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CASE STUDY OF THE ICELANDIC INTEGRATED SYSTEM FOR MONITORING, CONTROL AND SURVEILLANCE

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CASE STUDY OF THE ICELANDIC INTEGRATED SYSTEM FOR MONITORING, CONTROL AND SURVEILLANCE

by
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PREPARATION OF THIS DOCUMENT

The following case study was prepared by the author, who was attached to FAO for a period of six months in 2007 in the context of the Visiting Scientists Programme. Since joining the Icelandic Coast Guard some 40 years ago, the author has gained vast experience in all aspects of vessel monitoring, fisheries control and enforcement, as well as maritime surveillance using various means (i.e. at sea, by air and on land). He was a primary driving force in the creation of the Icelandic Vessel Monitoring System for fisheries control. This experience also includes responsibilities as Project Manager of the North Atlantic Coast Guard Forum under the Icelandic Chairpersonship, Chairperson of the Fisheries Enforcement Working Group of that Forum, and Officer-in-Charge of the Coast Guard's Explosives Ordnance Disposal squad for more than 20 years.

Considering this background, FAO extended an invitation to the author to prepare this study and share his experience and viewpoints with a broader audience both inside and outside the fisheries world.

Geirsson, G.
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ABSTRACT

This case study examines the creation and operation of an integrated system for monitoring, control and surveillance (MCS) in Iceland. While Iceland may present a unique situation, with the importance of the fisheries sector in a relatively small country and its particular historical evolution and institutional setup, the underlying concepts of closer collaboration among related institutions and organizations at the national level through creative and dedicated approaches can be adapted to a wide variety of circumstances.

The integrated system has proved to be effective in combating and eliminating illegal, unreported and unregulated (IUU) fishing in the Icelandic Exclusive Economic Zone (EEZ) and the North Atlantic Ocean. In addition to facilitating safety and security, the integrated system is a highly effective tool for combating organized crimes beyond fishing such as trafficking in humans and illegal drugs. This approach emphasizes using all available data – identification of the vessel, its movements, IUU lists, notifications, reports, fishing licences, permits, port State control reports, etc.

Components that have been included in this integrated format include traditional means of surveillance by vessels and aircraft, newer techniques such as vessel monitoring systems and satellite imagery, and requirements for manual notification, and the reception of all of these.

The functioning of the integrated system in Iceland entails significant investment and running costs, which may not be suitable for a developing country. However, the purpose of this study is to illustrate the benefits in terms of effectiveness and savings when adopting an integrated approach.

CONTENTS

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ABBREVIATIONS AND ACRONYMS

ADF	automatic direction finder
AIS	Automatic Identification System
COSPAS/SARSAT	international satellite system for search and rescue
DSC	digital selective calling
EEA	European Economic Area
EEZ	exclusive economic zone
EOD	explosives ordnance disposal
EU	European Union
FMC	Fisheries Monitoring Centre
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GSM	Global System for Mobile Communication
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICE-SAR	Icelandic Association of Voluntary Search and Rescue Organisations
ICG	Icelandic Coast Guard
ICE-SAR	Icelandic Association for Search and Rescue
IMA	Icelandic Maritime Administration
IMO	International Maritime Organization
IMPAST	Improving Fisheries Monitoring through Integrating Passive and Active Satellite-based Technologies
IR	Infrared
ISK	Icelandic Króna
ISPS Code	International Ship and Port Facility Security Code
IUU	illegal unreported and unregulated fishing
JRC	Joint Research Centre of the European Commission
JRCC	Joint Rescue Coordination Centre
LRIT	Long Range Identification and Tracking
MARPOL	International Convention for the Prevention of Pollution from Ships
MCS	monitoring, control and surveillance
MF/HF	medium frequency and high frequency
MRCC	Maritime Rescue Coordination Centre
MTS	Maritime Traffic Service
NAF	North Atlantic Format
NAFO	Northwest Atlantic Fisheries Organization
NAMMCO	North Atlantic Marine Mammal Commission
NASCO	North Atlantic Salmon Conservation Organization
NAVTEX	Navigational Telex
NEAFC	North East Atlantic Fisheries Commission
PDF	Portable Document Format
RFMO	regional fisheries management organization
SAR	search and rescue
SEAFO	South East Atlantic Fisheries Organization
SLAR	side looking airborne radar
SOLAS	International Convention for the Safety of Life at Sea
SPOC	single point of contact
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TETRA	Terrestrial Trunked Radio
UN	United Nations

UNCLOS	United Nations Convention on the Law of the Sea
VDS	Vessel Detection System
VHF	very high frequency
VMS	vessel monitoring system
X.25	standard protocol for packet switched wide area network (WAN) communication
XML	Extensible Markup Language

EXECUTIVE SUMMARY

Iceland is fortunate to have abundant resources and developed from being one of the poorest countries in Europe in 1800 to one of the richest two centuries later. Fisheries have played an important role in the country's economic growth, particularly since independence in 1918, by providing valuable export commodities. However, the productivity of Iceland's waters was well known by other fishing nations, and it took some time and effort for Iceland to establish control of its waters, including the so-called "Cod Wars". The declaration of Iceland's Exclusive Economic Zone (EEZ) became fully effective in 1976, increasing Iceland's fisheries zone from 25 000 km² before 1952 to 758 000 km². This was a period when many other coastal countries declared their respective EEZs, which occurred during the process leading up to the adoption of the United Nations Convention on the Law of the Sea (1982).

Icelandic fisheries are highly efficient and considered to be well managed; this status has been achieved by innovations in fishing and processing technology and in management approaches. Iceland also participates in a complex framework of fishing agreements and management arrangements in the North Atlantic Ocean. It plays an essential and strategic role in the effective monitoring of vessels within fisheries monitoring, control and surveillance (MCS), both in national and international waters, as well as other functions related to safety at sea and security.

This case study describes the creation of an integrated system, which involves various functions such as vessel monitoring for the purposes of safety at sea, security, customs and immigration as well as fisheries surveillance. This decision to integrate previously separate functions was recently consolidated by the passing of relevant legislation in 2006.

Overall operational responsibility for the integrated system has been given to the Icelandic Coast Guard (ICG). Collaboration with other institutions is essential, such as with the Icelandic Association for Search and Rescue with their trained rescue teams and all-weather lifeboats.

Historical background is given on how the structure for vessel monitoring systems (VMSs) evolved over time. Mandatory vessel reporting was introduced in 1968 for safety reasons, following a number of incidents where fishing boats were lost at sea and there was a perceived need for more rapid and coordinated response to emergency situations. At the same time, the ICG started to have an increasingly important role in fisheries surveillance, but this was kept as a separate function. By the mid-1990s, two separate, fully operational computerized vessel tracking systems were operating. One system was operated by the Life Saving Association and the other by the ICG, although these organizations cooperated in the case of search and rescue operations.

The ICG was interested in merging the mandatory vessel reporting system and the VMS for fisheries surveillance, based on considerations of effectiveness and cost-efficiency, but this met with resistance. Most importantly, it was argued that fishing skippers would refuse to collaborate with the ICG if the information was to be used for fisheries surveillance. A common understanding was reached, and this led to the structural reform and the creation of an integrated system over the period 2005–06. Industry has generally been cooperative, which supports the reasoning that fishers will generally collaborate and see the benefits of eliminating illegal fishing in a well-managed fishery. The same rules and regulations apply to all involved in fishing, thus eliminating unfair competition and ensuring sustainable fishing.

The nerve centre of the integrated system is the ICG Operations Centre. It serves as the communication centre for patrol units (i.e. two patrol vessels, three helicopters, one fixed-wing aircraft and a multipurpose vessel). Other essential functions of the ICG Operations Centre can be summarized as:

- VMS for safety, security and surveillance purposes in the Icelandic EEZ;
- providing the Maritime Traffic Service (MTS) and functioning as the single point of contact for all maritime related notifications; and
- monitoring and surveillance of fishing activity.

The MTS is primarily for safety and security purposes such as enhancing the safety and efficiency of maritime traffic, and improving the response of authorities to incidents, accidents or potentially dangerous situations at sea. However, fisheries monitoring and surveillance also includes the activity of Icelandic vessels operating inside the EEZs of other countries as well as international collaborative efforts in the fight against illegal, unreported and unregulated (IUU) fishing in the high seas of the North Atlantic.

All maritime-related information is now collected in one place and used jointly by various institutions for different purposes. This results in cost savings but also in increased effectiveness in terms of coordination of operations, as the ICG Operations Centre is the single point of contact for fishers and seafarers. Many of the new technologies introduced are cost-efficient from a human resources perspective and have made previously impossible or unrealistic tasks feasible. Conversely, many countries now have responsibilities and obligations in the context of international conventions and agreements, which creates a need for investment in acquiring or upgrading equipment and infrastructure.

It is important to point out that the ICG makes use of several VMSs. Apart from satellite-based systems, this includes monitoring of coastal activity through a dedicated land-based very high frequency (VHF) system. Another system is the Automatic Identification System (AIS), which has a similar range (30–60 nautical miles) as the VHF system and is expected to replace this in time. Alternative technologies, such as satellite radar images, are also being used for vessel detection and monitoring. The basic reason for such a variety of technologies and tools is that these all have their limitations when used as standalone solutions. Various examples are given on the combined use of these new technologies with traditional means of surveillance (e.g. patrol vessels, aircraft), making surveillance much more effective. Emphasis is also placed on data analysis, making use of VMS data in conjunction with other sources (e.g. IUU vessel lists, vessel registries, fishing licences, permits, port State control reports).

This study should be seen as part of a considerable effort by FAO to assist national fisheries administrations in addressing the issues of IUU fishing and to provide guidelines, updates on technical aspects and advice in relation to MCS at regional and national levels. In this context, Iceland is rather unique – a relatively small and developed country where fisheries play a major role and have a particular historic past in terms of fishing as well as institutional setup. This may have facilitated the creation of an integrated system for VMS, but the underlying concepts of closer collaboration among related institutions and organizations at the national level through creative and dedicated approaches can be adapted to a wide variety of circumstances. The benefits in terms of effectiveness and efficiency would be of particular relevance for a developing country.

1. INTRODUCTION

Iceland's geographical location, nature and topography have meant that, from its earliest days, the nation has been dependent to a considerable extent upon gathering and utilizing the riches of the sea (Figure 1). The relative shortage of fertile and suitable land for agriculture meant that Icelanders had to rely on marine resources for valuable export commodities, and this became the foundation for an economic renaissance and development in Icelandic society during the nineteenth and twentieth centuries. Around 1800, Iceland was one of Europe's poorest countries, but by 2000 it had become one of the world's wealthiest nations, largely thanks to fishing and abundant resources in Icelandic waters. Hence, the history of fishing and seafaring forms a central part of Iceland's culture and heritage.[1]

Figure 1: Map of Iceland and the North Atlantic Ocean

The financial crisis in 2008 nearly resulted in the Icelandic economy going bankrupt and the situation continues to be serious at present (2011), but there is a belief among fishers that it will again be the fisheries that will save the economy. Iceland has always been fiercely independent but after the collapse of its banks, and in the face of a global recession, Iceland has applied for European Union (EU) membership. However, fisheries is expected to be a major stumbling block in the negotiations. Icelandic fishers are unlikely to relinquish control of their fishing grounds without a fight. Public

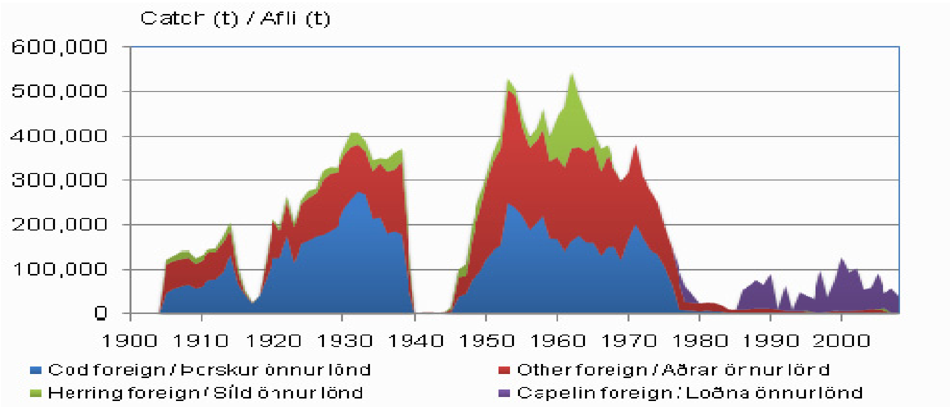
[1] Jón Þ. Þó, University of Akureyri (www.fisheries.is).

opinion is split and the question of EU membership will eventually have to be settled by a referendum.[2]

Box 1: The Cod Wars

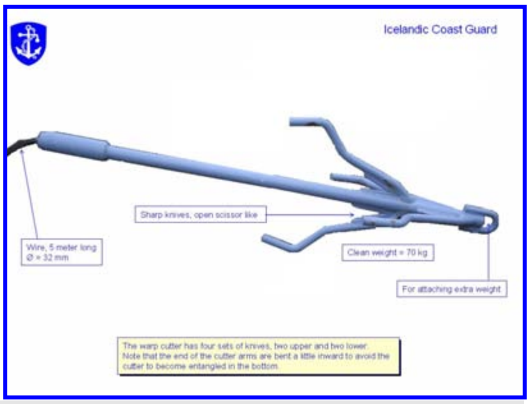
For centuries, foreign fishing vessels operated off the shores of Iceland. This caused no problems as long as these vessels were small and rather primitive fishing gear was used, but with the advent of steamships and trawlers at the beginning of the twentieth century, overfishing became a serious threat. Catches were almost doubling every decade in the early 1990s (see figure). On becoming independent in 1918, Iceland started to establish its own coast guard operations (formally on 1 July 1926) and attempted to control this foreign activity. The first vessel, *Thor*, was acquired in 1922 and had a displacement of 200 tonnes. It was equipped with a 47 mm cannon in 1924 because captains of foreign trawlers were unwilling to take orders from an unarmed patrol vessel.

Catches by foreign vessels in Icelandic waters since the 1900s



Source: Ministry of Fisheries and Agriculture (www.fisheries.is).

The fishing grounds off Iceland were given a much-needed respite during the two World Wars, but when peace was restored after the Second World War, foreign fishing began on an even greater scale than before, using larger vessels and increasingly sophisticated equipment (see figures below). To counter this, Iceland extended its fishing zone to four nautical miles in 1952 from a baseline drawn across the outermost points of promontories and islands, thereby protecting large bays from this threat. The fishing zone was subsequently extended to 12 miles in 1958, 50 miles in 1972 and 200 miles in 1975, increasing its area from 25 000 km² before 1952 to 758 000 km² in 1975.



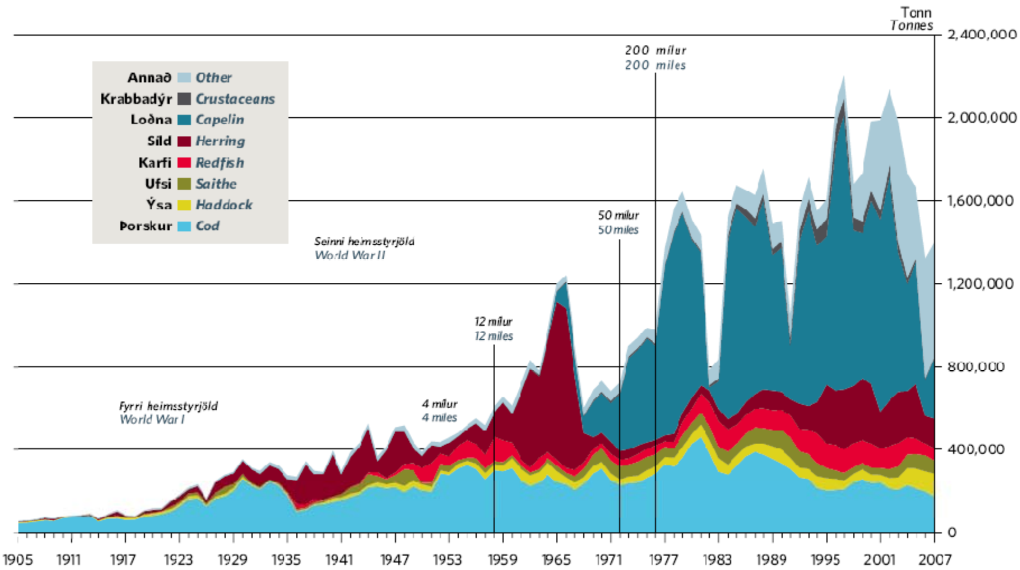
[2] *The Guardian*, “Iceland turns from the devil to the deep blue sea”, 2 June 2009 (www.guardian.co.uk); Euronews, “Iceland and the European Union – a lasting affair?”, 21 November 2009 (www.euronews.net).

