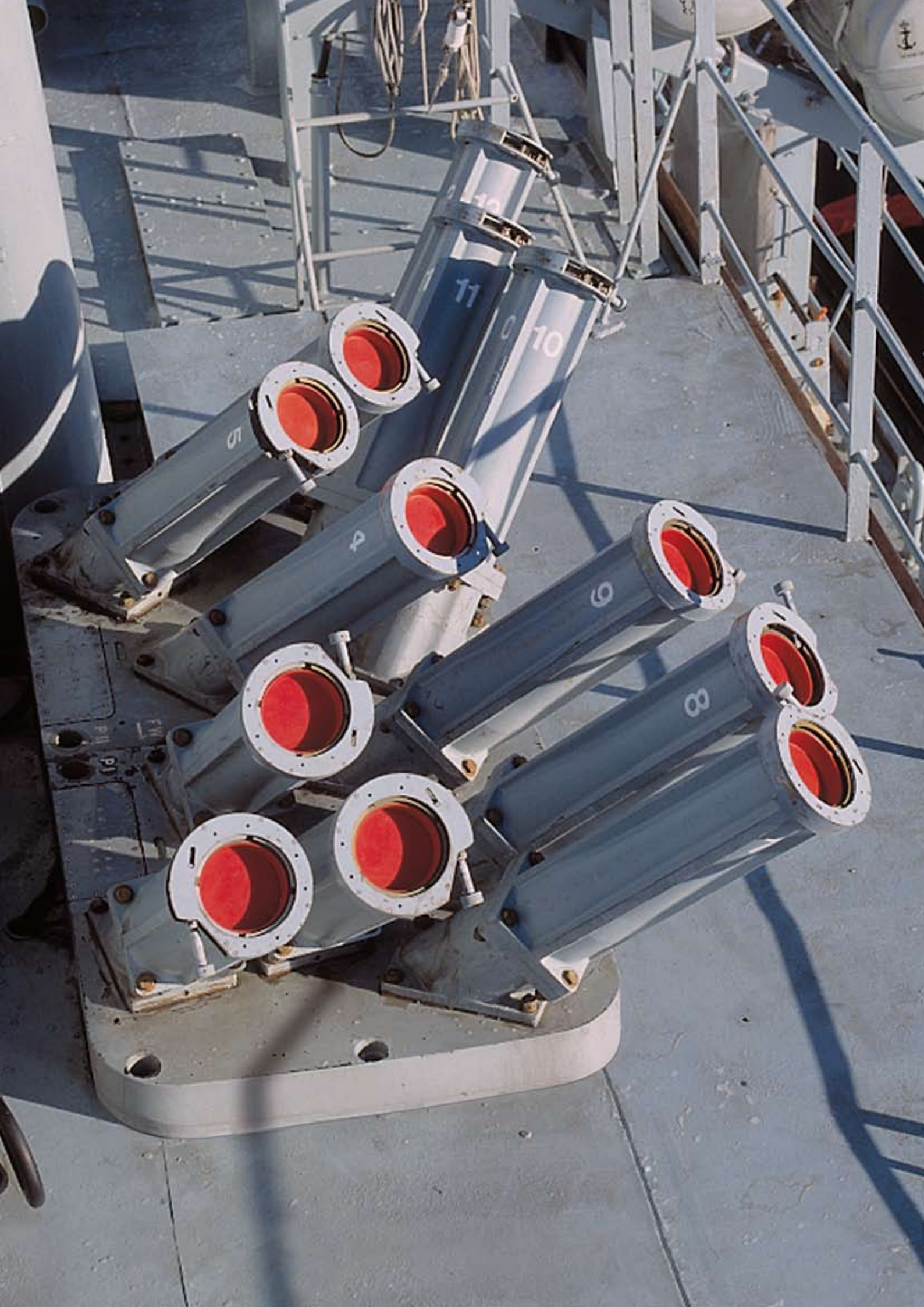
Terma SKWS
Decoy Launching System

the weapon of least regret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Terma SKWS Decoy Launching System

The anti-ship missile threats continue to increase and evolve. New missiles are faster, stealthier, more manoeuvrable, and increasingly more intelligent with regard to target discrimination and electronic counter-countermeasure functionality, a development leaving recent generations of hard- and soft kill systems less effective.

