

Final Report

Northern Irish CCTV Trials: 2009

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Executive Summary

Irish Sea CCTV camera trials were conducted during September 2009, in the Northern Irish *Nephrops* fishery out of Ardglass. An array of 3 standard definition cameras and associated hardware were installed on the *Nephrops* trawler MFV Supreme, fishing a dual-purpose 22 fathom single-rig net with 70mm cod end, co-owned by Leo McGirr and Simon Wills (skipped by Leo McGirr).

The aim of the project was to evaluate how effective CCTV technology was in assessing the cod bycatch as a percentage of the total catch in this fishery. In particular, the intention was to find a way of enhancing the monitoring of a sector of the fleet potentially excluded from cod recovery measures by virtue of that sector accounting for <1.5% of cod in the total catch.

Results from the first series of trials (9–11 September) showed that, where crew catch-handling was modified, accurate assessments of cod live weights and hence percentage cod in the total catch could be made by video analysis in a cost-effective manner. Conversely, the initial trials also highlighted problems with species recognition of fish <30 cm total length.

A second series of trials conducted from 23 to 27 September focused on whether or not the CCTV equipment could accurately assess the cod bycatch independent of any modified catch handling. Results indicated that video analysis failed to identify 81% of cod catches (by number). This was due to the small size of the cod being caught (mainly 12–20 cm), the presence of morphologically similar species (whiting, blue whiting, poor cod, haddock and Norway pout) in the catches, and the manual sorting and discarding procedures used on board.

The findings show that CCTV technology is perhaps not the most effective tool for monitoring small-mesh fisheries, such as the trawl fishery for *Nephrops*. The results do, however, support further investigation of the utility of CCTV technology in fisheries where larger fish are encountered (e.g. otter trawls using 120mm+ cod ends) or more selective fisheries (such as gillnetting or longlining), where gear (and by default, fish) retrieval is at a steady rate.

The Fisheries Science Partnership

The Fisheries Science Partnership (FSP) is a Defra-funded collaborative programme of scientific research between the UK fishing industry and scientists. Since it was established in 2003, the programme has undertaken some 60 projects, including investigations into fishing gear selectivity, the examination of spatial patterns and catch compositions, and time-series of relative abundance of commercial species. A full description of the development, aims and reports of the FSP programme can be found on the Cefas website (www.cefas.co.uk)

Introduction

The purpose of this project was to investigate whether CCTV technology could be used as a cost-effective means of monitoring the quantity of cod bycatch within the Irish Sea *Nephrops* fishery. In particular, the intention was to find a way of increasing the monitoring of a sector of the fleet potentially excluded from cod recovery measures, by virtue of the vessels catching <1.5% of the total catch as cod. Information from the project will be used to inform future monitoring and will be used in submissions to the European Commission on the level of cod catches from this sector of the fleet.

Methods

The fishing vessel “Supreme” (CN180) was selected to participate in the trials through an open tender process. It is a 16.16 m (LOA) wooden-hulled prawn trawler powered by a 229 bhp Gardner engine.

The fishing gear used during the trial consisted of a 22 fathom dual-purpose single-rig net with 70 mm codend, fished off 30 fathom bridles with 8 fathom rubber legs. The trawl doors were 6 foot Dunbar design.

Survey design

The first part of the trial consisted of a period of three sea-days, during which cameras were sited in the most appropriate positions available to monitor catches. It also allowed the observer the opportunity to become familiar with the recording equipment and the vessels catch-handling procedure. During this part of the trial, there was a requirement of the vessel’s crew to record details of total catch weight, along with numbers and estimated weights for any cod caught, whether retained or discarded. This information will be compared with data extracted from the video footage to evaluate the potential for video footage to be used to validate additional records completed by fishers. Based on the findings from Part 1 of the survey, the second leg (Part 2) trial was modified so that the only requirement for the crew of the vessel

was that all cod be placed in baskets and/or processed (i.e. no cod was to be discarded directly from the pound). This was done to test how effective the CCTV equipment and footage would be at assessing the cod catch independent of any modified crew behaviour.

