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Q340 Cruise Plan / RIMPASSE 2011 Trial Plan

Master Trial Plan: RIMPASSE (Radar Infra-red Electro-Magnetic Pressure Acoustic Ship Signature Experiments)

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Defence R&D Canada – Atlantic

Technical Note

DRDC Atlantic TN 2011-151

June 2011

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B. R. Hendriks[1], Z. A. Daya[2], L. Kätow[1], D. Fraedrich[3], F. M. Talbot[4], C. A. F. de Jong[5], T. C. Richards[2], A. Constable[6], L. Gilroy[2], M. Nakjem[7], S. Schäl[8],T. Krämer[8], B. Rasch[8], Jean-Marie Chapelier[9], J. B. Nelson[2], D. Rog[10], J. C. J. G. Withagen[1]

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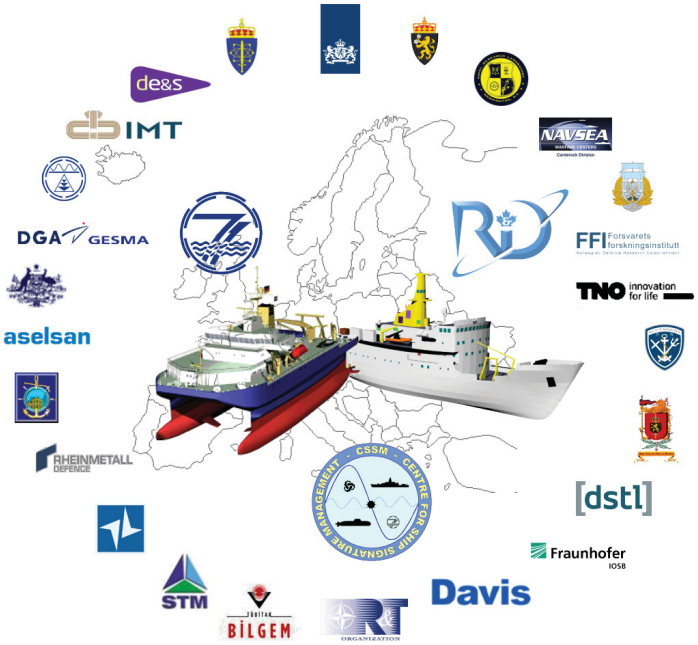
MASTER TRIAL PLAN



RIMPASSE 2011

(Radar Infra-red electro-Magnetic Pressure Acoustic Ship Signature Experiments)

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Iridium Satellite Phone	011-881-641-495-663 Primary link for scientific use. Located in Dry Lab, Scientific Plot Room, LS Cabin, CS Cabin
Ship's INMARSAT B	Located in Radio Room and Captain's Cabin 011-871(874)-33-160-8615 (unsecure telephone) 011-871(874)-33-160-8618 (Captain) 011-871(874)-33-160-8619 (commercial fax) * Use 871 or 874 depending on which satellite Quest's INMARSAT is tracking.
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ABBREVIATIONS

AASG	Advanced Active Shaft Grounding
AELF	Airborne Extremely Low Frequency (signature)
AE	Alternating electric (signature)
AHC	Active Hull Cooling
AM	Alternating magnetic (signature)
BE	Boundary Element
BURB	Broadband Underwater Recording Buoy System
BWB	Bundesamt für Wehrtechnik und Beschaffung (German Defence Materiel Organisation)
CAN	Canada, Canadian
CFAV	Canadian Forces Auxiliary Vessel
CLDG	Closed Loop Degaussing
CPA	Closest Point of Approach
CSSM	(German-Netherlands) Centre for Ship Signature Management
DEA	Data Exchange Agreement
DEU	German(y)
DE&S	Defence Equipment and Support (UK MoD)
DG	Degaussing (range)
DGA	French Defence procurement agency
DMO	(Netherlands) Defence Materiel Organisation
DRDC	Defence Research and Development Canada
DSIMS	Diver Signature Integrated Measurement System
DSTL	Defence Science and Technology Laboratory (UK)
DTGR	Date-Time-Group
DMO	(Netherlands) Defence Material Organization
DSTO	Defence Science and Technology Organisation
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FE	Finite element
FFI	Norwegian Defence Research Establishment
GESMA	Groupe d’Etudes Sous-Marines de l’Atlantique
ICCP	Impressed Current Cathodic Protection (system)
IR	Infra-Red

LWIR	Long-wave Infra-Red
MAD	Magnetic Anomaly Detection
MoD	Ministry of Defence
MoU	Memorandum of Understanding
MPA	Maritime Patrol Aircraft
MVS	Mobile Validation Source
MWIR	Mid-Wave Infra-Red
NATO	North Atlantic Treaty Organisation
NB	Narrow Band
NDLO	Norwegian Defence Logistic Organization
NLD	Netherlands
NOO	Norway, Norwegian
NRL	U.S. Naval Research Laboratory
NSWC	Naval Surface Warfare Centre (U.S.)
OSM	Onboard Signature Manager
OTO	One-Third-Octave
PoC	Point of Contact
PRIME	TransPortable Range for Influence Measurements and Evaluation
RCS	Radar Cross Section
RfV	Request for Visit
R&D	Research and Development
R&R	Rest and Recreation
RTO	(NATO) Research and Technology Organisation
RV	Research Vessel
SE	Static electric (signature)
SM	Static magnetic (signature)
SET	Sensors & Electronics Technology
SIGEMT	Signatures and Electromagnetic Engineering (technical department of DMO Sea Systems)
SOA	Speed of Advance
SWI	Sea Water Injection
TA	Technical Arrangement
TG	Task Group
TNO	Netherlands Organisation for Applied Scientific Research
UK	United Kingdom
US	United States
WTD 71	Wehrtechnische Dienststelle für Schiffe und Marinewaffen und Forschung (Bundeswehr Technical Centre for Ships and Naval Weapons, Maritime Technology and Research)

CHAPTER 1 - INTRODUCTION

§ 1.1 BACKGROUND

1.1.1. Canada, Germany and the Netherlands have had a close cooperation in the field of Signature Management since 2008. This cooperation has led to the annual organisation of Signature Management Conferences, which have brought this subject forward to a broad community. The MoD's and/or R&D institutions of Australia, Denmark, France, Norway, the United Kingdom, the United States and Sweden have expressed interest in Signature Management.

1.1.2. With the Signature Management conferences as connecting elements, R&D programmes are discussed and ideas have been and are being exchanged. A common view on a stepwise approach toward the introduction of 'operational signature management' on naval platforms is one of the results (see figure 1).

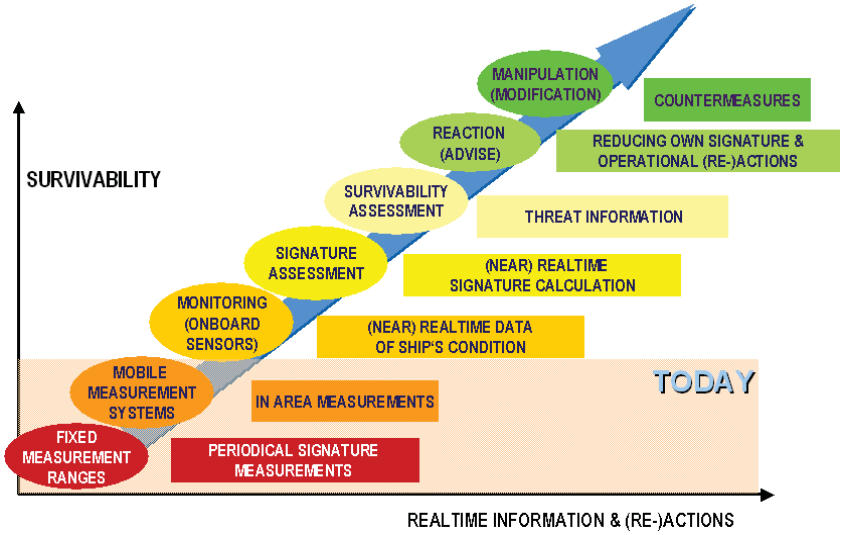


Figure 1 - Stepwise development of Operational Signature Management.

1.1.3. One of the focal points is the 'demonstration of signature monitoring' with onboard sensors for all relevant ship signatures. One of the key issues within this scope is the need for data supporting the ongoing scientific programmes. For this purpose dedicated naval platforms are needed, with installed equipment for measuring relevant signature parameters and for manipulating their signature behaviour.

1.1.4. These platforms are required to conduct dedicated programs at instrumented ranges in order to collect the relevant signature data in a controlled and reproduceable way. Since multiple ship signatures[1] are involved, the typical physical parameters to be observed and the need for different measurement set-ups (ranges) leads to a complex and potentially unrealistic requirement for experiments (in terms of time & finances).

1.1.5. As a result of the common ambition and vision that has emerged from the Signature Management Conferences, CSSM (representing the German and Netherlands MoD) and DRDC have taken the initiative for a cooperative trial programme with the aim of supporting the R&D programmes in the field of Signature Management. This initiative has led to the current trial programme that incorporates both the Canadian Research vessel QUEST (annex B) and the Research Vessel PLANET (annex C) of WTD 71.

1.1.6. During the trial preparations the initial scope of 'signature management' has been broadened. Having both CFAV QUEST and RV PLANET available at several test ranges provides unique opportunities for collecting signature data, that not only serves the R&D objectives that directly related to 'signature monitoring', but also serves the scientific objectives of the underlying signature fields. For this purpose the community involved in the preparing the trial programme has been widened, strengthening the programme and bringing it to its current scope and objective.

§ 1.2 SCOPE

1.2.1. The scope of the trial programme is to contribute, by means of conducting a series of trials at dedicated instrumented ranges, with the research vessels CFAV QUEST and RV PLANET, to:

a. the development and demonstration of signature monitoring;
b. the validation of signature prediction models for ship signature management systems;
c. the comparison of (signature) measurements of the same source at different ranges to evaluate propagation and environmental effects;
d. the evaluation and understanding of the effectiveness of signature reduction measures, including the effects of dedicated coatings (IR, RCS);
e. the development of closed-loop degaussing, including the assessment of the change of the magnetic ships signature due to transit effects.

[1] underwater noise signature, magnetic signature, electric signature, radar signature, infra-red signature, pressure signature.

§ 1.3 OBJECTIVES

1.3.1. The primary objective of the trial programme is to conduct cooperative sea trials with the aim to provide the participating nations and research institutions with data that supports their signature management and signature related research programmes.

1.3.2. The secondary objectives of the trial programme are:

a. to exchange and share the results of the research programmes in the field of signature management and ship signatures that make use of and/or are participating in the conduct of this trial programme;

b. to enhance the (R&D) cooperation between the participating nations and institutions with the aim to share the R&D efforts in the field of ship signatures in general and signature management in particular.

§ 1.4 BOUNDARY CONDITIONS & LIMITATIONS

1.4.1. Each nation or institution participating in this series of trials bears all costs incurred by their participation. Such costs include:

a. the use of test ranges and test equipment;

b. the deployment of naval platforms (including costs for tugs, pilots, etc.);

c. transport and deployment costs for equipment (e.g. PRIME);

d. personnel costs (e.g. travelling, allowances, etc.).

1.4.2. The scientific experiments (trials / measurements) are organised as an activity of three NATO SET groups 144, 154 and 166. The SET rules and regulations enable the exchange of information (including data). Taking into account the SET rules and regulations and noting that both governmental and non-governmental entities participate in the trial programme, the following principal rules apply:

a. the nation that provides the naval platform to be measured is the owner of the data and decides on the release of the data, taking into account national rules and regulations;

b. release of data will be among the governmental entities;

c. governmental entities may release the data to the participating non-governmental entities upon approval given by the owner of the data.

1.4.3. The participating entities will strive to make data available to all entities involved, taking into account the rules listed above. The data measured during Trial 11 (measurements using an MPA on CFAV QUEST) is both classified and subject to intellectual property rights and will therefore have a limited distribution.

1.4.4. The classification of the data measured on RV PLANET will be unclassified. For CFAV QUEST the classification depends upon the signature and signature data processing. See annex U for an overview.

1.4.5. All participants in a trial will strive to make analysis reports / results available to the participants that were involved in or contributed to that partial trial / experiment that provided the data used in the analysis report / result, unless such an exchange of information is not covered by (international) agreements (e.g. MoU, DEA, TA).

1.4.6. This 'master trial programme' provides an outline of the programme. Specific details on the partial trials that compose the programme are covered in the annexes.

1.4.7. The analysis objectives and process are covered by SET-144, SET-154 and SET-166. Except for principles for data handling and distribution, the analysis activities are not covered / described within this Master Trial Plan.

§ 1.5 DOCUMENT STRUCTURE

1.5.1. This document provides the following trial information:

a. **chapter 2 :** the organisational structure of the trial programme, including the identification of specific tasks and responsibilities that are of key importance to the proper conduct of the programme and for the distribution of data;

b. **chapter 3 :** the master time planning for the QUEST and PLANET up to the level of ETA's and ETD's at the specific ranges, transit times and available time slots for the specific trials;

c. **chapter 4, 5, 6 and 7 :** a description of the scientific experiments contributing to achieving the main objective of the trial programme, including a general description of the trials at the appropriate ranges and the identification of critical assets required for conducting specific trials (e.g. equipment).

CHAPTER 2 - ORGANISATION

§ 2.1 INTRODUCTION

2.1.1. In this chapter the organisational aspects of the trial programme will be addressed. Within this scope, the following items will be described:

a. the organisational structure used for the preparation and conduct of the trial;

b. the tasks and responsibilities;

c. the organisational aspects with respect to the trial planning and execution;

d. the organisational aspects with respect to the scientific preparation and content of the trial;

e. the operational aspects with respect to conducting the trials.

§ 2.2 ORGANISATION STRUCTURE

2.2.1. **Structure.** The organisation of the QUEST trial programme is a joint effort of all organisations involved. This organisation has both 'organisational' and 'scientific content' aspects. In order to cover both aspects in a balanced way the organisational structure as presented in figure 2 was established.

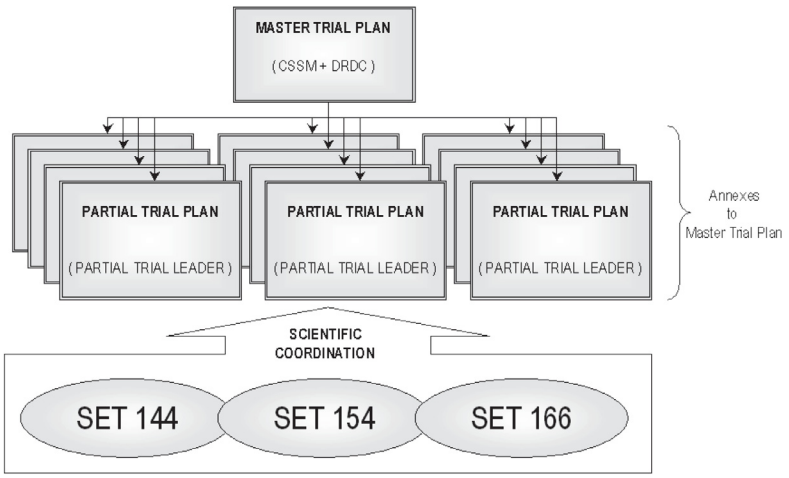


Figure 2 - Trial programme organisational structure.

2.2.2. **Master trial plan.** The overall trial organisation is conducted by CSSM and DRDC . For this purpose they have issued this master trial plan which sets the boundary conditions, scope and objectives for the entire programme. The main trial programme is split-up into 'partial trials' (see figure 3). In chapter 4 a concise overview of the partial trials will be given.

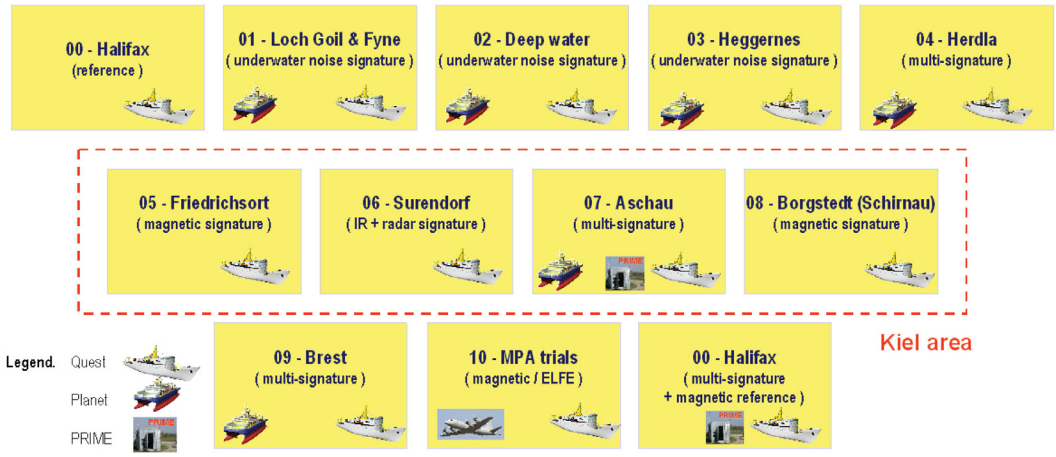


Figure 3 - Partial trials.

2.2.3. **Partial trial plans.** Each 'partial trial plan' covers all the preparations, activities and issues related to a specific part of the trial (see figure 3). For each measurement range / trial location a partial trial plan is made available by the designated 'partial trial leader'. The partial trials and partial trial leaders are presented in Table 1.

Table 1- Overview partial trials & partial trial leaders.

PARTIAL TRIAL			PARTIAL TRIAL		
NR.	TRIAL	LEADER	NR.	TRIAL	LEADER
00	Halifax trials (start & end of programme)	Mr. Richards (DRDC)	06	Surendorf trials	Mrs. Rasch (WTD 71)
01	Loch Goil / Fyne trials	Mr. Constable (QINETIQ)	07	Aschau trials	Mr. Schäl (WTD 71)
02	Deep water trials (QUEST-PLANET)	Mr. Gilroy (DRDC)	08	Schirnau (Borgstedt) trials	Mr. Krämer (WTD 71)
03	Heggernes trials	Mr. Schäl (WTD 71)	09	Brest trials	J.M. Chapelier (GESMA)
04	Friedrichsort trials	Mr. Krämer (WTD 71)	10	MPA trials (during transit)	Mr. Richards (DRDC)
05	Herdla trials	Mr. Nakjem (FFI)	11	Out-of-area trial	see § 2.2.4

2.2.4. It is envisaged that in the beginning of 2012 magnetic trials will be conducted, both in the Netherlands Antilles and in Halifax involving CFAV QUEST and the mobile range system PRIME. This trial is foreseen on February 6 and 7 2012 with a back-up time-slot on February 8th 2012. This trial will not be addressed in detail in this trial plan.

2.2.5. The magnetic / ELFE trials (partial trial 10) will take place on a non/delaying basis during transit.

2.2.6. **Scientific Coordination.** Complementary to the management structure provided by the 'master trial plan' and the 'partial trial plans', the scientific content and mutual coherence of the experiments is coordinated by three scientific working bodies (SET groups under the NATO RTO:

a. SET-144 and SET-154 for the above water signatures and above water signatures management related experiments;
b. SET-166 for the underwater signatures and underwater signature management related experiments.

§ 2.3 TASKS AND RESPONSIBILITIES

2.3.1. **Master trial plan.** CSSM and DRDC will provide the programme management during all phases of the programme. For this purpose they will:

a. coordinate preparations on the programme level;
b. coordinate the overall programme content with partial trial leaders and SET groups;
c. prepare and issue the master trial plan;
d. adjust the master trial plan in consultation with the parties involved, in case the conduct of the programme requires such actions.

2.3.2. **Partial trial leaders.** The partial trial leaders are tasked with and responsible for:

a. the all-over organisation, preparation and conduct of the partial trial;
b. the preparation of the partial trial program in close cooperation and direct liaison with the SET groups noted under paragraph 2.2.6 and the scientific leaders of the participating naval platform(s) (CFAV QUEST and RV PLANET);
c. the identification of supporting services and typical configurations of the participating naval platforms (QUEST & PLANET) and assets (e.g. PRIME, specific equipment / instruments, boat transfers, etc.);

d. the conduct, direct liaison and overall coordination of the partial trial, in close co-operation and coordination with the scientific leader(s) on board of the participating naval platform(s) (CFAV QUEST and RV PLANET);

e. identifying the analysis activities and reports on the different trial objectives, the organisation(s) that will conduct the analysis and the distribution of results;

f. the collection and hand-over over of data generated at the measurement site (range) to the Technical Support Officer of CSSM, in accordance with § 2.6 (data handling & distribution).

2.3.3. **Scientific leader.** The scientific leaders are tasked with and responsible for:

a. supporting the 'partial trial leader' during the trial preparations in close cooperation with the SET groups;

b. the direct liaison and coordination with the partial trial leader during the conduct of the trial;

c. the (direct) liaison during the trial preparations with the organisations (DRDC / WTD 71) that provide the test platform(s) (QUEST / PLANET) for the partial trial;

d. the coordination and allocation of the accommodation of people (e.g. scientists) involved with conducting the trials on board of CFAV QUEST and RV PLANET;

e. coordinating the on board data registration and collection (CFAV QUEST and RV PLANET);

f. the collection and hand-over over of data generated on board (CFAV QUEST and RV PLANET) to the Technical Support Officer of CSSM, in accordance with § 2.6 (data handling & distribution).

2.3.4. **SET groups.** The SET groups tasked with the scientific coordination of the trial programme are tasked with and responsible for:

a. the preparation of the scientific content of the experiments for each of the partial trials;

b. the coherency amongst the scientific experiments which are distributed over the partial trials (e.g. magnetic behaviour of a naval platform during transit, measured at different ranges);

c. the communication with all stakeholders involved in the experiments, striving to accommodate their needs and wishes for scientific experiments in the best possible way;

d. the communication and close cooperation with the partial trial leaders and scientific leaders, with the aim of providing timely and accurate information on the partial trial programmes content and the mutual verification that the experiments fit within the partial programmes.

§ 2.4 VISITS, SECURITY & PROCEDURES

2.4.1. Both governmental and non-governmental participants in the trial are to issue Request for Visit (RfV) enabling them to enter the premises an/or naval platform (CFAV QUEST and RV PLANET) at which the trials take place.

2.4.2. RfV's are to be sent, not later than July 1st 2011.

2.4.3. The procedure for issuing a RfV are to be coordinated with:

a. the Partial Trial Leader for the range / premises involved;
b. the Quest Scientific Coordinator for CFAV QUEST;
c. the Planet Scientific Coordinator for RV PLANET.

§ 2.5 TRIAL ORGANISATION

2.5.1. **Administrative organisation.**

a. **Master trial plan.** The trial programme will be conducted according to and within the boundaries set by the 'master trial plan', where the 'master trial plan' provides the overall time schedules, ports of call, sequence and general information on the partial trials.
b. **Partial trial plan.** For each partial trial the 'partial trial plan' provides all necessary and relevant information needed for conducting all activities of that particular trial. The 'partial trial plan' is the leading document for conducting the partial trial, within the boundaries set by the 'master trial plan'.

2.5.2. **Lines of communication.** For the conduct of the (partial) trials the following partners are directly involved:

a. the partial trial leader;
b. the scientific leader(s) on board of the participating naval platform(s);
c. the commanding officer(s) of the naval platform(s) involved;
d. the authority operating the test range.

2.5.3. The partial trials will be conducted under the direct control and supervision of the partial trial leader (at the test range) and the scientific leader (onboard of the naval platform).

2.5.4. The partial trial leader is the primary liaison to the authority operating the test range.

2.5.5. The scientific leader is the primary liaison to the commanding officer of the naval platform.

2.5.6. In the event that one or more of the envisaged partial trials cannot be realised within the boundary conditions set in the master trial plan (e.g. defects causing CFAV QUEST or RV PLANET to be unavailable, weather conditions, etc.), the partial trial leader will inform both the senior scientific leader appointed by DRDC and the Director of CSSM. They will consult all parties involved in such a case and issue an update of the master trial plan. Anticipation to such circumstances on the level of the master trial plan are required.

§ 2.6 DATA HANDLING & DISTRIBUTION

2.6.1. During the trials data will be registrated at the measurements sites and at CFAV QUEST and RV PLANET.

2.6.2. For the collection and distribution of data, the Technical Support Officer of CSSM will support the Partial Trial leaders on request.

2.6.3. The principles for the data collection are:

a. data will be collected on a day-to-day basis, both by the scientific leaders on board of CFAV QUEST / RV PLANET and the partial trial leader at the measurement site (range);
b. all data will be (pre)processed / compiled by the measurement teams conducting the partial trial, with the aim to provide a data package that contains all relevant information, enabling the analysis of the data;
c. the data (pre)processing / compilation will be realised and finished on the shortest possible notice in order to avoid delays in the analysis process; all data should be made available not later than **November 30th 2011**.

2.6.4. The principles for the data distribution are:

a. data distribution will be based upon the principles defined in paragraph 1.4.2 annex U;
b. the Technical Support Officer of CSSM will be provided with a copy of the data packages, with the aim to establish a complete dataset of the entire trial programme;
c. SET 144, 154 and 166 each will make proper arrangements for the handling and transfer of data.

CHAPTER 3 - MASTER PLANNING

§ 3.1 INTRODUCTION

3.1.1. This chapter will provide an overview of:

a. the movements and main trial events CFAV QUEST participates in;

b. the movements and main trial events RV PLANET participates in;

c. the deployment and transport events of the mobile test range PRIME / MVS.

3.1.2. All times used are **ZULU times**. It is to be noted that:

a. the local time in the UK (Loch Goil, Loch Fyne) will be ALFA time; add 1 hour to ZULU for transition to local time;

b. the local time in Norway, Germany and France, will be BRAVO time; add 2 hours to ZULU for transition to local time;

c. the local time in Halifax will be 'Atlantic Time'; subtract 4 hours from ZULU for transition to local time.

3.1.3. In case of bad weather conditions the Deep Water Trials may be diverted to the Sogne Fjord area (Norway). For contingency CFAV QUEST and RV PLANET will make mutually coordinated provisions for diverting to the Sogne Fjord area.

3.1.4. A compressed overview of the master trial plan is presented in Annex A.

§ 3.2 CFAV QUEST

3.2.1. The participation of CFAV QUEST consists of a main deployment and a reference measurement at Halifax after the main deployment takes place.

a. the main deployment takes place from August 3rd 2011 to October 30th 2011;

b. the magnetic verification / transit effect measurement (trial 11) after the main deployment takes place in February 2012;

c. an overview is presented in the following paragraphs, providing detailed information on:

1°. times of departure and arrivals (ETD's & ETA's);

2°. special events like on-/offloading equipment, refuelling and briefings;

3°. available time (slots) at the test ranges.

3.2.2. **Main deployment.**

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
July 28			00	Reference trial at Halifax
Aug 3				ETD for Campbeltown
Aug 14	1100	A		ETA at Campbeltown
		A		Embark scientific staff
Aug 15	1300	A		Briefing for trial 01 (Loch Goil & Loch Fyne)
Aug 16	0700	A		ETD for Loch Fyne range
	1400	A		ETA at Loch Fyne range
	1400-2300	A	01	Trials at Loch Fyne range
	2300	A		ETD for Loch Goil range
Aug 17	0600	A		ETA at Loch Goil range
	0600-1200	A		Moore at static range, sewage dump (barge)
	1200	A	01	Start trials at Loch Goil range
Aug 18	0900	A	01	End trials at Loch Goil range
	0900	A		Rendez vous with RV PLANET
	0900-1200	A		CFAV Quest and RV Planet berth along side, transfer mooring packs by PLANET's cranes, pax transfer for briefing; separate after transfer
	0900-1200	A		Briefing for deep water trial on RV PLANET
	1200	A		Pax transfer to CFAV QUEST
	1200	A		ETD for deep water trials
Aug 20	0700		02	Start deep water trials
Aug 22	0600			Rendez-vous with PLANET (58.50.00N, 08.20.00W)
Aug 23	1800		02	End deep water trials
	1800			ETD for Bergen (NO)
Aug 25	1300	B		ETA at Bergen (NO)
Aug 28	0800-1300	B		Briefing on RV PLANET for Herdla and Heggernes trial

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
	1400	B		ETD for Heggernes range
	1700	B		ETA at Heggernes range
	1900	B	03	Start trials at Heggernes range
Aug 29	1000	B		ETD for Bergen (black water drop)
	1300	B		ETA at Bergen
	1800	B		ETD for Heggernes range
	2100	B		ETA at Heggernes
	2200	B	03	Continue trials at Heggernes range
Aug 30	1000	B		ETD for Bergen (black water drop)
	1300	B		ETA at Bergen
	1800	B		ETD for Heggernes range
	2200	B	03	Continue trials at Heggernes range
Aug 31	1000	B	03	End trials at Heggernes range
	1000	B		ETD for Bergen (black water drop)
	1300	B		ETA at Bergen
	1800	B		ETD for Herdla range
	2000	B		ETA at Herdla range
	2100	B	04	Start trials at Herdla range
Sep 1	1000	B		ETD for Bergen (black water drop)
	1300	B		ETA at Bergen
	1800	B		ETD for Herdla range
	2000	B		ETA at Herdla range
	2100	B	04	Continue trials at Herdla range
Sep 2	1000	B	04	End trials at Herdla range
	1000	B		Pax transfer (to Herdla)
	1100	B		ETD for Kiel
Sep 5	0800	B		ETA at Kiel
		B		Transport of equipment to Surendorf and Eckernförde North

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
	1200	B		Briefing for Friedrichsort trial, black water drop
Sep 6	0700	B		ETD for Friedrichsort magnetic range
	0800	B		ETA at Friedrichsort magnetic range
	0800	B	05	Start trials at the Friedrichsort range
	1600	B		ETD for Kiel (black water drop)
	1700	B		ETA at Kiel
Sep 7	0700	B		ETD for Friedrichsort magnetic range
	0800	B		ETA at Friedrichsort magnetic range
	0800	B	05	Continue trials at the Friedrichsort range
	1600	B		ETD for Kiel (black water drop)
	1700	B		ETA at Kiel
Sep 8	0700	B		ETD for Friedrichsort magnetic range
see footnote [2]	0800	B		ETA at Friedrichsort magnetic range
	1300	B	05	End trials at the Friedrichsort range
	1300	B		ETD for Eckernförde North (black water drop), deploy meteo buoys enroute at Eckernförde
	1300-1500	B		deploy meteo buoys in sea area Surendorf
	1600	B		ETA at Eckernförde North
	1600	B		Install equipment for Surendorf trials
Sep 9		B		Install equipment for Surendorf trials (cont.)
	0800	B		Load ammunition for IR trials
	0800	B		Briefing for Surendorf trials
Sep 10		B		Install equipment for Surendorf trials
Sep 11	0500	B		ETD for Surendorf measurements range
	0600	B		ETA at Surendorf measurements range
	0600	B	06	Start trials at Surendorf measurements range

[2] September 8th is a spare time slot for the trial at Friedrichsort. If trials are completed, only the meteo buoys will be deployed.

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Sep 11-17	1800	B		ETD for Eckernförde Nord (black water drop)
	1900	B		ETA at Eckernförde Nord
	0500	B		ETD for Surendorf measurements range
	0600	B		ETA at Surendorf measurements range
	0600	B	06	Continue trial
Sep 17	1800	B	06	End trials at Surendorf measurements range
	1800	B		ETD for Eckernförde Nord (black water drop)
	1900	B		ETA at Eckernförde Nord
Sep 19-20	0500	B		ETD for Surendorf measurements range
	0600	B		ETA at Surendorf measurements range
	0600	B	06	Start trials at Surendorf measurements range
	0600	B	06	Continue trial
	1800	B		ETD for Eckernförde Nord (black water drop)
	1900	B		ETA at Eckernförde Nord
Sep 21		B		Quest in Eckernförde Nord (Northern Coast trial)
Sep 22	1700	B		ETD for Surendorf measurements range
	1800	B		ETA at Surendorf measurements range
	1800	B	06	Continue trial
	2200	B		End trials at Surendorf measurements range
	2200	B		ETD for Eckernförde Nord
	2300	B		ETA at Eckernförde Nord
Sep 23	0600	B		ETD for Surendorf measurements range
	0700	B		ETA at Surendorf measurements range
	0700	B	06	Continue trial
	1500	B		End trials at Surendorf measurements range
	1500-1700	B		Recover Canadian Buoy
	1700	B		ETD for Eckernförde Nord (black water drop)
	1800	B		ETA at Eckernförde Nord

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Sep 24	1000-1400	B		Briefing for Aschau trials (on CFAV QUEST)
Sep 24-25		B		Offload equipment from Surendorf trials Re-install equipment for Aschau trial
Sep 26	0600	B		ETD for Aschau measurements range
	0700	B		ETA at Aschau measurements range
	0700	B	07	Start trials at Aschau measurements range
Sep 26-28 see foot-note [3]	1500	B		ETD for Eckernförde Nord (black water drop)
	1600	B		ETA at Eckernförde Nord
	0600	B		ETD for Aschau measurements range
	0700	B		ETA at Aschau measurements range
	0700	B	07	Continue trial
Sep 28	1200	B	07	End trials at Aschau measurements range
	1200	B		ETD for Kiel (MarineArsenal)
	1400	B		ETA at Kiel (MarineArsenal)
Sep 29-30		B		dismounting mast, black water drop
Oct 1	0700	B		ETD for Borgstedt (Schirnau)
	1100	B		ETA at Borgstedt (Schirnau)
	1100-1800	B	08	Trials at Borgstedt measurements range
Oct 2-5	0600-1800	B	08	Trials at Borgstedt measurements range
Oct 6	0600-1000	B	08	Trials at Borgstedt measurements range
	1000	B		ETD for Kiel (MarineArsenal), black water drop
	1400	B		ETA at Kiel (MarineArsenal)
Oct 7		B		re-installing mast
Oct 10	0700	B		ETD for Brest
Oct 13	1400	B		ETA at Brest

[3] During the trial at Aschau the regular daytime measurement time slot may be diverted to nightly hours, depending on weather conditions. Measurements during the night will be at the static range. Details to be determined during the Aschau trials.

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Oct 14		B		Refuel & black water drop, install equipment
	0700-1100	B		Briefing for Brest trials (on CFAV QUEST)
Oct 17 see foot-note [4]	0600	B		ETD for Brest measurement range
	0700	B	09	Start trials at Brest measurements range
	1400	B	09	End trials at Brest measurements range
	1400	B		ETD for Brest
	1500	B		ETA at Brest (black water drop)
Oct 18 see foot-note [5]	0600	B		ETD for Brest measurement range
	0700	B	09	Start trials at Brest measurements range
	1400	B	09	End trials at Brest measurements range
	1400	B		ETD for Brest
	1500	B		ETA at Brest
Oct 19	0700-1800	B		off load equipment (at Brest), load PRIME prepare for transit to Halifax
	1800	B		ETD for Halifax
Oct 29, 30		Atlantic Time	11	MPA trial
Oct 31		Atlantic Time		ETA at Halifax

Nov 17-18	t.b.d.	Atlantic Time	00	Measurement with PRIME and DSIMS-MAG in Bedford Basin
Nov 21-22	t.b.d.	Atlantic Time	00	back-up timeslot for measurement with PRIME and DSIMS-MAG in Bedford Basin

[4] Time schedule may be adapted in order to have favorable tidal conditions. To be decided on during the trials.

[5] Time schedule may be adapted in order to have favorable tidal conditions. To be decided on during the trials.

§ 3.3 PLANET

3.3.1. The RV PLANET participation consists of three deployments:

a. the participation in the Loch Goil / Loch Fyne, deep water, Heggernes and Herdla trials from August 14th to September 5th;

b. the participation in the Aschau trial from September 29th to October 1st;

c. the participation in the Brest trial from October 9th to October 18th.

3.3.2. For each of these deployments an overview is presented in the following paragraphs.

3.3.3. **Loch Goil / Loch Fyne, deep water, Heggernes and Herdla trial.**

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Aug 14	1500	B		ETD from Eckernförde to Greenock
Aug 17	0800	A		ETA at Greenock
	1000	A		Briefing for trial 01 (Loch Goil / Loch Fyne)
Aug 18	0500	A		ETA at Greenock, boat transfer to be executed by RV Planet for embarking range-briefing team for Loch Goil
	0600	A		ETD for Loch Goil measurement range
	0600-0900	A		briefing for Loch Goil during transit
	0900	A		ETA at Loch Goil measurement range
	0900-1200	A		CFAV Quest and RV PLANET berth along side, transfer mooring packs using PLANET's cranes, pax transfer for briefing, separate after transfer
	0900-1200	A		Briefing for deep water trial on RV PLANET Mooring at Loch Goil range
	1200	A		Pax transfer to CFAV QUEST
	1200	A	01	Start trials at Loch Goil range
Aug 19	1400	A	01	End trials at Loch Goil range
	1400	A		ETD for Loch Fyne range
	2300	A	01	ETA at Loch Fyne range

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Aug 20	0600	A		Pax transfer
	0700-2000	A	01	Trials at Loch Fyne range
	2000	A		Pax transfer, equipment (GPS) offload
	2000	A		ETD for deep water trials (30 h transit)
Aug 22	0600			Rendez-vous with QUEST (58.50.00N, 08.20.00W)
Aug 22	0700		02	Start deep water trials
Aug 23	1800			ETD CFAV QUEST for Bergen (NO)
Aug 25	1800		02	End deep water trials
	1800			ETD for Bergen (NO)
Aug 27	0600	B		ETA at Bergen (NO)
Aug 28	0800-1300	B		Briefing for Heggernes & Herdla trial (on PLANET)
Aug 30	0400	B		ETD for Herdla range
	0600	B		ETA at Herdla range
	0600	B	04	Start trials at Herdla range
Aug 31	1500	B	04	End trials at Herdla range
	1500	B		ETD for Heggernes range
	1600	B		ETA at Heggernes range
Sep 1	0400	B	03	Start trials at Heggernes range
Sep 3	1500	B	03	End trials at Heggernes range
	1500	B		ETD for Eckernförde
Sep 5	1500	B		ETA at Eckernförde

3.3.4. **Aschau trial.**

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Sep 24	1100-1500	B		Briefing for Aschau trials (on QUEST)
Sep 29	0500	B		ETD for Aschau range
	0600	B		ETA at Aschau range
	0600	B	07	Start trials at Aschau range
Oct 01	1200	B	07	End trials at Aschau range
	1200	B		ETD for Eckernförde
	1300	B		ETA at Eckernförde

3.3.5. **Brest trial.**

DATE	TIME (Z)	LOCAL TIME	TRIAL	EVENT
Oct 9	1200	B		ETD for Brest
Oct 12	0700	B		ETA at Brest
	1200-1500	B		Briefing for Brest trial (on PLANET)
Oct 13,14	0600	B		ETD for Brest range
	0700	B	09	Start trials at Brest range
	1400	B	09	End trials at Brest range
	1500	B		ETA at Brest
Oct 15	1100	B		ETD for Eckernförde
Oct 18	0600	B		ETA at Eckernförde

§ 3.4 PRIME & MOBILE VALIDATION SOURCE

3.4.1. As a follow up of the main deployment of CFAV QUEST the deployment of PRIME is foreseen at Halifax (trial 10).

3.4.2. The PRIME movement / deployment (incl. the Mobile Validation Source movement / deployment) will be prepared and coordinated by ing. D. Rog (DMO / SIGEMT).

3.4.3. For the PRIME deployments (incl. the Mobile Validation Source movement / deployment)an overview is presented in the table below.

3.4.4. **Note:** discussion is going on about planning the Mobile Validation Source trials of Friedrichsort, Aschau and Schirnau in the same week. This could influence the planning table below.

Table 2 - PRIME and MVS deployment and transport.

DATE	TIME (Z)	TRIAL	EVENT
Jun 24 or Jun 27	15:00 10:00		PRIME arriving at WTD 71 (date depends on availability of transport capacity)
Jun 30	16:00		PRIME sensors deployed at Aschau
Jul 03	08:00		EM cal run / system test / background measurement
Aug 23	09:00		Transport of MOB.VAL to Herdla
Aug 25	15:00		Arrival of MOB VAL at Herdla
Aug 29	09:00		EM cal run at Herdla / background measurement
Aug 31	09:00		Transport of MOB VAL to Friedrichsort
Sep 02	15:00		Arrival of MOB VAL at Friedrichsort
Sep 09	08:30		EM cal run at Friedrichsort / background measurement
Sep 09	11:00		Transport of MOB VAL to Aschau
Sep 09	15:00		Arrival of MOB VAL at Aschau
Sep 16	08:00		EM cal run / system test / background measurement
Sep 19	09:00		MOB VAL transport to Schirnau
Sep 26	07:00	07	Start trials at Aschau
Sep 28	08:00		EM cal run at Schirnau

DATE	TIME (Z)	TRIAL	EVENT
Sep 29	09:00		MOB VAL transport to Aschau
Oct 02	14:00	07	End trials at Aschau
Oct 05	14:00		PRIME sensors recovered / ready for transport
Oct 05	15:00		PRIME (incl MOB VAL) transport to Brest
Oct 06	17:00		PRIME (incl MOB VAL) arriving at Brest
Oct 11	18:00		Prime stored at Brest
Oct 12	11:00		EM cal run / System test / background measurement
Oct 13	07:00	09	Start trials at Brest
Oct 18	17:00	09	End trials at Brest
Oct 19	09:00		PRIME loaded on Quest for transport to Halifax
Oct 20	10:00		PRIME (incl MOB VAL)transport to Halifax
Oct. 29			Quest (incl PRIME) arriving at Halifax
Oct 29 / 30		10	Start of trial 10 (MPA)
Nov 08 - 16			Deployment of PRIME at Halifax, EM-Cal run, Background measurements.
Nov 17 - 18			Trial 11 at Halifax
Nov 23 - 25			Recover PRIME; prepare for transport to St. Eustace
Jan 2012			Transport PRIME (incl. Mob.val) to St. Eustace
Feb 6 - Feb 9 (2012)			Trial with Quest on Dutch Antilles, EM cal run, Background measurements.

CHAPTER 4 - SET-144 TRIALS (INFRA-RED)

§ 4.1 INTRODUCTION

4.1.1. The NATO Panel TG-79 (formerly TG-06, TG-16 and TG-51) has the charter to investigate infrared research topics relating to Littoral Ship Self-Defence. Specifically, the two main research areas for TG-79 are:

a. low-altitude maritime IR propagation phenomenology;

b. IR ship susceptibility (including IR ship signature and signature management).

4.1.2. Atmospheric scintillation and refraction prediction models have been partially validated in several trials conducted by TG-51 and other NATO panels (e.g. TG-32). Over time, the phenomenology and the prediction accuracy have gotten better and better, and now the demonstrable validity of models are limited by the quality of the 'ground-truth' environmental data. A new trial is needed to implement lessons learned by previous NATO and national trials.

4.1.3. IR ship signature investigations have been pursued with the aid of the ShipIR model. The TG-79 SAPPHIRE trial was a state-of-the-art trial to assess the validity of IR ship signature models for standard-signature ships. Since SAPPHIRE, several TG-79 countries have been working on IR ship signature management systems. Canada has fielded a prototype system on it's research ship, QUEST. This system will be evaluated as part of the new TG-79 trial, quantifying signature reduction levels and impact on IR anti-ship seekers.

§ 4.2 MAIN OBJECTIVE

4.2.1. The main objective of the infra-red trial is to test the IR signature properties and missile susceptibility properties of a ship (CFAV QUEST) with an IR Ship Signature Control System, specifically:

a. the hull signature;

b. the plume Signature;

c. the full ship susceptibility.

4.2.2. See annex K for an overview of the partial trial at Surendorf.

§ 4.3 MILITARY BENEFIT

4.3.1. Quantitative assessment of an IR signature management system with respect to changes in signature, ASCM acquisition range and susceptibility.

Figure 4 - Surendorf test range.

§ 4.4 INFRARED TRIAL AND PERIOD

4.4.1. The trial will be conducted at the German WTD-71 Surendorf test site near Eckernförde Navy Base (see figure above). The overall test window is from 11 to 23 September 2011, see the table below.

Table 3 - overall SET-144 trial / preparation schedule.

DATES	ACTIVITY
7 Sept	Pre-Trial Meeting between SET-144 and SET-154 principals
8 Sept	Quest places buoy in Eckernförde bay en route to WTD-71 Eckernförde Base
8 Sept	Quest arrives in Eckernförde Nord/WTD-71
9 - 10 Sept	Install decoy launchers & other equipment on Quest
11 - 17 Sept	IR & RCS Trials at Surendorf
18 Sept	In port, Eckernförde Nord/WTD-71. Access to Quest if needed
19 - 20 Sept	IR & RCS Trials at Surendorf
21-Sept	Non-Quest related runs during Northern Coast trial
22 Sept (until 1600)	Non-Quest related runs during Northern Coast trial
22 Sept (from 16 00)	IR Trials in the evening / at night
23 Sept	IR-only Trials at Surendorf
24-25 Sept	Quest in port at Eckernförde Nord; remove IR instrumentation

§ 4.5 PARTICIPATING TEAMS & SPECIAL TEST EQUIPMENT

4.5.1. A total of 12 nations will participate in the IR trials: Germany, US, Greece, Italy, UK, Australia, Canada, Norway, Netherlands, Turkey, Belgium, and potentially a guest measurement team from South Africa. All of them will be located at a shore-based test site at Surendorf. All of the infrared measurement equipment will be at the shore site.

4.5.2. Shore instrumentation will be set up at several different locations at the Surendorf test range, see table below for an overview of the test teams / locations

Table 4 - Location of test teams.

NATION / ORGANISATION	LOCATION
AUS	PIER
BE	TOWER-Floor 3 or roof of the Geschützbettung (depending on the measurement object)
CA – DRDC-Valcartier	PIER
CA – DRDC-Valcartier	TOWER-Floor 1
GE -WTD71	TOWER-Floor 1 and 2
GE - IOSB	PIER & TOWER-Floor 2
GR	TOWER-Floor 3 or roof of the Geschützbettung (depending on the measurement object)
IT	TOWER-Floor 3
NL (IR and RF)	PIER
NO	PIER
TU	PIER
US - Army/ARL	TOWER-Floor 3
US - NRL	TOWER-Floor 3
ZAF	HILL

4.5.3. There is some special equipment that is unique to the IR trials. Several pieces of equipment will be installed on QUEST: the IR OSM system (already installed), decoy launchers, decoy storage locker, Pyranometer/Pyrgeometer pairs. See annex K for further details

§ 4.6 SIGNATURE MANAGEMENT SYSTEM DESCRIPTION

4.6.1. The IR Onboard Signature Manager (OSM) system is made by Davis Engineering, Ottawa Canada. See the figure below for a general impression.

Figure 5 - Overview of IR signature management system installed on QUEST.

4.6.2. The OSM system is comprised of two major subsystems: Sea Water Injection (SWI) and Active Hull Cooling (AHC).

4.6.3. **Sea Water Injection (SWI).**

a. The Davis Sea Water Injection (SWI) plume cooling system is used to achieve a reduction in exhaust gas temperature for horizontal exhaust systems. The device can be specified to cool the gas to below 150 degrees C.

b. The SWI plume cooling system reduces plume temperature by injecting a fine water mist directly into the exhaust stream. The SWI system is located at the end of the exhaust duct and interfaces to the ship hull. The SWI system relies on the evaporation of atomized water droplets in the exhaust to absorb thermal energy from the exhaust gas. The droplets are injected into the exhaust stream with a spray system which consists of an array of nozzles. These spray nozzles are supplied with sea water by either the fire fighting pumps or a separate pumping system.

c. The flow of the water is monitored and regulated by a control unit (the Onboard Signature Manager (OSM)) that interfaces to the ship integrated machinery control system (IMCS).

d. The SWI system is comprised of a water injection assembly followed by a length of duct over which the water droplets evaporate.

4.6.4. **Active Hull Cooling (AHC).**

a. **AHC.** The Active Hull Cooling (AHC) system automatically controls the temperature of the ship skin in order to minimize the susceptibility of the ship to IR guided missiles. The AHC system augments the NBC water wash system by providing full wash-down of the ship structure.

b. The AHC system is comprised of the following main components:

1°. hull temperature sensors;
2°. ambient environment sensors;
3°. water flow control valves, actuators, and sensors;
4°. four types of water sprinklers, including the custom designed Davis fan
5°. nozzle for spraying hull surfaces;
6°. the Onboard Signature Manager (OSM).

4.6.5. **OSM.** The AHC and SWI systems are controlled by the Onboard Signature Manager (OSM). OSM is built upon the NATO standard IR signature prediction code ShipIR / NTCS. Using real-time measurements of the ship skin temperature, ambient environmental conditions, and ship operating state, OSM is able to determine the optimal state of the SWI and AHC systems to minimize susceptibility to IR guided missiles. OSM can be software upgraded to be able to predict the ship's contrast IR signature in real time - providing important situational awareness for the combat officer.

§ 4.7 PRINCIPLE RUN DESCRIPTIONS

4.7.1. An overview of the run types is shown in the Table below.

Table 5- run types.

Run Type	Ship Track	Ship Configuration
Short Range-Ship	A	OSM on/off
Short Range-Plume	B	Stbd Diesel only, 50%, 75%, & 100%
Short Range-Decoy	E	2 diesels, 10kts
Long Range	C	OSM on/Off, Decoy or not
Littoral Background	D	2 diesels, 10kts
Mittelgrund Track	F	10 kts

4.7.2. All of the tracks are shown in the figure below. This figure shows Short Range Ship-Runs (Red, labelled A0 to A2) along with the close-to-shore Plume leg (green, labelled B0 to B2). An example long-range run is shown (orange, labelled C0 to C5.) The exact headings of the two legs of the C runs will be changed from run-to-run (see description below). After selected Long Range Runs, the Test Director may ask Quest to follow Track D near the north shore (blue, labelled D0 to D2) immediately after waypoint C5 for test teams to collect data on Quest with a land background. Note: The “F-Tracks” are for the Mittelgrund only and will NOT be used for Quest Testing.

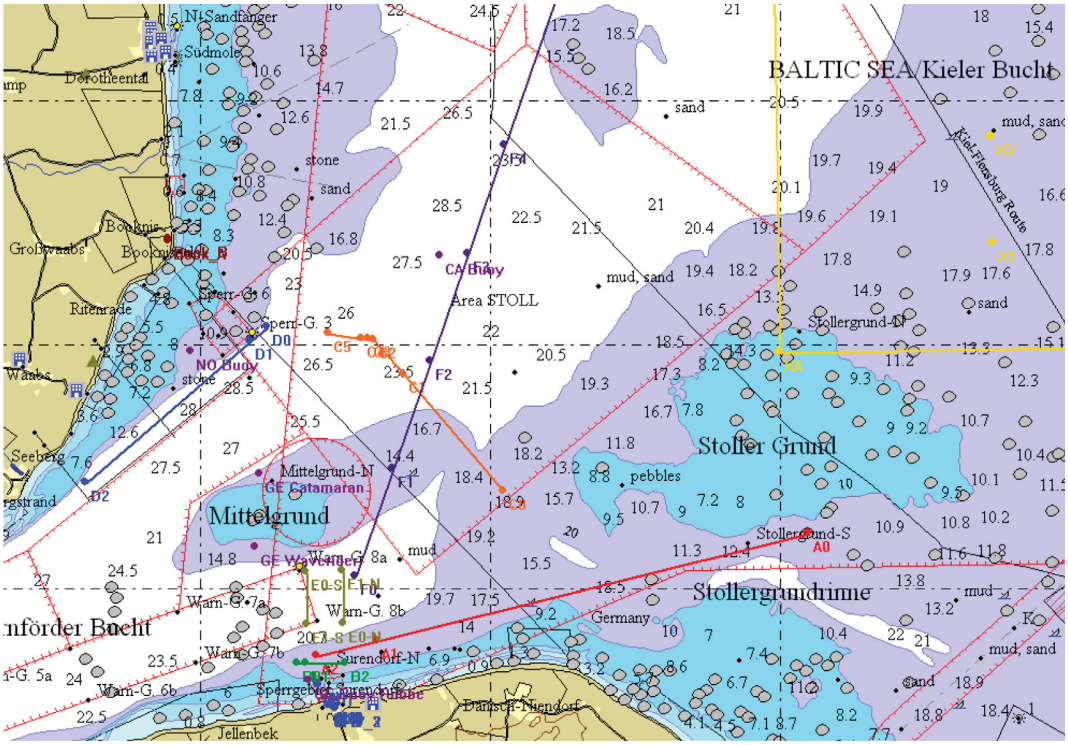


Figure 6 - Ship track overview.

4.7.3. See annex K for a detailed overview of the principle runs and the measurement procedures.

§ 4.8 SUPPORTING MEASUREMENTS

4.8.1. The IR measurements will be supported by:

a. meteo measurements:

1°. buoys: GE (FWG, IOSB), NO, CA;
2°. Quest: OSM;
3°. pier: GE (WTD71);
4°. Boockniseck: NO.

b. I-Buttons on Quest: Both GE (IOSB) and US (install 9 -10 Sept);

c. pyranometer/pyrgeometer on Quest: 2 (CAN and US);

d. Paint Reflectance: US SOC-410;

e. anemometers on Quest: CA sonic anemometers on bow.

4.8.2. Data types needed from Quest:

a. NADAS;

b. Differential GPS;

c. ICMS;

d. Ship Motion;

e. OSM Data (includes met data from weatherpak).

§ 4.9 DISCLOSURE AND USE OF INFORMATION

4.9.1. For the use and distribution of measured data, see paragraph 1.4.2.

4.9.2. The data gathered will be analysed by nations within SET 144. Analysis results will be available only to those nations participating in SET 144. See annex U for the classification of data.

4.9.3. SET-144 has gone to great lengths to plan an Unclassified trial. No classified targets will be measured and all data will be Unclassified with the exception of reduced/radiometric signature data on the Quest AHC system, which will be NATO Confidential. See Annex U for details. However, dissemination of information will be controlled.

Table 6 - data dissemination.

DATA TYPE	DISSEMINATION	WHEN/HOW TO DISTRIBUTE
Raw Meteorological data and GPS data	SET Task Groups participating in trial	At end of trial (on removable hard drive)
Quality controlled Meteorological data and GPS data	SET Task Groups participating in trial	Uploaded to SQUIRREL Sharepoint site
Quest CAD data	SET Task Groups participating in trial	At end of trial (on removable hard drive)
Quest IMCS, NADAS and OSM data	SET Task Groups participating in trial	At end of trial (on removable hard drive)
Raw, unprocessed IR signature data (e.g. raw binary files)	Limited to nation-to-nation agreements	Contingent on *ad hoc* agreements
Processed/reduced IR signature data (e.g. .xls file with radiometric signature data or calibrated imagery)	Limited to SET-144 nations participating in trial	Uploaded to SQUIRREL Sharepoint site (Unclassified data only)
Seeker results on Quest (non calibrated)	Limited to SET-144 nations participating in trial	At end of trial (on removable hard drive)
Powerpoint-level presentations & reports on trial results	Unclassified presentations are unlimited. NATO Confidential data will be only disseminated to SET-144 nations through proper channels.	Uploaded to SQUIRREL Sharepoint site (Unclassified data only)

CHAPTER 5 - SET-154 TRIALS (ABOVE WATER SIGNATURE MANAGEMENT)

§ 5.1 INTRODUCTION

5.1.1. This chapter will provide concise information on scientific objectives of the radar signature trials, organised by SET 154. The information in this chapter will focus on the scientific objectives and the experiments contributing to meeting these objectives.

5.1.2. Detailed information on each partial trial is provided in the annexes.

§ 5.2 CONTEXT

5.2.1. The trial is being planned as part of NATO SET 154 to provide an opportunity to test various signature management facilities, to validate predictions and to provide input into the signature management programme of work.

5.2.2. It is envisaged that the main vessel used during the trial will be the Canadian research ship CFAV Quest. The SET 154 trials are part of a larger trial programme for CFAV Quest as she visits Europe, this will include signature management related activities associated with other signatures, e.g. underwater signatures. The trial will be linked in with these other trials through this Master Trial Plan.

§ 5.3 OBJECTIVES

5.3.1. The objectives of the trial are as follows.

a. To investigate the effect of different ship configurations on the radar signature of the ship.
b. To validate prediction modelling of the ship in different configurations.
c. To investigate and validate modelling of the radar signature of the ship in its environment.
d. To evaluate the effect of the IR signature reduction techniques on the radar signature of the ship.
e. To evaluate a signature management system being developed by The Netherlands (TNO - programme V933).

f. To investigate propagation at radar frequencies, including reflections off the sea surface.

§ 5.4 PARTICIPATIONS & CONTRIBUTIONS

5.4.1. The member nations of SET154 will all contribute to the trial.

a. Canada will provide the Canadian research vessel CFAV Quest and an antenna for location on Quest.

b. Germany will provide two vessels, probably Mittelgrund and Kronsort, the former to carry the corner reflectors and the latter for the FWG drifting buoy and launching meteo buoys. They will also supply a small rib to carry a corner reflector. Germany will also supply two measurement radars MARSIG and MEMPHIS and a RF seeker on the shore. Germany will supply corner reflectors for location on the boats and at Boockniseck as well as plywood for making “metal” sheets for use on Quest,

c. The Netherlands plan to attend with their new measurement radar, CORA. The Netherlands also plans to bring its transmissometer to measure the path transmission between Surendorf and Boockniseck continuously at 6 frequencies.

d. The UK plans to bring a measurement radar. The UK will also supply RAM panels for fitting to Quest.

e. Denmark is planning to bring its measurement radar MRS, a transponder and the Platen box for recording GPS, time, range, bearing, roll, pitch and yaw, as well as high precision GPS for use on the shore to measure the heights of the measurement radars. Denmark will also supply laminated aluminium foil and glue for making “metal” sheets.

f. Meteo stations will be provided by several nations for location on the boats, at Surendorf and Boockniseck. Calibration targets, spheres or corner reflectors, will also be provided by each nation.

5.4.2. The nations in SET 154 not providing assets for the trial will assist with the preparatory modelling work and the analysis and reporting of the trial.

§ 5.5 ORGANISATION

5.5.1. The partial trial leader for the Surendorf test range (Dr. Birgit Rasch) will provide the co-ordination at the trial site.

5.5.2. Stephane Legault (DRDC) will co-ordinate the activities on board Quest, including the planning phases.

5.5.3. The execution of the trial will be conducted according to the trial plan prepared by SET 154, under the chairmanship of the Scientific Coordinator for the SET 154 trials, Dr. Frances Talbot. The member of SET 154 local to Surendorf, Mario Behn will liaise with Birgit Rasch and will provide day-to-day assistance.

§ 5.6 DISCLOSURE AND USE OF INFORMATION

5.6.1. The data gathered will be analysed by nations within SET 154. Data and results will be available only to those nations participating in SET 154, which is a closed group. The data available will include:

a.	UK	total RCS and high resolution data, supplied by QinetiQ;
b.	Denmark	RCS, high resolution range profiles and monopulse data (sum and difference for the SMS runs);
c.	Netherlands	total RCS and range profiles. Received powers from the RF transmissometer;
d.	Germany	MARSIG - total RCS processed data; MEMPHIS - total RCS and range profiles; for some runs calibrated raw data can be made available.

5.6.2. Danish telemetry data should be made available at the trial as well as Canadian data from Quest.

5.6.3. The meteo data gathered will be distributed to all nations in SET 154.

5.6.4. The RCS data on Quest and Mittelgrund is unclassified as stated in Annex U.

§ 5.7 TRIAL SET-UP

5.7.1. This paragraph describes the range, platforms and equipment to be used in the trial and any set-up procedure prior to the start of the main trial period.

5.7.2. **Range set-up.**

a. The measurement radars will be set up at Surendorf, co-located with the IR sensors. There will be a corner reflector set up on the other side of the bay at Boockniseck, a distance of 8.2 km from the radar site.

b. The pier at Surendorf is 330 metres long and it will probably be possible to fly spheres for calibration from the end of the pier.

c. A RF transmissometer will be setup with transmitter at Boockniseck and receiver on the pier in Surendorf

5.7.3. **Platform data.**

a. **Quest.** The main platform will be CFAV Quest, see annex B. CFAV Quest will be equipped with IR signature suppression devices.

Figure 7 - Auxiliary vessel Kronsort

b. **Mittelgrund and Kronsort.** The Mittelgrund and Kronsort are German research vessels, one of which (Mittelgrund) will be used to carry corner reflectors used to assess the environmental effects and the other (Kronsort) will be used to deploy the FWG drifting buoys.

c. **Rhib.** A rhib made available by WTD 71 will be used to carry a corner reflector to assess environmental effects.

Figure 8 - Auxiliary vessels Stollergrund (left) and Helmsand (right)

5.7.4. **Measurement radars and seekers.**

a. Germany has offered an I band RF seeker which will be located at Surendorf. Germany has also offered an 8-18 GHz measurement radar, MARSIG and a measurement radar, MEMPHIS, operating at 35 and 94 GHz.

b. The Netherlands plans to bring their new measurement radar, CORA.

c. The UK plans to bring their measurement radar capable of measuring at I, J and K bands.

d. Denmark intends to bring the MRS measurement radar.

e. The frequencies of operation, currently suggested are given in the table below, however these are under review to minimise the possibilities of interference.

Table 7- Radar systems and frequencies.

Radar	Frequencies of operation (GHz)
Danish MRS	8.6, 14.2, 17.2 GHz, all +/- 300 MHz
German MARSIG	8.2, 9.1, 14.6, 16.8 GHz, all +/- 150 MHz
German MEMPHIS	35.0, 93.8 GHz, all +/- 100 MHz
The Netherlands CORA	9.3, 16.1 GHz, all +/- 75 MHz
UK	9.728, 16.472, 35.372 GHz, all +/- 100 MHz
Transmissometer	3.86, 5.32, 8.015, 9.7, 13.45, 15.7 GHz

5.7.5. **Environmental measurement equipment.**

a. Germany will provide the FWG drifting buoys and also meteo buoys. The German buoys will be deployed daily before 0800 and recovered after 2000 (local time).

b. The Netherlands have offered a transmissometer, which would be operated with the receiver on the pier at Surendorf, at a height of 6.4 metres and the transmitter at Boockniseck, at a height of 11.5 metres. This transmissometer runs automatically at 3.86, 5.3, 8.015, 9.7, 13.45 and 15.7 GHz and could record data continuously through the trial period.

c. Germany will supply corner reflectors.

d. Meteo stations will be supplied by Germany, Norway, Canada (on board Quest) and the US (on board Mittelgrund).

5.7.6. **Calibration targets.** Each nation with a measurement radar will supply its own calibration target, whether spheres or corner reflectors. These targets may be used by other nations to compare calibrations.

§ 5.8 TRIAL PREPARATION AND PROCEDURES

5.8.1. **Preparations.**

a. Denmark requires a crane to off-load its radar container.

b. A container will be required at Boockniseck, it is envisaged that this will be shared with the IR team. This container will require a flat (on the container top).

c. A container at the end of the pier at Surendorf is also required for the transmissometer. It is envisaged that this will be shared with the IR team. This container does require a flat.

d. The equipment will be set up in the week prior to the trial and will be removed at the end of the trial.

5.8.2. **Communications.** Communications will be conducted using UHF. Telephones will be installed in each container to allow easy communication between different teams. See Annex K for detailed information.

5.8.3. **Trial plan.**

a. A detailed description of the run plans is given in Annex K.

b. The run plans assume that CFAV Quest and the range will be available between 11 and 20 September, for RCS measurements, as described in the time schedule in Annex K. Measurements will also be conducted on Mittelgrund with corner reflectors added and on a rhib with a corner reflector.

c. It is anticipated that the measurements of Quest will be made over a two week period, with RCS measurements for half of each (0800-2000) day, the other half of the day will be used for IR measurements. The exception to this is that in the second week it is anticipated that one day will be assigned exclusively to RCS and one exclusively to IR.

§ 5.9 DATA RECORDING, COLLECTION AND DISTRIBUTION

5.9.1. All data gathered (radar signature and environmental) will be unclassified, but it will only be distributed to SET154 nations.

5.9.2. Each nation gathering data will be responsible for the recording, collection and initial analysis of the data, it is that data which will then be made available within SET154, according to the following plan.

a. UK — Total RCS and high resolution data, supplied by QinetiQ.

b. Denmark — RCS, high resolution range profiles and monopulse data (sum and difference for the SMS runs)

c. Netherlands — Total RCS and range profiles, received powers from RF transmissometer

d. Germany — MARSIG - total RCS processed data.
MEMPHIS - total RCS and range profiles; for some runs calibrated raw data can be made available,

e. Denmark — Danish telemetry data should be made available at the trial as well as Canadian data from CFAV Quest.

5.9.3. It is assumed that the data from the environmental measurement stations will be made available to all members of SET154.

§ 5.10 ANALYSIS PLAN

5.10.1. The following analysis plan has been agreed.

a. It was agreed that for circular runs RCS would be plotted as polar plots on a 0-60 dBm2 scale. The statistics for the data would be calculated – mean and median for total circle and sector average, excluding +/- 5 degree at broadside and +/-2.5 degrees at bow and stern. Scattering centres should also be identified if possible.

b. For straight runs of the ship the data would be plotted as RCS against range, again on a scale of 0-60 dBm2.

c. For serials with the corner reflectors on board a ship or RIB, RCS of the individual corner reflectors against range would be plotted.

d. For measurements of the fixed corner at Boockniseck, RCS against time (5 minutes) should be plotted and the average value calculated.

e. For the straight runs for the SMS demonstrator, total RCS against time should be plotted and the scattering centres identified , if possible.

f. The sphere measurements will be plotted against time and the statistics, mean, median and upper decile calculated.

g. Measured propagation factors at the six frequencies from RF transmissometer, compared with computed propagation factors as a function of time

5.10.2. The first meeting to compare and present analysed data is being planned for the UK at the end of January 2012 (sixth meeting of SET 154).

CHAPTER 6 - SET-166 TRIALS (UNDERWATER NOISE)

§ 6.1 INTRODUCTION

6.1.1 This chapter provides concise information on scientific objectives of the acoustic trials to be conducted with CFAV QUEST and RV PLANET. The information in this chapter focuses on the scientific objectives to which the experiments contribute. Detailed information on each partial trial is provided in the annexes.

6.1.2 The scientific objectives are set by a group of acoustic specialists, organized in the NATO Research and Technology Board (RTB) Research Task Group SET-166 'Signature Management System for Underwater Signatures of Surface Ships'. Participating nations are Canada, France, Germany, Netherlands, Norway, Poland, Turkey, UK, USA and Australia.

6.1.3 The objective of SET-166 is to develop requirements, information and tools for the (national or joint international) development of integrated ship signature management systems (ISSMS). More detailed objectives are to:

a. evaluate methods to obtain information on the actual state of the ship as observed by the threat and to identify what could and needs to be done to optimize the real-time signature while maintaining coherence with the management of other signatures;
b. to develop and demonstrate the capability to monitor the actual underwater signatures in real-time with sufficient accuracy for subsequent susceptibility analysis;
c. provide operators with an indication of the likely current susceptibility and capabilities of the ship and hence influence tactical decisions; this may include an indication of the underwater acoustic and electromagnetic signatures of the ship at that time and place (e.g. whether it is 'good' or 'bad');
d. propose an outline design for a ship signature management system, ready for national implementation.

6.1.4 The main objective of the acoustic trials is to obtain a common data set to be used for development of acoustic signature monitoring, prediction and management systems in national (and joint international) projects.

6.1.5 A secondary objective is to obtain a common data set to be used for an evaluation of the differences in reported ship acoustic signatures at different ranges, due to range propagation and environmental effects, in particular to support an update of the AMP-15 procedure for measuring surface ship acoustic signatures in relation to mine threat.

6.1.2. The following sections elaborate on the two main objectives. Detailed information on each partial trial is provided in the annexes.

§ 6.2 ACOUSTIC SIGNATURE MONITORING, PREDICTION AND MANAGEMENT

6.2.1. The underwater acoustic, electromagnetic and pressure underwater signatures expose surface ships to the threat of detection, classification and localization by means of sensors of hostile vessels and weapon systems. The threat of influence mines in the littoral is of special concern, because appropriate counter measures are often lacking. The underwater signatures of a ship are not fixed values.

6.2.2. The signature level seen by a threat will depend on a number of parameters, including threat sensor characteristics, the environment and the state of the ship. If a ship's signature and the threat are known to the ship's command then informed operational decisions can be made with knowledge of the likely resultant susceptibility of the ship.

6.2.3. Currently signature management is used in the development of a new ship, but there is no real-time awareness of the signature and hence of the ship's susceptibility. An integrated ship signature management system (ISSMS) on board a vessel that covers 'all' signatures will provide the ship's commander with adequate information on current susceptibility and capabilities of the ship. It will provide advice on how to optimize the ship's configuration and operational settings for a tactical decision that enhances the ship's mission accomplishment/effectiveness.

6.2.4. An ISSMS will cover 'all' signatures but the proposed study focuses on the underwater acoustic and electromagnetic signatures. The underwater signature management part of the system will provide a real time assessment of the ship's underwater signatures on the basis of information from the platform management system and measurement data from on board acoustic and electromagnetic sensors, in combination with signature models. Ultimately, the system will take into account environmental effects as well as the likely threat to give an indication of the ship's susceptibility and how this might be improved.

6.2.5. Two different acoustic (radiated noise) signatures are distinguished, related to:

a. **Far field detection by passive sonar systems.** The corresponding signature is defined in the far field of the ship. This signature is usually measured at deep water noise ranges in 'beam aspect' (i.e. in horizontal directions perpendicular to the direction in which the ship is sailing), according to the procedure described in NATO standard STANAG 1136.

b. **Near field detection by passive acoustic sensors in sea mines and torpedoes.** The corresponding signature is defined as the maximum radiated noise in the near-field of the ship. This signature is usually measured at shallow water noise ranges in 'keel aspect' (i.e. under the keel of the ship), according to the procedure described in NATO standard STANAG 1418 (AMP-15).

6.2.6. These two signatures are essentially different. They are defined at a different distance from the ship and in a different orientation relative to the ship. Note that neither of the two measurement standards provides a proper (monopole) Source Level of the ship, as defined in the framework of Urick's sonar equation. That means that the resulting signatures cannot be directly applied as an input for sound propagation and threat models.

6.2.7. Signature Monitoring, Prediction and Management involves three subsequent steps:

a. **acoustic signature monitoring:** aimed at providing (near) real-time data of the ship's signature condition, based on information of the platform systems and onboard acoustic sensors;

b. **acoustic signature prediction:** using the information from the acoustic signature monitoring in combination with ship acoustic prediction models and underwater acoustic propagation models to determine (near) real-time underwater acoustic signatures of the ship in the actual environment;

c. **acoustic signature management:** using the information from the acoustic signature monitoring and prediction in combination with ship acoustic prediction models to provide the ship operators with tactical advices to manage the ship acoustic signatures in relation to the actual threat.

6.2.8. Research questions to be addressed in the trials, associated with acoustic signature monitoring, prediction and management, are:

a. can we monitor changes in the underwater acoustic signatures using on board sensors (and pinpoint the cause of these changes)?

b. can we calculate the underwater radiated acoustic signatures at the 'threat' sensor location (in real time?), using on board sensor signals and acoustic models?

c. can we predict/evaluate the effect of changes in the vessel's settings (operational actions) on the underwater radiated noise signatures?

§ 6.3 RANGE PROPAGATION AND ENVIRONMENTAL EFFECTS

6.3.1. The “STANAG 1418 MW (Ed.2) STANDARD FOR MINE WARFARE ACOUSTIC MEASUREMENT – AMP-15” provides standard procedures for the measurement and reporting of underwater acoustic signature information and for the establishment of acoustic signature goals to counter the naval mine threat to mine countermeasure vehicles, warships, merchant ships, mine countermeasure helicopters, divers, remotely operated vehicles and untethered unmanned vehicles.

6.3.2. These underwater acoustic signatures are usually measured at special noise ranges, but the AMP-15 procedures do not account for range propagation and environmental effects. NATO acoustic experts agree that there are difficulties in comparing ship signatures measured at different deep and shallow water ranges, because the local bottom can strongly influence the acoustic propagation and because shallow water measurements with respect to mine threat are often carried out in the near field of the ship. However, there is no generally accepted procedure available to account for environmental and near field effects in the measurement data. The NATO Mine Warfare Working Group was informed of this problem.

6.3.3. The 2011 trials, during which the same ships (QUEST and PLANET) visit several ranges in a short period of time, provide the opportunity to obtain a coherent set of acoustic data for the evaluation of range propagation and environmental effects.

6.3.4. Research questions to be addressed in the trials, associated with acoustic signature monitoring, prediction and management, are:

a. what are the differences between the acoustic (beam and keel aspect) signatures of the same vessel measured at different acoustic ranging sites?
b. what are the dominant causes for these differences (calibration, processing, bottom interference, near field characteristics, etc)?
c. can we correct for these differences (especially for the underwater signature in relation to mine threat) in updated measurement and analysis procedures (AMP-15)?
d. which propagation models are appropriate for calculate the underwater radiated acoustic signature of a ship at the threat sensor location and how accurate do these models predict measured signatures at an acoustic ranging site?

§ 6.4 METHODOLOGY

6.4.1. The overall approach towards answering the research questions associated with both objectives is to carry out acoustic trials with two research vessels, CFAV QUEST (CAN) and RV PLANET (DEU), at various acoustic ranges. Both vessels (see annex B and C) are provided with an on-board acoustic monitoring system, which consists of on-board acoustic sensors and a central recording system.

6.4.2. For the overall planning of the acoustic trials, the following methodology is followed:

a. measure the vessel's acoustic signatures (in keel and beam aspect) at defined machinery control states;

b. use controlled noise sources (underwater sound projectors, on board air-borne loudspeakers, shakers, impulse hammers, etc) to create well-defined and reproducible acoustic signatures;

c. simultaneously measure on board and off board acoustic signals at various sites;

d. apply realistic and substantial changes in the signatures, for demonstrating monitoring capabilities;

e. repeat dynamic runs for a fixed set of reference machinery control states at all ranges so that the signatures can be compared;

f. perform a series of static tests to determine on-board to off-board transfer functions and contributions of individual machines to the acoustic signature.

6.4.3. Runs are carried out at all reference control states in the tables given in annex S, at each of the acoustic trial locations. All runs are to be repeated 2 to 4 times, to obtain the necessary statistical certainty. Hence, the measurements at the 7 different reference control states will require at least 14 runs (with a minimum of 2 repeats per state), up to 28 runs (with 4 repeats per state).

6.4.4. During the trials, a decision about the number of repeats shall be made on the basis of an on-line interpretation of the measurement results: a third or fourth run are carried out if the resulting signatures, according to STANAG 1136 for deep water or STANAG 1418 (AMP-15) for shallow water, of 2 previous runs differ more than 3 dB per 1/3-octave band. The range personnel decides about this.

6.4.5. Several additional control states for dynamic and static runs are defined in the partial trial plans for the specific range locations.

6.4.6. The system for assigning run numbers is introduced and explained in annex V.

§ 6.5 ON-BOARD ACOUSTIC EQUIPMENT

6.5.1. QUEST and PLANET are both equipped with on board acoustic sensors and a recording system. Additional noise sources (loudspeakers and shakers) will be installed on board for these trials.

6.5.2. **CFAV QUEST**

a. On-board acoustic sensors: 40 hull and machinery mounted accelerometers (positions outlined in Annex X).

b. On-board 96-channel data acquisition system (for acoustic and non-acoustic data, maximum sample frequency 25 kHz).

c. The sensor suite is proposed in Annex X. The majority of accelerometers will be installed on the starboard side. The sensor fit includes 4 accelerometers forward, 4 on the frames and machinery in the refrigeration compartment, 13 in the engine room, 5 in the motor room, 4 on the frames and compressors in that compartment, 8 in tiller plates above the propeller, and 2 next to the new pump installation (IR trials). No microphones are currently planned and it will not be possible to install either through-hull hydrophones or pressure transducers for this trial. Propeller cavitation will be monitored using the DRDC Cavitation Monitoring System (based on the accelerometers above the propeller).

d. On-board shakers and loudspeakers will be provided by QinetiQ, see Annex X: These include piezoelectric and hydraulic shakers which will likely be installed in the bow thruster compartment, the engine room wing, and the motor room (hydraulic). DRDC will make an additional piezoelectric shaker available to the QinetiQ trials team. The equipment will be installed at Campbeltown prior to the Loch Goil trials and be removed after the trials in Brest, before QUEST sails back to Canada.

e. The output of shakers and loudspeakers is monitored on the acoustic recording system (either the driving signal, or a dedicated force / acceleration / microphone sensor output).

f. The QUEST DAQ will also measure non-acoustic data as per Annex X.