The Icelandic Coast Guard (ICG) was put to the test on many occasions during these successive extensions of the fishing zone. Strong protests were made by a number of nations, and one of them, the United Kingdom, sent warships to Iceland's fishing grounds in 1958, 1972 and 1975. This made it difficult for the ICG to enforce its fisheries zones and, in the attempts to do so, ICG vessels were frequently involved in hazardous manoeuvres and collisions with both trawlers and frigates. Nonetheless, the "Cod Wars" eventually came to an end with no loss of life.

This fierce independence, particularly in fisheries-related matters, is associated with the arduous campaign that lasted three-quarters of a century to win full jurisdiction over Icelandic fishing grounds. Iceland championed the international cause of coastal States to manage fisheries within their waters and prevent overfishing. Important milestones on that path were the extension of Iceland's economic zone to 12 miles in 1958 (being the first such initiative in the North Atlantic) and further to 50 miles in 1972. The 200 mile Exclusive Economic Zone (EEZ) was fully effective from May 1976. All the extensions of its fishing zone were opposed by distant-water fishing nations operating in the waters off Iceland, and these events are still referred to as the "Cod Wars" (Box 1). However, this was only one of many disputes between coastal States and fishing States, which was one of the issues to be resolved in the process leading up to the adoption of the United Nations Convention on the Law of the Sea (UNCLOS) (1982).[3]

Iceland accounts for a surprising 1.8 percent of global catches (FAO global catch statistics, 2005), which is comparable with much larger countries. Annual catches by Icelandic vessels exceeded 2 million tonnes in the late 1990s and early 2000s, falling to about 1.4 million tonnes in 2007.[4] Figure 2 shows that a large part of the variability observed in catches is due to the size of capelin catches and other pelagic resources (i.e. blue whiting and Atlanto-Scandian herring).[5]

Figure 2: Catches by Icelandic vessels in the period 1905–2007, showing when Iceland extended its fisheries zone



Source: Ministry of Fisheries and Agriculture.

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[3] UNCLOS: www.un.org/Depts/los/index.htm.

[4] The statistics provided in the text are given in "*Icelandic Fisheries in Figures: 2008*", published by the Ministry of Fisheries and Agriculture, Iceland (www.fisheries.is).

[5] Fishing and fish processing contributed about 7 percent of Iceland's gross domestic product in 2007.

In 2007, the Icelandic fishing fleet totalled 1 642 vessels, including 84 trawlers. This is a relatively small size for a fleet when considering total catches, which shows how efficient Icelandic fisheries are.[6] This efficiency has been achieved by innovation in management, fishing and fish processing through equipment design and product development. A technological development in recent years has been the increasing size of pelagic trawls and, with increasing engine power, the ability to catch pelagic fish at greater depths than previously possible (see figure in Box 2).

Not all of Iceland's catches are taken inside the Icelandic EEZ. Iceland participates in a framework of fisheries agreements in the North Atlantic, which typically gives reciprocal access to one another's fishing grounds. This involves Iceland, Faroe Islands, Greenland, Norway, the Russian Federation and the EU, as well as fishing activity in international waters under the management of regional fisheries management organizations (RFMOs, see Box 2). About 15 percent of catches by Icelandic vessels are taken outside the Icelandic EEZ.

Box 2: Icelandic fisheries relations in the North Atlantic

Icelandic vessels operate over a wide area in the North Atlantic outside their own exclusive economic zone (EEZ). This includes: fishing for cod in the Barents Sea; capelin in the Jan Mayen area and off east Greenland; mackerel and herring in Faroese and international waters; and redfish and northern shrimp in international waters. When fishing for stocks in the EEZ of another country, this is done in the context of bilateral fishing agreements. Many of these fish stocks (i.e. Atlanto-Scandian herring, blue whiting, mackerel and capelin) are straddling stocks that are managed through coastal State agreements, and their implementation by the North East Atlantic Fisheries Commission (NEAFC) in its regulatory area.

There is also an Icelandic fishery for shrimp in the Flemish Cap, which is managed by the Northwest Atlantic Fisheries Organization (NAFO). In some cases, such as redfish and Greenland halibut, there is still a need for agreement on allocation between fishing nations in order to secure their sustainable harvest.

Brimnes RE, one of the most modern trawlers operating in Icelandic fisheries, capable of hauling three trawls simultaneously

Source: www.fisheries.is

[6] The number of fishers is estimated to be about 5 000 by the Directorate of Fisheries. On average, an Icelandic fisher catches 210 tonnes of fish per year (www.fisheries.is).

Considering Iceland's strategic location as well as its role and responsibilities in the North Atlantic, the requirement for effective vessel monitoring both in national and international waters is evident in order to carry out fisheries control and enforcement as well as other functions related to safety at sea and security.

For many years, FAO has been assisting national fisheries administrations in addressing the issues they confront in managing and developing fisheries. This includes fisheries monitoring, control and surveillance (MCS) at the policy, planning and operational levels. Vessel monitoring systems (VMSs) are considered to be a powerful tool as part of implementing effective MCS, and it is estimated that there are now 80 countries that have introduced VMSs to monitor fishing vessel activity. The 2006 Expert Consultation on the use of VMSs came to a number of findings and recommendations that have direct relevance to this study (FAO, 2007).

Although a VMS is a valuable tool, it should form part of a system complementing and strengthening other existing and traditional MCS mechanisms (e.g. landings control, inspections, air and sea surveillance, and data analysis). Thus, a VMS is not a panacea for all MCS challenges nor is it capable of eliminating illegal fishing by itself. Good examples of VMS use show that it can increase the efficiency of MCS operations and make traditional means of surveillance more cost-effective. The 2006 Expert Consultation noted that some fisheries management authorities, including some of those responsible for MCS, were under the mistaken impression that a VMS would eliminate the need for other MCS tools. This is clearly a misconception, and it is also important to point out that a satellite-based VMS may not be a well-suited control mechanism in all fisheries. This has to be evaluated on a case-by-case basis.

Many developing countries are facing problems in implementing a VMS, and it is important to realize that an MCS framework should be in place prior to moving to implementation of a VMS because the efficiency of the VMS would be greatly enhanced. Other alternatives to satellite-based systems should be considered, depending on the characteristics of the fishery. FAO has contributed by providing guidelines, updates on technical aspects and advice at the regional and national levels through a number of initiatives (Flewwelling, 1995; FAO, 1998, 2007; Flewwelling, *et al*., 2002; Kelleher, 2002; FAO/FishCode, 2005).

The Icelandic case illustrates that integrating various functions, such as vessel monitoring for the purposes of safety at sea, security, customs, immigration as well as fisheries control and enforcement, is a particularly effective solution. It can be applied depending on national structures and priorities in each country. It is important to use complementary data (e.g. fishing licence data) together with VMS information so that its full potential can be realized. An effective VMS does not only gather and store data, it also analyses data in conjunction with other sources in order to assess the activity of a specific vessel or group of vessels.

This study also provides a historical background on how the responsible structure for Iceland's VMS evolved over time, leading up to the creation of an integrated system serving many different purposes. The system was set up for safety reasons primarily, but various aspects of fisheries MCS are highlighted. In this way, it is hoped to inform an audience of both specialists and non-specialists on the possible benefits of introducing or making use of a VMS in a broader context of maritime MCS.

2. HISTORICAL PERSPECTIVE

Icelandic Coast Guard

The ICG was formally established in 1926 and has a long history of search and rescue (SAR) missions. In the mid-1950s, the ICG opened its own operations centre, which was mainly for coordination and communication purposes, but fisheries monitoring was included later. In 1987, this centre was staffed at all times, as maritime SAR missions became increasingly more important. Consequently, the Ministry of Justice issued a regulation making the ICG responsible for maritime SAR. Next, the ICG started its air operations using fixed-wing aircraft in 1955, followed a decade later by helicopter operations, which now form an essential component of SAR. The permanent functioning of the centre soon showed its advantage, as SAR operations by helicopters could be initiated rapidly and, consequently, many lives have been saved.

Box 3: Vessel monitoring system

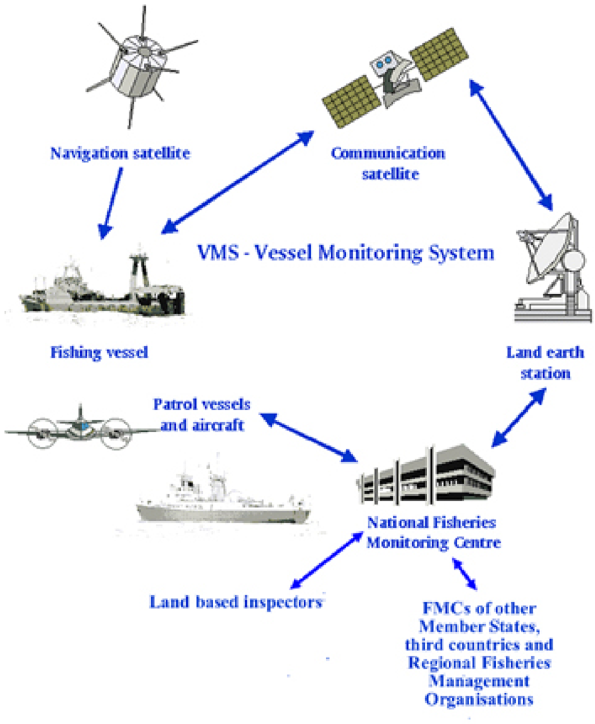
The basic function of a vessel monitoring system (VMS) is to provide reports on the location of a vessel at regular intervals, its movements as well as its speed and course. It can thus provide information on whether a fishing vessel is in an area where fishing activities are not allowed or specific measures are in force, which can then be followed up by physical inspections (at sea or on land) to check whether all is in order.

A VMS does not replace other means of monitoring, control and surveillance (MCS) such as patrol vessels, aircraft or land-based inspections, but it makes them more effective by providing the authorities with the location of vessels suspected of having committed infringements, thus enabling inspectors to carry out targeted checks at sea or on land (see accompanying figure). Even when suspected infringements are not immediately detected, irregularities can still be spotted later in the course of cross-checking data.

For a VMS to function, electronic devices (transceivers or transmitters) are installed on board fishing vessels. These devices automatically send data to a satellite system (e.g. every one or two hours), which transmits them to a land-based station, which, in turn, sends them to the appropriate fisheries monitoring centre. The result is that any member State of participating regional fisheries management organizations (RFMOs) can observe the activity of its own vessels in all waters and the activities of vessels from other member States in its own waters. The information received is then cross-checked against a range of other data.

The accompanying figure presents a VMS that is satellite-based, and there are a number of options in terms of satellite communication systems such as Inmarsat, Argos or Euteltracs, which are all different systems but can serve the same purpose as illustrated. Galileo is a global navigation satellite system being set up by the European Union (EU), which is still not operational but is expected to introduce new functions and capabilities in relation to a VMS. Some characteristics of the Galileo system can be used to ensure the integrity of retransmitted position, course and speed data (i.e. making this system more tamperproof) (Gallagher, 2005).

Illustration of a fisheries MCS system



Source: European Commission.

It is important to point out that there are alternatives to satellite-based systems such as those mentioned above. These include land-based systems such as very high frequency (VHF) systems, which are also being used in Iceland for vessel monitoring. Another alternative is the use of mobile communication systems, land-based or satellite-based. These alternatives may provide much cheaper services but are usually associated with some limitations, e.g. range of VHF and mobile telephones.

The ICG started to track its own patrol units via the Inmarsat C system in 1992 and acquired a computerized tracking system (VMS) in 1996 (Box 3). Tracking of fishing vessels for fisheries control purposes started soon afterwards based on requirements of the Northwest Atlantic Fisheries Organization (NAFO) and, later, the North East Atlantic Fisheries Commission (NEAFC). At this time, tracking Icelandic fishing vessels for safety purposes was done by the Life Saving Association on behalf of the Ministry of Transport and Communications. There were thus two independent tracking systems operating in Iceland with the associated complications and costs. Furthermore, the Life Saving Association was responsible for SAR in the area close to the coast, but the ICG had overall responsibility. This situation created all kinds of complications and was finally resolved in 2006 when the Ministry of Justice issued a regulation on the Maritime Traffic Service (MTS) (Reg. No. 672/2006), combining these functions and establishing that the ICG had overall leadership concerning SAR.

Icelandic Life Saving Association

The Life Saving Association has a long history of assistance to seafarers dating back to the early 1920s, when a number of catastrophic incidents occurred (i.e. foreign trawlers grounded). The Life Saving Association was based on voluntary work and formed numerous rescue teams all around the coast. Their history involves hundreds of lives saved, with many of these rescues taking place under adverse conditions. When mandatory vessel reporting for safety purposes was established in the late 1960s (Box 4), the daily operation was entrusted to the Life Saving Association, which operated a centre for this purpose at its headquarters in Reykjavik. This centre also functioned as the Rescue Coordination Centre.

These responsibilities have now been placed under the ICG following the structural reform in 2006. Subsequently, the Life Saving Association has merged with other voluntary rescue organizations in Iceland, which now operate under the name Slysavarnafélagið Landsbjörg, or in English, the Icelandic Association for Search and Rescue (ICE-SAR). Although overall responsibility has been placed with the ICG, the ICE-SAR continues to play an essential role in SAR.

Box 4: The *Stígandi* incident

In August 1967, the Icelandic fishing boat *Stígandi*, with a crew of 12, was out fishing for herring together with other boats in the area between the islands of Jan Mayen and Spitsbergen in the North Atlantic. The normal procedure was that the boats either landed their catch to herring tankers operating in the area or sailed to port in Iceland. Because of the distance involved, the trip to port could take several days. At the time, there was no system for regular reporting of vessel position and it could take days to discover that a boat was missing.

The fishing boat Stígandi

When the *Stígandi* did not return to port, the owner started an investigation to find out if it had landed to either of the two herring tankers operating in the area. When it became clear that there had been no transshipment, all vessels in the area were asked if they had any information regarding the *Stígandi*. There had not been any information on the whereabouts of the *Stígandi* for the previous five days and, as a consequence, a search operation was started.

As this was a large area, the search operation was expected to take several days. The boats in the area were lined up for visual search, and aircraft searched the area, starting from the north of Iceland and moving northeast towards the fishing area. Late in the evening of the first search day, one of the boats reported the sighting of a rubber dinghy and, shortly after, all the *Stígandi* crew, who were onboard, safe and sound. They had been in the dinghy for five days with no means of communication, as their boat had gone down very quickly and they had been unable to take the emergency radio set with them.

A unanimous decision was then taken by skippers in general to report their position at least daily to the herring tankers, which kept track of the reports and investigated immediately if there was a missing vessel report.[1]

The incident stimulated debate among fishers, the authorities and the Life Saving Association on the need for a system to enhance the safety of fishers, leading to the establishment of mandatory vessel tracking in 1968.

[1] The author was a radio operator on one of the herring tankers and, therefore, involved in the search as well as receiving and keeping track of the position reports from the boats from the first day of the voluntary reporting system.

Coastal radio operation

Iceland Telecom operated the coastal radio station system in Iceland from 1930 to 2004. Coastal radio stations formed an important part of SAR services, as they were the recipients of all distress calls, and the system functioned for a long time as part of the Maritime Rescue Coordination Centre (MRCC). During the period of mandatory vessel reporting in Iceland, most position reports came via the coastal radio stations located in various places around the coast of Iceland.