Sorting and processing the catch

The aim of the project was to evaluate whether or not the CCTV equipment was capable of accurately assessing the percentage of cod in relation to the total catch, independently of any modified catch handling. As such, the only condition placed on the crew was that no cod was to be discarded directly from the pound (as is common practice in many fisheries where fishers believe that returning the fish to the sea in a timely manner will increase the chances of the fish surviving). The observer was also given the opportunity to sort through baskets to identify and measure cod where present before re-basketing and processing by the crew as normal.

CCTV monitoring equipment

Appendix 3 gives a detailed description and specifications for the CCTV camera equipment.

Several camera positions were trialled during the trips, as were a variety of lenses (ranging from 2.1 to 12 mm) on the cameras. The most suitable locations for cameras were determined through trial and error through Part 1 and the early stages of Part 2. Final positions and mountings are shown in Figures 1 and 2.

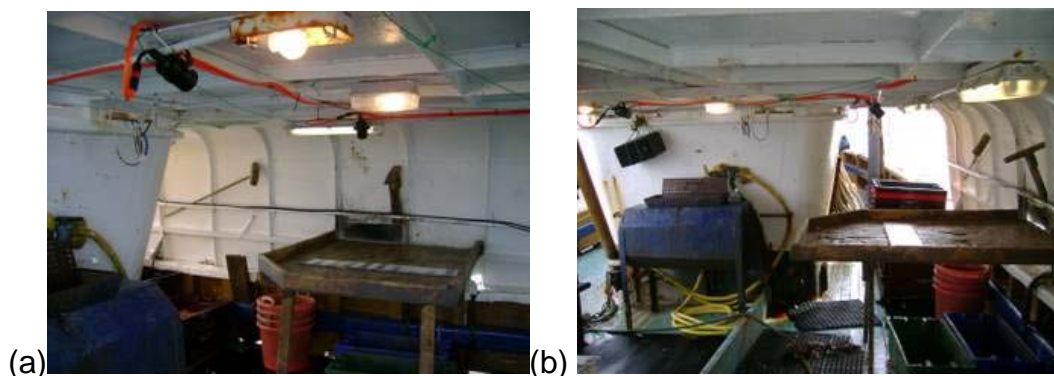


Figure 1. (a) Locations of the main sorting table (8 mm lens) camera (top left) and the discard monitoring camera (6 mm lens) above the sorting table. (b) The same cameras viewed from a forward position. Note the proximity of the discard camera to the sorting table.



Figure 2. View of the third camera (3.6 mm lens), located to observe the codend as it was hauled on board, to monitor possible slippage, to quantify the total catch, and to monitor the starboard warp to interpret fishing activity. The camera was mounted on a 600 mm extension arm to give greater coverage and to ensure that the camera was clear of lifting rigging.

Catch Assessment

In order to fulfil the requirements of the project, an estimate of total catch per fishing event, along with estimates (by length) for all cod (*Gadus morhua*) were required. During the first few days of Part 1 of the trial, all baskets were weighed, and the values averaged to provide a nominal average basket weight of 19.68 kg. This value was used for the remainder of the Part 1 trials, along with all hauls conducted during part 2 trials. As mentioned above, Part 1 trials involved a modified catch-handling regime, whereby all cod caught were to be passed over a fixed measuring board mounted on the sorting table prior to further processing and/or discarding. Actual basket counts, along with length measurements and the fate of all cod caught were recorded for all tows conducted during the trip. Video-footage was subsequently analysed on land (Part 1 trials by 1 person, Part 2 by 2 persons). The data collected included an estimate of total bulk (basket count + any observed discarding direct from the pound), presence or absence of cod, the fate of the cod observed, and an estimate of individual fish lengths. The length data were subsequently converted to a weight estimate by means of the conversion factor $W = aL^b$, where W is the fish weight (g), $a = 0.010752$, L is fish length (cm), and $b = 3$ (derived from data collected on AFBI trawl surveys of the Irish Sea up to 2000).