6.5.3. RV PLANET

a. Onboard 96-channel[6] data acquisition system (maximum sample frequency 50 kHz); 32 channels for online signature monitoring available via the on board network (positions outlined in Annex R).

b. Especially relevant for recording in the current trials are the 15 orthogonal pairs of accelerometers along the hull of the port side floater, the 4×3 accelerometers on the 4 AC propulsion motors, the 2×3 accelerometers on the 2 shaft bearings, a selection of the 4×9 accelerometers above and below the mounts of the 4 diesel generators and accelerometers on selected machinery items, like pumps and the hydraulic unit for the fins ('Flossen').

c. WTD71 and TNO will provide on board shakers and loudspeakers.

d. DMO will provide a towed acoustic source raft, containing three underwater acoustic projectors, plus a reference hydrophone and a depth gauge:

   1°. LF-source (12.5 Hz - 2 kHz): AJ-11:
   2°. MF-source (1 kHz - 20 kHz): ITC-1001;
   3°. HF-source (16 kHz - 80 kHz): ITC-1042.

e. The raft is suspended by a rope below a float (maximum depth 16 m), which is provided with radar and laser reflectors, that can be towed behind a ship with a towing cable (length 85 m).

f. The TNO/DMO equipment will be installed on board of PLANET in Eckernförde, prior to RIMPASSE, and removed from board when PLANET has returned to Eckernförde after the trials in Brest. The equipment will be dropped off at the Naval Establishment in Den Helder when PLANET sails back from Brest.

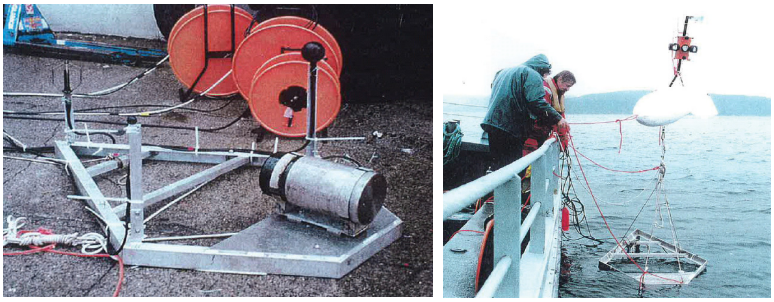


Figure 9 - Towed source raft (NLD / DMO).

[6] This includes 24 channels recorded on a SONY digital data recorder.

§ 6.6 ACOUSTICAL DATA REQUIREMENTS

6.6.1. All on-board and off-board acoustic measurement systems, including systems that record auxiliary data of e.g. the platform management system, shall be synchronized to a ± 0.5 s accuracy, using GPS-time as a reference.

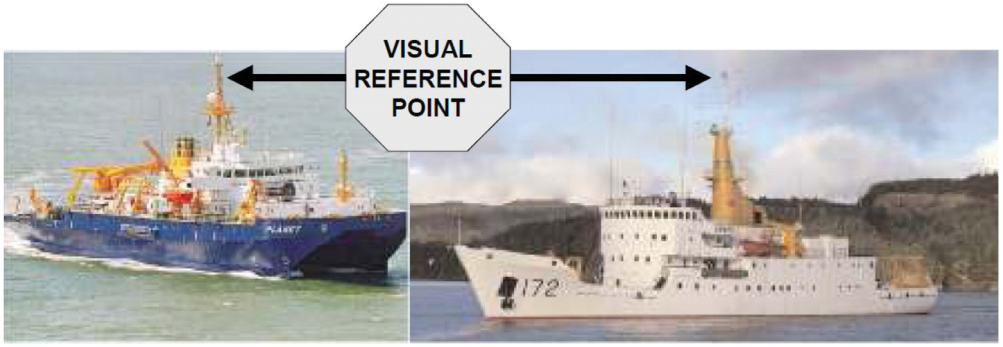
6.6.2. GPS tracking is recorded on the vessel. Underwater noise measurement teams are responsible for providing the tracking data of the vessel relative to the hydrophones. Local experience with the accuracy of GPS tracking (e.g. due to time delays) and local tracking procedures shall be applied to minimize tracking errors. Each range shall provide a clear description of the applied tracking procedure in addition to the delivered data. Each partial trial plan (Annexes E to N) specifies the GPS positions and depth relative to the mean water depth of all sensors and the nominal track lines.

6.6.3. QUEST and PLANET are requested:

a. to be on the track line in a steady state condition approximately 1000 meters before they reach the closest point of approach (CPA) to the hydrophone(s). The CPA is defined as the point where the horizontal distance from the geometric reference position on the ship under test is the closest to the hydrophone(s); The reference positions refer to frame number 57 for QUEST and to frame number 35 for PLANET.

b. not to change sailing speed, heading, machinery configuration and other platform conditions during the passage over the measurement site, unless the run description requires this.

Figure 10 - Reference position on PLANET (left) and QUEST (right).



6.6.4. Acoustic recordings will be started when the platform is at a distance of approximately 400 meters before CPA. The measurements will be stopped when the platform has passed CPA at a distance of 400 meters[7].

6.6.5. To avoid misinterpretations due to different averaging procedures used at different ranges, the data of **dynamic rangings** shall be provided as averaged in subsequent 1 s intervals[8] during the passage of the vessel over the hydrophones.

a. The resulting underwater acoustic data will be provided in the form of tables of the spectrogram, i.e. the SPL versus frequency (row) and time (column).

b. Additional columns in this table shall provide the actual GPS tracking information of the vessel at each time interval, in local X-Y coordinates (in metres relative to the CPA at the hydrophone(s)). A clear description of the applied geometry shall be provided in addition to the delivered data.

6.6.6. All underwater acoustic measurement data (from range hydrophones; mobile ranges PRIME, DSIMS and IGLOO; deep water recording systems I-Land buoys and VLA; etc.) shall be provided as calibrated Sound Pressure Level (SPL) spectra as recorded at the hydrophones, corrected for all gain settings and hydrophone and system calibration curves.

a. Data shall be provided in One-Third-Octave (OTO) bands (preferably in the 3.15 Hz to 80 kHz bands) and in narrow (NB) bands (3 to 1600 Hz, measured in a 1 Hz bandwidth).

b. OTO SPL spectra shall be provided in dB re 1 μPa, WITHOUT correction for bandwidth.

c. NB SPL spectra shall be provided as pressure spectral density, in dB re 1 $\mu Pa^2/Hz$

d. NB SPL spectra shall be obtained via FFT processing. Suggested processing parameters: block length 2 s, Hann window, 50% overlap (i.e. SPL at each 1 s interval, in a 1 Hz bandwidth). Deviating settings are allowed, but each range shall provide a clear description of the applied processing in addition to the delivered data.

e. OTO SPL spectra shall be obtained via either (digital) filtering or via FFT processing and summation in OTO bands. A clear description of the applied processing shall be provided in addition to the delivered data.

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[7] At the maximum speed of 15 knots, 800 m distance along track corresponds with a recording time of 104 s, at 6 knots with 259 s.

[8] If the standard processing available to the range provides a different interval, the resulting OTO and NB level spectra shall be linearly interpolated to the nearest 1 s intervals. The provided data shall be clearly marked when this interpolation is used.

6.6.7. Underwater acoustic measurement results shall also be provided as (uncalibrated) time series recordings (wav-format) of one keel hydrophone and one beam (80-120 m distance) hydrophone, where available, for each dynamic run, to provide the analysts with the possibility to check the data.

6.6.8. **Data of static rangings** shall be provided as averaged in subsequent 1 s intervals during in the same (OTO and NB spectrogram) format as the measurement data of the dynamic trials. Recording time is at least 60 seconds.

6.6.9. **Background noise** shall be regularly recorded before, between and after the trials, with the test vessels at a minimum distance of 1 km from the hydrophones. Background noise spectra tables shall be provided in the same (OTO and NB spectrogram) format as the measurement data of the dynamic trials. Recording time depends on the type of sound to be measured. Recording time for stationary sounds is at least 30 seconds.

6.6.10. **Environmental data** shall be regularly monitored:

a. During the trials, the ranges and platforms shall regularly (every 30 min) record water depth (tide), sea state, wave height, wind speed, wind direction, air temperature and air pressure.
b. The vessels shall record sound speed profile measurements (STD or CTD) at all trial locations, at least twice a day.

6.6.11. The on-board acoustic acquisition system record signals of the on board acoustic sensors during all runs, in a time window of least 60 s around the moment when the ship is at the closest point of approach (CPA) to the range hydrophones, synchronised with the underwater acoustic recording (see §6.6.1). On board acoustic recordings shall be available upon request from the measurement teams (i.e. DRDC Atlantic for QUEST and WTD71/FWG for PLANET).

a. Accelerometer data shall be provided as acceleration level in dB re 1 μm/s^2, with an indication of the direction in which they are measured (Preferred axes relative to the vessel axis: +*x* to starboard, +*y* to the bow and +*z* vertical up).
b. Force sensor data shall be provided as force level in dB re 1 μN, with an indication of the direction in which they are measured.
c. Hydrophone data shall be provided as SPL in dB re 1 μPa.
d. Microphone data shall be provided as SPL in dB re 20 μPa.

6.6.12. See § 2.6 for the principles on data handling and distribution and Annex U on data classification.

§ 6.7 LOCH GOIL/LOCH FINE ACOUSTIC TRIALS

6.7.1. Range information.

Table 8 - Loch Goil global characteristics.

Depth :	83 m
Hydrophone depth:	35 – 83 m
Bottom content:	mud rock
Frequency range:	10 Hz – 80 kHz
Frequency range narrow band:	1 Hz -16 kHz
Data acquisition system:	B&K PULSE

6.7.2. Both CFAV QUEST and RV PLANET will be at Loch Goil / Loch Fine for 2 days of acoustic trials. One day is reserved for dynamic runs at all reference control states, the second day will be used for static trials.

6.7.3. See annex F for details on the Loch Goil partial trial.

6.7.4. For the dynamic trials, QinetiQ will carry out standard acoustic range measurements in beam and keel aspect. The resulting underwater acoustic data will be provided in the form of tables of 1/3-octave band (OTO) and narrowband (NB) spectra versus time for each run.

6.7.5. For the static trials, the vessels will be moored at the static range location. The aim of the static measurements is to determine contributions of individual noise sources to the underwater acoustic signature (in beam and keel aspect) and the corresponding relationship between on-board and off-board sensor data.

6.7.6. The CFAV QUEST static trials will aim at signature contributions of the following sources:

a. propulsion Diesel-Generators;
b. ship Service Generators;
c. DC propulsion motors (can these be decoupled from the propellers?);
d. a variable pump, to study the possibility to monitor signature changes due to changes in pump settings (cavitation);
e. the IR hull cooling system (underwater noise due to water wash down);
f. the on-board shakers and loudspeakers used in state QRC4.

6.7.7. The RV PLANET static trials will aim at signature contributions of the following sources:

a. diesel-generators;

b. AC propulsion motors;

c. a variable pump, to study the possibility to monitor signature changes due to changes in pump settings (cavitation);

d. the on-board shakers and loudspeakers used in state PRC4;

e. the hydraulic 'Flossen' for the stabilizers

6.7.8. For the studies of range propagation and environmental effects, the ranges shall provide actual information on bathymetry, bottom content (sediment layers), sound speed profile and weather condition (wind generated surface wave height) and ambient noise during the trials.

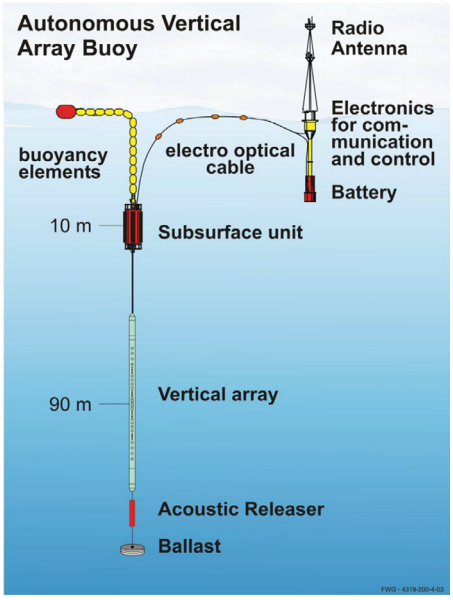
§ 6.8 DEEP WATER (NORWEGIAN SEA) ACOUSTIC TRIALS

6.8.1. CFAV QUEST and RV PLANET will carry out three days of joint trials at a deep water location in the Norwegian Sea. The planned rendezvous for the two ships is 58.50.00N 08.20.00W where the water depth is on the order of 1km. Over the planned three days, the ships may move to 59.13.00N 7.52.00W depending on weather conditions. The main motivations for carrying out these deep water trials are the negligible influence of reflections at the sea bed on the acoustic measurements and the possibility to carry out larger manoeuvres than possible at the confined acoustic ranges. Additionally, WTD71/FWG has expressed an interest in measurements of the effect of surface waves and swell on the underwater acoustic signature of RV PLANET. These deep water measurements are limited to the beam (and bow/stern) aspect signature in relation to far-field detection.

6.8.2. Measurement systems for the underwater acoustic measurements will be deployed and operated from QUEST and PLANET. PLANET will operate the WDT71/FWG vertical acoustic antenna buoy, QUEST will operate the DRDC Broadband Underwater Recording Buoy System (I-LANDs). Additionally, DRDC could deploy AN/SSQ 53F calibrated sonobuoys. In contrast with multi-hydrophone acoustic ranges, these systems measure the ship from one aspect at a time. That means that additional runs are required to measure both the port and starboard acoustic signature at a certain control state. The QUEST sensor fit will concentrate on the starboard side while for PLANET, the main emphasis will be on the port side far field signature. The sides selected were mainly chosen because each ship has their most extensive set of hull accelerometers installed on that particular side.

Table 9 - WTD 71 / FWG acoustic antenna buoy.

Depth:	variable: (array centre at 90 m)
Number of hydrophones:	128
Sample rate:	15625 Hz
Non acoustic sensors:	GPS, depth, acceleration
Data storage capacity:	25 hours of raw data storage from all sensors
Battery capacity:	8 hours of autonomous operation
Synchronization	GPS
Remote control	WLAN, VHF, ORBCOMM

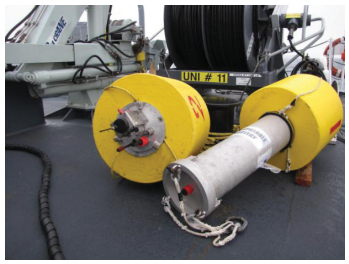


6.8.3. PLANET must operate at relatively close distance from the antenna buoy. Hence, PLANET must be static/silent when the antenna is used for acoustic antenna measurements of QUEST.

Table 10 - DRDC I-LAND Recording Buoy System (Lagrangian Ambient Noise Drifter)

Hydrophone Depth:	25 m
Hydrophone:	One ITC-6050c hydrophone
Sample rate:	40 kHz
Data storage capacity:	80 GB (128 hours of raw data storage)
Battery capacity:	37 hours of autonomous operation
Synchronization	Differential GPS
Remote Control	Line of sight FreeWave 900 MHz radio approximately 10 nm range

I-LAND Buoy



6.8.4. QUEST must operate at relatively close distance (max. 2-3 km) from the I-LAND's, to be able to recover them in timely manner.

6.8.5. For the studies of sound propagation and environmental effects, it is requested that the ships provides actual information on sound speed profile and weather condition (wind and swell generated surface wave height) and ambient noise during the trials.

6.8.6. DRDC will deploy a free-floating wave buoy (Tri-Axis Waverider). This GPS-equipped buoy can be used to measure wave height and direction (including spectral content) and the data is stored on board the buoy and transmitted to the ship when the ship is within range. DRDC also has been developing a wave fusion algorithm to improve the WaMoS radar wave height predictions. This algorithm combines the measured ship motions with the WaMoS data and numerical motions predictions to better calibrate the radar wave heights.

6.8.7. For the wave data fusion work, DRDC uses a Ship Motion Package near the ship CG which provides motion time series (pitch and roll angles, pitch, roll and yaw rates, and longitudinal, vertical and lateral accelerations) which are stored a LabView acquisition laptop. DRDC would also be using/storing the directional wave spectrum files created by wave radar and stored on the WaMoS computer.

6.8.8. See annex G for details on the deep water trial.

§ 6.9 HEGGERNES ACOUSTIC TRIAL

6.9.1. The Heggernes deep water noise range is situated in the Herdla Fjord nearby the city Bergen in Norway. The range is owned and exploited by the Norwegian, German and Netherlands Defence Material Organizations.

6.9.2. See annex H for details on the partial trial at Heggernes.

6.9.3. QUEST and PLANET will each visit the Heggernes range for 3 days of acoustic trials. It is proposed to spend all days on dynamic runs (no static acoustic trials).

6.9.4. For the dynamic runs of QUEST and PLANET shall carry out runs at all reference control states as defined in Annex S. Two series of measurements are planned: port and starboard beam aspect signature measurements in relation to far field detection, with the ship sailing over the track line and keel aspect signature measurements in relation to mine threat, with the ship sailing at a track over the North hydrophone chain, with the upper hydrophone at a depth of 20 m (corresponding to the hydrophone depth at Aschau) and (if possible) the lower hydrophone at a depth of 83 m (corresponding to Loch Goil).

§ 6.10 HERDLA ACOUSTIC TRIAL

6.10.1. The Herdla Range is the most comprehensive underwater test facility operational in Norway. Established chiefly for tactical training with MCM- assets and mine/ship engagement evaluation, but also for maintenance/control and studies of passive physical signatures of vessels, weapon systems and divers.

6.10.2. Wide open sea area providing ample operational space, located 20 NM from the Main Naval Base Haakonsvern in the vicinity of Bergen. Sensor and instrumentation functions featuring acoustic, seismic, hydrodynamic, magnetic and electric (UEP) measurement complemented by object tracking data. Sensor water depths ranging from 20m to 90m.

6.10.3. Each sensor package contains two acoustic channels:

a. acoustic LF: 1116 Hz sample frequency; 1 Hz – 500 Hz output;

b. acoustic HF: 250 kHz sample frequency; narrowband 500 Hz – 32 kHz (15 Hz bins) and 32 kHz – 100 kHz 1/10-octave bands.

6.10.4. See annex I for details on the Herdla partial trial.

6.10.5. QUEST and PLANET will each visit the Herdla range for 2 days of multi-influence trials.

6.10.6. The acoustic trial program for the Herdla range must be coordinated with the EM (and pressure) signature specialists. For the acoustic trials with QUEST and PLANET at the multi-influence ranges, the main priority is to carry out runs at all reference control states as defined in Annex S, while the ship is sailing over at least one sensor group (keel aspect signature measurements in relation to mine threat). It is up to the Herdla range staff to decide which sensor groups (and corresponding environmental properties) have the highest priority.

6.10.7. FFI (Norway) has proposed to carry out runs at various track offsets (in steps of 14 m) relative to the ‘MSP’ reference sensor package (at a water depth of 21 m).

§ 6.11 ASCHAU MULTI-INFLUENCE TRIAL

6.11.1. The Aschau range, located in Eckernförde Bay, is located in the Eckernförde bay near the city of Eckernförde in Germany. Aschau is a multi-influence range consisting of acoustic, magnetic, and electric field sensors. Pressure sensors, exercise mines and mobile systems may be deployed at the range. The range depth is approximately 21 meters.

6.11.2. See annex L for details on the partial trial at Aschau.

6.11.3. QUEST and PLANET will each visit the Aschau range for 3 days: 2 days on dynamic multi-influence trials and one day on static acoustic trials.

6.11.4. The acoustic trial program for the dynamic runs at the Aschau range must be coordinated with the EM (and pressure) signature specialists. For the acoustic trials with QUEST and PLANET, the main priority is to carry out runs at all reference control states as defined in Annex S, while the ship is sailing over the acoustic sensors of the range (keel aspect signature measurements in relation to mine threat).

6.11.5. For the static trials, the vessels will be moored at the static range location. The aim of the static measurements is to determine contributions of individual noise sources to the underwater acoustic signature (mainly in keel aspect) and the corresponding relationship between on-board and off-board sensor data.

6.11.6. In addition to the range sensors, it is currently planned to install the Dutch PRIME system, the Canadian DSIMS-MAG (Annex W) and the Polish IGLOO system (see annex T) at the Aschau range (at the track line of the range). This enables to compare signature measurements with the fixed and transportable range systems at the same location, to gain confidence in the system performance.

§ 6.12 BREST MULTI-INFLUENCE TRIAL

6.12.1. Located on the west coast of France just south of the city of Brest, the French Navy operates three ranges all connected via an underwater fiber optic cable as shown. For the QUEST 2011 trial, ranging trials will be conducted at the medium and 'deep' water ranges. The 'deep water' range (24-28 m) includes acoustic and electromagnetic measurements.

6.12.2. See annex N for details on the partial trial at Brest.

6.12.3. QUEST and PLANET will visit the Brest range for 2 days of multi-influence trials.

6.12.4. The acoustic trial program for the Brest 'deep water' range must be coordinated with the EM (and pressure) signature specialists. For the acoustic trials with QUEST and PLANET, the main priority is to carry out runs at all reference control states as defined in Annex S, while the ships are sailing over the acoustic sensors of the range (keel aspect signature measurements in relation to mine threat).

6.12.5. Due to the large tidal variation in the Brest area (~4m), it is recommended that the ranging trials be conducted at both low and high tide. This effectively provides signature data at two depths that can be used to verify depth correction procedures or used as additional input into physical models.

6.12.6. At the end of the trial period with QUEST in Brest, time is reserved for QinetiQ to deinstall the on board acoustic equipment (shakers/loudspeakers) and to remove it from board.

CHAPTER 7 - SET-166 TRIALS (ELECTROMAGNETIC)

§ 7.1 INTRODUCTION

7.1.1. This chapter will focus on the electromagnetic experiments to be conducted with CFAV QUEST. Where convenient, however, the recording of the Planet's EM signature should be undertaken as a target of interest, to confirm sensor operation and to expand the sharable signature database. The electromagnetic portion of the QUEST 2011 trial will answer critical research questions in understanding a ship's electromagnetic signature.

7.1.2. In particular, QUEST's magnetic signature will be measured onboard and off board at locations on both sides of the Atlantic Ocean with both fixed and portable ranges. In using QUEST's simple degaussing system, the goal will not be to produce the smallest signature but instead to accurately measure the ship's status and signatures, leading to an improved understanding of how the ship's magnetic signature varies with the transit, heading and coil settings.

7.1.3. The outcome of the electromagnetic signature management trials will support the goal of the SET-166 group to design a magnetic signature management system. Ultimately, these data should (will) help to improve the safety of our naval platforms when operating in mined waters.

§ 7.2 EM TRIAL OVERVIEW

7.2.1. The figure below shows the transit of QUEST for the 2011 trial. Over this distance QUEST will be exposed to significant magnetic variation. During the course of the experiment both QUEST's electric and magnetic signature will be measured at fixed ranges located in Halifax, Herdla, Aschau, and Brest. The portable ranges PRIME and DSIMS will be deployed during the rangings at Halifax, Aschau and Brest. In addition to the underwater measurements, flyovers of Military Patrol Aircraft will be conducted to measure QUEST's Magnetic Anomaly Detection (MAD) and Airborne Extremely Low Frequency (AELF) signatures.

7.2.2. Perhaps the most exciting part of the trial will be the experiments conducted at the Magnetic Earth Field Simulator at Schirnau. The Magnetic Earth Field Simulator provides the means to expose the ship to any magnetic field it might encounter worldwide. It also allows for zero fields to be produced. As a result, it will be possible to separate the induced and permanent magnetic signatures in all three components. Experiments conducted at the facility will also include coil effects, roll induced eddy currents and corrosion related magnetic signature measurements.

7.2.3. Just prior to the Magnetic Earth Field Simulator experiments, QUEST will also undergo a magnetic deperming treatment at Friedrichsort. Presently the ship has a significant permanent vertical dipole moment. This deperming will reduce the ship's magnetic signature and allow QUEST's degaussing system to operate to its designed specification. In the figure showing the QUEST route, this modification to the magnetic signature is indicated by changing the transit route from red to cyan at Friedrichsort.

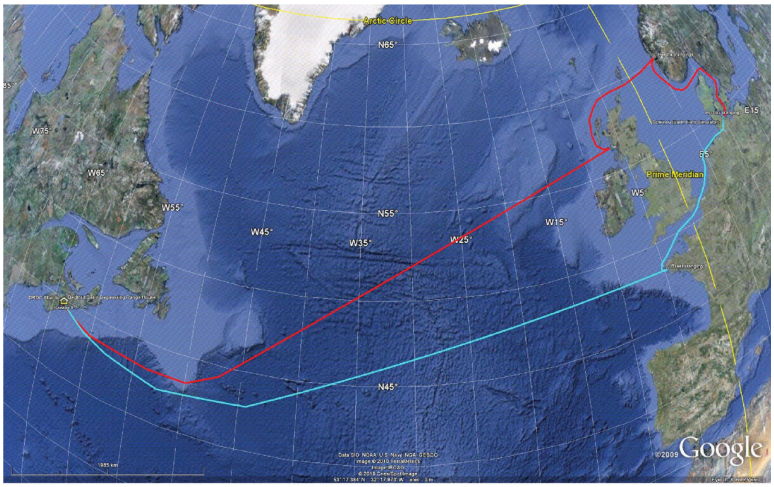


Figure 11 - QUEST route.

7.2.4. To meet the EM requirements of the trial it will be necessary to install magnetometers onboard QUEST and to time synchronize the onboard measurements with off board signature measurements. Furthermore, in order to adjust the onboard degaussing coils current quickly and accurately new computer controlled degaussing power supplies with GPS and heading inputs must be installed. Also, to support DRDC's advanced active shaft grounding project two AASG prototypes must be constructed and installed on QUEST.

7.2.5. In order to compare signature measurements made at multiple locations and ranges it will be essential to correct for variations in sensor depth, orientation, and other parameters. This will require some type of depth correction to be applied to the data, or

preferably the use of models to parametize the signature and then predict the signature at other depths or to a standard depth for comparison.

7.2.6. Essential to modelling the experiments is the requirement to accurately track the vessel. To accomplish this, QUEST will be outfitted with high resolution GPS tracking systems at its bow and stern. These data will be radioed to the range facility in real-time (or near real-time) so that the collected signature can be referenced to the ship and signature models produced immediately. This will encourage range comparisons to occur during the trials instead of after the fact. In some cases, local range staff will install additional GPS units on QUEST that will be integrated with the range collection system.

7.2.7. To confirm the consistency of measurements from one range to the next, calibrated sources will be used to produce known signature levels. Since the source will be accurately tracked, the signature can be used to refine the sensor positions. Calibrated sources should also permit the impact of the local geography to be assessed.

7.2.8. The table below lists all the partial trials that make up the QUEST 2011 signature management trial, and then identifies the EM activity occurring during each of the partial trials. Collectively, the EM trials represent a significant portion of the overall trial. Notably the experiments planned for the Earth Field Simulator are scheduled over 6 days.

Table 11 – EM activities for each partial trial.

Partial Trial	Location	EM Activity
00	HALIFAX	RANGING
01	LOCH GOIL	
02	DEEP WATER TRIAL	
03	HEGGERNES	
04	HERDLA	RANGING
05	FRIEDRICHSORT	DEPERMING
06	SURENDORF	
07	ASCHAU	RANGING
08	SCHIRNAU	SIMULATOR
09	BREST	RANGING
10	MPA TRIAL	MAD

§ 7.3 DEPERMING TRIAL

7.3.1. As discussed QUEST's permanent magnetic signature has increased to a level where the degaussing system is unable to properly compensate the magnetic signature. This is a common condition for steel hull ships and necessitates that the ship undergo a deperming to reduce the permanent magnetic signature.

7.3.2. The deperming of QUEST will be conducted at the Magnetic Treatment Facility at Friedrichsort. Annex I shows an overview schematic of the facility. In addition to the flash deperming capability, the facility includes a z-coil to invert the vertical component of the background magnetic field to permit separation of the vertical permanent and induced signature components, and magnetic ranges at 9m, 13m and 18m depths.

7.3.3. On arrival at Friedrichsort, QUEST's magnetic signature will be measured at all available sensor depths and headings, and the permanent and induced separation procedure performed for all three axes. Local experts will provide detailed instructions of the ranging and deperming process. Once the magnetic treatment has been completed, the on-arrival measurements should be repeated to establish the new signature parameters.

7.3.4. After the trials at Friedrichsort are completed, QUEST will conduct above-water trials at Surendorf, giving the vessel's magnetic domains time to settle to their new magnetic state prior to the ranging at Aschau and the experiments at Schirnau.

§ 7.4 EARTH FIELD SIMULATOR TRIAL

7.4.1. The Earth Field Simulator at Borgstedt (Schirnau) consists of 14 longitudinal coils, 3 athwartship coils, and 3 vertical coils as shown below. The magnetic field sensors are located at depths of 9m and 13m. This coil configuration provides the ability to simulate the magnetic field at any place on the earth, and at any heading and ship movement. It also provides the ability to zero the background field and measure the vessel's permanent magnetic signature directly.

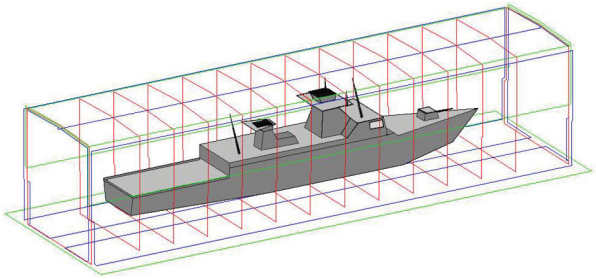


Figure 12 - Coil schematic of earth field simulator at Borgstedt (Schirnau).

7.4.2. The primary experiments at the simulator will focus on determining the optimum degaussing coil settings for QUEST at any location worldwide. To achieve this, the permanent signature will first be measured. This will be followed by the systematic variation of the individual field components to provide the induced signature. Then the individual coil effects will be measured at a number of current settings. Degaussing coil currents will then be predicted for selected worldwide locations using signature minimization techniques and compared to the measured signatures. The hypothesis that the individual components of the induced signature can be superimposed will be confirmed.

7.4.3. During all the measurements the onboard magnetometers signals will be recorded. Consideration should be given to having these data available in the control room of the range in real-time. It is envisioned that the onboard measurements will be used as input to an (experimental) CLDG system that predicts the current required for the DG coils.

7.4.4. The secondary experiments will investigate the corrosion related magnetic signature and the roll-induced eddy current signature. For the former, the ship's Impressed Current Cathodic Protection (ICCP) system (which is an open loop constant current supply) will be varied at a stepped interval. A systematic variation of the roll parameters will be conducted to simulate various sea states and rolling of QUEST.

§ 7.5 MEASUREMENTS AT FIXED RANGES

7.5.1. The four fixed ranges to be used during the trial include, in chronological order, Halifax, Herdla, Aschau and Brest. The earth's magnetic field varies appreciably for each of these ranges as shown in the table below. These background levels will impact the magnetic signatures recorded at each location. These predicted earth's magnetic field levels were calculated using the USGS Geomagnetic model available on the internet. DRDC has translated the distributed FORTRAN code into MATLAB®.

Table 12 - Earth's magnetic field at fixed range locations.

Location	Declination (˚)	Inclination (˚)	Horizontal (nT)	East (nT)	North (nT)	Vertical (nT)	Total (nT)
Halifax	-18.1	67.8	19,754.0	-6,119.8	18,782.1	48,351.5	52,231.1
Herdla	-0.5	73.0	14,948.8	-139.3	14,948.2	48,829.4	51,066.4
Kiel	1.9	69.1	17,803.1	577.0	17,793.7	46,516.2	49,806.7
Brest	-2.7	63.6	21,173.2	-1,002.8	21,149.5	42,634.5	47,602.6

7.5.2. To support the trial and for quick reference of the geographical sites involved DRDC has developed a Google Earth geographical database of the entire QUEST 2011 trial. Some examples of the output of this effort have already been presented in this chap-

ter. This Google Earth file will be distributed with this trial plan and will evolve to provide a geographically complete record of the trial. In the following descriptions of the ranges the goal would be to include a snapshot from the Google Earth database, but to date only the Halifax range has been presented. DRDC intends to work closely with local range experts to expand the Google Database during the trial preparations.

7.5.3. Detailed descriptions of the fixed ranges are provided in the annexes. The system for assigning run numbers is introduced and explained in annex V.

7.5.4. As is customary for magnetic ranging trials it is the intention that passes be conducted in pairs on reciprocal headings. For the QUEST 2011 trial, the 14 runs (representing 7 states) listed in the table below would meet the EM requirements of the trial. These selected states will permit the investigation of the degaussed and undegaussed magnetic signature, the static electric signature, the ELF magnetic and electric signatures, and the corrosion related magnetic signature to be performed.

Table 13 - Generic run plan.

Run	Heading	DG	ICCP	AASG
1	Θ	OFF	OFF	OFF
2	Θ - 180	OFF	OFF	OFF
3	Θ	OFF	current to get 0.85V	OFF
4	Θ - 180	OFF	current to get 0.85V	OFF
5	Θ	only M coil @ max	current to get 0.85V	ON
6	Θ - 180	only M coil @ max	current to get 0.85V	ON
7	Θ	only MF&FI coils @ max	current to get 0.85V	ON
8	Θ - 180	only MF&FI coils @ max	current to get 0.85V	ON
9	Θ	only MQ&QI coils @ max	current to get 0.85V	ON
10	Θ - 180	only MQ&QI coils @ max	current to get 0.85V	ON
11	Θ	Best Guess 1	2 x current to get 0.85V	ON
12	Θ - 180	Best Guess 1	2 x current to get 0.85V	ON
13	Θ	Best Guess 2	3 x current to get 0.85V	brushes lifted
14	Θ - 180	Best Guess 2	3 x current to get 0.85V	brushes lifted

§ 7.6 MPA TRIAL

7.6.1. Military Patrol Aircraft (MPA) are equipped with sensitive magnetic field sensors that can be used to detect both the DC magnetic field and ELF signatures of steel hull vessels at long distances. The CF CP-140 shown below is equipped with the ASQ-508 magnetic detection system.

Figure 13 - CF CP-140.

7.6.2. The aims of the MPA trial are to demonstrate the ASQ-508 existing MAD detection and localization, and the ELF detection capabilities against a known target, and to gather data for enhanced detection/localization/noise reduction algorithm development at DRDC.

7.6.3. For the MPA trial QUEST will tow an alternating electric source to increase the QUEST's ELF signature. The figure below shows the possible MPA trial locations on Canada's east coast.

Figure 14 - Possible MPA trial locations.

§ 7.7 REAL TIME SHIP TRACKING AND SIGNATURE COMPARISON

7.7.1. Referencing the collected underwater signature data to the ship is an important first step in the signature analysis process and requires that both the ship and sensor position be accurately known. To track the ship position and heading, high resolution GPS receivers will be installed at the bow and stern of QUEST. The underwater sensor positions will be determined from both the collected ship signatures and calibrated source data.

7.7.2. The GPS tracking system to be used for the QUEST 2011 trial is shown in the figure below. The system consists of NovAtel GPS receivers (top right corner) that are capable of achieving a tracking accuracy of 20 cm when the GPS data are differentially corrected. To make the tracking data available immediately after each run, the GPS data will be broadcast to shore using FreeWave radios (lower left corner). These radios provide Serial Port communications using spread spectrum technology in the (unlicensed) 900 MHz band and are capable of communicating at distances up to 60 miles. Once the ship's GPS data are collected on shore, it will be combined with the data from a shore station GPS to produce the differentially corrected ship tracks.

Figure 15 - DRDC GPS system

7.7.3. The GPS data required onboard for control of the degaussing system power supplies does not have to be highly accurate. As a result it is not necessary to provide the differentially corrected GPS data back to the ship. This represents a significant cost saving in the price of the system.

7.7.4. DRDC intends to upgrade its present inventory of NovAtel receivers and antennas to dual frequency (L1&L2) which will improve the GPS resolution to 2cm. This upgrade would effectively eliminate ship position as a source of error and ultimately improve the fidelity of the entire experiment.

§ 7.8 PORTABLE RANGES

7.8.1. For the QUEST 2011 trial the ship's EM signature will be measured at four fixed locations, Halifax, Herdla, Aschau and Brest. To complement the fixed ranges, portable ranges will also be deployed alongside the fixed ranges. Presently the portable ranges planned for use in QUEST 2011 trial include the Dutch PRIME system and the Canadian DSIMS-MAG. The intention is to deploy these systems concurrently during the rangings at Halifax, Aschau and Brest ranges.

7.8.2. **PRIME.** PRIME is a transportable range owned by the Netherlands. The system is shipped in two standard ISO containers and consists of five sensor pods. The pods are deployed and oriented by divers. Each sensor pod connects back to the underwater junction box. The data are transmitted back to the control centre on shore via an underwater cable. PRIME also includes a wireless DGPS tracking system, a calibration source, and a sensor wire positioning system. A detailed description of the system is provided in annex D.

7.8.3. **DSIMS-MAG.** DRDC has been developing a general purpose exercise mine for training naval clearance divers, known as DSIMS (Diver Signature Integrated Measurement System). The development has included an advanced sensor head designed as a ship signature check range. This advanced sensor head includes the standard magnetic, electric, acoustic, pressure and orientation sensors used in the diver version of DSIMS, as well as a multi-axis gradiometer known as the MAG. The DSIMS-MAG sensor head is shown on the right. The four Bartington magnetometers used to measure the magnetic gradient are pictorially shown in the four corners of the sensor head. This system includes a 500m cable which brings the data to shore.

Figure 16 – DSIMS magnetic head.

7.8.4. DRDC has used the DSIMS-MAG system in conjunction with the GPS system shown in § 7.7 , to conduct check rangings of Canadian Navy ships on deployment.

7.8.5. DRDC is in the project definition phase of a Forward Range project which will use technology based on the DSIMS design to construct a multi-influence forward range for the Canadian Navy. It is intended to have the system ready for use in the QUEST 2011 trial.

§ 7.9 CALIBRATED SOURCES

7.9.1. In order to test and validate deployed underwater sensor systems DRDC has developed a towed source with acoustic, magnetic and alternating electric sources. The framework to support the sources is fabricated from ABS pipe which is sealed to provide flotation. The individual sources are tied to the floating assembly and the sources are towed over the underwater sensors. GPS beacons are attached to the bow and stern of the framework to track its position. The system uses the same GPS receivers introduced in § 7.7 .

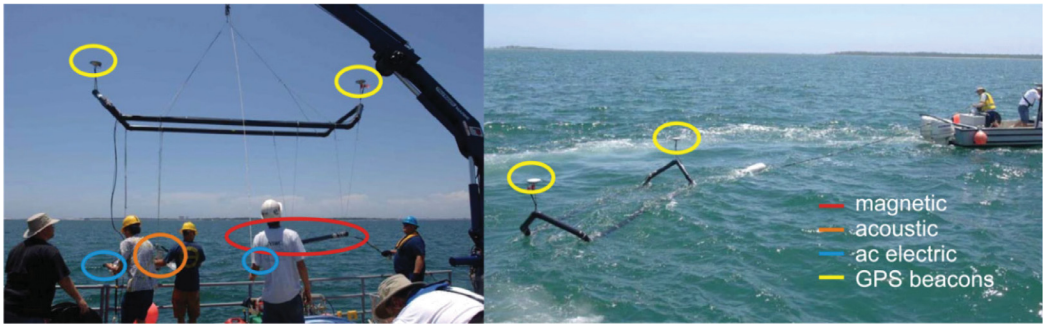


Figure 17 - DRDC calibrated towed source with GPS tracking.

§ 7.10 MODELLING

7.10.1. With its simple and dated degaussing system the goal of the QUEST 2011 trial is not about creating the ship with the smallest magnetic signature, but to understand how the signature changes and to create signature models that describe the changes. While signature data can be corrected to different depths by applying some type of depth correction scaling, the intent for the QUEST 2011 trial will be to compare signatures collected at different ranges but using physical models. The process would be to create the physical models based on data measured obtained at one depth, and then to generate signatures at alternate depths for comparison. Model concepts being considered by trial partners should be documented and included in the master trial plan or in a later version of this document. To reach the widest possible audience, it is recommended that any analytical models be implemented using MATLAB where possible.

7.10.2. DRDC has already created both finite element (FE) and boundary element (BE) of QUEST. These models are for use with the commercial software products Flux-3D and Beasy, respectively (see next page).

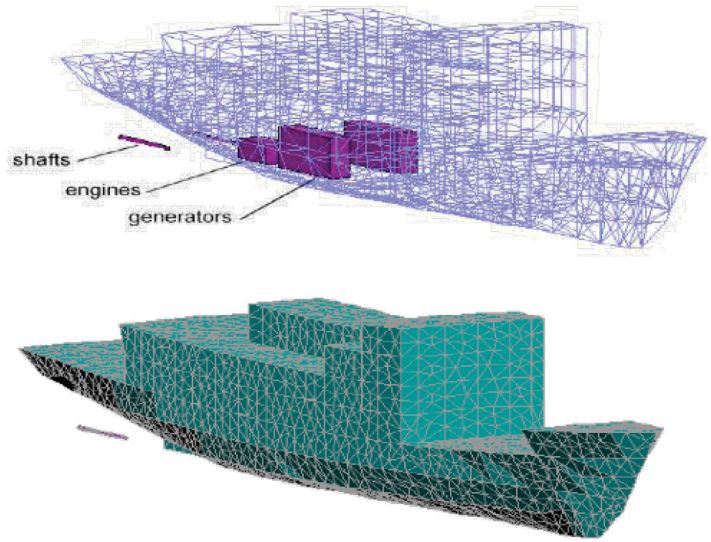


Figure 19 - QUEST finite element model.

7.10.3. DRDC has several analytical models that will be used to study QUEST's signature. The first consists of a grid of prolate spheroids and magnetizations that reproduce the data recorded at a particular depth. The magnetizations allow the magnetic signature to be predicted at any depth and offset; however, they are valid only for the heading the ship was travelling during the recording. A different set of magnetizations must be determined for each heading. The second model is based on a single prolate spheroid (with induced and permanent magnetization) and current line segments representing the degaussing system computed using the Biot-Savart law. This model is pictorially represented below. A third model uses several prolate spheroids at fixed positions on the QUEST with both permanent and induced magnetizations and current line segments to represent the DG coils.

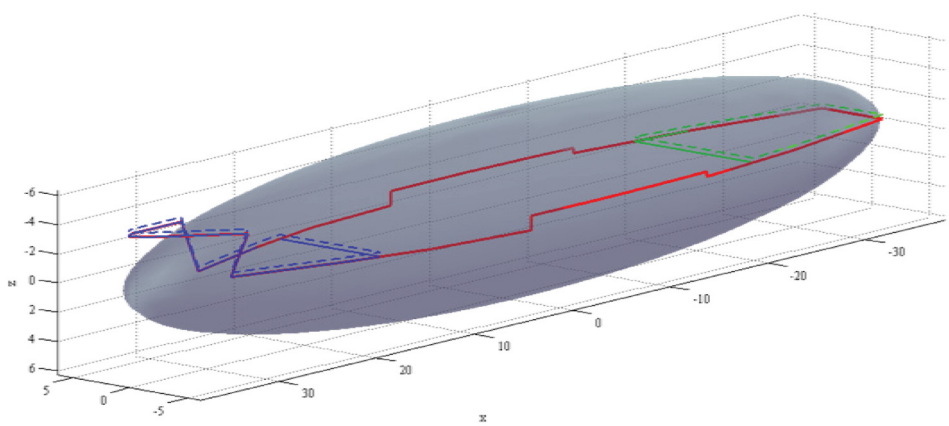


Figure 18 - Simple analytical model to predict QUEST's magnetic signature.

ANNEX A
TRIAL PLAN OVERVIEW

	week 29							week 30						
	18. Jul.	19. Jul.	20. Jul.	21. Jul.	22. Jul.	23. Jul.	24. Jul.	25. Jul.	26. Jul.	27. Jul.	28. Jul.	29. Jul.	30. Jul.	31. Jul.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	Halifax											trial 00	Halifax	
Planet														
PRIME	PRIME arriving in Aschau (24th or 27th), PRIME deployed on Jun 30th													
Special event														

	week 31							week 32						
	1. Aug.	2. Aug.	3. Aug.	4. Aug.	5. Aug.	6. Aug.	7. Aug.	8. Aug.	9. Aug.	10. Aug.	11. Aug.	12. Aug.	13. Aug.	14. Aug.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	Halifax			transit to Loch Goil										Campb.
Planet														transit
PRIME	deploy + use for trial 07 (Aschau)													
Special event														

	week 33							week 34						
	15. Aug.	16. Aug.	17. Aug.	18. Aug.	19. Aug.	20. Aug.	21. Aug.	22. Aug.	23. Aug.	24. Aug.	25. Aug.	26. Aug.	27. Aug.	28. Aug.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest (new)	Campbelt.	trial 01 (L.Fyne/Goil)			transit	trial 02 (deep water)				transit		port visit Bergen		
Planet	transit to Greenock		Greenock	trial 01 (L.Goil/Fyne)			transit	trial 02 (deep water)				transit		Bergen
PRIME	deploy + use for trial 07 (Aschau)													
Special event	<refuel>			<briefing>										

	week 35							week 36						
	29. Aug.	30. Aug.	31. Aug.	1. Sep.	2. Sep.	3. Sep.	4. Sep.	5. Sep.	6. Sep.	7. Sep.	8. Sep.	9. Sep.	10. Sep.	11. Sep.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	trial 03 (Heggernes)			trial 04 (Herdla)		transit to Kiel		Kiel	trial 05 (Friedrichsort - demag)			Eckernförde Nord		trial 06
Planet	Bergen	trial 04 (Herdla)		trial 03 (Heggernes)			transit to Eckernförde							
PRIME	deploy + use for trial 07 (Aschau)													
Special event	<EM cal run>										<EM cal run>	<load ammo>		

	week 37							week 38						
	12. Sep.	13. Sep.	14. Sep.	15. Sep.	16. Sep.	17. Sep.	18. Sep.	19. Sep.	20. Sep.	21. Sep.	22. Sep.	23. Sep.	24. Sep.	25. Sep.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	trial 06 - Surendorf (IR / RCS)						Eckernf. N.	trial 06 - Surendorf (IR / RCS)					Eckernförde Nord	
Planet														
PRIME	deploy + use for trial 07 (Aschau)													
Special event	<DSIMS,IGLOO>				<EM cal run>					<interf. North.Coast>			<social>	

	week 39							week 40						
	26. Sep.	27. Sep.	28. Sep.	29. Sep.	30. Sep.	1. Okt.	2. Okt.	3. Okt.	4. Okt.	5. Okt.	6. Okt.	7. Okt.	8. Okt.	9. Okt.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	trial 07 (Aschau)			Kiel (Arsenal)		trial 08 (Borgstedt / Schirnau)						port visit Kiel (Arsenal)		
Planet				trial 07 (Aschau)								transit to Brest		
PRIME	deploy + use for trial 07 (Aschau)													
Special event			<EM cal run>	<dismount mast>						<DSIMS, IGLOO recov.>		<mount mast>		

	week 41							week 42						
	10. Okt.	11. Okt.	12. Okt.	13. Okt.	14. Okt.	15. Okt.	16. Okt.	17. Okt.	18. Okt.	19. Okt.	20. Okt.	21. Okt.	22. Okt.	23. Okt.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	transit to Brest				port visit Brest			trial 09 (Brest)		Brest	transit to Halifax			
Planet	transit to Brest			trial 09 (Brest)		Brest	transit to Eckernförde							
PRIME									<load on QUEST>					
Special event			<EM cal run>		<refuel>				<off load>					

	week 43							week 44						
	24. Okt.	25. Okt.	26. Okt.	27. Okt.	28. Okt.	29. Okt.	30. Okt.	31. Okt.	1. Nov.	2. Nov.	3. Nov.	4. Nov.	5. Nov.	6. Nov.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	transit to Halifax						trial 10	arrival	Halifax					
Planet														
PRIME														
Special event						< -- MPA -- >								

	week 45							week 46						
	7. Nov.	8. Nov.	9. Nov.	10. Nov.	11. Nov.	12. Nov.	13. Nov.	14. Nov.	15. Nov.	16. Nov.	17. Nov.	18. Nov.	19. Nov.	20. Nov.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	Halifax									trial 00		Halifax		
Planet														
PRIME		PRIME deployed +												
Special event		<	----------		EM cal run (exact date t.b.d)				----------	>				

	week 47							week 48						
	21. Nov.	22. Nov.	23. Nov.	24. Nov.	25. Nov.	26. Nov.	27. Nov.	28. Nov.	29. Nov.	30. Nov.	1. Dez.	2. Dez.	3. Dez.	4. Dez.
	mon	tue	wed	thur	fri	sat	sun	mon	tue	wed	thur	fri	sat	sun
Quest	trial 00 (backup)		Halifax											
Planet														
PRIME			recovery of PRIME											
Special event														

	in port	Remarks : Planning accuracy is on '1 day' level. Departure or arrival in a port / on a range may be on the day before or after in order to be timely at a test range / in port. Exact details on ETA's and ETD's are to be found in chapter 3 of the master trial plan.
	transit	
	trials	
	PRIME deployment	

EM cal run	conduct test runs with towed calibrated magnetic source	interf. North.Coast	only limited trial time available on these days
briefing	joint briefing for Quest and Planet	MPA	sorties by Maritime Patrol Aircraft
off load	off load of test equipment at end of trials (Quest)		

ANNEX B
DATASHEET QUEST

Canadian Forces Auxiliary Vessel "QUEST"

The research, development, and testing of the systems needed by the Canadian Navy to maintain a state of readiness for maritime warfare often requires that the laboratory be transported to the field, so that the work can be performed under "real world" conditions.

To this end, the Defence R&D Canada – Atlantic employs the Canadian Forces Auxiliary Vessel QUEST. Maintained by the Navy and manned by Maritime Forces Atlantic Auxiliary seamen, QUEST conducts 7 to 10 trials per year, spending up to 160 days at sea. These trials encompass a wide range of R&D activity, from research on the acoustic properties of the ocean to experiments on ship signatures and safety. As well, the evaluation of prototype acoustic detection systems is often the first step in the process leading to procurement of new systems for the Navy.

This broad range of R&D activities requires a capable and versatile vessel, thus QUEST was designed with spacious laboratories, large working deck areas, and very capable marine cranes and specialized equipment handling systems. The vessel was designed with a large margin of stability and this, combined with its roll-stabilization system and constant displacement systems, makes QUEST a safe and stable platform from which to carry out experiments, even in heavy seas.

Of particular note are the acoustic quieting features of the vessel, which reduce the ship's radiated noise to virtually undetectable levels when the vessel is configured in its "quiet state". QUEST has conducted research in support of other Government Departments, Universities, and Canadian Industry, where joint research is mutually beneficial. QUEST has participated in Canadian and NATO naval exercises requiring the operational evaluation of prototype equipment.

General

Designer: • Canadian Department of National Defence

Builder: • Burrard Shipbuilding & Drydock Ltd., Vancouver, Canada (1969)

Construction: • General Purpose Research Vessel (Steel), Lloyd's Class 100A1 Ice Class1

Mid Life Refit: • Friede Goldman Newfoundland (FGN), Newfoundland, Canada (1997/99)

Ship Characteristics

Dimensions: • 76m x 12.6m x 4.8m (length x beam x draft)

Displacement: • 2130 tonnes standard; 2200 tonnes full load

Main Propulsion: • Diesel electric, twin shaft, twin rudder, 2 – 10 cyl. Fairbanks-Morse 38D8 diesels driving 2 – GE electric motors

Auxiliary Propulsion and Electrical: • 1 – 750kw gas turbine driving 2 – 500kw generators in tandem providing AC for ship service and/or DC for propulsion and a 150kw emergency diesel generator

Steering: • Integrated Steering & Autopilot RC Marine

Other: • Retractable bow thruster, ship roll stabilization system and water displacement fuel tanks

Max Speed: • 15 knots

Endurance: • 10, 000 nm @ 12 knots, 35 days

Complement

• 10 officers, 14 crew, up to 21 scientific and trials personnel

Electronics

Radar: • Racal-Decca Bridgemaster 2, "X" band and "S" band

Communication and Navigation: • Full suite of modern navigation and communication equipment

Special:
- Echo sounders
- Sub-bottom profile
- Current profiler
- Directional wave measurement system
- Wave height meter
- Environmental sensor
- Bathymetry
- Expendable bathythermograph launcher
- Radio direction finder
- Underwater telephone

Unique Features

Stabilized Electrical Power: In combination with fitted heavy batteries, the 125 kva uninterrupted power supply (UPS) provides power to scientific instrumentation in the event of shipboard power interruption, and for quiet state operations.

Acoustic: Main propulsion diesels raft mounted and acoustically hooded with raft de-coupled from the hull. The 750kw gas turbine, for quiet state operations, is located in superstructure (02deck) and is also acoustically isolated. The hull and sea-bays are coated internally with thick visco-elastic acoustic and de-coupler tiles. Internal divisions consist of special transmission loss bulkheads and acoustic ceilings, ventilation and piping systems, designed to minimize noise, and the steering hydraulics noise is suppressed. Unique, 5-bladed propellers provide low noise performance.

Laboratories and Workshops: Spacious "wet" and "dry" laboratory spaces capable of holding up to 53 "racks" of scientific instrumentation, plus well equipped electronics and mechanical workshops. All scientific areas and workshops are linked to a local area computer network.

For more information

Manager/Technical Services
Phone: (902) 426-3100 ext. 143
E-mail: atl.m.ts@drdc-rddc.gc.ca

Defence R&D Canada – Atlantic
P.O. Box 1012, Dartmouth, Nova Scotia B2Y 3Z7
Phone: (902) 426-3100 Fax: (902) 426-9654

www.atlantic.drdc-rddc.gc.ca

Fact Sheet No. TS0102
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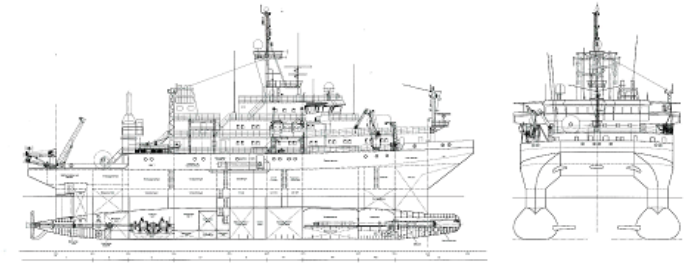
ANNEX C
DATASHEET PLANET

Research Vessel Class 751 "PLANET"



Class
Vessel GL + 100 A5 E
Propulsion System GL + 100 MC AUT E

Main Dimensions
Length o. a. 72,0m
Breadth 27,2m
Draught 6,8m
Tonnage approx. 3850 GT

Complement
25 Crew in single cabins
20 Scientific personnel in double cabins

Deck Equipment
Main crane 12,5to with swell sequence kit
2 Assistence cranes 2,7to
2 Bow anchors with combined anchor and mooring winches
Deep sea anchoring system 1000m
Bow mooring winch
Stern anchor with combined anchor and mooring winch
2 Stern mooring winches
2 Davits for life boats
Speed boat / Torpedo recover boat
Stern davit 15to, Side davit 6to
2 Folding davits 1to
Double towing winch for 1200/4000m cable (removeable)
Winch for 1000m steel wire (removeable)
Serial winch 4000m steel wire (removeable)

Range 5000 nm at 15knots
Endurance 30 days
Speed 15knots

Propulsion system
All electric propulsion system
2 Diesel-Generator sets with permament magnet (PM) generators 1275KW each
2 Diesel-Generator sets with PM generators 1700KW each
4 PM propulsion motors 1040 kW each at 0-150 1/min

Auxiliary:
Auxiliary diesel generator 200kVA
2 Bow- and 2 Stern thrusters 350kW each
3 Converter (board net) 440V/60Hz, 550KVA
2 Converter 400V/50Hz, 170kVA

Navigation equipment:
Gyro (Standard 20 Plus GG)
EM-Log (NAVIKNOT III)
GPS (P/Y), DGPS (C/A Code)
LORAN C Receiver (LC-90 MARK- II)
Navigation radar (Pathfinder ST MK2)
Short range radar (ELNA 4007 TFT)
Echo sounder (LAZ 5000)
Weather station (SYNMET)
Magnet compas (Reflecta 1)
Nautical Data Management System (Nautoconning)
Electronic Sea Chart System ECDIS
Dynamic Positioning System
Weather satellite receiver
Positioning-/Telemetrical system
Automatic Identification System (AIS)
Ships data log VDR

Comm Systems
Military Communication System
Public Communication System
Emergency Communication
Underwater communication (UT)
Digital Communication Netzwork, DKN
Integrated Message Handling and Distribution System (IMUS)

Scientific Equipment:
3 Laboratories, Moon pool
Container stowage on deck for additional laboratory container:
H-Deck 2 for 20´
B-Deck 3 for 20´ or 1 for 40´

Sonar Systems:
Dual channel single beam echosounder (DESO 25)
Deep sea multibeam echosounder (Hydrosweep DS-2)
Sub-bottom-profiler sonar (Parasound DS/X)
Doppler speed log (Dolog 23)
Torpedo search sonar (PILOS mod.)

Torpedo System:
Single Torpedo tube for positive discharge and swim out mode

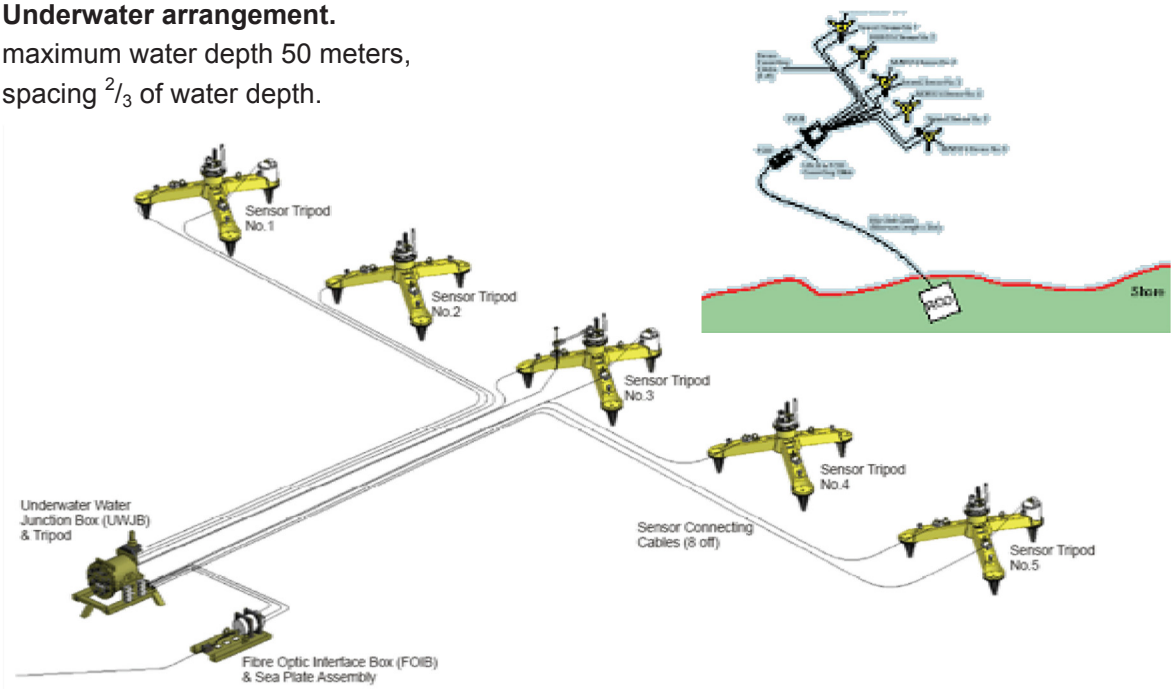
ANNEX D
DATASHEET PRIME

(Trans**P**ortable **R**ange for **I**nfluence **M**easurements and **E**valuation)

Range Control Office (RCO)
20 feet ISO container, 6000 Kg

Storage Container
20 feet ISO container, 8000 Kg

Underwater arrangement.
maximum water depth 50 meters,
spacing $^{2}/_{3}$ of water depth.



Weights and Measures

Item	Height (mm)	Width / Diameter (mm)	Depth / Length (mm)	Weight (Kg)
RCO	2895	2438	6058	6000
SC	2895	2438	6058	8000
MUWS 14 Sensor	450	230		18
Seismic Sensor	295	252		13
Sensor tripod (fully assembled)	1186	2050		112
UWJB (fully assembled)	570	958	940	130
FOIB (fully assembled)	155	460	1000	80

Sensor limits

Signature	Parameter	Range
Static Magnetic (SM)	Full scale	±100000 nT
	Dynamic range	>120 dB
	Resolution	12 pT
	Bandwidth	DC to 10 Hz
Alternating Magnetic (AM)	Full scale	±1000 nT ±100 nT ±10 nT
	Dynamic range	90 dB
	Resolution	30 pT 3 pT 0.3 pT
	Bandwidth	0.3 Hz to 3000 Hz
Pressure (P)	Full scale	10 Bar absolute
	Zero scale	Approx 1000 mBar
	Dynamic range	>80 dB
	Resolution	1.2 µBar
	Bandwidth	DC to 10 Hz
Acoustic (A)	Full scale	180 dB ref 1 µPa
	Dynamic range	90 dB
	Bandwidth	5 Hz (± 0.75) to 100 kHz

Signature	Parameter	Range
Static Electric (SE)	Full scale	± 250 mV (equivalent to 31 mV/m
	Dynamic range	>120 dB
	Resolution	30 nV
	Bandwidth	DC to 3000 Hz
Alternating Electric (AE)	Full scale	± 2.5 mV (equivalent to 0.313 mV/m
	Dynamic range	>90 dB
	Resolution	76 nV
	Bandwidth	0.3 Hz to 3000 Hz
Seismic (S)	Acceleration sensitivity	500V/g 5000 V/g 50000 V/g
	Dynamic range	120 dB
	Bandwidth	1 Hz to 100 Hz
	Resolution	0.06 µm/s/s
	Full scale	2 * 10^-3 m/s/s
Conductivity (C)	Full scale	6 S/m
	Dynamic range	10 mS/m to 6 /m
	Resolution	0.3 mS/m
Flow (F)	Full scale	5 m/s
	Resolution	0.005 m/s
Temperature (T)	Measurement range	-5 °C to 40°C
	Resolution	0.25 °C

ANNEX E
TRIAL 00 (HALIFAX)

OBJECTIVES

The principle objective of Trial 00 is to use the Bedford Degaussing Range to collect magnetic signature data of Quest in various magnetic conditions and to use that data to create and compare physic models that predict the magnetic signature. The secondary objective is to correlate onboard magnetic measurements with the off board signatures.

The trial will also include measurements of the magnetic gradient and the electric field signature and these data will be used to develop magnetic and electric models.

As the first partial trial, Trial 00 will provide the initial set of electromagnetic signature measurements of Quest, and will establish the data flow between the data collection teams, the data coordinator, and the analysis teams.

The trial will be repeated at the end of the trial programme, during which the Netherlands PRIME system will be deployed. See annex A for a general overview.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

The trial will be held at the Bedford Basin Degaussing Range which includes both a magnetic north-south (N-S) range and a magnetic east-west (E-W) range permanently mounted on the sea floor.

To provide a magnetic gradient, electric field, and acoustic measurement capability DRDC will deploy the DSIMS-MAG alongside the N-S range. If available, the DRDC Forward Range will also be deployed. For Trial 11 which will be a repeat of a Trial 00 the CSSM PRIME range will also be installed at the Bedford Basin Degaussing Range. See Annex D for details on the Netherlands PRIME system. The DSIMS-MAG and the DRDC Forward Range are described in annex W.

Throughout the trial, onboard data acquisition equipment will record Quest's position as described in Section 7.7. And the vessel's magnetic state will be recorded using the onboard magnetic monitoring system described in Annex P.

Contact Information

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RANGE INFORMATION

The Bedford Basin Degaussing range is located in the Bedford Basin which is part of Halifax Harbour. The facility consists of two underwater magnetic ranges, one positioned to measure magnetic north-south transits and the other for magnetic east-west transits as shown in the Figure 1. Each of the ranges consists of sixteen three-axis induction coils mounted on pedestals at a depth of 16 m. The low level signals from the coils are amplified and digitized on shore. The data are then integrated and scaled to arrive at the magnetic signature.

For Trial 00 DRDC's DSIMS-MAG and the DRDC Forward Range will be deployed alongside the N-S range. For Trial 11 PRIME will also be deployed alongside the N-S range.

Google Earth view of the N-S and E-W degaussing ranges in Bedford Basin

TRACKING

Bedford Basin DG range staff will install their own independent DGPS monitoring system. This DGPS system provides real-time differential processing and includes a navigation display provided on the bridge to assist the vessel's navigation officer. The tracking data is combined with the underwater signature data to yield the ship's magnetic signature for all three axes with respect to the ship.

As will be the case for the entire RIMPASSE experiment, DRDC will have the high resolution dual frequency L1/L2 GPS system installed onboard Quest and will mount its own differential correction GPS antennae on shore, see Section 7.7. Correction data from the shore GPS will be recorded in real time via an RF link (FreeWave Radio pair) from shore to the ship. After each pair of runs is complete the tracking data will be differentially corrected onboard the ship and transmitted to shore via a separate RF link where it will be integrated with the underwater signature data.

COMMUNICATION

Communication between CFAV Quest (call sign Quest) and the Bedford Basin degaussing range (call sign DG Range) will be conducted on VHF Channel 10.

PREPARATIONS

Deployment of the portable ranges alongside the N-S range will be conducted on July 28-29 and towed calibrated source trials will be conducted on Aug 2. (Aug 1 is a civic holiday in Canada.)

MEASUREMENT PROCEDURE

As is customary for degaussing operations, runs will be conducted in pairs with a short dwell between the pair of runs to facilitate data processing. In addition to the collection of GPS tracking data, the onboard magnetic state of Quest will be monitored using Quest's onboard magnetic monitoring system. The onboard condition of the AASG and cavitation inception system will also be monitored and recorded during the runs. All data collected during the trial will be time stamped and synchronized to GPS time.

RUN PLAN

On the N-S degaussing range Quest will conduct the 7 pairs of runs (14 runs in total) with its degaussing, ICCP, and AASG as listed in Table 1. Upon completion of the N-S degaussing range runs, Quest will proceed to the E-W degaussing range and conduct the 3 pairs of runs (6 runs in total) with its degaussing, ICCP, and AASG as listed in Table 2.

Run	Heading	Degaussing		ICCP	AASG	
		M supply	I supply		active	passive
1	162˚	0A	0A	off	off	off
2	-18˚	0A	0A	off	off	off
3	162˚	0A	0A	off	on	off
4	-18˚	0A	0A	off	on	off
5	162˚	40A	0A	off	off	on
6	-18˚	40A	0A	off	off	on
7	162˚	0A	25A	Iset	on	on
8	-18˚	0A	25A	Iset	on	on
9	162˚	0A	-25A	Iset	on	off
10	-18˚	0A	-25A	Iset	on	off
11	162˚	Best Guess 1	Best Guess 1	Iset	on	on
12	-18˚	Best Guess 1	Best Guess 1	Iset	on	on
13	162˚	Best Guess 2	Best Guess 2	Iset	on	on
14	-18˚	Best Guess 2	Best Guess 2	Iset	on	on

Table 14: Run plan for north-south magnetic range

Run	Heading	Degaussing		ICCP	AASG	
		M supply	I supply		active	passive
1	72˚	0A	0A	Iset	on	on
2	-108˚	0A	0A	Iset	on	on
3	72˚	Best Guess 1	Best Guess 1	Iset	on	on
4	-108˚	Best Guess 1	Best Guess 1	Iset	on	on
5	72˚	Best Guess 2	Best Guess 2	Iset	on	on
6	-108˚	Best Guess 2	Best Guess 2	Iset	on	on

Table 15: Run plan for east-west magnetic range

DATA REGISTRATION, COLLECTON AND DISTRIBUTION

Each of the individual collection systems will register their data to GPS time. The magnetic and electric data will be combined with the GPS tracking data and the signature data referenced to position from the ship. This process eliminates time as an independent variable in the signature data sets.

ANALYSIS PLAN

The signature data will be collected and converted to HDF5 format and forwarded to the Technical Support Officer for distribution to the nations identified in Table 3 for modelling requirements. As the only analysis participant at Trial 00, Canada will conduct its modelling plan in near real-time. The other nations will conduct their analysis and forward the results to the project leader as soon as possible.

For multi-influence trials conducted in Europe it is envisioned that the analysis countries would have representatives available at the trial to conduct the analysis in near real-time.

	Magnetic	Electric
Canada	1. prolate spheroid grid 2. single prolate spheroid with coil effect 3. Flux3d 4. MAD point source	1. point and line source 2. CPBEM 3. BEASY 4. Flux3d corrosion
Netherlands	1. prolate spheroidal expansion 2. mathematics-physics	
UK	1. WOWI worldwide magnetic	
Australia	1. gradient model with GPS tracking	
France	to be determined	to be determined

ANNEX F
TRIAL 01 (LOCH GOIL & LOCH FYNE)

OBJECTIVES

The main objective of the acoustic trials is to obtain a common data set to be used for development of acoustic signature monitoring, prediction and management systems in national (and joint international) projects.

A secondary objective is to provide a common data set to be used for an evaluation of the differences in reported ship acoustic signatures at different ranges, due to range propagation and environmental effects, to support an update of the AMP-15 procedure for measuring surface ship acoustic signatures in relation to mine threat.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

The trials will be held at both the Loch Goil and Loch Fyne Acoustic Ranges. These ranges are configured with a number of ITC 8201B omni-directional hydrophones at varying depths and distances as detailed in the following section. Two further keel aspect hydrophones (one at each range) will be deployed at a depth of 20m in support of these trials.

The primary trials platforms will be CFAV QUEST and RV PLANET (including their respective accelerometer sensor suites). In addition range support vessels (VIPER and BATHTUB) will provide support for the various trials.

Shakers, loudspeakers and sound sources to support the trials will be provided as detailed below.

Equipment	Manufacturer	Model
Low frequency shaker system	Data Physics	IV46
High Frequency shaker	Wilcoxon	F7
Medium Modal Hammer	PCB	086C40
Modal Hammer	PCB	Model 086C04
Speaker system	Norsonic	Nor 276 Dodecahedron speaker. Nor 280 ampl.
Hydraulic shaker system	Zonic	
Hydrosounder	Data Physics	UW350

RANGE INFORMATION

Contact Information

Alistair Constable QinetiQ Loch Goil Room 9 Corriesyke House Douglas Pier Lochgoilhead ARGYLL PA24 8AE	Tel : 01301 702009 Fax : 01301 702001

Request for Visits.

Foreign nationals visiting a UK MoD Establishment or UK Defence Contractor Site that require access to protectively marked information, and/or access to a Restricted Area, must provide official confirmation of their security clearance in the form of a RFV (Request for Visit). The RFV must arrive in IVCO at least 20 working days (please aim for 6 weeks) before the start of the visit.

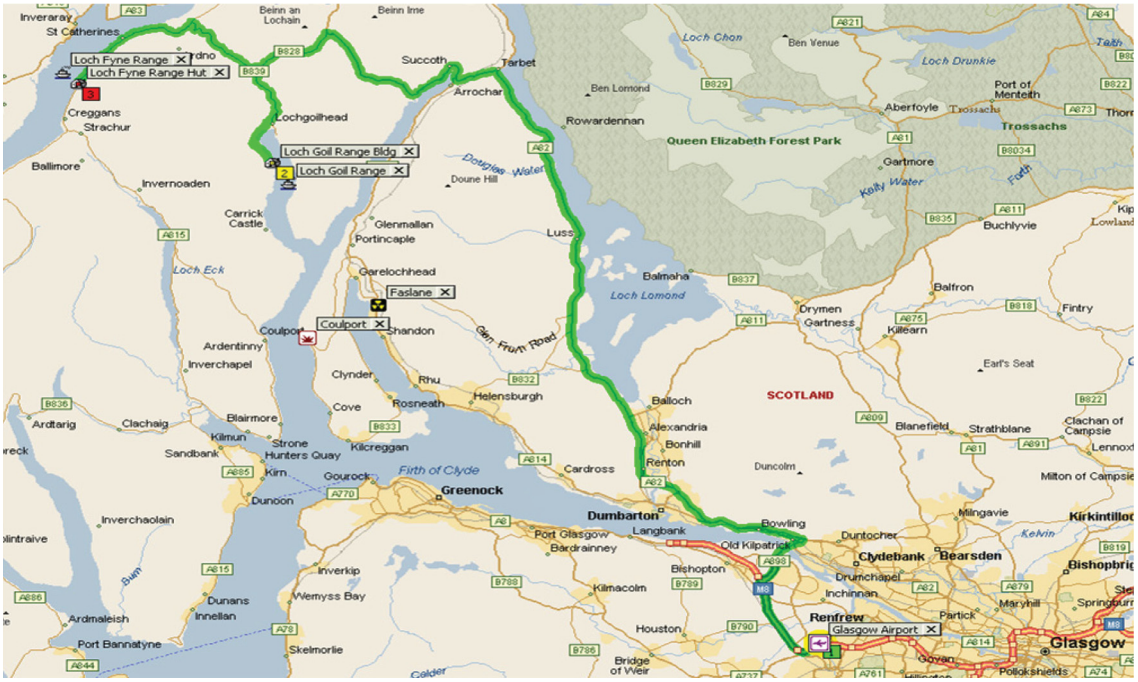
The visitors are to initiate the visit request and must ensure that it is approved by and transmitted through their own National Security Authorities (NSA) who should send the RFV to their Embassy/High Commission in London. The Embassy/High Commission should process the RFV to IVCO.

International Visits Control Office (IVCO) Poplar -1 #2004, MoD Abbey Wood Bristol BS34 8JH UK	E-mail - desinfra-ivco@mod.uk Fax No - +44 (0) 1179134924.

Once an RFV has been received by IVCO it will be forwarded to the relevant MOD Project Authority (DES SE Sea-SR).They consider the acceptability of the proposed visit including the clearance level required, and advise on any information that can/cannot be seen or areas that can/cannot be accessed by the visitor. The addresses of the places being visited are;

QinetiQ Loch Goil, Douglas Pier, Lochgoilhead, ARGYLL PA24 8AE	QinetiQ Loch Fyne, Hazelbank, Cairndow, ARGYLL PA25 8BA

Directions to Loch Goil and Loch Fyne



Local hotel accommodation

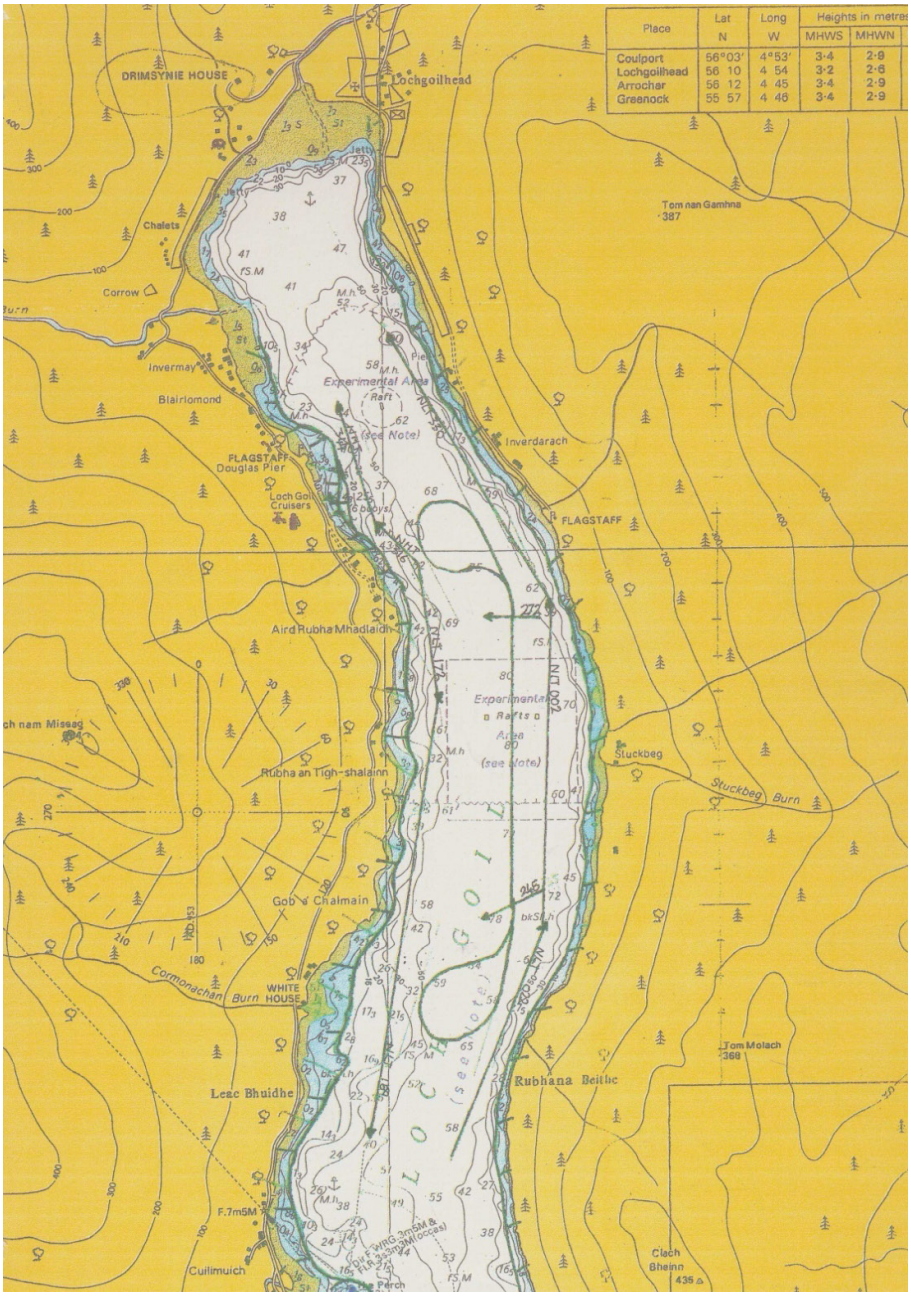
Loch Goil	Drimsynie House Hotel	http://www.argyllholidays.com/lochgoilhead-drimsynie-house-hotel.html
	Lochgoilhead Hotel	http://www.argyllholidays.com/lochgoilhead-hotel.html
	Shorehouse Inn	http://www.theshorehouse.net
Loch Fyne	The Creggans Inn	http://www.creggans-inn.co.uk
Further a field	The Village Inn (Arrochar)	http://www.villageinnarrochar.co.uk
	The George Hotel (Inverary)	http://www.thegeorgehotel.co.uk

Range information - Loch Goil.