When the terrestrial automatic tracking system was established, the technical branch of Iceland Telecom was responsible for the setup and maintenance of the necessary very high frequency (VHF) repeater stations around the coast. In the late 1990s, the vessel tracking system for safety purposes was moved into the main communication centre of Iceland Telecom in Reykjavik and the employees of the Life Saving Association worked there side-by-side with the radio operators of Iceland Telecom.

Iceland Telecom has now been privatized and no longer operates or services the coastal radio station system or the vessel tracking system by VHF, which were both integrated into the MTS under the optimal responsibility of the ICG in 2006.

3. THE INTEGRATED SYSTEM

In this section, the integrated system is introduced. This system combines some of the operational functions of various institutions and organizations into a single location – the ICG Operations Centre/MTS to achieve more effective operations, to enhance safety and security and to simplify procedures for fisheries and maritime activity by establishing a single point of contact (SPOC).

Operations Centre and objectives

The ICG carries out its operational tasks in the ICG Operations Centre. These tasks include:

- operating the VMSs for safety, security and surveillance purposes in the Icelandic EEZ;
- providing the MTS (including the Global Maritime Distress and Safety System [GMDSS] and SAR capacity) and functioning as the SPOC for all maritime-related notifications (e.g. Schengen, port calls, transit notifications);
- monitoring and surveillance of fishing activity.

It is important to point out that the various VMSs operated by the ICG are primarily for safety purposes. Apart from satellite-based systems, this includes monitoring of coastal activity through a dedicated land-based VHF system with a network of repeater stations around the coast and the Automatic Identification System (AIS), which has a range (30–60 nautical miles) similar to that of the VHF system. The requirements for fisheries monitoring and surveillance have increased over time, including international agreements to enhance cooperation and improve the coverage of high seas.

The MTS consists of a monitoring, control and information system for maritime traffic with a view to enhancing safety and efficiency, improving the response of authorities to incidents, accidents or potentially dangerous situations at sea, and contributing to better prevention and detection of pollution by ships.

However, there are other agencies and/or functions that are present at the same location as the ICG Operations Centre (also called the National Rescue Centre or the Joint Rescue Coordination Centre [JRCC] depending on the context). This includes the Capital District Fire and Rescue Service, the ICE-SAR, Emergency Alert 112, the Police National Communication Centre, the Police Vehicle Control and Maintenance Centre and the Civil Protection Department of the National Commissioner of the Police. Representatives from medical emergency, the Red Cross, the Road Department, Air Traffic Control, etc. may be called in depending on the situation. There is a clear advantage in having all these emergency response functions together in the same location, as it facilitates effective cooperation.

For civil protection operations, such as in the case of strong earthquakes or other natural disasters, the police maintain operational control, but maritime incidents come under ICG control. However, there may be a need for close cooperation between the various authorities depending on the nature and scale of the event.

Supporting units

In order to support operations in the field, the ICG uses two 70 m patrol vessels (Figure 3), three helicopters, one fixed-wing aircraft and a new multipurpose vessel (length 94 m) (Figure 4), which is also equipped for hydrographical surveys. Technical details are given in Annex I.

The Aviation Department of the ICG is located at Reykjavik Airport, where pilots, aviation mechanics and other personnel of the department are based. At Faxagarður quay in Reykjavik harbour, ICG personnel also staff a security post that is responsible for security of ICG patrol vessels when moored. They also carry out other tasks in support of the patrol vessels.

Figure 3: The Icelandic Coast Guard patrol vessel *Ægir*

Figure 4: The new Icelandic Coast Guard multipurpose vessel *Þór* (*Thor*) being launched at the Asmar shipyard in Chile

Institutional setup

There are several agencies and organizations involved, directly or indirectly, in the functioning of the ICG Operations Centre. In terms of maritime related matters, this involves the ICG, the Icelandic Maritime Administration (IMA) and the Directorate of Fisheries.

The ICG is a law enforcement agency under the Ministry of Justice with the general tasks of providing security as well as SAR services at sea. It is also responsible for carrying out Iceland's obligations in the context of international conventions and bilateral agreements in the context of maritime affairs.

The Directorate of Fisheries, under the Ministry of Fisheries and Agriculture, takes care of the day-to-day administration of fisheries, which includes implementing legislation on fisheries management, collecting and publishing data on fishing activity, issuing permits to vessels and allocating catch quotas (i.e. Iceland has a system of individual transferable quotas), as well as inspections of catches, gear and handling methods. It should be noted that weighing of catches at ports is mandatory for all vessels, Icelandic and foreign.

The IMA, under the Ministry of Transport, Communications and Local Government, is responsible for various tasks in maritime administration, such as operation of lighthouses and navigational systems, vessel registration and supervision of ship surveys, staffing and certification. The IMA is also responsible for establishing the MTS in Iceland, but the daily operation of the MTS is entrusted to the ICG according to a special service agreement.

In many of the tasks carried out through the ICG Operations Centre, the ICG cooperates with the Directorate of Fisheries and the IMA, as well as the Directorate of Customs (under the Ministry of Finance) for matters concerning imports and exports.

Other institutions and organizations

The communications centre of the National Commissioner of Police is at the same location as the ICG Operations Centre. Police operations in Iceland are coordinated and monitored from here, and the JRCC, managed by the police, is also located here. The JRCC is activated in the case of large operations, requiring the expertise and capacity of various agencies, such as in civil protection operations.

Emergency Alert 112 is the national service for answering all emergency calls and coordinating various response units (e.g. police, fire, ambulance) on land. This service is at the same location as those described above, thus forming part of the JRCC. In the context of the MTS, Emergency Alert 112 has the responsibility for routing emergency calls that are received via the telephone system to the ICG at the same centre.

Emergency Alert 112 is also responsible for the financing and functioning of technical systems of the MTS, including the GMDSS communication systems as well as the terrestrial VHF tracking system for the mandatory tracking of vessels for safety purposes. However, it is the ICG that is responsible for operating the MTS under a service agreement with the IMA. In addition, Emergency Alert 12 operates the Terrestrial Trunked Radio (TETRA)[7] emergency communication system with numerous transmitter stations around the coast and inland.

The ICE-SAR is an association of voluntary rescue teams in Iceland, of which there are about 100, located throughout Iceland (Figure 5). These are highly trained and specialized teams for SAR operations on land and at sea. The ICE-SAR forms part of the agreement between the IMA, Emergency Alert 112 and the ICG concerning the operations of the MTS. During maritime emergency operations, ICE-SAR units and boats (14 all-weather lifeboats) can be activated and directed from the centre.

Legal aspects and international obligations

According to Law Act No. 52 of 2006, the ICG is responsible for a wide range of maritime protection and security duties, which include:

1. Providing security and safety at sea in accordance with Iceland's international obligations, agreements with other States and the provisions of law.

[7] The Terrestrial Trunked Radio (TETRA) is a specialist professional mobile radio, designed specifically for use by government agencies, emergency services, transport services and the military. It works in a very similar way to the Global System for Mobile Communication (GSM) (mobile phone standard technology), but handsets have a longer range and there is more bandwidth allocated for data.

2. Law enforcement at sea, including fisheries patrol, and assistance to law enforcement ashore in co-operation with the National and regional commissioners of police.

3. Search and rescue services to mariners and ships and other means of transport at sea.

4. Search and rescue services to aircraft.

5. Search and rescue services on land.

6. Urgent ambulance services in co-operation with other rescue organisations.

7. Assistance to civil protection authorities.

8. Assistance in case of failure of ordinary communications, such as by reason of ice floe, layers of snow, violent weather or natural disasters.

9. Ocean patrol in accordance with the Act on the Maritime Security Act and other acts of law on similar matters.

10. Notification of, and disposal of, flotsam, mines, bombs or other sources of hazards to navigation, in addition to bomb disposal on land.

11. Hydrographic survey, charting, issue of notices to mariners, preparation of tide tables, sailing directions and other publications relating to navigation.

12. Reception of notifications from ships as provided for in the Act on Foreigners, and control of jurisdictional boundaries at sea.

According to Regulation No. 672/2006 on the MTS, issued by the Minister for Transport and Communications, a maritime SAR coordination centre for Icelandic waters shall be established in accordance with the International Convention on Maritime Search and Rescue.[8] This regulation states that the ICG shall administer the expert management of the MTS according to a service agreement, is responsible for the central administration of SAR coordination from the MTS and thus provides it with the role of MRCC for rescue units in Iceland in accordance with the International Convention on Maritime Search and Rescue.

Considering that the primary objective of the MRCC is for safety purposes, it should be noted that there are reporting requirements for all Icelandic vessels. According to Article 29 of the same Regulation No. 672/2006, Icelandic ships shall report their departure from and arrival into port and their position through the automatic ship reporting system as follows:

- ships of 24 m in length and over shall report at one-hour intervals;
- ships of less than 24 m in length that may navigate outside the service area of the automatic ship reporting system on the VHF channel shall report at one-hour intervals;
- ships of less than 24 metres in length that navigate within the service area of the automatic ship reporting system on the VHF channel shall report at 15-minute intervals;
- passenger ships engaged in commercial operations shall report at 15-minute intervals.

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[8] Facilitated by the International Maritime Organization (IMO), of which Iceland has been a member since 1960 (www.imo.org).

Icelandic Coast Guard ships and ships engaged in non-commercial operations are exempted from these provisions.

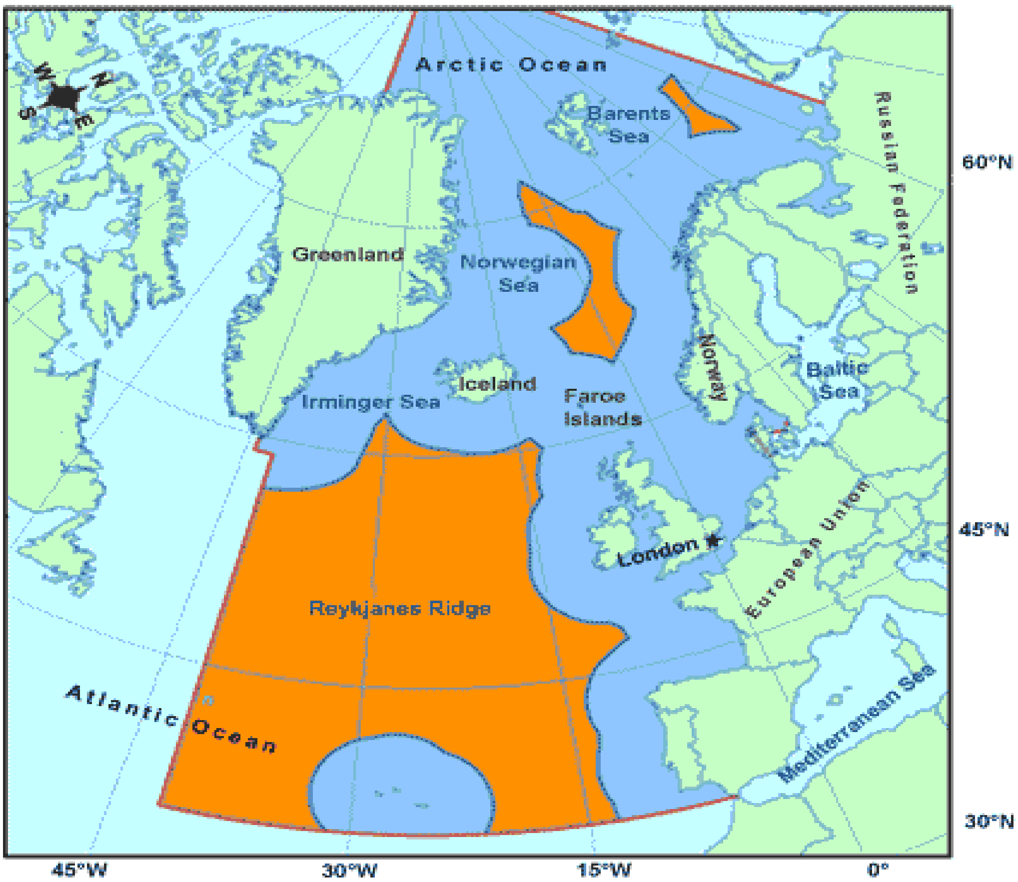
Also specified in Act No. 52 of 2006 is that the ICG may conclude service agreements on matters concerning fisheries patrol (or surveillance). Further details on applicable maritime-related legislation are available, including vessel safety requirements, maritime security, foreign fishing vessels, anti-pollution measures and investigation of accidents.[9]

International obligations

In the international context, Iceland is a party to the UNCLOS as well as the United Nations (UN) Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks (the Fish Stocks Agreement).

Iceland participates actively in regional cooperation regarding the sustainable utilization of marine resources and is a member of various regional fisheries organizations in whose areas it has fisheries interests. This cooperation is carried out within organizations such as the NEAFC (Figure 5), the NAFO, the International Commission for the Conservation of Atlantic Tunas (ICCAT), the North Atlantic Salmon Conservation Organization (NASCO), and the North Atlantic Marine Mammal Commission (NAMMCO). Iceland is also expected to become a contracting party of the South East Atlantic Fisheries Organization (SEAFO).

Figure 5: Regulatory area of the NEAFC (in orange), which covers the most important fisheries by Icelandic vessels in international waters



Source: NEAFC (www.neafc.org)

[9] Refer to the ICG Web site (www.lhg.is).

Representing Iceland, the IMA participates in a wide range of international collaborative efforts (Box 5) such as in the context of the International Maritime Organization (IMO), the International Association of Lighthouse Authorities and the Permanent International Association of Navigation Congresses, as well as relevant EEA[10]/EU meetings. The IMA is responsible for implementation of the Paris Memorandum of Understanding on Port State Control and foreign relations in respect of it. Furthermore, it participates in consultation meetings with counterpart organizations in other Nordic countries.

Area coverage

In terms of area coverage, it is important to make a distinction between the Icelandic EEZ and the much larger SAR area, the latter being under the responsibility of the ICG for SAR operations as agreed with the IMO (SAR Convention).

Box 5: International maritime obligations

Together with 168 other countries, Iceland is a member of the International Maritime Organization (IMO). The IMO was created with the main task of developing and maintaining a regulatory framework for shipping and its remit includes safety, environmental concerns, legal matters, technical cooperation, maritime security and the efficiency of shipping. This international cooperation has resulted in a comprehensive body of international conventions supported by numerous recommendations governing every facet of shipping. The International Convention for the Safety of Life at Sea (SOLAS), International Convention for the Prevention of Pollution from Ships (MARPOL) and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) are considered to be the cornerstone treaties of this international regulatory framework. Iceland has ratified 36 of these IMO conventions, amendments or protocols (as of November 2009).

In 1988, the IMO amended the SOLAS, requiring ships to fit Global Maritime Distress and Safety System (GMDSS) equipment. The GMDSS was developed to provide the communication support needed to implement the search and rescue (SAR) system, which is based on a combination of satellite and terrestrial radio services, changing international distress communications from being primarily ship-to-ship to ship-to-shore (rescue coordination centre). It consists of an internationally agreed-upon set of safety procedures, types of equipment and communication protocols used to increase safety and make it easier to rescue distressed ships, boats and aircraft. The system is intended to perform the following functions: automatic alerting (including position determination of the unit in distress using satellite emergency position-indicating radio beacons [EPIRBs]), SAR coordination, locating (homing), maritime safety information broadcasts (Navigational Telex [NAVTEX]), general communications, and bridge-to-bridge communications. Recreational vessels or vessels with a gross register tonnage (GRT) of less than 300 GRT do not need to comply with GMDSS radio carriage requirements, but are increasingly using digital selective calling (DSC) VHF radios.