Where discrepancies in video analysis were identified (for Part 2 trials only), footage was reviewed again by both analysts in an attempt to resolve them.

Results

Part 1

Part 1 trials took place over the period 9/09/2009–11/09/2009. A series of 8 valid tows was completed during the period. Catches remained fairly consistent in terms of species composition, and ranged from a minimum of 248 kg total bulk up to the largest catch of 512 kg.

Cod were not always present in the catch, but when present, constituted <1.5% of the total by weight throughout. Table 1 below describes tow quantities, cod by number, weight and as a percentage of the total catch for Part 1 hauls measured by the observer, and as estimated by the skipper and the video analyst.

Table 1. Part 1 cod catches as observed by the observer, the vessel and the video analyst.

Haul number	Analyst	Bulk estimate (kg)	Retained cod, number	Retained cod, est weight	Discard cod, number	Discard cod, est weight	% Cod in total catch
1	OBS	435.5	2	3.74	5	0.4	0.95
	VESSEL	440	2	3.5	5	0.5	0.91
	VIDEO	403	2	4.2	5	0.41	1.14
2	OBS	383.07	0	0	6	0.16	0.04
	VESSEL	385	0	0	6	0.1	0.03
	VIDEO	384	0	0	6	0.23	0.06
3	OBS	247	0	0	0	0	0
	VESSEL	270	0	0	0	0	0
	VIDEO	256	0	0	0	0	0
4	OBS	477	0	0	2	0.04	0.01
	VESSEL	500	0	0	2	0.25	0.05
	VIDEO	487	0	0	2	0.06	0.01
5	OBS	512	0	0	0	0	0
	VESSEL	480	0	0	0	0	0
	VIDEO	512	0	0	0	0	0
6	OBS	374	0	0	0	0	0
	VESSEL	360	0	0	0	0	0
	VIDEO	394	0	0	0	0	0
7	OBS	305	0	0	1	0.02	0.01
	VESSEL	300	0	0	1	0.1	0.03
	VIDEO	305	0	0	1	0.02	0.01
8	OBS	320	0	0	3	0.1	0.03
	VESSEL	320	0	0	3	0.1	0.03
	VIDEO	315	0	0	3	0.1	0.03

Video analysis of the hauls was reasonably straightforward, because the modified catch-handling regime meant that general processing of the catch did not require analysis, all cod being retained until the entire catch had been sorted. This meant that time for analysis was limited, i.e. footage of the catch as it was placed in basket was viewed (10–15 min per tow), then the footage at the end of processing was analysed to determine the number, estimated length and fate (retained or discarded) of all cod caught during that event. Therefore, all required information and estimates could be made from the analysis of approximately 0.5 h of footage per fishing event. The average processing time per haul throughout this part of the survey was just under 2.5 h, with a minimum of 2 h and a maximum of 3.5 h. Hence, three days of fishing effort were able to be analysed by one analyst in ~4 h.

Figure 3 shows the actual (observed) length frequency data for the eight hauls completed during Part 1, along with the length frequency data obtained from the video analysis.