Relevant chart: No.3746.

Range centre: 56° 08’ 26.9653” North 04° 53’ 25.9642” West.

Underway Course: Ordnance Survey Grid N or S (357° True or 177° True).



Loch Goil is a sea loch on the West Coast of Scotland within the Clyde estuary. The loch is 80 metres deep, about 8 km long and up to 1.5 km wide. It is enclosed by hills about 600m high, which shelter it from the wind. There are a few scattered houses along its shores and a small village at its head.

The entrance to the loch curves so that there are no direct 'lines of sight' between the range area and any other body of water. This ensures that external shipping noise is not a problem. Apart from range related activities, which are controlled so as not to interfere with trials, the only other frequent users of the loch are small pleasure craft. These craft may be a serious nuisance during holiday periods.

The Range area contains a pattern of four X-class mooring buoys spaced about the Range centre used to moor the ship for static measurements. The underway course, when in use, passes in a northerly or southerly direction between these buoys.

There are rafts either side of the moored position at Range centre, 120 metres east and 205 metres west. Measurement hydrophones are positioned at a depth of 35 metres around the moored position of the ship, approximately 110 m from the hull and also on the seabed (83 metres deep) below the centre of the ship.

Nominal positions are:

Buoy	Lat	Long	X	Y
NW	56°08' 26.9653N	04° 53' 25.9642W	-31	129
NE	56°08' 30.9512N	04° 53' 22.9597W	57	121
SW	56°08' 23.1799N	04° 53' 28.6938W	-52	-115
SE	56°08' 23.2318N	04° 53' 23.7132W	34	-117

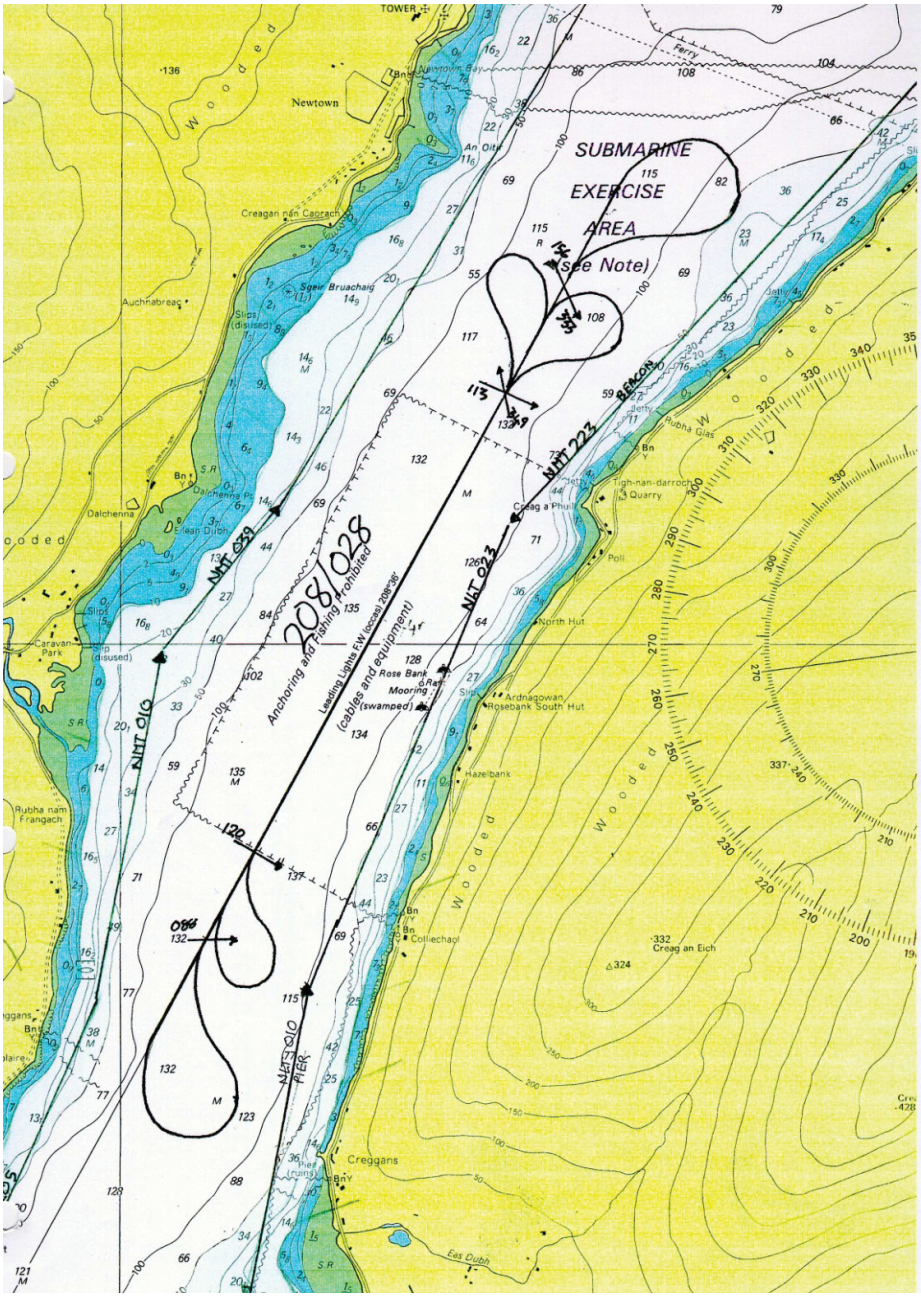
Hydrophone			X	Y	Z
Keel	56°08' 28.0259N	04° 53' 26.2757W	-4	33	-76
East	56°08' 28.8331N	04° 53' 19.4389W	115	53	-37
West	56°08' 28.3101N	04° 53' 33.5348W	-128	47	-37
South	56°08' 21.2475N	04° 53' 25.5348W	0	-177	-37
North	56°08' 32.8755N	04° 53' 26.4660W	-1	183	-39
Keel (20m)					

Range information - Loch Fyne.

Relevant chart: No.3746.

Range centre: 56° 11’ 59.8920” North 05° 04’ 47.5848” West.

Underway Course: Ordnance Survey Grid N or S (208° True or 028° True).



The range is situated at the head of Loch Fyne, a long sea loch that opens off the Clyde estuary. The loch is 140 metres deep in the area of the range. It is used where greater navigational freedom or water depth is required.

The trials area lies between Inveraray and Strachur. The measurements are carried out in the vicinity of range centre, opposite a raft. The range is laid out in cruciform shape, with two hydrophones at a depth of 35m east and west of the course line at range centre. A further two hydrophones are arranged, on the course line, north and south of range centre.

The underway runs are made along this course line which extends 9km between shores with a depth of water of 135 metres over much of that length. Turns are usually made opposite Inveraray and Strachur respectively. Two navigational lights in transit mark the southern end of the course line. The lights are only lit when the range is operational.

Underway trials are carried out on surface ships of frigate size at speeds approaching the maximum they can attain. The ranging speeds of larger ships are dependent on the individual ships manoeuvrability and navigational limitations.

There is a raft moored approximately 100 m east of Range centre.

Hydrophone	Lat	Long	X	Y	Z
Keel	56°11’ 58.0806N	005° 04’ 48.8947W	7	-60	-139
East	56°11’ 58.8172N	005° 04’ 40.4777W	124	29	-36
West	56°12’ 02.4592N	005° 04’ 53.0005W	-120	25	-35
North	56°12’ 01.0517N	005° 04’ 45.8885W	9	46	-48
Keel (20m)					

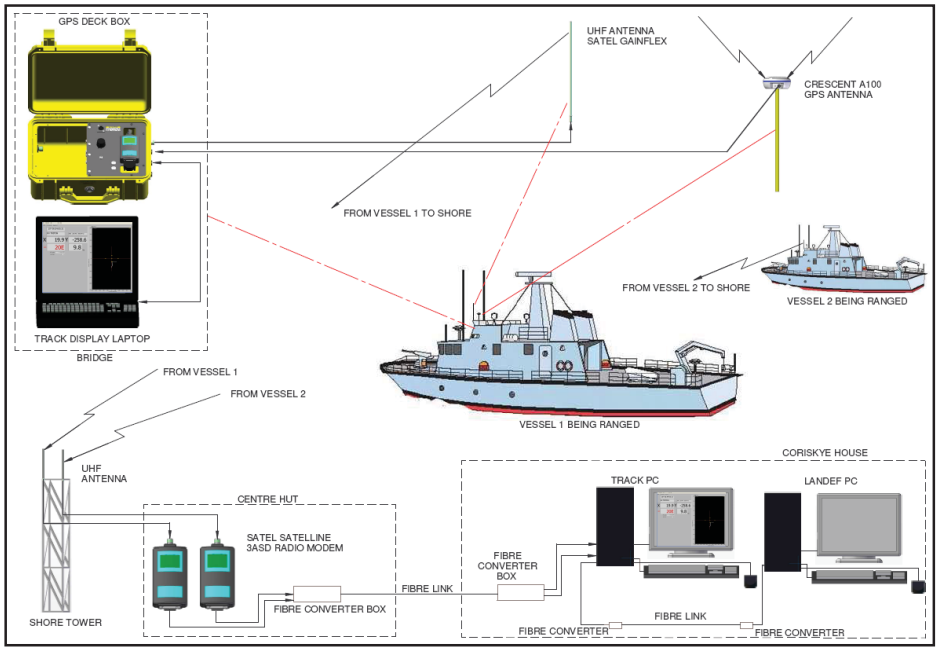
TRACKING

A DGPS tracking system will be installed by Range staff, this requires an antenna pole to be sited, normally on the bridge roof, however for the purposes of these trials will be sited as near as practically possible to the reference location (adjustments to the tracking system can compensate for any offset required).

Cables are run from the antenna to the deck box (sited on the bridge) which will involve fouling a bridge door, unless a gland access can be provided. A portable laptop computer will be set up on the bridge to display ship's track information. It should be noted that this facility is for display purposes only and should NOT be used for navigation. The equipment can be operated off both 240 volt or 115V 5A supplies.

Onboard UHF radio or satellite telephone transmissions may cause interference with the tracking system. The Ranging Officer should be informed if these transmissions are required.

Underway measurements will be completed at Loch Fyne on a course line 208/028° (see chart). All tracking data supplied is referenced (in metres) from the range centre.



COMMUNICATION

VHF-RADIO

Prior to mooring and whilst the ship is underway, communications will be primarily done via VHF as follows:

- Ranging conducted on: VHF Channel 69 (initially Channel 73 for contact)
  [Channel 10 has been designated spare]
- The Range call sign is: **XA**
- Ship's call sign will be: **TT**
- Range launch call signs: **Viper** and **Bath Tub**
- QinetiQ Loch Goil telephone number: 01301 703474.

The Range launches operating in Loch Goil are 'Viper' and 'Bath Tub'. Viper can also be contacted on 07765956604.

Ranging intercom.

The onboard Intercom Server Unit is normally located on the bridge or in a suitable office, and is connect to the 115V 5A supply. A number of remote units will be located throughout the ship, usually on the bridge and in the ship control centre.

Internal cables are run from the server box to these positions using CAT5 data cable. An external CAT5 cable, terminated with a watermate connection, runs between the server box and the umbilical.

Call signs will be: **Shore,**

Bridge,

SCC.

On the intercom boxes press '0' to talk and 'X' to end a call that your station initiated. If another station initiated the call they have the control to end the call. If you require to interrupt a conversation press and hold 'T' to talk.

Be advised that should the channel be left open, inadvertently or otherwise, the red light towards the top of the unit will remain illuminated.

Shore cables-

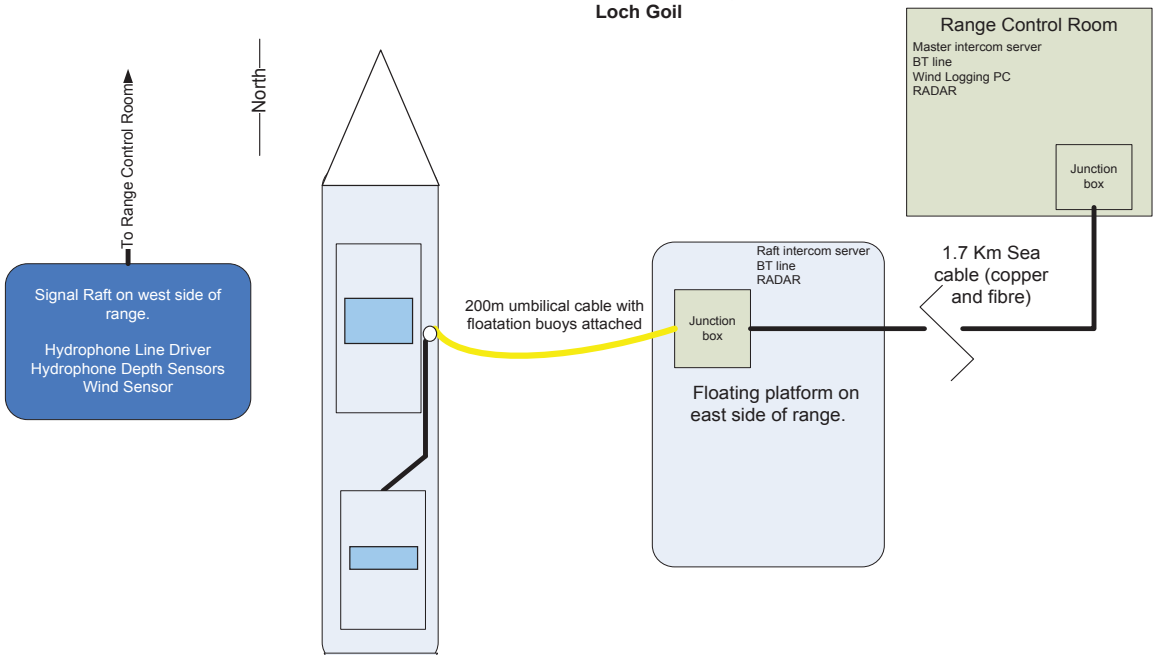
A light umbilical cable will be floated from the Power Raft (east side of the range) to the vessel for connection to internally run cables. Flotation buoys are attached along the harmess length to keep the harness on the surface. This reduces the strain on the cable ends and helps identify them to water users as a hazard when deployed.

This cable will carry the connections for:

- Ranging Intercom (stations in use will be mainly Shore, Bridge, SCC)
- BT telephone line (01301 703381)
- Shaker signals
- Reciprocity signals

Note: *as a result of the umbilical being deployed, all craft coming alongside should be directed to the port side.*

Typical Minor War Vessel Configuration for Loch Goil



Machinery numbers.

When referring to machinery in VHF radio messages the machinery number rather than the machine name should be used for brevity and security. Machinery numbers are listed in the machinery log sheets supplied to the ship.

Identification of noise and machinery characteristics (via VHF).

Identification No.	Suffix	Suffix Details	Description
301	A	Port	Propeller shaft
	B	Stbd	
302	–	–	Propeller cavitation
303	A	Port	Shaft knock
	B	Stbd	
304	A	Port	Shaft rub
	B	Stbd	
305	A	Port	Shaft squeal
	B	Stbd	
306	–	–	'A' bracket
307	A	Low Frequency	Broadband noise
	B	High Frequency	
308	A	Low Frequency	Discrete tone
	B	High Frequency	
309	–	–	Fluid discharge noise
310	–	–	Valve rattle / chatter
311	–	–	Shaft rotational frequency
312	–	–	Vane passing frequency
313	A	Port	Main gearboxes
	B	Stbd	
314	–	–	Tooth contact frequency
315	–	–	Vibration
316	–	–	Banging / Hammering
317	A	Port	Rudders / steering noise
	B	Stbd	
318	–	–	Propeller sing
319	–	–	Watertight doors
320	A	Higher	Side band
	B	Lower	

Alphanumerical reference table (via VHF).

Any rpm, speeds (in knots) or frequencies of interest should be passed via VHF using the following code.

Code	
0	Charlie
1	Hotel
2	Alpha
3	Delta
4	Victor
5	Romeo
6	Papa
7	Lima
8	Echo
9	Sierra

De–code	
Alpha	2
Charlie	0
Delta	3
Echo	8
Hotel	1
Lima	7
Papa	6
Romeo	5
Sierra	9
Victor	4

PREPARATIONS

1 - Programme.

The following tables present the expected programme of events for both QUEST and PLANET whilst on the Loch Goil and Loch Fyne ranges. **ALL TIMES ARE ZULU**

Time	CFAV QUEST
August 14th	
1100	ETA Campbeltown
	Embark QinetiQ staff to start deploying shaker fit
August 15th	
0800	QinetiQ staff to continue deploying and testing shaker fit
1300	QinetiQ range technicians fit DGPS system Partial Trial Leader to conduct final briefing.
August 16th	
0700	Depart Campbeltown to Loch Fyne underway range.
1400	ETA Loch Fyne range. “Quiet Rules” in force. Start underway measurements. Meal breaks and required boat transfers to be factored as required.
2300	Stop underway measurements, transit to Loch Goil over night.
August 17th	
0530	Range launch departs Douglas Pier.
0600	Ship arrives and rendezvous with Range launch off Carrick Castle. Communication equipment and mooring ropes transferred onboard. Engineers and Onboard Ranging Officers on–board to setup. Ship moors up bows **NORTH** assisted by Range launch and tug(s). Rig umbilical cable, comms and telephone.
0930	Sewage barge alongside for black water transfer
1200	"Quiet Rules" in force. Start reciprocity measurements. Meal breaks and required boat transfers to be factored as required.
2100	Stop reciprocity measurements Conduct boat transfers
2200	Start machinery, shaker and loudspeaker measurements
August 18th	
0600	Measurements complete. Range launch departs to assist with de–rigging.
0900	Rendezvous with PLANET for deep water brief. QUEST to transfer mooring lines to PLANET.

Time	RV PLANET
August 18th	
0600	ETD to Loch Goil BTX (supplied by PLANET) in Clyde area to board Partial Trials Leader for final briefing on transit to Loch Goil.
0900	Rendezvous with QUEST for deep water brief Receive mooring lines from QUEST
	Engineers and Onboard Ranging Officers on–board to setup. Ship moors up bows **NORTH** assisted by Range launch and tug(s). Rig umbilical cable, comms and telephone.
1200	BTX with QUEST
1200	"Quiet Rules" in force. Start reciprocity measurements. Meal breaks and required boat transfers to be factored as required.
2100	Stop reciprocity measurements Conduct boat transfers
2200	Start machinery, shaker and loudspeaker measurements
August 19th	
1800	Measurements complete. Range launch departs Douglas Pier to assist with de–rigging umbilical and mooring ropes.
2000	Depart Range, transit to Loch Fyne overnight.
August 20th	
0700	ETA Loch Fyne range. “Quiet Rules” in force. Start underway measurements. Meal breaks and required boat transfers to be factored as required.
2200	Stop underway measurements. Range launch departs Rosebank to assist with de–rigging DGPS.
2300	Depart Loch Fyne range for deep water trials

2 - Static measurements.

Mooring (with bows North). The ship will be provided with four coils of buoyant polypropylene ropes (48mm diameter, approx 220 metre lengths) for the mooring operation. These coils will be transferred from Range launch Viper, after the initial personnel transfer, upon arrival in Loch Goil. These coils will have been inspected by Serco and certified as fit for purpose prior to loading. Copies of the certificates will be filed at Loch Goil.

The actual tying–up will be conducted by the crew of ‘Bathtub’ (6m aluminium work boat). It is requested that a member of the ship’s crew is available in ‘Bathtub’ to report back to the Command that the mooring has been carried out to their satisfaction.

The four mooring buoys are 'X' class, 8 tons reserve buoyancy each, are approx 290m apart north/south and approx 110m apart east/west. The buoys are not equidistant from the course

line of the Range, but are offset by around 2 degrees clockwise (NE to SW orientation, with respect to the course line). The moorings are also inspected and certified by Serco. Copies of the certificates will be filed at Loch Goil.

Note : the ideal position (between the buoys), as indicated by the range DGPS system, that the ship should achieve is :

X co–ordinate = 0, Y co–ordinate = TBD.

A final position [WITH ROPES TIGHTLY TENSIONED] within a 10 metre radius of this point would be acceptable. This point relates to the GPS aerial position (nominally on the bridge roof) which in turn means that the assumed noise source (need location) is directly above the keel (centre) hydrophone. Data will be supplied by the DGPS laptop computer on the bridge.

The ship's head will be periodically requested throughout the static ranging for recording shore side. It is expected to be between 183 degrees and 187 degrees when in the mooring.

Slipping. The slipping procedure entails Bathtub untying the mooring ropes at the buoys, ship's staff hauling in and recovering the ropes inboard to the ship (repeated for all four mooring ropes). The order of rope recovery is under the CO's control.

On completion of slipping, it is requested that all four ropes are coiled as neatly as possible.

The four ropes will be transferred off onto Viper on completion of the measurements, whilst the GPS and comms equipment is being de–rigged and the Ranging Officer carries out a debrief with ship's command. Should the crane or boat davit not be available to off–load the ropes, it is requested that ship's staff be available to assist with the manual transfer.

Prerequisites.

- Ship moored between the buoys (bows south) centrally and tightly tensioned.
- Intercoms connected and working between the Range Control and the ship.
- Shore BT telephone (01301 703381) connected.
- All boat movements stopped and a quiet regime in being.
- A time check will be carried out with the Range at the start of each session.

Ship's normal routine machinery changing suspended except where it is vital.

3 - Underway measurements.

Prerequisites.

- A DGPS tracking system will be installed and checked out by Range staff. A portable laptop computer will be set up on the bridge to display ship's track information.
- Onboard UHF radio or satellite telephone transmissions may cause interference with the tracking system. The Ranging Officer should be informed if these transmissions are required.
- Echo sounders to be OFF (may be used for familiarisation runs).
- Pre–ranging hull inspection to be carried out, where possible. Draught marks and ballast configuration should also be noted.

4 - Shaker measurements

Controlled noise sources will be used to provide reference excitation for each acoustic ranging, changing of the signature (to demonstrate monitoring capability) and to assess the on-board to far field transfer function. Shaker excitation will be achieved using special to type electromagnetic shakers (low frequency excitation), piezo shakers (high frequency excitation) and hydraulic shaker (blade rate excitation).

CFAV Quest.

Four shaker positions have been provisionally identified, these will need to be surveyed for both access and their location relative to various structures and connections. Two of these positions will accommodate a LF shaker and HF shaker. Provisional positions are shown below.

Shaker	Position
1 (Blade rate)	Machinery control room, Frame 75 (port side)
2 (LF)	Frame 71
2 (HF)	
3 (LF)	Bow thruster compartment
3 (HF)	
4 (LF)	Below DG enclosure

Electromagnetic and Piezo shakers will be attached to the ships structure normal to the hull frame tables, T frames, and inter-frame hull plating utilising manufactured fixture. Each LF or LF/HF shaker position will consist of a shaker pad (or two pads for combined LF/HF position) and accelerometer block positioned near to the excitation point to allow near point impedance measurement. The aluminium shaker pads are 75mm dia. x 25mm drilled and tapped M12 to 20mm deep. Accelerometer blocks are 25mm aluminium cubes drilled and tapped

10/32 UNF. The shaker pads and accelerometer blocks are bonded to the ship structure using an industrial adhesive.

A series of test excitations will be conducted at Campbeltown and the structural response measured along with the onboard radiated noise. A Matlab script can be used to modify the control waveforms where necessary prior to commencement of the noise ranging. The test excitations will use Octave band centre frequencies from 63Hz to 2 kHz for the LF shaker and from 2kHz to 20kHz for the HF shaker.

Although it would be desirable to achieve excitation at all the third octave centre frequencies simultaneously, in practise this may not be possible for a number of reasons, for example where frequencies are coincident with any machinery generated tone. Shaker excitation is also likely to produce harmonics of excitation frequencies. This can complicate the excitation force applied to the structure to an extent where it increases the complexity of the analysis and reduces the actual force excitation in band. It may be therefore necessary to reduce the number of one-third octave excitation frequencies used or conduct multiple band excitations. For planning it is assumed that excitation will be split into four bands.

As well as the use of fixed tones several different source waveforms may be used to try and replicate real life sources disturbances for example compressor or a pump. Transient type excitation will be achieved using examples of valve operation etc. These waveforms have been produced from actual recordings of real machinery vibration from a non-military platform.

Prerequisites.

- Shaker and instrumentation installation.
- Interface to QUEST data acquisition system.
- Deploy temporary hydrophone at Campbeltown to allow test shakes. Adjust excitation waveform where necessary prior to deployment.

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Two shaker positions have been provisionally identified, these will need to be surveyed for both access and their location relative to various structures and connections. One of these positions (in the portside float) will accommodate a LF shaker and HF shaker. A second LF shaker will be mounted at the foundation structure of the diesel generators on the H-deck. Actual positions are to be confirmed following the April 2011 pre-tests at Aschau.

Prerequisites.

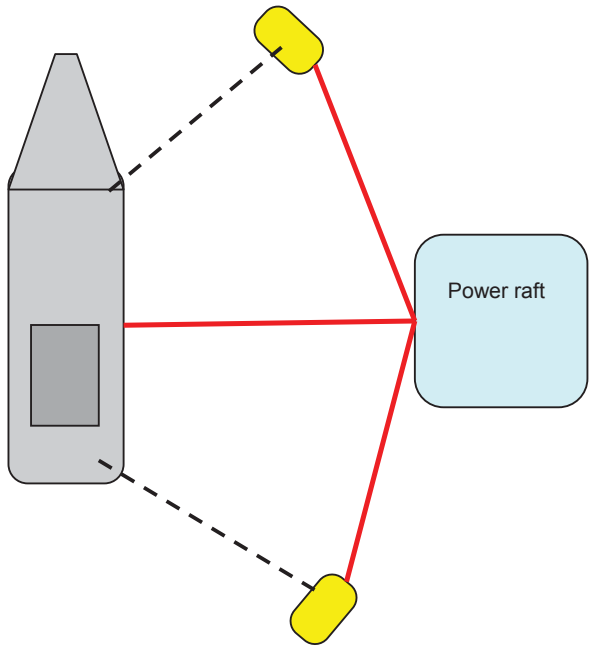
- Shaker and instrumentation installation.
- Interface to PLANET data acquisition system.

5 - Reciprocity measurements

This serial aims to use reciprocity to obtain the transfer functions and verify the consistency of the derived functions when the source and receiver locations are reversed. If the measurements are consistent and sufficient signal to noise can be obtained then this approach may prove advantageous over direct measurements due to the increased coverage afforded through an onboard instrumentation fit. Moreover, this approach may mitigate for instances when spatial or other limitations prevent the operation of structural or airborne noise sources in particular locations.

In order to conduct the reciprocity measurements a series of additional mooring lines will need to be connected (once the ship is moored) between the power raft, the NE and SE buoys, and the ship. These will have a number of marker buoys attached to warn other loch users of their presence. The umbilical cable will be connected between the power raft and the ship and will pass both reference hydrophone and hydrosounder data to the ship.

A second DGPS unit will utilised to give the position of the hydrosounder array relative to the range, in addition, depth sensors will be attached to both the reference hydrophone and the hydrosounder array, with depths recorded at the power raft.



MEASUREMENT PROCEDURE

1 -Static and shaker measurements.

- Ship to enforce quiet rules and make pipe reminding ship's staff (i.e. no unnecessary banging, clipping of watertight doors etc).
- A full list of running machinery is to be passed to the Range Control Room via intercom prior to start of measurements.
- Range requires at least 2 minutes between successive machinery changes. All changes should be at request of the Ranging Officer, unless absolutely necessary.
- An assessment of the heads may take place under the Ranging Officer's direction. If these are not detected they may be used as required. If there is any significant noise detected, which would interfere with results, their use may be limited, and a comfort break routine applied.
- There may be a requirement to modify the line–up if initial noise problems are experienced.

The following tables lists the bands and centre frequencies for the shaker and speaker measurements.

Band ident	Centre frequencies (Hz)
LF B1	63, 80, 100, 125
LF B2	160, 200, 250, 315
LF B3	400, 500, 630, 800
LF B4	1k, 1.25k, 1.6k, 2k
HF B1	2k, 2.5k, 3.15k
HF B2	4k, 5k, 6.3k
HF B3	8k, 10k, 12.5k
HF B4	16k, 20k

Band ident	Centre frequencies (Hz)
SPK1	63, 80, 100, 125, 160, 200
SPK2	250, 315, 400, 500, 630, 800
SPK3	1k, 1.25k, 1.6k, 2k, 2.5k, 3.15k
SPK4	4k, 5k, 6.3k, 8k, 10k, 12.5k, 16k, 20k

NOTE : *for the underway runs (2Q04 and 2P04 runs) we will not have time for multiple shaker ('controlled source') runs, so a single optimum configuration will have to be selected.*

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- The initial measurement condition will be the “Battery State”.
- On completion of baseline measurements the gas turbine and alternator will be started, followed by a controlled cascade to the “Self–sustaining State”. Once this state is achieved individual machinery and shaker measurements will made as identified in the following tables.
- All shaker measurements will be conducted in the self-sustaining state.
- Individual machine transfer functions will be conducted on an opportunity basis based on the suitability of the individual signatures measured.
- Machinery modification, for example by mount shorting or opening acoustic enclosures, will be conducted on an opportunity basis based on the suitability of the individual signatures measured.

Serial Q1: Battery State			**Priority 1**
Comments: None.			
Step	**Description**	**Measuring Condition**	**Run**
Q1.1	Baseline (Batteries and UPS only)		
Q1.2	Start 208V compressor for air/water cooled condenser	208V compressor	
Q1.3	Start No.1 LAC – Dry lab		
Q1.4	Start No.3 LAC – Dry lab		
Q1.5	Start No.7 LAC – Dry lab annex (LAN compt)		
Q1.6	Start No.8 LAC – Plotting room		
Q1.7	Start No.10 LAC – Fwd lab (wall mounted unit)		
Q1.8	Start No.12 LAC – Radio room		
Q1.9	Start No.14 LAC – Battery compartment		
Q.10	Start No.15 LAC – UPS compartment	Battery State baseline measurement	

Serial Q2: Self–sustaining State			Priority 1
Comments: None.			
Step	**Description**	**Measuring Condition**	**Run**
Q2.1	Start silent generator exhaust (slow)	Silent generator exhaust fan (slow)	
Q2.2	Start gas turbine and alternator	Gas turbine	
Q2.3	Energise all required transformers	[redacted]	
Heating and ventilation systems			
Q2.4	Start fwd FW boiler–heating (auto)	[redacted]	
Q2.5	Start No.1 accommodation supply fan (fast)		
Q2.6	Start No.2 accommodation supply fan (fast)		
Q2.7	Start fan 4 – Fwd washroom exhaust (fast)		
Q2.8	Start fan 5 – Refrigeration compartment exhaust (fast)		
Q2.9	Start fan 7 – Galley exhaust (fast)		
Q2.10	Start fan 11 – Steering gear exhaust		
Q2.11	Start fan 12 – Aft hydraulic compartment exhaust (fast)		
Q2.12	Start fan 13 – Rope store exhaust		
Q2.13	Start fan 19 – Port generator supply (slow)		
Q2.14	Start fan 21 – Port motor room supply (slow)		
Q2.15	Start fan 22 – Stbd motor room supply (slow)		
Q2.16	Silent generator compartment exhaust (increase to fast)		
Q2.17	Start fan 26 – Acoustic hood exhaust – centre (fast)		
Air conditioning systems			
Q2.18	Start 5H60 compressor for water cooled condenser (C2)	[redacted]	
Q2.19	Start 440V compressor for air/water cooled condenser		
Q2.20	Shutdown 208V compressor for air/water condenser		
Q2.21	Shutdown air cooled condenser fan		
Q2.22	Start No.1 SW circ pump (fwd)		
Q2.23	Start No.1 SW circ pump (aft)		
FW cooling preheat			
Q2.24	Start FW cooling preheat sets	Self–sustaining state	

Serial SQ1: Shaker serial 1			Priority 1
Comments: Blade rate			
Step	**Description**	**Measuring Condition**	**Run**
SQ1.1	Shaker 1 (hydraulic shaker)		
SQ1.2	Spare		
SQ1.3	Spare		

Serial Q3: Black, grey and sanitary systems			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
Q3.1	Shutdown all run running pumps	System shutdown	
Q3.2	Start No.1 fwd black water pump (recirc to tank)	No.1 fwd black water pp	
Q3.3	Shutdown No.1 fwd black water pump		
Q3.4	Start No.2 fwd black water pump (recirc to tank)	No.2 fwd black water pp	
Q3.5	Shutdown No.2 fwd black water pump		
Q3.6	Start No.1 aft black water pump (recirc to tank)	No.1 aft black water pp	
Q3.7	Shutdown No.1 aft black water pump		
Q3.8	Start No.2 aft black water pump (recirc to tank)	No.2 aft black water pp	
Q3.9	Shutdown No.2 aft black water pump		
Q3.10	Run sanitary SW supply pump	Sanitary SW supply pp	
Q3.11	Shutdown sanitary SW supply pump		
Q3.12	Spare		
Q3.13	Spare		
Q3.14	Spare		
Q3.15	Spare		

Serial SQ2: Shaker serial 2			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
SQ2.1	Shaker 2 (LF)	LF band 1	
	Shaker 3 (LF)	LF band 2	
	Shaker 2 (HF)	HF band 1	
	Shaker 3 (HF)	HF band 2	
SQ2.2	Shaker 2 (LF)	LF band 2	
	Shaker 3 (LF)	LF band 1	
	Shaker 2 (HF)	HF band 2	
	Shaker 3 (HF)	HF band 1	
SQ2.3	Loudspeaker (position 1)	SPK Band 1	
SQ2.4		SPK Band 2	
SQ2.5		SPK Band 3	
SQ2.6		SPK Band 4	
SQ2.7	Spare		
SQ2.8	Spare		
SQ2.9	Spare		

Serial Q4: Fresh water pump assessment			Priority 1
Comments: None.			
Step	**Description**	**Measuring Condition**	**Run**
Q4.1	Ensure water pumps shutdown	Water pumps shutdown	
Q4.2	Start No.1 domestic fresh water pump	No.1 domestic fresh water pump	
Q4.3	Stop No.1 domestic fresh water pump		
Q4.4	Start No.2 domestic fresh water pump	No.2 domestic fresh water pump	
Q4.5	Stop No.2 domestic fresh water pump		
Q4.6	Re–start quietest domestic fresh water pump as directed by Ranging Officer		
Q4.7	Stop domestic hot fresh water circ pump		
Q4.8	Start domestic hot fresh water circ pump	Domestic hot fresh water circ pump	
Q4.9	Spare		
Q4.10	Spare		
Q4.11	Spare		

Serial Q5: LP air compressor assessment			Priority 1
Comments: None.			
Step	**Description**	**Measuring Condition**	**Run**
Q5.1	Ensure LPACs shutdown	LPACs shutdown	
Q5.2	Start No.1 LPAC	No.1 LPAC	
Q5.3	Stop No.1 LPAC		
Q5.4	Start No.2 LPAC	No.2 LPAC	
Q5.5	Stop No.2 LPAC		
Q5.6	Spare		
Q5.7	Spare		
Q5.8	Spare		
Q5.9	Spare		

Serial SQ3: Shaker serial 3			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
SQ3.1	Shaker 2 (LF)	LF band 3	
	Shaker 3 (LF)	LF band 4	
	Shaker 2 (HF)	HF band 3	
	Shaker 3 (HF)	HF band 4	
SQ3.2	Shaker 2 (LF)	LF band 4	
	Shaker 3 (LF)	LF band 3	
	Shaker 2 (HF)	HF band 4	
	Shaker 3 (HF)	HF band 3	
SQ3.3	Loudspeaker (position 2)	SPK Band 1	
SQ3.4		SPK Band 2	
SQ3.5		SPK Band 3	
SQ3.6		SPK Band 4	
SQ3.7	Spare		
SQ3.8	Spare		
SQ3.9	Spare		

Serial Q6: Fuel system			Priority 1
Comments: None.			
Step	**Description**	**Measuring Condition**	**Run**
Q6.1	Stop all running fuel purifiers/pumps	Fuel system shutdown	
Q6.2	Start fwd fuel oil feed pump	Fwd fuel oil feed pump	
Q6.3	Start fwd fuel oil purifier	Fwd fuel oil feed pump and purifier	
Q6.4	Start fuel transfer pump	Fwd fuel system	
Q6.5	Stop fwd fuel system		
Q6.6	Start aft fuel oil feed pump	Aft fuel oil feed pump	
Q6.7	Start aft fuel oil purifier	Aft fuel oil feed pump and purifier	
Q6.8	Start fuel transfer pump	Aft fuel system	
Q6.9	Stop aft fuel system		
Q6.10	Stop fuel boost pump		
Q6.11	Start fuel boost pump	Fuel boost pump	
Q6.12	Spare		
Q6.13	Spare		
Q6.14	Spare		
Q6.15	Spare		

Serial Q7: Refrigeration plants			Priority 1
Comments: All coolers to be running, only one compressor to be assessed.			
Step	**Description**	**Measuring Condition**	**Run**
Q7.1	Shutdown all refrigeration systems	Refrigeration system shutdown	
Q7.2	Start Potato room, Dairy room and Fruit & Veg locker coolers	Coolers	
Q7.3	Start No.1 refrigeration compressor	No.1 fridge compressor	
Q7.4	Stop No.1 refrigeration compressor		
Q7.5	Start No.2 refrigeration compressor	No.2 fridge compressor	
Q7.6	Stop No.2 refrigeration compressor		
Q7.7	Spare		
Q7.8	Spare		

Serial SQ4: Shaker serial 4			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
SQ4.1	Shaker 4 (LF)	LF band 1	
	Loudspeaker (position 3)	SPK Band 1	
SQ4.2	Shaker 4 (LF)	LF band 2	
	Loudspeaker (position 3)	SPK Band 2	
SQ4.3	Shaker 4 (LF)	LF band 3	
	Loudspeaker (position 3)	SPK Band 3	
SQ4.4	Shaker 4 (LF)	LF band 4	
	Loudspeaker (position 3)	SPK Band 4	
SQ4.5	Spare		
SQ4.6	Spare		
SQ4.7	Spare		

Serial Q8: Steering gear assessment			Priority 1
Comments: None.			
Step	**Description**	**Measuring Condition**	**Run**
Q8.1	Ensure steering equipment shutdown	Steering equipment shutdown	
Q8.2	Start steering gear SW cooling pump	Steering gear SW cooling pump	
Q8.3	Run port steering equipment only		
Q8.4	Cycle both rudders port/starboard 35˚ with running commentary	Port motor on–load	
Q8.5	Start starboard steering equipment		
Q8.6	Cycle both rudders port/starboard 35˚ with running commentary	Both motors on–load	
Q8.7	Shutdown port steering equipment		
Q8.8	Cycle both rudders port/starboard 35˚ with running commentary	Stbd motors on–load	
Q8.9	Shutdown starboard steering equipment		
Q8.10	Shutdown steering gear SW cooling pump		
Q8.11	Spare		
Q8.12	Spare		
Q8.13	Spare		
Q8.14	Spare		

Serial SQ5: Shaker serial 5			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
SQ5.1	Shaker 2 (LF)	Transient 1	
SQ5.2	Shaker 2 (LF)	Transient 2	
SQ5.3	Shaker 3 (LF)	Transient 1	
SQ5.4	Shaker 3 (LF)	Transient 2	
SQ5.5	Shaker 4 (LF)	Transient 1	
SQ5.6	Shaker 4 (LF)	Transient 2	
SQ5.7	Spare		
SQ5.8	Spare		
SQ5.9	Spare		

Serial SQ6: Shaker serial 6			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
SQ6.1	Shaker 2 (HF)	Transient 1	
SQ6.2	Shaker 2 (HF)	Transient 2	
SQ6.3	Shaker 3 (HF)	Transient 1	
SQ6.4	Shaker 3 (HF)	Transient 2	
SQ6.5	Shaker 4 (HF)	Transient 1	
SQ6.6	Shaker 4 (HF)	Transient 2	
SQ6.7	Spare		
SQ6.8	Spare		
SQ6.9	Spare		

Serial Q9: Main motors assessment			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
Q9.1	Ensure all propulsion equipment shutdown		
Q9.2	Start No.1 propulsion motor SW cooling pump		
Q9.3	Stop No.1 propulsion motor SW cooling pump		
Q9.4	Start No.2 propulsion motor SW cooling pump		
Q9.5	Stop No.2 propulsion motor SW cooling pump		
Q9.6	Start No.1 propulsion motor lube oil pump		
Q9.7	Stop No.1 propulsion motor lube oil pump		
Q9.8	Start No.2 propulsion motor lube oil pump		
Q9.9	Stop No.2 propulsion motor lube oil pump		
Q9.10	Start port outboard main motor cooling fan (fast)	Port outboard fan only (fast)	
Q9.11	Start port inboard main motor cooling fan (fast)	Both port fans (fast)	
Q9.12	Stop port outboard main motor cooling fan	Port inboard fan only (fast)	
Q9.13	Stop port inboard main motor cooling fan	All fans shutdown	
Q9.14	Start stbd outboard main motor cooling fan (fast)	Stbd outboard fan only (fast)	
Q9.15	Start stbd inboard main motor cooling fan (fast)	Both stbd fans (fast)	
Q9.16	Stop stbd outboard main motor cooling fan	Stbd inboard fan only (fast)	
Q9.17	Start stbd inboard and both port cooling fans (fast)	All four fans (fast)	
Q9.18	Stop all four main motor cooling fans		
Q9.19	Spare		
Q9.20	Spare		
Q9.21	Spare		
Q9.22	Spare		

Serial Q10: Main engine assessment			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
Q10.1	Ensure main engines shutdown		
Q10.2	Start port main engine lube oil priming pump	Port lub oil priming pump	
Q10.3	Start port main engine	Port main engine at idle	
Q10.4	Start stbd main engine lube oil priming pump	Stbd lub oil priming pump	
Q10.5	Start starboard main engine	Both main engines at idle	
Q10.6	Stop port main engine	Starboard main engine at idle	
Q10.7	Stop starboard main engine	Both main engines shut-down	
Q10.8	Stop port & stbd ME lube oil priming pumps	Main engines shutdown	
Q10.9	Spare		
Q10.10	Spare		
Q10.11	Spare		

Serial Q11: Diesel generator assessment			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
Q11.1	Ensure all ship's service DGs shutdown		
Q11.2	Start fwd ship's service DG	Fwd DG off–load	
Q11.3	Transfer load to fwd DG	Fwd DG on–load	
Q11.4	Start aft ship's service DG		
Q11.5	Load share	Both DGs on–load	
Q11.6	Transfer load to aft DG and shutdown fwd DG	Aft DG on–load	
Q11.7	Transfer load to GTA	Aft DG off–load	
Q11.8	Shutdown aft DG.	All ship's service DGs shutdown	
Q11.9	Spare		
Q11.10	Spare		
Q11.11	Spare		
Q11.12	Spare		

Serial Q12: IR hull cooling system			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
Q12.1	Start the IR hull cooling system	System running	
Q12.2	Shutdown the IR hull cooling system	System shutdown	
Q12.3	Spare		
Q12.4	Spare		
Q12.5	Spare		
Q12.6	Spare		

Serial Q13: Bilge system assessment			Priority 2
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
Q13.1	Shutdown any running pumps	All pumps shutdown	
Q13.2	Start No.1 bilge and sullage pump	No.1 bilge and sullage pump	
Q13.3	Stop No.1 bilge and sullage pump		
Q13.4	Start No.2 bilge and sullage pump	No.2 bilge and sullage pump	
Q13.5	Stop No.2 bilge and sullage pump		
Q13.6	Start oily bilge pump	Oily bilge pump	
Q13.7	Stop oily bilge pump		
Q13.8	Spare		
Q13.9	Spare		
Q13.10	Spare		
Q13.11	Spare		

Serial Q14: Fire pump assessment			Priority 2
Comments: Please report system pressure in each condition.			
Step	**Description**	**Measuring Condition**	**Run**
Q14.1	Shutdown running fire pump	All fire pumps shutdown	–
Q14.2	Run No.1 fire pump	No.1 fire pump	
Q14.3	Throttle valve position 1		
Q14.4	Throttle valve position 2		
Q14.5	Throttle valve position 3		
Q14.6	Shutdown No.1 fire pump		
Q14.7	Run No.2 fire pump	No.2 fire pump	
Q14.8	Shutdown No.2 fire pump		
Q14.9	Restart quietest pump as directed by Ranging Officer		
Q14.10	Spare		
Q14.11	Spare		
Q14.12	Spare		
Q14.13	Spare		

Serial Q15: Ventilation assessment			Priority 2
Comments: Depending on results from the ventilation build up in serial 2, additional measurements of specific fans may be requested.			
Step	**Description**	**Measuring Condition**	**Run**
Q15.1	Start fan 3 – Foc'sle exhaust		
Q15.2	Start fan 6 – WR laundry exhaust		
Q15.3	Start fan 8 – Explosive handling supply		
Q15.4	Start fan 9 – Hospital exhaust		
Q15.5	Start fan 10 – Explosive handling and store exhaust		
Q15.6	Start fan 19 – Generator room port supply		
Q15.7	Start fan 24 – Acoustic hood exhaust – Stbd		
Q15.8	Start fan 25 – Acoustic hood exhaust – Port		
Q15.9	Reconfigure ventilation as required		
Q15.10	Spare		
Q15.11	Spare		
Q15.12	Spare		
Q15.13	Spare		

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- The initial measurement condition will be with single DG running.
- On completion of DG assessment the quietest DG (with required auxiliary i.e. SW cooling) will form the baseline.
- Cascade machinery required for ship habitability (self-sustaining) state. Once this state is achieved individual machinery and shaker measurements will made as identified in the following tables.
- All shaker measurements will be conducted in the self-sustaining state.
- Individual machine transfer functions will be conducted on an opportunity basis based on the suitability of the individual signatures measured.
- Machinery modification, for example by mount shorting or opening acoustic enclosure, will be conducted on an opportunity basis based on the suitability of the individual signatures measured.

Serial P1: Diesel generator assessment			**Priority 1**
Comments: Assume currently running No.1 DG			
Step	**Description**	**Measuring Condition**	**Run**
P1.1	No.1 DG on-load	No.1 DG on-load	1P20.1
P1.2	Start No.2 DG and share load	Nos.1 & 2 DGs on-load	1P20.2
P1.3	Transfer load to No.2 DG		
P1.4	Shutdown No.1 DG	No.2 DG on-load	1P20.3
P1.5	Start No.3 DG and share load	Nos.2 & 3 DGs on-load	1P20.4
P1.6	Transfer load to No.3 DG		
P1.7	Shutdown No.2 DG	No.3 DG on-load	1P20.5
P1.8	Start No.4 DG and share load	Nos.3 & 4 DGs on-load	1P20.6
P1.9	Transfer load to No.4 DG		
P1.10	Shutdown No.3 DG	No.4 DG on-load	1P20.7
P1.11	Start Nos.1, 2 and 3 DGs and share load	All four DGs on-load	1P20.8
P1.12	Transfer load to No.1 DG		
P1.13	Shutdown Nos.2, 3 and 4 DGs		
P1.14	Spare		
P1.15	Spare		
P1.16	Spare		
P1.17	Spare		

Serial P2: Config 0 (auxiliaries required for 3 knots)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
P2.1	Configure auxiliary machinery as required for 3 knots (with commentary)	Config 0	1P21.1
P2.2	Spare		
P2.3	Spare		
P2.4	Spare		
P2.5	Spare		

Serial P3: Config 1 (auxiliaries required for 6 knots)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
P3.1	Start No.2 DG and transfer load		
P3.2	Shutdown No.1 DG		
P3.3	Configure auxiliary machinery as required for 6 knots (with commentary)	Config 1	1P21.2
P3.4	Spare		
P3.5	Spare		
P3.6	Spare		
P3.7	Spare		

Serial P4: Config 2 (auxiliaries required for 6 knots)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
P4.1	Start No.3 DG and transfer load		
P4.2	Shutdown No.2 DG		
P4.3	Configure auxiliary machinery as required for 6 knots (with commentary)	Config 2	1P21.3
P4.4	Spare		
P4.5	Spare		
P4.6	Spare		
P4.7	Spare		

Serial P5: Config 6 (auxiliaries required for 9 and 12 knots)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
P5.1	Start No.2 DG and share load		
P5.2	Configure auxiliary machinery as required for 9 and 12 knots (with commentary)	Config 6	1P21.4
P5.3	Spare		
P5.4	Spare		
P5.5	Spare		
P5.6	Spare		

Serial P6: Config 7 (auxiliaries required for 15 knots)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
P6.1	Start Nos.1 and 4 DGs and share load		
P6.2	Configure auxiliary machinery as required for 15 knots (with commentary)	Config 7	1P21.5
P6.3	Revert to auxiliary machinery required for 6 knots		
P6.4	Spare		
P6.5	Spare		
P6.6	Spare		
P6.7	Spare		

Serial P7: Water pump assessment			Priority 1
Comments: Reconfigure to quietest DG as directed by range. (assume No.1 SW and FW cooling pumps running). Unclear what cooling is required and whether a shutdown of the systems can be achieved. Expectation is that 1 of each pump will be needed and therefore the four states achievable are detailed below.			
Step	**Description**	**Measuring Condition**	**Run**
P7.1	Initial condition of No.1 SW and No.1 FW pumps running	No.1 SW cooling pump & No.1 FW cooling pump	1P22.1 & 1P23.1
P7.2	Start No.2 SW cooling pump		
P7.3	Shutdown No.1 SW cooling pump	No.2 SW cooling pump & No.1 FW cooling pump	1P22.2 & 1P23.1
P7.4	Start No.2 FW cooling pump		
P7.5	Shutdown No.1 FW cooling pump	No.2 SW cooling pump & No.2 FW cooling pump	1P22.2 & 1P23.2
P7.6	Start No.1 SW cooling pump		
P7.7	Shutdown No.2 SW cooling pump	No.1 SW cooling pump & No.2 FW cooling pump	1P22.1 & 1P23.2
P7.8	Spare		
P7.9	Spare		
P7.10	Spare		
P7.11	Spare		

Serial SP8: Shaker tests			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
SP8.1	Shaker serial 1		1P30.1
SP8.2	Shaker serial 2		1P30.2
SP8.3	Shaker serial 3		1P30.3
SP8.4	Shaker serial 4		1P30.4
SP8.5	Spare		
SP8.6	Spare		
SP8.7	Spare		
SP8.8	Spare		

Serial LP9: Loudspeaker tests			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
LP9.1	Loudspeaker serial 1		1P31.1
LP9.2	Loudspeaker serial 2		1P31.2
LP9.3	Loudspeaker serial 3		1P31.3
LP9.4	Loudspeaker serial 4		1P31.4
LP9.5	Spare		
LP9.6	Spare		
LP9.7	Spare		
LP9.8	Spare		

2 - Underway (dynamic) measurements.

- Runs from North to South (208°) will be suffixed 'A'. Runs from South to North (028°) will be suffixed 'B'.
- A pair of runs will normally be required in each condition. Exceptions may apply.

CFAV Quest

Machinery states.

Config	DGs
1	No.1
2	No.2
3	Nos.1 and 2

Run plan.

Run No.	Config	Nominal Speed (knots)	Shaft rpm	Comments	Priority
0	-	10	100	Range Familiarisation	–
2Q01A1	1	6	60	QRC1	1
2Q01B2					
2Q01A3				Repeat measurements if required	2
2Q01B4					
2Q02A1	2	6	60	QRC2	1
2Q02B2					
2Q02A3				Repeat measurements if required	2
2Q02B4					
2Q03A1	3	12	120	QRC3	1
2Q03B2					
2Q03A3				Repeat measurements if required	2
2Q03B4					
2Q04A1	1	6	60	QRC4 (QRC1 and additional sources) Shakers (Bands TBC)	1
2Q04B2					
2Q04A3				Repeat measurements if required	2
2Q04B4					
2Q05A1	1	6	60	QRC5 Bottom profiler	1
2Q05B2					
2Q05A3				Repeat measurements if required	2
2Q05B4					
2Q06A1	1	9	90		1
2Q06B2					
2Q06A3				Repeat measurements if required	2
2Q06B4					

Run No.	Config	Nominal Speed (knots)	Shaft rpm	Comments	Priority
2Q10A1	1	3 – 10	30 – 100	Accelerating	1
2Q10B2					
2Q10A3				Repeat measurements if required	2
2Q10B4					
2Q11A1	1	10 – 0	100 – 0	Decelerating	1
2Q11B2					
2Q11A3				Repeat measurements if required	2
2Q11B4					
2Q12A1	1	9	90	Apply 20° rudder at CPA	
2Q12B2					
2Q12A3				Repeat measurements if required	
2Q12B4					
2Q13A1	1	9	90	Apply 30° rudder at CPA	
2Q13B2					
2Q13A3				Repeat measurements if required	
2Q13B4					
2Q20A1	1	6	60	IR washdown system running	1
2Q20B2					
2Q20A3					2
2Q20B4					
2Q21A1	1	6	60	Raft mounts shorted	
2Q21B2					
2Q21A3					
2Q21B4					
2Q22A1	1	6	60	Acoustic enclosures open	
2Q22B2					
2Q22A3					
2Q22B4					

RV Planet.

Machinery states.

State	DGs
0	No.1
1	No.2
2	No.3
3	Nos.1 and 4
4	Nos.1 and 3
5	
6	Nos.2 and 3
7	Nos.1, 2, 3 and 4

Run plan.

Run No.	Config	Nominal Speed (knots)	Shaft rpm	Comments	Priority
0	-	10	90	Range Familiarisation	–
2P01A1	1	6	55	PRC1	1
2P01B2					
2P01A3				Repeat measurements if required	2
2P01B4					
2P02A1	2	6	55	PRC2	1
2P02B2					
2P02A3				Repeat measurements if required	2
2P02B4					
2P03A1	4	15	140		1
2P03B2					
2P03A3				Repeat measurements if required	2
2P03B4					
2P04A1	1	6	55	PRC1 and additional sources	1
2P04B2					
2P04A3				Repeat measurements if required	2
2P04B4					

Run No.	Config	Nominal Speed (knots)	Shaft rpm	Comments	Priority
2P05A1	1	low	low	Towed noise source	1
2P05B2					
2P05A3				Repeat measurements if required	2
2P05B4					
2P06A1	3	9	75		1
2P06B2					
2P06A3				Repeat measurements if required	2
2P06B4					
2P07A1	3	12	1000		1
2P07B2					
2P07A3				Repeat measurements if required	2
2P07B4					
2P10A1	4	6 – max	55 – max	Accelerating	1
2P10B2					
2P10A3				Repeat measurements if required	2
2P10B4					
2P11A1	4	max – 6	140 – 55	Decelerating	1
2P11B2					
2P11A3				Repeat measurements if required	2
2P11B4					
2P12A1	3	9	75	Apply rudder at CPA	
2P12B2					
2P12A3				Repeat measurements if required	
2P12B4					

Reciprocity measurements (static).

All reciprocity measurements will be conducted in the self-sustaining state.

CFAV Quest.

Serial RQ1: Reciprocity serials (QUEST)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
RQ1.1	Position 1	Tones	
RQ1.2		Chirp	
RQ1.3	Position 2	Tones	
RQ1.4		Chirp	
RQ1.5	Position 3	Tones	
RQ1.6		Chirp	
RQ1.7	Position 4	Tones	
RQ1.8		Chirp	
RQ1.7	Spare		
RQ1.8	Spare		

RV Planet.

Serial RP1: Reciprocity serials (PLANET)			Priority 1
Comments:			
Step	**Description**	**Measuring Condition**	**Run**
RP1.1	Position 1	Tones	
RP1.2		Chirp	
RP1.3	Spare		
RP1.4	Spare		

DATA RECORDING, COLLECTION AND DISTRIBUTION

It is assumed that only processed data will be supplied in the form of:

- one-third octave time series data;
- narrowband time series data.

All data is time stamped from a time source utilising IRIG and the time can be assumed to be correct.

Note: During underway runs the time source is synchronised to a GPS reference and is the UTC time code. For static trials it is normal for the control room to synchronise to the on-board time of the vessel being ranged.

All data is acquired via the Bruel and Kjaer PULSE data acquisition system, with additional software used for further data handling and analysis.

The system uses the 3560C PULSE front-end with a 3110 module installed, with an associated PC, providing a 2 channel system. This is controlled by a separate PC which allows for up to four PULSE systems to be used together.

All data will be supplied be supplied as SPL spectra **WITHOUT** correction for bandwidth and will be in dB re 1μPa. This is for both one-third octave and narrowband data. It is **NOT** intended to supply the narrowband data as power spectral density.

As indicated above levels are corrected for hydrophone sensitivity and calibration, which accounts for items such as cable loss. The corrections are given for each one-third octave centre frequency and for both one-third octave and narrowband data corrected for each one-third octave band. For narrowband this is based on the equivalent upper and lower frequency for each one-third octave band/filter.

Levels are stored to the nearest dB.

No correction will be made for distance (i.e. no slant range correction). The range can supply data which has been corrected using tracking data based on a 20 log R correction, where R is the slant range. It is intended **NOT** to supply this data unless requested.

For underway runs it is intended to supply data for the duration of the run. This is normally always be greater than +/- 500m around CPA.

For static runs it is intended to supply data for the duration of the run. For a static run the duration is normally for a serial constituting a number of ship machine configurations. These serials can be between 1 to 3 hours dependent on the type of trial and amount of time required to perform changes.

One-third octave data.

Three acquisition modes will be available:

1. 2 second exponential average, levels stored 2 second intervals for bands CF 10Hz to 80kHz inclusive
2. 2 second exponential average, levels stored 1 second intervals for bands CF 10Hz to 80kHz inclusive.
3. Equal confidence exponential average, levels stored 0.1 second intervals for bands CF 10Hz to 80kHz inclusive

Only one mode can be acquired at a time, it is intended that modes 1 and 2 will be supplied. Mode 3 will **NOT** be supplied unless requested and this would require additional replays.

More information is available if required on equal confidence - but effectively it weights the average time so an increase in frequency the average time reduces based on each set of one-third octave filters in an octave.

An example one-third octave text output file is shown at the end of this section.

Narrowband data.

Narrowband data is acquired for a number of frequency ranges. All narrowband data is a baseband 800 line FFT with Hanning weighting. Details of the frequency ranges are detailed below. Further narrowband frequency ranges can be undertaken but these are by replay after the trial and it is **NOT** intended to supply this data unless requested.

Frequency (Hz)	Overlap (%)	Bandwidth, Hz (with weighting)	Output (Seconds)	Stored (Seconds)
0 - 200	87.5	0.375	½	1.5
0 - 800	50	1.5	½	1.5
0 - 1600	0	3	¼	1.5
0 - 3200	0	6	¼	1.5
0 - 6400	0	12	1/8	1.5
0 - 12800	0	24	1/8	1.5

Each narrowband is outputted by the PULSE system at the rate shown above and averaged for storage at 1.5 second intervals, for all ranges.

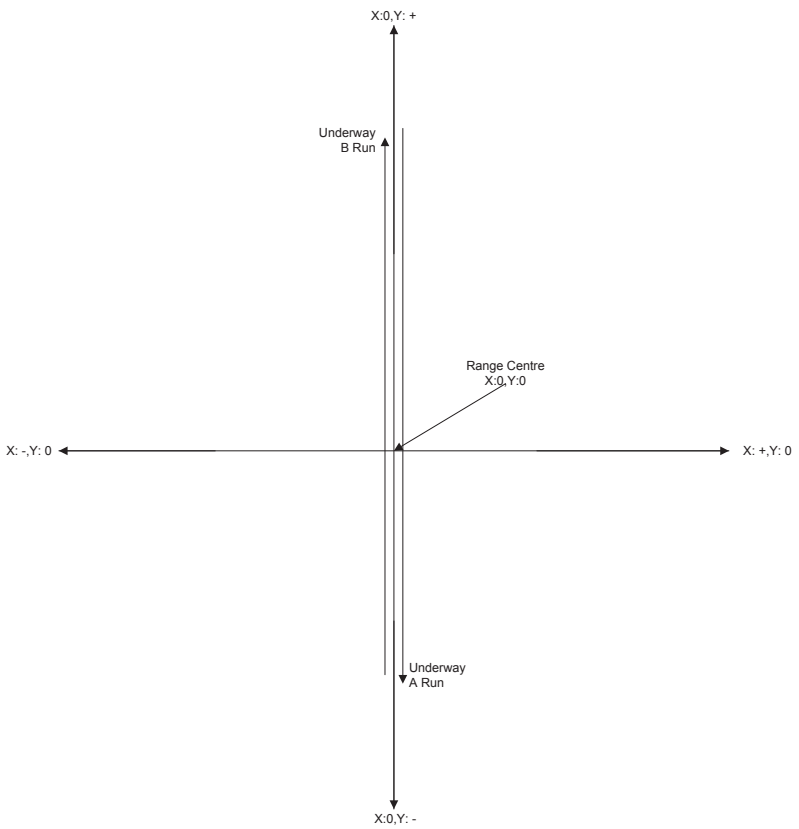
In addition, a second set of narrowband data shall be provided in the format as detailed below.

- NB SPL spectra shall be provided over the frequency range 0 – 1600Hz
- NB SPL spectra shall be provided as pressure spectral density, in dB re 1 μPa2/Hz;
- NB SPL spectra shall be obtained via FFT processing. Processing parameters: block length 2 s, Hann window, 50% overlap (i.e. SPL at each 1 s interval, in a 1 Hz bandwidth).

The raw acoustic signal is stored for all hydrophones and can be provided if required. It is intended that this will **NOT** be provided unless separately requested.

Tracking.

All tracking data is in metres and relative to a 'nominal' range centre. The range coordinates are in the notation of X, Y and Z. An illustration of the tracking is shown below.



For underway runs the vessel transits on a nominal X=0. For an A run the vessel will transit from a +Y decrementing through the range centre and completing the run on a –Y coordinate. For a B run the vessel will transit from a -Y incrementing through the range centre and completing the run on a +Y coordinate. Z is the depth and not used for surface vessel trials and is kept constant at Z=0.

Tracking data is received ashore in the control room from the vessel via a UHF modem link and processed by a dedicated PC to translate the GPS receiver message in to range coordinates. All tracking data is time stamped with the original time as given in the GPS receiver message.

Two track files are stored ‘Track.txt’ and ‘Fixtrack.txt’, both files are in ASCII (tab space) format.

Track.txt.

Stored as it arrives on the controller via an RS232 PC from the tracking PC. The tracking PC translates the GPS receiver data to the range coordinates. An illustration of the track.txt file data is given below.

Time	Vessel	X	Y				
216:11:16:06.0	1	-6	55	0	0	0	0
216:11:16:07.0	1	-6	48	0	0	0	0
216:11:16:08.0	1	-6	40	0	0	0	0
216:11:16:09.0	1	-6	33	0	0	0	0
216:11:16:10.0	1	-5	25	0	0	0	0
216:11:16:11.0	1	-5	17	0	0	0	0
216:11:16:12.0	1	-5	10	0	0	0	0
216:11:16:13.0	1	-5	2	0	0	0	0
216:11:16:14.0	1	-5	-5	0	0	0	0
216:11:16:15.0	1	-5	-13	0	0	0	0
216:11:16:16.0	1	-5	-21	0	0	0	0
216:11:16:17.0	1	-4	-28	0	0	0	0
216:11:16:18.0	1	-4	-36	0	0	0	0
216:11:16:19.0	1	-4	-43	0	0	0	0
216:11:16:20.0	1	-3	-51	0	0	0	0

The format is:

- Time Day:HH:MM:SS.S
- Vessel always 1
- X metres
- Y metres

All values after the Y coordinate on each line, which are set to 0, are for the provision of a second GPS receiver. Currently a second GPS receiver is not used and for this trial all values will be as above.

Fixtrack.txt.

Is the corrected tracking data which has any erroneous data corrected and has a distance correction applied (which is normally the distance from the GPS receiver to the assume noise source location). For this trial the distance correction will be set to 0.

An illustration of the fixtrack.txt file data is given below –

Time(1)	Time(2)	X	Y
8.39157361000000E+0008	11:16:01 04/08/2006	-4	94
8.39157362000000E+0008	11:16:02 04/08/2006	-4	86
8.39157363000000E+0008	11:16:03 04/08/2006	-5	78
8.39157364000000E+0008	11:16:04 04/08/2006	-5	71
8.39157365000000E+0008	11:16:05 04/08/2006	-6	63
8.39157366000000E+0008	11:16:06 04/08/2006	-6	55
8.39157367000000E+0008	11:16:07 04/08/2006	-6	48
8.39157368000000E+0008	11:16:08 04/08/2006	-6	40
8.39157369000000E+0008	11:16:09 04/08/2006	-6	33
8.39157370000000E+0008	11:16:10 04/08/2006	-5	25
8.39157371000000E+0008	11:16:11 04/08/2006	-5	17
8.39157372000000E+0008	11:16:12 04/08/2006	-5	10
8.39157373000000E+0008	11:16:13 04/08/2006	-5	2
8.39157374000000E+0008	11:16:14 04/08/2006	-5	-5
8.39157375000000E+0008	11:16:15 04/08/2006	-5	-13
8.39157376000000E+0008	11:16:16 04/08/2006	-5	-21
8.39157377000000E+0008	11:16:17 04/08/2006	-4	-28
8.39157378000000E+0008	11:16:18 04/08/2006	-4	-36
8.39157379000000E+0008	11:16:19 04/08/2006	-4	-43
8.39157380000000E+0008	11:16:20 04/08/2006	-3	-51
8.39157381000000E+0008	11:16:21 04/08/2006	-3	-59
8.39157382000000E+0008	11:16:22 04/08/2006	-3	-66
8.39157383000000E+0008	11:16:23 04/08/2006	-2	-74
8.39157384000000E+0008	11:16:24 04/08/2006	-2	-82
8.39157385000000E+0008	11:16:25 04/08/2006	-2	-89
8.39157386000000E+0008	11:16:26 04/08/2006	-1	-97
8.39157387000000E+0008	11:16:27 04/08/2006	-1	-105

The format is:

- Time1 A value for time relative to 00:00:01 01/01/1980
- Time 2 HH:MM:SS DD/MM/YYYY
- X metres
- Y metres

Environmental data. The following will be collected:

- **Water depth** - The depth of each hydrophone will be recorded once per hour. This depth will be relative to the surface. **Note:** the depth sensor interferes with the hydrophone signal and therefore normal trial acquisition must cease whilst this activity is undertaken.
- **Sea state and wave height** – It is assumed that this will be by observation of the ship's staff.
- **Wind speed, Wind direction, Air temperature, Air pressure** – this will be provided in an ASCII file(s). Currently, the wind speed and direction is recorded and it is intended that a commercial COTS unit will be purchased for the trial to provide air temperature and pressure.
- **Sound Speed Profile** – It is assumed that the ships will undertake this activity. It is **NOT** intended to supply this data as part of the trials data.

Owing to limited equipment or existing range information it is **NOT** intended to provide the following information as part of the trials data.

- Bathymetry (depth),
- Sound speed profile ms-1 every metre,
- Sediment/particle size/type, Sediment layer thicknesses, (limited data available for an area at the head of the Loch Goil)
- Current profile

ANALYSIS PLAN

Item	Detail
UWN static and dynamic ranging of CFAV Quest and RV Planet at Loch Goil and Loch Fyne ranges	UWN data (includes 1x beam and 1x keel hydrophone time series) UWN measurement report(s)
Onboard noise source 'shakers' operation on CFAV Quest at all European ranges	Equipment and staff (with Aus-DSTO)
Transfer functions, (shakers) onboard/off-board, static ranging at Loch Goil	Calculated transfer functions Analysis report
Correlation of data between limited onboard sensor set and UWN (HVME 'Lite')	Contribution to SET-166 final report
Range comparison	Contribution to SET-166 final report
Loch Goil Propagation Study	Contribution to SET-166 final report
EM Contributions	Onboard CFAV Quest (detail tbd) Range site activity (detail tbd)

ANNEX G
TRIAL 02 (DEEP WATER)

OBJECTIVES

The deep water trials are being performed to provide a measure of the two ships acoustic signature in an infinite half-space environment. All other rangings will be performed in shallow water with the associated difficulties of predicting propagation and reverberation in such complicated environments. While shallow water rangings provide valuable information for that particular environment, it is difficult to extrapolate those results to other littoral spaces or to the open ocean environment.

Measurements performed in deep water, essentially free of bathymetric effects, allow for a “true” signature measurement. It may prove to be much easier to extrapolate such an ideal measurement to a variety of environments and the measurement itself provides a valuable comparison (perhaps even a baseline) with the shallow water measurements.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

Units participating include CFAV QUEST and RV PLANET. PLANET will deploy its vertical hydrophone array to measure the signatures of both QUEST and PLANET and QUEST will deploy its LAND buoys to perform the same task. It is expected that the LAND buoys will also be used to perform signature measurements while QUEST is manoeuvring in the days leading up to when the two ships work together.

RANGE INFORMATION

All measurements will be performed in open ocean conditions. The actual timing of the trial will depend on transit speeds and the departure from Loch Goil. The current schedule is as follows.

DATE	ACTIVITY	TIME	COMMENT
2011-08-18	Rendezvous with Planet for pre-trial meeting	0900	Personnel transfer possible
2011-08-18	QUEST depart Loch Goil	1200	Transit of 340nm (34 hours)
2011-08-19	QUEST arrive at 58.50.00N 08.20.00W	2200	
2011-08-20	QUEST LAND buoy trials	0700	2 days of trials around LAND buoys and wavebuoy
2011-08-22	PLANET arrive at 58.50.00N 08.20.00W	0600	
2011-08-22	Commence combined trials, measure PLANET using LAND buoys	0700	
2011-08-23	Measure QUEST using PLANET vertical array	0700	
2011-08-23	Depart from 59.13.00N 7.52.00W for Bergen	1800	Transit of 410nm
2011-08-24	Measure PLANET using PLANET vertical array	0700	
2011-08-25	Arrive Bergen area	1300	

Note that the expected daylight hours for Bergen (reasonable approximation) are.:

DATE	SUNRISE	SUNSET	LENGTH
2010-08-20	0603	2120	15h 17m
2010-08-25	0615	2105	14h 50m

If the expected weather at the deep water position (58°50’00N, 008°20’00W) for a significant portion of the trial is unsuitable, both QUEST and PLANET will rendezvous at the Sognefjord and perform the necessary measurements there. The long range forecast will be evaluated at the pre-trial briefing in Loch Goil and the decision made then.

If the change in location is required, a request will be send out accordingly:

QUEST, PLANET

22/08/11, 06:00 UTC – 27/08/11, 16:00 UTC, Sognefjord, 5°23'E - 6°13'E

Note:

- that the exact dates have to be confirmed with Norway depending on the expected weather conditions and that a daily stay in Bergen harbour should be possible;
- for changes to the trial planning see the procedures in paragraph 2.3 of the Master Trial Plan.

Upon completion of each day’s trials, PLANET and QUEST will recover their equipment as required. If necessary (schedule requirements) and conditions permit, both ships are to consider redeploying to a new location closer to Bergen (travelling during the night). This potentially moves the trials to slightly deeper water, allows more time for buoy drifting, and shortens the final transit to the Bergen area.

TRACKING

No specific range tracking is required. Each ship will maintain GPS logs during the specified runs and both the vertical array and the LAND buoys are equipped with GPS systems for tracking their own positions. The LAND buoys are capable of broadcasting their position, so QUEST will note their deployment location and radio those positions to PLANET. Care must be taken to avoid striking the buoys as they will drift from those locations. Note that DRDC will deploy a wave buoy during the trials. This buoy is also equipped with GPS which will be transmitted to QUEST on a regular basis. This information will be passed to PLANET to avoid any damage to the buoy.

The distance between the vertical array and the target ship will be measured as mentioned out under Range Calculation at the end of this Annex.

COMMUNICATION

The ships will communicate with ship systems (assume VHF radio). Specific protocols will be confirmed during the pre-trial brief in Scotland, but a typical plan for Quest assumes:

HF SSB(RT)	PRI	25100 kHz
	SEC	2237 kHz
VHF	PRI	Channel 16
UHF	PRI	279.400 MHz
	SEC	302.250 MHz
Call signs:	CFAV Quest	tbd
	MV Planet	tbd

For general purpose communication, some Quest information is listed below (not all necessarily applicable to this trial)

Quest Phone Numbers. See contact data in Master Trial Plan.

MEASUREMENT PROCEDURE & RUN PLANS

20-21 August : QUEST in deep water (58°50’00N, 008°20’00W), measurement using LAND Buoys

QUEST will evaluate the current weather upon arrival to determine whether the projected drift of the buoys to be deployed will place them close to the undersea shelf. If so, QUEST will steam towards deeper waters until this is no longer of concern (and inform PLANET of the new location).

The wave buoy will be deployed at 0700 and the position marked. The four LAND buoys will then be deployed shortly thereafter roughly 250m from the wave buoy. They will be deployed sequentially in a line separated by 250m directly from QUEST. They will be aligned with the prevailing sea at the time so that passing runs will be either head or following seas. QUEST will perform two sets of runs, the minimum ranging set and some manoeuvring runs.

The minimum set is that indicated in the table below (and agreed upon in the SET panel).

CFAV Quest (Land Buoys).