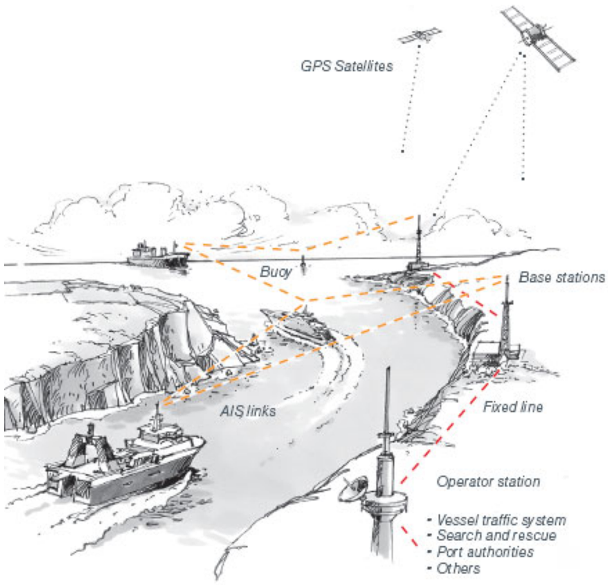
Another requirement in the context of the SOLAS is the installation of the Automatic Identification System (AIS; see accompanying figure) on board ships of more than 300 GRT and all passenger ships regardless of size. The AIS is a short-range coastal tracking system used on ships and by vessel traffic services (whose requirements are also specified in the SOLAS). Vessel information such as unique identification, position, course and speed can thus be displayed on a screen, which allows maritime authorities to track and monitor vessel movements.

Ships outside AIS radio range can be tracked with the Long Range Identification and Tracking (LRIT) system, which is a complementary system being put in place by the IMO under the SOLAS. The LRIT

[10] The European Economic Area (EEA) was established on 1 January 1994, allowing European Free Trade Association (EFTA) countries to participate in the European single market without joining the European Union (i.e. implies harmonization in terms of legislation over a wide range of sectors). Contracting parties are Iceland, Liechtenstein and Norway (but not Switzerland, which rejected the EEA Agreement).

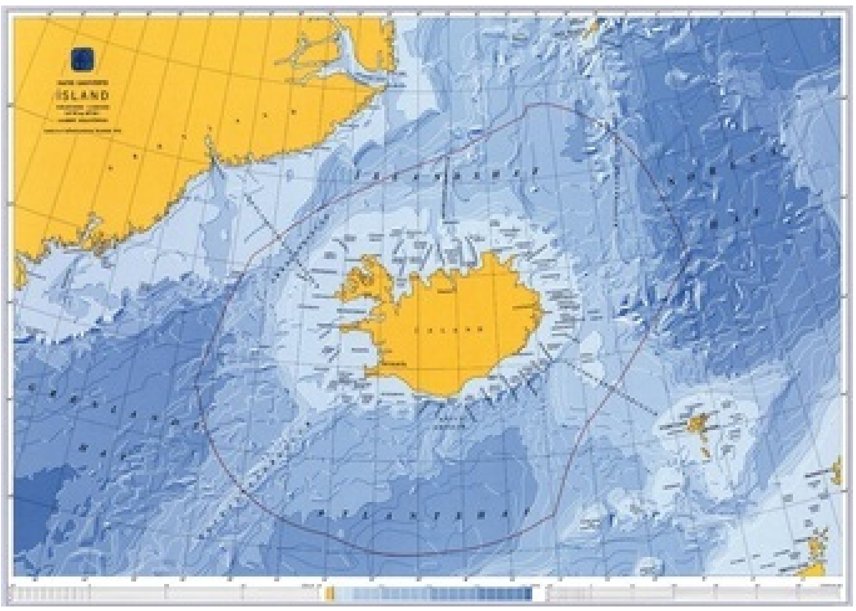
system is currently in the phase of implementation, which will require ships (i.e. larger than 300 GRT and all passenger ships as well as oil rigs) to report their position automatically to their flag administration at least four times a day. Other contracting governments may request information about vessels in which they have a legitimate interest under the regulation.

How the Automatic Identifications System (AIS) works



The size of the Icelandic EEZ is about 754 000 km², extending to the full 200 nautical miles to the south and southwest, where it abuts the large area of high seas in the central North Atlantic, and to the northeast, where it abuts an enclave of high seas in the Norwegian Sea sometimes referred to as the "banana hole". Elsewhere, the EEZ extends to the EEZs/fishing zones of Faroe Islands, the Norwegian island of Jan Mayen and Greenland (Figure 7).

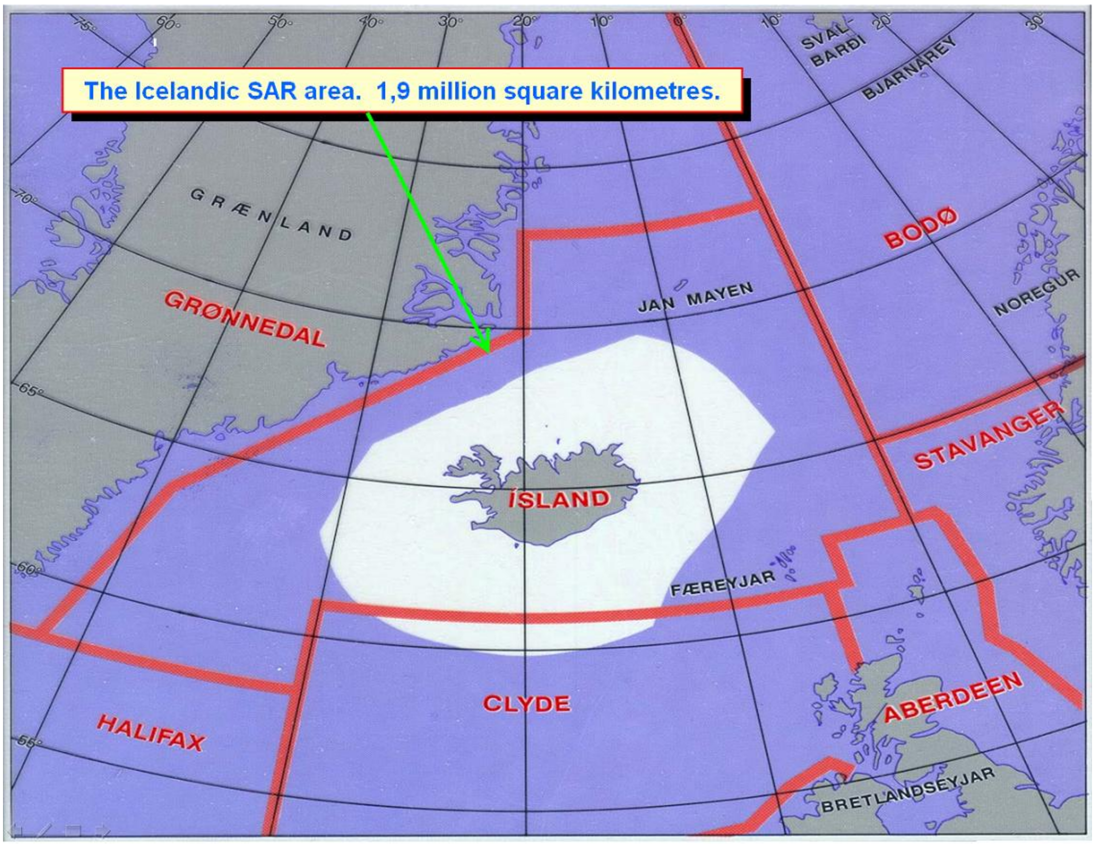
Figure 6: Map of the Icelandic Exclusive Economic Zone



The ICG Operations Centre functions as the SPOC for vessels operating inside the EEZ as well as vessels heading for ports in Iceland and for vessels transiting the Icelandic EEZ. In relation to fisheries, the centre also keeps track of Icelandic vessels operating in the regulatory areas of the NEAFC and NAFO as well as vessels operating in the EEZs of other countries such as Faroe Islands, Greenland, Norway and the Russian Federation. The centre also tracks foreign fishing vessels operating in Icelandic waters under fishing agreements, including Norwegian, Faroese, Russian and Greenlandic vessels.

The ICG is also responsible for SAR operations as described below, as agreed in the context of the IMO. This is a vast area of about 1.9 million km², extending from 0 degrees longitude westward to the Greenland coast (Figure 7). The area to the south of Iceland that is referred to as "Clyde" is more or less covered by Iceland; with examples of ambulance flights by helicopters into that area. Faroe Islands has claimed responsibility for the part of the area that is inside its EEZ, but this is still to be approved by the IMO.

Figure 7: The search and rescue (SAR) area under the responsibility of the ICG



4. IMPLEMENTATION

The ICG is responsible for operations in one of the toughest marine areas in the world, the North Atlantic Ocean. A series of depressions cross the waters around Iceland on the way from North America to Europe, bringing heavy storms during a large part of the year as well as dangerous ice flows during the winter. The difficulties of mounting operations for missing ships or aircraft in such a vast area, and under possibly dangerous conditions, are obvious. Maintaining permanent alert status in a centre that is staffed 24 hours a day, every day of the year, is important. As mentioned above, the ICG Operations Centre joins together previously separate functions that are essential for the ICG to carry out its responsibilities. The following sections describe the implementation of these functions in Iceland as well as operational and technical aspects.

Implementing the VMS in Iceland

Before the implementation of mandatory vessel reporting (see Box 4), there were often great difficulties in obtaining information about a missing vessel, as radio equipment onboard was generally of poor quality, if there was any at all. The Life Saving Association had been encouraging fishing boat skippers to report their position regularly as well as to report departure and arrival in port. This was done on a voluntary basis in some areas but not in a systematic way.
The normal procedure in the event of a missing boat was for coastal radio stations to send enquiries to all boats in the area and to contact a number of harbours to check if the boat had entered in a port away from its home port. Finally, the state broadcasting service would request the missing boat, usually prior to the daily news broadcast, to contact the nearest coastal radio station. It often happened that an investigation about a missing boat was initiated several days after the last contact. Sometimes, these boats never returned and nothing was ever found.

In 1968, the Icelandic parliament issued a law on mandatory vessel reporting, requiring all boats to report their position twice a day to a centre in Reykjavik, directly or via the coastal radio stations, as well as their departure and arrival in port. Fishers were reluctant to give their positions to the ICG and the task of running the mandatory reporting service was given to the Life Saving Association of Iceland.

The implementation of the system created a great deal of radio traffic and a high workload for radio operators, who were receiving and relaying the positions of each boat to the tracking centre (i.e. the first VMS in Iceland). All positions were recorded manually on paper and the operators had to compare the list of positions with the list of boats that had reported departure from port. With the introduction of computers, this became easier, removing some of the workload.

The ICG was not a recipient of these vessel reports, but its patrol vessels monitored and recorded radio communication for fisheries enforcement purposes to some extent, although not foreseen in law. The ICG gathered information on vessel location based on the interpretation that the information was available and also of essential importance in the case of SAR operations.

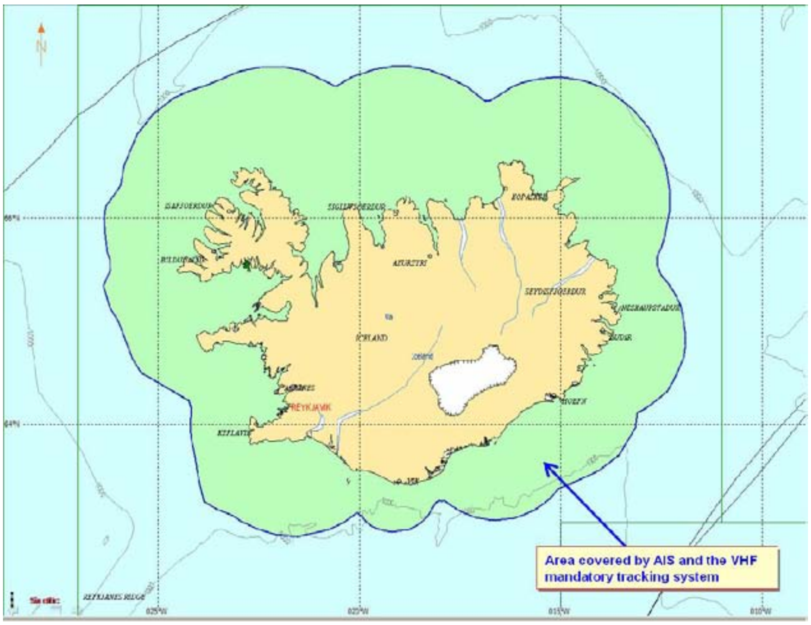
A fully automated system was discussed for years, but it was not until the late 1990s that a political decision was made to establish such a system. This consisted of a coastal tracking system using VHF repeater stations located around the coast and with a monitoring range of 20–60 nautical miles. Larger boats operating outside the range of the VHF system are mostly tracked via a satellite-based system (Inmarsat C). These systems have proved themselves as essential for the safety of fishers and seafarers, cutting down response times drastically in cases of emergencies and saving numerous lives.

Currently, the Icelandic VMS is composed of several tracking systems that have now been merged into one system. The system consists of four main technical components:

- a VHF tracking system composed of numerous base, repeater and backup stations around the coast;
- the AIS system, consisting of base stations with similar coverage as the VHF system (Figure 8);
- Inmarsat C vessel monitoring by satellite;
- Iridium satellite communication systems.

Recently, the LRIT system has begun to be implemented, as agreed in the context of the IMO (Box 5).

Figure 8: Range of the VHF and AIS systems in Iceland



Resistance against an integrated system

By the mid-1990s, two separate, fully operational computerized vessel tracking systems were operating. One system was operated by the Life Saving Association, and the other by the ICG. However, there was cooperation between the systems, especially during SAR operations, and when the ICG provided position reports from the fisheries surveillance system to the safety system. Larger vessels operating in international waters or in the EEZs of other coutries were required to report to the fisheries VMS system, that has been run by the ICG.

Discussions went on for a number of years about merging the radio services and the different systems for vessel tracking, thus including the functions of surveillance as well as SAR. However, this met with resistance from the authorities and organizations operating the different components for a number of reasons: conceptual, institutional and financial. Some of the components had been operated independently for decades, such as the maritime radio services. Most importantly, it was considered preferable to maintain the system for fisheries control and enforcement separate from the safety system. Various projects looked into these issues, financed and run by different institutions, with limited interchange and cooperation among the interested parties. Although not an ideal process, this resulted in some competition, which, in hindsight, may have created the conditions that led to the creation of an integrated system.

The ICG was particularly interested in merging the mandatory vessel reporting system and the VMS for fisheries surveillance, based on considerations of effectiveness and cost-efficiency. There were obstacles, actual and perceived, to overcome before that could happen. The main arguments were that: (i) the safety system should not be used for fisheries surveillance purposes; and (ii) fishing boats would refuse to inform the ICG about their positions. In fact, these arguments are interrelated as argument (ii) leads to (i). In the late 1990s, a common understanding was forming between the ICG and the Life Saving Association on the benefits for all parties to merge these services. However, this merger did not take place until 2005.

In the end, the earlier assumptions have proved to be false with very few exceptions. The exceptions are normally related to vessels that may be involved in illegal fishing, for example, in closed areas, and do not want to report their position to the ICG. Sometimes, skippers or vessel owners report their position, pointing out that this is for safety reasons and not for control and enforcement. However, according to legislation (Act No. 41/2003 and Register No. 672/2006), it is clearly stated that reported positions can be used for fisheries control purposes. In addition, the service agreement concerning the MTS specifies that the ICG is free to use all the information received for control and enforcement purposes and other coast guard duties. A regulation has also been issued by the Directorate of Fisheries requiring all fishing vessels to report automatically their position, speed and heading at least once every hour in the context of fisheries control and enforcement.

Establishing the Maritime Traffic Service (MTS)

In 2003, the parliament of Iceland issued new legislation establishing a centre for the MTS in order to achieve harmonization with EU legislation on maritime affairs. This is a requirement for countries such as Iceland, Liechtenstein and Norway in order to form part of the EEA with the EU.

The MTS centre was expected to run the mandatory vessel tracking system for safety purposes as well as receive maritime notifications that the ICG had handled previously. In addition, this should be the GMDSS centre, responsible for coastal radio services, broadcast of navigational information and warnings (Box 5). The IMA was given the responsibility to establish the centre and decided to start discussions with the various stakeholders.