The use of hard-kill is further limited with the increasing peacekeeping and controlling activities in littoral waters where the release of weapons frequently is bound by strict engagement rules, but also requiring fast reaction time calling for a high degree of automation. In this situation, soft-kill i.e. decoy systems, have come to be seen as the non-aggressive self-defence solution, a weapon of least regret.
Decoy systems are today fitted to all naval war vessels ranging from fast attack crafts, mine warfare vessels, frigates to even bigger units as LPD's as a key element in their electronic warfare suites. Integrated with the ship EW and Radar sensor assets the decoy system will provide fast and intelligent firing of all types of off-board decoys.
For high value and larger units, the advent of Active Offboard decoys provides improved defence. A further extension of the decoy launching system is to fire acoustic decoys as part of the ship's torpedo defence suite.

The Terma Soft Kill Weapon System, SKWS, fulfils all these demands.

Terma SKWS is a modern decoy launching system that can fire all existing 130 mm decoys – also known as SeaGnat decoys. The system is based on two Terma DL-6T launchers for small vessels or two Terma DL-12T launchers for larger vessels, one for port and one for starboard mounting. The system may be expanded to control up to 24 firing tubes on each side of the ship. The Terma launcher is designed to provide 360 degrees coverage against attacking anti ship missiles. This is obtained by carefully positioning a decoy from one of the multi-angular launchers.

The key system features include:
- Lightweight launchers with small footprint
- Low pressure deck mounts
- Effective 360° horizontal coverage
- Advanced launch algorithms
- Fully automated operation
- Support of all SeaGnat type decoys
- Support of SIREN Active Jammer Decoy
- High flexibility and easy integration of user defined algorithms and libraries

The 130 mm decoy ammunition is supported throughout NATO and around the world with more than 500 systems in service. The high number of systems in service has promoted a continuous development of decoys from different and competing sources.

Currently the following types of decoys are available and supported by Terma SKWS:

- Seduction Chaff: SeaGnat 214
- Distraction/Confusion Chaff: SeaGnat 216 / PW216
- Infrared Rounds: PIRATE / GIANT (MK245 and DM19A1) / TALOS
- Dual Mode (RF and IR) decoys: Chimera and Bullfighter
- Torpedo Decoys: LEAD MK12, MK13, MK14, MK15, and LESCUT

An upgrade kit provides full support of:
- SIREN Active Offboard Decoy
- PW 216 Distraction Chaff with automatic range programming.