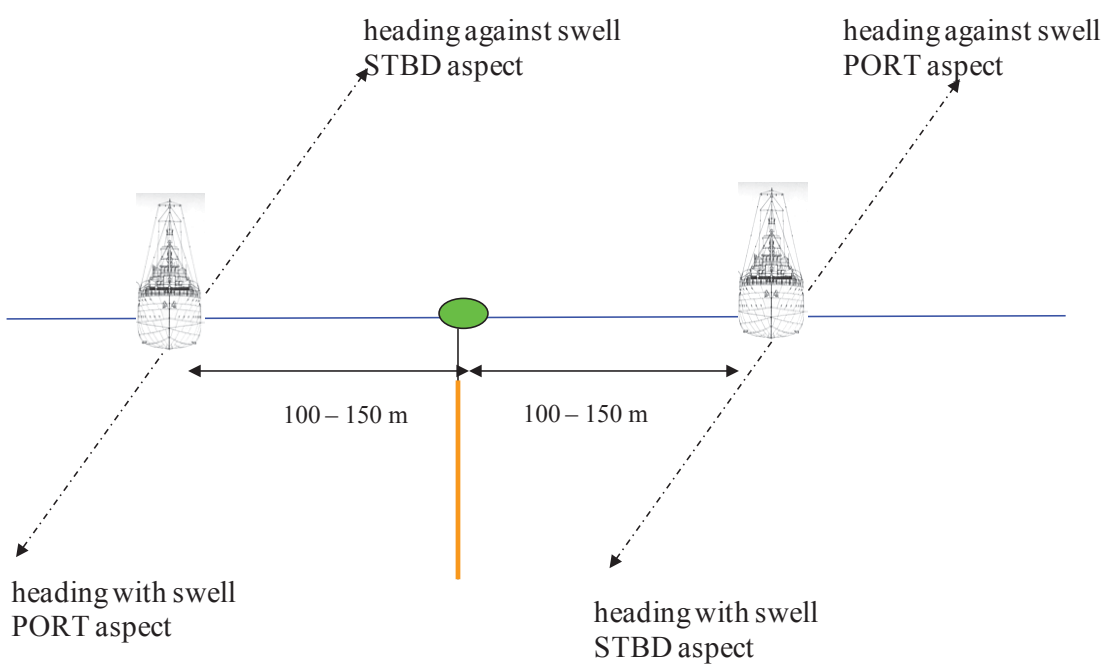
Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3Q1A1	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q1A2	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q1A3	1	60	60	6	against swell	150	PORT		
3Q1A4	1	60	60	6	against swell	150	PORT		
3Q1B5	**1**	**60**	**60**	**6**	**with swell**	**-150**	**PORT**		
3Q1B6	**1**	**60**	**60**	**6**	**with swell**	**-150**	**PORT**		
3Q1B7	1	60	60	6	with swell	-150	PORT		
3Q1B8	1	60	60	6	with swell	-150	PORT		
3Q2A1	**2**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q2A2	**2**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q2A3	2	60	60	6	against swell	150	PORT		
3Q2A4	2	60	60	6	against swell	150	PORT		
3Q3A1	**3**	**120**	**120**	**12**	**against swell**	**150**	**PORT**		
3Q3A2	**3**	**120**	**120**	**12**	**against swell**	**150**	**PORT**		
3Q3A3	3	120	120	12	against swell	150	PORT		
3Q3A4	3	120	120	12	against swell	150	PORT		
3Q4A1	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		**QRC1 + additional sources**
3Q4A2	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		**QRC1 + additional sources**
3Q4A3	1	60	60	6	against swell	150	PORT		QRC1 + additional sources
3Q4A4	1	60	60	6	against swell	150	PORT		QRC1 + additional sources
3Q12A1	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		**rudder at cpa**

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3Q12A2	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		**rudder at cpa**
3Q12A3	1	90	90	9	against swell	150	PORT		*rudder at cpa*
3Q12A4	1	90	90	9	against swell	150	PORT		*rudder at cpa*
3Q6A1	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		
3Q6A2	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		

Legend. Minimal 2 runs for each condition
Bold - priority run
Italics - when required

The runs will proceed according to the diagram below. Note that the green circle indicates the line of buoys in this case.

Deep water trials



Upon completion of the runs mentioned in the previous tables, a series of manoeuvring runs will be performed. QUEST will approach the buoy line at the specified speed and, once at CPA or as soon as possible after passing CPA, apply ship rudder in the direction noted. QUEST will hold this condition for 3 minutes or as long as safety permits

Run #	Ship Speed (kts)	Comex Range (Meters)	Rudder Angle	Turn Direction
XXX1	6	200	5 degrees	Starboard
XXX2	6	200	5 degrees	Starboard
XXX3	6	200	15 degrees	Starboard
XXX4	6	200	15 degrees	Starboard
XXX5	12	400	5 degrees	Starboard
XXX6	12	400	5 degrees	Starboard
XXX7	12	400	15 degrees	Starboard
XXX8	12	400	15 degrees	Starboard
XXX9	9	300	5 degrees	Starboard
XX10	9	300	5 degrees	Starboard
XX11	9	300	15 degrees	Starboard
XX12	9	300	15 degrees	Starboard
XX13	6	200	5 degrees	Port
XX14	6	200	5 degrees	Port
XX15	6	200	15 degrees	Port
XX16	6	200	15 degrees	Port
XX17	12	400	5 degrees	Port
XX18	12	400	5 degrees	Port
XX19	12	400	15 degrees	Port
XX20	12	400	15 degrees	Port
XX21	9	300	5 degrees	Port
XX22	9	300	5 degrees	Port
XX23	9	300	15 degrees	Port
XX24	9	300	15 degrees	Port

QUEST will continue the requested turn until the heading has changed by 90º.

QUEST will perform all or some of these runs depending on the time available. Two days are available until PLANET arrives. It is expected that QUEST will recover the LAND buoys at the end of each day to recover the data and reset the buoys for the following day. If required, they can be left in place as they possess sufficient battery life. It is expected that QUEST will perform measurements until approximately 2000 (if necessary) to optimize the daylight hours available.

Note that the wave buoy should have sufficient battery life for the expected 4-day duration of the trial and DRDC may choose to monitor the buoy overnight for further wave fusion work. It may be recovered if it is necessary to move the ship(s).

22 August - PLANET in Deep Water (58°50'00N, 008°20'00W), Measurement Using LAND Buoys

It is expected that PLANET will arrive some time during the night of August 21 or the morning of August 22. PLANET and QUEST should rendezvous at approximately 0600. It may be necessary to transfer a liaison person (Tara LeBlanc – DRDC) by boat from QUEST to PLANET.

QUEST and PLANET will perform CTD and/or XBT measurements and QUEST will deploy the wave buoy and LAND buoys as noted above. Both ships will depart the vicinity of the LAND buoys and stay silent at a distance of approximately 3 km while an initial ambient noise measurement is performed. QUEST will then stand off at a distance of 1-2 kilometres running on gas turbine only (to reduce noise). PLANET will prepare for their runs. PLANET will then perform the runs as specified below as per the run geometry noted above.

The run list (22/08/11, 06:00 UTC - 22/08/11, 20:00 UTC), includes 2 hours for deploying systems before the first run, 1 hour CTD measurement and 2 hours picking up deployed systems.

RV Planet (LAND Buoys).

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3P2A1	2	55	55	6	against swell	-150	STBD		
3P2B2	2	55	55	6	with swell	-150	PORT		
3P2A3	2	55	55	6	against swell	150	PORT		
3P1A1	1	55	55	6	against swell	-150	STBD		
3P4B2	1	55	55	6	with swell	-150	PORT		additional sources
3P4A3	1	55	55	6	against swell	150	PORT		additional sources
3P6B1	3	75	75	9	with swell	-150	PORT		
3P6B2	3	75	75	9	with swell	150	STBD		

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3P7A1	3	100	100	12	against swell	-150	STBD		
3P7B2	3	100	100	12	with swell	-150	PORT		
3P7A3	3	100	100	12	against swell	150	PORT		
3P3B1	4	140	140	15	with swell	-150	PORT		
3P3A2	4	140	140	15	against swell	150	PORT		
3PBG1	0	0	0	0		4000			
3PP1	0	0	0	0		1500			Buoy off, towed source into water
3P5A1	1	low	low	low	against swell	150	PORT		Towed noise source
3P5B2	1	low	low	low	with swell	-150	PORT		Towed noise source

For performing the runs, the following procedure is proposed:

1. PL, prepare for run XXXX.
2. QU gives information about distances and I-LAND buoy positions.
3. PL tracks the I-LAND buoy and adjust course only.
4. PL (PLANET): Preparing run XXXX.
5. QU (QUEST): Buoy ready for measurement.
6. PL: Run XXXX prepared. We are ready for run.
7. QU: Start run XXXX.
8. PL: Run XXXX started. Config No. XX, rpm xx, stw XX knots.
9. PL (once a distance of 1000 m before LAND buoy is reached): We have reached pos. 1. Structure borne measurement run XXXX was started.
10. PL (once a distance of 400 m before LAND buoy is reached): We have reached pos. 2. QU, please start the hydrophone measurement.
11. QU: Hydrophone measurement started.
12. PL (gives a Ping, LFM up, fm=4kHz, BW= 250Hz, 100ms): Ping gone out.
13. PL: We have reached CPA on buoy 1.
14. PL: We have reached CPA on buoy 4.

15. PL (once a distance of 400 m behind last LAND buoy is reached, PLANET gives a ping, LFM up, fm=4kHz, BW= 250Hz, 100ms): We have sent a ping at pos. 3. Please stop the hydrophone measurement.
16. QU: Hydrophone measurement was stopped.
17. PL (once a distance of 1000 m behind LAND buoy is reached): We have reached pos. 4. Structure borne measurement run XXXX was stopped.
18. QU: Run was (not) successful.

Upon completion of the run series (or if it is necessary to stop due to loss of daylight), PLANET will recover the towed source on board, if not be done earlier. QUEST will recover the LAND buoys and the wave buoy (if desired). QUEST and PLANET will perform CTD and/or XBT measurements. The DRDC liaison will remain onboard PLANET for the next trial.

23 August - QUEST in Deep Water (58°50’00N, 008°20’00W), Measurement using VAIII Buoy

PLANET and QUEST will rendezvous again at approximately 0600. PLANET will transfer a liaison person to QUEST by ship’s boat. The DRDC liaison will remain aboard PLANET to observe the measurements.

Starting at 0700, QUEST and PLANET will perform CTD and/or XBT measurements and QUEST will deploy the wave buoy while PLANET deploys the VAIII system. QUEST will deploy the wave buoy in the general area (approximately 300m from the array to minimize the risk of collision). Both ships will depart the vicinity of the VAIII system and stay silent at a distance of approximately 3 km while an initial ambient noise measurement is performed. PLANET will then stand off to operate the VAIII while QUEST prepares for the runs. QUEST will activate a pinger (2-8 kHz, 40 ms, every 20 s, LFM) for the duration of the runs. QUEST will then perform the runs as specified below as per the run geometry noted above.

The run list (23/08/11, 06:00 UTC - 22/08/11, 18:00 UTC), includes 2 hours for deploying systems before the first run, 1 hour CTD measurement and 2 hours picking up deployed systems.

For performing the runs, the following procedure is proposed:

1. PL (PLANET): Buoy ready for measurement. QUEST, prepare for run XXXX.
2. QU (QUEST): Preparing run XXXX.
3. QU: Run XXXX prepared. We are ready for run.
4. PL: Start run XXXX.
5. QU: Run XXXX started. Config No. XX, rpm xx, stw XX knots.
6. QU (once a distance of 1000 m before VAIII buoy is reached): We have reached pos. 1. Structure borne measurement run XXXX started.

7. QU (once a distance of 400 m before VAIII buoy is reached): We have reached pos. 2. PL, please start the hydrophone measurement.
8. PL: Hydrophone measurement started.
9. QU: We have reached CPA.
10. QU (once a distance of 400 m behind VAIII buoy is reached): We have reached pos 3. Please stop the hydrophone measurement!
11. PL: Hydrophone measurement was stopped.
12. QU (once a distance of 1000 m behind VAIII buoy is reached): We have reached pos. 4. Structure borne measurement run XXXX was stopped.
13. PL: Run was (not) successful.

CFAV Quest (VAIII Buoy).

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3Q1A6	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q1A7	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q1A8	1	60	60	6	against swell	150	PORT		
3Q1A9	1	60	60	6	against swell	150	PORT		
3Q1B9	**1**	**60**	**60**	**6**	**with swell**	**-150**	**PORT**		
3Q1B10	**1**	**60**	**60**	**6**	**with swell**	**-150**	**PORT**		
3Q1B11	1	60	60	6	with swell	-150	PORT		
3Q1B12	1	60	60	6	with swell	-150	PORT		
3Q2A5	**2**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q2A6	**2**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		
3Q2A7	2	60	60	6	against swell	150	PORT		
3Q2A8	2	60	60	6	against swell	150	PORT		
3Q3A5	**3**	**120**	**120**	**12**	**against swell**	**150**	**PORT**		
3Q3A6	**3**	**120**	**120**	**12**	**against swell**	**150**	**PORT**		

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3Q3A7	3	120	120	12	against swell	150	PORT		
3Q3A8	3	120	120	12	against swell	150	PORT		
3Q4A5	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		**QRC1 + additional sources**
3Q4A6	**1**	**60**	**60**	**6**	**against swell**	**150**	**PORT**		**QRC1 + additional sources**
3Q4A7	1	60	60	6	against swell	150	PORT		QRC1 + additional sources
3Q4A8	1	60	60	6	against swell	150	PORT		QRC1 + additional sources
3Q12A5	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		**rudder at cpa**
3Q12A6	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		**rudder at cpa**
3Q12A7	1	90	90	9	against swell	150	PORT		*rudder at cpa*
3Q12A8	1	90	90	9	against swell	150	PORT		*rudder at cpa*
3Q6A3	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		
3Q6A4	**1**	**90**	**90**	**9**	**against swell**	**150**	**PORT**		

Legend. Minimal 2 runs for each condition
Bold - priority run
Italics - when required

Upon completion of the run series (or if it is necessary to stop due to loss of daylight), PLANET will recover the VAIII system and QUEST will recover the wave buoy. QUEST and PLANET will perform CTD and/or XBT measurements. QUEST and PLANET will also exchange the liaison officers by ship's boat. QUEST will then depart for Bergen. Note that Quest must depart by 1800 to insure a timely arrival in Bergen.

24 August - PLANET in Deep Water (58°50'00N, 008°20'00W), Measurement using VAIII Buoy

Preparations and actions start in deep water 58°50'00N, 008°20'00W: 24/08/11, 06:00 UTC. PLANET will start by performing a CTD measurement followed by deploying the VAIII system. PLANET then leaves the VAIII buoy and stays silent at a distance of approximately 3 km while an ambient noise measurement is performed. PLANET then prepares to perform the runs as listed below as per the run geometry noted above.

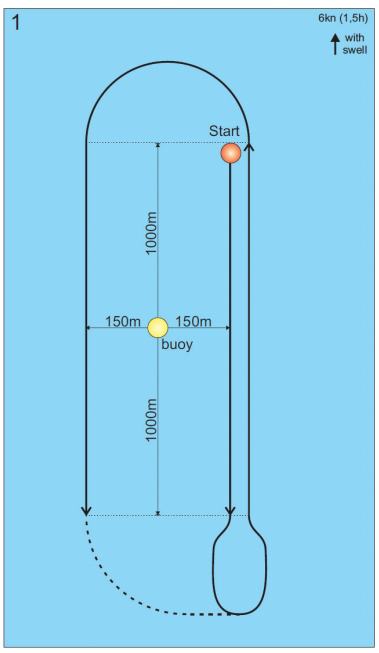
The run list (23/08/11, 06:00 UTC - 22/08/11, 18:00 UTC) includes 2 hours for deploying systems before the first run, 1 hour CTD measurement and 2 hours picking up deployed systems.

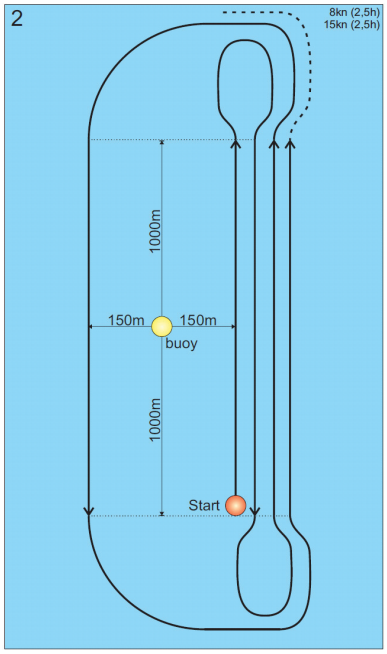
Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
3P2A4	2	55	55	6	against swell	-150	STBD		
3P2B5	2	55	55	6	with swell	-150	PORT		
3P2A6	2	55	55	6	against swell	150	PORT		
3P1A2	1	55	55	6	against swell	-150	STBD		
3P4B4	1	55	55	6	with swell	-150	PORT		additional sources
3P4A5	1	55	55	6	against swell	150	PORT		additional sources
3P6B3	3	75	75	9	with swell	-150	PORT		
3P6B4	3	75	75	9	with swell	150	STBD		
3P7A4	3	100	100	12	against swell	-150	STBD		
3P7B5	3	100	100	12	with swell	-150	PORT		
3P7A6	3	100	100	12	against swell	150	PORT		
3P3B3	4	140	140	15	with swell	-150	PORT		
3P3A4	4	140	140	15	against swell	150	PORT		
3PBG2	0	0	0	0		4000			
3PP2	0	0	0	0		1500			Buoy off, towed source into water
3P5A3	1	low	low	low	against swell	150	PORT		Towed noise source
3P5B4	1	low	low	low	with swell	-150	PORT		Towed noise source

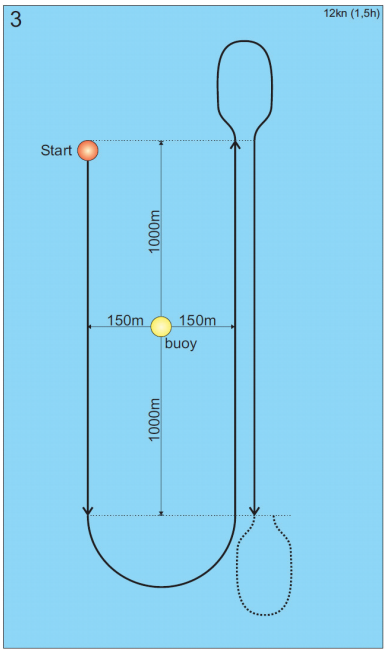
Upon completion of the day's activities, PLANET will recover the towed source (if necessary) as well as the VAIII system. PLANET will then perform a CTD measurement and depart for Bergen.

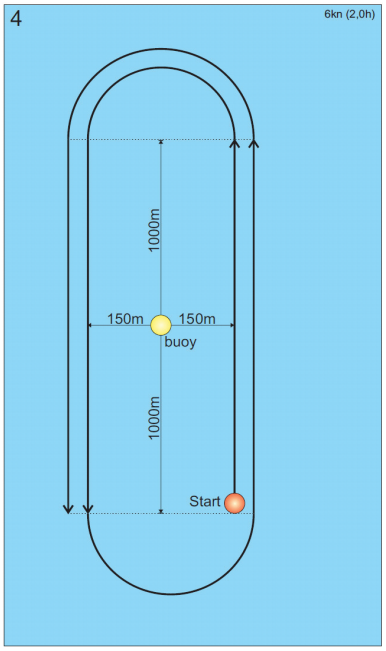
MANEUVERING

The figures below provide possible ship manoeuvres to carry out the proposed runs.









DATA RECORDING, COLLECTION, AND DISTRIBUTION

For QUEST data collection, DRDC will collect sensor data from its DAQ on removable or plug-in hard drives. DRDC will pre-process the data to a format agreed to by Australia. IMCS and NADAS data will be recorded separately (with a GPS time stamp) and a daily data file will be made available. This will be done for all acoustic trials. QUEST will also recover the wave buoy data whenever possible and make a summary available to PLANET as soon as possible.

PERSONNEL

Proposed personnel relevant for conducting the trial on board each ship is listed below.

CFAV Quest

Layton Gilroy	DRDC	Partial Trials Leader, Scientific Leader
Zahir Daya	DRDC	Overall Scientific Leader
Dave Stredulinsky	DRDC	Wave buoy operations and data
Scott Hall	DRDC	DAQ management
Bob MacDonald	DRDC	Lab supervisor, NADAS & IMCS data, XBT
Mark Baldin	DRDC	NADAS & IMCS data
Tim Murphy	DRDC	LAND buoy management and data retrieval
Dave Wheaton	DRDC	DAQ and sensor support
Tara LeBlanc	DRDC	PLANET liaison
UK1	QinetiQ	Dynamic ranging, shaker operation
UK2	QinetiQ	Dynamic ranging, shaker operation
AUS1	DSTO	Data processing and distribution
AUS2	DSTO	Data processing and distribution

Other DRDC personnel will be on board and available as required.

RV Planet

Lutz Kätow	CSSM	Scientific Leader
Volkmar Nejedl	FWG	FWG coordination of measurements and evaluation, run management, evaluation of acoustic data
Edgar Schmidtke	FWG	FWG coordination of measurements, structure borne sound measurements
Jan Abshagen	FWG	run management, acoustic evaluation, evaluation of air borne sound, loudspeaker measurements
Arne Stoltenberg	FWG	evaluation of structure borne sound data, structure borne sound measurements
Jörg Schulz	FWG	Acoustic measurements, VAIII data acquisition
Jennifer Karstens	FWG	Structure and air borne sound measurements, DataRec4 data acquisition, technical support
Rainer Kühl	FWG	Acoustic measurements, CTD and ADCP data measurements
Klaus Balzer	FWG	Acoustic measurements
Christian Will	CAU Kiel	Evaluation of structure and air borne sound
Carsten Zerbst	Müller-BBM	Special data aquisition for source level modelling
Ingmar Pascher	Müller-BBM	Special data aquisition for source level modelling
Andreas Gahlka		Special data measurements and analysis for structure borne sound mapping
Kees de Vries	DMO	Towed source and shaker measurements
Klaas de Vries	DMO	Towed source and shaker measurements
Roland Tolstrup	GF310	Long term data aquisition, sea state measurements, VAMOS
Arne Oewerdieck	GF310	Long term data aquisition, sea state measurements, VAMOS

ANALYSIS PLAN

For the data measured on QUEST, Australia (DSTO) will be responsible for the analysis of the data into the formats agreed to by the SET-166 group. Long-term analysis of this data will be performed by Australia and the US.

LAND BUOYS

The LAND (Lagrangian Ambient Noise Drifter) buoys (specifically known as I-LAND buoys) have been developed and assembled at DRDC and used in other acoustic trials. See annex W.

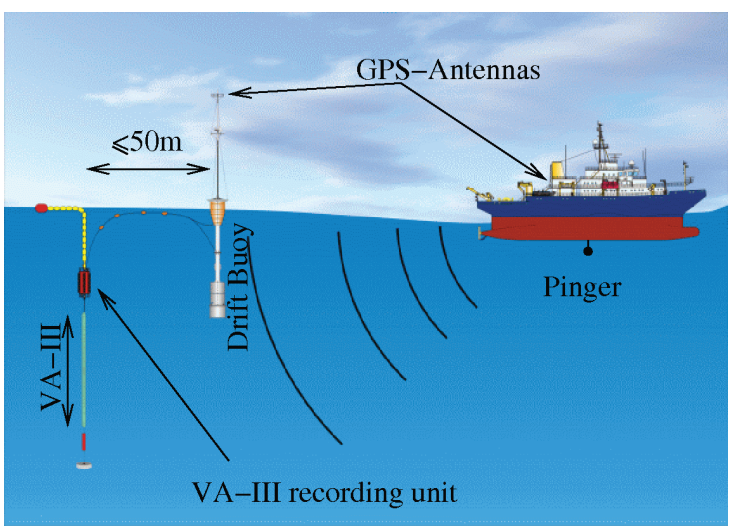
RANGE CALCULATION

FS PLANET and the drift buoy of VA-III have their own GPS-Antenna and sensor. Both know their respective time and place independently. So there is a first rough estimation of the distance between them. The vertical array VA-III (and recording unit) is located within 50 m (length of cable) from the visible drift buoy (see Figure below).

For an exact calculation of the distance between FS PLANET and the vertical array VA-III we use an acoustic source with a well defined signal (pinger).

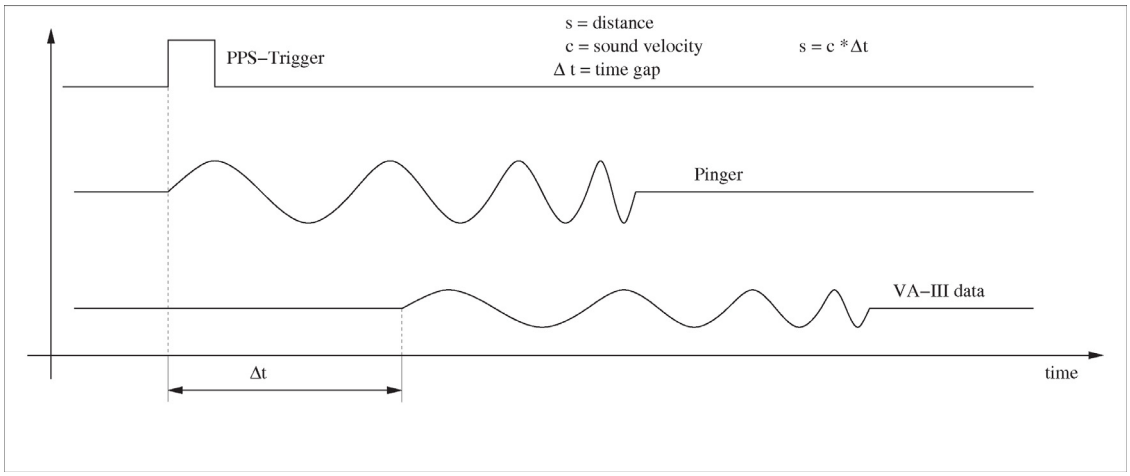
FS PLANET: The pinger is mounted to the starboard keel and is configured for sending a LFM-Sweep (100 ms, 3875 Hz to 4125 Hz every 10 s). This sweep is triggered by the GPS-Trigger signal. The time data of the signal is recorded, the signal itself if necessary. The trigger is programmed into a FWG-designed/manufactured GPS-receiver, it is defined by a cycle length (10 s) and a cycle start time at the start of a minute.

VA-III: The same trigger and the GPS-Strings ($GPRMC and others) are multiplexed into the recorded digital VA-III data stream (15625 Samples/sec, 16bits, 149 channels, 128 of them acoustic data), so we know the exact data sample at which the trigger rises from low to high.

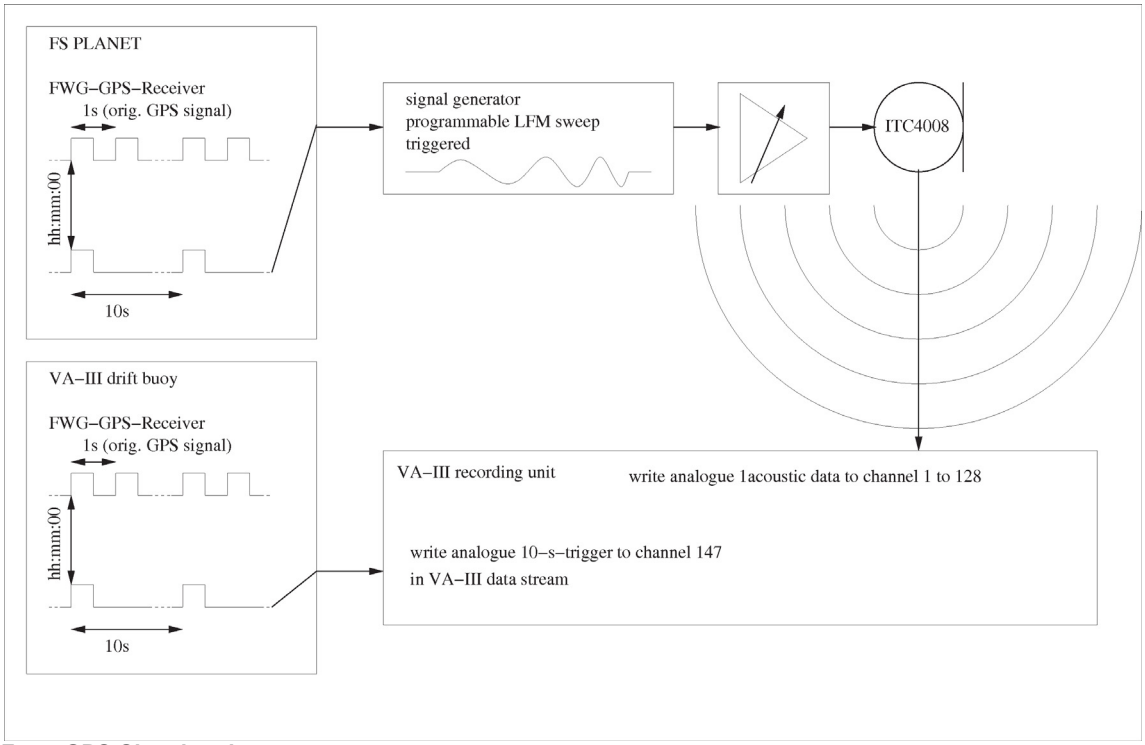


Sketch of hydro acoustic experiments for measuring the ship's source level.

The time gap □t between the GPS-Trigger and the received LFM in the VA-III data is equivalent to the distance between ship and array, see figure below. The sound velocity has to be measured. Both GPS-receivers on RV PLANET and VA-III generate a 10-s-PPS for their respective purpose independently, see figure below.



Determining the distance from acoustic signals.



From GPS-Signal to data stream

ANNEX H
TRIAL 03 (HEGGERNES)

OBJECTIVES

The performance of the trials delivers basic data sets for the post processing analysis according to the objective of the master trial plan to the participating nations and research institutions. Valid data can only be achieved by following the run programme and the table of the machinery control states. In these trials the ranging consists of simultaneously recording of structure borne noise data and waterborne noise data. The measurements will be synchronized by GPS time.

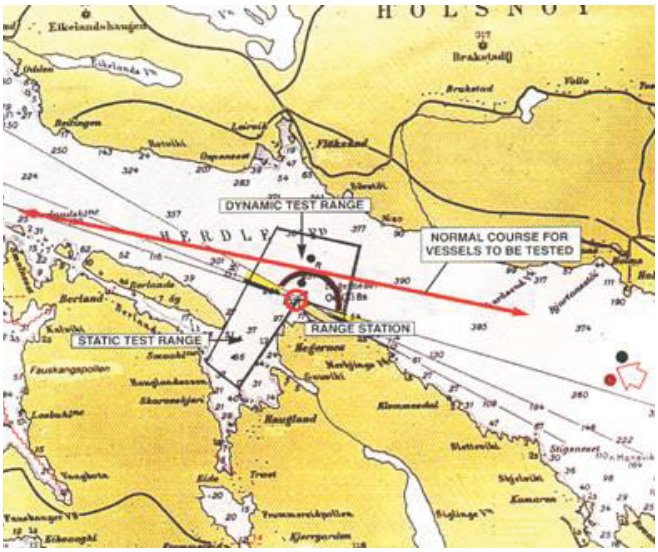
For the overall scope of the trials it is necessary to collect the relevant signature data in a controlled and reproduceable way. Procedures and configuration are defined and will be logged.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

PLANET and QUEST will perform the requested run program. Support ships by NO will be requested to conduct the personnel transfer. On request it would be possible to limit the ship traffic in the Fjord. The GPS System will be provided by the Heggernes Team.

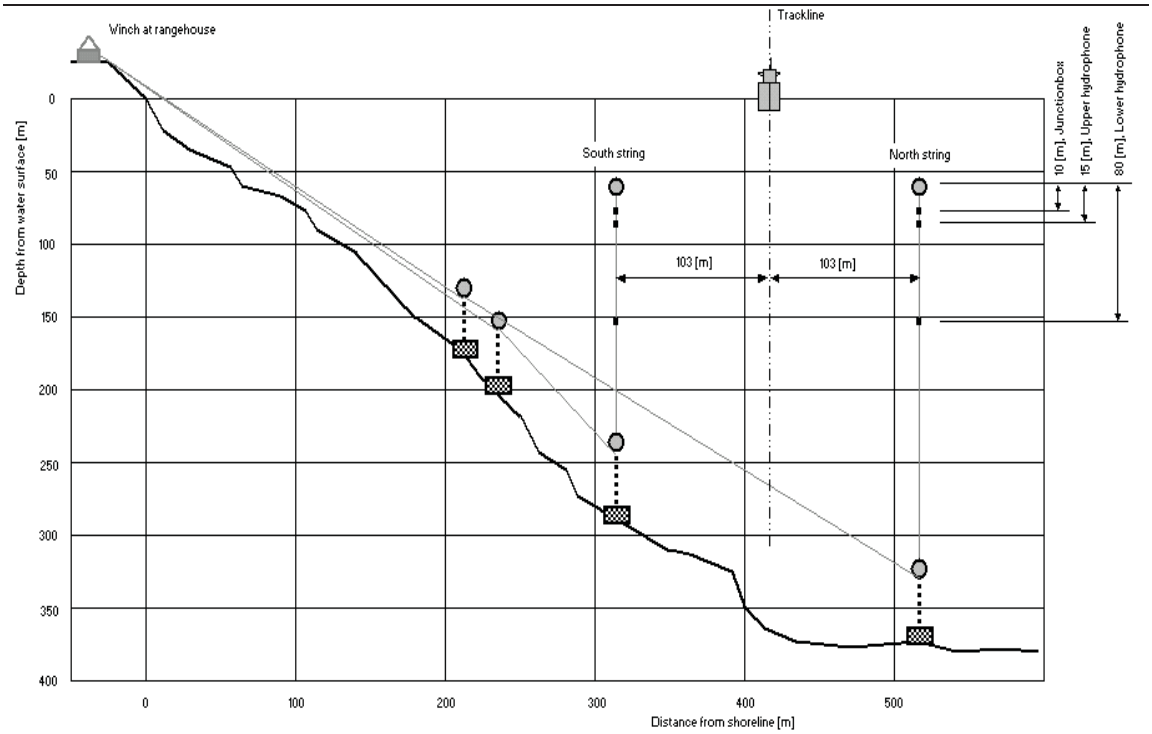
RANGE INFORMATION

The Heggernes deep water noise range is situated in the Herdla Fjord nearby the city Bergen in Norway. The range is owned and exploited by the Norwegian, German and Netherlands Defence Material Organisations. The main objective of the range is to determine the underwater sound power level as function of all relevant ship parameters, like speed and diving depth without the interference of background noise and reverberations due to reflections of walls and the sea bottom. The Herdla Fjord was chosen as a suitable location to fulfil this requirement.



Heggernes measurement range.

Dynamic noise range. The Fjord with a depth of circa 400 meters and a width of more than 1200 meters at the measurement location is equipped with 2 x 2 hydrophones. The hydrophones are connected through a junction box to two separate cable systems of approximately 1200 meters which lead the measurement signals to the measurement station. The cable systems are kept vertical by two buoys. The depth of the buoys can be adjusted through a hydraulic winch system at shore. The horizontal distance between the buoys and hydrophones is circa 206 meters.



Location of the hydrophones.

The coordinates of the CPA and the North and South hydrophone measurement systems are shown in the table below.

Coordinates of the anchor buoys at the dynamic noise range.

WGS84 COORDINATES DYNAMIC NOISE RANGE		
CPA	N 60°31’43.20	E 05°05’47.04
North Hydrophones	N 60°31’46.92	E 05°05’47.88
South Hydrophones	N 60°31’39.66	E 05°05’46.02

Static noise range. The static noise range is situated in a small bay near the measurement station and the dynamic range. The platform to be measured will be moored between 3 buoys approximately in the middle of the bay above the bottom mounted hydrophones. The average bottom depth in the bay at the location of the hydrophones is 50 meters.

TRACKING

The ‘Norse See map nr. 23’ will be used for the runs on the range.

The measurement runs will be carried out at the track line at a heading of 110 degrees and in the opposite direction with a heading of 290 degrees.

In order to determine the exact position of the naval platform in relation to the track line and the hydrophones, a Differential Global Positioning System (DGPS) will be used. One antenna will be installed by the Heggernes team onboard of the naval platform. Information of the position of the platform during the runs will be made available at the bridge of the naval platform and inside the measurement stations.

Offsets to the track line will be indicated with a “ + ” for north side of the track and “ – “ when the platform is at the south side of the track.

All tracking is related to the CPA point of the hydrophone systems.

The measurement team is requested to give an ‘event marker’ when the ‘visual reference point’ of the platform is at CPA of the hydrophones. The reference point of the platform will be the radar antenna on top of the mast behind the bridge.

COMMUNICATION

During the trials a liaison officer will be present on the navigation bridge of the naval platform. The liaison officer will be accompanied by a specialist, controlling the DGPS recording.

For the communication during the trials the bridge of the naval platform will have call sign “PLATFORM” and the Heggernes measurement station will have call sign “DECIBEL”.

All communication between the naval platform and the measurement team at the Heggernes range will be in the English language.

For initial communication between the naval platform and the Heggernes range control centre the VHF Channel 10 will be used. If necessary the trial officer will request an other channel.

For the communication between the range officer at the Heggernes range control centre, the naval platform at the range and the measurement teams the procedure (communication plan) as stated in the table on the next page.

#	ACTOR	SUBJECT	ACTION
1	Range officer	Announcement run number	The range officer will inform the platform about the run number and the run specifications. The range officer will also inform all onshore measurement teams.
2	Platform	Confirmation	The platform will confirm and will prepare the required condition as described in the run program.
3	Platform	Internal communication on board	The platform will inform all onboard measurement teams about the run number.
4	Platform	Information	The platform will inform the range officer on the current average keel depth before the first run
5	Platform	Preparations	The platform will install the required condition and manoeuvre to a position at the track line and sufficient distance before CPA with the hydrophones
6	Platform	Ready for run	Platform will inform the range officer when it is ready to start the run.
7	Range officer	Start run	The range officer will inform the platform and measurement team to start the run.
8	Platform	Sail on track	The platform will sail along the required track. The required speed, heading, offset and condition shall be installed at 1000 m before CPA
9	Measurement teams	Measurements	The measurement teams will record the signals and give a required 'event marker' when the reference point of the platform is at CPA
10	Platform	Determine required data	The platform bridge and technical command room will record the required platform data
11	Range officer	End of run	The range officer will inform the platform and measurement team when the run is finished
12	Platform	Confirmation	The platform will confirm the end of the run and inform all onboard measurement teams
13	Range officer	Announcement next run	Preparation and reposition for next run

PREPARATIONS

Prior (directly) to starting the trial.

The underwater part of the hull, all appendages and in particular the rudder and the propeller blades should be cleaned. When the blades are damaged the crew is requested to report this to the trial leader.

The crew is requested to check if all valves of the sea cool water intake and outlet systems are either fully opened or fully closed[9].

For the runs which have to be conducted in the Quiet State, the ship's crew is requested to choose the machinery which has the best (most quiet) noise performance.

The ship's crew is requested to:

- record the keel depth markers at the bow, mid and stern of the ship at the beginning and end of each trial day;
- inform the range officer on the average keel depth at every day before the measurement program starts.

The DGPS systems will be installed and removed by the Heggernes team. The ships crew is requested to assist on request.

The Norwegian team will be requested to perform the CDT probes (measurement of water temperature).

During trial preparation phase.

- Rearrange the sensor configuration by the Heggernes team.
- Test runs due to the new configuration.
- Pre-test of GPS synchronizing.

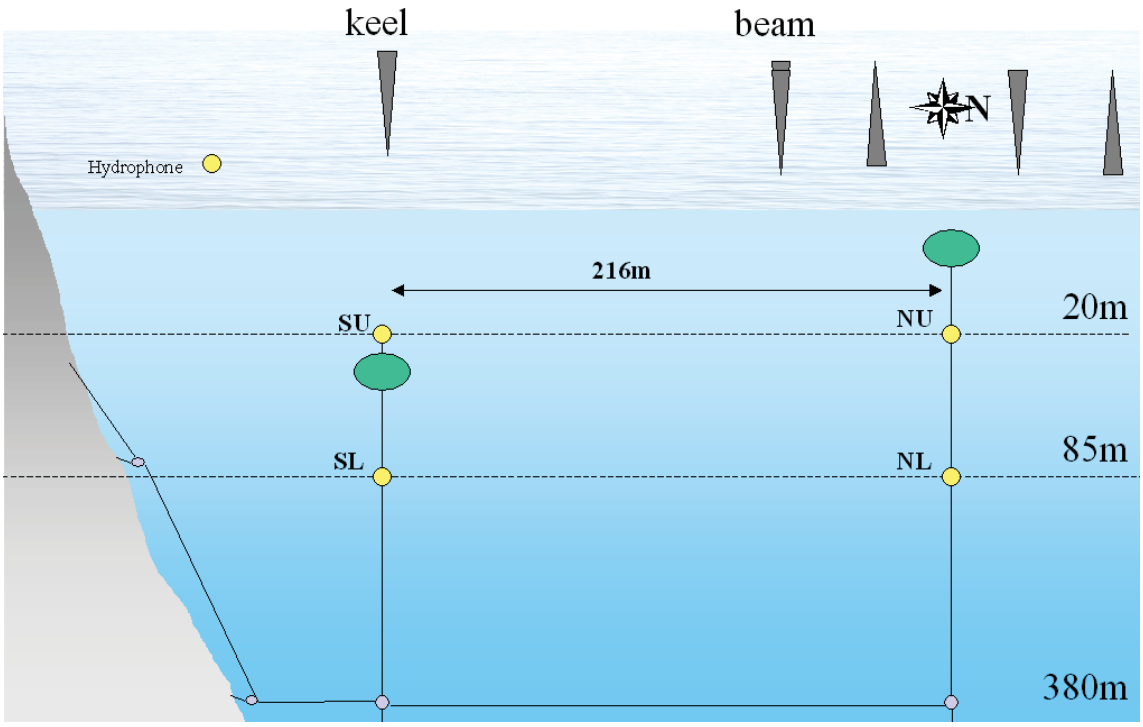
[9] A not fully opened or closed valve will lead to noise.

MEASUREMENT PROCEDURE

The naval platform is requested:

- to be on the track line in a steady state condition approximately 1000 meters before CPA;
- not to change sailing speed, heading, machinery configuration and other platform conditions during the passage over the measurement site;
- to keep rudder movements to a minimum.

Measurements will be started when the platform is at a distance of approximately 400 meters before hydrophones. The measurements will be stopped when the platform has passed the last measurement site at a distance of 400 meters.



The deployment of the sensor configuration in Heggernes according to the comparability of the different ranges is shown in the above figure.

It will be necessary to pass by the hydrophone NU facing with both sides of the ship in one direction as long as the radiation of the noise source is side dependant. Therefore the Heggernes team will be requested to rearrange the equipment in June.

RUN PLAN

Run Plan - CFAV Quest.

Last details and information will be distributed at the briefing on the August 28th 08:00-013:00 on RV Planet. Requested are the scientific leader from the Planet, liaison officer, subgroup leader of the underwater signature according to the deployed systems and crew engineer and navigator

After personal transfer and the preparation on board the operational readiness will be communicate to the partial trial leader. The runs of the towed calibration source will be performed on the first day. The measurement will be performed by two teams in shifts.

First shift starts at 02:30 on September 1st.

Start at 03:00 01.09.2011

No	Run ID	Condition	State	direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
	HG1	no disturber						
1	**4P050W**	towing source	Config1*	**W**	6 / **55**	keel	0	related to SU
2	**4P051E**	towing source	Config1*	**E**	6 / **55**	keel	0	related to SU
3	**4P052W**	towing source	Config1*	**W**	6 / **55**	keel	0	related to NU
4	**4P053E**	towing source	Config1*	**E**	6 / **55**	keel	0	related to NU
5	**4P054W**	towing source	Config1*	**W**	6 / **55**	SB	40	related to NU
6	**4P055W**	towing source	Config1*	**E**	6 / **55**	PS	40	related to NU
7	**4P056E**	towing source	Config1*	**W**	6 / **55**	SB	80	related to NU
8	**4P057E**	towing source	Config1*	**E**	6 / **55**	PS	80	related to NU
	HG 2	no disturber						
9	**4P010W**		Config1*	**W**	6 / **55**	keel	0	SU, PRC1
10	**4P011E**		Config1*	**E**	6 / **55**	keel	0	SU,PRC1
11	**4P012W**		Config1*	**W**	6 / **55**	SB	80	related to NU,PRC1

No	Run ID	Condition	State	direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
12	**4P013E**		Config1*	**E**	6 / **55**	PS	80	related to NU,PRC1
13	**4P014W**		Config1*	**W**	6 / **55**	PS	80	related to NU,PRC1
14	**4P015E**		Config1*	**E**	**6** / **55**	SB	80	related to NU,PRC1
15	**4P016W**		Config1*	**W**	6 / **55**	SB	40	related to NU,PRC1
16	**4P017E**		Config1*	**E**	6 / **55**	PS	40	related to NU,PRC1
17	**4P018W**		Config1*	**W**	6 / **55**	PS	40	related to NU,PRC1
18	**4P019E**		Config1*	**E**	6 / **55**	SB	40	related to NU,PRC1
	HG3							
19	**4P020W**		Config2*	**W**	6 / **55**	SB	80	related to NU,PRC2
20	**4P021E**		Config2*	**E**	6 / **55**	PS	80	related to NU,PRC2
21	**4P022W**		Config2*	**W**	6 / **55**	PS	80	related to NU,PRC2
22	**4P023E**		Config2*	**E**	**6** / **55**	SB	80	related to NU,PRC2
23	**4P024W**		Config2*	**W**	6 / **55**	keel	0	SU,PRC2
24	**4P025E**		Config2*	**E**	6 / **55**	keel	0	SU,PRC2
25	**4P026W**		Config2*	**W**	6 / **55**	SB	40	related to NU,PRC2
26	**4P027E**		Config2*	**E**	6 / **55**	PS	40	related to NU,PRC2
27	**4P028W**		Config2*	**W**	6 / **55**	PS	40	related to NU,PRC2
28	**4P029E**		Config2*	**E**	**6** / **55**	SB	40	related to NU,PRC2
29	**4P030W**		Config7*	**W**	**max** / **140**	keel	0	SU
30	**4P031E**		Config7*	**E**	**max** / **140**	keel	0	SU
31	**4P032W**		Config7*	**W**	**max** / **140**	SB	80	related to NU
32	**4P033E**		Config7*	**E**	**max** / **140**	PS	80	related to NU

No	Run ID	Condition	State	direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
33	**4P034W**		Config7*	**W**	**max** / **140**	PS	80	related to NU
34	**4P035E**		Config7*	**E**	**max** / **140**	SB	80	related to NU
35	**4P036W**		Config7*	**W**	**max** / **140**	SB	40	related to NU
36	**4P037E**		Config7*	**E**	**max** / **140**	PS	40	related to NU
37	**4P038W**		Config7*	**W**	**max** / **140**	PS	40	related to NU
38	**4P039E**		Config7*	**E**	**max** / **140**	SB	40	related to NU
	HG4							
39	**4P040W**	shaker/ loudspeaker	Config1*	**W**	6 / **55**	SB	80	related to NU,PRC4
40	**4P041E**	shaker/ loudspeaker	Config1*	**E**	6 / **55**	PS	80	related to NU,PRC4
41	**4P042W**	shaker/ loudspeaker	Config1*	**W**	6 / **55**	PS	80	related to NU,PRC4
42	**4P043E**	shaker/ loudspeaker	Config1*	**E**	6 / **55**	SB	80	related to NU,PRC4
43	**4P044W**	shaker/ loudspeaker	Config1*	**W**	6 / **55**	keel	0	SU,PRC4
44	**4P045E**	shaker/ loudspeaker	Config1*	**E**	6 / **55**	keel	0	SU,Prc4
45	**4P046W**	shaker/ loudspeaker	Config1*	**W**	6 / **55**	SB	40	related to NU,PRC4
46	**4P047E**	shaker/ loudspeaker	Config1*	**E**	6 / **55**	PS	40	related to NU,PRC4
47	**4P048W**	shaker/ loudspeaker	Config1*	**W**	6 / **55**	PS	40	related to NU,PRC4
48	**4P049E**	shaker/ loudspeaker	Config1*	**E**	6 / **55**	SB	40	related to NU,PRC4
49	**4P060W**		Config3*	**W**	**9** / **75**	SB	80	related to NU
50	**4P061E**		Config3*	**E**	**9** / **75**	PS	80	related to NU

No	Run ID	Condition	State	direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
51	**4P062W**		Config3*	**W**	**9** / **75**	PS	80	related to NU
52	**4P063E**		Config3*	**E**	**9** / **75**	SB	80	related to NU
53	**4P064W**		Config3*	**W**	**9** / **75**	keel	0	SU
54	**4P065E**		Config3*	**E**	**9** / **75**	keel	0	SU
55	**4P066W**		Config3*	**W**	**9** / **75**	SB	40	related to NU
56	**4P067E**		Config3*	**E**	**9** / **75**	PS	40	related to NU
57	**4P068W**		Config3*	**W**	**9** / **75**	PS	40	related to NU
58	**4P069E**		Config3*	**E**	**9** / **75**	SB	40	related to NU
	HG5							
59	**4P070W**		Config3*	**W**	**12** / **100**	SB	80	related to NU
60	**4P071E**		Config3*	**E**	**12** / **100**	PS	80	related to NU
61	**4P072W**		Config3*	**W**	**12** / **100**	PS	80	related to NU
62	**4P073E**		Config3*	**E**	**12** / **100**	SB	80	related to NU
63	**4P074W**		Config3*	**W**	**12** / **100**	keel	0	SU
64	**4P075E**		Config3*	**E**	**12** / **100**	keel	0	SU
65	**4P076W**		Config3*	**W**	**12** / **100**	SB	40	related to NU
66	**4P077E**		Config3*	**E**	**12** / **100**	PS	40	related to NU
67	**4P078W**		Config3*	**W**	**12** / **100**	PS	40	related to NU
68	**4P079E**		Config3*	**E**	**12** / **100**	SB	40	related to NU
69	**4P080W**		Config4*	**W**	**6-max** / **55-140**	SB	80	related to NU
70	**4P081E**		Config4*	**E**	**6-max** / **55-140**	PS	80	related to NU
71	**4P082W**		Config4*	**W**	**6-max** / **55-140**	PS	80	related to NU

No	Run ID	Condition	State	direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
72	**4P083E**		Config4*	**E**	**6-max** / **55-140**	SB	80	related to NU
73	**4P084W**		Config4*	**W**	**6-max** / **55-140**	keel	0	SU
74	**4P085E**		Config4*	**E**	**6-max** / **55-140**	keel	0	SU
75	**4P090W**		Config4*	**W**	**max-6** / **140-55**	SB	80	related to NU
76	**4P091E**		Config4*	**E**	**max-6** / **140-55**	PS	80	related to NU
77	**4P092W**		Config4*	**W**	**max-6** / **140-55**	PS	80	related to NU
78	**4P093E**		Config4*	**E**	**max-6** / **140-55**	SB	80	related to NU
79	**4P094W**		Config4*	**W**	**max-6** / **140-55**	keel	0	SU
80	**4P095E**		Config4*	**E**	**max-6** / **140-55**	keel	0	SU
	HG7							

Legend. Configuration :

- 1: diesel set 2, power converter 2,3 NT freshwater pump 1 45 Hz, sea cooling level1 Portside
- 2 : like 1 but diesel 3
- 3 : diesel 2 +3 ,
- 4 : all diesel 1-4

Mark Runs have lower priority

RUN PLAN - CFAV QUEST

Last details and information will be distributed at the briefing on August 28th 08:00 -13:00 on CFAV Planet. Requested are the scientific leader from the PLANET, liaison officer, subgroup leader of the underwater signature according to the deployed systems and crew engineer and navigator.

After the personal transfer and the preparation on board the operational readiness will be communicate to the partial trial leader. The measurement will be performed by two teams in shifts.

No	Run ID	Condition	State	Direction	Speed (kts) / RPM	side towards hydro-phone	distance sensor - ship horizontal [meter]	Remarks
	HG1	no disturber						
		ange familiari-sation			10/100	keel		
1	**4Q010W**		Config1*	**W**	6 / **60**	keel	0	SU, QRC1
2	**4Q011E**		Config1*	**E**	6 / **60**	keel	0	SU,QRC1
3	**4Q012W**		Config1*	**W**	6 / **60**	SB	80	related to NU,QRC1
4	**4Q013E**		Config1*	**E**	6 / **60**	PS	80	related to NU,QRC1
5	**4Q014W**		Config1*	**W**	6 / **60**	PS	80	related to NU,QRC1
6	**4Q015E**		Config1*	**E**	**6** / **60**	SB	80	related to NU,QRC1
7	**4Q016W**		Config1*	**W**	6 / **60**	SB	40	related to NU,QRC1
8	**4Q017E**		Config1*	**E**	6 / **60**	PS	40	related to NU,QRC1
9	**4Q018W**		Config1*	**W**	6 / **60**	PS	40	related to NU,QRC1
10	**4Q019E**		Config1*	**E**	6 / **60**	SB	40	related to NU,QRC1

No	Run ID	Condition	State	Direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
	HG3							
11	**4Q020W**		Config2*	**W**	6 / **60**	SB	80	related to NU,QRC2
12	**4Q021E**		Config2*	**E**	6 / **60**	PS	80	related to NU,QRC2
13	**4Q022W**		Config2*	**W**	6 / **60**	PS	80	related to NU,QRC2
14	**4Q023E**		Config2*	**E**	**6** / **60**	SB	80	related to NU,QRC2
15	**4Q024W**		Config2*	**W**	6 / **60**	keel	0	SU,QRC2
16	**4Q025E**		Config2*	**E**	6 / **60**	keel	0	SU,QRC2
17	**4Q026W**		Config2*	**W**	6 / **60**	SB	40	related to NU,QRC2
18	**4Q027E**		Config2*	**E**	6 / **60**	PS	40	related to NU,QRC2
19	**4Q028W**		Config2*	**W**	6 / **60**	PS	40	related to NU,QRC2
20	**4Q029E**		Config2*	**E**	**6** / **60**	SB	40	related to NU,QRC2
	HG4							
21	**4Q040W**	shaker/ loudspeaker	Config1*	**W**	6 / **60**	SB	80	related to NU,QRC4
22	**4Q041E**	shaker/ loudspeaker	Config1*	**E**	6 / **60**	PS	80	related to NU,QRC4
23	**4Q042W**	shaker/ loudspeaker	Config1*	**W**	6 / **60**	PS	80	related to NU,QRC4
24	**4Q043E**	shaker/ loudspeaker	Config1*	**E**	6 / **60**	SB	80	related to NU,QRC4
25	**4Q044W**	shaker/ loudspeaker	Config1*	**W**	6 / **60**	keel	0	SU,QRC4
26	**4Q045E**	shaker/ loudspeaker	Config1*	**E**	6 / **60**	keel	0	SU,QRC4

No	Run ID	Condition	State	Direction	Speed (kts) / RPM	side towards hydro-phone	distance sensor - ship horizontal [meter]	Remarks
27	**4Q046W**	shaker/ loudspeaker	Config1*	**W**	6 / **60**	SB	40	related to NU,QRC4
28	**4Q047E**	shaker/ loudspeaker	Config1*	**E**	6 / **60**	PS	40	related to NU,QRC4
29	**4Q048W**	shaker/ loudspeaker	Config1*	**W**	6 / **60**	PS	40	related to NU,QRC4
30	**4Q049E**	shaker/ loudspeaker	Config1*	**E**	6 / **60**	SB	40	related to NU,QRC4
31	**4Q060W**		Config 3*	**W**	**9** / **90**	SB	80	related to NU
32	**4Q061E**		Config 3*	**E**	**9** / **90**	PS	80	related to NU
33	**4Q062W**		Config 3*	**W**	**9** / **90**	PS	80	related to NU
34	**4Q063E**		Config 3*	**E**	**9** / **90**	SB	80	related to NU
35	**4Q064W**		Config 3*	**W**	**9** / **90**	keel	0	SU
36	**4Q065E**		Config 3*	**E**	**9** / **90**	keel	0	U
37	**4Q066W**		Config 3*	**W**	**9** / **90**	SB	40	related to NU
38	**4Q067E**		Config 3*	**E**	**9** / **90**	PS	40	related to NU
39	**4Q068W**		Config 3*	**W**	**9** / **90**	PS	40	related to NU
40	**4Q069E**		Config 3*	**E**	**9** / **90**	SB	40	related to NU
	HG5							
41	**4Q070W**		Config 3*	**W**	**12** / **120**	SB	80	related to NU
42	**4Q071E**		Config 3*	**E**	**12** / **120**	PS	80	related to NU

No	Run ID	Condition	State	Direction	Speed (kts) / RPM	side towards hydrophone	distance sensor - ship horizontal [meter]	Remarks
43	**4Q072W**		Config 3*	**W**	**12** / **120**	PS	80	related to NU
44	**4Q073E**		Config 3*	**E**	**12** / **120**	SB	80	related to NU
45	**4Q074W**		Config 3*	**W**	**12** / **120**	keel	0	SU
46	**4Q075E**		Config 3*	**E**	**12** / **120**	keel	0	SU
47	**4Q076W**		Config 3*	**W**	**12** / **120**	SB	40	related to NU
48	**4Q077E**		Config 3*	**E**	**12** / **120**	PS	40	related to NU
49	**4Q078W**		Config 3*	**W**	**12** / **120**	PS	40	related to NU
50	**4Q079E**		Config 3*	**E**	**12** / **120**	SB	40	related to NU
51	**4Q030W**		config1	**W**	**6** / **60**	keel	0	IR shower
52	**4Q031E**		config1	**E**	**6** / **60**	keel	0	IR shower
53	**4Q080W**		Config 3*	**W**	**3-10** / **30-100**	SB	80	related to NU
54	**4Q081E**		Config 3*	**E**	**3-10** / **30-100**	PS	80	related to NU
55	**4Q082W**		Config 3*	**W**	**3-10** / **30-100**	PS	80	related to NU
56	**4Q083E**		Config 3*	**E**	**3-10** / **30-100**	SB	80	related to NU
57	**4Q084W**		Config 3*	**W**	**3-10** / **30-100**	keel	0	SU
58	**4Q085E**		Config 3*	**E**	**3-10** / **30-100**	keel	0	SU

No	Run ID	Condition	State	Direction	Speed (kts) / RPM	side towards hydro-phone	distance sensor - ship horizontal [meter]	Remarks
59	**4Q090W**		Config 3*	**W**	**10-2** / **100-25**	SB	80	related to NU
60	**4Q091E**		Config 3*	**E**	**10-2** / **100-25**	PS	80	related to NU
61	**4Q092W**		Config 3*	**W**	**10-2** / **100-25**	PS	80	related to NU
62	**4Q093E**		Config 3*	**E**	**10-2** / **100-25**	SB	80	related to NU
63	**4Q094W**		Config 3*	**W**	**10-2** / **100-25**	keel	0	SU
64	**4Q095E**		Config 3*	**E**	**10-2** / **100-25**	keel	0	SU
	HG7							

Legend. * : config1: DG1; config2: DG2; config3: both DG

During the measurement it will be determined if the cruising by PS and SB side is necessary. The runs with 8 (69-78) are additional runs according to the time.

The time duration for one run is estimated to appr.10-15 min.

Mark Runs have lower priority

DATA RECORDING, COLLECTION AND DISTRIBUTION

The data of the waterborne noise measurement will recorded digital on tape. These data sets are uncorrected and unprocessed.

The processed data sets of each run will be available after post processing procedures within 6 weeks after measurement. The procedures and formats are aligned to §6.4. The data sets will be delivered to the partial trial leader. The processed data will be synchronized with the GPS Position.

On the basis of the analysis plan of SET 166 the data sets will be distributed on request by the CSSM.

ANALYSIS PLAN

The following processed Data sets will be provided:

- in One-Third-Octave bands (OTB) in the 10 Hz to 80 kHz bands without bandwidth correction;
- in narrow (NB) bands 10 to 1600 Hz, with a frequency resolution of 1 Hz;
- OTB spectrum level in dB re 1 μPa;
- GPS Tracking data;
- environmental information(CTD and weather).

For further requirements in the post analysis requests have to be addressed to the Chairman of SET 166.

ANNEX I
TRIAL 04 (HERDLA)

OBJECTIVES

The objectives of the partial trial at the Herdla range are:

- to conduct a mine/ship engagement evaluation of QUEST;
- to conduct range calibration with use of PLANET and towed sources;
- to compare results from the Herdla Range with data from other ranges.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

Both CFAV Quest and RV Planet will participate in the trial. For the QUEST/PLANET trial the Herdla range will be augmented with a MP-80 exercise mine.

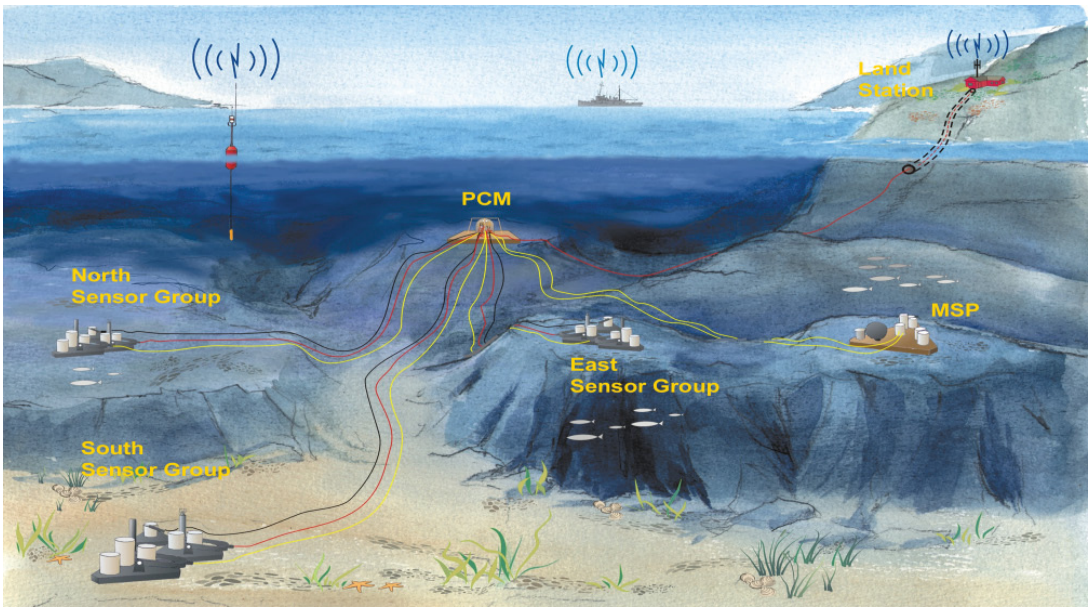
CFAV Planet will be equipped with a towed source.

RANGE INFORMATION

The Herdla Range is the most comprehensive underwater test facility operational in Norway. Established chiefly for tactical training with MCM- assets and mine/ship engagement evaluation, but also for maintenance/control and studies of passive physical signatures of vessels, weapon systems and divers.

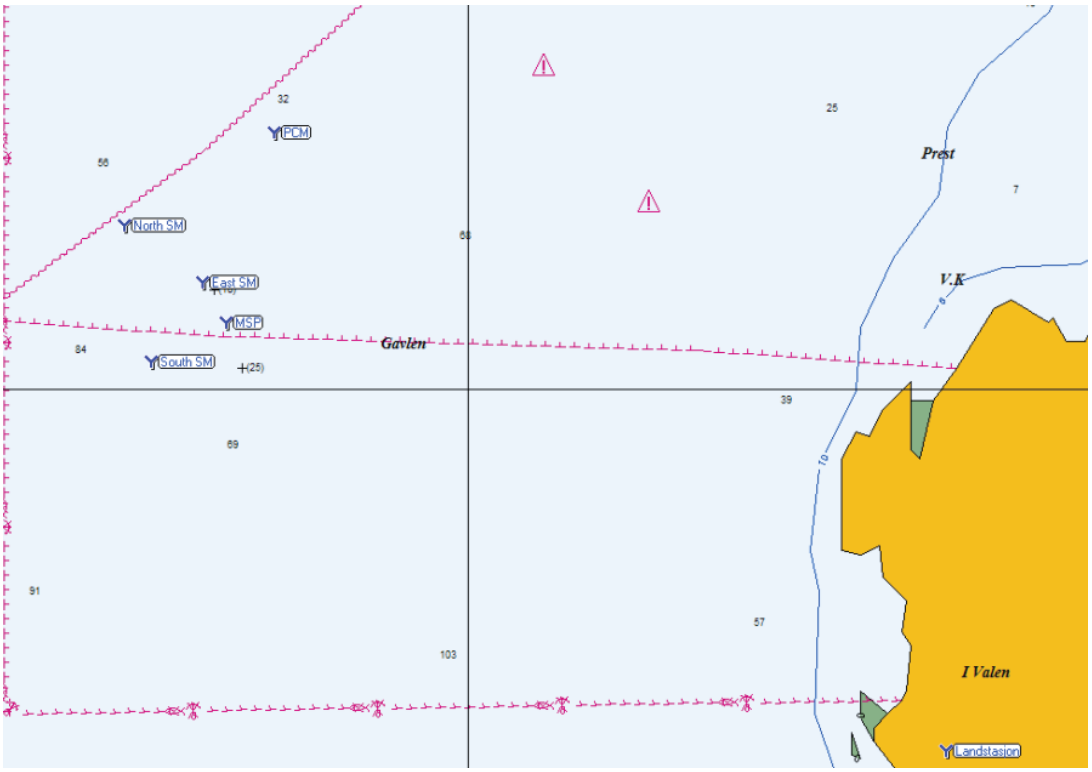
The range is located in a wide open sea area providing ample operational space, located 20NM from the Main Naval Base Haakonsvern in the vicinity of Bergen. Sensor and instrumentation functions featuring acoustic, seismic, hydrodynamic, magnetic and electric (UEP) measurement complemented by object tracking data. Sensor water depths ranging from 20 to 90m.

The range consists of four sensors groups identified as north, south, east and main. The figure on the next page shows the location of the sensor groups with respect to neighbouring geography.



Herdla range.

Herdla range. The specifications of each sensor group are provided in the table on the next page.



Herdla sensor specifications.

Platform	Sensor	Features	Bandwidth	Max range	Tot. dynamics
SM platform	Magnetic I	3-axial	DC – 20 Hz	± 100 µT	120 dB
EM platform	Magnetic II	3-axial	5 mHz – 500 Hz	± 70 µT	140 dB
EM platform	Electric (UEP)	3-axial	5 mHz – 500 Hz	± 3 mV/m	160 dB
CPA platform	Seismic	3-axial	1 – 100 Hz	± 8 mG	100 dB
CPA platform	Pressure	Omni	DC – 2 Hz	1.38 MPa	111 dB
CPA platform	Water velocity	3-axial	DC – 2 Hz	6 m/s	76 dB
	Direction	Compass	DC – 0,5 Hz		
MSP platform	Acoustic LF	Omni hydro-phone	0,7 Hz – 3,125 kHz	-196 dB Ref 1 V/µPa	105 dB (1 Hz) 135 dB (1 kHz)
MSP platform	Acoustic HF	Omni hydro-phone	3,125 Hz – 100 kHz	-170 dB Ref 1 V/µPa	129 dB (3 kHz) 131 dB (30 kHz)
CPA platform	Acoustic LF	Omni hydro-phone	0,7 Hz – 500 Hz	-200 dB Ref 1 V/µPa	116 dB (250 Hz)
CPA platform	Acoustic HF	Omni hydro-phone	500 Hz – 100 kHz	-200 dB Ref 1 V/µPa	121 dB (50 kHz)

TRACKING

The ships will be tracked by use of GPS systems.

COMMUNICATION

During the trials a national liaison officer will be present on the navigation bridge of the naval platform.

All communication between the naval platform and the measurement team at the Herdla range will be in English language.

For communication between the naval platform and the Herdla range the VHF channel 72 will be used.

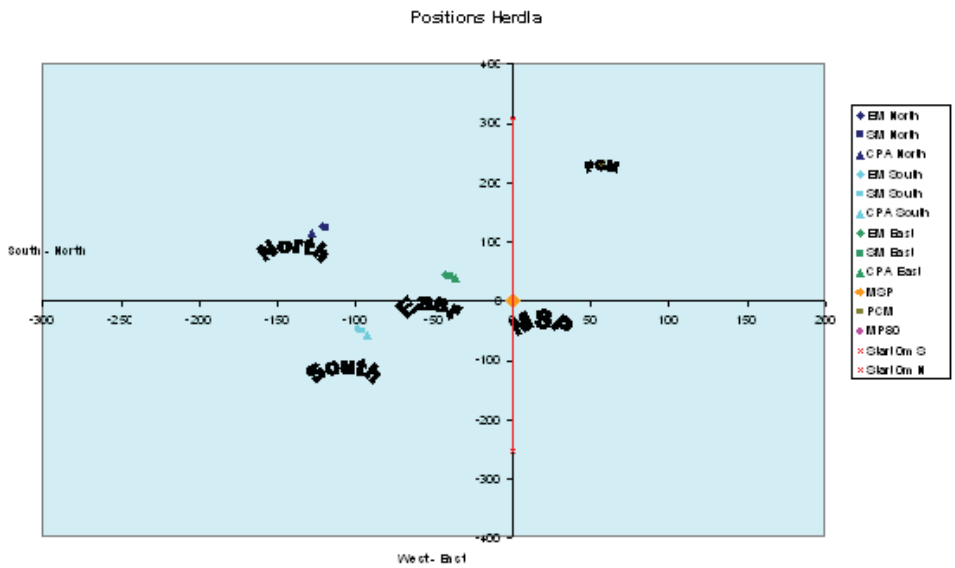
PREPARATIONS

The GPS systems will be installed and removed by personnel from RNoN. The ships crew is requested to assist on request. Power is necessary for the GPS systems. (110 – 240Vac).

On August 28th a combined briefing for both CFAV Quest and RV Planet will be held on board of RV Planet, both for the trials at Herdla and Heggernes.

MEASUREMENT PROCEDURE

Run start positions. The red track shown in the figure below defines an offset of 0 meter, directions are North (0°) and South (180°). *Note:* in the start position the ship is expected to be on track with correct speed and heading.



SENSOR GROUP	RUN HEADING	GPS POSITION (DEGREE)	GPS POSITION (DEGREE)	GPS HEMISPHERE
Start position 0m	North (0°)	60	34.434	N
Start position 0m	North (0°)	4	55.694	E
Start position 0m	South (180°)	60	35.04	N
Start position 0m	South (180°)	4	55.694	E

Off set positions. The runs have may have off sets to the start position.

- Offset 1 : 14 m West.
- Offset 2 : 28 m West.
- Offset 3 : 42 m West.
- Offset 4 : 56 m West.
- Offset 5 : 84 m West.
- Offset 6 : 112 m West.
- Offset 7 : 100 m West.
- Offset 8 : 120 m West.

RUN PLAN

Background. As a part of the RIMPASSE 2011 the vessels PLANET and QUEST will be ranged at the Herdla Measurement Range in the timeframe from 30. August to the 2. September.

Programme. The main contents of the programme for the different days of the measurement week are:

DAY/DATE	ZULU TIME	LOCAL TIME	REMARKS
Sunday 28/08	08:00 – 13:00	10:00 – 15:00	Brief on PLANET for Herdla and Heggernes trial. Place: Bergen harbour.
Sunday 28/8	08:00 – 13:00	10:00 – 15:00	Installation of Herdla GPS on PLANET.
Tuesday 30/8	04:00 – 06:00	06:00 – 08:00	Liaison officer from RNoN embark PLANET. Bergen or at Herdla. (Decision to be taken at brief 28/8)
Tuesday 30/8	06:00 – 24:00	08:00 – 24:00	Ranging PLANET at Herdla.
Wednesday 31/8	0:00 – 15:00	00:00 – 17:00	Ranging PLANET at Herdla.
Wednesday 31/8	15:00	17:00	Removal of Herdla GPS. Boat transfer to shore for RNoN liaison officer.
Wednesday 31/8	13:00 –	15:00 –	Installation of Herdla GPS on QUEST.

DAY/DATE	ZULU TIME	LOCAL TIME	REMARKS
	21:00	23:00	Liaison officer from RNoN embark Bergen or at Herdla. (Decision to be taken at brief 28/8)
Wednesday 31/8	21:00 – 24:00	23:00 – 24:00	Ranging QUEST at Herdla
Thursday 1/9	00:00 – 10:00	00:00 – 12:00	Ranging QUEST at Herdla
Thursday 1/9	13:00 – 21:00	15:00 – 23:00	Exchange of RNoN liaison officer. Bergen or at Herdla. (Decision to be taken at brief 28/8)
Thursday 1/9	21:00 – 24:00	23:00 – 24:00	Ranging QUEST at Herdla
Friday 2/9	00:00 – 10:00	00:00 – 12:00	Ranging Quest at Herdla
Friday 2/9	10:00	12:00	Removal of Herdla GPS. Boat transfer to shore for RNoN liaison officer.

Note: for explanation of EM-settings and reference machinery control states see annex S.

Detailed run plan for PLANET (priority runs: 5, 4 and 3):

Run identifiers: the acoustic, magnetic and electric ‘state identifiers’ are defined in Annex V.

