Expeditionary Capability Production Document, which calls for a solid waste disposal capability with an objective of waste to energy conversion. PM-FSS endorses demonstration of various WEC systems for competitive down-select and technology insertion into Force Provider procurements and upgrades. The PM FSS life cycle plan is to begin procurement of Force Provider waste disposal systems as early as FY13.

AUTOMATED SHIPBOARD DISHWASHING SYSTEM (ASDS) - NAVY

PURPOSE:

The washing and sanitation of mess gear and cooking and serving utensils and disposal of foodservice waste (scullery functions) is currently an extremely labor-intensive operation for U.S. Navy shipboard personnel. These processes are almost entirely manual, with minimal modern equipment and limited automation. An integrated Automated Shipboard Dishwashing System (ASDS) is currently being developed to address and perform scullery responsibilities such as mess gear scrapping, sorting, soaking, washing, drying, and storing. The system will reduce manpower requirements associated with performing these functions and contribute to the Navy's goal of optimized crew sizes onboard naval vessels.

CHARACTERISTICS:

The ASDS is planned to utilize smart process controls that can automatically load, unload, sort, scrape, and inspect all shipboard dishware used onboard naval vessels. Earlier technological advances in scullery operations were centered on the improvement of dishwashers and washing agents that still required intense manual labor. This program focuses on innovative technology to construct a high speed automated system to accomplish all dishwashing and sanitation functions. The system is envisioned to include computer-controlled sensors and electronic components able to function in all shipboard environments and withstand shipboard motions and sea states.

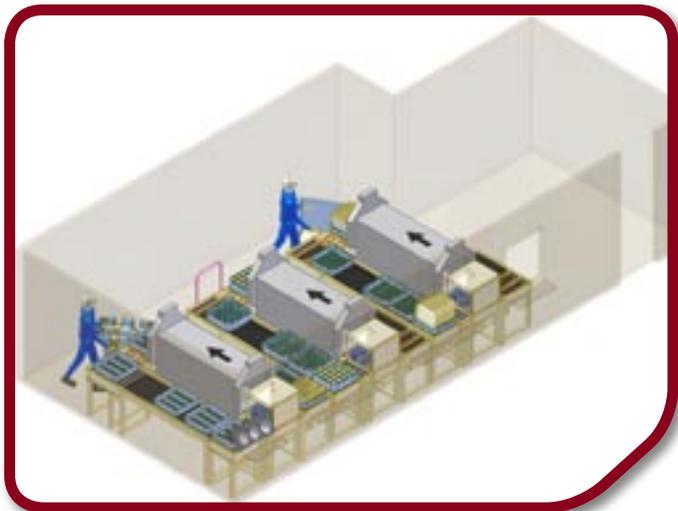
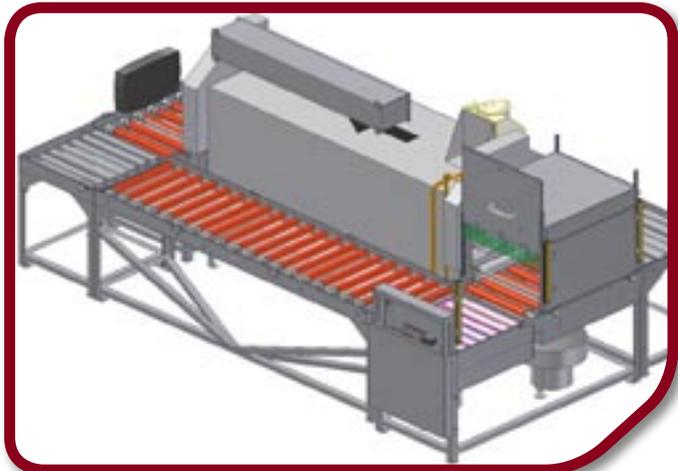
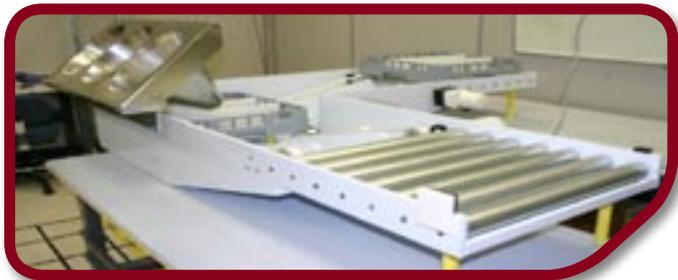
CAPABILITIES & BENEFITS:

- Decreases carrier scullery life-cycle costs.
- Improves efficiency of scullery operations.
- Reduces manpower requirement.
- Improves morale of Culinary Specialists & Food Service Attendants.