By initiative of the Ministry of Justice, an agreement was made between the parties, and the MTS centre was placed in the same location as the JRCC in Reykjavik. Following this integration of the various systems and functions, the ICG moved its operations centre into the same location in 2005, and subsequently its headquarters in 2006.

The MTS has the following main tasks:

- monitoring, operating and maintaining the automatic ship reporting system for Icelandic ships;
- monitoring the international AIS;
- monitoring, operating and maintaining the GMDSS as well as editorship for international safety broadcasting system for ships (NAVTEX[11]);
- general radio communication services for ships;
- reception and distribution of notifications from vessels carrying dangerous cargo or polluting agents;
- reception and distribution of distress calls as well as notifications of incidents or accidents at sea;
- reception and distribution of notifications from passenger ships for counting and registration of passengers;
- notifications on the arrival of ships into Icelandic harbours;
- registration of vessels subject to port State control;
- reception of notifications and distribution of information on malfunctions in navigational systems as well as dangers to navigation;
- cooperation with ports that the IMA has designated as emergency ports;

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[11] NAVTEX (Navigational Telex) is an international, automated, direct-printing service for delivery of navigational and meteorological warnings and forecasts as well as urgent marine safety information to ships.

- other tasks for the benefit of third parties authorized by the IMA;
- other tasks that the IMA delegates to the MTS.

The MTS has an important function in SAR operations, but as it forms part of ICG operations, it attains the status of an MRCC, as defined in legislation (Reg. No. 672/2006).

Iceland requires all vessels entering its EEZ, whether sailing through or heading for port, to notify the relevant authorities. This is based on Icelandic legislation as well as Schengen[12] requirements and international conventions on the prevention of pollution. There are also special areas to be avoided and traffic routes for vessels over a certain size and vessels carrying hazardous cargo. The activity of all vessels in the Icelandic EEZ is monitored for maritime security purposes and in the context of the International Ship and Port Facility Security Code (ISPS Code).[13]

Fisheries Monitoring Centre (FMC)

The ICG Operations Centre functions also as the Fisheries Monitoring Centre (FMC), which is a joint collaboration with the Directorate of Fisheries. The tasks of the FMC include monitoring fishing vessels by VMS and receiving notifications from fishing vessels engaged in the following activities:

- Icelandic vessels fishing in the Icelandic EEZ;
- foreign fishing vessels operating under licence in the Icelandic EEZ;
- Icelandic fishing vessels operating outside the Icelandic EEZ or in the EEZ of other countries;
- Icelandic fishing vessels operating in the regulatory areas of the NEAFC and NAFO (i.e. high seas).

All foreign fishing vessels licensed to operate in the Icelandic EEZ are required to send daily catch reports as well as entry, exit and control reports.[14] More specifically, this includes Catch on Entry (COE), Catch (CAT), Transshipment (TRA), Port of Landing (POR), Catch on Exit (COX) and Port State Control (PSC) reports. This applies also to Icelandic vessels operating in the regulatory areas of the NEAFC and NAFO or in the EEZ of another State, where the relevant notification is forwarded to the relevant RFMO or State (Box 6).

These generated data become part of the FMC databases (but have to be entered manually at present) and are available for control and enforcement purposes together with complementary databases run by the IMA (e.g. ship registry, seaworthiness) and the Directorate of Fisheries (e.g. licensing, registry of foreign fishing vessels, closed areas, RFMO vessel registries, illegal, unreported and unregulated [IUU] fishing blacklists) (Figure 9). The databases are designed to keep track automatically of all relevant reports, for example, issuing a warning if a report is missing (i.e. vessel detected by VMS that has not notified), if a vessel is not recorded in available registries, or if a vessel is not licensed to fish.

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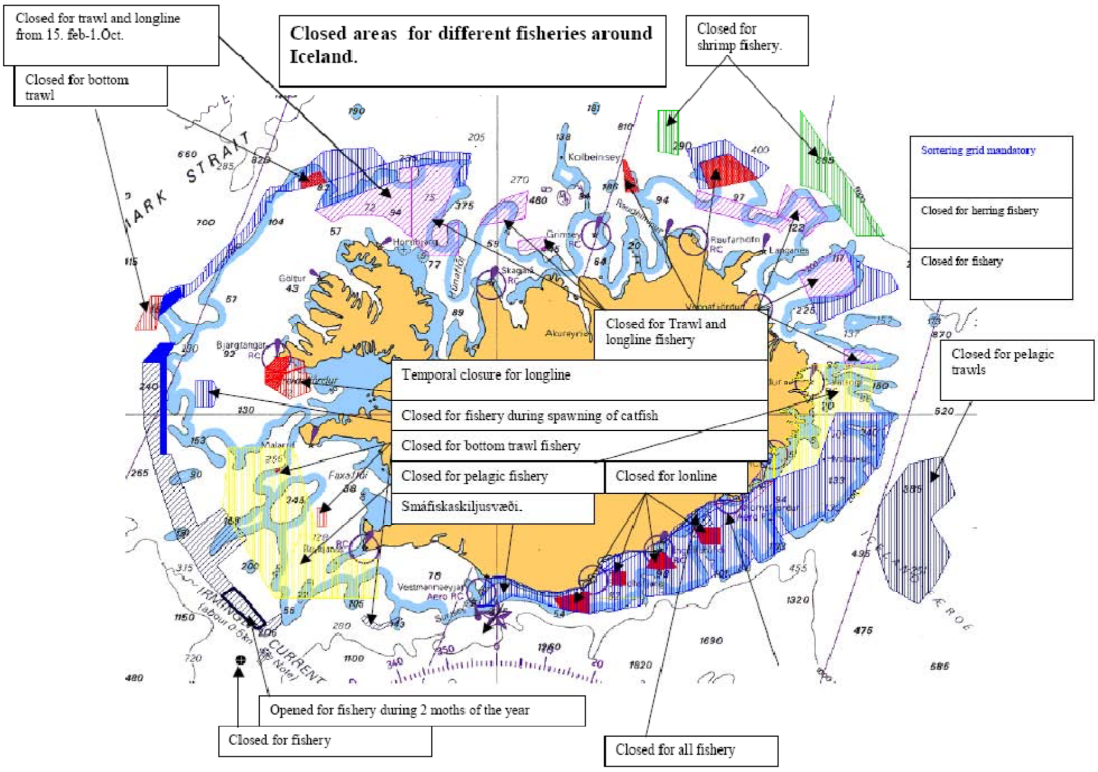
[12] Schengen Agreement (1985) and the convention implementing the Schengen Agreement are treaties providing for the removal of systematic border controls between participating countries. These Schengen rules have been adopted by most European Union countries (except Ireland and the United Kingdom) as well as by Iceland and Norway.

[13] Also part of the amended SOLAS under the IMO.

[14] Entry and exit reports refer to notification by vessels when entering or exiting a State's EEZ.

Figure 9: An example of closed areas in force in 2004 around Iceland



Note: The boxes are of a different nature and can be closed for different time periods and gear type.
Source: International Council for the Exploration of the Sea (ICES) Advice for 2008, Iceland and East Greenland (www.ices.dk).

A rather unique feature of fisheries management in Iceland is that the Directorate of Fisheries keeps daily track of fishing activity, maintaining a database where all landings are registered in real time and making this publicly available on the Internet (available at www.fiskistofa.is). This is facilitated by the requirement for all catches to be weighed upon landing under supervision (including a requirement for foreign vessels to weigh-in), and automatically registered in a database. This ensures full transparency and it is common for fishers to check landings of other fishing boats. Anyone can follow the landings of a specific vessel, their quota status as well as the transfer of quotas between individual vessels.[15] Icelandic law does not treat these catch and landings data as confidential but it is important to note that the VMS data (i.e. vessel movements and associated catch reports) are treated as confidential.

[15] Iceland has introduced an individual transferable quota system for fisheries management, allocating an annual share of total quota to each vessel in the fishery and allowing for quota transfers between vessels (up to 50 percent of annual share).

Box 6: Requirements of regional fisheries management organizations (RFMOs)

In 1996, the members of the Northwest Atlantic Fisheries Organization (NAFO) were required to establish vessel monitoring systems (VMSs) and report the positions of their vessels to the NAFO Secretariat. Vessels are normally tracked via Inmarsat C and the information is forwarded by the flag State of the vessel to the NAFO Secretariat. Two years later, a similar system was established by the North East Atlantic Fisheries Commission (NEAFC), using the same message format and communication protocol.

Recently, the NEAFC has established a system of catch and activity electronic reporting in addition to the position reports. The amount of data transmitted increases substantially and there have also been problems in finding adequate and standardized formats (i.e. reports had to be entered manually to correct errors), but these issues are expected to be resolved in the near future. The NAFO has followed this initiative, thus making the reporting requirements of these two organizations very similar.

Another recent initiative is the implementation of port State control in the North Atlantic. Fishing vessels requesting entry to Icelandic ports for landing or transshipment of catch are required to make advance notification according to NEAFC and NAFO rules. The duty officer either authorizes a vessel entry to port or refuses (if the information provided by the vessel in the advance notification cannot be confirmed by the vessel's flag State). This is to ensure that a vessel that has undertaken illegal, unreported and unregulated (IUU) fishing activity is not allowed to land its catches. Flag State confirmation is mandatory and is in fact one of the key elements of port State control in the North Atlantic.

Operational aspects

The ICG Operations Centre has multiple functions, as described above. It serves as the communication centre for ICG patrol units, collection and distribution of information to and from patrol units as well as a planning station for daily operations. It also serves as a base for:

- various vessel monitoring/tracking systems[16] (VMS, AIS);
- the MTS;
- SAR operations;
- monitoring of fishing activity (the FMC).

This enables the ICG to carry out its overall task of general policing in the Icelandic EEZ. Moreover, the centre functions as the MRCC in times of emergencies and it is the SPOC for all maritime-related notifications (including SAR SPOC for International Satellite System for Search and Rescue [COSPAS/SARSAT] messages).

Technical details concerning the ICG Operations Centre and supporting units are given in Annex I.

Safety-related aspects

In the case of a maritime distress situation, the ICG Operations Centre can activate the ICG's units (i.e. patrol vessels, fixed-wing aircraft and helicopters), all vessels in the vicinity that may be able to assist, as well as ground rescue teams and high-speed rescue boats via the national rescue centre (MRCC/JRCC), depending on the scale of the operation. Ground rescue teams and high-speed rescue boats are operated by the ICE-SAR in coordination with the ICG. The ICG also responds to urgent calls for ambulance flights. Such flights are quite frequent, especially by helicopter, and there are

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[16] There are about 2 000 vessels listed in the Icelandic registry and more than 1 500 vessels arrive from abroad to Iceland every year.

always one or more helicopter crews available. Helicopters carry the TETRA radio communication system, which allows for the tracking of response units (Figure 10).

Figure 10: Example of an actual rescue mission carried out in 1987, where a crew of 12 were trapped in the wheelhouse of the grounded boat and had to be rescued by helicopter

The main components of the MTS are GMDSS and SAR. The MTS includes also the mandatory vessel tracking systems for safety purposes, including the AIS, as well as reception and delivery of maritime notifications. The coastal radio station system consists of remote controlled VHF stations all around the coast as well as medium frequency and high frequency (MF/HF) receivers and transmitters that are according to GMDSS requirements, making it possible to communicate with ships by MF, HF and VHF. Radiotelephone calls from vessels have diminished drastically owing to modern telephone systems, both terrestrial-based and satellite-based systems being common onboard every vessel. Thus, radiotelephone calls have not been accepted by the ICG Operations Centre since July 2007, the focus of communication services being on safety and security.

The personnel of the combined centre are employees of the ICG. Some of them are former radio operators from Iceland Telecom or former employees of the Life Saving Association of Iceland. The rest of the staff are duty officers, some of whom are former skippers of fishing vessels, who have been trained for their roles in the joint centre. Today, most of the staff are fully qualified duty officers, trained for operations in the ICG, MTS and MRCC. This includes training provided by the United States Coast Guard or the United Kingdom's Maritime and Coastguard Agency. When recruiting new staff members, a solid maritime or aeronautical background has proved to be essential.

Mandatory vessel reporting

Smaller vessels are mostly tracked by the VHF system using a high frequency, down to every few minutes and even less. The ICG Operations Centre can change the frequency, which is often done in situations where the weather has changed unexpectedly, but the maximum interval between position reports is 15 minutes for smaller vessels (below 24 m) and one hour for larger vessels. Inmarsat C is used for tracking larger ocean-going vessels and vessels operating outside the VHF range.

The contract for the VHF system was given to the company Racal in the United Kingdom to manufacture the ship equipment as well as the land stations, but the computerized tracking system was made by the Icelandic software company Trackwell. Ship equipment has an inbuilt Global Positioning System (GPS) receiver and an emergency button. As the infrastructure and communication cost in the dedicated VHF system is nearly the same for 100 or 100 000 reports, the boats are tracked with a VHF, down to every 30 seconds if necessary. The system has automatic polling features, and boats within range can function as a relay for boats outside range (Box 5). However, boats are not expected to operate outside range of the VHF system unless using other means of communication. Boats are charged a fixed yearly fee for this service.

There are strict rules on how to respond if a vessel is not reporting according to schedule. The system issues an automatic warning if a vessel is overdue for reporting, which consequently starts the alert phase. In that phase, which is a total of 30 minutes from the expected time of next report, the system operator attempts to localize the vessel, contact the vessel directly or contact other vessels in the area. If a contact cannot be established, a distress phase is initiated, which may lead to a full-scale SAR operation. Vessels in the vicinity may also use emergency buttons on the VHF system, displaying their positions automatically on a screen in the ICG Operations Centre.

The VHF system is theoretically a line-of-sight communication; the range is limited and depends on the elevation of the repeater station on land. Vessels that use this system are required to operate within range unless they carry other means of VMS equipment, i.e. a satellite-based system.

Data from the newer AIS system is used as complementary data and will eventually replace the old VHF tracking system. Vessels are now authorized to use the AIS instead of the old VHF tracking system, but unlike the VHF system, there is no emergency button in regular AIS equipment. Therefore, there is a requirement to carry VHF with digital selective calling (DSC), which has the benefit of alerting all nearby vessels in addition to the MTS in the case of emergencies.

Use of AIS equipment has increased significantly, and many vessels that are not required to use it do so anyway as skippers find it convenient. Installation of new AIS stations, many of which are located on mountain tops (as in the old VHF system), has shown that the range exceeds 60 nautical miles in some areas, but it is 30 nautical miles on average. This depends on the elevation of the AIS station and the ship's antenna equipment (Figure 10).

The combined use of land-based and satellite-based systems keeps track of all vessel positions, making them visible on screen, including positions entered manually, such as Schengen notifications. This forms an almost complete surface picture,[17] which is automatically updated as new data are received and forwarded to patrol units. In terms of control and enforcement, this is extremely useful for the identification of targets and to plan operations. Moreover, this greatly enhances safety aspects as well, as all vessels are visible, enabling SAR operations to respond rapidly and in a coordinated way.