Tuesday 30/8: Local time 08:00 – 16:30.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
1	5P5A1	1	low	low	low	North (0)	0	K (MSP)	PRC_EM2	Towed noise source
2	5P5B2	1	low	low	low	South (180)	0	K (MSP)	PRC_EM2	Towed noise source
3	5P5A5	1	low	low	low	North (0)	14	K (MSP)	PRC_EM2	Towed noise source
4	5P5B6	1	low	low	low	South (180)	14	K (MSP)	PRC_EM2	Towed noise source
5	5P5A9	1	low	low	low	North (0)	28	K (MSP)	PRC_EM2	Towed noise source
6	5P5B10	1	low	low	low	South (180)	28	K (MSP)	PRC_EM2	Towed noise source
7	5P5A13	1	low	low	low	North (0)	42	K (MSP)	PRC_EM2	Towed noise source
8	5P5B14	1	low	low	low	South (180)	42	K (MSP)	PRC_EM2	Towed noise source
9	5P5A17	1	low	low	low	North (0)	56	K (MSP)	PRC_EM2	Towed noise source
11	5P5B18	1	low	low	low	South (180)	56	K (MSP)	PRC_EM2	Towed noise source
11	5P5A21	1	low	low	low	North (0)	84	K (MSP)	PRC_EM2	Towed noise source
12	5P5B22	1	low	low	low	South (180)	84	K (MSP)	PRC_EM2	Towed noise source
13	5P5A25	1	low	low	low	North (0)	112	K (MSP)	PRC_EM2	Towed noise source
14	5P5B26	1	low	low	low	South (180)	112	K (MSP)	PRC_EM2	Towed noise source
15	5P5A29	1	low	low	low	North (0)	100	K (MSP)	PRC_EM2	Towed noise source
16	5P5B30	1	low	low	low	South (180)	100	K (MSP)	PRC_EM2	Towed noise source
17	5P5A33	1	low	low	low	North (0)	120	K (MSP)	PRC_EM2	Towed noise source
18	5P5B34	1	low	low	low	South (180)	120	K (MSP)	PRC_EM2	Towed noise source

Tuesday 30/8 - Local time 16:30 – 21:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
19	5P4A1	1	55	55	6	North (0)	0	K & B (-40)	PRC_EM1	PRC1 + additional sources
20	5P4B2	1	55	55	6	South (180)	0	K & B (-40)	PRC_EM1	PRC1 + additional sources
21	5P4A5	1	55	55	6	North (0)	14		PRC_EM1	PRC1 + additional sources
22	5P4B6	1	55	55	6	South (180)	14		PRC_EM1	PRC1 + additional sources
23	5P4A9	1	55	55	6	North (0)	28		PRC_EM1	PRC1 + additional sources
24	5P4B10	1	55	55	6	South (180)	28		PRC_EM1	PRC1 + additional sources
25	5P4A13	1	55	55	6	North (0)	42	K (East)	PRC_EM1	PRC1 + additional sources
26	5P4B14	1	55	55	6	South (180)	42	K (East)	PRC_EM1	PRC1 + additional sources
27	5P4A17	1	55	55	6	North (0)	56		PRC_EM1	PRC1 + additional sources
28	5P4B18	1	55	55	6	South (180)	56		PRC_EM1	PRC1 + additional sources
29	5P4A21	1	55	55	6	North (0)	84		PRC_EM1	PRC1 + additional sources
30	5P4B22	1	55	55	6	South (180)	84		PRC_EM1	PRC1 + additional sources
31	5P4A25	1	55	55	6	North (0)	112		PRC_EM1	PRC1 + additional sources
32	5P4B26	1	55	55	6	South (180)	112		PRC_EM1	PRC1 + additional sources
33	5P4A29	1	55	55	6	North (0)	100	K (South)	PRC_EM1	PRC1 + additional sources
34	5P4B30	1	55	55	6	South (180)	100	K (South)	PRC_EM1	PRC1 + additional sources
35	5P4A33	1	55	55	6	North (0)	120	K (North)	PRC_EM1	PRC1 + additional sources
36	5P4B34	1	55	55	6	South (180)	120	K (North)	PRC_EM1	PRC1 + additional sources

Tuesday 30/8 - Local time 21:00 – 24:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Off-set	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
37	5P3A1	4	140	140	15	North (0)	0	K (MSP)	PRC_EM2	
38	5P3B2	4	140	140	15	South (180)	0	K (MSP)	PRC_EM2	
39	5P3A5	4	140	140	15	North (0)	14	K (MSP)	PRC_EM2	
40	5P3B6	4	140	140	15	South (180)	14	K (MSP)	PRC_EM2	
41	5P3A9	4	140	140	15	North (0)	28	K (MSP)	PRC_EM2	
42	5P3B10	4	140	140	15	South (180)	28	K (MSP)	PRC_EM2	
53	5P3A13	4	140	140	15	North (0)	42	K (MSP)	PRC_EM2	
44	5P3B14	4	140	140	15	South (180)	42	K (MSP)	PRC_EM2	
45	5P3A17	4	140	140	15	North (0)	56	K (MSP)	PRC_EM2	
46	5P3B18	4	140	140	15	South (180)	56	K (MSP)	PRC_EM2	
47	5P3A21	4	140	140	15	North (0)	84	K (MSP)	PRC_EM2	
48	5P3B22	4	140	140	15	South (180)	84	K (MSP)	PRC_EM2	
49	5P3A25	4	140	140	15	North (0)	112	K (MSP)	PRC_EM2	
50	5P3B26	4	140	140	15	South (180)	112	K (MSP)	PRC_EM2	
51	5P3A29	4	140	140	15	North (0)	100	K (MSP)	PRC_EM2	
52	5P3B30	4	140	140	15	South 53(180)	100	K (MSP)	PRC_EM2	
53	5P3A33	4	140	140	15	North (0)	120	K (MSP)	PRC_EM2	
54	5P3B34	4	140	140	15	South (180)	120	K (MSP)	PRC_EM2	

Wednesday 31/8 - Local time 00:00 – 04:30.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
55	5P6A1	3	75	75	9	North (0)	0	K (MSP)	PRC_EM1	
56	5P6B2	3	75	75	9	South (180)	0	K (MSP)	PRC_EM1	
57	5P6A5	3	75	75	9	North (0)	14	K (MSP)	PRC_EM1	
58	5P6B6	3	75	75	9	South (180)	14	K (MSP)	PRC_EM1	
59	5P6A9	3	75	75	9	North (0)	28	K (MSP)	PRC_EM1	
60	5P6B10	3	75	75	9	South (180)	28	K (MSP)	PRC_EM1	

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
61	5P6A13	3	75	75	9	North (0)	42	K (MSP)	PRC_EM1	
62	5P6B14	3	75	75	9	South (180)	42	K (MSP)	PRC_EM1	
63	5P6A17	3	75	75	9	North (0)	56	K (MSP)	PRC_EM1	
64	5P6B18	3	75	75	9	South (180)	56	K (MSP)	PRC_EM1	
65	5P6A21	3	75	75	9	North (0)	84	K (MSP)	PRC_EM1	
66	5P6B22	3	75	75	9	South (180)	84	K (MSP)	PRC_EM1	
67	5P6A25	3	75	75	9	North (0)	112	K (MSP)	PRC_EM1	
68	5P6B26	3	75	75	9	South (180)	112	K (MSP)	PRC_EM1	
69	5P6A29	3	75	75	9	North (0)	100	K (MSP)	PRC_EM1	
70	5P6B30	3	75	75	9	South (180)	100	K (MSP)	PRC_EM1	
71	5P6A33	3	75	75	9	North (0)	120	K (MSP)	PRC_EM1	
72	5P6B34	3	75	75	9	South (180)	120	K (MSP)	PRC_EM1	

Wednesday 31/8 - Local time 04:30 – 09:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
73	5P1A1	1	55	55	6	North (0)	0	K (MSP)	PRC_EM2	
74	5P1B2	1	55	55	6	South (180)	0	K (MSP)	PRC_EM2	
75	5P1A5	1	55	55	6	North (0)	14	K (MSP)	PRC_EM2	
76	5P1B6	1	55	55	6	South (180)	14	K (MSP)	PRC_EM2	
77	5P1A9	1	55	55	6	North (0)	28	K (MSP)	PRC_EM2	
78	5P1B10	1	55	55	6	South (180)	28	K (MSP)	PRC_EM2	
79	5P1A13	1	55	55	6	North (0)	42	K (MSP)	PRC_EM2	
80	5P1B14	1	55	55	6	South (180)	42	K (MSP)	PRC_EM2	
81	5P1A17	1	55	55	6	North (0)	56	K (MSP)	PRC_EM2	
82	5P1B18	1	55	55	6	South (180)	56	K (MSP)	PRC_EM2	
83	5P1A21	1	55	55	6	North (0)	84	K (MSP)	PRC_EM2	
84	5P1B22	1	55	55	6	South (180)	84	K (MSP)	PRC_EM2	
85	5P1A25	1	55	55	6	North	112	K (MSP)	PRC_EM2	

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
						(0)				
86	5P1B26	1	55	55	6	South (180)	112	K (MSP)	PRC_EM2	
87	5P1A29	1	55	55	6	North (0)	100	K (MSP)	PRC_EM2	
88	5P1B30	1	55	55	6	South (180)	100	K (MSP)	PRC_EM2	
89	5P1A33	1	55	55	6	North (0)	120	K (MSP)	PRC_EM2	
90	5P1B34	1	55	55	6	South (180)	120	K (MSP)	PRC_EM2	

Wednesday 31/8 - Local time 09:00 – 13:30.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
91	5P7A1	3	100	100	12	North (0)	0	K (MSP)	PRC_EM2	
92	5P7B2	3	100	100	12	South (180)	0	K (MSP)	PRC_EM2	
93	5P7A5	3	100	100	12	North (0)	14	K (MSP)	PRC_EM2	
94	5P7B6	3	100	100	12	South (180)	14	K (MSP)	PRC_EM2	
95	5P7A9	3	100	100	12	North (0)	28	K (MSP)	PRC_EM2	
96	5P7B10	3	100	100	12	South (180)	28	K (MSP)	PRC_EM2	
97	5P7A13	3	100	100	12	North (0)	42	K (MSP)	PRC_EM2	
98	5P7B14	3	100	100	12	South (180)	42	K (MSP)	PRC_EM2	
99	5P7A17	3	100	100	12	North (0)	56	K (MSP)	PRC_EM2	
100	5P7B18	3	100	100	12	South (180)	56	K (MSP)	PRC_EM2	
101	5P7A21	3	100	100	12	North (0)	84	K (MSP)	PRC_EM2	
102	5P7B22	3	100	100	12	South (180)	84	K (MSP)	PRC_EM2	
103	5P7A25	3	100	100	12	North (0)	112	K (MSP)	PRC_EM2	
104	5P7B26	3	100	100	12	South (180)	112	K (MSP)	PRC_EM2	
105	5P7A29	3	100	100	12	North (0)	100	K (MSP)	PRC_EM2	
106	5P7B30	3	100	100	12	South (180)	100	K (MSP)	PRC_EM2	
107	5P7A33	3	100	100	12	North (0)	120	K (MSP)	PRC_EM2	
108	5P7B34	3	100	100	12	South (180)	120	K (MSP)	PRC_EM2	

Wednesday 31/8. Local time 13:30 – xx:xx

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting	Remarks
			PORT	STBD	(kts)	(deg)	(m)			
109	5P2A1	2	55	55	6	North (0)	0	K (MSP)	PRC_EM2	
110	5P2B2	2	55	55	6	South (180)	0	K (MSP)	PRC_EM2	
111	5P2A5	2	55	55	6	North (0)	14	K (MSP)	PRC_EM2	
112	5P2B6	2	55	55	6	South (180)	14	K (MSP)	PRC_EM2	
113	5P2A9	2	55	55	6	North (0)	28	K (MSP)	PRC_EM2	
114	5P2B10	2	55	55	6	South (180)	28	K (MSP)	PRC_EM2	
115	5P2A13	2	55	55	6	North (0)	42	K (MSP)	PRC_EM2	
116	5P2B14	2	55	55	6	South (180)	42	K (MSP)	PRC_EM2	
117	5P2A17	2	55	55	6	North (0)	56	K (MSP)	PRC_EM2	
118	5P2B18	2	55	55	6	South (180)	56	K (MSP)	PRC_EM2	
119	5P2A21	2	55	55	6	North (0)	84	K (MSP)	PRC_EM2	
120	5P2B22	2	55	55	6	South (180)	84	K (MSP)	PRC_EM2	
121	5P2A25	2	55	55	6	North (0)	112	K (MSP)	PRC_EM2	
122	5P2B26	2	55	55	6	South (180)	112	K (MSP)	PRC_EM2	
123	5P2A29	2	55	55	6	North (0)	100	K (MSP)	PRC_EM2	
124	5P2B30	2	55	55	6	South (180)	100	K (MSP)	PRC_EM2	
125	5P2A33	2	55	55	6	North (0)	120	K (MSP)	PRC_EM2	
126	5P2B34	2	55	55	6	South (180)	120	K (MSP)	PRC_EM2	

Detailed run plan for CFAV Quest.

Run identifiers: the acoustic, magnetic and electric 'state identifiers' are defined in Annex V.

Wednesday 31/8. Local time 23:00 – 24:00 and Thursday 1/9. Local time 00:00 – 03:30.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
127	5Q4A1	1	60	60	6	North (0)	0	K & B (-40)	A	A	QRC1 + additional sources
128	5Q4B2	1	60	60	6	South (180)	0	K & B (-40)	A	A	QRC1 + additional sources
129	5Q4A5	1	60	60	6	North (0)	14		A	A	QRC1 + additional sources
130	5Q4B6	1	60	60	6	South (180)	14		A	A	QRC1 + additional sources
131	5Q4A9	1	60	60	6	North (0)	28		A	A	QRC1 + additional sources
132	5Q4B10	1	60	60	6	South (180)	28		A	A	QRC1 + additional sources
133	5Q4A13	1	60	60	6	North (0)	42	K (East)	A	A	QRC1 + additional sources
134	5Q4B14	1	60	60	6	South (180)	42	K (East)	A	A	QRC1 + additional sources
135	5Q4A17	1	60	60	6	North (0)	56		A	A	QRC1 + additional sources
136	5Q4B18	1	60	60	6	South (180)	56		A	A	QRC1 + additional sources
137	5Q4A21	1	60	60	6	North (0)	84		A	A	QRC1 + additional sources
138	5Q4B22	1	60	60	6	South (180)	84		A	A	QRC1 + additional sources
139	5Q4A25	1	60	60	6	North (0)	112		A	A	QRC1 + additional sources
140	5Q4B26	1	60	60	6	South (180)	112		A	A	QRC1 + additional sources
141	5Q4A29	1	60	60	6	North (0)	100	K (South)	A	A	QRC1 + additional sources
142	5Q4B30	1	60	60	6	South (180)	100	K (South)	A	A	QRC1 + additional sources

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
143	5Q4A33	1	60	60	6	North (0)	120	K (North)	A	A	QRC1 + additional sources
144	5Q4B34	1	60	60	6	South (180)	120	K (North)	A	A	QRC1 + additional sources

Thursday 1/9. Local time 03:30 – 07:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
145	5Q3A1	3	120	120	12	North (0)	0	K (MSP)	C	B	
146	5Q3B2	3	120	120	12	South (180)	0	K (MSP)	C	B	
147	5Q3A5	3	120	120	12	North (0)	14	K (MSP)	C	B	
148	5Q3B6	3	120	120	12	South (180)	14	K (MSP)	C	B	
149	5Q3A9	3	120	120	12	North (0)	28	K (MSP)	C	B	
150	5Q3B10	3	120	120	12	South (180)	28	K (MSP)	C	B	
151	5Q3A13	3	120	120	12	North (0)	42	K (MSP)	C	B	
152	5Q3B14	3	120	120	12	South (180)	42	K (MSP)	C	B	
153	5Q3A17	3	120	120	12	North (0)	56	K (MSP)	C	B	
154	5Q3B18	3	120	120	12	South (180)	56	K (MSP)	C	B	
155	5Q3A21	3	120	120	12	North (0)	84	K (MSP)	C	B	
156	5Q3B22	3	120	120	12	South (180)	84	K (MSP)	C	B	
157	5Q3A25	3	120	120	12	North (0)	112	K (MSP)	C	B	
158	5Q3B26	3	120	120	12	South (180)	112	K (MSP)	C	B	
159	5Q3A29	3	120	120	12	North (0)	100	K (MSP)	C	B	
160	5Q3B30	3	120	120	12	South (180)	100	K (MSP)	C	B	
161	5Q3A33	3	120	120	12	North (0)	120	K (MSP)	C	B	
162	5Q3B34	3	120	120	12	South (180)	120	K (MSP)	C	B	

Thursday 1/9. Local time 07:00 – 12:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
163	5Q5A1	1	30	30	3	North (0)	0	K (MSP)	B	G	Bottom pro-filer
164	5Q5B2	1	30	30	3	South (180)	0	K (MSP)	B	G	Bottom pro-filer
165	5Q5A13	1	30	30	3	North (0)	42	K (MSP)	B	G	Bottom pro-filer
166	5Q5B14	1	30	30	3	South (180)	42	K (MSP)	B	G	Bottom pro-filer
167	5Q5A29	1	30	30	3	North (0)	100	K (MSP)	B	G	Bottom pro-filer
168	5Q5B30	1	30	30	3	South (180)	100	K (MSP)	B	G	Bottom pro-filer
169	5Q5A33	1	30	30	3	North (0)	120	K (MSP)	B	G	Bottom pro-filer
170	5Q5B34	1	30	30	3	South (180)	120	K (MSP)	B	G	Bottom pro-filer

Thursday 1/9. Local time 23:00 – 24:00 and Friday 2/9. Local time 00:00 – 03:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
171	5Q6A1	3	90	90	9	North (0)	0	K (MSP)	D	C	
172	5Q6B2	3	90	90	9	South (180)	0	K (MSP)	D	C	
173	5Q6A5	3	90	90	9	North (0)	14	K (MSP)	D	C	
174	5Q6B6	3	90	90	9	South (180)	14	K (MSP)	D	C	
175	5Q6A9	3	90	90	9	North (0)	28	K (MSP)	D	C	
176	5Q6B10	3	90	90	9	South (180)	28	K (MSP)	D	C	
177	5Q6A13	3	90	90	9	North (0)	42	K (MSP)	D	C	
178	5Q6B14	3	90	90	9	South (180)	42	K (MSP)	D	C	
179	5Q6A17	3	90	90	9	North (0)	56	K (MSP)	D	C	
180	5Q6B18	3	90	90	9	South (180)	56	K (MSP)	D	C	
181	5Q6A21	3	90	90	9	North (0)	84	K (MSP)	D	C	
182	5Q6B22	3	90	90	9	South (180)	84	K (MSP)	D	C	
183	5Q6A25	3	90	90	9	North (0)	112	K (MSP)	D	C	
184	5Q6B26	3	90	90	9	South (180)	112	K (MSP)	D	C	

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
185	5Q6A29	3	90	90	9	North (0)	100	K (MSP)	D	C	
186	5Q6B30	3	90	90	9	South (180)	100	K (MSP)	D	C	
187	5Q6A33	3	90	90	9	North (0)	120	K (MSP)	D	C	
188	5Q6B34	3	90	90	9	South (180)	120	K (MSP)	D	C	

Friday 2/9. Local time 03:00 – 07:30.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
189	5Q1A1	1	60	60	6	North (0)	0	K (MSP)	B	F	
190	5Q1B2	1	60	60	6	South (180)	0	K (MSP)	B	F	
191	5Q1A5	1	60	60	6	North (0)	14	K (MSP)	B	F	
192	5Q1B6	1	60	60	6	South (180)	14	K (MSP)	B	F	
193	5Q1A9	1	60	60	6	North (0)	28	K (MSP)	B	F	
194	5Q1B10	1	60	60	6	South (180)	28	K (MSP)	B	F	
195	5Q1A13	1	60	60	6	North (0)	42	K (MSP)	B	F	
196	5Q1B14	1	60	60	6	South (180)	42	K (MSP)	B	F	
197	5Q1A17	1	60	60	6	North (0)	56	K (MSP)	B	F	
198	5Q1B18	1	60	60	6	South (180)	56	K (MSP)	B	F	
199	5Q1A21	1	60	60	6	North (0)	84	K (MSP)	B	F	
200	5Q1B22	1	60	60	6	South (180)	84	K (MSP)	B	F	
201	5Q1A25	1	60	60	6	North (0)	112	K (MSP)	B	F	
202	5Q1B26	1	60	60	6	South (180)	112	K (MSP)	B	F	
203	5Q1A29	1	60	60	6	North (0)	100	K (MSP)	B	F	
204	5Q1B30	1	60	60	6	South (180)	100	K (MSP)	B	F	
205	5Q1A33	1	60	60	6	North (0)	120	K (MSP)	B	F	
206	5Q1B34	1	60	60	6	South (180)	120	K (MSP)	B	F	

Friday 2/9. Local time 07:30 – 12:00.

Test no:	Run iden-tifier	Con-fig	Propeller (RPM)		Expected speed	Heading	Offset	Aspect	EM setting		Remarks
			PORT	STBD	(kts)	(deg)	(m)		M	E	
207	5Q2A1	2	60	60	6	North (0)	0	K (MSP)	B	G	
208	5Q2B2	2	60	60	6	South (180)	0	K (MSP)	B	G	
209	5Q2A5	2	60	60	6	North (0)	14	K (MSP)	B	G	
210	5Q2B6	2	60	60	6	South (180)	14	K (MSP)	B	G	
211	5Q2A9	2	60	60	6	North (0)	28	K (MSP)	B	G	
212	5Q2B10	2	60	60	6	South (180)	28	K (MSP)	B	G	
213	5Q2A13	2	60	60	6	North (0)	42	K (MSP)	B	G	
214	5Q2B14	2	60	60	6	South (180)	42	K (MSP)	B	G	
215	5Q2A17	2	60	60	6	North (0)	56	K (MSP)	B	G	
216	5Q2B18	2	60	60	6	South (180)	56	K (MSP)	B	G	
217	5Q2A21	2	60	60	6	North (0)	84	K (MSP)	B	G	
218	5Q2B22	2	60	60	6	South (180)	84	K (MSP)	B	G	
219	5Q2A25	2	60	60	6	North (0)	112	K (MSP)	B	G	
220	5Q2B26	2	60	60	6	South (180)	112	K (MSP)	B	G	
221	5Q2A29	2	60	60	6	North (0)	100	K (MSP)	B	G	
222	5Q2B30	2	60	60	6	South (180)	100	K (MSP)	B	G	
223	5Q2A33	2	60	60	6	North (0)	120	K (MSP)	B	G	
224	5Q2B34	2	60	60	6	South (180)	120	K (MSP)	B	G	

DATA RECORDING, COLLECTION AND DISTRIBUTION

The data will be ready for distribution before end of November 2011.

ANALYSIS PLAN

Mine ship vulnerability study for QUEST finished before end of 2012.

Study: Comparing of EM data from the Herdla Range with data from other ranges. (2012/2013).

ANNEX J
TRIAL 05 (FRIEDRICHSORT)

OBJECTIVES

The objective is to deperm CFAV Quest. QUEST's permanent magnetic signature has increased to a level where the degaussing system is unable to properly compensate the magnetic signature. This is a common condition for steel hull ships and necessitates that the ship undergo a deperming to reduce the permanent magnetic signature. The deperming of CFAV QUEST will be conducted at the Magnetic Treatment Facility at Friedrichsort.

SPECIAL TEST EQUIPMENT

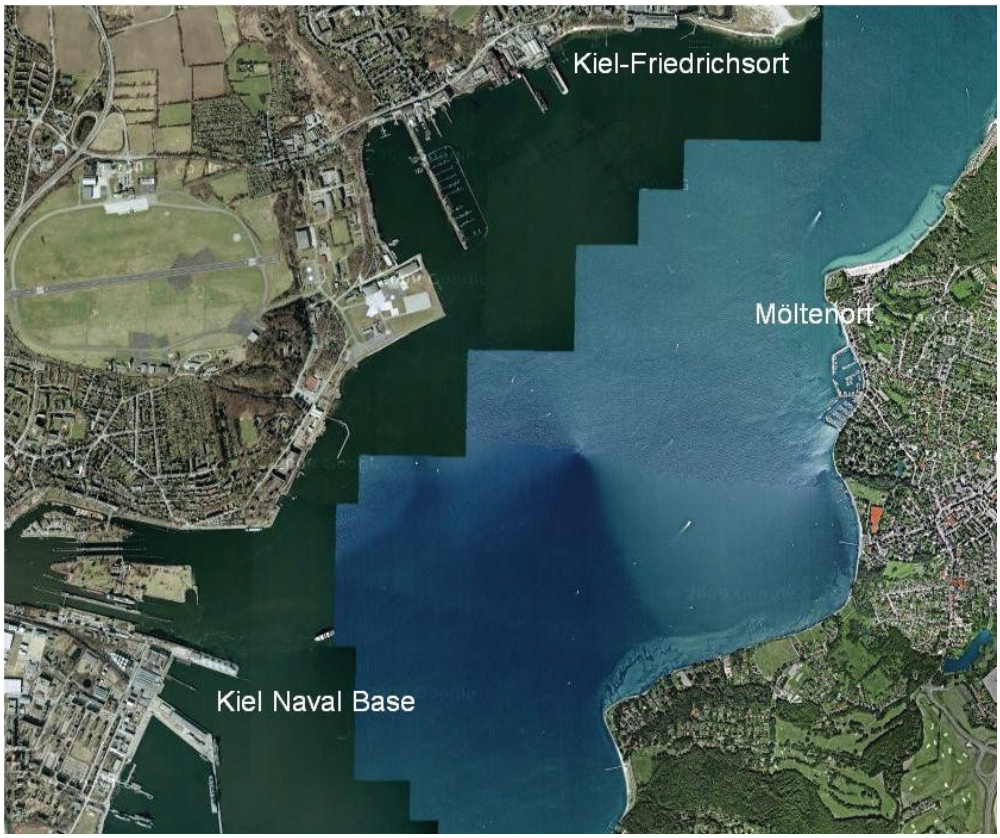
In order to test and validate deployed underwater sensor systems DRDC has developed a towed source with acoustic, magnetic and alternating electric sources (description in paragraph 7.9.1). This equipment will be used at all over run ranges to make the results comparable.

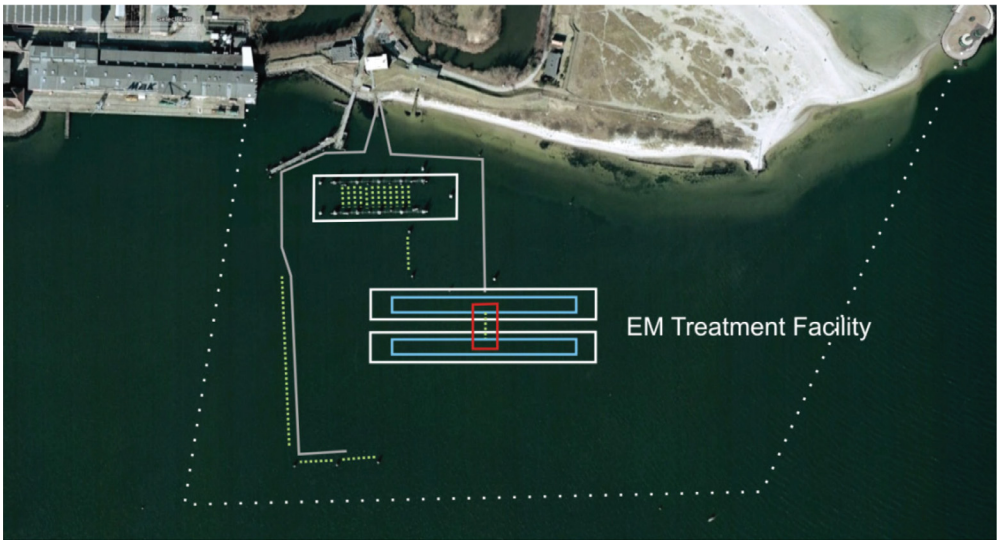
RANGE INFORMATION

An auxiliary boat is available on request.

LOCATION	HEADING	MEASURING DEPTH	PROBE DISTANCE	MAXIMUM # OF PROBES
FRIEDRICHSORT	EAST	13 m	5 m	15
FRIEDRICHSORT	WEST	13 m	5 m	15
FRIEDRICHSORT	P/I-SEPARATION	13 m	4 m	7
MÖLTENORT	SOUTH	13 m	5 m	15
MÖLTENORT	NORTH	13 m	5 m	15

Kiel harbour with Kiel Friedrichsort and Möltenort





SENSOR POSITION

The given position of probe 1 and 15 described the outer limits of the sensor line as a gate were the “Quest” has to run through in the centre.

Friedrichsort:

Probe 1	N 54°23.3090'	E 010°11.0415'	UTM32	E 576886	N 6027392	(Meter)
Probe 15	N 54 23.2895	E 010 11.0430	UTM32	E 576888	N 6027356	

Möltenort:

Probe 1.	N 54 22.7135	E 010 11.4710	UTM32	E 577370	N 6026295
Probe 15	N 54 22.7125	E 010 11.4050	UTM32	E 577298	N 6026292

COMMUNICATION

WTD 71 provides a PoC onboard “Quest” during ranging. WTD 71 will provide a portable radio. An auxiliary boat is available on request.

Address of Station.

Wehrtechnische Dienststelle für Schiffe u. Marinewaffen, Magn. Messstelle Kiel-Friedrichsort, Deichweg 15, 24159 Kiel

Telephone Numbers. Postal line: Kiel +49 431 384-7621 and +49 4331-35209-302.

Address of Friedrichsort station.

Wehrtechnische Dienststelle für Schiffe u. Marinewaffen, Magn. Meßstelle Kiel-Friedrichsort, Deichweg 15, 24159 Kiel.

Telephone Numbers: +49 431 384-7621 and +49 4331-35209-242.

PREPARATIONS

It is a prerequisite that the degaussing system works properly; operation of the degaussing system has to be done by the crew of QUEST.

For adjustment of the degaussing system, the coil layout of the vessel is necessary and has to be made available to the range officer conducting the measurements at Friedrichsort.

A briefing will take place on the day of arrival at Kiel Naval Base at 12:00. measurement procedure

Both, Kiel Friedrichsort and Möltenort, are open ranges in Kiel harbour. Speed is limited inside the harbour to 10 knots. Treatment will be done at a speed of approx. 3 knots. The number of runs cannot be determined in advance. Procedure depends on magnetic status of "Quest" and is iterative.

RUN PLAN

Kiel-Friedrichsort / Möltenort, over run measurements at a depth of 13m.

Day 1:
1. Arrival measurement under local magnetic conditions and all main headings Generic run plan, see chapter 7.5.4, table 10 master trail plan
2. Vertical P-I separation, degaussing system switched on and off
3. Magnetic treatment with degaussing system switched off!

Day 2:
1. Presetting of the degaussing system. Compensation of the magnetic signature (permanent and vertical induced). Final setting will be obtained at the Earth Field Simulator.
2. Presetting of the longitudinal magnetic signature component by adjusting the degaussing system on north and south heading

Day 3: Spare day until 13:00

The break between the measurement in Kiel and Lehmbek should be at least 10 days. This is necessary to get stable conditions for the magnetic signature for further measurements.

DATA RECORDING, COLLECTION AND DISTRIBUTION

Data will be collected to conduct the treatment and presetting of the degaussing system successfully. The data will be available acc. to § 2.5 Data Handling and distribution.

ANALYSIS PLAN

Data will be used as information for Earth field simulator.

ANNEX K
TRIAL 06 (SURENDORF)

SQUIRREL (SURENDORF QUEST INFRARED AND RADAR EXPERIMENTS IN LITTORALS)

INTRODUCTION

The SET 144 and SET 154 will perform joint infrared and radar trials with the Quest at Surendorf test range in the time period form 12. until 23. September 2011. The trials are named SQUIRREL (Surendorf Quest Infrared and Radar Experiments in Littorals). For details see Master trial plan, chapter 4 and 5.

OBJECTIVES

SET-144. The main objective of the infra-red trial is to test the IR signature properties and missile susceptibility properties of a ship (CFAV QUEST) with an IR Ship Signature Control System, specifically:

a. hull signature;
b. plume Signature;
c. full ship susceptibility.

SET-155. The objectives of the trial are as follows:

a. to investigate the effect of different ship configurations on the radar signature of the ship;
b. to validate prediction modelling of the ship in different configurations;
c. to investigate and validate modelling of the radar signature of the ship in its environment;
d. to evaluate the effect of the IR signature reduction techniques on the radar signature of the ship;
e. to evaluate a signature management system being developed by The Netherlands (TNO).
f. to investigate propagation at radar frequencies, including reflections off the sea surface.

Additional trial objectives. In addition to the trials resulting from the SET 144 and SET 155 objectives, propagation measurements (MWIR / VIS) and small target detection measurements will be conducted.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

The CFAV Quest is equipped with an IR onboard Signature Management System (IR OSM) including active hull cooling (AHC) and seawater Injection (SWI) for plume cooling.

CFAV Quest

Length: 76,0 m; beam: 12,6 m; draught: 4,8 m

Several additional pieces of equipment will be installed on Quest: decoy launchers (see figure below: decoy storage locker, Pyranometer/Pyrgeometer pairs for irradiation measurements, an anemometer, several iButtons (for hull temperature monitoring), a GPS tracking system from WTD 71. This additional equipment will be installed the pier-side the weekend between Trials 5 & 6.With the exception of the OSM, all other equipment will be installed the pier side the weekend between trials 5 & 6.

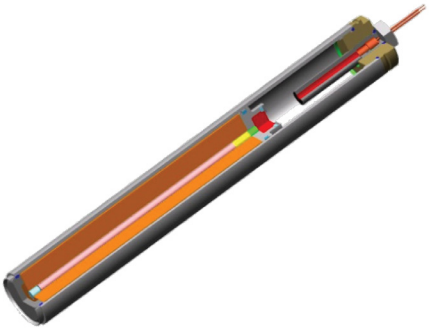
ROSY DECOY SYSTEM

PYRANOMETER / PYRGEOMETER

ANEMOMETER

IBUTTON

ROSY DECOY MONITION



Equipment on board Quest for radar signature measurements

An antenna, supplied by Canada will be installed on Quest, prior to departure from Canada. Various DGPS units will also be installed once the ship arrives in Eckernförde.

For some of the runs Quest will be fitted with RAM (radar absorbent material) panels, These will be fitted for the day the measurements are conducted.

For another set of runs, Quest will be fitted with “metal” plates, these will be obtained from plywood, covered with aluminium foil. Again these will be fitted

Meteorological measurements

Meteorological measurements will be performed at different distances with the medium WTD 71 auxiliary vessel “Kronsort”. Therefore, the Kronsort will be equipped with meteorological sensors. In addition, the Kronsort will deploy drifting meteorological buoys and launch tether sondes.

MULTI PURPOSE VESSEL”Kronsort”

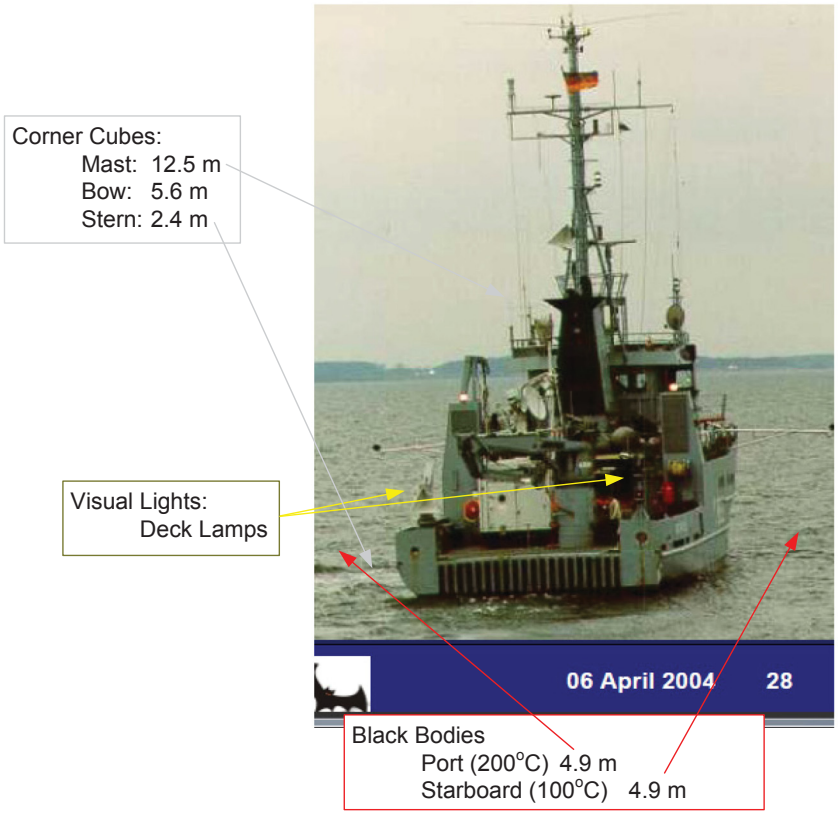
(length: 56.6 m beam: 10.8 m draught: 3.5 m)

IR / VIS and radar propagation trials.

The IR/VIS and radar propagations trials at different distances will be performed with the small WTD 71 auxiliary vessel “Mittelgrund”.

MULTI PURPOSE VESSEL”MITTELGRUND”
(Length: 38.5 m, beam: 9.2 m , draught: 3.5 m)

Dedicated equipment such as blackbodies, lights , optical corner reflectors and radar corner reflectors, a meteorological station, and a GPS tracking system will be mounted onboard (see figure below).



The black bodies and radar corner reflectors on Mittelgrund will be measured as the ship steams towards and away from the measurement cameras and radars in order to perform IR transmission, detection, tracking, classification, and identification range measurements as well as multipath reflections of the sea surface and radar propagation measurements.

If necessary a Radar corner will also be mounted on a Rhib, which will steam in a straight line away from or towards the measurement site to repeat the assessment with a corner at a lower height than those on Mittelgrund.

Small target detection (IR/VIS)

Several small vessels will be measured, a RHIB, a Zodiac, and a small WTD 71 work boat (AM 7). In addition, swimmer (diver team) will be investigated. These small objects will be equipped with GPS systems and the vessels possibly with I-buttons.

SPEED BOAT
(length: 6.5 m, beam: 2.5 m)

WORK BOAT AM7
(length: 16.3 m, beam: 4.4 m, draught: 1.35 m)

Two mine like object (MLO) are planned to be measured. Both MLO (from BE) will be moored or placed close to the shore. The mines will be equipped with GPS systems.

Mine like Objects

Cylinder-shaped bottom mine
Length: 1,6 m Diameter: 0.5 m

Spherical floating mine.
Diameter 0.8 m

On shore propagation measurements

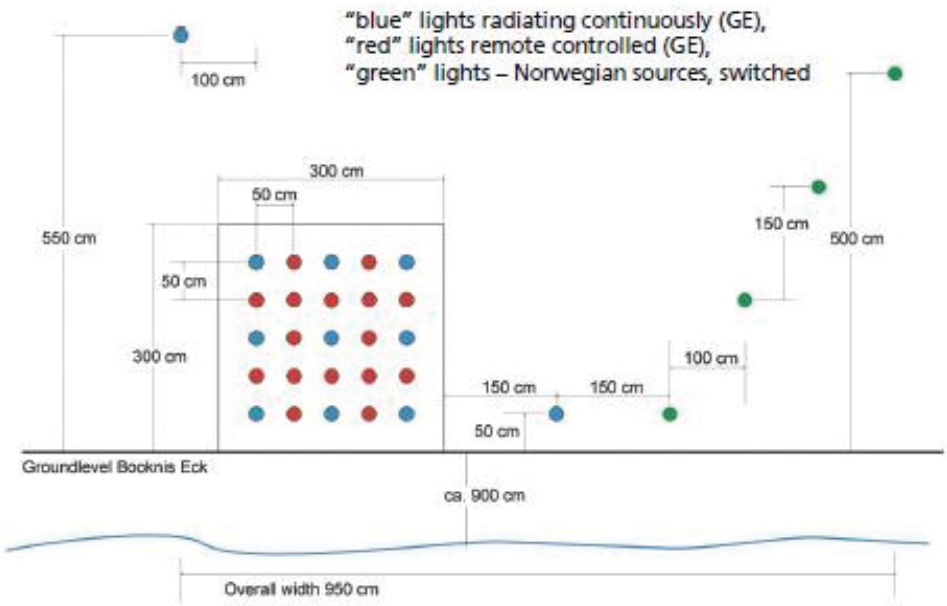
Continuous on shore IR and radar propagation measurements will be performed between Surendorf pier and Boockniseck at a distance of 8.2 km. In Boockniseck several lights and blackbodies, and a RF emitter will be installed. At Surendorf pier a RF receiver will be mounted.

The IR propagation measurements will be performed either continuously throughout the duration of the trial or during long intermittent intervals throughout the trial.

Instrumentation at Surendorf will monitor the beam angle of arrival, refraction, turbulence and scintillation using multiple band imagers and high speed imagers.

The radar propagation measurements of the corner reflector will be made each day, before and after the Quest measurements and also at several times during the day.

LIGHT SET UP BOOCKNISECK

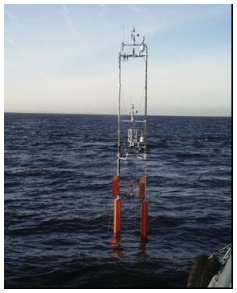


Meteorological buoys and weather stations

During the SQUIRREL trial period meteorological and oceanographic data (e.g. air temperature, water temperature, wind direction and wind speed) will be measured at different locations. Therefore, weather stations will be installed in Surendorf and Boockniseck as well as on board of the vessels Kronsort and Mittelgrund, In addition, tether sondes will be started at Surendorf pier and on board of Kronsort. Furthermore, several meteorological and oceanographic buoys will be deployed at the sea area close to the measurement sides and QUEST waypoints (see next page).

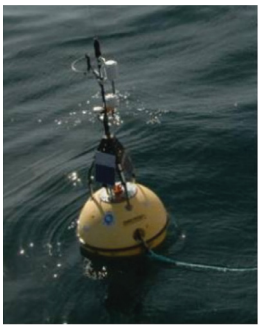
Air-Sea-Interaction buoy (ASIB)

GE (FWG) Meteo Buoys III and IV



Catamaran

CA Meteo Buoy



NO Meteo Buoy

GE (IOSB) Meteo Buoy (Robbe)

GE Wave Rider Buoy

GE (FWG)
Theter Sondes

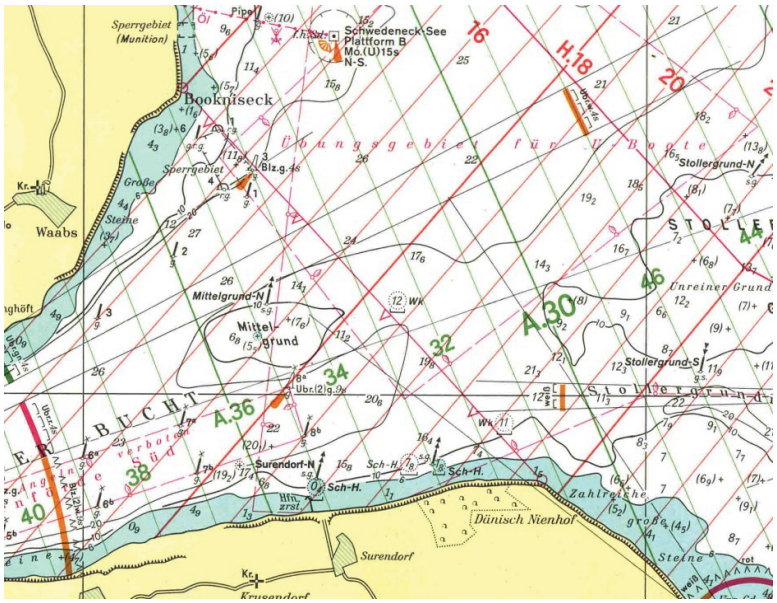
Helicopter

For specific runs a helicopter will measure the IR signature of CFAV Quest. For this purpose, a dedicated research helicopter (B0 105C) of the German Aerospace Centre DLR will be equipped with a IR-signature (AIR-sig) measurement system. The measurement system consists of a cardanic mounted dual band IR camera (MWIR & LWIR), a visual camera and a laser range finder.

RANGE INFORMATION

The Surendorf range, located in Eckernförde Bay, near the city of Eckernförde in Germany.

A nautical chart of the local area is shown in the figure below. The shore site is in the lower-middle part of the figure, labelled Surendorf. The pier, where several test teams will be located, is illustrated on the chart. The QUEST will need to pay close attention to water depth for the close-in (500m range) runs for plume measurements.



TRACKING

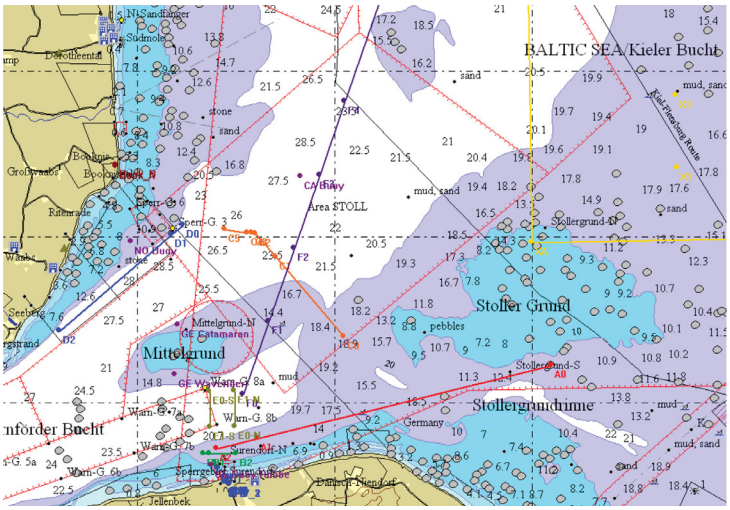
SET-144 IR trial. Having accurate tracking information on the QUEST is critical to the success of the trial. Differential Global Positioning System (DGPS) will be installed on the QUEST and this information will be telemetered to the Test Director at the shore site. In addition the tracking information will be monitored by the measurement teams.

GPS will also be installed on board of the auxiliary vessels Kronsort and Mittelgrund and on board of the small test vessels (AM 7 Rhib and zodiac). Furthermore the swimmer, MLO and meteo buoys will be equipped with GPS.

There will be five primary types of waypoints for QUEST Infrared runs, A, B, C, D, and E. In Chapter 4 and with the 'run descriptions' these measurement points are described in detail The waypoints which mark the starting locations for the different types of runs are A0, B0, C0, E0S or E0N and D0. The run types F are for Mittelgrund only in order to measure IR/VIS propagation.

SET-154 trial. With the exception of the measurements of the corner reflector at Boockniseck and the transmissometer runs, the radar signature measurements will be conducted about an axis in the 030 direction. The circular and straight runs will be centred on this line. The circles will be conducted at ranges of 4, 7, 10 and 12 km. The circular runs will be conducted clockwise and counter clockwise and will have a diameter of 500 meters each. A detailed overview will be provided prior to the trial.

Positions of Buoys. The locations of the meteorological and oceanographic buoys are shown below (figure & table).



Meterological Stations														
GE Buoy	54,5039720	54	30,2383	54	30	14,30	10,0486940	10	2,9216	10	2	55,30	German Waverider Buoy
CA Buoy	54,5493560	54	32,9614	54	32	57,68	10,1000000	10	6,0000	10	6	0,00	Canadian buoy
Catamaran	54,5155120	54	30,9307	54	30	55,84	10,0503600	10	3,0216	10	3	1,30	German Meteorological platform
NO Buoy	54,5349920	54	32,0995	54	32	5,97	10,0321000	10	1,9260	10	1	55,56	Norwegian buoy
GE Buoy Robbe	54,4828560	54	28,9714	54	28	58,28	10,0627060	10	3,7624	10	3	45,74	German buoy (FhG-IOSB)
Drift Buoy Area													
XA	54,5333333	54	32,0000	54	32	0,00	10,1916667	10	11,5000	10	11	30,00	SW-Corner
XB	54,5333333	54	32,0000	54	32	0,00	10,3333333	10	20,0000	10	20	0,00	SE-Corner
XC	54,6500000	54	39,0000	54	39	0,00	10,3333333	10	20,0000	10	20	0,00	NE-Corner
XD	54,6500000	54	39,0000	54	39	0,00	10,1916667	10	11,5000	10	11	30,00	NW-Corner
Drift Buoy Launch Position													
X1	54,5500000	54	33,0000	54	33	0,00	10,2500000	10	15,0000	10	15	0,00	ASIB
X2	54,6166667	54	37,0000	54	37	0,00	10,2500000	10	15,0000	10	15	0,00	METEO III
X3	54,5666667	54	34,0000	54	34	0,00	10,2500000	10	15,0000	10	15	0,00	METEO IV

The drifting buoys will be launched by the vessel Kronsort daily in the morning at start position (X1 to X3) and recovered in the evening in the drift buoy area (XA to XD).

Position of Mine-like-Objects (MLO). The MLO will be deployed in the restricted sea area Surendorf or close to it.

COMMUNICATION

Communications frequencies for this trial are:

a. primary : 234.425 MHz (AM modulation);
b. secondary : 233.775 MHz (AM modulation);
c. On arrival at Eckernförde Bay: Eckernförde Naval radio (for reporting to port): CHANNEL 11

Communication table.

LOCATION	NAME	ORGANI-SATION/ NATION	EMAIL AD-DRESS	TELEPHONE NO. (Fax)	RADIO CALL SIGN
Test Director	Dr. Birgit Rasch	WTD 71 (GE)	wtd71560 @bwb.org (birgitRasch @bwb.org)	+49 (0)4308 186 - 305 **During the trial at SQUIRREL Trial Coordinator office: +49 (0)4308 186 – 350** (Fax: +49 (0)4308 186 – 304)	DELTA ROMEO SIERRA DELTA
Deputy Test Director	Mario Behn	WTD 71 (GE)	wtd71550 @bwb.org (mariobehn	+49 (0)4308 186 - 324 Fax:	

LOCATION	NAME	ORGANI-SATION/ NATION	EMAIL AD-DRESS	TELEPHONE NO. (Fax)	RADIO CALL SIGN
			@bwb.org)	+49 (0)4308 186 - 304)	
Test Coordi-nator on Quest	Dr. Zahir Daya	DRDC-A (CA)	Zahir.Daya @drdc-rddc.gc.ca	902-426-3100 x 346	TBD
Deputy Test Coordinator on Quest	Yves Perron	DRDC-A (CA)			
Launcher handling on Quest	Sascha Diezmann	Rhein-metall (GE)			
Firing Officer on Quest	Ziegen-feuther	WTD 71 (GE)			
Project Scientist on Quest	David Vaitekunas	Davis Eng. (CA)	Davidv @wrdavis.com	613-748-5500	
IR Trial Co-ordinator (SET 144)	Doug Fraedrich	NRL (US)	doug.fraedrich @nrl.navy.mil	202-404-3810	
RCS Trial coordinator (SET 154)	Dr. Francis Talbot	Dstl (UK)	Fmtalbot @dstl.gov.uk	+44-23 92 53 7962	
Propagation Trial Coordinator	Dr. Karin Stein	Fhg IOSB (GE)	karin.stein @iosb. fraunhofer.de	+49-7243-992-120	
Meteo Trial coordinator	Dr. Jörg Förster	WTD 71 – FWG (GE)	JoergFoerster @bwb.org	+49 (0) 431 607- 4123 During the trial on board of Kronsort	
Deputy Meteo Trial Coordinator	Malte Ehlers	WTD 71-FWG (GE)	malteehlers @bwb.org		
CFAV Quest				Quest MSAT Voice : 1-600-700-6980 Quest Globalstar : 1-613-988-2688	CFAV QUEST or DELTA ROMEO SIERRA TANGO
MZB Kronsort				N/A	DELTA ROMEO MIKE ECHO

LOCATION	NAME	ORGANI-SATION/ NATION	EMAIL AD-DRESS	TELEPHONE NO. (Fax)	RADIO CALL SIGN
MZB Mittelgrund				N/A	DELTA ROMEO XRAY PAPA
AM7					--
RHIB (Speed Boat)					KELLE
ZODIAC (rubber boat of diverteam)				N/A	Diver
Eckernförde WTD 71 Port				CHANNEL 11	WTD 71 port radio
Eckernförde Navy Base Port				CHANNEL 11	Naval port radio

IR TEST TEAMS	NAME	ORGANISATION / NATION	EMAIL ADDRESS	TELEPHONE NO.
AUS	Leo de Yong	DSTO (AUS)	Leo.Deyong @dsto.defence.gov.au	61 3 96268548
BE	Alexander Borghgraff	RMA (BE)	Alexander.Borghgraef @rma.ac.be	+32 2 742 6667
CA	Luc Forand	DRDC-V (CA)	luc.forand @drdc-rddc.gc.ca	418-844-4000 ext 4506
GE (WTD 71)	Dr. Tobias Gensty	WTD 71 (GE)	tobiasgensty@bwb.org	+49 (0)4308 186 - 305
GE (IOSB)	Dr. Karin Stein	Fraunhofer IOSB (GE)	karin.stein @iosb.fraunhofer.de	+49-7243-992-120
GR	Dr. Nikolaos Solomos	HNA (GR)	nsolom@hna.gr	30-210-4581319
IT	LT Raffaele VITA	CSSN ITE (IT)	RAFFAELE.VITA @marina.difesa.it	39-0586-238355
NL	Henny Veerman	TNO (NL)	Henny.veerman@tno.nl	+31 8886 61006 +31 641 080 810
NO	Dr. Lars Trygve Heen	FFI (NO)	lth@ffi.no	+47-63-80-7242
TU	Dr. Cemil B. Erol	Tubitak (TU)	cemil.erol @iltaren.tubitak.gov.tr	+90 312 291 6109

IR TEST TEAMS	NAME	ORGANISATION / NATION	EMAIL ADDRESS	TELEPHONE NO.
UK	Pierre Adedeze	Dstl (UK)	padedze@dstl.gov.uk	+44-23-9253-2600
US -NRL	Dr. Tom Taczek	NRL (US)	thomas.taczak.ctr @nrl.navy.mil	202-767-4059
US -ARL	Kristian Guarton	ARL (US)		
ZAF	Willem Gunter	IMT (ZAF)	whg@imt.co.za	+27-21-786-8209

PREPARATIONS

A number of preparations must be made before the trial. These preparation tasks are summarized in the table below.

TASK	PERFORMER	WHEN	WHERE
Delivery of I Buttons to WTD 71	US-NRL, GE (IOSB), UK)	6 weeks before the trials	To WTD 71- 330 in Kiel-Ellerbek
”Calibration” of IButtons”	GE (WTD 71-330)		WTD 71 Kiel-Ellerbek
Install Decoy lockers	DRDC/Quest	1 - 2 Aug	Halifax
Install Antenna on Quest	DRDC	TBD	Halifax
SOC 410 colour measurements of Mittelgrund	US	5 or 9 Sept.	WTD-71 Pier, Eckernförde
SOC 410 colour measurements of Kronsort,	US	5 - 7 Sept.	Naval Arsenal -FWG Pier, Kiel
SOC 410 colour measurements of RHIB	US	6 - 9 Sept.	Pier Surendorf
SOC 410 colour measurements of ZODIAC	US	9 or 12 Sept.	Pier Surendorf
Temperature profile measurements (LWIR) on board of Quest	GE (IOSB)	during trial	Pier Eckernförde
Install Launchers on Quest	Rheinmetall	9 - 10 Sept	Pier Eckernförde
Lad ammunition on Quest	Rheinmetall, WTD 71, Quest	9 Sept.	Pier Eckernförde
Install DGPS on Quest (first priority, for trial director and SET 144)	WTD-71	8-10 Sept	Pier Eckernförde
Install DGPS on Quest (for SET 154)	UK	8 - 10 September	Pier Eckernförde
Install Pyranometer and Pyrgeometer on Quest	US-NRL)	8-10 Sept	Pier Eckernförde

TASK	PERFORMER	WHEN	WHERE
Install iButtons on Quest	(US-NRL	8 – 10 Sept	Pier Eckernförde
Install Anemometers on Quest	DRDC	8- 10 Sept	Pier Eckernförde
Install Metal Plates on Quest	SET154 team	during trial	Pier Eckernförde
Install RAM Panels on Quest	SET154 team	during trial	Pier Eckernförde
Install nettings/mesh on Quest	SET154 team	during trial	Pier Eckernförde
Install IButtons on RHIB, Zodiac	IOSB	9 or 12 Sept	Pier Surendorf
Install DPGS on Kronsort,	GE (WTD 71)	5 - 7 Sept.	Naval Arsenal -FWG Pier, Kiel
Install DPGS on Mittelgrund	GE (WTD 71)	5. Sept	WTD-71 Pier, Eckernförde
Install DPGS on AM 7	GE (WTD 71)	5 - 9. Sept	WTD-71 Pier, Eckernförde
Install DPGS on RHIB	GE (WTD 71)	5. – 9. Sept.	Surendorf
Install DPGS on Zodiac	GE (WTD 71)	9. Sept.	Surendorf
DGPS to Swimmer	GE (WTD 71)	9. Sept.	Surendorf
Install DPGS on MLO	BE/GE	Not later than 5 Sept. (prior to deployment)	TBD
Install AIS on GE meteo buoys, catamaran etc.	GE (WTD/FWG)	prior to de-ployment	Kiel
Install Meteo Containers onboard of “Kronsort”	GE (FWG)	5 - 7 Sept.	Naval Arsenal -FWG Pier, Kiel
Install blackbodies on board of Mittelgrund	GE (IOSB/WTD 71)	5 Sept	WTD-71 pier Eckernförde
Install radar corner reflector on board of Mittelgrund	GE (FHR)	5 Sept or 8 - 9 Sept	WTD-71 pier Eckern-förde
Deployment of CA Meteo buoy	DRDC/Quest	8 Sept	at sea by Quest
Deployment of NO Meteo buoy	NOR/FWG/Kronsort	8 Sept	at sea by Kronsort
Deployment of GE (IOSB) Meteo Buoy Robbe	IOSB /FWG/Kronsort /Diver team	8 Sept	at sea by Kronsort
Deployment of GE (FWG) wave rider buoy and catamaran	FWG/IOSB/Kronsort	8 Sept	at sea by Kronsort
Deployment and recovery of drift-ing GE (FWG) Air-interception Buoy and two Meteo Buoys	FWG/IOSB/Kronsort	Daily during trial	at sea by Kronsort
Deployment of MLO	WTD-71/Mittelgrund/	7 Sept	at sea by Mittelgrund

TASK	PERFORMER	WHEN	WHERE
	Speedboat		
Set up IR and Radar Equipment on shore	All IR and Radar Test Teams	5 - 10 Sept.	Surendorf
Set up IR and Radar Propagation Equipment on shore at Boockniseck	All IR and Radar Test Teams	5 - 10 Sept.	Boockniseck
Set up meteo equipment	All IR and Radar Test Teams	5- 10. Sept.	Surendorf
Set up meteo equipment	NO/GE (IOSB)/WTD-71	5 - 10. Sept.	Boockniseck
Set up meteo equipment on board of Kronsort	WTD-71(FWG)	5 - 7 Sept.	Naval Arsenal -FWG Pier, Kiel
Set up meteo equipment on board of Mittelgrund	US/WTD-71 (FWG)	5 Sept	
Set up radar corner reflector on board of speedboat	GE (FHR)/WTD-71	during the trials	Surendorf pier

BRIEFINGS

The following meetings are planned prior to and during the trials at Surendorf (also see master time table).

TASK	PERFORMER	WHEN	WHERE
Preparation Meeting	Trial director, deputy trial director, partial trial coordinators (SET 144, SET 154, Meteo), Quest test coordinator, Quest Project scientist etc.	7. Sept (13:00 local time)	Surendorf, building 3, meeting room
SET 154 Briefing	SET 154 members	9 Sept	Surendorf, building 3, meeting room
Start of trials meeting	SET 144 and SET 154 members (Trial director, deputy trial director, partial trial coordinators (SET 144, SET 154, Meteo), one member of each measurement team)	10 Sept. (10:00 local time)	Surendorf, building 3, large meeting room
Daily meetings	TBD (e.g. Trial director, partial trial coordinators)	TBD	Surendorf, building 3, small meeting room

INSTRUMENTATION

IR instrumentation. Several IR imagers, two IR seeker head simulators, and additional IR equipment will be installed in Surendorf (land side), see the table below for an overview.

Radar instrumentation. Several measurement and additional Radar equipment will be installed in Surendorf (land side). See the table below for an overview. Note: the radar frequencies of the systems involved are listed in Chapter 5.

Propagation instrumentation. For static, fixed range propagation measurements some blackbodies, visible lights, radar corner reflectors and a meteorological station will be installed in Boockniseck (North shore of Eckernförde Bay, 8.2 km distance to Surendorf pier).

Meteorological instrumentation. Meteo stations will be placed at Surendorf pier and Boockniseck. A Tether sonde (with balloon) will be used at Surendorf pier if possible. Sea level will be recorded at Surendorf pier. Additional information will be requested from by Kiel Lighthouse.

PARTICIPANT	TEST EQUIPMENT	MEASURING OBJECT	TEST SITE
GE (WTD 71)	IR cameras CEDIP (LWIR, MWIR etc.)	Quest, MZB	Lab. (2nd floor)
GE (FhG IOSB)	VIS (high resolution), dual colour MW,)IS photo camera, dual FOV, MW, laser gated viewing	Quest, MZB	Lab. (2nd floor)
GE (WTD 71)	IR seeker head	Quest/ Decoys	Lab. (1st floor)
CA	IR seeker head	Quest/ decoys	Lab. (1st floor)
BE (RMA)	MWIR, LWIR cam, optical cam. (mounted on tripods)	Quest	Tower (3rd floor)
GR (HNA)	LWIR, MWIR, Opt. cameras	Quest, (propagation)	Tower (3rd floor)
IT (CSSN ITE)	3 IR cam. (AGEMA 900 MW+LW, CEDIP MW, AGEMA PM 695, LW)	Quest	Tower (3rd floor)
US-NRL	MWIR/LWIR cam. Photometer, Range finder, IR black body	Quest	Tower (3rd floor)
US-ARL	Polarimetry LWIR/MWIR	Quest, small targets	Tower (3rd floor)
BE (RMA)	MWIR , LWIR cam Opt. camera (mounted on a tripod)	Small targets	Roof of Geschützbettung
GR (HNA)	Imaging radiometer -fast camera	Quest, propagation	roof of Geschützbettung (= small building)

PARTICIPANT	TEST EQUIPMENT	MEASURING OBJECT	TEST SITE
GE (FWG)	Meteo station (WXT 520)	Meteo	Roof of Geschützbet-tung
DE	MRS-Radar	Quest	Parking lot next Geschützbettung (be-tween GE and UK)
GE (WTD 71)	MARSIG-Radar	Quest	Parking lot next Geschützbettung
UK (2x)	MRP-Radar, grundlark	Quest	Parking lot next Geschützbettung
CA	Scintilla-meters and meteoro-logical measurements (sonic anemometer, visibility)	CN2 measurements	sensors on the wharf
GE (Fhg-HFR)	MEMPHIS-Radar	Quest	Ground, side right from helicopter land-ing space
NL	Radar	Quest	Hill
ZAF	VIS/NIR, SWIR, MWIR; LWIR, MWIR, VIS/NIR CCD, Tracker	Quest	Hill
AUS	MWIR/ LWIR, 2 tripods	Quest, propagation	pier
CA	Fast camera, MWIR/ LWIR, Laser gated viewing, laser range finder	Quest, propagation, flares	Pier in direction to Boockniseck and Quest
GE (IOSB)	2 MWIR, high speed VIS, high speed MWIR Dual band MW/LW, Scintillometer,	Quest, propagation	Pier in direction to Boockniseck and Quest
NL-1	RF transmissiometer	Propagation	Pier, in direction of Boockniseck
NL-2	MWIR/LWIR camera, daylight cam.	Quest (plume)	Pier
NO	a) CEDIP (MWIR/ LWIR) and QUESTAR (0,4 – 1,0 μm) b) FTIR spectrometer and track camera) (short range c) Laser range finder 1,54 μ d) AIS receiver, e) black body	Quest (with land back-ground), propaga-tion	Pier
TU (TUBITAK)	LWIR, MWIR, VIS, 1 tripod	Quest with litt. background, propa-gation	pier

MEASUREMENT PROCEDURE - IR MEASUREMENTS (SET-144)

IR Short range runs.

a. Quest will start each run ~ 4.5km east of the test site in the Baltic Sea, see next two figures. It will attain a constant course (~257 deg) and speed (~10kts) for approximately 20 minutes prior to the first data collection point, A1. The shore-based test director will announce over the radio the start of the measurements as “Point A1: mark”.

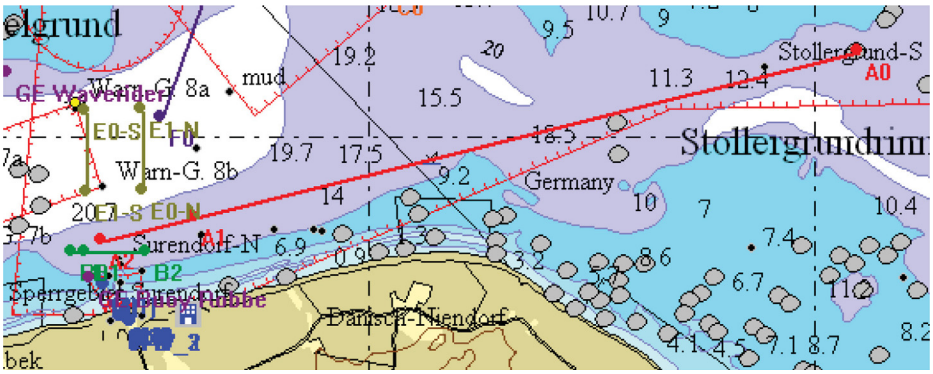


Figure 21 - Tracks A, B, and E for short range ship and short range decoy runs

b. The IR teams on shore will collect full-ship IR signature data when Quest is on the track between Point A1 and Point A2. After passing through Point A2, the Test Director will instruct the Quest to break off the constant heading, change engine configuration and loop to port to come in along the B track. Reaching point B1 (see Figure 5 and 6) the test director will signal over the radio the start of the plume measurements as “Point B1: mark”.

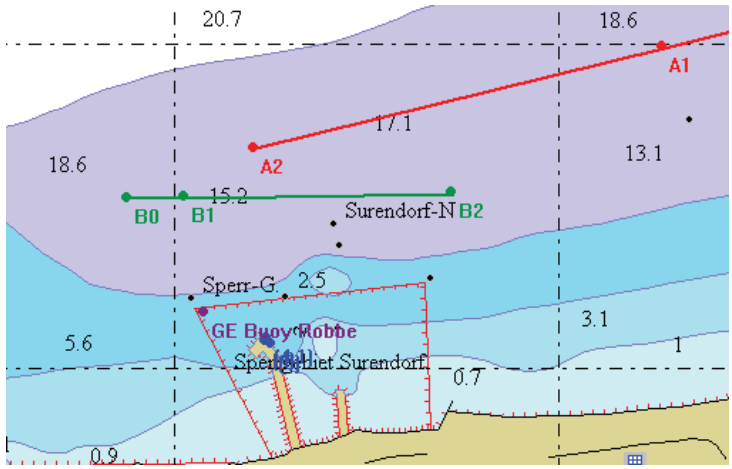


Figure 20 - Track B for plume measurements as part of short range ship runs.

c. The shore teams will collect close-in plume data when the Quest is on the track between Point B1 and Point B2. After the Quest passes through Point B2, the Test Director will announce “End of Run.”

d. After selected runs along the A or B tracks, the Test Director may ask the Quest to start one of the two E tracks, either North to South (E0N to E1N) or South to North (E0S to E1S) (see Figure 5). The test director will announce start of the measurements at point E0N or E0S over the radio as “point E0N: mark” or “point E0S: mark”, respectively. A decoy will be deployed at a point defined by the Quest along the tracks between E0N and E1N or between E0S and E1S, depending on wind speed and direction.

e. For runs with decoys, the Quest will provide a countdown for flare firing, “T-30 sec, T-10,9,…1, Fire.” At the end of the run the test director will signal this over the radio as “End of the run”.

IR Long range runs.

a. Each long-range run will consist of a “dog-leg” track. Data will be collected between points C3 and C5 on the chart (see figure below).

b. The heading of the first part of the trajectory will depend on the solar azimuth, and will rotate during the day. The heading for the second part of the trajectory will be decided based on wind direction, so it will likely not change much during each afternoon of testing but could change day-today.

c. The Quest will start each run near the Northwest border of the “Stollergrund shallows” area, indicated in darker blue in Figures 6 and 7. It will attain a constant course (~280 to 350 deg) and speed (~3 kts) for approximately 25 minutes on the route between point C0 and point C1. After passing through point C1, Quest will increase speed to 10 kts and stay on course for approximately 5 minutes from point C1 to point C2).

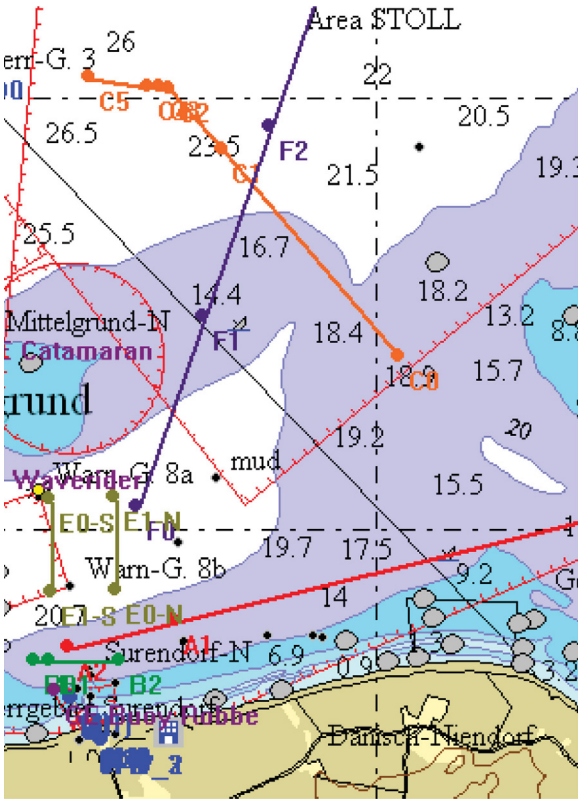


Figure 22 - Diagram of Long range runs for Decoy firings.

d. At point C2, Quest will turn to port and attain a new constant heading (~240-320 deg) towards point C3. The shore-based test director will signal over the radio the start of the measurements at point C3 as “Point C3: mark”. Shore teams will collect ship signature data, seeker acquisition and decoy data between point C3 and C5.

e. After passing through point C5, the Test Director will then signal “End of Run”. For selected runs, a decoy may be deployed at Point C4, depending on wind speed and direction. For runs with decoys, the Quest will provide a countdown to Point C4, “T-30 sec, T-10,9,…1, Fire.” Runs will be repeated with the OSM system on and off.

Littoral Runs.

After selected Long Range Runs, the Test Director may ask Quest to follow Track D near the north shore (blue, labelled D0 to D2) immediately after waypoint C5 for test teams to collect data on Quest with a land background, see figure below. The test director will announce over the radio the start of the measurement as “Point D1; mark” as well as the end of the run as “End of the run”. The IR teams on shore will collect signature data between point D1 and point D 2. This track also may be used at the end of the day as the ship returns to Eckernförde.

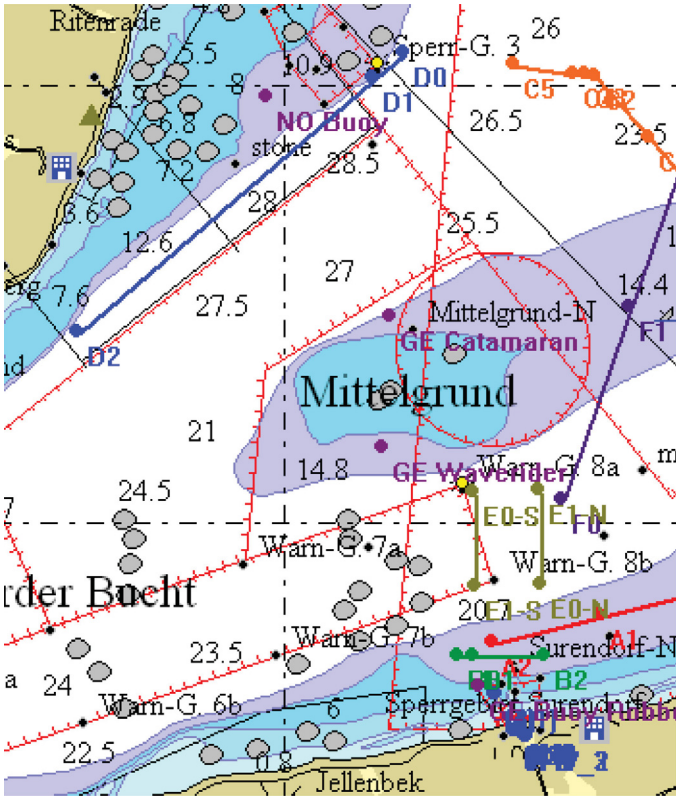


Figure 23 - Diagram of Littoral Background runs.

Propagation Runs of Mittelgrund.

The vessel Mittelgrund (equipped with radar corner reflectors and black bodies) will run on Route F (about 20 deg) for IR propagation measurements. Route F is also shown in Figure 4. These runs will start a point F0. The end of each run depends on the weather conditions. *Note: CFAV Quest will not run on route F during the IR trials.*

Way-point overview.

A summary of all the waypoints are listed in the table below.

Waypoint	Latitude (North)						Longitude						Bearing	Distance	Total
	(GG.GG)	(GG)	(MM.MM)	(GG)	(MM)	(SS.SS)	(GG.GG)	(GG)	(MM.MM)	(GG)	(MM)	(SS.SS)	(deg. True)	(m)	(m)
Route A (Signature Measurement Route)															
A0	54,5047220	54	30,2833	54	30	17,00	10,1986110	10	11,9167	10	11	55,00	257	0	0
A1	54,4889030	54	29,3342	54	29	20,05	10,0813360	10	4,8802	10	4	52,81	257	7800	7800
A2	54,4866780	54	29,2007	54	29	12,04	10,0647970	10	3,8878	10	3	53,27	257	1100	8900
Route B (Plume Measurement Route)															
B0	54,4855560	54	29,1334	54	29	8,00	10,0596640	10	3,5798	10	3	34,79	090	0	0
B1	54,4855560	54	29,1334	54	29	8,00	10,0619780	10	3,7187	10	3	43,12	090	150	150
B2	54,4855560	54	29,1334	54	29	8,00	10,0727780	10	4,3667	10	4	22,00	090	700	850
Route C (Flare Route for Seeker Analysis)															
C0	54,5122010	54	30,7321	54	30	43,92	10,1163370	10	6,9802	10	6	58,81	320	0	0
C1	54,5307860	54	31,8472	54	31	50,83	10,0895440	10	5,3726	10	5	22,36	320	2700	2700
C2	54,5362920	54	32,1775	54	32	10,65	10,0816010	10	4,8961	10	4	53,76	280	800	3500
C3	54,5364480	54	32,1869	54	32	11,21	10,0800790	10	4,8047	10	4	48,28	280	100	3600
C4	54,5366040	54	32,1962	54	32	11,77	10,0785580	10	4,7135	10	4	42,81	280	100	3700
C5	54,5375400	54	32,2524	54	32	15,14	10,0694290	10	4,1657	10	4	9,94	280	600	4300
Route D (Land Background Route)															
D0	54,5386970	54	32,3218	54	32	19,31	10,0528590	10	3,1715	10	3	10,29	230	0	0
D1	54,5363890	54	32,1833	54	32	11,00	10,0481230	10	2,8874	10	2	53,24	230	400	400
D2	54,5144540	54	30,8672	54	30	52,03	10,0031560	10	0,1894	10	0	11,36	230	3800	26050
Route E (Flare Signature Route)															
E0-N	54,4916670	54	29,5000	54	29	30,00	10,0722220	10	4,3333	10	4	20,00	360	0	0
E1-N	54,5000000	54	30,0000	54	30	0,00	10,0722220	10	4,3333	10	4	20,00	360	925	925
E0-S	54,5000000	54	30,0000	54	30	0,00	10,0625000	10	3,7500	10	3	45,00	180	0	0
E1-S	54,4916670	54	29,5000	54	29	30,00	10,0625000	10	3,7500	10	3	45,00	180	925	925

Decoy Operations

The Rheinmetall Rosy decoy will be fired during this trial, Figure 8 and 9. The launchers will be installed at WTD-71 pier at Eckernförde before the IR trial. A decoy locker will be installed on the Quest by DRDC and Quest personnel before the Quest leaves Halifax. A total of 144 decoys will be launched during the 2 week trial period. Decoys will be stored on shore at the WTD-71. Decoys will be loaded from the base to Quest by qualified personnel. On board Quest, decoys will be moved from the storage locker and loaded into the launcher by qualified personnel. WTD-71 will provide the firing officer and will be responsible for firing all decoys. All unexpended decoys will be returned to WTD-71 at the end of the trial. Rheinmetall will be responsible for removing the launchers from the Quest and transporting any unused decoys back to Rheinmetall.

MEASUREMENT PROCEDURE - RADAR MEASUREMENTS (SET-154)

For dynamic IR, and VIS propagation measurements the following runs are planned with "Mittelgrund": radial in bound and out bound runs from/to the pier in the direction 020, from approximately 3 km from pier to the horizon (about 30 km). The starting and end point can be extended (depending on weather conditions). Note: for combined IR and radar propagation measurement runs, the main bearing will be 20 degrees.

The IR propagation measurements will be performed prior to dawn or sunset if possible.

The way-points are presented in the table below.

Waypoint	Latitude (North)						Longitude						Bearing	Distance	Total	Comments
	(GG.GG)	(GG)	(MM.MM)	(GG)	(MM)	(SS.SS)	(GG.GG)	(GG)	(MM.MM)	(GG)	(MM)	(SS.SS)	(deg. True)	(m)	(m)	
Route F (Detection route)																
Pier (4.1)	54,4822095	54	28,9326	54	28	55,95	10,0652095	10	3,9126	10	3	54,75	020	0	0	Cameras and receicers
F0	54,4990930	54	29,9456	54	29	56,73	10,0757670	10	4,5460	10	4	32,76	020	2000	2000	Detection @ 2 km from pier
F1	54,5159750	54	30,9585	54	30	57,51	10,0863340	10	5,1800	10	5	10,80	020	2000	4000	Detection @ 4 km from pier
F2	54,5328560	54	31,9714	54	31	58,28	10,0969100	10	5,8146	10	5	48,88	020	2000	6000	Detection @ 6 km from pier
F3	54,5497360	54	32,9842	54	32	59,05	10,1074940	10	6,4496	10	6	26,98	020	2000	8000	Detection @ 8 km from pier
F4	54,5666160	54	33,9970	54	33	59,82	10,1180870	10	7,0852	10	7	5,11	020	2000	10000	Detection @ 10 km from pier
F5	54,6088090	54	36,5285	54	36	31,71	10,1446070	10	8,6764	10	8	40,59	020	5000	15000	Detection @ 15 km from pier
F6	54,6509970	54	39,0598	54	39	3,59	10,1711830	10	10,2710	10	10	16,26	020	5000	20000	Detection @ 20 km from pier

MEASUREMENT PROCEDURE - SMALL TARGET DETECTION FOR IR

With the RHIB, Zodiac and "AM7" boat the following runs are planned:

f. radial in bound and out bound runs from/to pier to a maximum range of 10 -12 km (depending on visibility) at different speeds (about 10 kts and max. speed);

g. cross bay runs with land background to a max. range of 8 km;

h. Zick-zack manoeuvring from approximately 5 km from pier to the horizon (about 30 km). The starting point can be extended.

For swimmer measurements and Kayak measurements the exact locations will be determined during the trial. Locations are expected nearby the Surendorf measurement site.

MEASUREMENT PROCEDURE - HELICOPTER MEASUREMENTS

Depending on the specific IR runs during the Surendorf trial, the following runs will be scheduled:

a. IR signature measurement of CFAV Quest with and without the AHC activated during serials C (between C1 and C2);
b. IR signatures of individual decoys (flares) during serials E;
c. approach flights against deployed flares for 'seeker simulation';
d. IR measurements of the wake induced by CFAV Quest during serials C or A.

MEASUREMENT PROCEDURE - RADAR MEASUREMENTS (SET-154)

An overview of the Radar run types is listed below:

a. circular runs:
   1°. minimum diameter (turn of the spot);
   2°. ranges: 4, 7, 10 and 12 km to assess propagation effects;
   3°. clockwise (CW) and counter-clockwise (CCW) circles:
   4°. ship upright and listing.
b. straight runs: maximum range about 3 to 20 km, direction 30°;
c. short straight runs presenting quarter aspects to the radar at 4, 7, 10 and 12 km ranges.

The runs will be performed under different conditions (baseline, antenna positions, cranes covered, metal plate covers, IR signature suppression etc.)