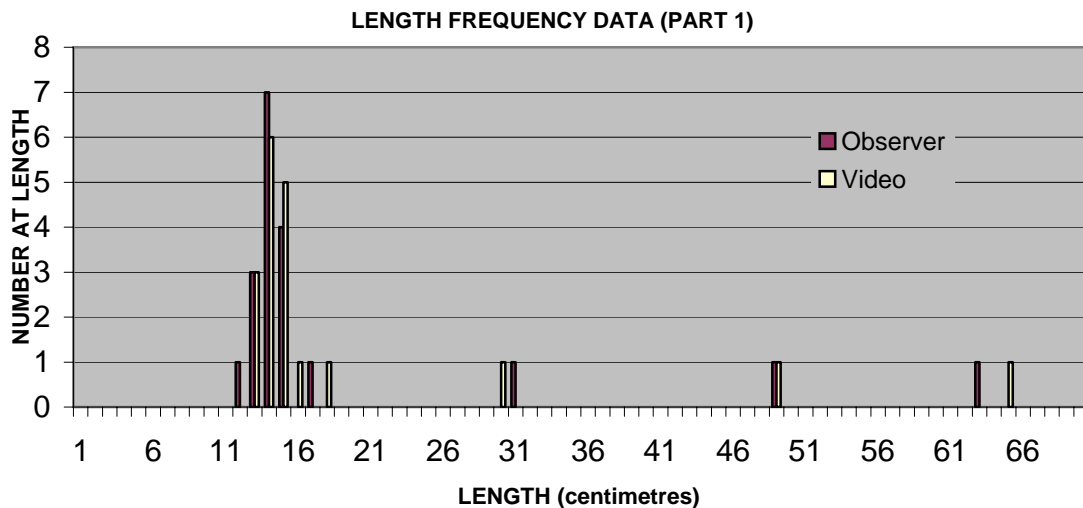


Figure 3. Length frequency data showing observed length frequency data along with length frequency data obtained from video footage.

The total number of cod observed by the observer, the vessel skipper, and the video analyst was equal, with slight discrepancies only in the length estimates made by the video analyst. Of the 19 cod caught throughout this period of the trial, length estimates and actual lengths matched in 11 cases, were ± 1 cm for 7 hauls, and the video estimate was 2 cm greater than the actual length on 1 occasion. A similar study carried out in the North Sea (Course, 2009) reported similar findings: when there was a condition upon the crew or the observer to place all cod on a measuring board prior to further processing and/or discarding, length estimates could be made by video analysts to ± 5 cm.

Length estimates collected through the video analysis were then converted to an estimated whole weight using conversion factors calculated from Northern Irish groundfish surveys (early 1990s–2000), which allowed cod percentage

(by weight) of the total catch weight to be calculated. Again, in 6 of the 8 hauls, observer data matched that of the video analysis, and there was only slight variation in the percentages calculated, the largest (+0.19%) being attributed to the overestimated (+2 cm) length of the largest fish retained through the Part 1 trials, which added 0.26 kg to the overall weight of cod for that tow.

Part 2

Part 2 trials were carried out over five consecutive fishing days, 23–27/09/2009. In all, 12 valid tows were conducted. Once again, cod catches were sporadic, with low numbers, and cod present in just 9 of the 12 tows completed. Modifications to the CCTV equipment for Part 2 trials included relocating the cameras to positions (with appropriate lenses) aimed at maximising the potential to identify small cod positively and setting the camera resolution and quality to maximum possible values. Over the course of the five days at sea, the video data collected amounted to approximately 128 GB of data stored out of a possible 320 GB.

Table 2 provides summary figures collected by the observer and two video analysts. Cod catches remained <1.5% by weight in all but the last tow, where cod accounted for 2.31% (10.25 kg) of the total catch of 443 kg. Otherwise, the percentage estimates showed some variability, but in all cases the variability did not affect whether the estimate was above or below the critical level of 1.5%. There was total agreement between observer and video analysts on the numbers of cod retained, but some variation in estimated weights of those cod, based on variations in length estimates made by the video analysts.

In all, 69 cod were caught (10 retained, 59 discarded) throughout Part 2 trials. Of these, just 13 (10 retained, 100% by number; 3 discarded (5% by number) were identified positively by both video analysts. These values show that just 19% (by number) of cod caught were positively identified by video, but that 82% (by weight) of the cod were positively identified.