Chimera decoys loaded

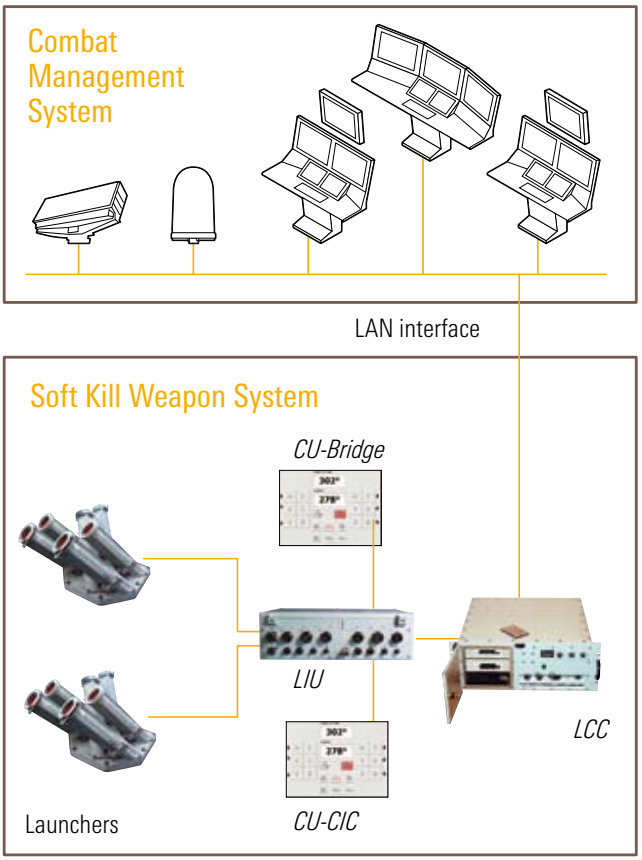
Chimera decoy

Pirate IR decoy

SIREN

The System

The Soft Kill Weapon System (SKWS) is divided into above deck and below deck equipment. The deck equipment consists of launchers, warning horns and safety switches. A ship can be configured from having 12 up to 48 tubes. Below deck equipment consists of Launcher Interface Unit(s) (LIU), Launch Control Computer (LCC) with advanced engagement algorithms, and Control Unit (CU). If required, the system can be configured with additional Control Units, e.g. one in the CIC and one on the bridge.



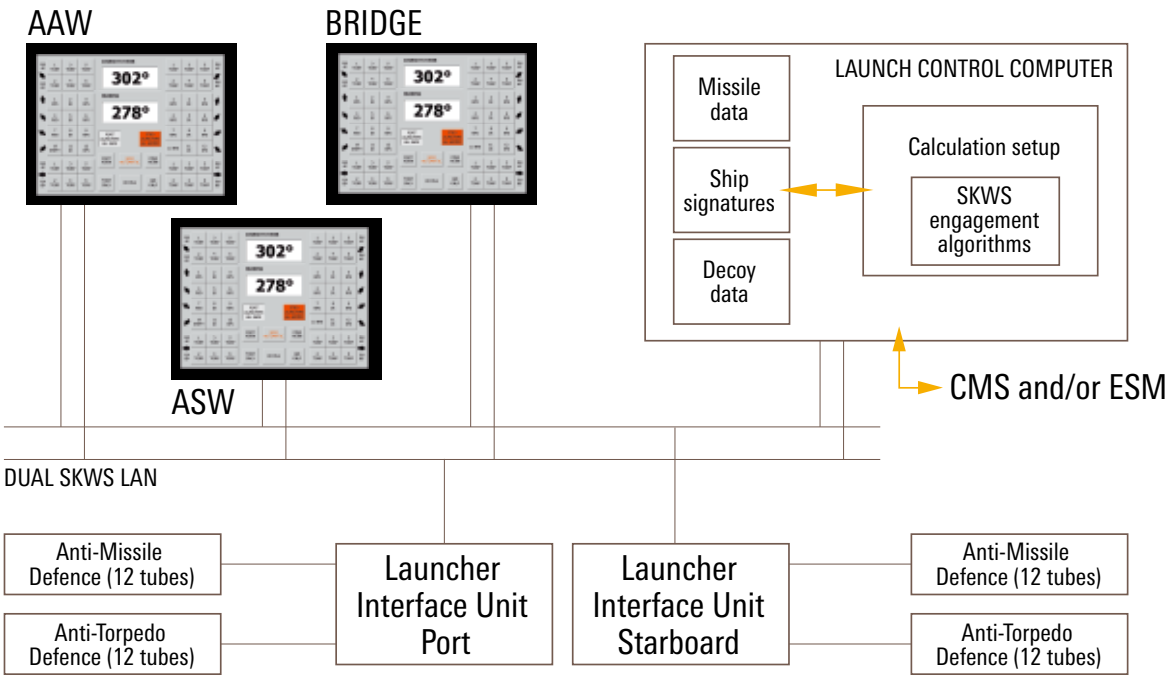
The SKWS is supplied as a complete and full function weapon system for complete integration with the ship combat system. It may, however, also be delivered as a stand-alone system interfacing directly to the sensors and other subsystems and controlled from the control unit.

System Modes

SKWS can operate in Automatic, Semi-Automatic or Manual mode. The mode is easily set by the operator on the Control Unit or through the CMS. When one or more threats are designated to SKWS, the LCC will evaluate several thousand different proposals per second and select the proposal with highest probability of survival. In Automatic mode, the best solution is fired after a preset delay interval where the firing can be aborted. If the delay is set to zero the firing is instantaneous. In Semi-Automatic mode the operator selects between the two best firing solutions.