Fisheries-related aspects

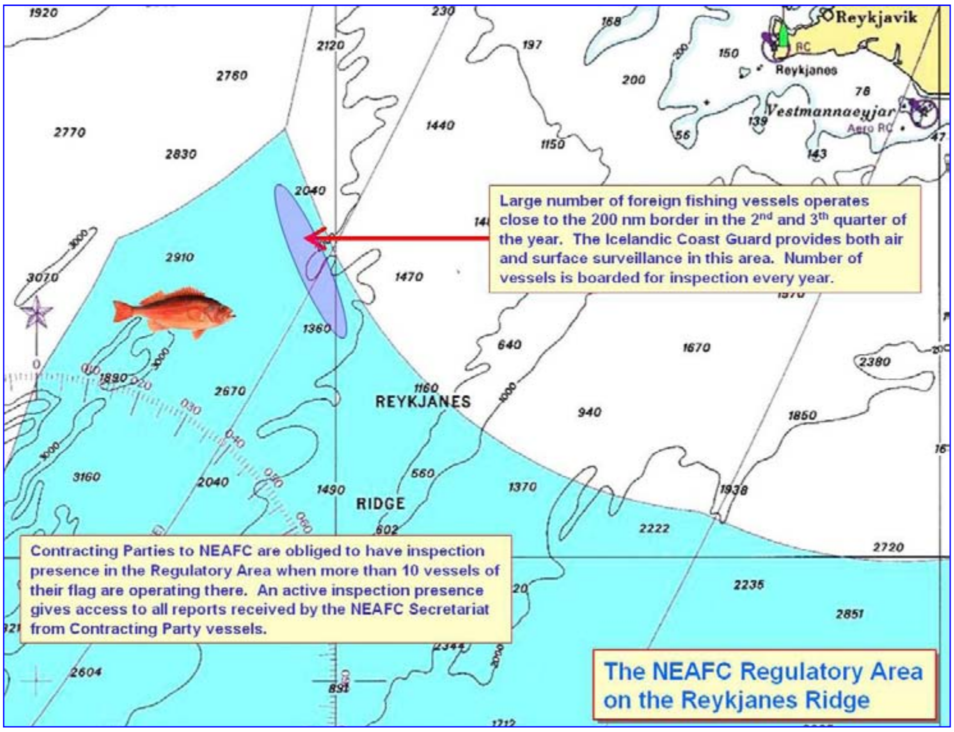
There are about 2 000 fishing vessels registered in the system, so the volume of reporting per day can be extremely high. On a busy day when a high number of smaller vessels are at sea, the system can receive more than two million reports daily. Most of this is electronic but there are about 10 000 manual reports received and entered into the system per year, consisting mostly of catch reports. The workload can be high as these manual reports are received in batches and vary seasonally.

[17] Smaller pleasure boats are not required to be monitored by the system, but they are encouraged to participate for their own safety.

Box 7: Control and enforcement of the redfish fishery in the Irminger Sea

According to the rules of the North East Atlantic Fisheries Commission (NEAFC), when more than ten Icelandic fishing vessels are operating in the Irminger Sea (i.e. outside the Icelandic EEZ, see accompanying figure), there must be an active inspection presence provided by the Icelandic Coast Guard (ICG). At the same time, this gives access to all reports received by the NEAFC on the activity of vessels from other member countries. This condition for access to data on the activity of all vessels in the area is, however, changing, as NEAFC members that are conducting regular inspections and surveillance in the area are given open access to the tracking data as well as the catch and activity reports during the redfish season in the Irminger Sea. This is considered to be an important step forward for the general inspection and surveillance of this international fishery (i.e. unauthorized fishing is more easily detected). Previously, there were significant problems in terms of illegal, unreported and unregulated (IUU) fishing, but this has been largely reduced in recent years as a result of collaborative action by NEAFC members.

The NEAFC regulatory area southwest of Iceland (in blue), which is an important area for the redfish fishery in international waters



Vessels operating outside designated areas without valid permits are detected, and numerous citations have been issued. In some cases, this has led to the arrest of vessels, bringing them into port, as well as court procedures depending on the seriousness of the incident. In some cases, the police simply wait for the vessel to arrive in port. Generally, this serves as an important preventive measure, as fishers know they will be detected and are, therefore, encouraged to operate legally, making sure that all certificates, permits and licences are valid and in order. This is also an indication of effective MCS with most vessels operating legally, fulfilling all the different requirements, and only occasional arrests and court proceedings.

The VMS automatically detects if an Icelandic vessel is inside an RFMO regulatory area (Box 7) or in the EEZ of another State. If relevant, an automatic entry or exit report is generated and transmitted to the relevant recipient (i.e. another state or an RFMO). Subsequent position reports are forwarded automatically every second hour until the system detects that the vessel has moved outside the relevant area. However, there are exceptions to the two-hour reporting rule where positions are required every hour, and the trend is in this direction.

In relation to foreign fishing vessels operating inside the Icelandic EEZ, the relevant flag authorities transmit VMS data to the ICG (e.g. vessels from Faroe Islands, Greenland, Norway, the Russian Federation and EU countries). This is based on bilateral agreements concerning the use of VMSs as well as RFMO-adopted management measures.

All communication between the various authorities for maritime control and enforcement (including the NEAFC [Box 8] and NAFO) in the North Atlantic is by electronic means using a standardized format (North Atlantic Format [NAF]), developed for this purpose, and transmitted via the Internet using the https protocol. The NAF has a simple format that is not only computer readable but also easily understood by operators.

Box 8: The fight against illegal, unreported and unregulated (IUU) fishing in the North Atlantic

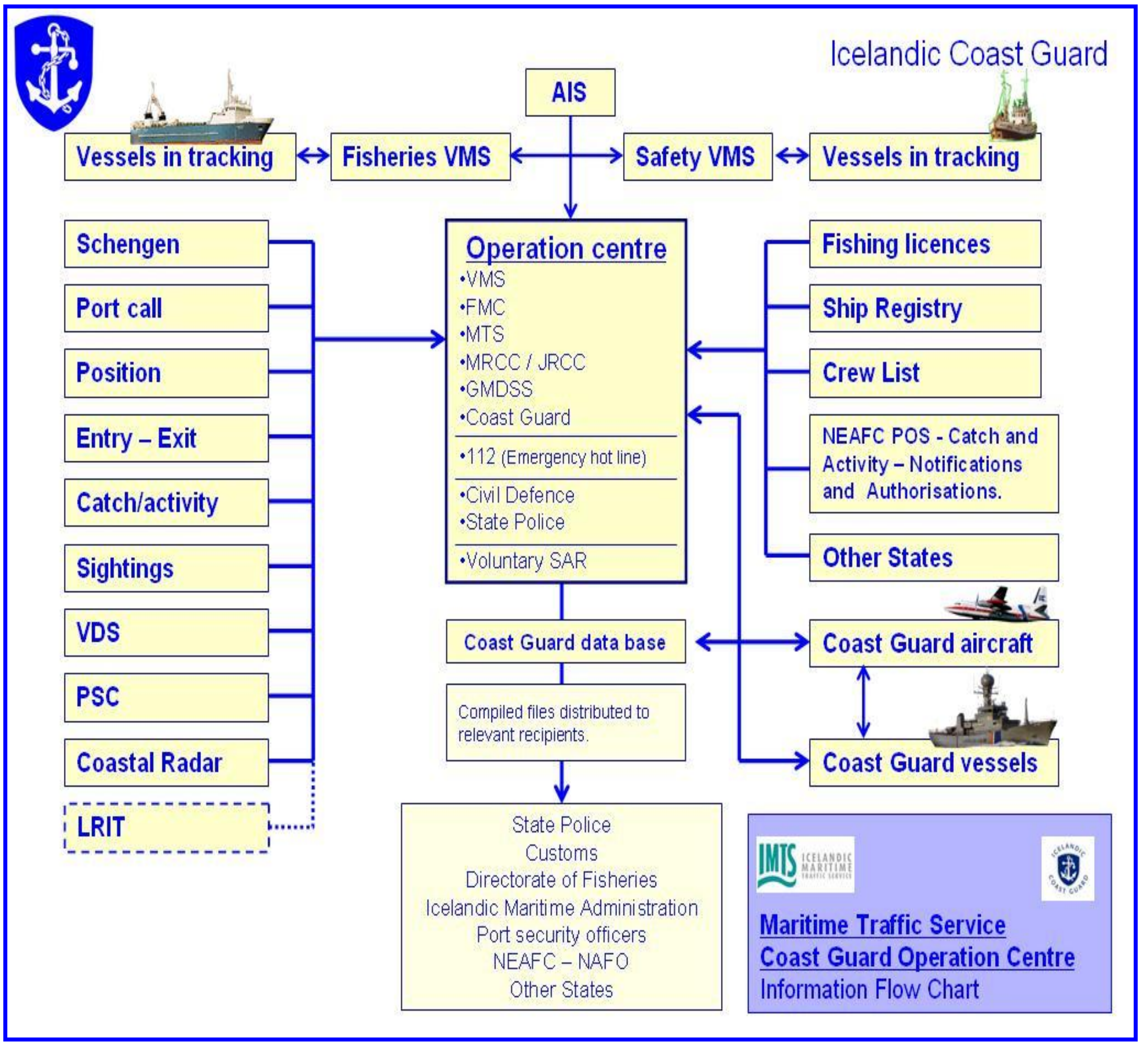
The accompanying figure shows the MV *Polestar* and the IUU fishing vessel *Carmen* about to start a transshipment operation in the North East Atlantic Fisheries Commission (NEAFC) regulatory area in June 2006. As a result, the *Polestar* was put on the IUU list and had severe difficulties in offloading its catch. Finally, it was forced to sail to Asia in order to offload, but continued to have difficulties operating in the North Atlantic owing to the restrictions of entering port in countries that were members of the NEAFC and the Northwest Atlantic Fisheries Organization (NAFO). The fishing vessel *Carmen*, together with a number of other fishing vessels on the IUU list, was unable to operate and was scrapped. A few years later, the *Polestar* was taken off the IUU list.

There have been some discussions about changing from the NAF to other more widely used formats such as Extensible Markup Language (XML), which would also allow more flexibility in reporting, including catches for example. Problems associated with such a change are that communication costs would be substantially higher (i.e. for vessels) and most vessels are currently equipped for transmitting in NAF. However, new communication technologies are increasingly being installed on vessels, giving access to broadband Internet connections, so that costs have been reduced substantially. Moreover, costs are no longer a problem for communication between authorities and RFMOs as this is already done using the Internet Hypertext Transfer Protocol Secure (HTTPS) Communication Protocol.

Information flow

Data are distributed automatically to relevant recipients, within and outside the ICG (Figure 11).

Figure 11: Schematic illustration of information flow to and from the Icelandic Coast Guard Operations Centre



Patrol units receive updates and compiled files every few hours or in real time depending on circumstances. Other recipients such as the National Commissioner of Police, the Directorate of Fisheries and the Maritime Authority, receive compiled files a few times a day. The National Commissioner of Police and the IMA do however receive all Schengen and Safe Sea Net notifications instantly.

Databases are synchronized between patrol units and the central computer at the ICG Operations Centre. When a connection is made to the network, all data are automatically transmitted in both directions and databases are updated if relevant.

Copies of the onboard database for the last three days (including messages, sightings, inspections and logbook) are transmitted from the patrol units to the ICG Operations Centre.

The following files are transmitted from the ICG Operations Centre to the units:

- copy of database entries from other units for the last three days;
- all VMS positions;
- catch and activity reports;

- compiled reports for catch;
- ship registry;
- fishing licences and suspension list;
- vessel information;
- NEAFC authorizations;
- NEAFC notifications;
- IUU list;
- traffic lists (compilation of all known arrival and departures in Iceland).

When a vessel is sighted and its identifier is entered into the system, all relevant information is automatically displayed. The name, registry numbers, nationality, last known position, fishing licences, status of seaworthiness certificate for domestic vessels, IUU status and the date and time of the latest Schengen report. This immediately tells the operator if the vessel needs further investigation and if there is a reason to issue a warning or, if the sighting is from an ICG patrol vessel, to board for inspection.

As all inspections of fishing vessels are registered in the synchronized databases, all information regarding a vessel to be boarded is available. Before boarding for inspection, a so-called “pre-boarding list” is printed where all relevant information can be found: registry data, fishing licence, crew list and results of previous inspections. This helps determine whether there is a reason for boarding and if there are particular issues, e.g. records of repeated violations.

Recently, trials have been conducted giving the ICG vessels direct access to the surface picture at the ICG Operations Centre and constantly updated via satellite communication link. The results have been excellent and greatly enhanced the operations of ICG vessels.

In addition, there are several procedures for automatically generating lists and reports for distribution. These are described below.

Missing report list: this is in addition to the automatic warnings generated by the VMSs if a vessel is not reporting its position according to schedule (e.g. missing Schengen or Port Call reports). Data given are radio call sign, vessel name, last known position including date and time as well as the last type of report received.

List of foreign vessels with valid licences: distributed to patrol units with data on vessels grouped by their nationality, with vessel name, radio call sign, external registration number, type of licence and validity.

Catch list: a catch by species list for all foreign vessels operating in the Icelandic EEZ is compiled every three hours and transmitted to the patrol units (Figure 13), which may be used for inspection out at sea for comparing reported catch with actual catch onboard.

Figure 12: Example of a Catch List

```
NA:  Name of vessel          RC: Radio call sign      XR: Ext. reg. number
POS: 64.20N - 013.34W        DA: 30/04/07             TI: 06:00
Date of ENTRY: 21/04/07      STATUS: CATCH            TN: 1    MSG: 10
--------------------------------------------------------------------------
CAA-Atlantic wolffish         1,820
COD-Atlantic cod             13,975
HAD-Haddock                  18,525
LIN-Ling                      2,405
POK-Saithe(=Pollock)          0,845
RED-Atlantic redfishes        0,260
USK-Tusk(=Cusk)               5,655
WHG-Whiting                   0,065
                    ------------------
                    Total:   43,550
====================================
```

Due for control list: foreign licensed fishing vessels may be required to sail through control points on entering or exiting the Icelandic EEZ.

Figure 13: Example of a Schengen/Port Call list

Icelandic Coast Guard
Operation Centre

Following vessels have reported "SCHENGEN or PORT CALL" during *DD/MM/YY – DD/MM/YY*

Date and time:	*DD/MM/YY HH:MM*	Schengen N°: *SCH+ serial N°*
Vessel:	*Name of the vessel*	C/S: *IRCS*
Vessel Length:	*Length in meters*	
Registration N°:	*IMO or Ext. Reg. Number*	Vessel Type: *CARGO/PAX/TANK etc*
Nationality:	*Flag State of the vessel*	Message Type: *SCHENGEN/PORTCALL*
Position:	*DD.MM N - DDD.MM E/W*	
Last port of call:	*Name of port*	
Port to call:	*Name of port*	ETA: *DD/MM/YY HH:MM*
Next port abroad:	*Name of port*	ETD: *DD/MM/YY HH:MM*
Other port calls:	*Name of port(s)*	
Port of departure:	*Name of port*	
Fishing area:	*Geographical Area or Area Code*	
Fished for:	*Species name*	
Pos. at entering:	*Lat/Long at entering the EEZ*	At: *DD/MM/YY HH:MM:*
Services needed:	*Type of service*	Report forwarded: *yes/no HH:MM*
Agent:	*Name of agent*	
Reported by:	*Report received from vessel or agent*	
Text:	*Free text*	
Catch onboard:	*FAO Species Code and quantity*	

Schengen, ISPS and Port Call list: all vessels entering Iceland from abroad are required to send a Schengen report as well as a crew and passenger list at least 24 hours before entering Icelandic territorial waters as well as the required notification based on the International Ship and Port Security Code (ISPS Code). Furthermore, all foreign fishing vessels are required to send a notification at least six hours prior to entering the Icelandic EEZ. An automatic procedure compiles an overview of all received notifications for the last 72 hours into a Portable Document Format (PDF) file, which is automatically e-mailed to relevant recipients several times a day (Figure 14).

Warning list: list of vessels from VMSs, located outside designated harbour areas, with a comparison with ship registry data to check the validity of certificates and fishing licences, which is updated several times every day (Figure 15). This type of information has proved to be effective in tracing vessels at sea with expired relevant certificate or licences.

Figure 14: Example of a Warning List

Icelandic Coast Guard
Operations Centre
Maritime Traffic Service

The following vessels are at sea without either a valid certificate of seaworthiness, fishing licence or are on the suspension list.

IR	NA	XR	RC	HVS	LKP	SP	CO	DA	TI
Int. reg.	*Vessel Name*	*Ext. reg.*	*IRCS*	*HVS*	*Latitude-Longitude*	*Speed*	*Course*	*Date*	*Time*

Fishing licence expired:	*Date*
Seaworthiness certificate expired:	*Date*
Suspended:	*Date*
Captain:	*Name, Number, Certificate and validity*
Owner: Name, Operator	*Name*
Size of vessel:	*Tons*

Number of vessels at sea with remarks: *Number*
Date and time of printout: *Date and Time*

Legend:
H = Without a valid certificate of seaworthiness
V = Without a valid fishing licence
S = Fishing licence suspended

Due for departure list: list of vessels that are due for departure from Icelandic ports and heading abroad within the next six hours, which is compiled from Schengen notification with an indication of estimated time of departure, radio call sign, vessel name and port of departure.