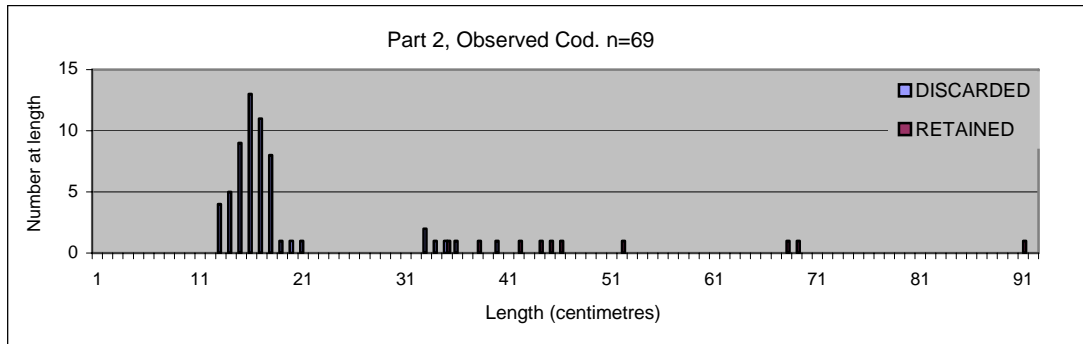
The length distributions (Figure 4) clearly show that the video equipment and subsequent analysis failed to identify any cod <30 cm, which by number accounted for the majority of the cod catch by number. This was due to a number of factors, namely camera resolution, catch composition, and the volume and condition of the discarded portion of the catch.

Addressing the catch composition, detailed discard sampling conducted on Days 1 and 2 of Part 2 trials showed discarding rates of between 62 and 79% by volume. Highest rates were on 23 September, when tidal conditions were only just starting to improve. On that day just 5 or 6 vessels sailed (of the approximately 30-strong Ardglass fleet), and all (excluding the “Supreme”) returned to port after their first haul, owing to the poor nature of the catches.

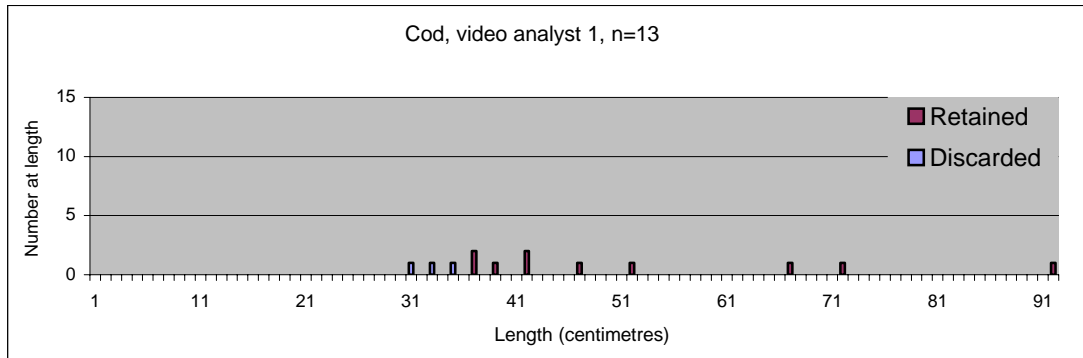
Table 2. Part 2 cod catches as observed by the observer and two video analysts.