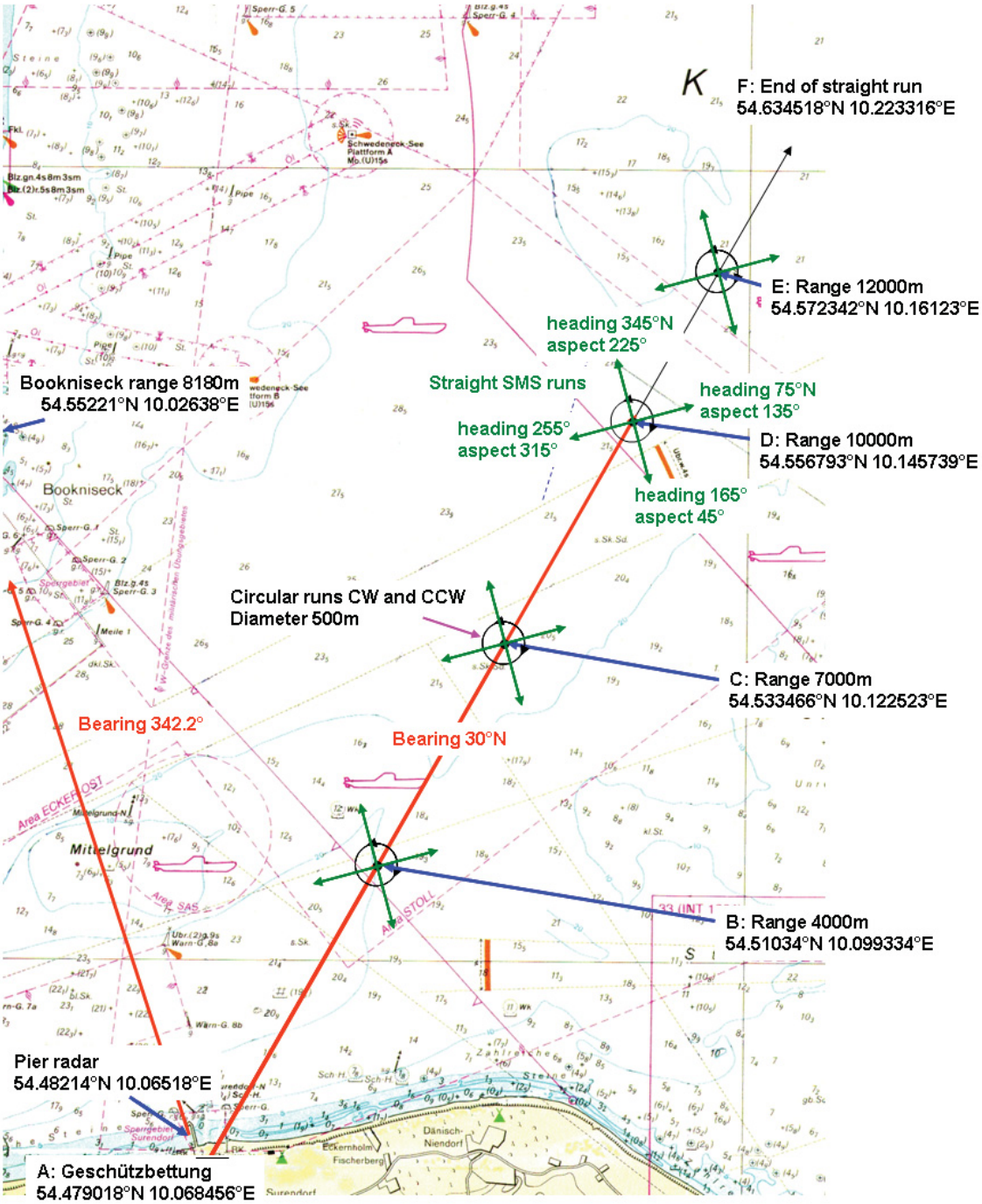
Each nation will calibrate its radar using national methods and then will measure the sphere deployed from the end of the pier, hopefully on several occasions.

The following table gives the Latitude and Longitude (in both degrees and degrees and minutes) for the way-points for the radar signature measurements. Point A is the car park, the measurement radars will be located close to here. Points B-E are the centres of the circles and the mid-point of the SMS runs.

Waypoint	Latitude (deg N)	Longitude (deg E)	Bearing from point A (car park) (deg true)	Distance from point A (car park) (in metres)	Latitude (deg & min N)	Longitude (deg & min E)
A car park	54.479018	10.068456	0	0	54°28.74'	10°4.11'
B	54.510134	10.099334	030	4000	54°30.61	10°5.96'
C	54.533466	10.122523	030	7000	54°32.01'	10°7.35'
D	54.556793	10.145739	030	10000	54°33.41'	10°8.74'
E	54.572342	10.161230	030	12000	54°34.34'	10°9.67'
F	54.634518	10.223316	030	20000	54°38.07'	10°13.4'

Latitude and longitude values on the table above are in WGS84 datum.

The positions are shown in the following figure.



IR, VIS AND RADAR PROPAGATION MEASUREMENTS

For radar propagation measurements the following runs are planned with “Mittelgrund”: radial in bound and out bound runs from/to the radar site (position A), from approximately 3 km from pier to about 30 km on a bearing of 30 degrees from the radar site, that is on the line A-B-C-D-E-F, where the positions of A, B, C etc. are given in the table of waypoints above. The range of the starting and end points may be altered. The ship may steam at any speed for these runs, but preferably as fast as possible. For combined IR and radar propagation measurement runs, the main bearing will be 20 degrees.

Radial radar runs may also be performed by the Rhib with a corner reflector. The Rhib should travel on outbound runs from the radar site, position A from 3 km to about 15km on a bearing of 30 degrees from the radar site. The Rhib may travel fast, but must keep the corner steady and at a constant height above the sea level.

Measurements will also be made several times a day of the corner reflector at Boockniseck. Five minutes of continuous measurements will be made. The corner should be measured each day before, during and after the Quest measurements.

The RF path transmission between Boockniseck and Surendorf will be measured continuously during the measurement period at six frequencies by a RF transmissometer.

ENVIRONMENTAL MEASUREMENTS FOR BOTH RADAR AND IR SERIALS

The GE drifting meteo buoys will be deployed daily before 0800 and recovered after 2000. The Kronsort runs will be performed in the sea area west of Boockniseck or west of Damp.

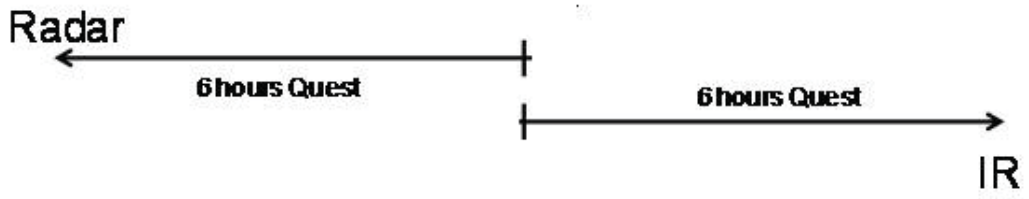
Possibly measurements can be performed near to Quest run profiles. The speed of the Kronsort is limited due to the tether sondes (max. 12 knots).

RUN PLANS

General aspects. A daily schedule is illustrated in the figure below and consists of the following elements (see figure - next page).

a. 12 hour days working with Quest, nominally 0600-1800Z ;
b. Both SET-144 (IR) and SET-154 (RCS) get 6 hours/day w/ Quest;
c. Each SET will have 1 entire day for IR and radar testing respectively;
d. radar non-Quest testing will take place when the measurement sensors are not conducting trials with Quest;

e. non-Quest testing must not interfere with the trials being performed by the other teams on Quest.



IR measurements. The IR runs will be executed from 1400-2000 (local time) every day. Both the short range and long range runs will each require ~1hour to complete. The exact order of the runs each day will depend on the environmental conditions. We plan to start each day with a short range run. Decoys will only be fired under certain wind conditions. OSM testing will be focused during conditions of high solar loading, e.g. daytime, clear skies, and early afternoon.

Most of the testing can take place under 'all weather' conditions except for rain or fog. Exceptions are decoy testing. Decoy tests will be cancelled in case of high wind, high sea state, fog or rain.

For the run plans see the table below.

Route	ship configuration		Flares firing	bearing	speed	distance to pier	length of run	duration of run	remark
	Status OSM	Diesel engine							
A (Short Range-ship)	OSM off	Stbd + Bbd	--	257°	10 kn		8.9 km	~30 min	
	OSM on	Stbd + Bbd	--	257°	10 kn		8.9 km	~30 min	
B (Short range-Plume)	OSM off	Stbd Diesel only, 50%	--	90 °			0.9 km		
	OSM off	Stbd Diesel only, 75%	--	90 °			0.9 km		
	OSM off	Stbd Diesel only, 100%	--	90 °			0.9 km		
			--						
	OSM on	Stbd Diesel only, 50%	--	90 °			0.9 km		
	OSM on	Stbd Diesel only, 75%	--	90 °			0.9 km		
	OSM on	Stbd Diesel only, 100%	--	90 °			0.9 km		
E (Short Range-Decoy)	OSM off	Stbd + Bbd	--	180 ° or 360 °	10 kn		0.9 km		
	OSM off	Stbd + Bbd	yes	180 ° or 360 °	10 kn		0.9 km		single decoy
	OSM on	Stbd + Bbd	--	180 ° or 360 °	10 kn		0.9 km		
	OSM on	Stbd + Bbd	yes	180 ° or 360 °	10 kn		0.9 km		single decoy
C (Long Range-Decoy)	OSM off		--		3kn/10kn		4.3 km	~1 h	starting point and bearing depending on solar azimuth; change of speed and bearing during run
	OSM off		yes		3kn/10kn		4.3 km	~1 h	
	OSM on		--		3kn/10kn		4.3 km	~1 h	
	OSM on		yes		3kn/10kn		4.3 km	~1 h	
D (Littoral backgrund)	OSM off	Stbd + Bbd	--	230°	10 kn		3.8 km	~12 min	
	OSM on	Stbd + Bbd	--	230°	10 kn		3.8 km	~12 min	

Radar measurements. The run plan given below assumes that Quest and the range will be available 11-17 September and 19 and 20 September for RCS measurements. Measurements will also be conducted on Mittelgrund with corner reflectors added, on a RIB with a corner reflector and on the fixed corner reflector at Boockniseck.

Each day will generally have the following timetable (note: details to be defined during (daily) briefings and to be harmonised with IR measurements):

0555 UTC	0755 local	Measurement of corner at Boockniseck
0600 UTC	0800 local	Measurements of Quest, with several measurements of corner at Boockniseck
1200 UTC	1400 local	Finish Quest measurements
1200 UTC	1400 local	Measure corner at Boockniseck
1215 UTC	1415 local	Measure corners on Mittelgrund and/or RHIB (when applicable)
1515 UTC	1715 local	Close

The exception will be Tuesday 20th September when Quest will be available all day for RCS measurements (Sep 23 will be IR measurements all day)

There will be a standard set of runs, clockwise (CW) and counter-clockwise (CCW) circles at different ranges and straight runs, which should be completed for the ship in each of the configurations, except where otherwise stated. It is anticipated that to complete these runs will take 1 day. There is a separate set of runs for the Signature Management System runs (SMS serial numbers). The run set is as given in the table below.

Serial	Ship manoeuvre	Distance from measurement site	Duration of run	Maximum diameter of circle
CW 1	CW circle	Range 12 km	10-15 minutes	0.5 km
CW 2	CW circle	Range 10 km	10-15 minutes	0.5 km
CW 3	CW circle	Range 7 km	10-15 minutes	0.5 km
CW 4	CW circle	Range 4 km	10-15 minutes	0.5 km
CW 5	CW circle listing	Range 7 km	10 minutes	0.5 km
CCW 1	CCW circle	Range 12 km	10-15 minutes	0.5 km
CCW 2	CCW circle	Range 10 km	10-15 minutes	0.5 km
CCW 3	CCW circle	Range 7 km	10-15 minutes	0.5 km
CCW 4	CCW circle	Range 4 km	10-15 minutes	0.5 km
CCW 5	CCW circle listing	Range 7 km	10 minutes	0.5 km

Serial	Ship manoeuvre	Distance from measurement site	Duration of run	Maximum diameter of circle
STR 1	Straight run in presenting 20 degrees off bow to measurement site	20-4 km	Depending on speed of vessel	
STR 2	Straight run out presenting 20 degrees off stern to measurement site	4-20 km	Depending on speed of vessel	

The ship configurations to be used are given in the following table, together with the expected duration of that part of the trial and an indication of the serials to be completed.

Description	Ship configuration	Serials to be completed	Expected duration of serials
Baseline	**Standard**	**Standard**	**One day**
Antenna	Antenna to be installed on the stern of the ship. The antenna will be loaded and will be positioned in at fixed orientations; more than one orientation will be used.	Parts of the CW and CCW circles at different ranges will be completed. A straight run out will be conducted, possibly one for each orientation of the antenna.	Half a day
Cranes	Cranes to be covered with RAM panels or netting and also the crane on the stern to be in different positions	Standard run set, may be a subset to allow completion in one day with the crane in different states.	One day
Metal plates	Metal plates to be used to obscure large corner reflectors previously identified in predictions or measurements	Standard set, or sub-set thereof.	Half a day
RCS measurement of IR Sig suppression	RCS measurements of the ship using different signature suppression techniques, e.g. active hull cooling, sea water injection, plume cooling, pre-wet	Standard set or a sub-set	Half a day
Signature Management System	Testing The Netherlands' signature management system	SMS run set	One day

The above runs all involve the use of the main test platform: CFAV Quest. One of the baseline runs for Quest will be repeated each day to check for consistency, ideally at the first and last runs with Quest each day.

The SMS run set is given below. Each straight run will be centred on way point, B, C, D or E, the run will be 3 km long: Ship aspects 45, 135, 225 and 315 will be presented to the measurement site, i.e. the ship will have a heading of 75, 165, 255 or 345 degrees.

Serial	Ship manoeuvre	Distance from measurement site	Duration of run	Length of run
SMS 1	Straight run presenting 45 degrees off starboard bow to measurement site, ship heading 165 degrees	Range 12 km	10 minutes	3 km
SMS 2	Straight run presenting 135 degrees off starboard bow to measurement site, ship heading 75 degrees	Range 12 km	10 minutes	3 km
SMS 3	Straight run presenting 45 degrees off port bow to measurement site, ship heading 255 degrees	Range 12 km	10 minutes	3 km
SMS 4	Straight run presenting 135 degrees off port bow to measurement site, ship heading 345 degrees	Range 12 km	10 minutes	3 km
SMS 5	Straight run presenting 45 degrees off starboard bow to measurement site, ship heading 165 degrees	Range 10 km	10 minutes	3 km
SMS 6	Straight run presenting 135 degrees off starboard bow to measurement site, ship heading 75 degrees	Range 10 km	10 minutes	3 km
SMS 7	Straight run presenting 45 degrees off port bow to measurement site, ship heading 255 degrees	Range 10 km	10 minutes	3 km
SMS 8	Straight run presenting 135 degrees off port bow to measurement site, ship heading 345 degrees	Range 10 km	10 minutes	3 km
SMS 9	Straight run presenting 45 degrees off starboard bow to measurement site, ship heading 165 degrees	Range 7 km	10 minutes	3 km
SMS 10	Straight run presenting 135 degrees off starboard bow to measurement site, ship heading 75 degrees	Range 7 km	10 minutes	3 km

Serial	Ship manoeuvre	Distance from measurement site	Duration of run	Length of run
SMS 11	Straight run presenting 45 degrees off port bow to measurement site, ship heading 255 degrees	Range 7 km	10 minutes	3 km
SMS 12	Straight run presenting 135 degrees off port bow to measurement site, ship heading 345 degrees	Range 7 km	10 minutes	3 km
SMS 13	Straight run presenting 45 degrees off starboard bow to measurement site, ship heading 165 degrees	Range 4 km	10 minutes	3 km
SMS 14	Straight run presenting 135 degrees off starboard bow to measurement site, ship heading 75 degrees	Range 4 km	10 minutes	3 km
SMS 15	Straight run presenting 45 degrees off port bow to measurement site, ship heading 255 degrees	Range 4 km	10 minutes	3 km
SMS 16	Straight run presenting 135 degrees off port bow to measurement site, ship heading 345 degrees	Range 4 km	10 minutes	3 km

Six scenarios have been defined:

a. Scenario 1 Standard ship configuration;
b. Scenario 2 SMS straight runs;
c. Scenario 3 Antenna straight runs with and without amplifier;
d. Scenario 4 IR signature suppression;
e. Scenario 5 Ship with metal plates;
f. Scenario 6 Ship with RAM.

For the whole day of RCS measurements on Quest, a standard set of runs and SMS straight runs with RAM and metal plates will be conducted. The order of priority will be clockwise runs then straight runs then counter-clockwise runs.

Corner runs will also be conducted with Mittelgrund with corner reflectors and possibly a Rhib with a corner reflector. RCS measurements will also be made of a corner reflector to be sited at Boockniseck, these measurements will be made daily, hopefully several times a day.

The radars will need to be calibrated as often as possible, preferably daily.

Environmental measurements will be required throughout the trials period.

Transmissometer recordings will be made continuously.

Procedure for treating and measuring corner reflectors .

a. Estimate positions of scattering centres for port and starboard quarters from predictions and visiting the ship.
b. Visit the ship in Eckernförde.
c. Prepare RAM panels and rope, metal sheets and wire mesh.
d. Conduct initial day of measurements with the ship in the standard configuration. Analyse the slow runs at two ranges to identify the hot spots and scattering centres suitable for treatment.
e. Produce a plan for fitting RAM, sheets and mesh.
f. Prepare sheets/mesh for fitting.
g. Fit sheets/RAM/mesh.
h. Conduct serials with modified ship.
i. Remove panels/mesh/RAM.
j. Repeat some of measurements without treatment.

For the “metal” sheets, Germany will supply the plywood and Denmark the laminated aluminium foil and glue.

IR, VIS and Radar propagation measurements.

The principles of the IR, VIS and radar propagation measurements are described in the paragraph “measurement procedures’ of this annex. Some runs will be performed as combined radar-IR runs (020 heading). The following table summarizes the propagation measurement runs.

Route type	ship configuration	bearing	speed	distance to pier	length of run	duration of run
F propagation trials IR/VIS	Mittelgrund	020° or 200 °	10 kn	2 to 30 km	~28 km	~65 min
G propagation trials Radar	Mittelgrund	030° or 210 °	10 kn	3 to 30 km	~27 km	~65 min
H propagation trials Radar	RHIB	030° or 210 °	30 to 40 kn	2 to 15 km	13 km	~10 min
H propagation trilas _IR and Radar	Mittelgrund	020° or 200 °	10 kn	2 to 30 km	~28 km	~65 min

ANNEX L
TRIAL 07 (ASCHAU)

OBJECTIVES

The performance of the trials delivers basic data sets for the post processing analysis according to the objective of the master trial plan to the participating nations and research institutions. Valid data can only be achieved by following the run programme and the table of the machinery control states. In these trials the ranging consists of simultaneously recording

- structure borne noise data
- pressure data
- static and alternating electrical and magnetic field data
- waterborne noise data

The measurements will be synchronized by GPS time.

Besides the dynamic ranging a static ranging will be performed.

For the overall scope of the trials it is necessary to collect the relevant signature data in a controlled and reproduceable way. Procedures and configuration are defined and will be logged.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

For the QUEST/ PLANET TRIAL 2011 the range will be augmented with a:

- pressure sensor chain, Mr. Martsch WTD 71 , installation finished by the end of June;
- as well as the PRIME, Mr. D Rog DMO, installation finished by end of June;
- Multi Sensor Module IGLOO by Poland , Mr. Listewnik PL, CW 37;
- Modelling of the ranges by TU;
- (SPIER).

For the static ranging additional noise sources are installed within the ship and will be operated by the scientific team on board. CDT measurements will be performed each day by GF 540 WTD 71 as well as verifying the sites by a towed noise source (TNO/DMO) before ranging. Track information will be distributed by GF 120 WTD 71.

The instrumentation of the GPS System will be installed on board of the ship on the first day before ranging by WTD 71 personal.

The deployment of the additional underwater sensors will be determined by the partial trial leader. Support by naval divers and support boats are requested. The ranging will be performed by a night and day shifts if necessary. The subleader of the additional mobile systems should be prepared for this possibility. It will be mandatory that the every subleader of the different signature will perform the complete program.

After finishing the deployment of mobile systems there will be a test run organized by the partial trial leader. The overview of the set up of the sensors will be distributed at the briefing before ranging.

The deployment, handling and operating of the calibrated source will be pre-tested in CW 18 and CW 19.

REQUEST FOR VISITS

Foreign nationals visiting the German MoD establishments are requested to provide official confirmation of their security clearance. The RFV must arrive at least 10 days before start of the visit.

The visitors are to initiate the visit request and must ensure that it is approved by and forwarded through their own National Security Authorities.

The address of the place being visited is:

WTD 71

Berliner Strasse 115

24340 Eckernfoerde, Germany

Place to be visited: Measurement range Aschau

RANGE INFORMATION

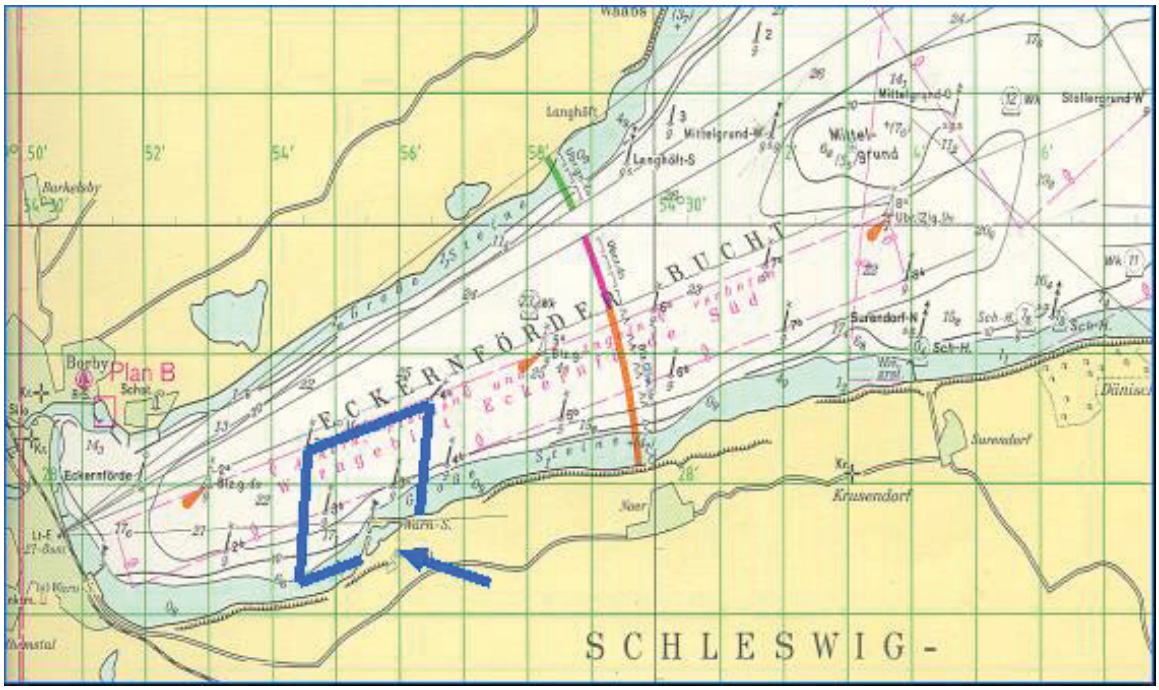
Directions from Eckernfoerde to Aschau.

Hotel accommodation.

Eckernförde:

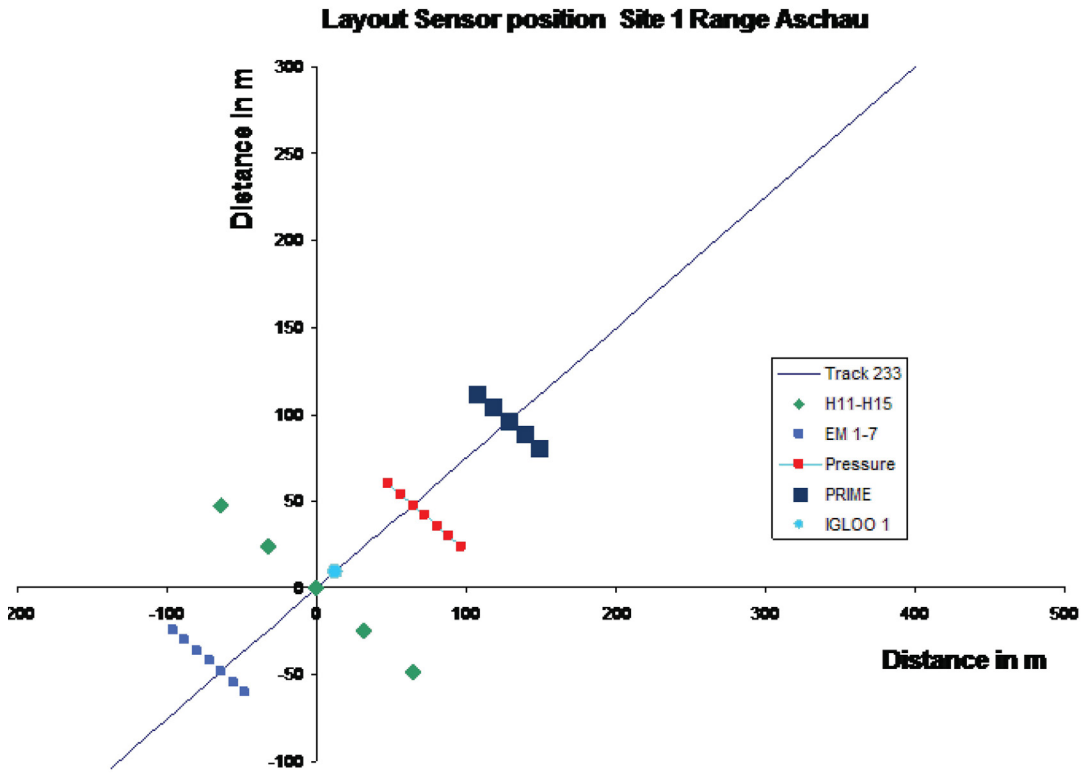
- Stadthotel
- Strandlust
- Seegarten
- Siegfried Werft
- Allte Fischerreischule
- Hotel Boldt

The Aschau range, located in Eckernförde Bay, is a The Aschau range is located in the Eckernförde bay near the city of Eckernförde in Germany. Aschau is a multi-influence range consisting of acoustic, magnetic, and electric field sensors. Pressure sensors, exercise mines and mobile systems may be deployed at the range. The range depth is approximately 21 meters.



The relevant sea map from the Bundesamt für Seeschifffahrt und Hydrographie is No. 32 INT 1359, Falshöft bis Holtenau, ISBN 978-3-89871-597-3, Maßstab 1:50 000, 114 x 82 cm, Ausgabe 2007, II.

A general arrangement of the sensors is shown in the figure below. A detailed presentation is given o the next page.

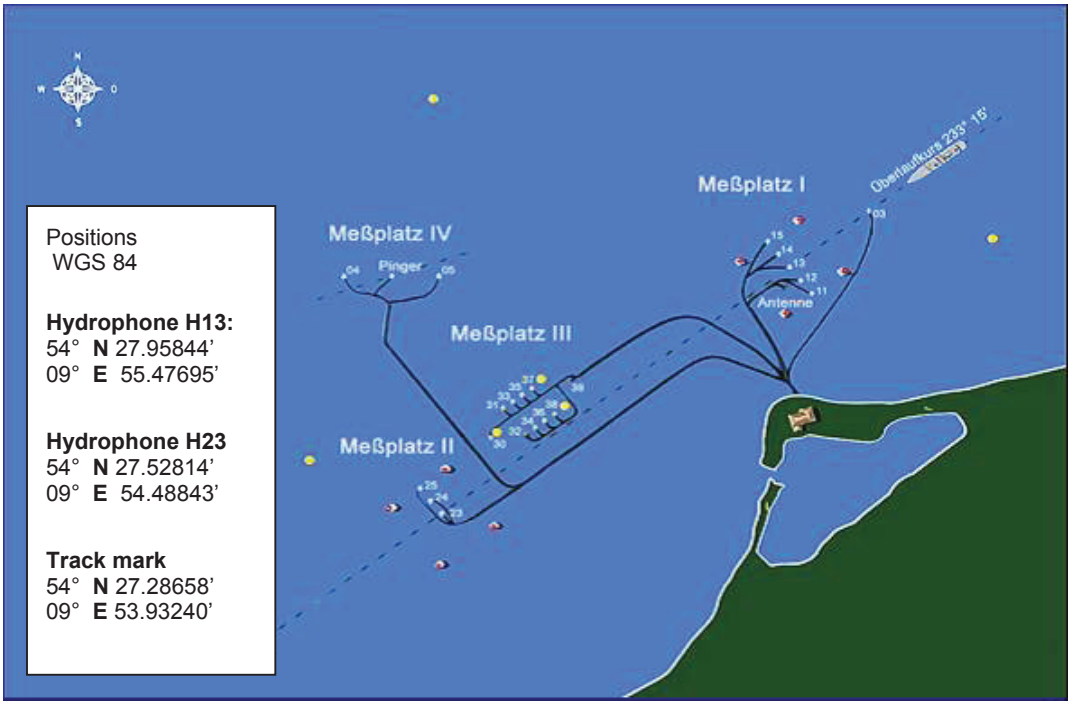


Sensors / positions.

- GPS Position H13: 54° N 27.95844'09° E 55.47695'
- IGLOO will be deployed 10m in Northeast direction referred to H13
- Pressure chain 80 m to H13
- PRIME 160 m to H13
- EM - 80 m to H13

TRACKING

All tracking is related to one 'range centre point' for which hydrophone no. 13 (H13) is used. The measurements will take place in the areas of measurement site 1 and 2. The coordinates of the acoustic sites and the 'range centre point' (H13) are presented in the figure below.



The coordinates of the anchor buoys at the acoustic site 2 are shown in the table below.

Coordinates of the anchor buoys at the acoustic site 2.

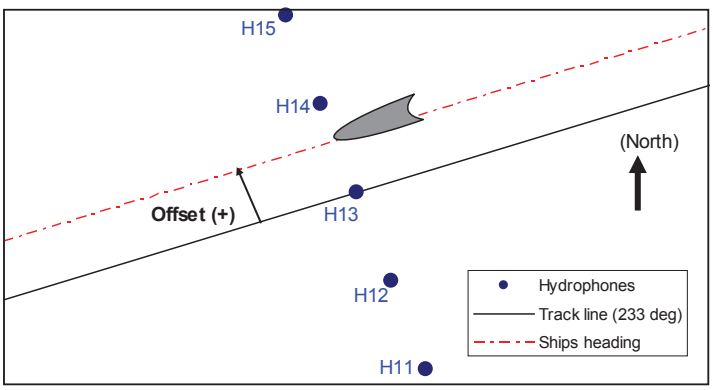
BUOY	LONGITUDE	LATITUDE
NW	54°N 27.977'	9°E 55.363'
SW	54°N 27.899'	9°E 55.436'
NE	54°N 28.054'	9°E 55.537'
SE	54°N 27.965'	9°E 55.599'

Aschau range and coordinates of the acoustic sites 1 and 2 (Messplatz I and II).
Range centre point = hydrophone 13 (messplatz 1))

The measurement runs will be carried out at the track line at a heading of 233 degrees. In addition, a small number of runs will be carried out in the opposite direction with a heading of 53 degrees, in order to obtain the required magnetic data. Furthermore, some runs will be performed with a offset of 40 m (south) to the track line in a heading of 233 degrees in order to obtain the required exercise mine data.

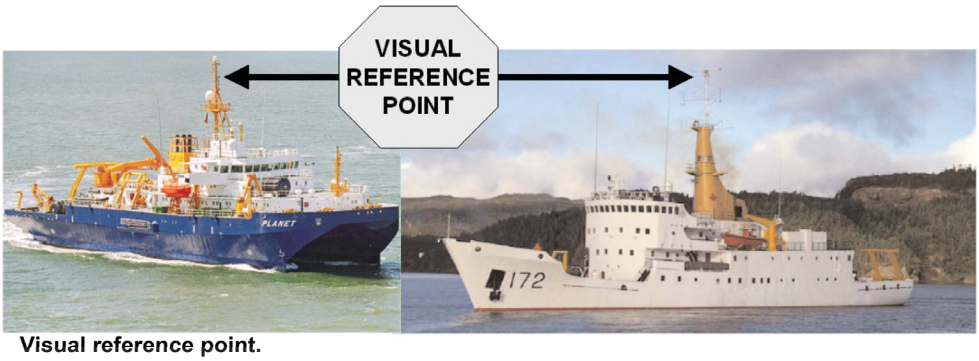
In order to determine the exact position of the naval platform in relation to the track line and the different sensors, a Differential Global Positioning System (DGPS) will be used. Two antennas will be installed by WTD 71 personal onboard of the naval platform. Information of the position of the platform during the runs will be made available at the bridge of the naval platform and inside the measurement stations.

Offsets to the track line will be indicated with a + for north side of the track and – when the platform is at the south side of the track. See the figure below for an example.



Offset from track.

All measurement teams are requested to give an ‘event marker’ when the ‘visual reference point’ of the platform is at the position of their local measurement equipment (see figure below).



Visual reference point.

COMMUNICATION

During the trials a national liaison officer will be present on the navigation bridge of the naval platform. The liaison officer will be accompanied by a specialist, controlling the DGPS recording.

All communication between the naval platform and the measurement team at the Aschau range will be in the English language.

For initial communication between the naval platform and the Aschau range control centre the VHF Channel 16 will be used. After that (portable) communication equipment provided by the Aschau range will be used for the communication between the platform and the Aschau range control centre.

For the communication between the range officer at the Aschau range control centre, the naval platform at the range and the measurement teams, the procedure as stated in the table below will be used.

#	ACTOR	SUBJECT	ACTION
1	Range officer	Announcement run number	The range officer will inform the platform about the run number and the run specifications. The range officer will also inform all onshore measurement teams.
2	Platform	Confirmation	The platform will confirm and will prepare the required condition as described in the run program.
3	Platform	Internal communication on board platform	The platform will inform all onboard measurement teams about the run number.
4	Platform	Information	The platform will inform the range officer on the current average keel depth before the first run
5	Platform	Preparations	The platform will install the required condition and manoeuvre to a position at the track line and sufficient distance before the first measurement system.
6	Platform	Ready for run	Platform will inform the range officer when it is ready to start the run.

#	ACTOR	SUBJECT	ACTION
7	Range officer	Start run	The range officer will inform the platform and measurement teams to start the run.
8	Platform	Sail on track	The platform will sail along the required track. The required speed, heading, offset and condition shall be installed at 1000 m before H13.
9	Measurement teams	Measurements	The measurement teams will record the signals and give a required 'event marker' when the reference point of the platform is at the position of their local measurement equipment.
10	Platform	Determine required data	The platform bridge and technical command room will record the required platform data.
11	Range officer	End of run	The range officer will inform the platform and measurement teams when the run is finished.
12	Platform	Confirmation	The platform will confirm the end of the run and inform all onboard measurement teams.
13	Range officer	Announcement next run	Preparation and reposition for next run.

PREPARATIONS

General preparations (upcoming months).

The deployment of the pressure sensor chain and the PRIME system will be accomplished in CW 25 and 26. Support boat and diver are requested. Further support has to be requested ASAP . The exercise of operating the towed noise source is planed in CW 19. The operating GPS system of WTD 71 and distribution of GPS tracking data will be pre-tested also in CW 19.

The EM calibration runs will performed in week 37 in Aschau.

Preparations (directly) prior to the trial.

The under water part of the hull, all appendages and in particular the rudder and the propeller blades should be cleaned. When the blades are damaged the crew is requested to report this to the trial leader.

The crew is requested to check if all valves of the sea cool water intake and outlet systems are either fully opened or fully closed[10].

For the runs that have to be conducted in the Quiet State, the ship's crew is requested to choose the machinery which has the best (most quiet) noise performance.

The ship crew is requested to switch off the ICCP installation (Only QUEST) 2 to 3 days in advance of the trial program (if required for conducting the run programme).

The crew is requested to record the keel depth markers at the bow, mid and stern of the ship and to inform the range officer on the average keel depth at every day before the measurement program starts. The DGPS systems will be installed and removed by WTD 71. The tracking data will be distributed to each team. The visible track information during the ranging will be accomplished by installing a software tool provided by WTD 71. Therefore the sub-leader are requested to provide a computer with administration rights.

MEASUREMENT PROCEDURE

In general the runs will be performed near to measurement site 1; some will be extended to measurement site 2.

The naval platform is requested:

- to be on the track line in a steady state condition approximately 1000 meters before hydrophone nr. H13;
- not to change sailing speed, heading, machinery configuration and other platform conditions during the passage over the measurement sites;
- to keep rudder movements to a minimum.

Measurements will be started when the platform is at a distance of approximately 400 meters before hydrophone H13. The measurements will be stopped when the platform has passed the last measurement site at a distance of 300 meters.

[10] A not fully opened or closed valve will lead to noise.

RUN PLAN (PLANET)

Last details and information will be distributed at the briefing on September 24th 10:00-14:00 on board CFAV Quest. Requested are the scientific leader from the PLANET, liaison officer, subgroup leader of the underwater signature according to the deployed systems, crew engineer and navigation officer.

The personal transfer and preparation on board is finished by 07:45. The operational readiness will be communicate to the partial trial leader. Whether the trials begin with the dynamic or static ranging due to weather condition. Definitely the runs of the towed calibration source will be performed on the first day.

Start at 08:00 - 29.09.2011

Basic dynamic RUN Program for Planet.

No.	Run ID	State	Speed (kts) RPM	Keel (runs) H13 and H23	Beam (26 ° & 14 °) (runs)	EM Conditions		Remarks
						M	E	
I	6P05A1	Config1*	6 **55**	2	2			Towing calibration source
II	6P05A2	Config1*	6 **55**	2	2			Towing calibration source
III	6P05A3	Config1*	6 **55**	2	2			Towing calibration source
1	6P01A1	Config1*	6 **55**	2	2			
2	6P01B2	Config1*	6 **55**	2	2			
3	6P01A3	Config1*	6 **55**	2	2			
4	6P01B4	Config1*	6 **55**	2	2			
5	6P02A1	Config2*	6 **55**	2	2			
6	6P02B2	Config2*	6 **55**	2	2			
7	6P02A3	Config2*	6 **55**	2	2			
8	6P02B4	Config2*	6 **55**	2	2			

No.	Run ID	State	Speed (kts) RPM	Keel (runs) H13 and H23	Beam (26 ° & 14 °) (runs)	EM Conditions		Remarks
						M	E	
9	6P07A1	Config3*	12 **100**	2	2			
10	6P07B2	Config3*	12 **100**	2	2			
11	6P07A3	Config3*	12 **100**	2	2			
12	6P07B4	Config3*	12 **100**	2	2			
13	6P04A1	Config1*	6 **55**	2	2			Shaker/ Loudspeaker
14	6P04B2	Config1*	6 **55**	2	2			Shaker/ loudspeaker
15	6P04A3	Config1*	6 **55**	2	2			Shaker/ loudspeaker
16	6P04B4	Config1*	6 **55**	2	2			Shaker/ loudspeaker
17	6P06A1	Config3*	9 **75**	2	2			
18	6P06B2	Config3*	9 **75**	2	2			
19	6P06A3	Config3*	9 **75**	2	2			
20	6P06B4	Config3*	9 **75**	2	2			
21	6P03A1	Config4*	15 **140**	2	2			Cavitation
22	6P03A2	Config4*	15 **140**	2	2			Cavitation
23	6P10A1	Config4*	6-15 **55-140**	2	2			Acceleration 200m before CPA
24	6P10A2	Config4*	6-15 **55-140**	2	2			acceleration
25	6P11A1	Config4*	max – 6 **140-55**	2	2			Deceleration 130m before CPA
26	6P11A2	Config4*	max – 6 140-55	2	2			deceleration
27	6P22A1	Config1*	6 **55**	2	2			Bow thruster locked
28	6P22A2	Config1*	6 **55**	2	2			Bow thruster locked

No.	Run ID	State	Speed (kts) RPM	Keel (runs) H13 and H23	Beam (26 ° & 14 °) (runs)	EM Conditions		Remarks
						M	E	
29	6P20A1	Config1*	6 **55**	2	2			30 kw stab fin hydraulic
30	6P20A2	Config1*	6 **55**	2	2			30 kw stab fin hydraulic

Legend. **c*** Config1: Power Generator (PG) II ; config2:PG III; config3: PG III&PG II; config4: PG I - IV;

This programme will be distributed in a final version with run IDs at the briefing.

Run Plan for the static ranging of RV Planet

Note: *a detailed list of equipment to be switched on / off will be delivered during the pre-trial briefing.*

Nr	Run ID	condition	amount of runs	configuration	remarks	
	HG	no disturber	2 runs		ambient noise	
1	6P21-25	silent ship	5 runs	variation of the cooling system 2 different levels in 4 modes	dead ship	at least one repetition for each run
6	6P31-34	silent ship	4 runs	4 diesel generator in combination		
10	6P41-48	silent ship	8 runs	power converter		
18	6P51-55	silent ship	5 runs	additional sound generators loudspeaker and shakers		
23	6P61-67	silent ship	7 runs	stabilization system rudder and stabi fin		
31	6P71-78	silent ship	8 runs	configuration of 4 cruise conditions(6, 8, 12, 15 kts)		
39	6P81-83	silent ship	3 runs	bow thruster system		
42	6P91-96	silent ship	6 runs	selection of specific devices (fire pumps, fresh water circulation..)		

End of measurement: 18:00 01.10.2011

RUN PROGRAM (QUEST)

Last details and information will be distributed at the briefing on September 24th 10:00 - 14:00 on board CFAV Quest. Requested are the scientific leader from the QUEST, liaison officer, subgroup leader of the underwater signature according to the deployed systems, engineer and navigation officer.

The personal transfer and preparation on board is finished by 07:45. The operational readiness will be communicate to the partial trial leader. Whether the trials begin with the dynamic or static ranging due to weather condition. For the communication a team member of WTD 71 will stay on board during the ranging.

Before the measurement the ambient noise will be measured.

Start at 08:00 - 26.09.2011.

Basic dynamic RUN Program for QUEST.

Nr	Run ID	State	Speed (kts) RPM	Keel (runs) H13 and H23	Beam (26° & 14°) (runs)	EM Conditions		Remarks
						M	E	
1	6Q01A1	Config1*	6 **60**	2	2			
2	6Q01B2	Config1*	6 **60**	2	2			
3	6Q01A3	Config1*	6 **60**	2	2			
4	6Q01B4	Config1*	6 **60**	2	2			
5	6Q02A1	Config2*	6 **60**	2	2			
6	6Q02B2	Config2*	6 **60**	2	2			
7	6Q02A3	Config2*	6 **60**	2	2			
8	6Q02B4	Config2*	6 **60**	2	2			
9	6Q03A1	Config3*	12 **120**	2	2			
10	6Q03B2	Config3*	12 **120**	2	2			
11	6Q03A3	Config3*	12 **120**	2	2			
12	6Q03B4	Config3*	12 **120**	2	2			
13	6Q04A1	Config1*	6 **60**	2	2			Shaker/ Loudspeaker

Nr	Run ID	State	Speed (kts) RPM	Keel (runs) H13 and H23	Beam (26° & 14°) (runs)	EM Conditions		Remarks
						M	E	
14	6Q04B2	Config1*	6 **60**	2	2			Shaker/ loudspeaker
15	6Q04A3	Config1*	6 **60**	2	2			Shaker/ loudspeaker
16	6Q04B4	Config1*	6 **60**	2	2			Shaker/ loudspeaker
17	6Q05A1	Config1*	6 **60**	2	2			Bottom profiler
18	6Q05B2	Config1*	6 **60**	2	2			Bottom profiler
19	6Q05A3	Config1*	6 **60**	2	2			Bottom profiler
20	6Q05B4	Config1*	6 **60**	2	2			Bottom profiler
21	6Q06A1	Config1*	9 **90**	2	2			
22	6Q06B2	Config1*	9 **90**	2	2			
23	6Q06A3	Config1*	9 **90**	2	2			
24	6Q06B4	Config1*	9 **90**	2	2			
25	6Q10A1	Config3*	3-10 **30-100**	2	2			acceleration
26	6Q10A2	Config3*	3-10 **30-100**	2	2			acceleration
27	6Q11A1	Config3*	max – 4 **100-30**	2	2			deceleration
28	6Q11A2	Config3*	max to **100-30**	2	2			deceleration
29	6Q20A1	Config1*	6 **60**	2	2			IR wash
30	6Q20A2	Config1*	6 **60**	2	2			IR wash
31	6Q22A1	Config1*	6 **60**	2	2			Acoustic Enclosures open
32	6Q22A2	Config1*	6 **60**	2	2			Acoustic Enclosures open

Legend. ☼ after finishing 28

* Config 1= DG1; Config2 = DG2; Config3=DG1 and DG2,
Config 4= Gas turbine

This programme will be distributed in a final version with run IDs at the briefing.

Run Plan for the static ranging of CFAV QUEST

For CFAV Quest the static range will be a selection of the runs conducted at Loch Goil (annex F). This comprises the following set of runs.

SERIAL NR.	NAME	SERIAL NR.	NAME
Serial Q1	Battery State	Serial SQ4	Shaker serial 4
Serial Q2	Self–sustaining State	Serial Q8	Steering gear assessment
Serial SQ1	Shaker serial 1	Serial SQ5	Shaker serial 5
Serial Q3	Black, grey and sanitary systems	Serial SQ6	Shaker serial 6
Serial SQ2	Shaker serial 2	Serial Q9	Main motors assessment
Serial Q4	Fresh water pump assessment	Serial Q10	Main engine assessment
Serial Q5	LP air compressor assessment	Serial Q11	Diesel generator assessment
Serial SQ3	Shaker serial 3	Serial Q12	IR hull cooling system
Serial Q6	Fuel system	Serial Q13	Bilge system assessment
Serial Q7	Refrigeration plants	Serial Q15	Ventilation assessment

End of measurement: 18:00 UTC +2 28.09.2011.

DATA RECORDING, COLLECTION AND DISTRIBUTION

The data of the waterborne noise measurement will recorded digital on tape. These data sets are uncorrected and unprocessed.

The processed data sets of each run will be available after post processing procedures within 6 weeks after measurement. The procedures and formats will be written attached to the data sets according to § 6.4

ANALYSIS PLAN

Processed Data sets will be provided :

- in One-Third-Octave bands (OTB) in the 10 Hz to 80 kHz bands without bandwidth correction;
- OTB spectrum level in dB re 1 µPa;
- GPS Tracking data ;
- environmental information(CTD and weather);

The subgroup leader will provide the measurement data and the processed data as requested in RIMPASS if available after the trials or within 4 weeks to the partial trial leader.

For further requirements in the post analysis requests have to be addressed to the Chairman of SET 166.

ANNEX M
TRIAL 08 (BORGSTEDT / SCHIRNAU)

OBJECTIVES

This annex will focus on the electromagnetic experiments to be conducted with CFAV QUEST. Where convenient, however, the recording of the Planet's EM signature should be under-taken as a target of interest, to confirm sensor operation and to expand the sharable signature database. The electromagnetic portion of the QUEST 2011 trial will answer critical research questions in understanding a ship's electromagnetic signature.

In using QUEST's simple degaussing system, the goal will not be to produce the smallest signature but instead to accurately measure the ship's status and signatures, leading to an improved understanding how the ship's magnetic signature varies with the transit, heading and coil settings.

The outcome of the electromagnetic signature management trials will support the goal of the SET-166 group to design a magnetic signature management system. Ultimately, these data should (will) help to improve the safety of our naval platforms when operating in mined waters.

The primary experiments at the simulator will focus on determining the optimum degaussing coil settings for QUEST at any location worldwide. To achieve this, the permanent signature will first be measured. This will be followed by the systematic variation of the individual field components to provide the induced signature. Then the individual coil effects will be measured at a number of current settings. Degaussing coil currents will then be predicted for selected worldwide locations using signature minimization techniques and compared to the measured signatures. The hypothesis that the individual components of the induced signature can be superimposed will be confirmed.

During all the measurements the onboard magnetometers signals will be recorded. Consideration should be given to having these data available in the control room of the range in real-time. It is envisioned that the onboard measurements will be used as input to an (experimental) CLDG system that predicts the current required for the DG coils.

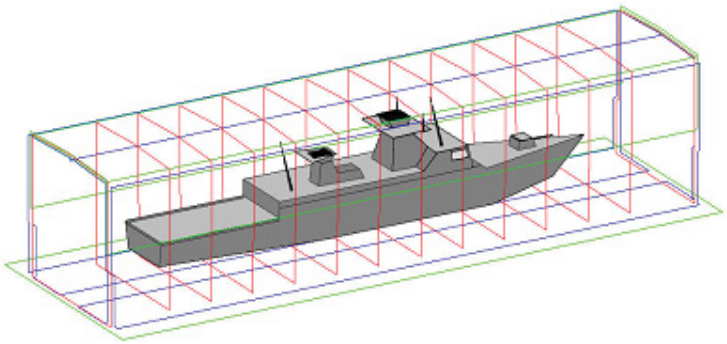
PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

The Magnetic Earth Field Simulator is designed to simulate any magnetic condition that naval vessels may face worldwide and additionally magnetic conditions to get proper settings for the degaussing system.

Magnetic fields in the Simulator are generated with 14 coils in longitudinal and 3 coils each in transversal and vertical direction.

Tri axial magnetic probes are aligned in a grid of 39 by 94 meters below the vessel at two levels 9 and 13m from waterline to range the response of the vessel on different magnetic conditions.

The Magnetic Earth Field Simulator is located close to the Kiel-Canal at the coordinates N 54.341763, E 9.739453. The depth in the simulator is about 8.10 m and on the seabed between Kiel-Canal and mouth of the range about 9 meter (updated in 2011).



RANGE INFORMATION

The range recommends using tugs for entering the Earth Field Simulator for the most units. Considering the beam of the “Quest” with about 13 m only 8 meters left for the bow tug to leave the range after the Ship is within the range.

Tracking.

In case of using tugs guiding the “Quest” into the simulator they will tow the vessel to one side within the simulator depending on wind direction. Once being inside she will be fixed with two ropes provided of the range.

The tugs release the ropes and leave the range. The ship is still moored on one side only and the crew of the range delivers two ropes from the other side.

With these at the end four ropes the “Quest” will be put in the right position centred in the simulator by using their winches.

Dimension of the Entrance

Height: 24.44m

Width: 21m

Safety distance: 0.5m

Waterlevel variation: ±0.3m

COMMUNICATION

WTD 71 provides a PoC onboard “Quest” during ranging. WTD 71 will provide communication. An auxiliary boat is available.

Telephone Numbers: postal line: +49 4331-35209-242.

Address of Station: Wehrtechnische Dienststelle für Schiffe u. Marinewaffen, Magn. Messstelle Bünsdorf

PREPARATIONS

A briefing will take place on two days before arrival at Kiel Arsenal at 12:00.

While moored in Simulator, black water can be disposed by means of a hose connection to a sewage truck. Fresh water is available.

MEASUREMENT PROCEDURE

In preparation every magnetic condition has to be simulated and measured in advance without any specimen placed within the simulator. All further measurements of the specimen use this set of data as reference by subtracting.

As result of a single measurement two files are written automatically. One file includes binary file format with the unprocessed data and the second file is a text file with processed data (Earth field variation, coil effect suppression …).

For the text files following results are hosted in the data. In the case the measurement was taken as reference ranging the residual earth field is still included because reference sensors and range sensors are not perfectly identical. Otherwise the data from the suitable reference measurement has been taken into account and only the magnetic provoked changing is readable in values. In case that nothing has changed between reference and signature ranging the values are supposed to be zero.

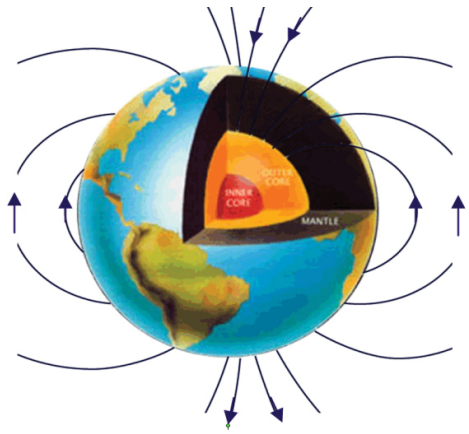
The sample rate is 20 S/s each channel synchronized.

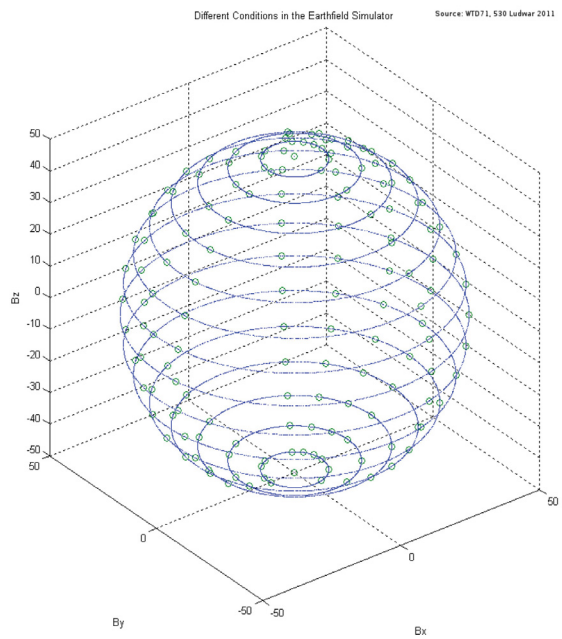
Besides ranging of static magnetic signatures the system also is able to measure alternating magnetic fields up to 4000 Hz with a sample rate of 10 kS/s. That gives unique possibilities to isolate sources by position and time because essential systems aboard can be switched on and off without causing problems a vessel would face during overruns.

RUN PLAN

The Trials of the “Quest“ in the Earth Field Simulator are subdivided into several parts to separate the contributions to the magnetic signature. All responses are ranged with tri axial magnetic sensors below the vessel at a depth of 9m and 13 m below water level.

- Simulation of the magnetic conditions related to the different ranges on the journey of the ship.
- Simulation of the main headings corresponding to the ranges and rolling with 12s period time and ± 15° rolling angle.
- Simulation of a single magnetic induction (50µT) with different angles.
- Quest will be measured under plenty of different conditions illustrated as markers in the graphs below, using one single magnetic total field value of 50 µT with different angles, to keep the processing as simple as possible with the highest information density.





- **Simulation of turns.** Additionally “magnetic” turns will be simulated, corresponding to the 50 µT conditions mentioned before illustrated as the blue circles in the graph. These turns corresponds to the magnetic field variation while the vessel conduct the turns in a time range of for instance of 120 seconds.

- **Internal ELF Magnetic Dipoles.** Situation of a three axis coil system within the vessel at different positions. Power with different frequencies (ELF) each axis. Range the response with sensors of the range.

The table below provides the estimated planning for the distribution of the experiments over the available days for the measurements.

DAY	START	END	COMMENT
0	1	224	Preparation of all necessary reference measurements in advance
1. Oct.	300	430	Arrival runs
2. Oct.	450	480	Coil Effects
2. Oct.	600	708	Linearity Test, circles
3. Oct.	750	830	Degaussed runs
4. Oct.	850	858	Rolling
4. Oct.	900	909	ELF Source aboard
5. Oct.	500	549	AM Coil Effects

EFS PROGRAM 1. OCTOBER									
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5	Reference in advance
300	0	0	0	0	0	0 V	No ICCP as reference	5	
301	0	0	0	0	0	0.85V	ICCP closed loop operation		
302	0	0	0	repeat for dc offsets of +20A, 0A, and -20A	0	2 Iset	ICCP open loop twice the current		
303	10000	0	0	0	0	0.85V	start of linearity	170	1
304	30000	0	0	0	0	"	"		1
305	50000	0	0	0	0	"	"		1
306	40000	0	0	0	0	"	"		1
307	20000	0	0	0	0	"	"		1
308	0	0	0	0	0	"	Redo Perm only (zero field measurement)		1
309	-10000	0	0	0	0	"	"		1
310	-30000	0	0	0	0	"	"		1
311	-50000	0	0	0	0	"	"		1
312	-40000	0	0	0	0	"	"		1
313	-20000	0	0	0	0	"	"		1
314	0	0	0	0	0	"	Redo Perm only		
315	0	10000	0	0	0	"	"		1
316	0	30000	0	0	0	"	"		1
317	0	50000	0	0	0	"	"		1
318	0	40000	0	0	0	"	"		1
319	0	20000	0	0	0	"	"		1
320	0	0	0	0	0	"	Redo Perm only		
321	0	-10000	0	0	0	"	"		1
322	0	-30000	0	0	0	"	"		1
323	0	-50000	0	0	0	"	"		1
324	0	-40000	0	0	0	"	"		1
325	0	-20000	0	0	0	"	"		1
326	0	0	0	0	0	"	Redo Perm only		
327	0	0	10000	0	0	"	"		1
328	0	0	30000	0	0	"	"		1
329	0	0	50000	0	0	"	"		1
330	0	0	40000	0	0	"	"		1
331	0	0	20000	0	0	"	"		1
332	0	0	0	0	0	"	Redo Perm only		
333	0	0	-10000	0	0	"	"		1

Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5	Reference in advance
334	0	0	-30000	0	0	"	"		1
335	0	0	-50000	0	0	"	"		1
336	0	0	-40000	0	0	"	"		1
337	0	0	-20000	0	0	"	end of linearity		1
338	0	0	0	0	0	"	Redo Perm only	5	
350	19754	0	48352	0	0	"	North for Bedford B=(19,7 0 48,4)µT	45	8
351	13968	13968	48352	0	0	"	NE "		
352	0	19754	48352	0	0	"	E "		
353	-13968	13968	48352	0	0	"	SE "		
354	-19754	0	48352	0	0	"	S "		
355	-13968	-13968	48352	0	0	"	SW "		
356	0	-19754	48352	0	0	"	W "		
357	13968	-13968	48352	0	0	"	NW "		
358	0	0	0	0	0	"	Redo Perm only		
359	14949	0	48829	0	0	"	North for Herdla B=(14.9 0 48,8)µT	45	8
360	10570	10570	48829	0	0	"	NE "		
361	0	14949	48829	0	0	"	E "		
362	-10570	10570	48829	0	0	"	SE "		
363	-14949	0	48829	0	0	"	S "		
364	-10570	-10570	48829	0	0	"	SW "		
365	0	-14949	48829	0	0	"	W "		
366	10570	-10570	48829	0	0	"	NW "		
367	0	0	0	0	0	"	Redo Perm only		
368	17803	0	46516	0	0	"	North for Aschau B=(17,8 0 46,5)µT	45	8
369	12589	12589	46516	0	0	"	NE "		
370	0	17803	46516	0	0	"	E "		
371	-12589	12589	46516	0	0	"	SE "		
372	-17803	0	46516	0	0	"	S "		
373	-12589	-12589	46516	0	0	"	SW "		
374	0	-17803	46516	0	0	"	W "		
375	12589	-12589	46516	0	0	"	NW "		
376	0	0	0	0	0	"	Redo Perm only		
377	21173	0	42635	0	0	"	North for Brest B=(21,2 0 42,6)µT	45	8
378	14972	14972	42635	0	0	"	NE "		
379	0	21173	42635	0	0	"	E "		
380	-14972	14972	42635	0	0	"	SE "		

Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5	Reference in advance
381	-21173	0	42635	0	0	"	S "		
382	-14972	-14972	42635	0	0	"	SW "		
383	0	-21173	42635	0	0	"	W "		
384	14972	-14972	42635	0	0	"	NW "		
385	0	0	0	0	0	"	Redo Perm only		
386	27319	0	24578	0	0	"	North for St. Eustache B=(27,3 0 24,6)µT	45	8
387	19318	19318	24578	0	0	"	NE "		
388	0	27319	24578	0	0	"	E "		
389	-19318	19318	24578	0	0	"	SE "		
390	-27319	0	24578	0	0	"	S "		
391	-19318	-19318	24578	0	0	"	SW "		
392	0	-27319	24578	0	0	"	W "		
393	19318	-19318	24578	0	0	"	NW "		
394	0	0	0	0	0	"	Redo Perm only		
395	23150	0	-53571	0	0	"	North for Perth, AU B=(23,2 0 -53,6)µT	45	8
396	16369	16369	-53571	0	0	"	NE "		
397	0	23150	-53571	0	0	"	E "		
398	-16369	16369	-53571	0	0	"	SE "		
399	-23150	0	-53571	0	0	"	S "		
400	-16369	-16369	-53571	0	0	"	SW "		
401	0	-23150	-53571	0	0	"	W "		
402	16369	-16369	-53571	0	0	"	NW "		
403	0	0	0	0	0	"	Redo Perm only		
404	24623	0	-51698	0	0	"	North for Sydney, AU B=(24,6 0 -51,7)µT	45	8
405	17411	17411	-51698	0	0	"	NE "		
406	0	24623	-51698	0	0	"	E "		
407	-17411	17411	-51698	0	0	"	SE "		
408	-24623	0	-51698	0	0	"	S "		
409	-17411	-17411	-51698	0	0	"	SW "		
410	0	-24623	-51698	0	0	"	W "		
411	17411	-17411	-51698	0	0	"	NW "		
412	0	0	0	0	0	"	Redo Perm only		
413	34011	0	27889	0	0	"	North for Persian Gulf B=(34,0 0 27,9)µT	45	8
414	24049	24049	27889	0	0	"	NE "		
415	0	34011	27889	0	0	"	E "		
416	-24049	24049	27889	0	0	"	SE "		

Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5	Reference in advance
417	-34011	0	27889	0	0	"	S "		
418	-24049	-24049	27889	0	0	"	SW "		
419	0	-34011	27889	0	0	"	W "		
420	24049	-24049	27889	0	0	"	NW "		
421	0	0	0	0	0	"	Redo Perm only	5	
422	35457	0	-29762	0	0	"	North for Darwin AU B=(34,5 0 -29,7)μT	45	8
423	25072	25072	-29762	0	0	"	NE "		
424	0	35457	-29762	0	0	"	E "		
425	-25072	25072	-29762	0	0	"	SE "		
426	-35457	0	-29762	0	0	"	S "		
427	-25072	-25072	-29762	0	0	"	SW "		
428	0	-35457	-29762	0	0	"	W "		
429	25072	-25072	-29762	0	0	"	NW "		
430	0	0	0	0	0	"	Redo Perm only	5	

EFS PROGRAM 2. OCTOBER								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
450	-	-	-	0	0	"	Reference	
451				-10	0	"	M coil effects, perm only, hyphen indi-cates 0 current in EFS coil	30
452	-	-	-	-20	0	"	"	
453	-	-	-	-30	0	"	"	
454	-	-	-	-40	0	"	"	
455	-	-	-	-35	0	"	"	
456	-	-	-	-25	0	"	"	
457	-	-	-	-15	0	"	"	
458	-	-	-	-5	0	"	"	
459	0	0	0	0	0	"	Redo Perm only	
460	-	-	-	5	0	"	"	
461	-	-	-	15	0	"	"	
462	-	-	-	25	0	"	"	
463	-	-	-	35	0	"	"	
464	-	-	-	40	0	"	"	
465	-	-	-	30	0	"	"	
466	-	-	-	20	0	"	"	
467	-	-	-	10	0	"	"	

EFS PROGRAM 2. OCTOBER								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
468	0	0	0	0	0	"	Redo Perm only	
469	-	-	-	0	-10	"	Fi-Qi coil effects, Perm only	
470	-	-	-	0	-20	"	"	
471	-	-	-	0	-25	"	"	
472	-	-	-	0	-15	"	"	
473	-	-	-	0	-5	"	"	
474	-	-	-	0	0	"	"	
475	-	-	-	0	5	"	"	
476	-	-	-	0	15	"	"	
477	-	-	-	0	25	"	"	
478	-	-	-	0	20	"	"	
479	-	-	-	0	10	"	"	
480	0	0	0	0	0	"	Redo Perm only	

LINEARITY TEST- 2. OCTOBER					
nr.	Run nr.	B_horizontal (µT)	B_vertical (µT)	heading (degrees)	inclination (degrees)
1	600	0,00	50,00	0	90
2	601	17,10	46,98	0	70
3	602	17,10	46,98	60	70
4	603	17,10	46,98	120	70
5	604	17,10	46,98	180	70
6	605	17,10	46,98	240	70
7	606	17,10	46,98	300	70
8	607	32,14	38,30	0	50
9	608	32,14	38,30	40	50
10	609	32,14	38,30	80	50
11	610	32,14	38,30	120	50
12	611	32,14	38,30	160	50
13	612	32,14	38,30	200	50
14	613	32,14	38,30	240	50
15	614	32,14	38,30	280	50
16	615	32,14	38,30	320	50
17	616	43,30	25,00	0	30
18	617	43,30	25,00	20	30
19	618	43,30	25,00	40	30
20	619	43,30	25,00	60	30

LINEARITY TEST- 2. OCTOBER					
nr.	Run nr.	B_horizontal (µT)	B_vertical (µT)	heading (degrees)	inclination (degrees)
21	620	43,30	25,00	80	30
22	621	43,30	25,00	100	30
23	622	43,30	25,00	120	30
24	623	43,30	25,00	140	30
25	624	43,30	25,00	160	30
26	625	43,30	25,00	180	30
27	626	43,30	25,00	200	30
28	627	43,30	25,00	220	30
29	628	43,30	25,00	240	30
30	629	43,30	25,00	260	30
31	630	43,30	25,00	280	30
32	631	43,30	25,00	300	30
33	632	43,30	25,00	320	30
34	633	43,30	25,00	340	30
35	634	49,24	8,68	0	10
36	635	49,24	8,68	20	10
37	636	49,24	8,68	40	10
38	637	49,24	8,68	60	10
39	638	49,24	8,68	80	10
40	639	49,24	8,68	100	10
41	640	49,24	8,68	120	10
42	641	49,24	8,68	140	10
43	642	49,24	8,68	160	10
44	643	49,24	8,68	180	10
45	644	49,24	8,68	200	10
46	645	49,24	8,68	220	10
47	646	49,24	8,68	240	10
48	647	49,24	8,68	260	10
49	648	49,24	8,68	280	10
50	649	49,24	8,68	300	10
51	650	49,24	8,68	320	10
52	651	49,24	8,68	340	10
53	652	49,24	-8,68	0	-10
54	653	49,24	-8,68	20	-10
55	654	49,24	-8,68	40	-10
56	655	49,24	-8,68	60	-10
57	656	49,24	-8,68	80	-10
58	657	49,24	-8,68	100	-10
59	658	49,24	-8,68	120	-10
60	659	49,24	-8,68	140	-10
61	660	49,24	-8,68	160	-10
62	661	49,24	-8,68	180	-10

LINEARITY TEST- 2. OCTOBER					
nr.	Run nr.	B_horizontal (µT)	B_vertical (µT)	heading (degrees)	inclination (degrees)
63	662	49,24	-8,68	200	-10
64	663	49,24	-8,68	220	-10
65	664	49,24	-8,68	240	-10
66	665	49,24	-8,68	260	-10
67	666	49,24	-8,68	280	-10
68	667	49,24	-8,68	300	-10
69	668	49,24	-8,68	320	-10
70	669	49,24	-8,68	340	-10
71	670	43,30	-25,00	0	-30
72	671	43,30	-25,00	20	-30
73	672	43,30	-25,00	40	-30
74	673	43,30	-25,00	60	-30
75	674	43,30	-25,00	80	-30
76	675	43,30	-25,00	100	-30
77	676	43,30	-25,00	120	-30
78	677	43,30	-25,00	140	-30
79	678	43,30	-25,00	160	-30
80	679	43,30	-25,00	180	-30
81	680	43,30	-25,00	200	-30
82	681	43,30	-25,00	220	-30
83	682	43,30	-25,00	240	-30
84	683	43,30	-25,00	260	-30
85	684	43,30	-25,00	280	-30
86	685	43,30	-25,00	300	-30
87	686	43,30	-25,00	320	-30
88	687	43,30	-25,00	340	-30
89	688	32,14	-38,30	0	-50
90	689	32,14	-38,30	40	-50
91	690	32,14	-38,30	80	-50
92	691	32,14	-38,30	120	-50
93	692	32,14	-38,30	160	-50
94	693	32,14	-38,30	200	-50
95	694	32,14	-38,30	240	-50
96	695	32,14	-38,30	280	-50
97	696	32,14	-38,30	320	-50
98	697	17,10	-46,98	0	-70
99	698	17,10	-46,98	60	-70
100	699	17,10	-46,98	120	-70
101	700	17,10	-46,98	180	-70
102	701	17,10	-46,98	240	-70
103	702	17,10	-46,98	300	-70
104	703	0,00	-50,00	0	-90

LINEARITY TEST- 2. OCTOBER					
nr.	Run nr.	B_horizontal (µT)	B_vertical (µT)	heading (degrees)	inclination (degrees)
105	704	17,10	46,98	circle	T = 120s
106	705	32,14	38,30	circle	T = 120s
107	706	43,30	25,00	circle	T = 120s
108	707	49,24	8,68	circle	T = 120s

EFS PROGRAM 3. OCTOBER								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
750	19754	0	48352	Best Guess	Best Guess	"	North for Halifax with DG	45
751	13968	13968	48352	Best Guess	Best Guess	"	NE "	
752	0	19754	48352	Best Guess	Best Guess	"	E "	
753	-13968	13968	48352	Best Guess	Best Guess	"	SE "	
754	-19754	0	48352	Best Guess	Best Guess	"	S "	
755	-13968	-13968	48352	Best Guess	Best Guess	"	SW "	
756	0	-19754	48352	Best Guess	Best Guess	"	W "	
757	13968	-13968	48352	Best Guess	Best Guess	"	NW "	
758	0	0	0	0	0	"	Redo Perm only	
759	14949	0	48829	Best Guess	Best Guess	"	North for Herdla with DG	45
760	10570	10570	48829	Best Guess	Best Guess	"	NE "	
761	0	14949	48829	Best Guess	Best Guess	"	E "	
762	-10570	10570	48829	Best Guess	Best Guess	"	SE "	
763	-14949	0	48829	Best Guess	Best Guess	"	S "	
764	-10570	-10570	48829	Best Guess	Best Guess	"	SW "	
765	0	-14949	48829	Best Guess	Best Guess	"	W "	
766	10570	-10570	48829	Best Guess	Best Guess	"	NW "	
767	0	0	0	0	0	"	Redo Perm only	
768	17803	0	46516	Best Guess	Best Guess	"	North for Aschau with DG	45
769	12589	12589	46516	Best Guess	Best Guess	"	NE "	
770	0	17803	46516	Best Guess	Best Guess	"	E "	
771	-12589	12589	46516	Best Guess	Best Guess	"	SE "	
772	-17803	0	46516	Best Guess	Best Guess	"	S "	
773	-12589	-12589	46516	Best Guess	Best Guess	"	SW "	
774	0	-17803	46516	Best Guess	Best Guess	"	W "	
775	12589	-12589	46516	Best Guess	Best Guess	"	NW "	

EFS PROGRAM 3. OCTOBER								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
776	0	0	0	0	0	"	Redo Perm only	
777	21173	0	42635	Best Guess	Best Guess	"	North for Brest with DG	45
778	14972	14972	42635	Best Guess	Best Guess	"	NE "	
779	0	21173	42635	Best Guess	Best Guess	"	E "	
780	-14972	14972	42635	Best Guess	Best Guess	"	SE "	
781	-21173	0	42635	Best Guess	Best Guess	"	S "	
782	-14972	-14972	42635	Best Guess	Best Guess	"	SW "	
783	0	-21173	42635	Best Guess	Best Guess	"	W "	
784	14972	-14972	42635	Best Guess	Best Guess	"	NW "	
785	0	0	0	0	0	"	Redo Perm only	
786	27319	0	24578	Best Guess	Best Guess	"	North for St. Eustache with DG	45
787	19318	19318	24578	Best Guess	Best Guess	"	NE "	
788	0	27319	24578	Best Guess	Best Guess	"	E "	
789	-19318	19318	24578	Best Guess	Best Guess	"	SE "	
790	-27319	0	24578	Best Guess	Best Guess	"	S "	
791	-19318	-19318	24578	Best Guess	Best Guess	"	SW "	
792	0	-27319	24578	Best Guess	Best Guess	"	W "	
793	19318	-19318	24578	Best Guess	Best Guess	"	NW "	
794	0	0	0	0	0	"	Redo Perm only	
795	23150	0	-53571	Best Guess	Best Guess	"	North for Perth, AU with DG	45
796	16369	16369	-53571	Best Guess	Best Guess	"	NE "	
797	0	23150	-53571	Best Guess	Best Guess	"	E "	
798	-16369	16369	-53571	Best Guess	Best Guess	"	SE "	
799	-23150	0	-53571	Best Guess	Best Guess	"	S "	
800	-16369	-16369	-53571	Best Guess	Best Guess	"	SW "	
801	0	-23150	-53571	Best Guess	Best Guess	"	W "	
802	16369	-16369	-53571	Best Guess	Best Guess	"	NW "	
803	0	0	0	0	0	"	Redo Perm only	
804	24623	0	-51698	Best Guess	Best Guess	"	North for Sydney, AU with DG	45
805	17411	17411	-51698	Best Guess	Best Guess	"	NE "	
806	0	24623	-51698	Best Guess	Best Guess	"	E "	
807	-17411	17411	-51698	Best Guess	Best Guess	"	SE "	
808	-24623	0	-51698	Best Guess	Best Guess	"	S "	

EFS PROGRAM 3. OCTOBER								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
809	-17411	-17411	-51698	Best Guess	Best Guess	"	SW "	
810	0	-24623	-51698	Best Guess	Best Guess	"	W "	
811	17411	-17411	-51698	Best Guess	Best Guess	"	NW "	
812	0	0	0	0	0	"	Redo Perm only	
813	34011	0	27889	Best Guess	Best Guess	"	North for Persian Gulf with DG	45
814	24049	24049	27889	Best Guess	Best Guess	"	NE "	
815	0	34011	27889	Best Guess	Best Guess	"	E "	
816	-24049	24049	27889	Best Guess	Best Guess	"	SE "	
817	-34011	0	27889	Best Guess	Best Guess	"	S "	
818	-24049	-24049	27889	Best Guess	Best Guess	"	SW "	
819	0	-34011	27889	Best Guess	Best Guess	"	W "	
820	24049	-24049	27889	Best Guess	Best Guess	"	NW "	
821	0	0	0	0	0	"	Redo Perm only	
822	35457	0	-29762	Best Guess	Best Guess	"	North for Darwin AU with DG	45
823	25072	25072	-29762	Best Guess	Best Guess	"	NE "	
824	0	35457	-29762	Best Guess	Best Guess	"	E "	
825	-25072	25072	-29762	Best Guess	Best Guess	"	SE "	
826	-35457	0	-29762	Best Guess	Best Guess	"	S "	
827	-25072	-25072	-29762	Best Guess	Best Guess	"	SW "	
828	0	-35457	-29762	Best Guess	Best Guess	"	W "	
829	25072	-25072	-29762	Best Guess	Best Guess	"	NW "	
830	0	0	0	0	0	"	Redo Perm only	

EFS PROGRAM 4. OCTOBER - ELFE								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
900	-	-	-	0	0	"	Reference	
900	-	-	-	0	0	"	begin ELF positioning coil 0Adc + 0.25 Hz	10
901	-	-	-	0	0	"	0Adc+0.5 Hz	10
902	-	-	-	0	0	"	0Adc+1 Hz	10
903	-	-	-	0	0	"	0Adc+ 2 Hz	10
904	-	-	-	0	0	"	0Adc+4 Hz	10
905	-	-	-	0	0	"	0Adc+8 Hz	10

EFS PROGRAM 4. OCTOBER - ELFE								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
906	-	-	-	0	0	"	0Adc+16 Hz	10
907	-	-	-	0	0	"	white noise @ low sampling rate	10
908	-	-	-	0	0	"	white noise @ high sampling rate	10
909	0	0	0	0	0	"	Redo Perm only	5

EFS PROGRAM 4. OCTOBER - ROLLING									
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5	Reference in ad-vance
850	-	-	-	0	0	"	±10000 nT sine roll @ 8 s	8	1
851	-	-	-	0	0	"	±10000 nT sine pitch @ 8 s	8	1
852	-	-	-	0	0	"	combined pitch in Earth field @ 8s (DG off) B=(17,7 0 46,2)	8	1
853	-	-	-	0	0	"	combined roll in Earth field @ 8s (DG off) B=(0 17,7 46,2)	8	1
854	-	-	-	0	0	"	combined pitch in Earth field @ 8s (DG on) B=(17,7 0 46,2)	8	1
855	-	-	-	0	0	"	combined roll in Earth field @ 8s (DG on) B=(0 17,7 46,2)	8	1
854	-	-	-	0	0	"	±10000 nT sine roll @ 16 s	8	1
855	-	-	-	0	0	"	±10000 nT sine pitch @ 16 s	8	1
856	-	-	-	0	0	"	combined pitch in Earth field @ 16s (DG off) B=(17,7 0 46,2)	8	1

EFS PROGRAM 4. OCTOBER - ROLLING									
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5	Reference in ad-vance
857	-	-	-	0	0	"	combined roll in Earth field @ 16s (DG off) B=(0 17,7 46,2)	8	1
857	-	-	-	0	0	"	combined pitch in Earth field @ 16s (DG on) B=(17,7 0 46,2)	2	1
858	-	-	-	0	0	"	combined roll in Earth field @ 16s (DG on) B=(0 17,7 46,2)	2	1
858	0	0	0	0	0	"	Redo Perm only	5	

EFS PROGRAM 5. OCT								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
500	-	-	-	0	0		Reference SM	1
501	-	-	-	0	0		Reference AM	2
502	-	-	-	0Adc + 0.25 Hz	0	"	AC current through M coil	10
503	-	-	-	0Adc+0.5 Hz	0	"	Possibly change bias currents	10
504	-	-	-	0Adc+1 Hz	0	"	"	10
505	-	-	-	0Adc+ 2 Hz	0	"	"	10
506	-	-	-	0Adc+4 Hz	0	"	"	10
507	-	-	-	0Adc+8 Hz	0	"	"	10
508	-	-	-	0Adc+16 Hz	0	"	"	10
509	-	-	-	pos off-set+0.25Hz	0	"	"	10
510	-	-	-	pos off-set+0.5Hz	0	"	"	10
511	-	-	-	pos off-set+1Hz	0	"	"	10
512	-	-	-	pos off-set+2Hz	0	"	"	10
513	-	-	-	pos off-set+4Hz	0	"	"	10
514	-	-	-	pos off-set+8Hz	0	"	"	10
515	-	-	-	pos off-	0	"	"	10

EFS PROGRAM 5. OCT								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
				set+16Hz				
516	-	-	-	neg off-set+0.25Hz	0	"	"	10
517	-	-	-	neg off-set+0.5Hz	0	"	"	10
518	-	-	-	neg off-set+1Hz	0	"	"	10
519	-	-	-	neg off-set+2Hz	0	"	"	10
520	-	-	-	neg off-set+4Hz	0	"	"	10
521	-	-	-	neg off-set+8Hz	0	"	"	10
522	-	-	-	neg off-set+16Hz	0	"	"	10
523	0	0	0	0	0	"	Redo Perm only	5
524	-	-	-	0	0Adc + 0.25 Hz	"	AC current through Fi-Qi coil	10
525	-	-	-	0	0Adc+0.5 Hz	"	Possibly change bias currents	10
526	-	-	-	0	0Adc+1 Hz	"	"	10
527	-	-	-	0	0Adc+ 2 Hz	"	"	10
528	-	-	-	0	0Adc+4 Hz	"	"	10
529	-	-	-	0	0Adc+8 Hz	"	"	10
530	-	-	-	0	0Adc+16 Hz	"	"	10
531	-	-	-	0	pos off-set+0.25Hz	"	"	10
532	-	-	-	0	pos off-set+0.5Hz	"	"	10
533	-	-	-	0	pos off-set+1Hz	"	"	10
534	-	-	-	0	pos off-set+2Hz	"	"	10
535	-	-	-	0	pos off-set+4Hz	"	"	10
536	-	-	-	0	pos off-set+8Hz	"	"	10
537	-	-	-	0	pos off-set+16Hz	"	"	10
538	-	-	-	0	neg off-set+0.25Hz	"	"	10
539	-	-	-	0	neg off-set+0.5Hz	"	"	10
540	-	-	-	0	neg off-set+1Hz	"	"	10
541	-	-	-	0	neg off-set+2Hz	"	"	10

EFS PROGRAM 5. OCT								
Run	Longitudinal	Transversal	Vertical	M current	Fi-Qi Current	ICCP	Comment	Time x5
542	-	-	-	0	neg off-set+4Hz	"	"	10
543	-	-	-	0	neg off-set+8Hz	"	"	10
544	-	-	-	0	white noise	"	low sampling rate	10
545	-	-	-	0	white noise	"	high sampling rate	10
546	-	-	-	white noise	0	"	low sampling rate	10
547	-	-	-	white noise	0	"	high sampling rate	10
548	-	-	-	0	neg off-set+16Hz	"	"	10
549	0	0	0	0	0	"	Redo Perm only	5

DATA RECORDING, COLLECTION AND DISTRIBUTION

Data will be available acc. to § 2.5 Data Handling and distribution. In addition annex U provides further information on data handling and classification.