Maximum System Configuration

The maximum system configuration shown below supports 48 tubes, three Control Units and uses two Launcher Interface Units providing a dual network. This configuration and the dual voltage power supply in each LIU secure a high MTBCF and graceful degradation in case of any malfunction.



The Algorithms

The firing of the correct decoy type, at the right time, to the right position, and in combination with a specific evasive manoeuvre are key elements in a successful decoy engagement. The algorithms in Terma SKWS ensure these important criteria. The Launch Control Computer is equipped with algorithms handling seduction of IR, RF, and Dual Mode threats as well as distraction of RF threats. The algorithms are based on comprehensive co-operation with Navies, research institutions, and decoy manufacturers.

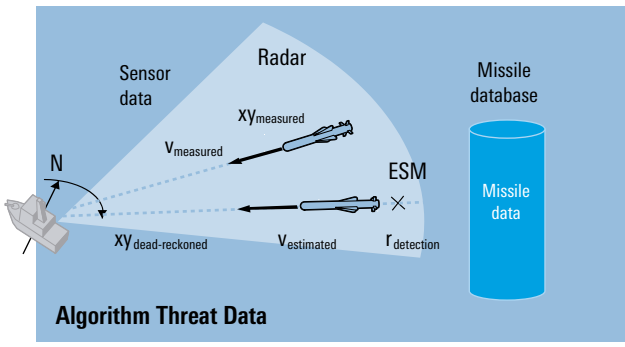
Algorithm Processing
The Launch Control Computer executes the algorithms and receives continuously the latest data for ship's heading, course, speed, roll and pitch as well as wind direction and speed. These data, combined with the current threat data and the databases, are the basic inputs to the algorithms. Based on a combination of brute force calculations, rules, and look-up data countermeasure proposals are calculated and executed according to the current mode (Automatic, Semi-Automatic or Manual). Successful defence can be achieved against up to four simultaneously incoming threats. This requires heavy duty processing which is provided by the latest in COTS hardware for the LCC.

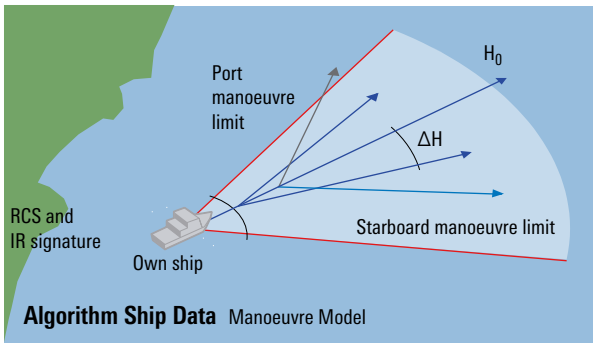
The implementation is made so that incorporation of future algorithms is easy. The algorithms can be modified and new algorithms can be designed and programmed by the Navy or third parties for integration in the system software without any involvement by Terma.

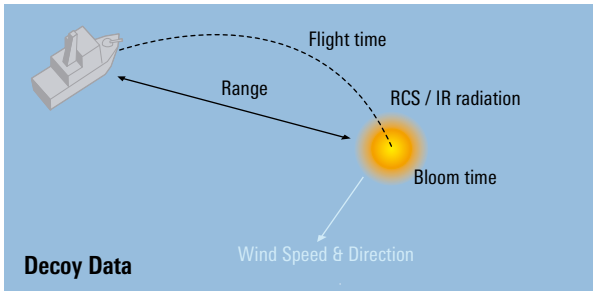
Databases
The algorithms use a set of databases with data compiled by the customer. These are data specific to the threats (e.g. seeker data and missile speed), the ship (e.g. radar cross section data and manoeuvre capabilities) and the available decoys (e.g. type, bloom time, and range). These data will normally be compiled and distributed from a shore based EW-centre.