Haul number	Analyst	Bulk estimate (baskets/kg)	Retained cod, number	Retained cod, est weight	Discard cod, number	Discard cod, est weight	% Cod in total catch
1	OBS	6.2/122	0	0	0	0	0.00
	VID 1	6.5/128	0	0	0	0	0.00
	VID 2	6.33/125	0	0	0	0	0.00
2	OBS	9.5/187	0	0	0	0	0.00
	VID 1	9.1/179	0	0	0	0	0.00
	VID 2	9.0/177	0	0	0	0	0.00
3	OBS	16.5/325	0	0	1	0.352	0.11
	VID 1	17.5/344	0	0	1	0.290	0.08
	VID 2	15.5/305	0	0	1	0.422	0.14
4	OBS	11.3/222	1	0.5	1	0.386	0.40
	VID 1	11.3/222	1	0.461	0	0	0.21
	VID 2	11.0/216	1	0.352	0	0	0.16
5	OBS	13.5/266	1	1.344	1	0.044	0.52
	VID 1	13.3/262	1	1.344	0	0	0.51
	VID 2	12.0/236	1	1.344	0	0	0.57
6	OBS	20.25/399	1	0.62	10	1.283	0.48
	VID 1	19.5/384	1	0.688	1	0.352	0.27
	VID 2	19.75/389	1	0.796	1	0.688	0.38
7	OBS	15.5/305	2	1.34	6	0.233	0.52
	VID 1	14.5/285	2	1.005	0	0	0.35
	VID 2	15.5/305	2	1.429	0	0	0.47
8	OBS	18.5/364	1	0.92	13	0.626	0.42
	VID 1	18.3/360	1	0.688	0	0	0.19
	VID 2	19.5/384	1	1.047	0	0	0.27
9	OBS	7.5/148	0	0	0	0	0.00
	VID 1	8.75/172	0	0	0	0	0.00
	VID 2	8.75/172	0	0	0	0	0.00
10	OBS	13.5/266	1	3.58	6	0.221	1.43
	VID 1	13.0/256	1	3.233	0	0	1.26
	VID 2	12.3/242	1	1.788	0	0	0.74
11	OBS	21.0/413	1	0.94	8	0.271	0.29
	VID 1	20.5/403	1	0.980	0	0	0.24
	VID 2	19.0/374	1	0.688	0	0	0.18
12	OBS	22.5/443	2	9.08	13	1.169	2.31
	VID 1	22.0/433	2	10.791	1	0.291	2.56
	VID 2	21.0/413	2	6.622	1	0.741	1.78

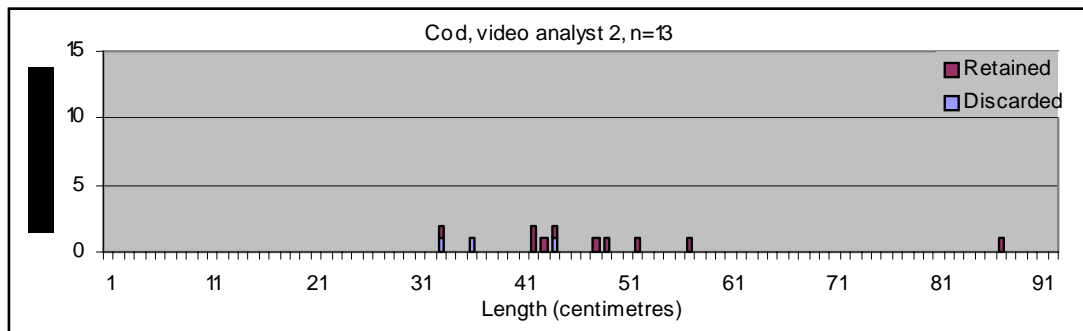
Also, owing to logistic and delivery problems with the CCTV equipment, the Part 2 trial was conducted at the very end of the Northern Ireland *Nephrops* fishery, when catch rates and estimated discard rates may not be indicative of the fishery as a whole.



(a)



(b)



(c)

Figure 4. Length frequency distributions for Part 2 trials. (a) Observed (actual) length distribution. (b) Video analyst 1 estimated length distribution. (c) Video analyst 2 estimated length distribution.

By the process of raising discard subsamples, it was estimated that an average of 2172 fish, all mixed gadoids ranging from 7 to 26 cm (whiting *Merlangius merlangus*, poor cod *Trisopterus minutus*, blue whiting *Micromesistius poutassou*, haddock *Melanogrammus aeglefinus*, and Norway pout *Trisopterus esmarkii*) were being discarded per tow (this value does not include other species present in the discards). As these species share many morphological traits with cod, it would be necessary to identify all these fish as not being cod in order to positively identify the actual cod, which at the size ranges encountered proved impossible through video footage. Figure 5 provides a still photograph from the discard camera with Norway pout, blue whiting, whiting, haddock and cod in the frame.



Figure 5. Top left shows (from top) Norway pout, blue whiting, whiting, haddock and cod.