5. ASSESSMENT OF EFFECTIVENESS

The ICG provides the operational component with Emergency Alert 112 supplying the technical component of the MTS on behalf of the Ministry of Transport and Communications trough the IMA for which it received ISK267 million (about US$3.4 million) in 2008. This includes the costs of running the ICG operation centre, the VMSs together with the network of base and repeater stations around the coast as well as the GMDSS communication system. In addition, the ICG spent ISK108 million (about US$1.4 million) for personnel and running costs of the combined centre. This gives a total of ISK375 million (about US$6.8 million). It should be noted that Iceland's currency has depreciated considerably in recent years against the US dollar and the euro.

The total budget in 2008 including the various functions of the ICG was ISK2 796 million, which corresponded to EUR24.3 million (Table 1), or about US$33.4 million. Assuming that the total budget has been similar in recent years, this implies a strong reduction in 2009 to about EUR15.9 million (about US$22.3 million) because of changing exchange rates.

Table 1: Budget of the Icelandic Coast Guard for the financial year 2008 and a comparison of costs in Euro using changing exchange rates

	Currency			
	ISK	EUR		
	2008	2007	2008	2009
		(thousand)		
Operations centre	108 000	1 297	939	615
Explosives ordnance disposal and diving division	69 000	829	600	393
Patrol vessels	632 000	7 590	5 492	3 601
Flight department	1 625 000	19 515	14 122	9 258
Hydrographical department	101 000	1 213	878	575
Administration and other costs	261 000	3 134	2 268	1 487
Total cost	2 796 000	33 578	24 298	15 930

Note: Exchange rate of EUR1 = ISK83.270 (2007); ISK115.070 (2008): ISK175.520 (2009).

One way to assess the aforementioned costs is to compare them with the total value of fisheries exports, which was about ISK125 billion in 2007. The total budget of the ICG corresponds to about 2.2 percent of this export value in 2007. However, this includes safety-related tasks carried out by the ICG, but it does not include control and enforcement costs associated with the overall MCS framework, carried out by the Directorate of Fisheries.

Before merging the different functions and services into one integrated system, there were several operational centres (described above). Table 2 gives an indication of the reduction in human resources that took place when creating the integrated system. However, comparisons of overall costs and human resources are difficult, as they tend to evolve over time.

Table 2: Comparison of human resources before and after creating the integrated system

System	Before	After
Coastal radio station system	28	–
Mandatory tracking system	7	–
Icelandic Coast Guard Operations Centre	9	–
New combined centre	–	14
Total number of operators	44	14

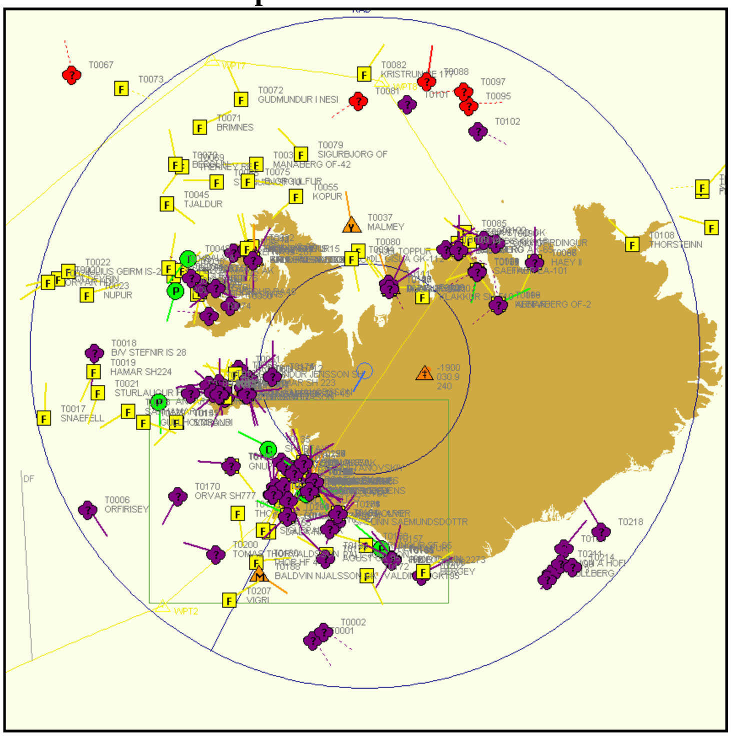
For example, total personnel in the coastal radio system were well over 50 operators when this was used for normal communication services as well as for emergencies. This evolved over time with the introduction of satellite communication as well as mobile telephone services. Use of mobile telephones started in the mid-1980s and spread quickly among fishers, as the signal range covered a large part of the fishing grounds. Just before creating the integrated system, there was only one staffed coastal radio station, the Vestmannaeyjar station located on an island off the south coast.

Box 9: Combination of a VMS and aerial surveillance

One example of effective use of a vessel monitoring system (VMS) and traditional forms of surveillance concerns aerial surveillance. Given that the majority of fishing vessels are being tracked by satellite and/or the Automatic Identification System (AIS), aerial surveillance can take place at higher altitude and thus cover a larger area (i.e. up to a radius of 200 nautical miles). By combining the information collected at the Icelandic Coast Guard (ICG) Operations Centre with the sensors onboard the ICG aircraft, it is possible to identify vessels remotely. Possible intruders or vessels providing false information become the main focus, which together with the high detection radius makes aerial surveillance highly effective and cost-efficient.

The accompanying figure shows a sample tactical plot for the ICG aircraft, flying at an altitude of 20 000 feet. The outer circle has a 200 nautical mile limit. Targets are automatically identified by the AIS, either yellow, green or orange. Positions identified by the VMS are shown in purple. The red targets in the upper part of the plot are of special interest and would normally be the focus of surveillance.

Tactical plot from the ICG aircraft



Many of the new technologies introduced are normally cost-efficient from a human resources perspective. These technologies are also able to perform previously impossible or unrealistic tasks that are now required by law and international conventions/agreements, but which also incur costs in terms of investment in equipment and infrastructure. Gains in terms of effectiveness are significant and evident, but assessing efficiency in terms of value for money would be complex, involving numerous factors and would have to adopt a broad perspective on all the benefits that are being provided (e.g. safety, fisheries MCS, SAR, immigration, and customs). Such a cost–benefit analysis is outside the scope of this study but some indications of gains in terms of effectiveness are indicated as follows.

Volume of automatic position reports

The volume of automatic reports varies according to season and time of day. During peak season, the total number of reports received from the VHF, AIS and satellite-based VMSs can reach as two million reports per day. This is because the frequency of reports in the terrestrial systems (VHF and the AIS) is very high, down to every few seconds if necessary (Box 9). However, the terrestrial systems are dedicated for this use only, so there is no charge for each report such as in satellite services. The cost of running the system is more or less the same for a single report received per hour or one every few seconds.

Volume of manual reports

The volume of manual reports is also variable according to seasons but averages about 10 000 reports every year. That is more than one manual report being received and handled every hour of the year on average – sometimes many more per hour and at other times fewer. Handling of the reports means recording and storing as well as forwarding to different recipients.

Volume of COSPAS/SARSAT reports

In recent years, the volume of COSPAS/SARSAT reports has been very high, especially from the 121.5 MHz emergency beacons, but only a fraction have been true. This is because the system is vulnerable to interference, where the transmissions may provide no identification or position or a false mirror position. The total number of alerts received has been from 600 to 900 per year and although only a small fraction have been true, all these alerts must be investigated until proved to be false alerts. On the whole, only one or two of these alerts have been real, but they have sometimes been the only signal of distress as boats have sunk rapidly, thus a number of lives have been saved.

As listening for emergency beacons on 121.5 MHz has now been terminated in the COSPAS/SARSAT and the new more advanced 406 MHz emergency beacons have been taken into service, the false alert rate has dropped dramatically. These new beacons transmit identification together with the alert and there is also the possibility of an inbuilt GPS receiver in the beacon, giving the actual position, which makes the system much more reliable and further ensures swift reaction. The European Galileo satellite system is expected to further enhance the SAR services with more reliable information and instant alert.

NAVTEX transmissions

The combined operations centre is responsible for broadcasting safety information to mariners. Every month, between 800 and 900 NAVTEX messages are sent from the station. Gale or storm warnings, navigational warnings and other maritime safety and security-related information are broadcast. In addition, the station sends messages in Icelandic language on the national channel at 490 kHz.

Search and rescue operations

There are 90–150 SAR operations conducted annually. These are different in scale, some being solved quickly without a full-scale SAR operation being launched. Others can be extensive, involving a number of SAR units such as patrol vessels, aircraft and helicopters as well as other vessels in the vicinity and ground rescue teams, if the incident is at the coast or inland. The ICG Operations Centre has played a crucial role in a number of cases, launching SAR operations rapidly with instant availability of all necessary information, and thus maintaining control and coordination of the operation.

Emergency ambulance service

An emergency ambulance service is provided both at sea as well as inland. The number of operations varies from one year to another, but on average there are about 50–70. In a number of these operations, helicopters have played an essential role in saving lives.

Inspections onboard vessels at sea

Fishing vessels are boarded every year for inspection of catch, fishing gear, safety equipment and verification of certificates and permits as well as inspection of crew certificates. Typically, the number of such inspections ranges from 200 to 450 per year. Some inspections lead to an area being temporarily closed for fishing (e.g. the percentage of juvenile fish in the catch is high) and others can lead to charges being filed owing to illegal fishing gear, lack of valid certificates either for the vessel or the crew, etc.

6. POSSIBLE IMPROVEMENTS

Safety-related improvements

Some parts of the Icelandic SAR region are out of range of the available helicopters and other rescue units can be far away (Figure 8). Increased traffic has been observed in such areas, including large passenger vessels as well as merchant shipping. Further increase in traffic is expected owing to the melting of polar ice and the opening of new sea routes, which raises concerns about the possible need for mass rescue operations in these areas as well as possible environmental response operations.

A recent multinational SAR exercise showed that the rescue of a large number of people could only be done with another vessel, even in areas within range of the rescue helicopters. The areas that have recently become open to navigation are poorly surveyed or not surveyed at all. Considering the dangers to navigation in these areas, including weather conditions, icebergs and frequent limited visibility due to fog, the authorities in Iceland and Greenland are considering introducing requirements for passenger vessels to sail in pairs, at least, and with a maximum distance between them.

There are plans for installation of new coastal radars, and a location in the southwest corner of Iceland is being considered. This is to monitor traffic in areas to be avoided by vessels over a certain size or carrying dangerous cargo as well as to monitor traffic that is for any reason not visible in the tracking systems. Such a system will incorporate software to compare radar targets with information from other sources (e.g. VMS and the AIS), which will automatically give an alert if a radar target cannot be matched with available information on vessels in that location.

Improvements are also being considered for further utilization of the already installed TETRA gateway onboard the ICG patrol vessels. This would enable emergency services on land to be connected directly with the JRCC if normal means of communication have broken down, i.e. in the event of natural disasters. There are also plans for installing VHF automatic direction finders (ADFs), which would give an instant bearing on a vessel transmitting on VHF channel 16, and to increase the use of satellite communication between patrol units and the ICG Operations Centre, when the former are outside the range of normal communication channels.

Surveillance

Further automation is needed to facilitate data analysis in the context of surveillance, which includes:

- automatic comparison of VMS and AIS data on foreign vessels with data on required manual notifications;

- automatic comparison of VMS and AIS data with data on a vessel’s authorization to operate in a specific area, taking note of its speed, if relevant, for the type of fishing it is authorized;

- checks for positions prior to landing of catch, which verifies whether the vessel was visible in the VMS prior to landing.

Mandatory electronic fishing logbooks (Box 10) for all Icelandic fishing vessels are now being introduced by the Directorate of Fisheries – this step includes the capacity to automatically report catches directly into the system. This is intended to simplify the procedures drastically and ensure prompt delivery and distribution of reports. However, there is still a need for harmonization between countries and RFMOs with the development of a standardized format and content (Box 6).

The use of alternative technologies for vessel detection and monitoring is expected to increase in order to further enhance control and enforcement. This is for example the case with satellite radar images that are used as the Vessel Detection System (VDS) (Box 11). This is to distinguish from the satellite-based VMSs that require vessels to have equipment onboard that is continuously transmitting data on their position and bearing. This may not be evident for the non-specialist, so one should consider that a vessel may not be transmitting owing to technical problems or simply because there is no transmitter onboard or because it has intentionally been switched off. Provision of false position data by the vessel is also possible. In order to detect possible illegal activity, particularly for offshore and/or in international waters, authorities have to use alternative methods such as the VDS in combination with traditional means (i.e. patrol vessels or aircraft).

Box 10: Trials with computerized reporting software onboard fishing vessels

In the late 1990s, the Icelandic Coast Guard (ICG) produced fishing-logbook reporting software that was used for a four-year trial period onboard an Icelandic fishing vessel during its operation in the North East Atlantic Fisheries Commission (NEAFC) regulatory area. The trial was very successful. Reports were transmitted from the vessel via Inmarsat C direct to the X.25 VMS address in Iceland and forwarded to the NEAFC Secretariat in London, with positive acknowledgement from London within three minutes, on average, after transmission from the vessel.

In addition to translating the catch and activity reports into the North Atlantic Format (NAF), the software kept track of all messages and ensured that they were transmitted in the correct sequence, were correctly numbered according to areas and the current year, and automatically showed the FAO species code and the species name as well as the total catch quantity by species in each fishing trip. This made it much easier for the captain and reduced the workload at the ICG Operations Centre, as it eliminated manual reporting. In addition, mistakes in constructing the reports in the NAF were eliminated.

As a follow-up, the Ministry of Fisheries has financed a commercial version and this has now been distributed to some vessels for trial. Software like this, either standalone or as part of an electronic logbook system, is essential owing to increasing requirements for daily catch reporting. The general rule in the NEAFC has been for weekly catch reporting, but this has increased to daily reports in certain types of fisheries, which appears to be the trend.

Recently, the cost of using the VDS was compared with traditional aerial surveillance, i.e. the cost of flight against the cost of a satellite image. At the time, the cost for a single satellite image was EUR2 180 and the cost of a flight hour on an F-27 patrol plane was calculated as EUR1 775. This has since changed as the cost of satellite images has gone down and the ICG has taken a new patrol aircraft into service. However, it is clear that a single image is now cheaper than the flight hour and, consequently, justifiable to buy satellite images, especially of distant areas, to determine whether there is a need for aerial or surface surveillance or not.

Like other systems, the VDS has its limitations and should only be considered as a complementary tool in MCS. The advance ordering of an image is one such limitation as well as the availability of radar satellites. Smaller vessels or the use of certain materials do not give a good reflection and are not necessarily detected. Sea surface conditions are also a factor and can give false echoes. It takes experience for operators to learn to filter through what are actual targets.

As there can be a time difference between the time of the satellite radar image and the actual poll, correlations cannot always confirm a target as known even though there may be a VMS position in the vicinity. However, it is straightforward for an experienced operator to determine this.

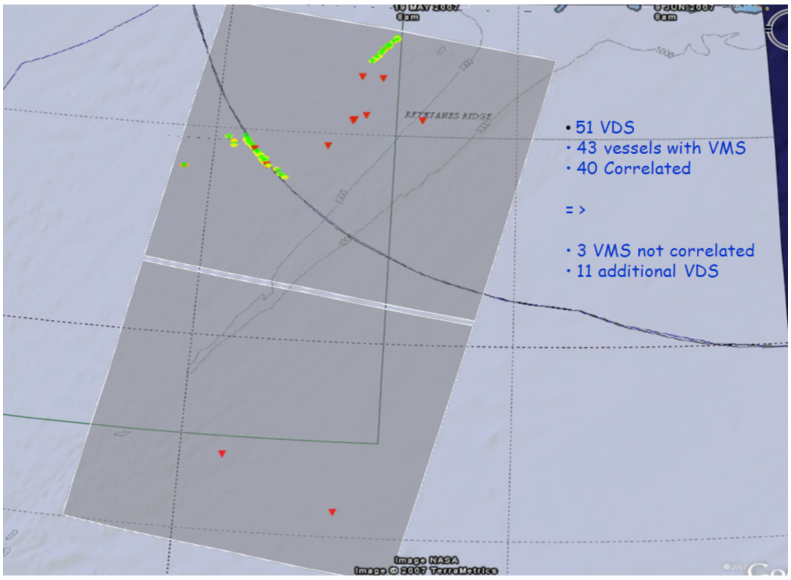
The ICG has collaborated with the Joint Research Centre of the European Commission (JRC) in other areas such as the Flemish Cap, and continues to do so in the Irminger Sea.