ANNEX N
TRIAL 09 (BREST)

OBJECTIVES

The objectives of the trial are to contribute to the Master trial Plan as expected and to succeed in collecting underwater signature data and in particular acoustic, magnetic and electric data.

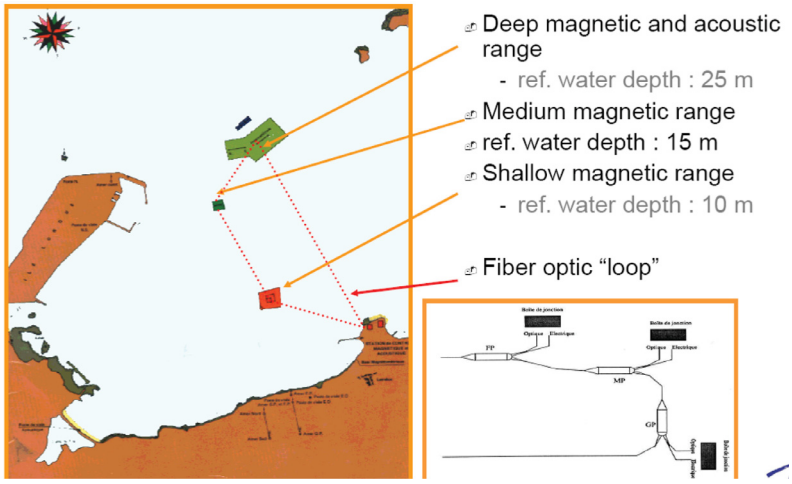
With our Brest/Lanveoc range we can also get pressure data.

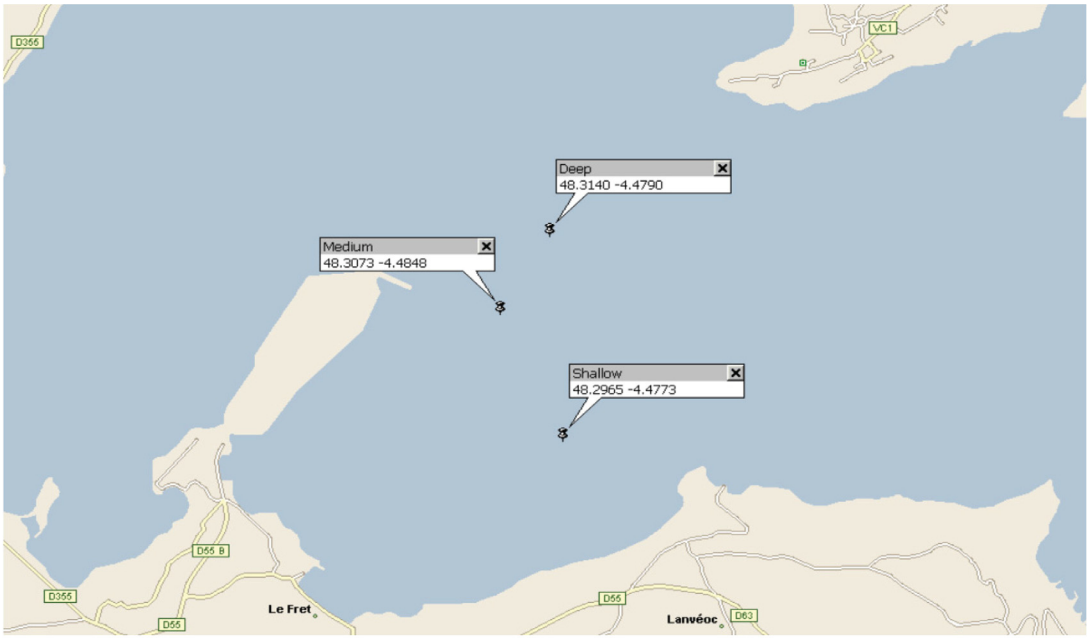
PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

Besides the participation of CFAV Quest and RV Planet, only the PRIME EM-calibration source will be deployed at Brest.

RANGE INFORMATION

Located on the west coast of France just south of the city of Brest, the French Navy operates three ranges all connected via an underwater fibre optic cable as shown in the figure below. For the QUEST 2011 trial, ranging trials will be conducted at the medium and deep water ranges. Both the medium and deep ranges include static and alternating magnetic sensors, shown in the two figures below. The deep range also includes acoustic and electrical measurements.

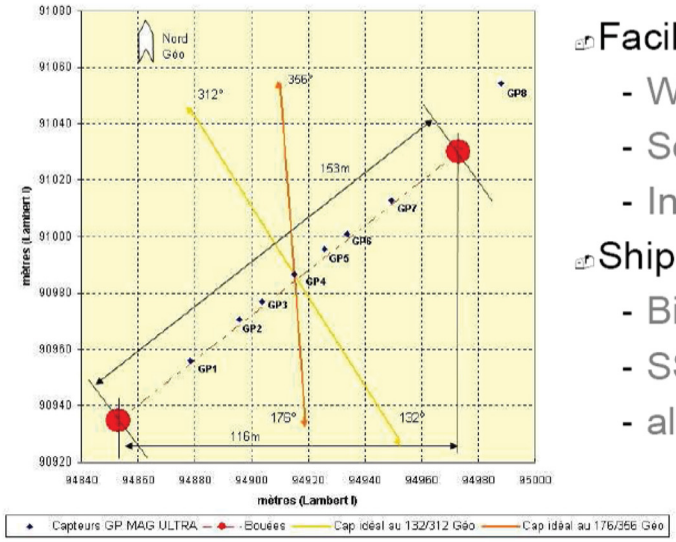




The Brest range has just been upgraded in 2010 with eight electric field sensors and including electric field measurements in the QUEST 2011 trial would be of interest.

Due to the large tidal variation in the Brest area (~4m), it is recommended that the ranging trials should be conducted at both low and high tide. This effectively provides signature data at two depths that can be used to verify depth correction procedures or used as additional input into physical models. If magnetic trials are done on deep range, electrical trials could be gathered at the same time.

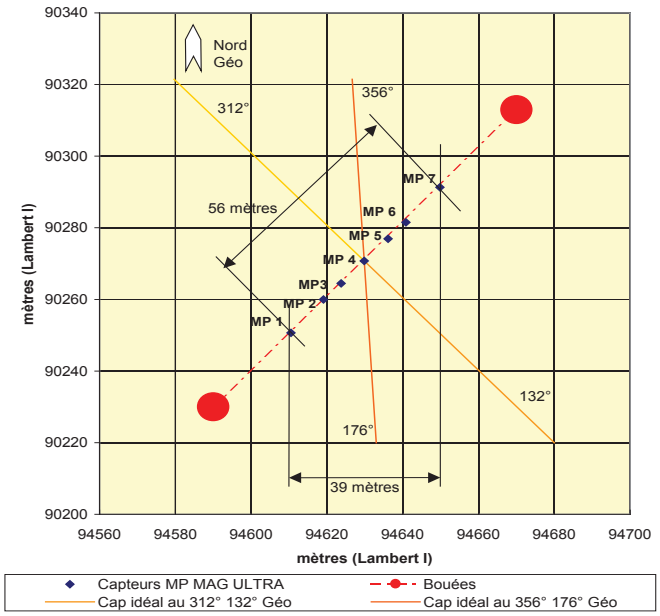
Deep range



- Facilities :
  - Water Depth : 24 to 28 m
  - Sensors : 8 (1 remote)
  - Influences : SM, AM, LAC
- Ship :
  - Bigger ship
  - SSBN
  - all : acoustic measurements

If preferable, magnetic measurements could be done on medium magnetic range (water depth 15 meters) , at about 800m from deep range. The facilities are the same as for deep range: 7 sensors with SM and AM influences.

Medium range



The facilities of this range:
- Water depth : 13 to 17m
- Sensors : 7
- -Influence : SM, AM

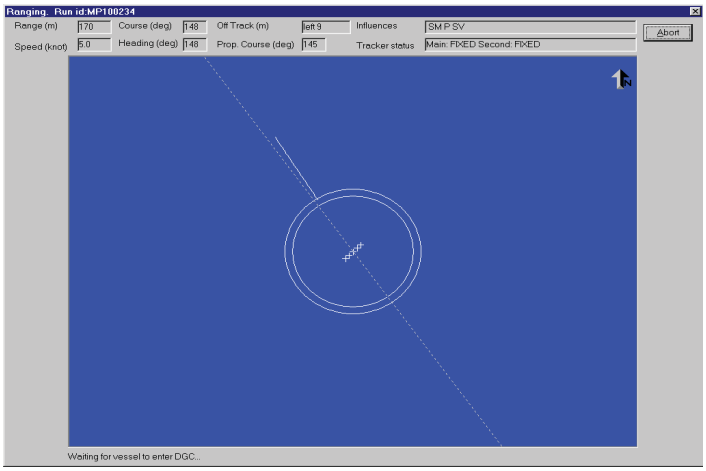
Ship:
- Frigate
- SSN, SSK

TRACKING

A GPS system will be installed on the ship for the tracking and the aid for navigation (Navaid).

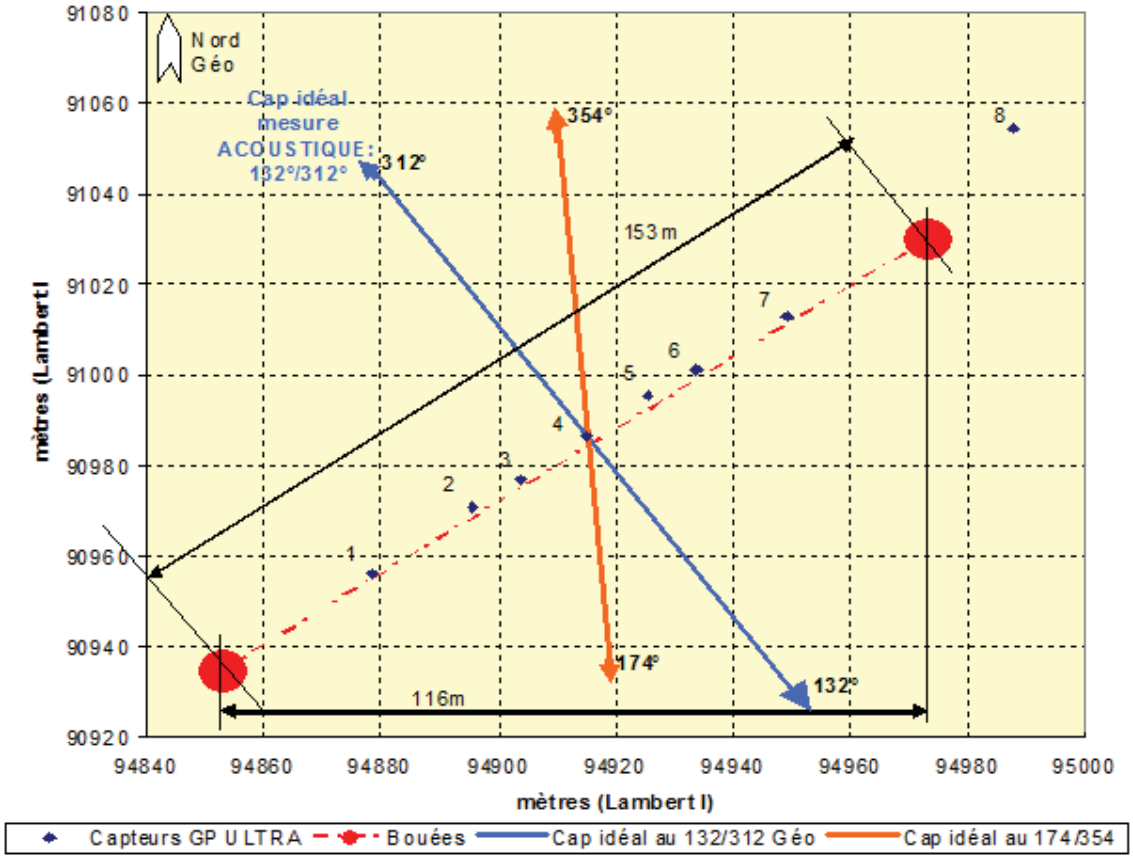
Two GPS and VHF antennas will be installed on the bow and stern of the ship by Brest team in order to determine its exact position in relation to the sensors.

The Navaid is a PC which marks out the route of the ship on the range. It will help the ship to keep the right course.



Acoustic trial (deep range):

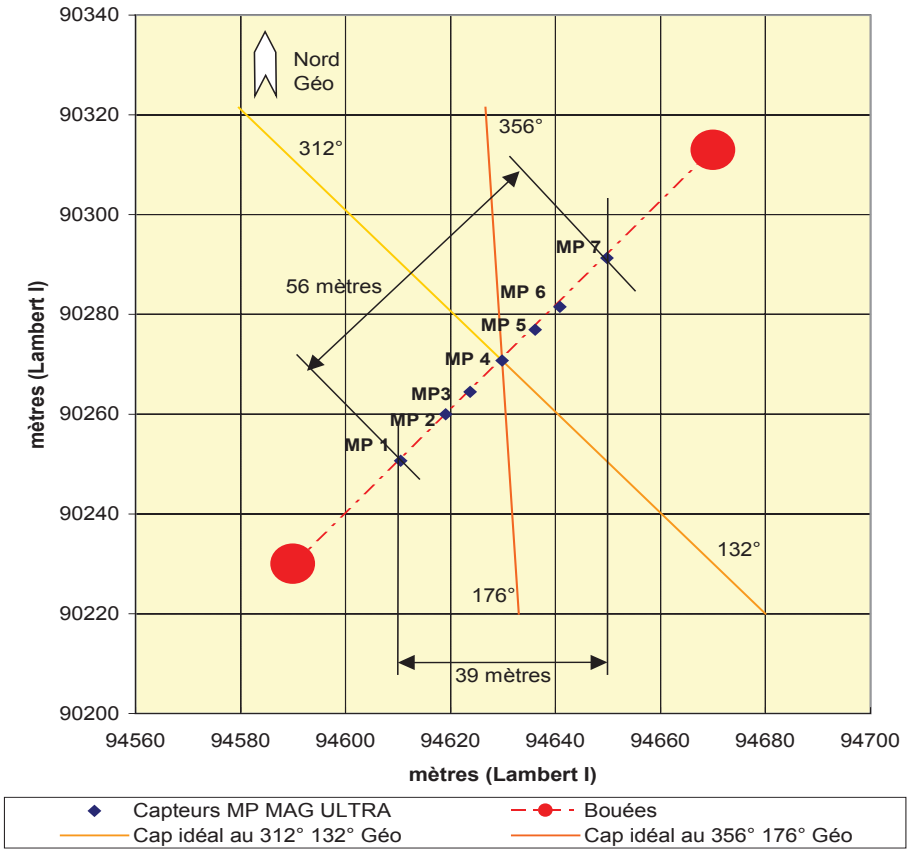
The course of the ship will be 132° and 312° and the trajectory will be just above sensor n°4, just like shown in the picture below.



Capteurs	WGS84 en DM			
	Latitude (Nord)		longitude (Ouest)	
	Deg	Min	Deg	Min
GP1	48	18,81753	4	28,93685
GP2	48	18,82623	4	28,92395
GP3	48	18,83012	4	28,91800
GP4	**48**	18,83582	**4**	28,90952
GP5	48	18,84112	4	28,90178
GP6	48	18,84441	4	28,89553
GP7	48	18,85154	4	28,88395
GP8	48	18,87572	4	28,85587
Bouée S/O	**48**	**18,80494**	**4**	**28,95569**
Bouée N/E	**48**	**18,86196**	**4**	**28,86611**

Magnetic trial (deep and medium range).

The measurements will be conducted simultaneously with the acoustic measurements on the deep range. The course will be 132° and 312°. Measurements on the medium range, will be conducted according to the same principle as shown in the picture below:



COMMUNICATION

For the communication during the trial the VHF Channel 11 will be used. The Brest/Lanveoc measurement station will have a call sign “AMELIE”.

PREPARATIONS

A DGPS system will be installed on board by a Brest team. These persons will control it during the trial, and then remove it at the end of the trial. The installation and de-installation will take about half an hour and could be done during the transit of the ship between the quay and the range. The Brest team will have to embark and land of the ship on quay. Should the trial last more than one day, we would ask the possibility to recharge the batteries on board during the rest.

A on-board briefing is to take place before the trial starts. Define when/where for Quest and Planet in accordance with the time tables chapter 3.

MEASUREMENT PROCEDURE

Acoustic and Magnetic trial programs will have to be coordinated. Electric recording data will be done in the same time than acoustic or magnetic data. Electric range is just next to the deep range.

In general the ship is asked:

- to be on the track line in a steady state condition approximately 1000m before sensor 4 (GP4 if deep range or MP4 if medium range),
- for acoustic, not to change sailing speed, heading, machinery configuration during the passage.

The recording will start when the bow of the ship is at a distance of at least 100m before sensor 4, and will stop when the stern of the ship is at least at 100m from sensor 4 of the range.

RUN PLAN

For the Quest, we plan to do a minimum of 30 measurements on 2 days (17+ 18 October). The heading for all runs will be 132 and 312 deg.

At the deep water range Acoustic, Electric, Magnetic and pressure measurements will be carried out simultaneously

At the first day 16 runs will be carried out at the deepwater range. At the second day the program will start at the medium range , where run Q16 to Q24 will be carried out. After this part of the run program the vessel will return to the deep water range in order to carry out the remaining 6 runs of the run program.

Note: the acoustic and EM conditions are defined in annex S.

CFAV QUEST:

Day 1.

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Range	EM conditions		Remarks
		PORT	STBD	(kts)	(deg)	(m)		M	E	
7Q1A1	1	60	60	6	132	0	Deep	A	B	
7Q1B2	1	60	60	6	312	0	Deep	A	B	
7Q2A1	2	60	60	6	132	0	Deep	B	C	
7Q2B2	2	60	60	6	312	0	Deep	B	C	
7Q3A1	3	120	120	12	132	0	Deep	B	C	
7Q3B2	3	120	120	12	312	0	Deep	B	C	
7Q3A3	3	120	120	12	132	0	Deep	A	D	
7Q3B4	3	120	120	12	312	0	Deep	A	D	
7Q4A1	1	60	60	6	132	0	Deep	C	D	Additional sources
7Q4B2	1	60	60	6	312	0	Deep	C	D	Additional sources
7Q4A3	1	60	60	6	132	0	Deep	B	E	Additional sources

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Range	EM conditions		Remarks
		PORT	STBD	(kts)	(deg)	(m)		M	E	
7Q4B4	1	60	60	6	312	0	Deep	B	E	Additional sources
7Q5A1	1	60	60	6	132	0	Deep	D	A	Bottom profiler
7Q5B2	1	60	60	6	312	0	Deep	D	A	Bottom profiler
7Q6A1	1	90	90	9	132	0	Deep	A	B	
7Q6B2	1	90	90	9	312	0	Deep	A	B	

Day 2.

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Range	EM conditions		Remarks
		PORT	STBD	(kts)	(deg)	(m)		M	E	
7Q17A	1	90	90	9	NW	0	Medium	A	G	
7Q18B	1	90	90	9	SE	0	Medium	A	G	
7Q19A	1	90	90	9	NW	0	Medium	B	F	
7Q20B	1	90	90	9	SE	0	Medium	B	F	
7Q21A	1	90	90	9	NW	0	Medium	C	F	
7Q22B	1	90	90	9	SE	0	Medium	C	F	
7Q23A	1	90	90	9	NW	0	Medium	B	G	
7Q24B	1	90	90	9	SE	0	Medium	B	G	
transit from medium to deep range										
7Q3A5	3	120	120	12	132	0	Deep	A	B	
7Q3B6	3	120	120	12	312	0	Deep	A	B	
7Q6A3	1	90	90	9	132	0	Deep	B	C	
7Q6B4	1	90	90	9	312	0	Deep	B	C	

Run	Config	Propeller (RPM)		Expected speed	Heading	Offset	Range	EM conditions		Remarks
		PORT	STBD	(kts)	(deg)	(m)		M	E	
7Q3A7	3	120	120	12	132	0	Deep	A	D	
7Q3B8	3	120	120	12	312	0	Deep	A	D	

RV PLANET:

RV Planet will only be measured at the deep water range (no EM related measurements).

Note: the acoustic conditions are defined in annex S.

Run	DG set	Propeller (RPM)		Expected speed	Heading	Offset	Range	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
7P1A1	**1**	**55**	**55**	**6**	**132**	**0**	**Deep**		
7P1B2	**1**	**55**	**55**	**6**	**312**	**0**	**Deep**		
7P1A3	*1*	*55*	*55*	*6*	*132*	*0*	Deep		
7P1B4	*1*	*55*	*55*	*6*	*312*	*0*	Deep		
7P2A1	**2**	**55**	**55**	**6**	**132**	**0**	**Deep**		
7P2B2	**2**	**55**	**55**	**6**	**312**	**0**	**Deep**		
7P2A3	*2*	*55*	*55*	*6*	*132*	*0*	Deep		
7P2B4	*2*	*55*	*55*	*6*	*312*	*0*	Deep		
7P3A1	**3**	**140**	**140**	**15**	**132**	**0**	**Deep**		
7P3B2	**3**	**140**	**140**	**15**	**312**	**0**	**Deep**		
7P3A3	*3*	*140*	*140*	*15*	*132*	*0*	Deep		
7P3B4	*3*	*140*	*140*	*15*	*312*	*0*	Deep		
7P4A1	**1**	**55**	**55**	**6**	**132**	**0**	**Deep**		Additional sources
7P4B2	**1**	**55**	**55**	**6**	**312**	**0**	**Deep**		Additional sources

Run	DG set	Propeller (RPM)		Expected speed	Heading	Offset	Range	EM setting	Remarks
		PORT	STBD	(kts)	(deg)	(m)			
7P4A3	*1*	*55*	*55*	*6*	*132*	*0*	Deep		Additional sources
7P4B4	*1*	*55*	*55*	*6*	*312*	*0*	Deep		Additional sources
7P5A1	**1**	**30**	**30**	**3**	**132**	**0**	**Deep**		Towed noise source
7P5B2	**1**	**30**	**30**	**3**	**312**	**0**	**Deep**		Towed noise source
7P5A3	*1*	*30*	*30*	*3*	*132*	*0*	Deep		Towed noise source
7P5B4	*1*	*30*	*30*	*3*	*312*	*0*	Deep		Towed noise source
7P6A1	**1**	**75**	**75**	**9**	**132**	**0**	**Deep**		
7P6B2	**1**	**75**	**75**	**9**	**312**	**0**	**Deep**		
7P7A1	**1**	**100**	**100**	**12**	**132**	**0**	**Deep**		
7P7B2	**1**	**100**	**100**	**12**	**312**	**0**	**Deep**		

Legend. Minimal 2 runs for each condition
bold - priority run
italics - spare run (when needed)

DATA RECORDING, COLLECTION AND DISTRIBUTION

Data recorded during the acquisition of the pass will be:

- trajectory in text format (GPS coordinates each second);
- configuration of the pass in text format;
- acoustic, magnetic and electric data in binary format.

After the trial, acoustic, magnetic and electric data, in binary format, have to be converted in ASCII format before being distributed.

ANNEX O
TRIAL 10 (MPA TRIALS)

OBJECTIVES

The first objective is to gather data from an ASQ-508 system mounted on a CP-140 aircraft as it flies over *CFAV QUEST* at various altitudes to evaluate/improve the long-range detection algorithm. The second objective is to collect ASQ-508 ELF data from a DRDC-made synthetic source towed behind *CFAV QUEST*. These data will be used to evaluate/improve the ASQ-508 ELF detection algorithm.

PARTICIPATING UNITS & SPECIAL TEST EQUIPMENT

This trial requires four CP-140 flights from 14 Wing Greenwood, Nova Scotia, with one of the Block III aircraft that has an ASQ-508 system already installed. In addition to the ASQ-508 system, we require that an approved laptop computer be installed for recording the ASQ-508 data. This will require the standard EMI testing for all CP-140 installations. The laptop computer will be connected to the ASQ-508 amplifier computer by an Ethernet cable. The laptop will be powered from 60 Hz, 110 Volt power as the internal batteries will not last for a full 6 hours of data collection.

DAEPM(M), in consultation with DRDC and various CF units, will determine which laptop computer will be used for this trial. They will also be responsible for determining how the laptop will be mounted and how the cables will be routed.

Contact Information.

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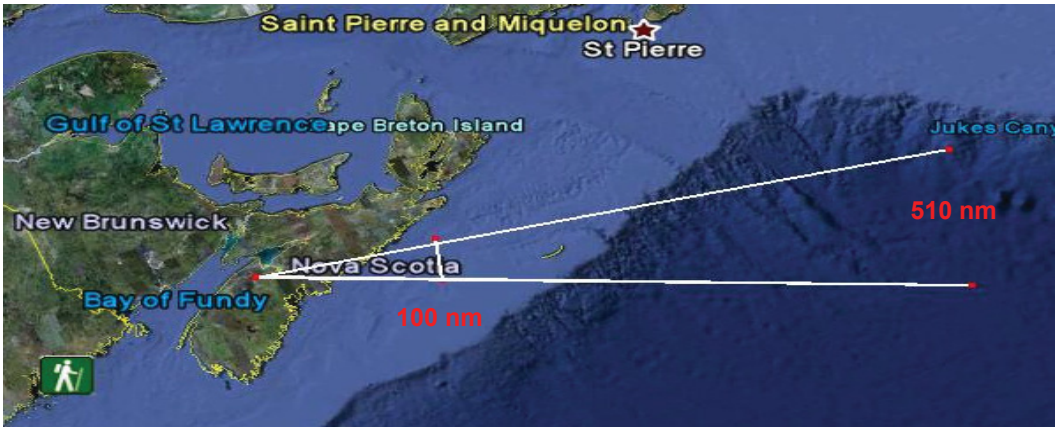
Email: scott.campbell@forces.gc.ca

RANGE INFORMATION

These trials will not be conducted on a range; they will be conducted east of Nova Scotia as shown in the plot below.



The geological noise can be significant in near-shore regions of the Scotian Shelf. Thus the preferred op area is beyond 100 nm from shore, extending out over the deep ocean. The furthest east boundary for the op area will be set at 510 nm from Greenwood (2 hours at a CP-140 transit speed of 255 nm/hour). Although the preceding figure shows the approximate operational area, a final decision will be made in consultation with CFAV QUEST crew.

TRACKING

The aircraft will fly directly over CFAV QUEST so that the radar altimeter can be used to determine the approximate CPA for the long-range detection portion of the trial. GPS position data for both the aircraft and ship will be collected to further refine the range at CPA.

For the synthetic source trials, the source position will be derived from the ship GPS position and heading, and the known length of tow-cable to the source. The aircraft GPS position will be recorded to determine range and bearing at CPA.

COMMUNICATION

The CP-140 and CFAV QUEST shall monitor marine VHF channel 16. Communications will be conducted using UHF radios with the primary frequency = 249.8 MHz and the secondary frequency = 259.4 MHz.

PREPARATIONS

The exact flight times will have to be coordinated with the departure/arrival schedule of CFAV QUEST to ensure that the data is collected over areas where geological magnetic noise sources do not cause too much interference.

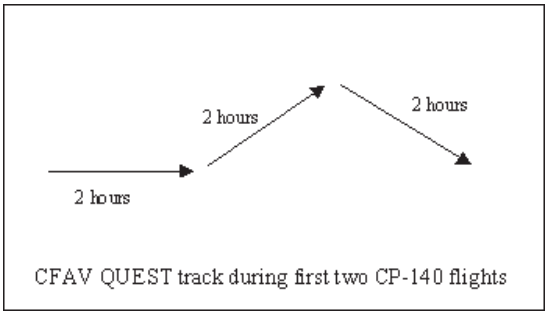
Advance testing will be required to verify the data recording laptop does not cause EMI/EMC problems in the CP-140. This will be done in the late Spring/Summer 2011 at 14 Wing Greenwood. Installation of the data recording system will be done just prior to the actual flight trials.

MEASUREMENT PROCEDURE

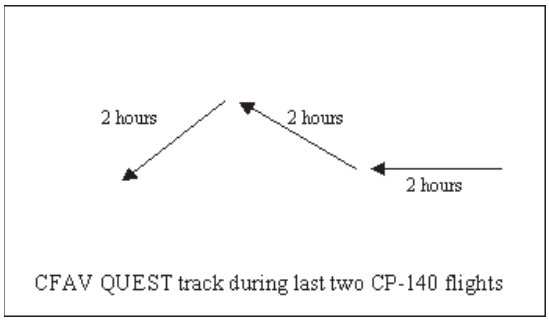
The trial will require four over flights of CFAV QUEST – two shortly after the ship departs Halifax at the start of the European 2011 deployment, and two just before the ship returns to Halifax at the end of the deployment. Each CP-140 flight will provide roughly 6 hours of on-top data for a total of 24 hours of data collection.

The tests will be conducted while CFAV QUEST is transiting in order to minimize the interruption in the deployment schedule. On the first two days of CP-140 data collection, this means that the CFAV QUEST will be on a predominantly eastern heading and on the last two days of CP-140 data collection, she will be predominantly on a western heading.

If possible, we request that CFAV QUEST deviate from the desired transit path by -45° for 2 hours, and then by +45° for 2 hours as shown in the following diagrams. Because both the MAD and ELF signatures are heading dependent, this will provide a better evaluation of both the long-range detection and ELF detection algorithms. These deviations from the desired transit path will add approximately 1.2 hours per CP-140 sortie (total = 2.4 hours) to the transit time on both of CFAV QUEST's outbound and return transits.



CFAV QUEST track during first two CP-140 flights



CFAV QUEST track during last two CP-140 flights

In addition to the track deviations, we request that CFAV QUEST tow a DRDC-made synthetic ELF source. This source will consist of two electrodes separated by a distance of roughly 20 m, carrying an AC electric current of roughly 5 Amperes, modulated by a square wave at a frequency of roughly 1 Hz. The specific details of the towing distance behind the ship, exact electrical current, frequency, etc will be determined in consultation with other DRDC scientists.

The CP-140 will fly each pass directly over top of CFAV QUEST and the CP-140 radar altimeter will be used to determine the range at the closest point of approach (CPA). This eliminates the requirement for accurate GPS positioning for both the ship and aircraft in order to calculate the range at CPA. Aircraft altitude will vary from 750 - 3500 ft or higher if long-range detections are still being called at 3500 ft. Passes be will up/down the mean line of advance (MLA) of the ship at all altitudes.

Each pass will include 4 minutes of “run in before CPA” and 4 minutes of “run out after CPA” as some of the advanced ELF noise reduction techniques that DRDC is working on involve frequency-domain processing that requires several minutes of data for optimum processing. The aircraft speed will be ~ 180 knots during these passes.

Assuming two minutes per corner and eight minutes per pass, this yields 36 passes in six hours of on-site time.

RUN PLAN

The ASQ-508 trials will be conducted during the second and third days, and the third last and second last days of the CFAV QUEST deployment. Assuming the ship departs Halifax at 1200 (local) on August 4, 2011 and returns @ 1200 local on Oct 30, 2011 yields:

- Sortie #1 = 0700-1600 (local) on August 6 (ship ~ 200-270 nm from shore)
- Sortie #2 = 0700-1700 (local) on August 7 (ship ~ 420-510 nm from shore)
- Sortie #3 = 0700-1700 (local) on Oct 28 (ship ~ 510-420 nm from shore)
- Sortie #4 = 0800-1600 (local) on Oct 29 (ship ~ 270-200 nm from shore)

Sortie #1:

0700 depart CFB Greenwood and
0730 establish comms with CFAV QUEST
0800 conduct aircraft compensation manoeuvres at > 20,000 ft & measure FOM
0845 descend to 1000 ft altitude, 180 knots, and rendezvous with CFAV QUEST
0900 COMEX, using continuous compensation mode on ASQ-508
1500 FINEX
1600 arrive CFB Greenwood

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
1.1	1000	“East”	Up
1.2	1000	“East”	Down
1.3	1500	“East”	Up
1.4	1500	“East”	Down
1.5	2000	“East”	Up
1.6	2000	“East”	Down
1.7	2500	“East”	Up
1.8	2500	“East”	Down
1.9	3000	“East”	Up
1.10	3000	“East”	Down
1.11	3500	“East”	Up
1.12	3500	“East”	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
1.13	3500	“East” – 45 °	Up
1.14	3500	“East” – 45 °	Down
1.15	3000	“East” – 45 °	Up
1.16	3000	“East” – 45 °	Down
1.17	2500	“East” – 45 °	Up
1.18	2500	“East” – 45 °	Down
1.19	2000	“East” – 45 °	Up
1.20	2000	“East” – 45 °	Down
1.21	1500	“East” – 45 °	Up
1.22	1500	“East” – 45 °	Down
1.23	1000	“East” – 45 °	Up
1.24	1000	“East” – 45 °	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
1.25	1000	“East” + 45 °	Up
1.26	1000	“East” + 45 °	Down
1.27	1500	“East” + 45 °	Up
1.28	1500	“East” + 45 °	Down
1.29	2000	“East” + 45 °	Up
1.30	2000	“East” + 45 °	Down
1.31	2500	“East” + 45 °	Up
1.32	2500	“East” + 45 °	Down
1.33	3000	“East” + 45 °	Up
1.34	3000	“East” + 45 °	Down
1.35	3500	“East” + 45 °	Up
1.36	3500	“East” + 45 °	Down

Sortie #2:

0700 depart CFB Greenwood
0830 establish comms with CFAV QUEST
0845 descend to 750 ft altitude, 180 knots, and rendezvous with CFAV QUEST
0900 COMEX, using continuous compensation mode on ASQ-508
1500 FINEX
1700 arrive CFB Greenwood

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
2.1	750	“East”	Up
2.2	750	“East”	Down
2.3	1250	“East”	Up
2.4	1250	“East”	Down
2.5	1750	“East”	Up
2.6	1750	“East”	Down
2.7	2250	“East”	Up
2.8	2250	“East”	Down
2.9	2750	“East”	Up
2.10	2750	“East”	Down
2.11	3250	“East”	Up
2.12	3250	“East”	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
2.13	3250	“East” – 45 °	Up
2.14	3250	“East” – 45 °	Down
2.15	2750	“East” – 45 °	Up
2.16	2750	“East” – 45 °	Down
2.17	2250	“East” – 45 °	Up
2.18	2250	“East” – 45 °	Down
2.19	1750	“East” – 45 °	Up
2.20	1750	“East” – 45 °	Down
2.21	1250	“East” – 45 °	Up
2.22	1250	“East” – 45 °	Down
2.23	750	“East” – 45 °	Up
2.24	750	“East” – 45 °	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
2.25	750	“East” + 45 °	Up
2.26	750	“East” + 45 °	Down
2.27	1250	“East” + 45 °	Up
2.28	1250	“East” + 45 °	Down
2.29	1750	“East” + 45 °	Up
2.30	1750	“East” + 45 °	Down
2.31	2250	“East” + 45 °	Up
2.32	2250	“East” + 45 °	Down
2.33	2750	“East” + 45 °	Up
2.34	2750	“East” + 45 °	Down
2.35	3250	“East” + 45 °	Up
2.36	3250	“East” + 45 °	Down

Sortie #3:

0700 depart CFB Greenwood
0800 conduct aircraft compensation manoeuvres at > 20,000 ft & measure FOM
0830 establish comms with CFAV QUEST
0845 descend to 1000 ft altitude, 180 knots, and rendezvous with CFAV QUEST
0900 COMEX, using continuous compensation mode on ASQ-508
1500 FINEX
1700 arrive CFB Greenwood

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
3.1	1000	“West”	Up
3.2	1000	“West”	Down
3.3	1500	“West”	Up
3.4	1500	“West”	Down
3.5	2000	“West”	Up
3.6	2000	“West”	Down
3.7	2500	“West”	Up
3.8	2500	“West”	Down
3.9	3000	“West”	Up
3.10	3000	“West”	Down
3.11	3500	“West”	Up
3.12	3500	“West”	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
3.13	3500	“West” + 45 °	Up
3.14	3500	“West” + 45 °	Down
3.15	3000	“West” + 45 °	Up
3.16	3000	“West” + 45 °	Down
3.17	2500	“West” + 45 °	Up
3.18	2500	“West” + 45 °	Down
3.19	2000	“West” + 45 °	Up
3.20	2000	“West” + 45 °	Down
3.21	1500	“West” + 45 °	Up
3.22	1500	“West” + 45 °	Down
3.23	1000	“West” + 45 °	Up
3.24	1000	“West” + 45 °	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
3.25	1000	“West” – 45 °	Up
3.26	1000	“West” – 45 °	Down
3.27	1500	“West” – 45 °	Up
3.28	1500	“West” – 45 °	Down
3.29	2000	“West” – 45 °	Up
3.30	2000	“West” – 45 °	Down
3.31	2500	“West” – 45 °	Up
3.32	2500	“West” – 45 °	Down
3.33	3000	“West” – 45 °	Up
3.34	3000	“West” – 45 °	Down
3.35	3500	“West” – 45 °	Up
3.36	3500	“West” – 45 °	Down

Sortie #4:

0800 depart CFB Greenwood
0830 establish comms with CFAV QUEST
0845 descend to 750 ft altitude, 180 knots, and rendezvous with CFAV QUEST
0900 COMEX, using continuous compensation mode on ASQ-508
1500 FINEX
1600 arrive CFB Greenwood

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
4.1	750	“West”	Up
4.2	750	“West”	Down
4.3	1250	“West”	Up
4.4	1250	“West”	Down
4.5	1750	“West”	Up
4.6	1750	“West”	Down
4.7	2250	“West”	Up
4.8	2250	“West”	Down
4.9	2750	“West”	Up
4.10	2750	“West”	Down
4.11	3250	“West”	Up
4.12	3250	“West”	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
4.13	3250	“West” + 45 °	Up
4.14	3250	“West” + 45 °	Down
4.15	2750	“West” + 45 °	Up
4.16	2750	“West” + 45 °	Down
4.17	2250	“West” + 45 °	Up
4.18	2250	“West” + 45 °	Down
4.19	1750	“West” + 45 °	Up
4.20	1750	“West” + 45 °	Down
4.21	1250	“West” + 45 °	Up
4.22	1250	“West” + 45 °	Down
4.23	750	“West” + 45 °	Up
4.24	750	“West” + 45 °	Down

Sortie.Pass #	Radar Alt (ft)	Ship Hdg	Pattern vs. MLA
4.25	750	“West” – 45 °	Up
4.26	750	“West” – 45 °	Down
4.27	1250	“West” – 45 °	Up
4.28	1250	“West” – 45 °	Down
4.29	1750	“West” – 45 °	Up
4.30	1750	“West” – 45 °	Down
4.31	2250	“West” – 45 °	Up
4.32	2250	“West” – 45 °	Down
4.33	2750	“West” – 45 °	Up
4.34	2750	“West” – 45 °	Down
4.35	3250	“West” – 45 °	Up
4.36	3250	“West” – 45 °	Down

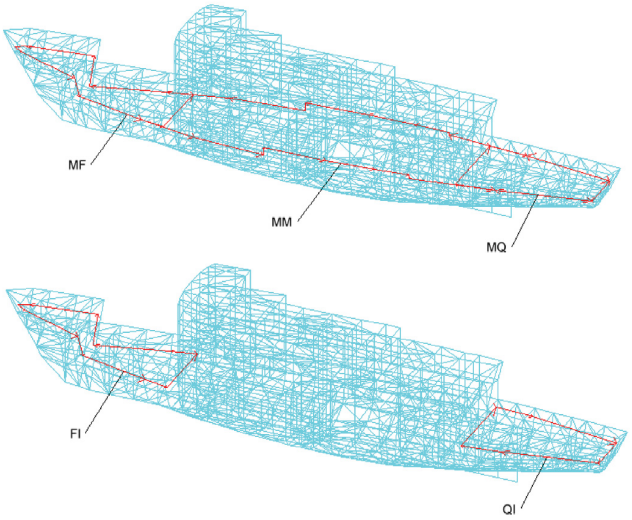
ANNEX P
CFAV QUEST ELECTROMAGNETIC CONFIGURATION

DEGAUSSING SYSTEM

Built in 1969, CFAV QUEST has a relatively simple degaussing (DG) system by present standards. The system includes just 5 coils which are powered by two separate supplies. The M-coil supply is 10kW (240V/42A) and it powers the series combination of the MM, MF & MQ coils as shown in the (upper part of) the figure below. The turns ratio for the three coils are 19/7/7 respectively. The FI-QI supply is 6kW (240V/25A) and it powers the series combination of the FI & QI coils as shown in the lower part of the figure below. The turns ratio for these two coils are 19/16 respectively. The FI-QI and MF-MQ coil combinations are connected in a figure-eight arrangement to create a longitudinal magnetic field effect beneath ship.

The present mode of operation for the DG system is to set a constant M-coil current and tune the signature along the hull by adjusting the MM, MF & MQ turns ratio. Typically, the turns ratio would be set once during a magnetic calibration trial and the current level would be adjusted for different geographically locations. The FI-QI coils provide a crude 3-course-correction of the magnetic signature, whereby bridge staff, using a reversing switch located just behind the ship's bridge, energize the coils in the forward direction when on a magnetic north heading, reverse the current when on a magnetic south heading, and zero the current when on magnetic east or west headings.

For the QUEST 2011 trial, DRDC plans to replace the two existing degaussing supplies with a modern computer controlled system. Modern power supplies can be easily controlled from a local area network and can also reverse their polarity. The computer control system would require GPS and gyro inputs and would be able to continually adjust the current for geographical location and heading.

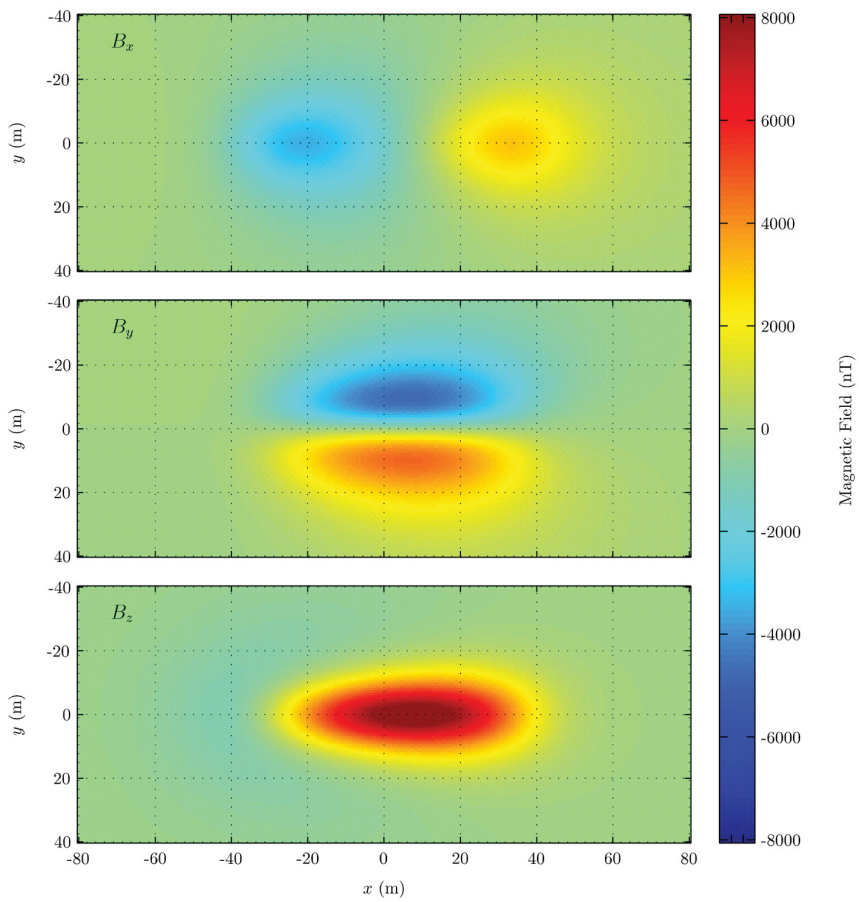


QUEST'S MAGNETIC SIGNATURE

For the discussion of magnetic signatures, we will use the right-handed coordinate system $((x, y, z)\ x,\ y,\ z\ )$ where x is parallel to the ship's longitudinal axis and positive in the forward direction, y is parallel to the ship's athwartship axis and positive in the starboard direction, and z is parallel to the ship's vertical axis and positive downwards.

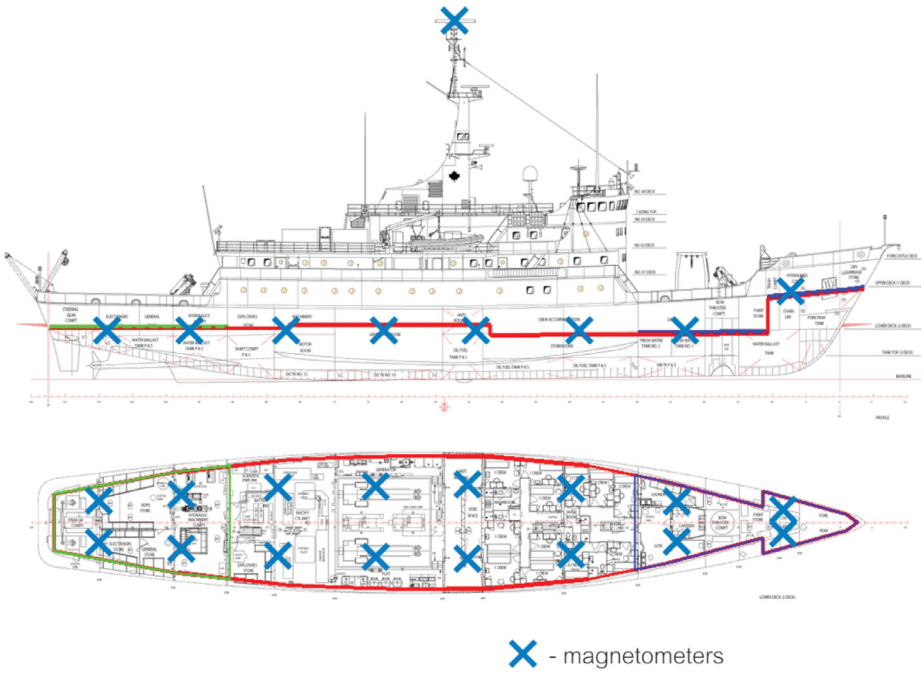
Having spent most of its working life in northern latitudes, QUEST has developed a predominantly vertical magnetic dipole pointing downwards. An example of the ship's magnetic signature, collected at a depth of 16 m during a degaussing trial in Halifax Harbour, is shown below. The vertical dipole moment (bar magnet shape) can be easily identified.

The combined effect of the ship's permanent and induced magnetic signature in Halifax Harbour is such that the ship's degaussing system cannot properly compensate the ship's magnetic signature. For this reason it is considered essential to deperm the ship.



QUEST ONBOARD MAGNETOMETERS

To monitor the magnetic signature onboard of QUEST it is recommended that sixteen (16) 3-axis magnetometers be installed in two lines of 8 magnetometers as shown below. While RS232 controlled magnetometers connected in a daisy-chain configuration can be used to simplify the installation, typically, the signals are not simultaneously-sampled and (accurate) phase information between the magnetometers is lost. Since the phase might be useful for CLDG or ac coil-effects tests, it is recommended that the data channels be simultaneously sampled. DRDC is still investigating the data acquisition system to support the recording of the onboard magnetometers.

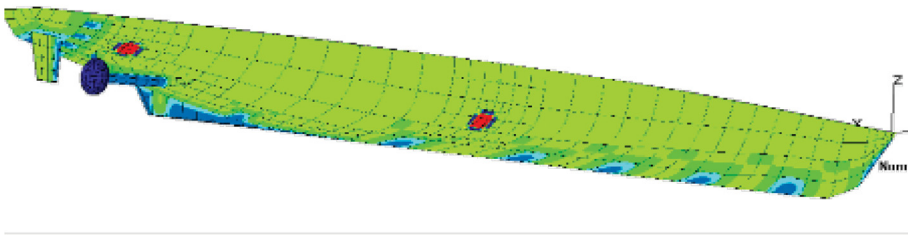


Since it is generally agreed that to understand the underlying physics of a CLDG system a significant data history will be required, it is envisioned that the magnetometers will be semi-permanently installed onboard QUEST and that the onboard monitoring of the magnetic field will continue beyond the 2011 trial. As a result, it will be important to maintain the position and orientation of the magnetometers as accurately as possible throughout their installation.

Consideration is also being given to adding a magnetometer to QUEST's mast head. Some commercially available degaussing systems use masthead magnetometers in an attempt to monitor the background earth magnetic field. The QUEST 2011 trial provides an excellent opportunity to investigate this approach.

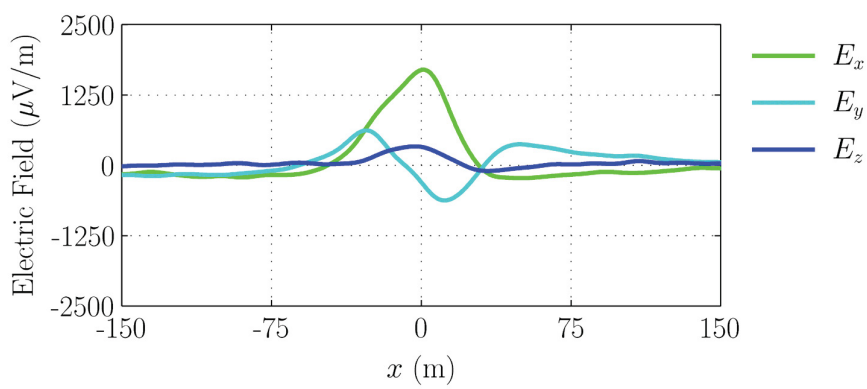
CORROSION PROTECTION SYSTEM

QUEST's corrosion protection system is a combination of an active Impressed Current Cathodic Protection (ICCP) system and sacrificial aluminium anodes placed at corrosion hot spots on the hull. A boundary element (BE) model, used to model the ship's electrical properties, is shown below.

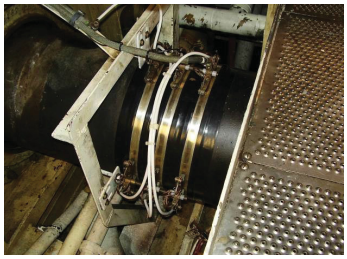


The ship's ICCP system uses a manual current adjustment to bring the hull's potential to 0.85 V (the protected state). Since the system is open-loop it will be possible to set any desired current (for short periods of time) up to 40 A.

A typical electric field signature for QUEST is shown below. For the QUEST 2011 trial, the ship's electric field will be measured at several of the fixed ranges, and with the portable ranges.

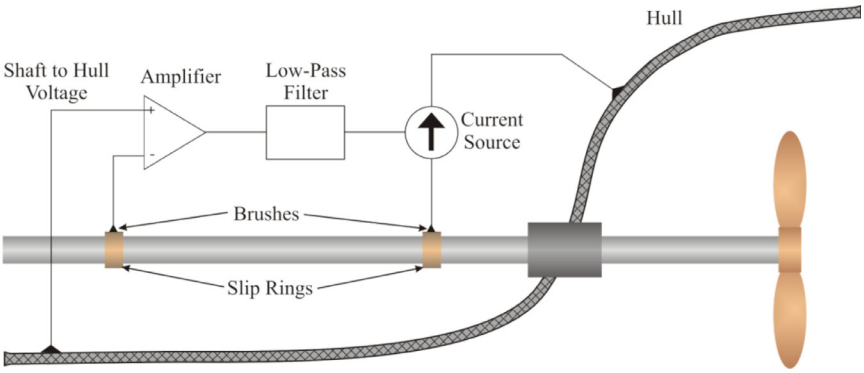


ADVANCED ACTIVE SHAFT GROUNDING (AASG)

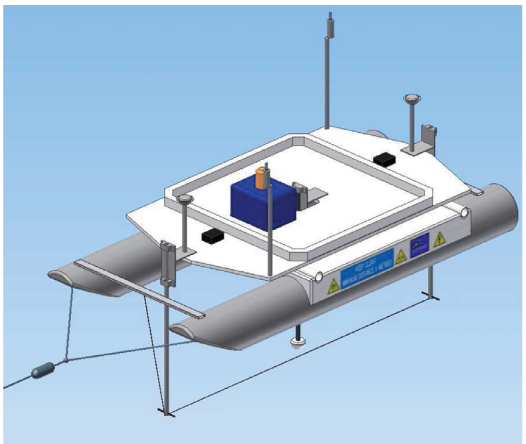


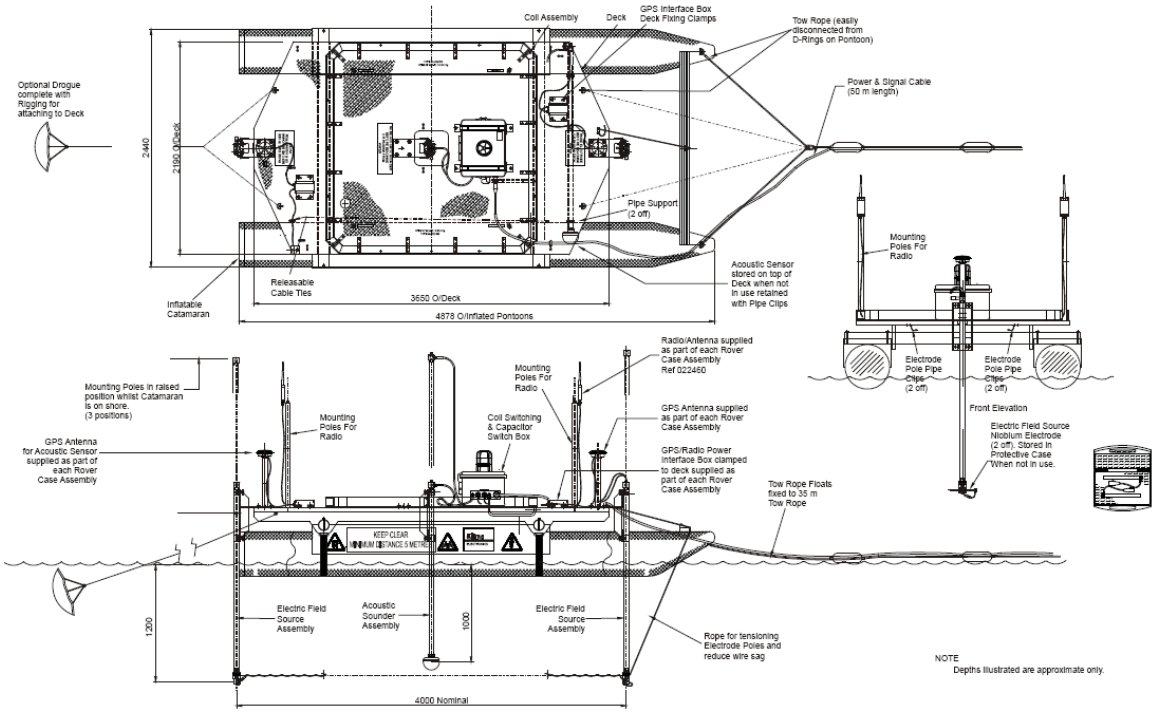
The ship has been equipped with a set of brushes and slip rings on its shafts, to allow QUEST to be used at a testbed for DRDC's AASG studies, For the QUEST 2011 trial two AASG prototype systems will be constructed and installed onboard of QUEST. Part of this installation will include a data acquisition system to continuously monitor the electrical condition of the shaft and hull.

The AASG is a closed loop control system that monitors the shaft-to-hull voltage and applies an opposing current to zero (or ground) this voltage. This is sketched the figure below. Electrically grounding the shaft serves two purposes: first it extends corrosion protection to the shaft and propeller, and second it eliminates the shaft rate signature created as corrosion currents are chopped by the shorting of the shaft to the hull as the shaft rotates.



ANNEX Q
FACT SHEET MOBILE VALIDATION SOURCE





PRE-PROGRAMMED WAVE FORMS IN WAVE FORM GENERATOR

Wave form generator memory store	Function	Channel 1 Output Settings	Function	Channel 2 Output settings
1	M/E DC	DC Variable Amplitude	Acoustic continuous	4 KHz sine wave 2.951 V rms
2	M/E AC	75 Hz sine wave Variable Amplitude		8 KHz sine wave 822 mV rms
3				16 KHz sine wave 164 mV rms
4	Seabed Calibration	0.5 Hz square wave burst frokm 1 PPS trigger Variable amplitude	Acoustic burst Short Interval	4 KHz sine wave burst 2.951 V rms 300 ms every 2 s
5				8 KHz sine wave burst 822 mV rms 300 ms every 2 s
6				16 KHz sine wave burst 164 mV rms 300 ms every 2 s
7	Seismic Continuous	75 Hz sine wave Variable Amplitude	Acoustic burst long Interval	4 KHz sine wave burst 2.951 V rms 300 ms every 10 s
8	Seismic Burst	75 Hz sine wave burst 500 ms every 10 s Variable Amplitude		8 KHz sine wave burst 822 mV rms 300 ms every 10 s
9				16 KHz sine wave burst 164 mV rms 300 ms every 10 s

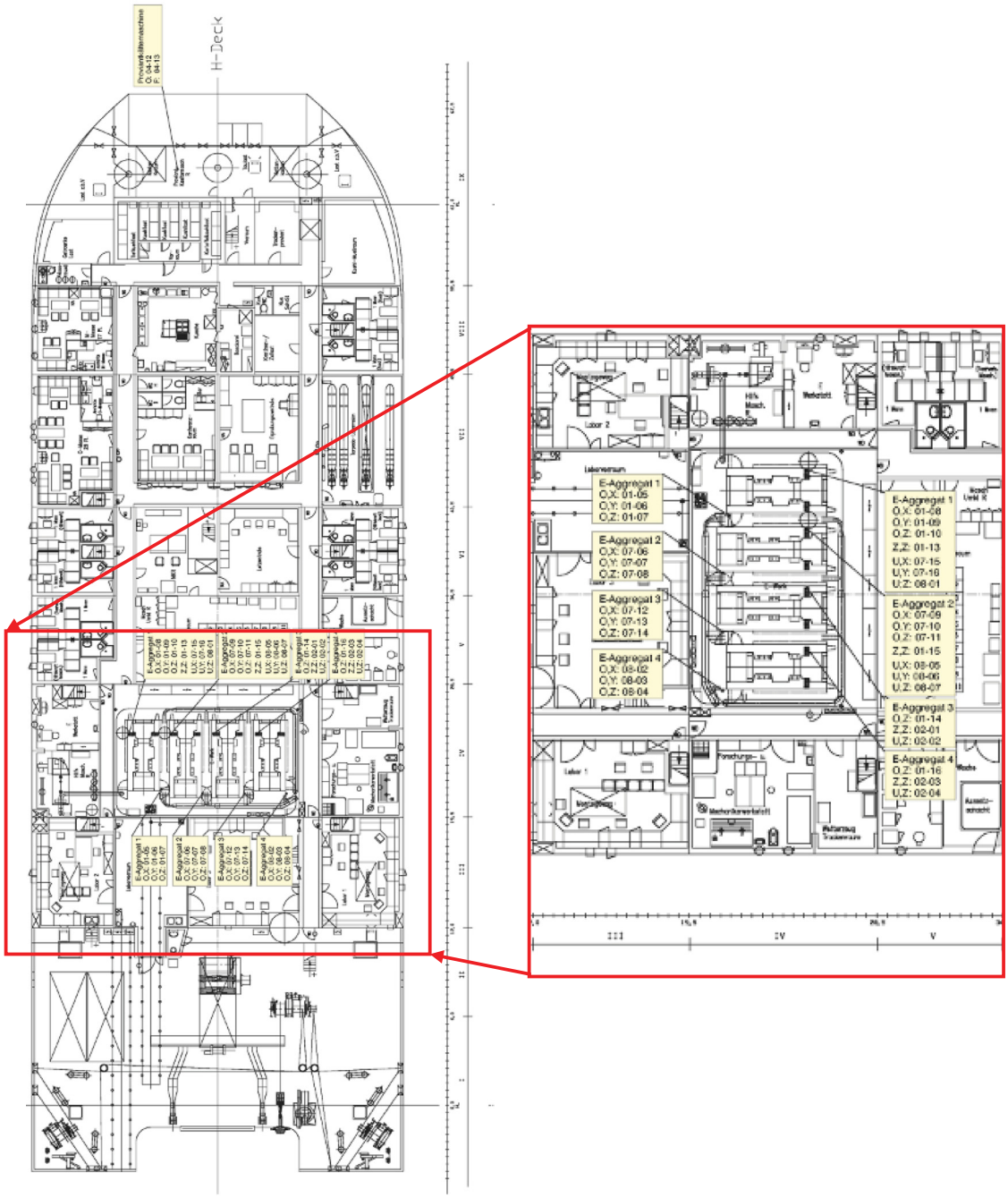
WEIGHTS AND MEASURES

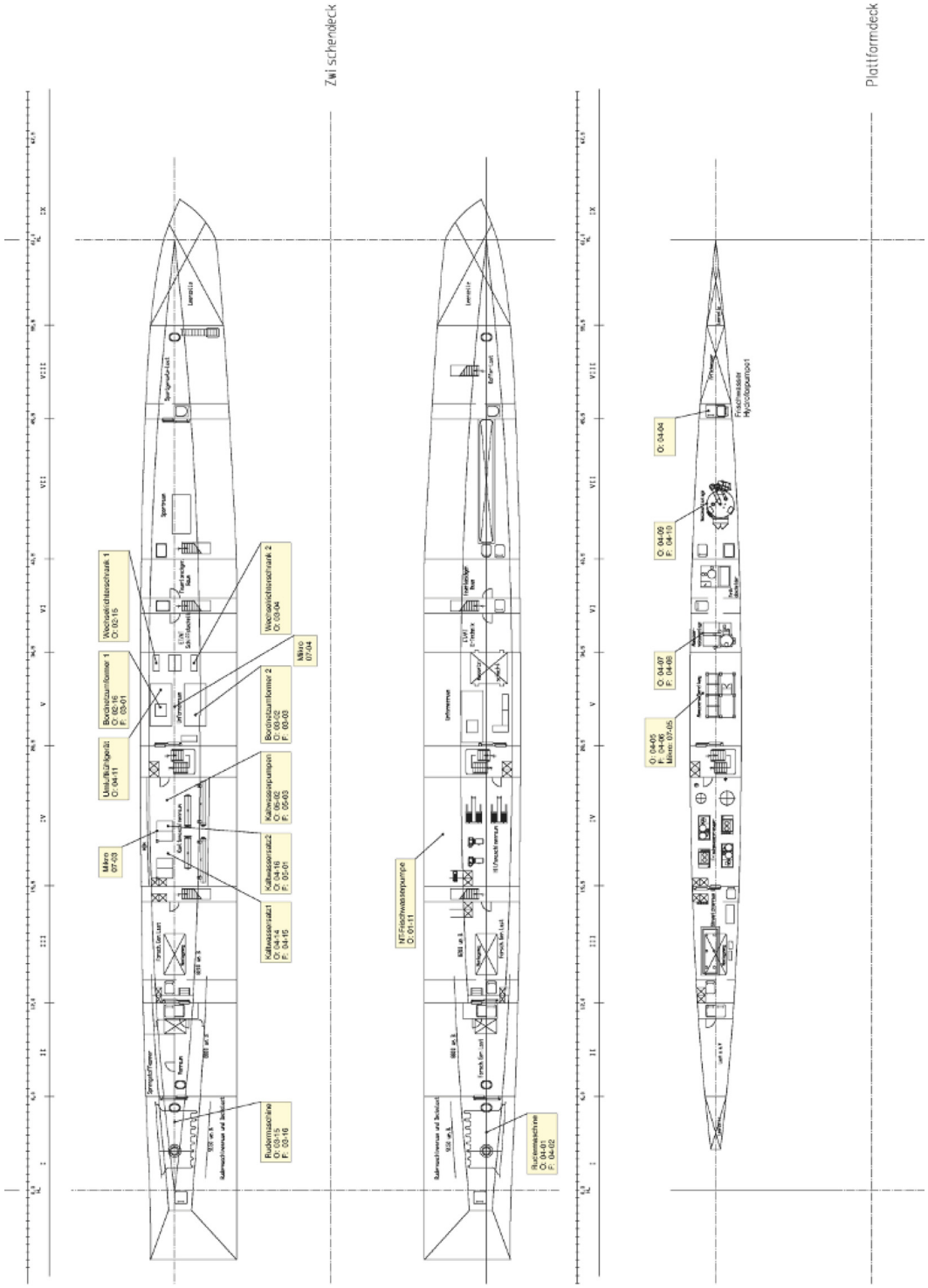
ITEM	HEIGHT	WIDTH	LENGTH	WEIGHT
Mobile Validation source		2440	4878	650
Distribution & Amplifier box	712	651	767	86
MVS generator	990	750	1070	225

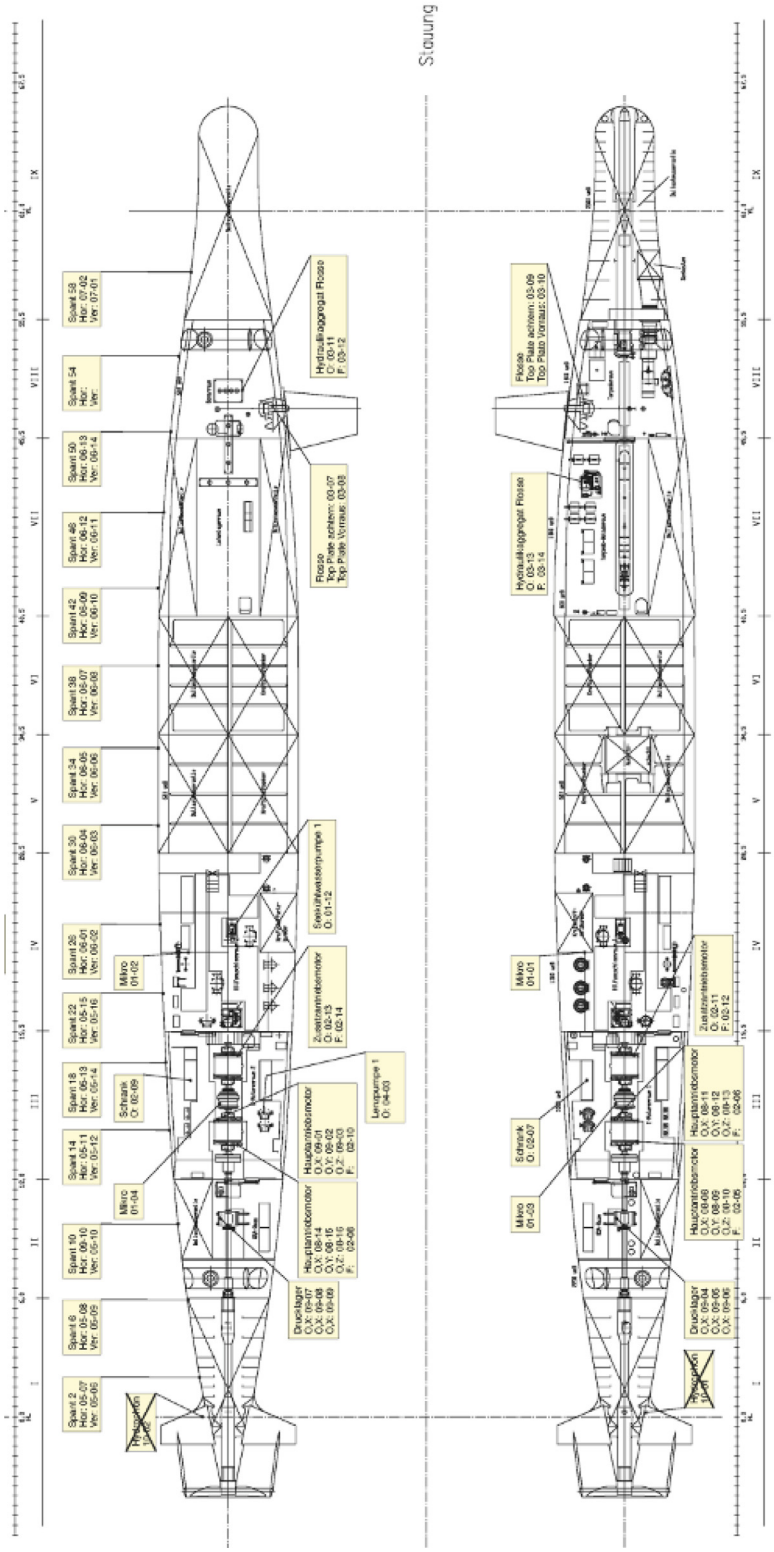
EM CURRENT SETTINGS AND ACOUSTIC SOURCE LEVELS

Nominal Sensor Depth	SM Source Level (A)	AM Source Level (A rms)	SE Source level (A)	AE Source Level (A rms)	Acoustic Source Level (dB)	Seismic Source Level (dB)
5	1	0.707	1	0.707	165	160
8	1	0.707	1	0.707	165	160
15	5	3.536	5	3.536	165	160
30	25	17.678	25	17.678	165	160
40	25	17.678	25	17.678	165	160
50	25	17.678	25	17.678	165	160

ANNEX R
SENSOR POSITIONS ON BOARD OF RV PLANET




Zwischendeck
Plattformdeck
Wechselrichterschrank 1
O: 02-15
Wechselrichterschrank 2
O: 03-04
Borcinstzumformer
O: 03-05
F: 03-01
Borcinstzumformer 2
O: 03-02
F: 03-03
Umluftkühlgerät
O: 04-11
Kühlwasserpumpe
O: 05-02
F: 05-03
Kühlwasserpumpe 2
O: 04-16
F: 05-01
Kühlwasserpumpe 1
O: 04-14
F: 04-15
Ruderanlage
O: 03-15
F: 03-16
NT-Frischwasserpumpe
O: 06-11
Ruderanlage
O: 04-01
F: 04-02
Frischwasser
Hydrofoilpumpe
O: 04-04
O: 04-05
F: 04-10
O: 04-07
F: 04-08
O: 04-05
F: 04-06


Spant 2
Hor: 05-07
Ver: 05-06
Spant 6
Hor: 05-08
Ver: 05-09
Spant 10
Hor: 05-10
Ver: 05-10
Spant 14
Hor: 05-11
Ver: 05-12
Spant 18
Hor: 05-13
Ver: 05-14
Spant 22
Hor: 05-15
Ver: 05-16
Spant 26
Hor: 06-01
Ver: 06-02
Spant 30
Hor: 06-04
Ver: 06-03
Spant 34
Hor: 06-05
Ver: 06-06
Spant 38
Hor: 06-07
Ver: 06-08
Spant 42
Hor: 06-09
Ver: 06-10
Spant 46
Hor: 06-12
Ver: 06-11
Spant 50
Hor: 06-13
Ver: 06-14
Spant 54
Hor:
Ver:
Spant 58
Hor: 07-02
Ver: 07-01
Stauung
Hydraulikaggregat Flosse
O: 03-11
F: 03-12
Flosse
Top Plate achtern: 03-07
Top Plate Vorraus: 03-08
Spant-Zusatzwasserpumpe 1
O: 01-12
Zusatzmotorsmotor
O: 02-13
F: 02-14
Hauptantriebsmotor
O.X: 09-01
O.Y: 09-02
O.Z: 09-03
F: 02-10
Hauptantriebsmotor
O.X: 08-14
O.Y: 08-15
O.Z: 09-16
F: 02-08
Drucklager
O.X: 09-07
O.X: 09-08
O.X: 09-09
Lenzpumpe 1
O: 04-03
Mikro
01-02
Mikro
01-04
Schaare
O: 02-09
Flosse
Top Plate achtern: 03-09
Top Plate Vorraus: 03-10
Hydraulikaggregat Flosse
O: 03-13
F: 03-14
Mikro
01-01
Mikro
01-03
Schaare
O: 02-07
Zusatzantriebsmotor
O: 02-11
F: 02-12
Hauptantriebsmotor
O.X: 08-11
O.Y: 08-12
O.Z: 09-13
F: 02-06
Hauptantriebsmotor
O.X: 08-08
O.Y: 08-09
O.Z: 09-10
F: 02-05
Drucklager
O.X: 09-04
O.X: 09-05
O.X: 09-06