Add to this the presence of significant volumes of other discard species, including elasmobranchs, flatfish, smaller *Nephrops* and *Nephrops* heads, and a video analyst's ability to discriminate all fish, let alone positively identify them, is greatly reduced. Similarly, the nature of the catch-handling process on the sorting table did not provide a single stream of individual fish under the camera, but rather aggregations of fish. These comprised smaller *Nephrops*, *Nephrops* heads and other discarded species directed towards the discard chute either by hand or by way of a timber shovel. Figure 6 shows a screen grab of a typical view provided by the fish catch monitoring system. The top left image shows the area adjacent to the discard chute/slot. Obviously, a closer view would potentially increase the likelihood of positive identification of cod. However, the lens selected for this camera (6 mm) was chosen to provide a view that encompassed the entire width of the discard chute, along with the area of the sorting table over which most of the discarded catch passed.

Similarly, the ability to identify species discarded can be affected by the presence of mud in the catch. Figure 7 shows how the presence of mud can greatly influence the ability of an analyst to identify fish by species.

Video analysis of Part 2 hauls took considerably longer to complete throughout the trials, because the analysts were required to watch all processing. On occasion footage could be viewed at $\times 2$ – $\times 8$ speed, but there was often a necessity to pause, rewind and slow the footage down in order to identify species. This resulted in times for analysis being roughly equal to processing times (approximately 2.5 h average per fishing event).



Figure 6. Top left picture shows typical assemblage of discard mix. Note species mix and density, leading to not all fish discarded being visible.



Figure 7. Processing a catch containing large quantities of mud.

Comparison of effort observed and electronically monitored observations

In addition to trying to assess cod catches from the video footage, the date, time and positional data overlays allowed for a comparison or validation of effort data. Appendix 2 shows the shooting/hauling positions recorded by the observer during Part 2 of the trial, along with the same data reviewed from the relevant video files. Determining the time of fishing events required the positioning of a camera that would provide a view of the starboard warp. This was relatively easy to accomplish, the camera being placed in a position where it also recorded imagery that allowed an estimate of the total catch to be made.

Appendix 2 clearly shows that the video footage provides a good record of shooting and hauling data. Estimates of tow duration were generally in agreement, with variations (where present) ranging from +5 min to –1 min. This variation could be the result of observer/video analyst interpretation of the start of a fishing event differing, as well as the use of different clocks throughout the trip. Similarly, positional data showed only small discrepancies (± 1 min of latitude or longitude) over 6 of the 12 fishing events conducted throughout Part 2 trials. The other 6 hauls showed 100% agreement between observer and video analyst data.

Discussion

The study highlighted strengths and weaknesses in the potential use of electronic monitoring equipment in the *Nephrops* fishery. Where the equipment and associated video footage were used to supplement and validate on-board self-sampling, as in Part 1 of the trial, results were positive. This result was corroborated in a 2009 Danish trial, where it was found that estimates of discard quantities decreased when there were no specific handling requirements placed upon vessels crews (Dalskov and Kindt-Larson, 2009). However, Part 1 trials also highlighted the fact that species identification of smaller cod was a problem, because although a good estimate of length was possible when small fish were placed on the fixed measuring board, positive identification of the same fish was problematic. Therefore, the Part 2 trials were modified to evaluate whether or not the video equipment could be used effectively independent of crew interactions to monitor cod catches accurately.

The nature of the catch encountered in this fishery (with a 70 mm codend) and the catch-handling process (manual discarding) proved to be factors that caused a significant loss of data quality. Dalskov and Kindt-Larson (2009) noted similar problems in their Danish trial, where discard estimate accuracy (by video) increased markedly where vessels had discard conveyor belts that presented discarded fish individually, rather than manual discarding off a sorting table or tray. Perhaps unsurprisingly, a similar study in an Australian prawn fishery (Stanley, 2006) showed “the image quality of the CCTV cameras is just not sufficient when there is a possible requirement to understand some of the by-catch of prawn fishing operations”. As mentioned above, Part 2 trials only succeeded in identifying 19% of the total catch by number, which equated to 82% (by weight) of total cod captures.