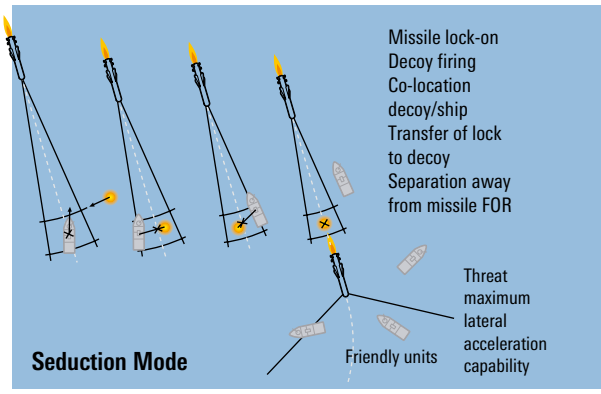
Terma delivers all necessary tools and training for the Navy for configuring and updating of the algorithm data. Terma will thus never require access to such sensitive data.

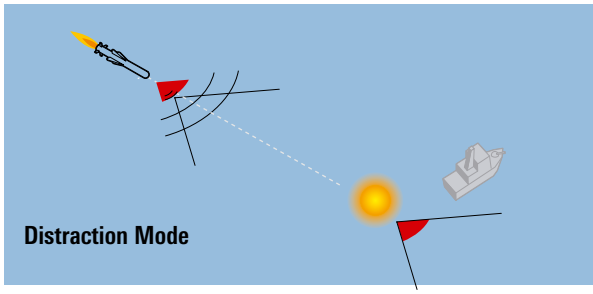
Engagement Modes
Seduction Mode: This mode is used when the missile has acquired lock-on to own ship. Depending on seeker type the algorithm(s) assures that a number of key conditions are met in the proposal(s).
Co-location: In order to have effect on a missile the fired decoy(s) must come inside the missile seeker's field of view (FOV) and - in case of a RF guided missile – the range gate. The centroid point formed by the ship and decoy signatures (in the gate) is decisive for the missile direction.
Transfer of Lock: At some point in time the missile comes so close that decoy and ship can no longer both be within FOV and/or distance gate. The position and ratio between the two signatures will then determine whether the missile will follow the decoy or the ship.
Separation: When moving the ship away from the decoy it must also be assured that re-acquisition by the missile is avoided.
Distraction Mode: This mode is used before the missile has obtained lock-on to the target. It may not even have started the search phase. The purpose of firing a distraction decoy is to lure the missile to lock-on to the decoy instead of the ship. If a distraction decoy shall have effect it must be placed within the field of regard (FOR) of the missile seeker and between the missile and own ship but off the direct line of sight. The decoy will - when it blooms - attract the missile and the seeker will shift to field of view and home directly on the decoy. When passing through the decoy chaff cloud own ship must be outside the missile seeker's field of regard in order to avoid re-acquisition.

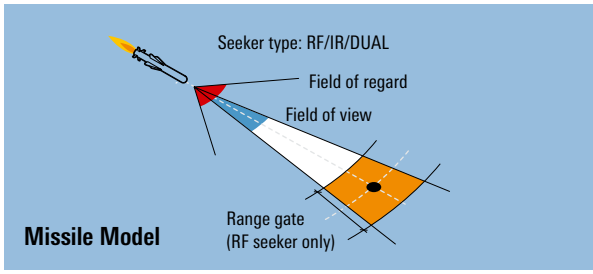












Control Unit Flexibility

The large flat panel touch sensitive display on the CU gives easy access to all relevant information. For manual operation the tube or tubes to fire is simply pressed and the selection acknowledged by a press on the separate hardwired fire key on the Control Unit front panel. Firing can only be executed if the Control Unit safety key switch is in armed position.

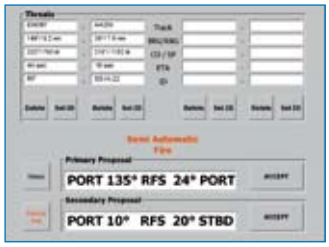
DL-6T
The layout of the display is in this example configured for a DL-6T system as used on Fast Attack Crafts and similar sized ships.