COMMENTS:

Currently, a prototype land-based ASDS that incorporates smart process controls is planned for demonstration. As part of the demonstration, the characterization of all maintenance procedures, systems diagnostics and prognostics, and projected lifecycle costs for all Navy shipboard platforms will be delineated.

Future efforts for this item include CFD SEET engineers partnering with PEO Carriers on a cost sharing initiative to support the demonstration of the ASDS configuration aboard a U.S. Navy ship. During this demonstration, documentation will be made for demonstrated manpower reductions, lifecycle cost projections, maintenance requirements, impacts and interfaces with other ship systems, and performance in the Navy unique environment. Also, a plan for integration of the ASDS concept on legacy aircraft carriers is expected to be developed.



NAVAL REFRIGERATION PROJECT (NAVRP) - NAVY

PURPOSE:

The objective of the Naval Refrigeration Project (NAVRP) is to develop modular, hatchable, re-configurable, dual-temperature refrigerated and frozen space to support endurance requirements for legacy/future ships and to support Navy increased ice consumption from 1.5 lbs (.7 kg)/man/day to 2.5 lbs (1.1 kg)/man/day. The NAVRP also supports the Navy's transition towards advanced foods utilized in the Navy Standard Core Menu (NSCM).

Currently, most ships in the fleet have fixed refrigerated or freezer storage capacities that limit the use of advanced foods and endurance loading. A considerable percentage of the components of advanced foods are pre-cooked and prepared frozen and therefore require modular and dual/multiple temperature storage systems. Currently fielded refrigeration assets in hot ambient climates, such as the Middle East, are exposed to excessive thermal loading, resulting in frequent breakdowns and high operation and maintenance costs. Deployed Army owned refrigeration is inadequate to meet current and future field feeding missions. Traditional insulation materials used in refrigerated container fabrication deteriorate over time and offer poor thermal resistance (R-6 or less). Based on feedback provided by military personnel most breakdowns are attributed to excessive solar loading and continual opening and closing of refrigeration doors. The high solar roof loading combined with the low solar reflective index of conventional paint reduces the system's service life by increasing the system's operational hours. Life cycle cost impacts resulting from increased fuel consumption rates and increased maintenance requirements are significant. Thus, there is a need to develop a modular chill/freeze equipment system that optimizes crew size, reduces logistics requirements, and support the use of advanced foods in the NSCM.

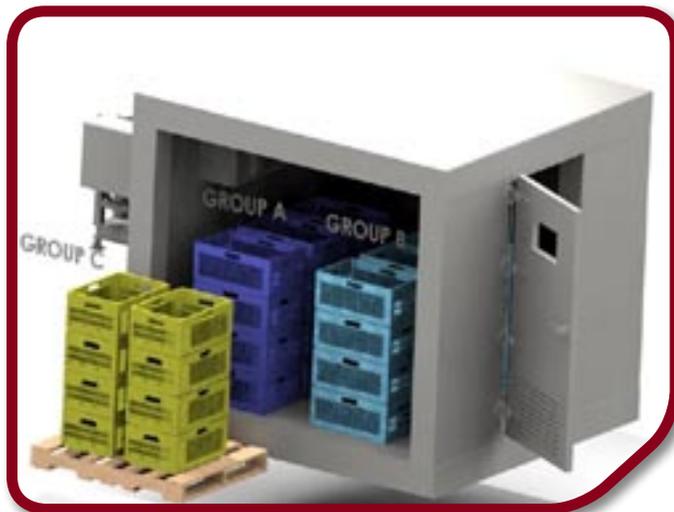
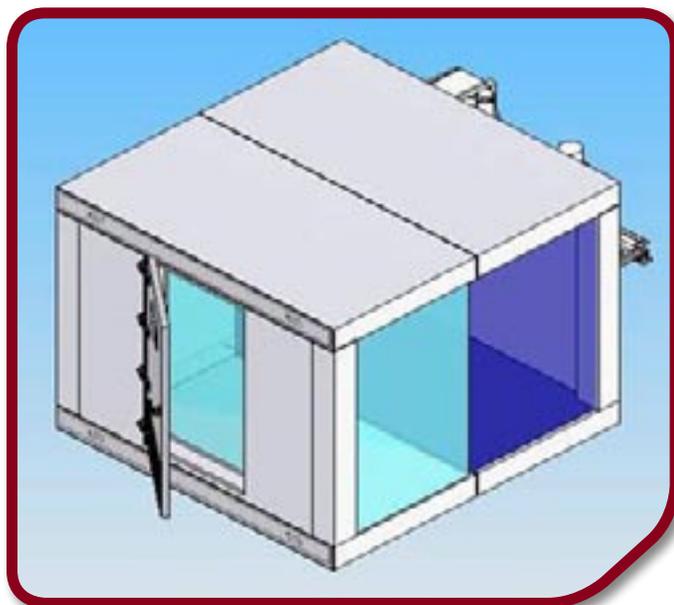
CHARACTERISTICS:

Due to its modular and multi-temperature capabilities, the NAVRP will make meal breakout and return processes more efficient, less costly, and directly contribute to a reduction in shipboard labor. One NAVRP will replace one stick built refrigerator, one stick built freezer and one conventional bulk icemaker. This decreases the logistical footprint and also reduces the weight and operation and maintenance costs aboard ships.

CAPABILITIES & BENEFITS:

The NAVRP will result in a prototype and eventual fully developed modular chill/freeze system that:

- Supports the Navy's goal of optimizing crew size.
- Decreases overall footprint in galleys.
- Reduces operation and maintenance costs.
- Is modular and hatchable for utilization on legacy and future ships & subs.
- Supports increased ice consumption from 1.5 lbs (.7 kg)/man/day to 2.5 lbs (1.1 kg)/man/day.
- Supports utilization of advanced foods in NSCM.



COMMENTS:

The NAVRP is a natural progression of the already proven Shipboard Modular Refrigerator technology in use aboard ships, with advanced capabilities such as multiple temperature and ice making capabilities and a movable partition wall to increase refrigeration/freezer space based upon mission requirements.

In 2009, the CFD SEET conducted market research to identify the various marine grade walk-in and reach-in freezer/refrigeration systems available. A front-end analysis was also completed, determining chill/freeze and ice making requirements and resulted in a procured ice maker; this ice maker will be incorporated into the dual temperature NAVRP prototype footprint. The NAVRP prototype is planned to consist of two combined refrigerated container systems to provide dual temperatures that will be retrofitted to include advanced insulation, solar reflective paint, and an advanced Refrigeration Unit (RU), as well as a retrofitted ice maker. The fabrication effort for the NAVRP prototype is currently planned for FY10.





WANT TO LEARN MORE?

If you would like more information about the DoD CFD and the projects, equipment, and field feeding systems described in this book, please visit our website. In addition to the information found in this book, the website contains fact sheets and brochures about the research and development of emerging technologies that have potential application for future field feeding systems, as well as information about military rations and the product improvement process that the CFD follows to ensure that all ration platforms provide the highest quality food product for Warfighters. You can also learn more about the CFD Teams and our unique facilities.

- hotchow.natick.army.mil

HAVE FEEDBACK ABOUT FIELD FEEDING EQUIPMENT?

Please submit your comments, questions, and ideas to:

- Nati-amsrd-nsc-ad-b@conus.army.mil

You may also contact us at:

- U.S. Army Natick Soldier RD&E Center
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Kansas Street
Natick, MA 01760-5018
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NEED NATIONAL STOCK NUMBERS?

NSNs can be found through a variety of online sources:

- Defense Logistics Agency:
www.dscp.dla.mil/subs/rations/dfs/dfsnsn.pdf
- Defense Logistics Information Service:
www.dlis.dla.mil/WebFlis/pub/pub_search.aspx
www.dlis.dla.mil/dlis-k/default.asp
- Navy Food Service Equipment Catalog:
<https://90machinery.navsses.navy.mil/habitability/fsc/home.asp>

OTHER RELATED CONTACTS:

The DoD CFD teams work closely with other government organizations to ensure that the equipment and related systems they support are part of a total systems approach. You can learn more about these organizations at the following websites:

Army:

- Natick Soldier RD&E Center:
nsrdec.natick.army.mil/index.htm
- Product Manager – Force Sustainment Systems:
peocscs.tacom.army.mil/pmFSS.html

Marine Corps:

- Marine Corps Systems Command:
www.marcorsyscom.usmc.mil/

Navy:

- Naval Supply Systems Command:
<https://www.navsup.navy.mil/navsup>
- Naval Sea Systems Command:
www.navsea.navy.mil/default.aspx
- Commander, Naval Air Forces:
www.navair.navy.mil

Air Force:

- Air Force Materiel Command:
www.afmc.af.mil/main/welcome.asp





THE SCIENCE BEHIND THE WARRIOR: YESTERDAY, TODAY AND TOMORROW.

**US ARMY NSRDEC
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