Box 11: The IMPAST Project

In 2001, the ICG joined the Improving Fisheries Monitoring through Integrating Passive and Active Satellite-based Technologies (IMPAST) Project, which was coordinated by the Joint Research Centre of the European Commission (JRC). The aim of the project was to investigate how satellite radar could be used in fisheries control (Vessel Detection System [VDS]). The project lasted for three years, and one of the focus areas was the Irminger Sea to monitor the redfish fishery. The problem was that there were several vessels operating illegally and these vessels were under flags of countries that were not members of the North East Atlantic Fisheries Commission (NEAFC).

Satellite radar images of 300 km × 300 km were used. As the satellite came over and scanned the area with the space borne Synthetic Aperture Radar, the relevant fisheries monitoring centres of NEAFC members extracted the positions of their vessels in the area with a poll command. The collected VMS reports were transmitted to the JRC, where a correlation was made between the identified vessels in the area and the radar targets. The result of the correlation was transmitted to the participants in the project as surveillance targets in a nautical chart indicating known, unconfirmed and unknown echoes (see accompanying figure).

Correlation between VMS and VDS data on 19 May 2007



Note: The targets shown in red were non-identified vessels.

7. CONCLUSION

The setting up of an integrated system for the monitoring of all maritime-related activity is groundbreaking and, in the case of Iceland, this is also a recent initiative. A common understanding was reached among the various institutions, organizations and stakeholders involved. This process of reaching a consensus took time and it was met with some resistance.

One of the major stumbling blocks was the assumption that the fishing industry would not collaborate in such an integrated system, the view being that safety aspects should be maintained separately from control and enforcement. This resistance was overcome and the assumption proved to be false, which supports the reasoning that fishers will generally collaborate and see the benefits of an efficient MCS system to eliminate IUU fishing in a well-managed fishery. The same rules and regulations apply to all involved in fishing, thus eliminating unfair competition and ensuring sustainable fishing.

Overall operational aspects have been greatly enhanced in the three main functions of the ICG: (i) VMS for safety, security and surveillance purposes in the Icelandic EEZ; (ii) provide the MTS and function as the SPOC for all maritime related notifications (and the MRCC); and (iii) fisheries monitoring and surveillance. All maritime-related information is now collected in one place and used jointly by various institutions for different purposes. This results in cost savings and substantial gains in effectiveness, particularly in terms of coordination of operations. The relevant information is instantly available in the case of emergencies, making the response time short for the rapid launching of patrol units, rescue teams and contact to other vessels in the vicinity of the vessel in distress, depending on the situation.

Safety and security issues are integrated in the system. In the past, there tended to be a distinction between these, as safety is more related to vessels in terms of dangers to navigation, weather conditions or technical failures. On the other hand, security concerns protection against human-induced scenarios, normally of an illegal nature (e.g. smuggling, drug trafficking, illegal immigration, and terrorism). However, the current trend is for an integration of these two aspects.

As in every system, there are disadvantages, although in this case the advantages are far greater. One possible disadvantage could be expressed as “having all the eggs in the same basket”. The workload under emergency situations can reach such levels that regular operations may be neglected. However, this is compensated for by moving such operations into the JRCC, which operates with extra personnel. Another aspect is that operators handle a wide variety of information and issues, which is demanding and requires experienced staff with solid backgrounds in fisheries and maritime activities.

The integrated system for MCS consists of several components or tools. These are traditional means of surveillance by patrol vessels and aircraft, VMS and satellite imagery as well as the various requirements for notification and reporting. All of these different components are useful as part of the overall MCS framework, but all of them have their limitations. It is fundamental to use these various tools in combination as in the integrated system, which makes each tool and the overall MCS framework effective.

Satellite-based VMSs are generally considered as effective tools for MCS, but it is not always evident to the non-specialist that this requires vessels to have equipment onboard that is continuously transmitting data on their position and bearing. This entails an investment cost that may not always be the best solution (i.e. small-scale fisheries). In more general terms, there are two main problems associated with these systems: (i) the ability of seemingly cooperative vessels to tamper with their VMS hardware and thus transmit intentionally false positions; and (ii) the inability to detect IUU fishing vessels that are not fitted with VMS or vessels that are not reporting. Thus, if the primary objective for implementing a VMS is to identify illegal fishing by foreign vessels, this will meet with failure as these vessels will most probably not be transmitting their position. Patrol vessels or helicopters are needed to board vessels for inspections and/or arrests as well as for visual identifications, when that is needed. As illustrated in this case study, a satellite-based VMS (or the

VDS) cannot replace the traditional means of surveillance (i.e. patrol vessels or aircraft) in the fight against IUU fishing, but integrating the various available tools can make this much more effective overall.

It is acknowledged that in many aspects Iceland may present a unique situation – the importance of fisheries, being a relatively small country, its particular historical evolution and institutional setup, etc. This may have made the creation of a joint operations centre more feasible. However, the underlying concepts of closer collaboration among related institutions and organizations at the national level through creative and dedicated approaches can be adapted to a wide variety of circumstances.

The integrated system has proved to be effective in combating and eliminating IUU fishing operations in the Icelandic EEZ and in the North Atlantic. The approach of using all available data is emphasized – identification of vessel, movements, IUU lists, notifications, reports, fishing licences, permits, port state control reports, etc. However, it is important to point out that this has been the result of collaborative efforts among countries and RFMOs in the North Atlantic. The functioning of the integrated system in Iceland entails significant investment and running costs, which may not be suitable for a developing country, but the purpose of this study is to illustrate the benefits in terms of effectiveness and savings when adopting an integrative approach. In many cases, investments are necessary and inevitable owing to international obligations in the field of maritime affairs and fisheries, so the best possible solutions should be studied.

REFERENCES

FAO. 1998. *Fish operations. 1. Vessel monitoring systems*. FAO Technical Guidelines for Responsible Fisheries No. 1, Suppl. 1. Rome. 58 pp.

FAO. 2007. *Report of the Expert Consultation on the Use of Vessel Monitoring Systems and Satellites for Fisheries Monitoring, Control and Surveillance, Rome, 24–26 October 2006*. FAO Fisheries Report No. 815. Rome. 68 pp.

FAO/FishCode. 2005. *Reports of the regional vessel monitoring systems workshops: Indian Ocean, Central America, the Caribbean and Southeast Asia*. FAO/FishCode Review No. 14. Rome. 91 pp.

Flewwelling, P. 1995. *An introduction to monitoring, control and surveillance for capture fisheries*. FAO Fisheries Technical Paper No. 338. Rome. 217 pp.

Flewwelling, P., Cullinan, C., Balton, D. & Reynolds, J.E. 2002. *Recent trends in monitoring, control and surveillance systems for capture fisheries*. FAO Fisheries Technical Paper No. 415. Rome. 200 pp.

Gallagher, R. 2005. *Fishing vessel monitoring systems: past, present and future*. Prepared for the High Seas Task Force, OECD, Paris, 17 October 2005. Navigs, sarl.

Kelleher, K. 2002. *The costs of monitoring, control and surveillance of fisheries in developing countries*. FAO Fisheries Circular No. 976. Rome. 47 pp.

Web sites

Directorate of Fisheries, Iceland: en.fiskistofa.is/
Icelandic Association for Search and Rescue: www.icesar.com
Icelandic Coast Guard: www.lhg.is
Icelandic Maritime Administration: skip1.sigling.is/english/
International Maritime Organization: www.imo.org
Ministry of Fisheries and Agriculture, Iceland: www.fisheries.is

ANNEX 1

Technical characteristics

Patrol vessels

The Icelandic Coast Guard (ICG) operates two offshore patrol vessels, *Týr* and *Ægir*. The vessels are 70 m long, especially designed for coast guard duties, including salvage and search and rescue (SAR). The vessels were built in 1968 and 1975, respectively, and have been fitted with the latest technology for navigation and communication as well as major modifications to the bridge. For data communication, the vessels are equipped with a V–Sat system, which is a broadband data connection giving steady access to the Internet as well as the ICG's information systems. There is a fixed price per month for V–Sat services with an unlimited volume of data. Internet access is available in every cabin of the vessels, giving the crew full and constant access.

The vessels are equipped with twin engines, twin rudders and a helicopter landing platform as well as an inflight refuelling system. These vessels are armed with one Bofors 40 mm cannon and have a top speed of more than 20 knots. They are also reinforced for navigation in ice and are able to operate in extreme weather conditions. The crew is rather small with a total of only 18.

Helicopters

Helicopters are used for SAR, ambulance flights and inshore patrols. There are two Super Puma helicopters and one Dolphin, but there are also plans to purchase new all-weather SAR helicopters in cooperation with the Norwegian authorities. Helicopter operations increased significantly in 2006, following the departure of the United States military forces from Iceland, so that larger more capable helicopters were taken into use.

Although the primary objective is emergency services, helicopters are also used for maritime surveillance in near-shore areas and are also used to place inspectors on board fishing vessels. The ICG Operations Centre is capable of activating helicopters for emergencies at very short notice.

Multipurpose offshore patrol vessel

A new multipurpose offshore patrol vessel has been built and it was expected to be delivered in early 2010. However, delivery has been delayed by the earthquake that struck Chile in February 2010. The vessel is 94 m long and 16 m wide, equipped for salvage, SAR, pollution control and hydrographical surveys. She was launched in April 2009 and given the name *Þór* (*Thor*). The vessel is equipped with two engines, two propellers and twin rudders, two bow thrusters, one foldable 360° azimuth thruster and one stern thruster. The bollard pull will be 120 tonnes and maximum speed about 20 knots. The *Þór* is equipped with a combined dynamic positioning–joystick steering system, enabling the vessel to hold position and attitude (heading) steady under normal operating conditions.

The vessel is not configured for helicopter operations, as the long-range helicopters in use are relatively large and would not be suited to operating from a vessel of this size. Instead, the vessel is equipped with a helicopter inflight refuelling system, making it possible to fuel helicopters while hovering over the vessel.

There will be equipment onboard for environmental response operations, large tanks for polluted water and a FIFI1 fire-fighting system. The *Þór* will be well equipped for monitoring, control and surveillance (MCS) with sophisticated surveillance equipment especially designed for boarding operations and inspections. The vessel will also act as a communication centre for helicopters in area by relaying their reports to the ICG Operations Centre and back.

Maritime patrol aircraft

The ICG has been using aircraft for maritime surveillance continuously since 1955. The first aircraft was a PBY Catalina seaplane and later a Douglas DC-4, but Fokker F-27 aircraft have been used since 1972.

In 2009, the ICG took delivery of a new maritime patrol aircraft of the type Dash-8 (Figure A1.1), made by Bombardier in Canada. The aircraft was converted by Field Aviation in Canada, which installed various pieces of equipment for maritime surveillance. The aircraft has a range of 2 200 nautical miles, a normal cruising speed of 180–240 km per hour and an endurance of ten hours. Communication systems installed include HF, VHF, UHF, cellular, Terrestrial Trunked Radio (TETRA) and satellite. The maritime search radar has a 360° view, especially designed for detecting small targets in rough seas as well as larger targets when the aircraft is operating at an altitude of 25 000 feet. Side looking airborne radar (SLAR) systems are installed with antennas on both sides of the fuselage to detect pollution and ice. Stabilized infrared and video cameras allow for day and night operation, enabling the crew to identify vessels in low light conditions as well as from a distance.

The Dash-8 Q300 with its sophisticated surveillance equipment is revolutionary in maritime surveillance, as vessels can be detected and identified from a distance, enabling it to fly at higher altitudes and therefore greatly extend the radar horizon – making it possible to pick up a vessel at a distance of up to 200 nautical miles. This, combined with the aircraft's AIS receiver as well as tracking data from the VMS at headquarters, makes remote identification possible and minimizes the need for low-altitude visual identification. If a visual identification is needed, this can be done from a distance of several miles owing to sophisticated electro-optical and infrared camera systems with zooming and lock-on target function as well as laser illumination for night operations.

Figure A1.1: The new Dash-8 aircraft operated by the ICG

Coastal radar

Currently, only one radar station is operated to monitor vessel traffic off the coast of Iceland. This is a regular X-band marine radar, which is located on an island off the south coast and has the main function of monitoring traffic around the Canadian transatlantic telephone communications cable (CANTAT). The radar is owned by Iceland Telecom but operated by the MTS under a special contract. The radar is also used for general surveillance in the area and the radar picture displayed at the ICG Operations Centre.

Rescue boats

The Icelandic Association for Search and Rescue (ICE-SAR) operates a network of high-speed, rescue boats (Figure A1.2) around the coast as well as ground rescue teams that can be activated from the ICG Operations Centre. These boats can also be made available for coast guard duties if needed, but their main purpose is for emergency response operations. These boats are also frequently used in assisting fishing boats all around the coast. The ICE-SAR is composed of numerous volunteer rescue workers and is financed mainly by voluntary donations. One of its main sources of income is selling fireworks at New Year.

Figure A1.2: Rescue boat operated by the ICE-SAR

Icelandic Coast Guard Operations Centre

The joint centre is equipped with various communication and computer systems as well as remote-controlled equipment in locations around the coast. There are two wall-mounted large liquid-crystal-display (LCD) screens in the main room where all information from the tracking systems as well as any other information from the information system can be displayed. There are monitors from closed-circuit television (CCTV) cameras installed in the ICG hangar at Reykjavik airport as well as the ICG pier in Reykjavik harbour. There is a chart table containing a selection of nautical paper charts in addition to the electronic charts and navigation software on the work stations.

All communications, telephone and radio, are recorded in a computerized recording system with an instant, short-time playback function at the work stations as well as long-time playback recording for further analyses when needed.

Work stations

There are four work stations in the centre, three together in one room and one in a separate adjacent room, which can be isolated by a glass wall and glass door. All four stations have the same capability for communication and access to computer systems and software. They are all equipped with five LCDs except the main controllers' station, where there are seven LCDs enabling the operators to display multiple information and control the communication systems at the same time. Up to four LCDs are connected to one computer, thereby reducing the number of keyboards and trackballs.

Computer systems

The central server system is a combination of Windows and Linux servers, Windows domain controller, file and print servers, Exchange mail server, Windows and Linux database servers and Linux name and web servers.

Communication systems

The centre is equipped for communication in conformity with the regulations of the Global Maritime Distress and Safety System (GMDSS) as well as communication with the ICG helicopters, aircraft and vessels. In addition, the centre is equipped with a TETRA communication system (Table A1.1).

Recently, the whole GMDSS coastal radio system was renewed with a high-technology digital system, greatly simplifying procedures in the ICG Operations Centre and at the same time increasing communication capacity. All stations around the coast are fully controllable from each work station at the centre. Any or all remote stations can be selected. The VHF stations are configured for 90 channels, including international VHF channels, duplex or simplex.

Table A1.1: Communication systems at the Icelandic Coast Guard Operations Centre

Item	Number	Location	Remarks
VHF	52	All around the coast	Digital system with digital selective calling
MF/HF receivers	28	All around the coast	HF receivers are tunable from 10 kHz to 30 MHz
MF/HF transmitters	2	At different locations	HF receivers are tunable from 10 kHz to 30 MHz
Inmarsat C	2	Local	–
TETRA	1	Local	In a network with numerous remote stations around the coast and inland
VHF automatic direction finder	1	Local	–
VHF tracking	60	All around the coast	Network of base and repeater stations connected in a network into the centre
Automatic Identification System	25	Around the coast	Number of new stations to be installed. Will eventually replace VHF tracking

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