DL-12T
The layout of the display is in this example configured for a DL-12T system. The high flexibility of the system allows use of the same hardware solution independent of the size of the system. This means that the same type of Control Unit may be used on various types of ships. This provides for savings in education of operational personnel, maintenance personnel, and spare parts. The touch sensitive display is configured during installation and possible changes are up-loaded automatically at system start-up.

MK137 Launcher
This configuration caters for two MK137 launchers. These are in this example dedicated for anti-torpedo defence. This emerging concept is based on launch of Launched Expendable Acoustic Decoys (LEAD).
The ASW operator will have access to the dedicated anti-torpedo decoy launching tubes only. This will exclude any distraction by information related to AAW activities.
The LEADs are available in two basic versions. The payload is in principle the same, but the decoy is either mortar or rocket propelled for deployment close to the ship or further away.

Total Overview
A touch of a key will render all information available to the authorised operator or the officer in charge.
There are no physical bindings between the firing tubes and the type of decoys. The Round Identification System will simply report the exact content of each tube and present the information to the operator and up-date the Launch Control Computer accordingly so that the data are available for the calculations of the defence proposals.

Colour Code
The touch sensitive display is configurable to the Navy's preferences as to abbreviations for decoy type and possibly a colour code for each type of decoy.
The Control Unit is constantly checking the system availability and a status screen will display the actual state of all safety-related switches.
For service purposes the system is keeping track of all firings including detailed information on the type of decoys fired for each firing tube.



Stand-alone Applications
For stand-alone applications or for back-up solutions with direct interface to ESM the Control Unit may be configured with full control capabilities. This includes operation in Manual-, Semi-Automatic-and Automatic Operation modes.
The system will in the Automatic modes handle up to four simultaneous threats and present the best defence solution(s) for the operator for accept or veto depending of Operation mode.
The system is set to Manual Operation mode by the touch of a switch.

System Components

DL-6T Launcher Group
The DL-6T launchers are fitted with 6 tubes, 2 in each of the firing angles 20°, 40°, and 135° (port and starboard side), in the azimuth plane in relation to the sailing direction. The firing angles have been selected using extensive modeling simulations by the Danish Defence Research Establishment. The tubes are elevated at 45° enabling firing of both mortar or rocket propelled decoy types. Despite the fact that most decoys are mortar-launched, deck reinforcement will usually not be required due to the force distributing baseplate.

DL-12T Launcher Group
The DL-12T launchers are fitted with 12 tubes, 3 in each of the firing angles 10°, 40°, 60° and 135° in the azimuth plane in relation to the sailing direction. Both the DL-6T and the DL-12T launcher tubes are fitted with a Round Identification System (RIS).

MK 137 Launcher Group
Terma can also provide launchers in the traditional SRBOC MK137 design (SeaGnat). This launcher type is normally recommended as additional launchers for anti-torpedo decoys.

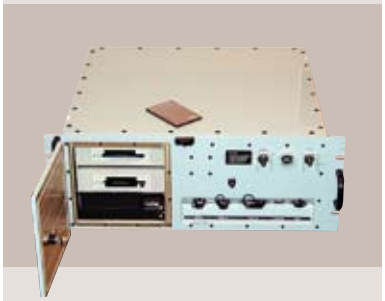
Control Unit
The Control Unit (CU) is located in the CIC (Optionally two additional units can be installed e.g. one on the bridge). It is intended for local operation and to provide a graceful degradation in case the CMS or LCC fails.
The Terma SKWS Control Unit has three switches and a large touch sensitive graphic flat panel colour display. The display is designed for use at night (and in CIC) as well as for daylight use on the bridge.