OVERVIEW OF SENSOR POSITIONS

Kanal	Empfindlich-keit (mV)	Empfindlich-keit (mV) Kalibriert	Sensorart	Installationsort	Achsenausrichtung / Montageort
01-01	27,3		Mikrophon	Maschinenraum (Stb)	
01-02	30,3		Mikrophon	Maschinenraum (Bb)	
01-03	28,8		Mikrophon	E-Motorenraum 1 (Stb)	
01-04	29,9		Mikrophon	E-Motorenraum 2 (Bb)	
01-05	10,5		Triax	E-Werk E-Aggregat 1	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
01-06	10,5		Triax	E-Werk E-Aggregat 1	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
01-07	10,2		Triax	E-Werk E-Aggregat 1	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
01-08	10,6		Triax	E-Werk E-Aggregat 1	Stb achtern Spt-24,5 oberhalb doppelt-elastischer Lagerung
01-09	10,6		Triax	E-Werk E-Aggregat 1	Stb achtern Spt-24,5 oberhalb doppelt-elastischer Lagerung
01-10	10,2		Triax	E-Werk E-Aggregat 1	Stb achtern Spt-24,5 oberhalb doppelt-elastischer Lagerung
01-11	9,49		KS-Aufnehmer	Hilfsmaschinenraum	achtern mittig Spt-22,5 oberhalb Lagerung
01-12	10,38		KS-Aufnehmer	Maschinenraum (Bb)	Stb mittig Spt-24,5 oberhalb Lagerung
01-13	9,97		KS-Aufnehmer	E-Werk E-Aggregat 1	Bb voraus Spt-24,5 Zwischenmasse
01-14	9,96		KS-Aufnehmer	E-Werk E-Aggregat 3	Bb voraus Spt-24,5 oberhalb Lagerung
01-15	9,76		KS-Aufnehmer	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 Zwischenmasse
01-16	9,89		KS-Aufnehmer	E-Werk E-Aggregat 4	Bb voraus Spt-24,5 oberhalb Lagerung
02-01	9,83		KS-Aufnehmer	E-Werk E-Aggregat 3	Bb voraus Spt-24,5 Zwischenmasse
02-02	9,94		KS-Aufnehmer	E-Werk E-Aggregat 3	Bb voraus Spt-24,5 Fundament
02-03	10,27		KS-Aufnehmer	E-Werk E-Aggregat 4	Bb voraus Spt-24,5 Zwischenmasse
02-04	10,05		KS-Aufnehmer	E-Werk E-Aggregat 4	Bb voraus Spt-24,5 Fundament
02-05	9,73		KS-Aufnehmer	E-Motorenraum 1 (Stb)	Stb achtern Spt-14,0 Fundament
02-06	9,68		KS-Aufnehmer	E-Motorenraum 1 (Stb)	Bb achtern Spt-15,0 Fundament
02-07	9,67		KS-Aufnehmer	E-Motorenraum 1 (Stb)	Bb mittig Spt-17,0 oberhalb Lagerung
02-08	9,88		KS-Aufnehmer	E-Motorenraum 2 (Bb)	Bb achtern Spt-14,0 Fundament
02-09	9,76		KS-Aufnehmer	E-Motorenraum 2 (Bb)	Stb mittig Spt-17,0 oberhalb Lagerung
02-10	9,79		KS-Aufnehmer	E-Motorenraum 2 (Bb)	Stb voraus Spt-14,0 Fundament
02-11	9,77		KS-Aufnehmer	E-Motorenraum 1 (Stb)	Stb voraus Spt-17,0 schräg oberhalb Lagerung
02-12	9,51		KS-Aufnehmer	E-Motorenraum 1 (Stb)	Stb voraus Spt-17,0 Fundament
02-13	9,97	9,84	KS-Aufnehmer	E-Motorenraum 2 (Bb)	Bb voraus Spt-17,0 schräg oberhalb Lagerung
02-14	10	9,83	KS-Aufnehmer	E-Motorenraum 2 (Bb)	Fundament Bb voraus Spt-17,0
02-15	9,75		KS-Aufnehmer	Wechselrichterschrank 1 Umformerraum (Bb)	oberhalb Lagerung Stb mittig Spt-31,0
02-16	9,61	9,82	KS-Aufnehmer	Bordnetzumformer 1 Umformerraum (Bb)	oberhalb Lagerung Stb mittig Spt-31,0
03-01	9,84	9,8	KS-Aufnehmer	Bordnetzumformer 1 Umformerraum (Bb)	Fundament Stb mittig Spt 31,0
03-02	9,83		KS-Aufnehmer	Bordnetzumformer 2 Umformerraum (Bb)	oberhalb Lagerung Stb mittig Spt-31,0
03-03	9,88		KS-Aufnehmer	Bordnetzumformer 2 Umformerraum (Bb)	Fundament Stb mittig Spt 31,0
03-04	9,92	9,95	KS-Aufnehmer	Wechselrichterschrank 2 Umformerraum (Bb)	oberhalb Lagerung Stb mittig Spt-33,5
03-05	9,75		KS-Aufnehmer	Stromrichterraum (Stb)	oberhalb Lagerung Bb mittig Spt-15,5
03-06	9,68		KS-Aufnehmer	Stromrichterraum (Stb)	oberhalb Lagerung Stb mittig Spt-18,0
03-07	10,02	9,75	KS-Aufnehmer	Flosse Bb Stabilisierung	Top Plate Unit achtern Spt-50,0
03-08	9,79	9,63	KS-Aufnehmer	Flosse Bb Stabilisierung	Top Plate Unit voraus Spt-51,5
03-09	9,74		KS-Aufnehmer	Flosse Stb Stabilisierung	Top Plate Unit achtern Spt-50,0
03-10	9,78		KS-Aufnehmer	Flosse Stb Stabilisierung	Top Plate Unit voraus Spt-51,5
03-11	9,87		KS-Aufnehmer	Sonarraum (Bb) Hydraulik	oberhalb Lagerung Bb mittig Spt-52,5
03-12	9,81		KS-Aufnehmer	Sonarraum (Bb) Hydraulik	Fundament Bb mittig Spt-52,5
03-13	9,87		KS-Aufnehmer	Torpedoladeraum (Stb) Hydraulik	oberhalb Lagerung Stb mittig Spt-48,5
03-14	9,8		KS-Aufnehmer	Torpedoladeraum (Stb) Hydraulik	Fundament Stb mittig Spt-48,5
03-15	9,51		KS-Aufnehmer	Rudermaschinenraum	oberhalb Lagerung achtern Spt-2,5
03-16	9,88		KS-Aufnehmer	Rudermaschinenraum	Fundament achtern Spt-2,5
04-01	9,77		KS-Aufnehmer	Rudermaschinenraum	oberhalb Lagerung achtern Spt-2,5
04-02	9,85		KS-Aufnehmer	Rudermaschinenraum	Fundament achtern Spt-2,5
04-03	10	9,76	KS-Aufnehmer	E-Motorenraum 2 (Bb)	Fundament achtern Spt-15,0
04-04	9,95		KS-Aufnehmer	Frischwasser Hydroforpumpe1 Notausstieg (Bb)	oberhalb Lagerung Stb achtern Spt-50,0
04-05	9,51	9,91	KS-Aufnehmer	Abwasseraufbereitung	oberhalb Lagerung Bb mittig Spt-31,5
04-06	9,7		KS-Aufnehmer	Abwasseraufbereitung	Fundament Bb mittig Spt-31,5
04-07	9,88		KS-Aufnehmer	Abwasseraufbereitung	oberhalb Lagerung Bb mittig Spt-36,0
04-08	10,1		KS-Aufnehmer	Abwasseraufbereitung	Fundament Bb mittig Spt-36,0
04-09	10,16		KS-Aufnehmer	Naßmüllanlage (Bb)	oberhalb Lagerung Bb mittig Spt-45,0
04-10	10,31		KS-Aufnehmer	Naßmüllanlage (Bb)	Fundament Bb mittig Spt-45,0
04-11	9,87	9,4	KS-Aufnehmer	Umformerraum (Bb)	oberhalb Lagerung Stb achtern Spt-31,0
04-12	9,87		KS-Aufnehmer	Proviant-Kälte-Maschinenraum	oberhalb Lagerung Bb mittig Spt-63,0
04-13	9,82		KS-Aufnehmer	Proviant-Kälte-Maschinenraum	Fundament Bb mittig Spt-63,0
04-14	9,6	9,4	KS-Aufnehmer	Kältemaschinenraum	oberhalb Lagerung Stb mittig Spt-21,0
04-15	9,68	9,59	KS-Aufnehmer	Kältemaschinenraum	Fundament Stb mittig Spt-21,0
04-16	9,91		KS-Aufnehmer	Kältemaschinenraum	oberhalb Lagerung Stb mittig Spt-23,5
05-01	10,04	10,06	KS-Aufnehmer	Kältemaschinenraum	Fundament Stb mittig Spt-23,0
05-02	9,77		KS-Aufnehmer	Kältemaschinenraum	oberhalb Lagerung mittig voraus Spt-25,5
05-03	9,57		KS-Aufnehmer	Kältemaschinenraum	Fundament mittig voraus Spt-25,5

05-04	10,07		KS-Aufnehmer	Druckluft-Hydraulikanlage	oberhalb Lagerung Stb mittig Spt-25,0
05-05	9,88		KS-Aufnehmer	Druckluft-Hydraulikanlage	Fundament Stb mittig Spt-25,0
05-06	9,84		KS-Aufnehmer	Leerzelle (Bb) Spt-2,0	vertikal
05-07	9,97		KS-Aufnehmer	Leerzelle (Bb) Spt-2,0	horizontal
05-08	9,81	9,56	KS-Aufnehmer	Querstrahlruder (Bb)	horizontal
05-09	10,2	9,97	KS-Aufnehmer	Querstrahlruder (Bb)	vertikal
05-10	1,007		KS-Aufnehmer	BW-Zelle (Bb) Spt-10,0	vertikal
05-11	9,78	9,6	KS-Aufnehmer	E-Motorenraum 2 (Bb)	horizontal
05-12	9,66	9,5	KS-Aufnehmer	E-Motorenraum 2 (Bb)	vertikal
05-13	10,4	0,998	KS-Aufnehmer	E-Motorenraum 2 (Bb)	horizontal
05-14	10,05	9,90	KS-Aufnehmer	E-Motorenraum 2 (Bb)	vertikal
05-15	9,7	9,74	KS-Aufnehmer	Maschinenraum (Bb) Spt-22	horizontal
05-16	10,07	9,80	KS-Aufnehmer	Maschinenraum (Bb) Spt-22	vertikal
06-01	9,83	9,99	KS-Aufnehmer	Maschinenraum (Bb) Spt-26	horizontal
06-02	9,66	9,69	KS-Aufnehmer	Maschinenraum (Bb) Spt-26	vertikal
06-03	1,005		KS-Aufnehmer	BW-Zelle Spt-30	vertikal
06-04	1,003		KS-Aufnehmer	BW-Zelle Spt-30	horizontal
06-05	1,021		KS-Aufnehmer	BW-Zelle Spt-34	horizontal
06-06	1,007		KS-Aufnehmer	BW-Zelle Spt-34	vertikal
06-07	1,02		KS-Aufnehmer	BW-Zelle Spt-38	horizontal
06-08	1,001		KS-Aufnehmer	BW-Zelle Spt-38	vertikal
06-09	1,004		KS-Aufnehmer	BW-Zelle Spt-42	horizontal
06-10	0,995		KS-Aufnehmer	BW-Zelle Spt-42	vertikal
06-11	1,015		KS-Aufnehmer	BW-Zelle Spt-46	vertikal
06-12	1,02		KS-Aufnehmer	BW-Zelle Spt-46	horizontal
06-13	10,08	10,03	KS-Aufnehmer	Sonarraum (Bb) Spt-50	horizontal
06-14	9,98	1,06	KS-Aufnehmer	Sonarraum (Bb) Spt-50	vertikal
06-15	10,03	10,08	KS-Aufnehmer	Sonarraum (Bb) Spt-54	horizontal
06-16	10,03	1,00	KS-Aufnehmer	Sonarraum (Bb) Spt-54	vertikal
07-01	1,008		KS-Aufnehmer	BW-Zelle Spt-58,0	vertikal
07-02	1,01		KS-Aufnehmer	BW-Zelle Spt-58,0	horizontal
07-03	30,8		Mikrophon	Kältemaschinenraum	
07-04	31,9		Mikrophon	Umformerraum	
07-05	29,6		Mikrophon	Abwasseraufbereitung	
07-06	10,7		Triax	E-Werk E-Aggregat 2	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
07-07	10,3		Triax	E-Werk E-Aggregat 2	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
07-08	10,3		Triax	E-Werk E-Aggregat 2	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
07-09	10,9		Triax	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 oberhalb doppelt-elastischer Lagerung
07-10	11		Triax	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 oberhalb doppelt-elastischer Lagerung
07-11	10,2		Triax	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 oberhalb doppelt-elastischer Lagerung
07-12	10,5		Triax	E-Werk E-Aggregat 3	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
07-13	10,6		Triax	E-Werk E-Aggregat 3	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
07-14	10,4		Triax	E-Werk E-Aggregat 3	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
07-15	10,5		Triax	E-Werk E-Aggregat 1	Bb voraus Spt-24,5 Fundament
07-16	10,7		Triax	E-Werk E-Aggregat 1	Bb voraus Spt-24,5 Fundament
08-01	10,1		Triax	E-Werk E-Aggregat 1	Bb voraus Spt-24,5 Fundament
08-02	10,3		Triax	E-Werk E-Aggregat 4	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
08-03	10,3		Triax	E-Werk E-Aggregat 4	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
08-04	10,8		Triax	E-Werk E-Aggregat 4	Stb achtern Spt-23,0 oberhalb doppelt-elastischer Lagerung
08-05	10,2		Triax	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 Fundament
08-06	10,7		Triax	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 Fundament
08-07	10,3		Triax	E-Werk E-Aggregat 2	Bb voraus Spt-24,5 Fundament
08-08	10,3		Triax	E-Motorenraum 1 Hauptmotor	achtern Spt-14,0 schräg oberhalb Lagerung Stb
08-09	10,4		Triax	E-Motorenraum 1 Hauptmotor	achtern Spt-14,0 schräg oberhalb Lagerung Stb
08-10	10,2		Triax	E-Motorenraum 1 Hauptmotor	achtern Spt-14,0 schräg oberhalb Lagerung Stb
08-11	10,7		Triax	E-Motorenraum 1 Hauptmotor	voraus Spt-15,0 schräg oberhalb Lagerung Bb
08-12	10,2		Triax	E-Motorenraum 1 Hauptmotor	voraus Spt-15,0 schräg oberhalb Lagerung Bb
08-13	10,3		Triax	E-Motorenraum 1 Hauptmotor	voraus Spt-15,0 schräg oberhalb Lagerung Bb
08-14	10,6		Triax	E-Motorenraum 2 Hauptmotor	achtern Spt-14,0 schräg oberhalb Lagerung Bb
08-15	10,5		Triax	E-Motorenraum 2 Hauptmotor	achtern Spt-14,0 schräg oberhalb Lagerung Bb
08-16	10,5		Triax	E-Motorenraum 2 Hauptmotor	achtern Spt-14,0 schräg oberhalb Lagerung Bb
09-01	10,3		Triax	E-Motorenraum 2 Hauptmotor	voraus Spt-15,0 schräg oberhalb Lagerung Stb
09-02	10,5		Triax	E-Motorenraum 2 Hauptmotor	voraus Spt-15,0 schräg oberhalb Lagerung Stb
09-03	10,4		Triax	E-Motorenraum 2 Hauptmotor	voraus Spt-15,0 schräg oberhalb Lagerung Stb
09-04	10,4		Triax	Querstrahlruder Stb	Spt-9 Fundament
09-05	10,4		Triax	Querstrahlruder Stb	Spt-9 Fundament
09-06	10,3		Triax	Querstrahlruder Stb	Spt-9 Fundament
09-07	10,5		Triax	Querstrahlruder Bb	Spt-9 Fundament
09-08	10,9		Triax	Querstrahlruder Bb	Spt-9 Fundament
09-09	10.6		Triax	Querstrahlruder Bb	Spt-9 Fundament
09-10	1,035		KS-Aufnehmer	BW-Zelle Spt-10,0	horizontal
10-01			Hydrophon	BW-Zelle Stb Spt-0,25	nicht nutzbar, abgetrennt
10-02			Hydrophon	BW-Zelle Stb Spt-0,25	nicht nutzbar, abgetrennt

PLANET DATA ACQUISITION

WFES Planet has an acoustic sensor fit, consisting of 103 accelerometers and microphones, mounted in various machinery spaces. The figures and table on the following pages give an overview of the acoustic sensors and sensor positions.

On-board shakers and loudspeakers will be provided by WTD71 and DMO, see the table below: The WTD71 shaker will likely be installed in the bow thruster compartment of the port side float. One DMO shaker will be installed in the same bow thruster compartment. A second DMO shaker will be installed at the foundation of a diesel generator at the H-deck. A WTD71 loudspeakers will likely be installed in the auxiliary machinery room (pump room) in the port side float.

Acoustic equipment to be provided by WTD71.

Equipment	Manufacturer	Model / type	Specifications
Electromagnetic shaker	Wilcoxon	F10/Z820WA	40 N at 8 Hz to max 200 N up to 2 kHz
Loudspeaker system		USL-05	

Acoustic equipment to be provided by DMO.

Equipment	Manufacturer	Specifications
Two electromagnetic shakers	TNO design, built by Rubber Design	2 kN at 30 Hz, down to 200 N at 1 kHz

The DMO actuator is driven by a LabGruppen13000 audio amplifier which will be provided by TNO. The maximum power required is 1.2 kW. Water cooling is required. The driving signals will be generated by DMO. The output is monitored via accelerometers on the mounting plate of the shaker. The driving force is estimated from the driving current and from the accelerations (in combination with a measured driving point impedance). The actuator will be operated by DMO staff.

ANNEX S
REFERENCE MACHINERY CONTROL STATES AND EM-CONDITIONS FOR QUEST AND PLANET

QUEST – REFERENCE MACHINERY CONTROL STATE

The following table provides an overview of the principle control states for the dynamic runs of CFAV QUEST.

Table 17 - Reference Control States for QUEST dynamic trials.

Run	Description	Shaft rpm (speed kts)	Propulsion configuration	Remark	Loch Fyne	Deep water	Heggernes	Herdla	Aschau	Brest
1	Reference Machinery Control State 1	60 rpm (~6 kts)	DG 1		X	X	X	X	X	X
2	Reference Machinery Control State 2	60 rpm (~6 kts)	DG 2	Backup in case DG1 fails or changes between trials	X	X	X	X	X	X
3	High Speed Cavitating State	120 rpm (~12 kts)	DG 1+ 2	Note : QUEST only has 2 DG's	X	X	X	X	X	X
4	Controlled Noise State	60 rpm (~6 kts)	DG 1	QRC1 + shaker/loudspeaker genera-ted dominant tonals at or near to 10 Hz to 10 kHz 1/3-oct	X	X	X	X	X	X
5	CAN/DRDC bottom profiler	30 rpm (~3 kts)	DG 1	Bottom profiler	X	X	X	X	X	X
6	9 kts run	90 rpm (~9 kts)	DG 1+ 2		X	X	X	X	X	X
10	Monitoring Study State 1: ac-celerating	30-100 rpm (~3-10 kts)	DG 1+ 2	commence slow, set for 10 kts at ~30s before CPA	X	X	X	X	X	X
11	Monitoring Study State 2: decelerating	100-0 rpm (~10-0 kts)	DG 1+ 2	approach at 10 kts, stop propelling at ~30 s before CPA	X		X		X	
12	Manoeuvring with 20 deg rudder	90 rpm (~9 kts)	DG 1+ 2		X		X		X	
13	Manoeuvring with 30 deg rudder	90 rpm (~9 kts)	DG 1+ 2		X	X				
20	IR washdown system running	60 rpm (~6 kts)	DG 1	effect water spray	X		X		X	
21	Raft mounts shorted	60 rpm (~6 kts)	DG 1		X		X		X	
22	Acoustic enclosures open	60 rpm (~6 kts)	DG 1		X		X		X	

RV PLANET- REFERENCE MACHINERY CONTROL STATE

The following table provides the reference control states for the dynamic runs for RV PLANET.

Table 18 - Reference Control States for PLANET dynamic trials

Run	Description	Shaft rpm (speed kts)	Configiruration	Remark	Loch Fyne	Deep water	Heggernes	Herdla	Aschau	Brest
1	Reference Machinery Control State 1	55 rpm (~6 kts)	1 (DG-set 2)		X	X	X	X	X	X
2	Reference Machinery Control State 2	55 rpm (~6 kts)	2 (DG-set 3)	Backup in case DG set 2 fails or changes between trials	X	X	X	X	X	X
3	High Speed Cavitating State	140 rpm (~15 kts),	4 (All DG-sets)		X	X	X	X	X	X
4	Controlled Noise State	55 rpm (~6 kts)	1 (DG-set 2)	PRC1 + shaker/loudspeaker generated dominant tonals at or near to 10 Hz to 10 kHz 1/3-oct band centre freq	X	X	X	X	X	X
5	Possible NLD/DMO towed acoustic source	low rpm (~ low kts)	1 (DG-set 2)	source projecting dominant tonals at or near to 10 Hz to 10 kHz 1/3-oct band centre freq	X	X	X	X	X	X
6	9 kts run	75 rpm (~9 kts)	3 (DG-sets 2 & 3)		X	X	X	X	X	X
7	12 kts run	100 rpm (~12 kts)	3 (DG-sets 2 & 3)		X	X	X	X	X	X
10	Monitoring Study State 1: accelerating	30-100 rpm (~6-max kts)	4 (All DG-sets)	commence slow, set for 15 kts at ~# s before CPA	X		X		X	
11	Monitoring Study State 2: decelerating	1140-55 rpm (~max-6 kts)	4 (All DG-sets)	approach at 15 kts, stop propelling at ~.. s before CPA	X		X		X	
12	Manoeuvring	75 rpm (~9 kts)	3 (DG-sets 2 & 3)	apply # deg rudder angle at CPA	X	X				

STATIC RUNS - ACOUSTIC REFERENCE STATE

Settings for the static runs are defined in the respective partial trial plans.

EM-CONDITIONS (QUEST ONLY)

MAGNETIC CONDITIONS							
condition	DG M supply	DG I supply	M coil turns	MF turns	MQ turns	FI turns	FQ turns
A	OFF	OFF	-	-	-	-	-
B	ON	ON	BEST	BEST	BEST	BEST	BEST
C	ON	OFF	BEST	BEST	-	-	-
D	OFF	ON	-	-	BEST	BEST	BEST
E	ON	OFF	MAX	ZERO	ZERO	-	-
F	ON	OFF	MAX	MAX	ZERO	-	-
G	ON	OFF	MAX	MAX	MAX	-	-
H	ON	ON	MAX	MAX	MAX	MAX	ZERO
I	ON	ON	MAX	MAX	MAX	MAX	MAX

Legend

- power supply - off condions
- power supply - on condions

ELECTRIC CONDITIONS					
Condition	ICCP	Aft Anode	Fwd Anode	AASG Active	AASG Passive
A	OFF	OFF	OFF	ON	OFF
B	ON	ON	ON	ON	OFF
C	ON	OFF	ON	ON	OFF
D	ON	ON	OFF	ON	OFF
E	ON	ON	ON	OFF	ON
F	ON	ON	ON	OFF	OFF
G	ON	ON	ON	ON	ON
H	OFF	OFF	OFF	ON	ON

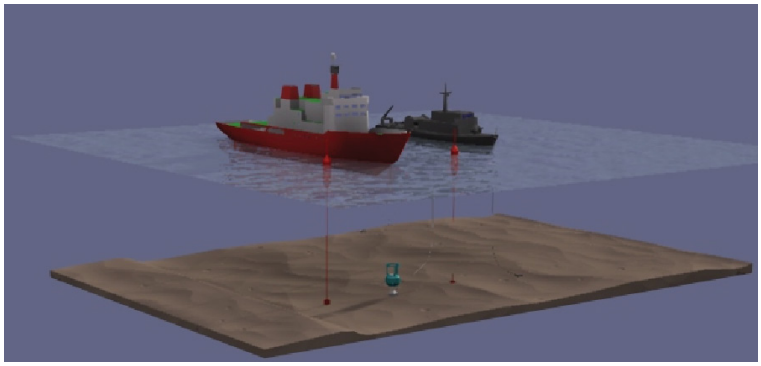
Legend

- off condition
- on condition
- power supply on
- power supply off

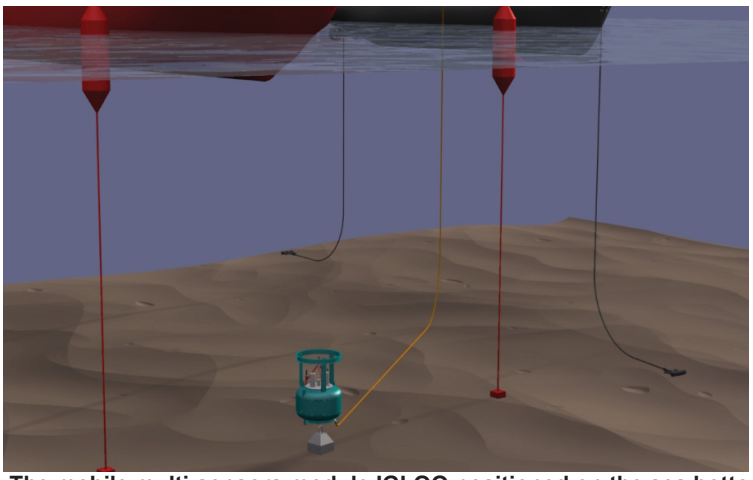
ANNEX T
FACT SHEET IGLOO SYSTEM

The IGLOO system is a mobile multi-sensors module designed by The Polish Naval Academy. IGLOO consist of:

a. underwater measurement platform with mounted sensors (see figure below);
b. measurement console used to monitoring, analysis signals and registration data – mounted on measurement ship or land measurement platform (e.g. car) on the seacoast;
c. communication module between underwater platform and measurement console;
d. autonomous power supply source 12 V DC;
e. set of sensors (see table).



concept for using the mobile multi-sensors module IGLOO



The mobile multi-sensors module IGLOO positioned on the sea bottom

IGLOO - SENSOR PARAMETERS

NO.	SENSORS	
	PARAMETER	**RANGE**
1	**Static Magnetic (SM, 3 - axis):**	
	Full scale	±100 μT
	Dynamic range	120 dB
	Resolution	10 pT
	Bandwidth	DC to 60 Hz
2	**Pressure (P):**	
	Full scale	0 - 1MPa
	Dynamic range	> 96 dB
	Resolution	1 ppm FS
	Bandwidth	DC to 10 Hz
3	**Hydroacoustic (A):**	
	Full scale	± 3.5 V RMS
	Dynamic range	120 dB
	Sensitivity	170 dB re 1 μPa
	Bandwidth	5 Hz - 120 kHz
4	**Static Electric (SE):**	
	Full scale	± 1000 mV
	Dynamic range	64 dB
	Resolution	1 mV
	Bandwidth	DC – 30 Hz
5	**Alternating Electric (AE):**	
	Full scale	± 10 mV
	Dynamic range	64 dB
	Resolution	1 mV
	Bandwidth	10 Hz – 3000 Hz

NO.	SENSORS	
	PARAMETER	**RANGE**
6	**Seismic (S) (under way)**	
	Sensitivity	10, 100, 1000 V/g
	Full scale	0.5 g peak
	Dynamic range	120 dB
	Bandwidth	0.08 - 300 Hz
7	**STD/CTD probe – Conductivity (C)**	
	Conductivity:	Inductive cell
	Range	0 to 70 mS/cm
	Resolution	0.01 mS/cm
	Accuracy	+/- 0.02 mS/cm
	Salinity:	Calculated from C,T & D
	Range	0 to 40 ppt
	Resolution	0.01 ppt
	Accuracy	+/- 0.02 ppt
	Temperature:	-
	Range	-2 to +40°C
	Resolution	0.001^{o}C
	Accuracy	+/- 0.01^{o}C
	Response time	0.2 sec
	Pressure:	
	Ranges	500, 1000, 2000, 6000 m
	Resolution	0.01 dbar (m)
	Accuracy	+/- 0.01% FS (-2 to +40°C)
	Response time	0.1 sec
	Sound velocity:	Calculated from S,T & D
	Range	1300 to 1700 m/s
	Resolution	1 cm/s
	Accuracy	+/- 5 cm/s

ANNEX U
DATA CLASSIFICATION SHEET CFAV QUEST

INTRODUCTION

CFAV QUEST is the primary asset in the trial which consists of a sequence of 11 (partial) trials at a total of 9 fixed range sites in 5 countries. At several of these ranges QUEST will be accompanied by the German research vessel PLANET and a handful of mobile ranges, in particular the Dutch PRIME system.

This trial is being developed under the NATO SET 144, 154 and 166 task groups. As a result the NATO SET framework proffers the appropriate auspices for participation and collaboration. However, with participating organizations from several countries and a range of signature management systems and measurement instrumentation, it is imperative to unambiguously define the classification and distribution/releasability restrictions on the QUEST data.

This Annex states the classification and distribution/releasability restrictions of the various QUEST signature data that are obtained in this trial. In compliance, nations receiving the QUEST signature data are expected to maintain the minimum classification stated. Requests for distribution of the QUEST signature data beyond the listed national partners should be referred to the Canadian point of contact.

While this Annex addresses the classification and distribution/releasability restrictions of QUEST signature data (derived from measurements), it is advised that signature predictions from scientific modelling (analytical or numerical) should have comparable classifications and distribution/releasability restrictions.

GUIDING PRINCIPLES

The overall guiding philosophy on collaborative trial participation and the sharing of data amongst all trial participants within national regulations is consistent with that stated in paragraph 1.4.2.

Trial participation encompasses a substantial contribution to trial planning and/or trial measurements and/or trial data analysis and/or modelling.

Classification and distribution/releasability restrictions are mechanisms that are designed to control the dissemination of data/information/knowledge that can potentially be exploited to harm national interests.

While QUEST is a dedicated research platform, she was designed, built and maintained to be acoustically silent. The design considerations were extensive and of a sensitive nature. Consequently, the Maritime Acoustic Security Policy (Ref. 1, see U.5.2) and references therein, provide direction on underwater acoustic data collection, analysis and intelligence for Canadian Naval vessels including QUEST.

QUEST is a proving ground for future defence technologies and caution must be exercised when determining the appropriate classification and distribution/releasability restrictions when signature management or other defence technologies are engaged.

The classification is determined by whether the data/information/knowledge can potentially compromise Canadian defence interests. The adjudged degree of compromise is reflected in the assigned classification amongst UNCLASSIFIED, CONFIDENTIAL, SECRET and TOP SECRET. The nature of the compromise to Canadian defence interests is largely dependent on the defence assets or defence system capabilities under study. For signatures and signature management systems, the extent to which the signature data/ information/knowledge compromise the detection/recognition/identification of Canadian Navy assets or inform on the capabilities of current or near-to-mid term signature management systems or measurement/detection/surveillance systems of Canadian Military assets determines the classification. The range of none to slight to significant to severe compromise can be used to assign the classification.

The distribution/releasability restrictions are determined largely by the intent for distributing or sharing the data/information/knowledge. Limiting the distribution to partner nations is an effective means of controlling dissemination without hindering collaboration. In such arrangements there is an expectation that the distribution is mutually beneficial to Canada and her partner nations.

We distinguish two types of data: **RAW** and **PROCESSED**.

- **RAW** data will always refer to un-calibrated, un-annotated data that is derived from the measurement signal and not expressed in physical units. The data can be simply the measurements from a single-axis magnetometer or an image from an infrared focal plan array so long as the measured signal or signals are on an arbitrary scale.

- **PROCESSED** data will refer to data that has been calibrated and/or annotated and expressed in relevant physical units. Knowledge and information that is deduced from PROCESSED data will have the same or stricter classification as the PROCESSED data.

The auxiliary and meta-data that are needed in the processing of RAW data are, by themselves, UNCLASSIFIED. These data consist of calibrations, meteorological data, geographical location, ship and system performance data such as temperatures, fuel consumption, speed, heading etc. Though they are essential in interpreting the RAW and PROCESSED data, in and of themselves, the data are designated UNCLASSIFIED.

CLASSIFICATION AND DISTRIBUTION OF ABOVE WATER SIGNATURES

NATO SET–144 “Mitigation of Ship Electro-Optical Susceptibility against Conventional and Asymmetric Threats” is charged with all aspects of infrared signatures of QUEST for this trial.

The members and observers of NATO SET–144 are Australia, Belgium, Canada, Germany, Greece, Italy, Netherlands, Norway, Spain, South Africa, Turkey, the United Kingdom, and the United States.

All members and observers listed in U.3.2 are participants of the trial.

NATO SET–154 “Signature Management System for Radar and Infrared signatures of Surface Ships” is charged with all aspects of the radar and infrared signature management systems in the trial.

The members and observers of NATO SET–154 are Australia, Belgium, Canada, Denmark, Germany, Netherlands, Sweden, Turkey, and the United Kingdom.

All members and observers listed in U.3.5 are participants of the trial.

The classifications and distribution/releasability of QUEST above water signature data under various trial configurations are stated in Table I.

CLASSIFICATION AND DISTRIBUTION OF UNDERWATER SIGNATURES

NATO SET–166 “Signature Management System for Underwater Signatures of Surface Ships” is charged with all aspects of underwater acoustic, pressure and electromagnetic signatures of QUEST for this trial.

The members and observers of NATO SET–166 are Australia, Canada, Germany, Netherlands, Norway, Poland, Turkey, the United Kingdom, and the United States.

All members and observers listed in paragraph 4.2 are participants of the trial.

The classifications and distribution/releasability of QUEST underwater signature data under various trial configurations are stated in Table II.

END NOTES AND REFERENCES

This Annex is largely derived from an internal DRDC Atlantic Document: “Classifications of CFAV QUEST Signatures”, Z. A. Daya, DRDC Atlantic TN 2010-182.

Ref 1: Maritime Acoustic Security Policy, MARCORD 4-14 Vol. 1, Sept. 2008.

DRDC Atlantic is authorized to share CFAV QUEST acoustic data obtained in trial Q340 with the members of NATO SET-166 by Ref 2: “Authorization to share CFAV QUEST Acoustic Data”, DMPOR 4-4-2 RDIMS 207386, 7 January 2011.

TABLE I: Classifications of QUEST above-water signature data.

Signature	Type of data	Signature Management measures	Classification	Releasability
Radar Cross Section	RAW	NONE	UNCLASSIFIED	NATO SET-154
	PROCESSED	NONE	UNCLASSIFIED	NATO SET-154
	RAW	Radar Absorbing Materials	UNCLASSIFIED	NATO SET-154
	PROCESSED	Radar Absorbing Materials	UNCLASSIFIED	NATO SET-154
Infrared	RAW	NONE	UNCLASSIFIED	NATO SET-144
	PROCESSED	NONE	UNCLASSIFIED	NATO SET-144
	RAW	Hull Cooling on Grey paint zone	UNCLASSIFIED	NATO SET-144
	PROCESSED	Hull Cooling on Grey paint zone	CONFIDENTIAL	NATO SET-144
	RAW	Hull Cooling on Grey paint zone, flares	UNCLASSIFIED	NATO SET-144
	PROCESSED	Hull Cooling on Grey paint zone, flares	CONFIDENTIAL	NATO SET-144
	RAW	Plume Cooling	UNCLASSIFIED	NATO SET-144
	PROCESSED	Plume Cooling	UNCLASSIFIED	NATO SET-144
Airborne electromagnetic (from Canadian Forces Military Patrol Aircraft CP-140)	RAW	NONE or degaussing or cathodic protection or advanced shaft grounding	CONFIDENTIAL	Nil. Subsequent distribution under bilaterals.
	PROCESSED	NONE or degaussing or cathodic protection or advanced shaft grounding	CONFIDENTIAL	Nil. Subsequent distribution under bilaterals.

TABLE II: Classifications of QUEST underwater signature data.

Signature	Type of data	Signature Management measures	Classification	Releasability
Pressure	RAW	NONE	UNCLASSIFIED	NATO SET-166
	PROCESSED	NONE	UNCLASSIFIED	NATO SET-166
Acoustic Radiated Noise	RAW	Extensive	UNCLASSIFIED	NATO SET-166
	PROCESSED	Extensive	SECRET	NATO SET-166. Authorization to share this data from trial Q340 with NATO SET 166 trial participants has been granted.
Static Magnetic	RAW	NONE	UNCLASSIFIED	NATO SET-166
	PROCESSED	NONE	UNCLASSIFIED	NATO SET-166
	RAW	Degaussing	UNCLASSIFIED	NATO SET-166
	PROCESSED	Degaussing	UNCLASSIFIED	NATO SET-166
Underwater Electric Potential	RAW	NONE	UNCLASSIFIED	NATO SET-166
	PROCESSED	NONE	UNCLASSIFIED	NATO SET-166
	RAW	Cathodic Protection	UNCLASSIFIED	NATO SET-166
	PROCESSED	Cathodic Protection	UNCLASSIFIED	NATO SET-166
Extremely-low frequency electromagnetic	RAW	NONE	UNCLASSIFIED	NATO SET-166
	PROCESSED	NONE	UNCLASSIFIED	NATO SET-166
	RAW	Advanced Shaft Grounding	UNCLASSIFIED	NATO SET-166
	PROCESSED	Advanced Shaft Grounding	CONFIDENTIAL	NATO SET-166

ANNEX V
UNDERWATER RUN NUMBERS

INTRODUCTION

For the underwater trials the acoustic, magnetic, electric and pressure signatures will be measured for CFAV Quest and RV Planet at different ranges. The measurements at the different ranges will be compared in the analysis phase. For this purpose ‘reference machinery control states are defined (see annex S).

In this annex a structure will be described for assigning run numbers, identifying unambiguously the platform measured, the range involved and the machinery control state applied.

	Range indentifier		Platform identifier	Acoustic state identifier	Direction	repeat	Magnetic State Identifier	Electric State Identifier
Example	**2**		**P**	**01**	**A**	**5**	**C**	**F**
	0	Halifax (before)	P = Planet	01-99	A	1-9	A-D	A-G
	1	Loch Goil	Q = Quest		B			
	2	Loch Fyne						
	3	Deep water (open sea)						
	4	Heggernes						
	5	Herdla						
	6	Aschau						
	7	Brest						
	8	West Indies						
	9	Halifax (after)						

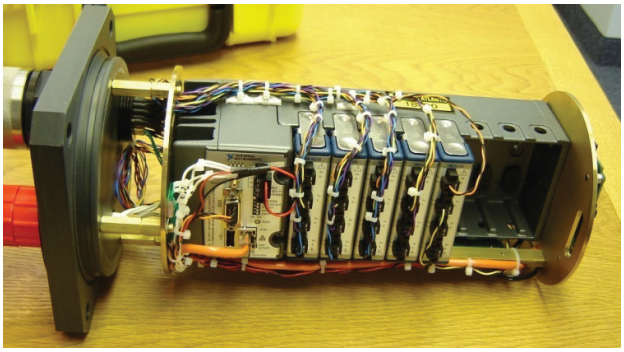
Note: for ‘direction’ the standard indicators are ‘A’ and ‘B’. If applicable for a range, N (north), S (south), W (west) and E (east) may be used as well.

ANNEX W
DSIMS, I-LAND BUOY AND DRDC FORWARD RANGE

DSIMS - MAG

DRDC has developed a general purpose exercise mine for training naval clearance divers, known as DSIMS (Diver Signature Integrated Measurement System). The development has included an advanced sensor head designed as a ship signature check range known as DSIMS-MAG. In addition to the standard sensors (magnetic, electric, acoustic, and orientation) used in the diver version of DSIMS, the DSIMS-MAG includes a high resolution pressure sensor and a multi-axis gradiometer (MAG).

The DSIMS-MAG sensor head is shown in the figure below (left). The four Bartington 3-axis magnetometers used to measure the magnetic gradient are pictorially shown in the four corners of the sensor head. Analog sensor data is transmitted via a 60 m cable to a separate pressure vessel, shown below (right) with the casing removed, which contains a National Instruments' Compact RIO data acquisition chassis.



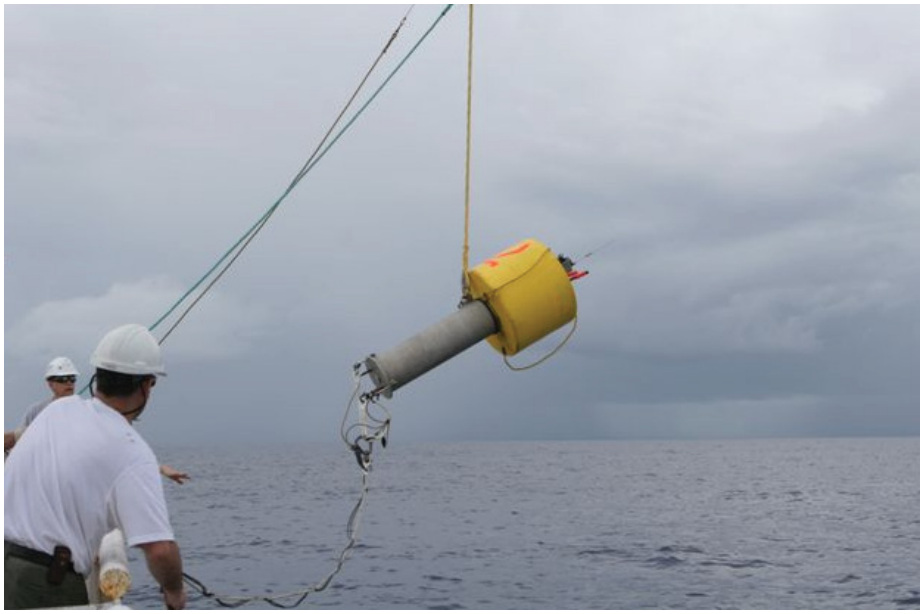
DSIMS - M.A.G. sensor head **DSIMS data acquisition chassis**

Once digitized the sensor data is multiplexed and transmitted over a 500 m cable to a top-side computer for data recording and analysis. The connection between the CompactRIO chassis to the topside computer is established using an ethernet-over-twisted-pair network connection.

The sensor type and specifications for the DSIMS-MAG are provided in the table below.

Sensor	Description	Bandwidth	Sampling Rate	Accuracy (Noise)
Magnetometer	3-axis magnetometer Bartington Instruments MAG-03MSL100	0 - 3 kHz	2 kS/s	6 pT/√Hz
Magnetic Gradient	9-axis gradiometer 4 MAG-03MSL100 34 cm orthogonal spacing	0 - 3 kHz	2 kS/s	6 pT/√Hz
Electric Field	DRDC preamplifiers 3-axis Ag-AgCl electrodes 40 cm spacing	1 mHz – 3 kHz	2 KS/s	1 nV/√Hz
Acoustic	Geospectrum Technologies M15F hydrophone	5 Hz – 10 kHz	50 kS/s	-200 dBV re 1µPa
Pressure	Paroscientific depth sensor 8DP060-2		1 S/s	0.01%
Orientation Node	Sparton 3-D compass SP3003D		async.	<0.2º

I-LAND BUOY (LAGRANGIAN AMBIENT NOISE DRIFTER)



Specifications.

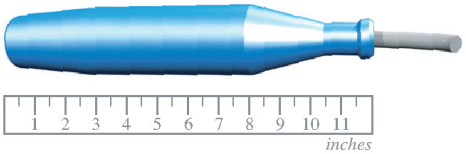
- Single Channel Hydrophone.
- Cable depth 30m, 60m
- Filter board Frequency bandwidth (2kHz, 10KHz, 20kHz, 40kHz)
- 35 dB of gain in 5dB steps
- GPS position logged
- 900 MHZ free wave radio link real-time position, command and control up to 10 nm.
- Battery life ~ 96 hours

Model ITC-6050C

Preamplified Hydrophone

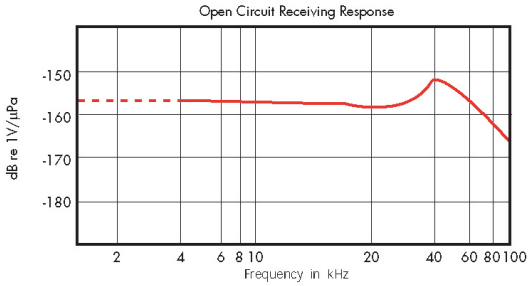
Model ITC-6050C

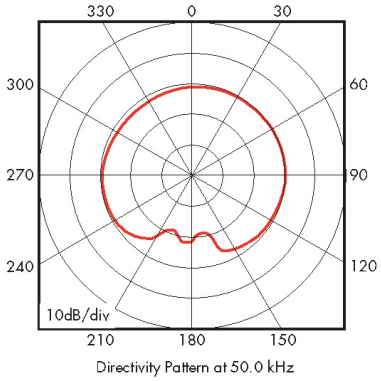
The Model ITC-6050C is a popular broadband hydrophone. The unit has a built-in, low noise preamplifier making it excellent for many field applications. Fully encapsulated in high quality polyurethane, it is well suited for rigorous conditions.

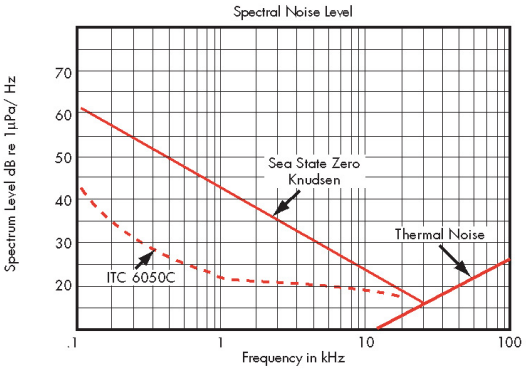


Specifications (Nominal)

Type	Hydrophone w/ Preamplifier
Resonance f_r	50 kHz
Depth	900 meters
Envelope Dimensions (in.)	2D x 12L
Midband OCV	-157 dB//1V/µPa
Suggested Band	.03 - 70 kHz
Beam Type	Spherical







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DRDC FORWARD RANGE

DRDC is in the project definition phase of a Forward Range project to provide a portable multi-influence forward range for the Canadian Navy. The requirement for the system is included as part of the Canadian Patrol Frigate (CPF) midlife upgrade. As of the writing of this annex DRDC is still awaiting the final signature for funding thus the use of the Forward Range in the trial is still tentative.

The underwater array will be a robust, light weight, digital array approximately 85 metres in length. The array will include the following sensors:

a. 12 tri-axis magnetometers;

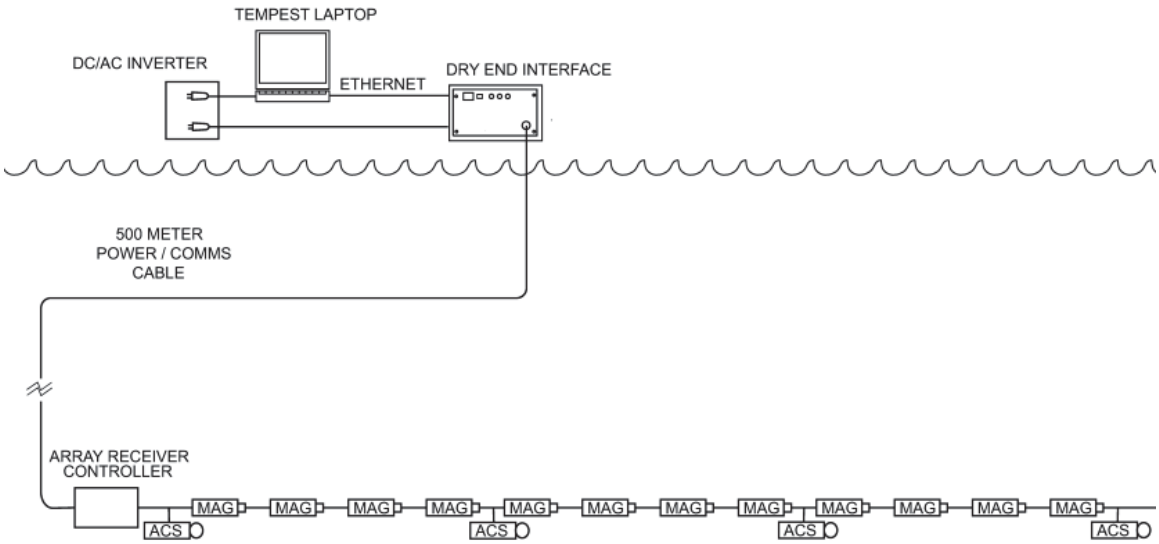
b. 12 orientation sensors (co-located with the magnetometers);

c. 4 hydrophones (to provide more accurate positioning information of the array);

d. 4 pressure sensors for array depth (co-located with the hydrophones).

The array will be connected to the surface with a 500 metre underwater cable. This cable will provide power to the array and provide telemetry between the array and the dry-end interface unit. The array without the connecting cable will weigh approximately 60 kg in air.

The project will also provide the capability to substitute up to four of the magnetic field nodes with combined electric and magnetic field nodes.



DRDC Forward range schematic

ANNEX X
CFAV QUEST ACOUSTIC FIT

INTRODUCTION

The following sections discuss the sensor fit on CFAV Quest and the planned data acquisition (DAQ) system. This includes NADAS, IMCS, vibration instrumentation, and sea state statistics. Note that these data sets will be recorded separately with differing data rates as described below and, as such, there should be a fair number of free channels available on the DRDC DAQ. The ECPINS navigation software provides a record and playback feature for the entire voyage. This will also be included in the data set available to the SET panel.

NADAS AND IMCS

The Non-Acoustic Data Acquisition System records environmental and ship operating status data with remote displays available in all labs. The following data are available:

1	GPS (Pos, SOG, COG, Time)
2	Shaft RPM (P & S)
3	TSK wave height, H_s (m)
4	Speed (Doppler)
5	Air temp (C)
6	
7	Gyro (º true)
8	Water temp (C)
9	IMCS*
10	Water depth (m)
11	Relative humidity
12	Ship manoeuvre plot (4 markers)
13	Wind (speed and direction, true and apparent)
14	Atm. pressure (mb)
15	
16	Rudder angle (P & S)
17	Motion (pitch, roll, heading)

* Selected IMCS parameters are available.

NADAS data rates are configurable. Most parameters can be recorded at 1 sec intervals although some strings may be lost. IMCS data is updated every 8 seconds, but for this stream, only a select set of IMCS data can be recorded (about 30 tags). NADAS is recorded continuously. For special requirements, DRDC may be able to set up a second NADAS PC. The NADAS data are recorded in the computer room adjacent to the main lab.

Note that some of the IMCS data is recorded within the NADAS system as mentioned above. DRDC can separately record up to 250 IMCS tags out of about 800 and a separate data stream is provided for these purposes. A complete list is available. As part of the static rangings, DRDC will be suggesting a list of IMCS tags for recording. This will be tested during the ranging in Halifax in June, 2011, and will be modified as required. David Vaitekunas (Davis Eng.) has written an EXCEL routine to extract and sort the tag data. This stream will be recorded during the trials by Quest and will be available.

A selected set of data strings are available in all labs and these include GPS, water depth, rudder angle, motions, radar autotrack, gyro, Doppler speed, WaMoS data (if available), and wind speed and direction.

SEA STATE

DRDC has several free-floating wave buoys (Tri-Axis Waverider) available for use. These GPS-equipped buoys can be used to measure wave height and direction (including spectral content) and the data is stored on board the buoy and transmitted to the ship when the ship is within range. DRDC also has been developing a wave fusion algorithm to improve the WaMoS wave height predictions. This algorithm combines the measured ship motions with the WaMoS data and numerical motions predictions to better calibrate the radar wave heights. DRDC is proposing to deploy a wave buoy during the open water trials and the buoys will be available for other trials if required.

For the wave data fusion work, DRDC uses a DRDC Ship Motion Package near the ship CG which provides motion time series (pitch and roll angles, pitch, roll and yaw rates, and longitudinal, vertical and lateral accelerations) which are stored a LabView acquisition laptop. DRDC would also be using/storing the directional wave spectrum files created by wave radar and stored on the WaMoS computer. This data would be available if of interest to others.

DRDC DAQ

The DRDC data acquisition system will record up to 96 channels with various sampling rates up to 65 kHz (24-bit resolution). It is expected that the sampling rates will reflect the capabilities of the sensors (e.g. most of the accelerometers are limited to 10 or 12 kHz, thus the sampling rate will be limited to about 25 kHz).

It is expected that the DAQ will be used to monitor the Quest accelerometer fit along with any added instrumentation such as shakers (and associated equipment). At this time, it is not possible to drill additional holes in the hull (e.g. to mount either pressure transducers or hydrophones), nor use the existing propeller viewing ports by manufacturing mounting plates to replace the existing blanking plates.

SUB BOTTOM PROFILER

Quest is outfitted with a sub- bottom profiler (Edgetech X-Star hull-mounted Sub-Bottom Profiler with EPC 1086 Thermal Printer, 12 kHz chirp. 2x2 Hull Mounted transducer array). As the SBP name implies, it measures sub-bottom contours up to 50m below the seabed. It is possible to classify the bottom and sub-bottom by looking at the reflection coefficients. It is output on a Thermal printer or in JPEG format. The raw data is saved and can be played back and reprocessed. The sub-bottom profiler will be used on each range and the data will be made available in a separate data package. Typically the depth sounder echogram is not recorded, bottom depths are simply saved. The echogram is a memory intensive operation and can affect the record rate of other parameters (having said that Quest will likely have a new echo sounder by the trial which will record the echogram independently). The bottom and subbottom classification will be highly relevant for understanding acoustic propagation on the (shallow water) ranges, to provide the necessary input parameters for the sediment in propagation models.

CFAV QUEST SENSOR FIT

DRDC has the following four types of accelerometers available for use (recently calibrated):

1. Wilcoxon 748 – 1.5 Hz to 10 kHz (±3 dB) – 10 available;
2. Wilcoxon 712F – 6 Hz to 20 kHz (±10%) – 6 available;
3. Kistler 8702B25M1 – 0.7 Hz to 10 kHz (±10%) – 9 available;
4. Wilcoxon 726T – 1.0 Hz to 12 kHz (±10%) – 25 available.

This includes four (4) accelerometers suitable for rugged environments (Wilcoxon 748) which are used under the acoustic hood containing the main diesels.

The following table shows the intended layout of the accelerometers and other possible sensors to be recorded by the DAQ (A indicates accelerometer, S indicates shaker). Note that the majority of sensors will be located on the starboard (S) side. At this point Channels 50 to 96 are vacant.

Channel	Identifier	General Location	Specific Loc.	Type
1	A1	Forepeak	Frame 2 S	8702B25M1
2	A2	Forepeak	Frame 4 S	8702B25M1
3	A3	Bow Thruster	Frame 16 S	8702B25M1
4	A4	Bow Thruster	Frame 18 S	8702B25M1
5	A5	Refrig.	Frame 42 P	726T
6	A6	Refrig.	Frame 51 P	726T
7	A7	Refrig.	Compressor mount	726T
8	A8	Refrig.	B/GW pump mount	726T
9	A9	ER Wing	Frame 62 S	726T
10	A10	ER Wing	Frame 67 S	726T
11	A11	ER Wing	Frame 72 S	726T
12	A12	Under Hood	Frame 63 P	748
13	A13	Under Hood	Frame 63 S	748
14	A14	Under Hood	Frame 73 P	748
15	A15	Under Hood	Frame 73 S	748
16	A16	Engine Room	Port Diesel Fwd	748
17	A17	Engine Room	Port Diesel Aft	748
18	A18	Engine Room	Fwd SS Generator	748
19	A19	Engine Room	Aft SS Generator	748
20	A20	Engine Room	Stbd Diesel Fwd	748
21	A21	Engine Room	Stbd Diesel Aft	748
22	A22	Motor Room	Frame 76 S	726T
23	A23	Motor Room	Frame 80 S	726T
24	A24	Motor Room	Frame 83 S	726T
25	A25	Motor Room	Port Propulsion Motor	726T
26	A26	Motor Room	Stbd Propulsion Motor	726T
27	A27	Compressor Room	Frame 92 P	726T
28	A28	Compressor Room	Fwd Compressor	726T
29	A29	Compressor Room	Aft Compressor	726T
30	A30	Compressor Room	Frame 98 P	726T

Channel	Identifier	General Location	Specific Loc.	Type
31	A31	Tiller Flats	Frame 110.5 S	726T
32	A32	Tiller Flats	Frame 111.5 S Inner	726T
33	A33	Tiller Flats	Frame 111.5 S Outer	726T
34	A34	Tiller Flats	Frame 112.5 S	726T
35	A35	Tiller Flats	Frame 110.5 P	726T
36	A36	Tiller Flats	Frame 111.5 P Inner	726T
37	A37	Tiller Flats	Frame 111.5 P Outer	726T
38	A38	Tiller Flats	Frame 112.5 P	726T
39	A39	New IR Pump	Near Inlet	8702B25M1
40	A40	New IR Pump	Near Pump	8702B25M1
41	S1 - Force	Bow Thruster*	Frame 17 S*	
42	S1 - Accel	Bow Thruster		
43	S1 - Mount accel	Bow Thruster		
44	S2 - Force	ER Wing Stbd*	Frame 72-73 S*	
45	S2 - Accel	ER Wing Stbd		
46	S2 - Mount accel	ER Wing Stbd		
47	S3 - Hyd. 1	Motor Room*	Frame 76 S*	
48	S3 - Hyd. 2	Motor Room		
49	S3 - Hyd. 3	Motor Room		

*** Suggested location.**
Note that shaker locations will be confirmed during the June, 2011, ranging of Quest.

The suggested accelerometer usage means that 6 of 9 Kistlers, 24 of 25 726Ts, and 10 of 10 748s are accounted for. QinetiQ will be supplying the shaker sensors. If another shaker is required, DRDC has a Wilcoxon F4/F7 similar to that used by QinetiQ. It is recommended that the shakers be fitted and not moved during the entire trial (with the possible exception of the hydraulic shaker due to the hoses and large size which may interfere with ship operations). It is currently expected that the hydraulic shaker power pack will be located on the flight deck. For the IR and RCS trials, this can be removed and stored with the other equipment in Kiel.

On-board shakers and loudspeakers will be provided by QinetiQ, see Table 4. These include piezoelectric and hydraulic shakers which will likely be installed in the bow thruster compartment, the engine room wing, and the motor room (hydraulic).

Acoustic equipment to be provided by QinetiQ.

Equipment	Manufacturer	Model / type	Specifications
Hydraulic shaker	'Zonic'		5 kN up to 1 kHz
Low frequency shaker system	Data Physics	IV46	170 N at 22 Hz
High Frequency shaker	Wilcoxon	F7	2 N at 500 Hz to max 4 kN at 16 kHz
Max Medium Modal Hammer	PCB	086C40	
Speaker system	Norsonic	Nor 276 Dodeca-hedron speaker Nor 280 amplifier	Up to 120 dB re 1 pW for pink noise

CAVITATION MONITORING SYSTEM

DRDC will install a cavitation monitoring system which is expected to run for the entire trial. The system will monitor the accelerometers installed above the propellers (8) as well as the NADAS, IMCS, and ship motions data streams. The accelerometer data will be read by a Compact RIO data acquisition system. The RMS signal level will be calculated continuously. At a specified interval (probably around 5 seconds), the system will take a "snapshot" of the RMS accelerometer signals along with the NADAS, IMCS, and ship motion feeds. By assessing the RMS signal values, it is possible to determine whether the propellers were cavitating. Post-trial analysis may be able to show correlations with selected parameters (such as sea state, rudder angle, speed, etc.). This will be a stand-alone system located in the main lab. DRDC will occasionally stop the recording to backup and check the accumulated data. The system will be tested during the June, 2011, acoustic ranging in Halifax.

DATA PROCESSING

The lab supervisor on board Quest will record the requested NADAS and IMCS files using their system and these (text) files will be made available at the end of each trial. The DRDC Ship Motions Package (SMP) also records a time history while it is running and these data files will also be backed up and passed on at the end of each trial. It is likely that the SMP data will also be recorded on the DAQ at lower data rates (comparable to the SMP itself). During the Open Water trials (and elsewhere if desired), DRDC will recover any wave buoy data recorded and these files will be made available to the RIMPASSE data centre. A daily summary will be made available to any interested parties.

The sub-bottom profiler data may be practically difficult to share. Processed images from the profiler will be made available as a daily (or trial-based) package. DRDC will be responsible for the analysis of the data and reporting of bottom conditions to the panel. A report will be prepared for the November deadline.

As noted, the Cavitation Monitoring System will be halted when the opportunity presents, the results backed up, and made available to the RIMPASSE data centre if desired. While DRDC will analyze the data at a later date, there are no current plans to present a complete analysis to SET 166. Preliminary cavitation incidence rates will be provided for the final report.

The data recorded on the DRDC DAQ will be transferred to the Australian analysis crew for reduction. The data will be recorded on removable hard drives which will then also be used as the permanent backup. This “raw” data will NOT be transferred to the RIMPASSE data centre. DSTO will process the data into the required form and this processed data will be transferred either daily or at the end of each trial to the RIMAPSSE data centre.

DRDC will perform at least two daily XBTs (morning and evening) and this data is stored as text files. A sample text file has been provided. These files will be collected and provided to the RIMPASSE data centre either daily or at the end of each trial. Note that this will be done automatically for all acoustic trials, but must be requested for other signature trials.

ANNEX Y
CFAV QUEST - BRIDGE & MACHINERY LOG (TEMPLATES)

Ship **CFAV QUEST** **Date:** _____

Range: _____

Ship draught:_____

Run No.				
Start Time (Zulu)				
Ship information				
	Port	Stbd	Port	Stbd
Shaft speed				
Shaft torque				
Speed through water (Log)				
Speed over ground (GPS)				
Ships head				
Rudder angle				
Track error at CPA				
Propulsion machinery				
Gas turbine speed (rpm)				
Gas turbine load (AC/DC)				
Port main engine speed (rpm)				
Port main engine load				
Stbd main engine speed (rpm)				
Stbd main engine load				
Port main motor load				
Stbd main motor load				
Environmental conditions				
Wind speed (knots)				
Wind direction (relative)				
Wind direction (true)				
Sea state				
Swell height and direction				
Wave Height and direction				

Ship **CFAV QUEST** **Date:** _____

Range: _____

Ship draught:_____

General comments	
Run number	
Run number	

Ship **CFAV QUEST** **Date:** _____ **Range:** _____

R – running, RF – running (fast), RS – running (slow), S – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
1	Lifting and towing frame forward system		S													
2	Lifting and towing frame aft system		S													
3	Scientific crane hydraulic power pack		S													
4	Black water pump (No.2 Fwd)		S													
5	Black water pump (No.1 Fwd)		S													
6	Black water pump (No.2 Aft)		S													
7	Black water pump (No.1 Aft)		S													
8	Sanitary SW supply pump		R													
9	No.1 bilge and ballast pump		S	R												
10	No.2 bilge and ballast pump		S													
11	Oily bilge pump		S													
12	5H60 compressor for water cooled condenser (C2)		R													
13	6H60 compressor for water cooled condenser (C1)		R													
14	208V 20HP compressor for air/water cooled condenser		R													
15	440V 20HP compressor for air/water cooled condenser		R													
16	No.1 LAC – Dry lab		R													
17	No.2 LAC – Dry lab		R													
18	No.3 LAC – Dry lab		R													
19	No.4 LAC – Dry lab		R													
20	No.5 LAC – Dry lab		R													
21	No.6 LAC – Dry lab		R													
22	No.7 LAC – Dry lab Annex LAN compartment		R													
23	No.8 LAC – Plotting room		R													
24	No.9 LAC – Plotting room		R													
25	No.10 LAC – Fwd lab		R													
26	No.11 LAC – Fwd lab		R													
27	No.12 LAC – Radio room		R													
28	No.13 LAC – Wet lab		R													
29	No.14 LAC – Battery compartment		R													
30	No.15 LAC – UPS compartment		R													

Ship **CFAV QUEST** **Date:** _____ **Range:** _____

R – running, RF – running (fast), RS – running (slow), S – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
31	No.1 AC SW circ pump		R	S												
32	No.2 AC SW circ pump		S	R												
33	Fwd FW boiler–heating		R													
34	Aft FW boiler–heating		R													
35	No.2 accommodation supply fan		RF													
36	No.1 accommodation supply fan		RS	RF												
37	Fan 3 – Foc'sle exhaust		R													
38	Fan 4 – Fwd washroom exhaust		R													
39	Fan 5 – Refrigeration compartment exhaust		R													
40	Fan 6 – WR laundry exhaust		R													
41	Fan 7 – Galley exhaust		R													
42	Fan 8 – Explosive handling supply		R													
43	Fan 9 – Hospital exhaust		R													
44	Fan 10 – Explosive handling and store exhaust		R													
45	Fan 11 – Steering gear exhaust		R													
46	Fan 12 – Aft hydraulic compartment exhaust		R													
47	Fan 13 – Rope store exhaust		R													
48	Fan 18 – Battery room		R													
49	Fan 19 – Generator room supply (Port)		R													
50	Fan 20 – Generator room supply (Stbd)		R													
51	Fan 21 – Motor room supply (Port)		R													
52	Fan 22 – Motor room exhaust (Stbd)		R													
53	Fan 23 – Silent generator compartment exhaust		R													
54	Fan 24 – Acoustic hood exhaust (stbd)		R													
55	Fan 25 – Acoustic hood exhaust (port)		R													
56	Fan 26 – Acoustic hood exhaust (centre)		R													
57	Fan 29 – Air cooled condenser fan		R													
58	No.1 refrigeration compressor		A	S												
59	No.2 refrigeration compressor		S	A												
60	Meat and vegetable stores		R													

Ship CFAV QUEST Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), S – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
61	Fruit and vegetable locker cooler		R													
62	Potato room cooler		R													
63	Dairy room cooler		R													
64	No.2 LP air compressor		S	R												
65	No.1 LP air compressor		S													
66	Electric whistle/horn		S													
67	Unit 1 forward hydraulics		S	R												
68	Unit 2 forward hydraulics		S	R												
69	Unit 3 forward hydraulics		S	R												
70	Unit 1 aft hydraulics		S													
71	Unit 2 aft hydraulics		S													
72	Unit 3 aft hydraulics		S													
73	Fuel oil feed pump (fwd purifier)		S													
74	Fuel oil feed pump (aft purifier)		R													
75	Fuel boost pump		R													
76	Fuel transfer pump		S	R												
77	Fuel transfer pump		S													
78	No.1 fuel oil purifier		R													
79	No.2 fuel oil purifier		S													
80	No.1 fire pump		S													
81	No.2 fire pump		R	S												
82	No.1 domestic FW pump		R													
83	No.2 domestic FW pump		S													
84	Domestic HW circ pump		R													
85	Port steering gear (hydraulics and motors)		R													
86	Stbd steering gear (hydraulics and motors)		R													
87	Steering gear SW cooling pump		R													
88	No.1 propulsion motor SW cooling pump		R													
89	No.2 propulsion motor SW cooling pump		R													
90	Excitation cubicles (and equipment)		R													

Ship CFAV QUEST Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), S – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
91	Auxiliary propulsion generator excitation control		R													
92	Propulsion control system		R													
93	Machinery alarm panel		R													
94	Port main engine		R													
95	Stbd main engine		R													
96	FW cooling preheat sets		R													
97	Main engine pre–lube priming pump (port)		A													
98	Main engine pre–lube priming pump (stbd)		A													
99	Lube oil clarifier		R													
100	Lube oil clarifier feed pump		R													
101	No.1 lube oil transfer pump		S													
102	No.2 lube oil transfer pump		S													
103	Port main propulsion motor		R													
104	Stbd main propulsion motor		R													
105	Propulsion motor vent fan (port outboard)		R													
106	Propulsion motor vent fan (port inboard)		R													
107	Propulsion motor vent fan (stbd outboard)		R													
108	Propulsion motor vent fan (stbd inner)		R													
109	Propulsion motor lube oil pump (No.1)		R													
110	Propulsion motor lube oil pump (No.2)		R													
111	Propulsion DC generator (port)		R													
112	Propulsion DC generator (stbd)		R													
113	300kW Ships service DG (fwd)		S	R												
114	300kW ships service DG (aft)		S	R												
115	750kW Solar gas turbine		R	S												
116	500kW AC alternator		R													
117	DC generator (aux propulsion system)		R													
118	Scientific UPS (primary)		R													
119	Scientific UPS (standby)		R													
120	Primary UPS filter/transformer		R													

Ship CFAV QUEST Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), S – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
121	Secondary UPS filter		R													
122	UPS batteries		R													
123	Battery monitoring system		R													
124	Transformer – Laundry room		R													
125	Transformer – Laundry room		R													
126	Transformer – Propulsion motor room		R													
127	Transformer – Radar room		R													
128	Transformer – Machinery control room stairway		R													
129	Transformer – Wet lab (outboard)		R													
130	Transformer – Gym (for fwd lab)		R													
131	Transformer – Machinery control room stairway		R													
132	Transformer – Air conditioning compartment		R													
133	Transformer – Silent generator compartment		R													
134																
135																
136																
137																
138																
139																
140																
141																
142																
143																
144																
145																
146																
147																
148																
149																
150																

ANNEX Z
RV PLANET - BRIDGE & MACHINERY LOG (TEMPLATES)

Ship RV PLANET Date: _____

Range: _____

Ship draught:_____

Run No.				
Start Time (Zulu)				
Ship information				
	Port	Stbd	Port	Stbd
Shaft speed				
Shaft torque				
Speed through water (Log)				
Speed over ground (GPS)				
Ships head				
Rudder angle				
Track error at CPA				
Propulsion machinery				
No.1 DG speed (rpm)				
No.1 DG load				
No.2 DG speed (rpm)				
No.2 DG load				
No.3 DG speed (rpm)				
No.3 DG load				
No.4 DG speed (rpm)				
No.4 DG load				
Port main motor load				
Port secondary motor load				
Stbd main motor load				
Stbd secondary motor load				
Environmental conditions				
Wind speed (knots)				
Wind direction (relative)				
Wind direction (true)				
Sea state				
Swell height and direction				
Wave Height and direction				

Ship RV PLANET Date: _____

Range: _____

Ship draught:_____

General comments	
Run number	
Run number	

Ship RV PLANET Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), X – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
1	No.1 freshwater pump		R	X												
2	No.2 freshwater pump		X	R												
3	No.1 seawater cooling pump		R													
4	No.2 seawater cooling pump		X													
5	No.1 1250 kVA generator		X													
6	No.1 rectifier		X													
7	No.2 1700 kVA generator		R													
8	No.2 rectifier		R													
9	No.3 1700 kVA generator		X	R												
10	No.3 rectifier		X	R												
11	No.4 1250 kVA generator		X													
12	No.4 rectifier		X													
13	Starboard propulsion drive control system		R													
14	Port propulsion drive control system		R													
15	Starboard main propulsion motor		R													
16	Starboard main propulsion motor inverter		R													
17	Starboard secondary propulsion motor		X	R												
18	Starboard secondary propulsion motor inverter		X	R												
19	Port main propulsion motor		R													
20	Port main propulsion motor inverter		R													
21	Port secondary propulsion motor		X	R												
22	Port secondary propulsion motor inverter		X	R												
23	No.1 fuel transfer pump		X													
24	No.2 fuel transfer pump		X	R												
25	No.3 fuel transfer pump		X													
26	No.4 fuel transfer pump		X													8
27	No.1 fuel separator		X													
28	No.2 fuel separator		X	R												
29	No.1 fuel separator boost pump		X													
30	No.2 fuel separator boost pump		X	R												

Ship RV PLANET Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), X – stopped, A – automatic

equip no.	machinery	location	run numbers												
			Example												
31	No.1 inverter cabinet		R												
32	No.1 converter		R												
33	No.2 inverter cabinet		R												
34	No.2 converter		R												
35	No.3 inverter cabinet		R												
36	No.3 converter		R												
37	No.1 measurement converter		R												
38	No.1 inverter cabinet		R												
39	No.2 measurement converter		R												
40	No.2 inverter cabinet		R												
41	No.1 transformer 235V		R												
42	No.2 transformer 235V		X												
43	Navigation systems transformer 235V		R												
44	Communications suite transformer 235V		R												
45	Communications suite transformer 120V		R												
46	Sickbay transformer		R												
47	Emergency lighting transformer		R												
48	Navigation lighting transformer		R												
49	Emergency navigation lighting transformer		R												
50	Computer systems		R												
51	No.1 rudder pump (port)		R	X											
52	No.2 rudder pump (port)		X	R											
53	Port rudder		R												
54	No.1 rudder pump (starboard)		R												
55	No.2 rudder pump (starboard)		X												
56	Starboard rudder		R												
57	Stabiliser fins system (port)		X	R											
58	Stabiliser hydraulics (port)		X	R											
59	Stabiliser fins system (starboard)		X	R											
60	Stabiliser hydraulics (starboard)		X	R											

Ship RV PLANET Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), X – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
61	No.1 main bilge pump		X													
62	No.2 main bilge pump		X													
63	No.3 main bilge pump		X													
64	No.4 main bilge pump		X													
65	FW supply pump (assume domestic)		R													
66	Hot water circ pump (assume domestic)		R													
67	Waste water treatment plant		R													
68	Ballast pump		X													
69	Waste water vacuum system		A													
70	Wet waste storage		R													
71	Fan A13 (vacuum system)		X													
72	Fan A16 (wet waste room)		X													
73	Fan Z2 (rudder room – port)		R													
74	Fan A4a (electric propulsion room – port)		X													
75	Fan Z4 (electric propulsion room – port)		R													
76	Fan U10 (converter room – port)		R	X												
77	Fan A9 (converter room – port)		X	R												
78	Fan Z12 (waste vacuum systems – port)		X													
79	Fan Z15 (fathom system port)		X													
80	Fan Z1 (rudder room – stbd)		R													
81	Fan A3a (electric propulsion room – stbd)		X	R												
82	Fan Z3 (electric propulsion room – stbd)		R													
83	Fan Z5 (auxiliary engine and pump room)		X	R												
84	Fan U8 (starboard converter room)		X													
85	Fan A7 (starboard converter room)		X													
86	Fan Z11 (fire fighting equipment room)		X													
87	Fan A20a (laboratory 2)		X													
88	Air conditioning fan 20 (laboratories)		R													
89	Fan A39 (Nos.3 & 4 E-generators)		X													
90	Fan Z6 (air conditioning room)		X	R												

Ship RV PLANET Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), X – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
91	Fan A40 (Nos.1 & 2 E-generators)		R													
92	Fan A41 (mechanical workshop)		X													
93	Fan Z14 (torpedo room)		X													
94	Fan A42 (waste room)		R													
95	Fan Z23 (storage room)		X													
96	Fan A32 (toilets)		X													
97	Air conditioning fan 25 (switching room)		R													
98	Air conditioning fan 26 (Probe room)		R													
99	Air conditioning fan 27 (H & B deck cabins)		RF	RS												
100	Air conditioning fan 28 (galley and mess)		R													
101	Fan A29 (food storage room)		R													
102	Fan A31 (mess)		R													
103	Fan A30 (galley)		R													
104	Fan A34 (sickbay)		R													
105	Fan Z21 (E-generator room)		R													
106	Fan Z22 (E-generator room)		X													
107	Fan A36 (batteries)		R													
108	Fan A37 (bathrooms)		R													
109	Air conditioning fan 35 (C & D deck cabins)		R													
110	Air conditioning fan 38 (Bridge)		R													
111			X													
112	Fan Z45 (boiler room)		R													
113	Fan A43 (laundry room)		X													
114	Fan A24 (emergency DG room – stbd)		X													
115	Boiler		R													
116	Oil burner		R													
117	No.1 heating pump		R													
118	No.2 heating pump		X													
119	No.1 heating pump recuperation diesel		X													
120	No.2 heating pump recuperation diesel		X													

Ship RV PLANET Date: _____ Range: _____

R – running, RF – running (fast), RS – running (slow), X – stopped, A – automatic

equip no.	machinery	location	run numbers													
			Example													
121	No.3 heating pump recuperation diesel		X													
122	No.4 heating pump recuperation diesel		X													
123	Cooling system (food and waste storage)		R													
124	No.1 air conditioning system		R													
125	No.2 air conditioning system		R													
126	No.1 cooling water pump (circ pump)		R													
127	No.2 cooling water pump (circ pump)		R													
128	No.3 cooling water pump (circ pump)		X													
129	No.1 air compressor		R													
130	No.2 air compressor		X													
131	Communications suite		R													
132	Radar (F-band)		R													
133	Radar (I-band)		R													
134	Radar		R													
135	Doppler log		X													
136	Echosounder		X													
137	Acoustic self-monitoring system		R													
138	Magnetic compass		R													
139	Wind speed monitor		R													
140	Weather station		R													
141	Weather station receiver		R													
142	Nautical data manager		R													
143	ECDIS (electronic chart display information system)		R													
144	UPS for data transmitting system		R													
145																
146																
147																
148																
149																
150																

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