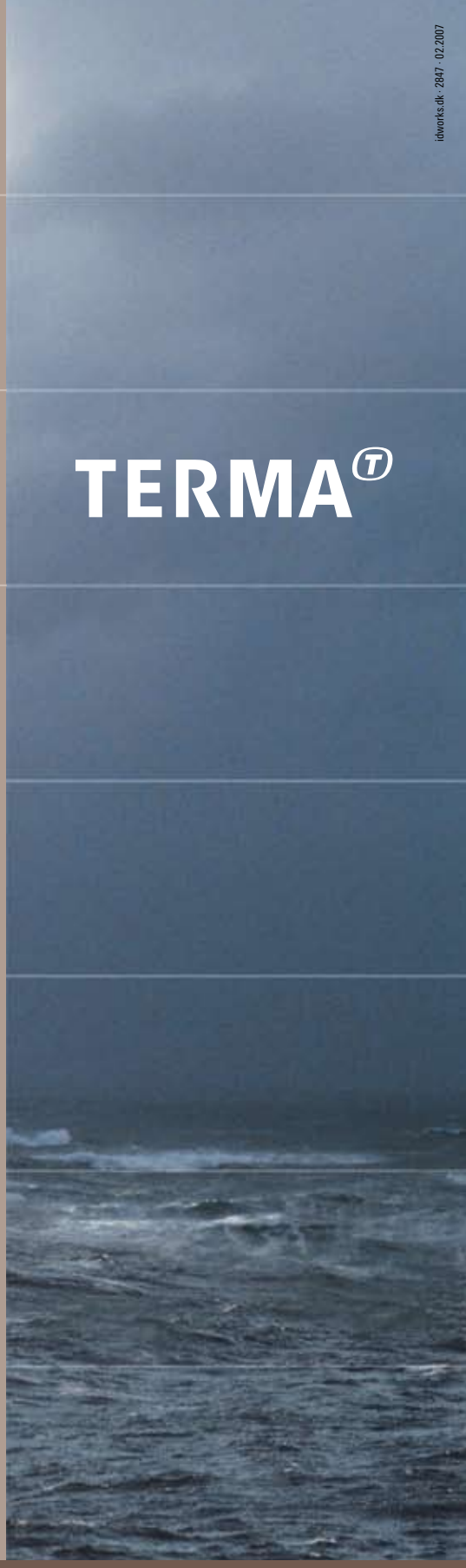
Launch Control Computer
The Launch Control Computer (LCC) is a workstation computer with a fast microprocessor and advanced engagement algorithms in software. The algorithms are used for calculating the optimum proposal for firing expendable decoys.
The LCC is interfaced to the LIU and the CMS for controlling launch of the decoys and monitoring the tube content and system status e.g. launcher safety switch. As an alternative, a direct interface with the ESM and the Ship Services allows stand-alone operation controlled through the CU.

Launcher Interface Unit
The Launcher Interface Unit (LIU) is an intelligent power supply that controls the firing pulses and communicates with the Control Unit(s) and the LCC. The LIU is connected to primary and secondary power such that SKWS can continue operation in power failure situations. The LIU is prepared for support of the SIREN Active Offboard Decoy that requires extra power supplies and computer capacity.

Round Identification System (RIS)
In order to provide correct loading information to the SKWS operators, a Round Identification System (RIS) is fitted so that the content of each tube is shown to operators of the CU or CMS. This avoids completely the delay in communicating the tube content and potential misunderstandings between loaders on deck and operators in CIC or on the bridge. The RIS is based on a tag that is fitted on the decoy barrel extender, either by the Navy or by the decoy manufacturer. The system works with all available decoys.





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Technical Data

Power Requirements

LCC	115 or 230VAC +15/-20%, 47-63 Hz, < 150W	
LIU	Mains:	115 or 230VAC +15/-20%, 47-63 Hz
	Back-up:	24VDC nom. (18-32VDC)
	< 600 W	during firing
	< 150 W	in stand-by
CU & RIS	Powered from the LIU	

Dimensions and weight

Launcher DL-12T	1000 x 2400 x 1200 mm	550 kg
Launcher DL-6T	1000 x 1200 x 1200 mm	275 kg
Launcher Interface Unit	560 x 610 x 220 mm	30 kg
Launch Control Computer	177 x 483 x 460 mm	20 kg
Control Unit	260 x 400 x 180 mm	7 kg

Deck Pressure during fire of MK-214 decoy round

The launchers do not in general require reinforcement of the deck. The baseplate construction distributes the impact without permanent deformation and with less than 0.5° tube angle deflection. The resulting force on the deck is < 95 kN (15-20 ms) on the baseplate area.

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