Also worth noting is that during the main *Nephrops* fishery off Ardglass, this vessel, along with the majority of the Ardglass fleet, utilise twin-rig gear. Bulk catches can be 2–3 times greater than those experienced during this trial. When fishing well during the season, the vessel used for the project utilises a second portable sorting table, situated adjacent to the wheelhouse on the starboard side. To monitor that table too, an additional two cameras (at a minimum) would be required, and associated video analysis time and data storage requirements would also nearly double.

In light of the findings of this report, Cefas would propose that further studies employing CCTV technology be targeted at large mesh (minimum 100 mm) otter trawl fisheries or static gear fisheries (longline and gillnet), where gear retrieval would dictate that fish retrieval on board occurs at a steady rate. Under such conditions, analysts would have a better chance of identifying and quantifying the catch accurately.

Acknowledgements

Skipper and part-owner Leo McGirr, owner Simon Wills and the crew of the *Supreme* are warmly thanked for their help, advice and willing cooperation throughout this project. All Cefas staff involved in data collection and video analysis and project administration are thanked for their valuable contribution to the success of this project, which was funded by Defra. Thanks are also due to Andy Payne and Andy Revill for reviewing the report.

References

- Course, G. 2009. Catch monitoring trials using video technology. Unpublished report. 8 pp.
- Dalskov J., and Kindt-Larson, L. 2009. Report. Fully documented Fishery.. National Institute for Aquatic Resources, Technical University of Denmark. 56 pp.
- Stanley, B. 2006: Report for Electronic Monitoring in the Northern Prawn Fishery. Australian Fisheries Management Authority. 12 pp.

Appendix 1: Detailed operation plan

N I CCTV Project: August/September 2009

Detailed Operation Plan (as agreed September 2009)

VESSEL

FV Supreme (CM180)

Skipper: Leo McGirr

OBSERVER

Guy Pasco

DEPARTURE DATE AND LOCATION

25 August (weather dependent), Ardglass, Northern Ireland

OBJECTIVE

The purpose of this project is to develop a cost effective method in monitoring the amount of cod by-catch within the Irish Sea Nephrops fishery by using CCTV. In particular to increase monitoring of that sector of the fleet potentially excluded from cod recovery measures, by virtue of the vessels having cod less than 1.5% of the total catch. Information from the project will be used to inform future monitoring and will be used in submissions to the European Commission on the level of cod catches from this sector of the fleet.

FISHING GEAR

The fishing gear (single-rig nephrops trawl) must be consistent with that used in previous years in this fishery, and comply with all relevant regulations. Cefas is to be provided with full details of gear prior to completion of the project.

AREA OF OPERATION and TOW POSITIONS

Fishing operations will be carried out on fishing grounds between the latitudes 54° 00' N and 55° 30' N, and to the West of 5° 00' W. ICES division VIIa, statistical rectangle 37E4.

Tow location and duration within the above specified area will be determined by the skipper, but should be consistent with normal commercial practice.

PERIOD OF SURVEY

The first part of the trial will consist of 3 days fishing (day trips), commencing on or about Monday 24th August 2009. Cefas observer to notify local MFA of intention to commence fishing under the dispensation. Once data from the initial trial has been analysed, a further 5-day trial will be completed. Timings for this part of the survey to be confirmed, but would estimate a start date of approximately 14th September 2009.

WORKING PATTERN

- Tow duration: To follow normal commercial fishing patterns.
- The observer, with help from crew, must have adequate time to carry out the prescribed scientific work on a catch before the next catch is brought on board.
- The observer must have sufficient rest periods (up to 8 hours per day in one or two periods).
- All tows will form part of the survey and must be sampled by the observer as per the sampling requirements.
- The crew should be available to help the observer

SORTING AND RECORDING THE CATCH

1. It is important that the entire catch (retained and discarded) is quantified as accurately as possible. Prior to any sorting of the catch, the observer will be required to weigh baskets before they are delivered to the vessels sorting table. Similarly, it will be necessary to weigh all retained catch prior to it being stowed in fish room. Additionally, all cod (both those to be retained and discarded) caught in the tow should be passed over a measuring board (within camera view) and made available to the observer prior to gutting and or discarding. The crew will be required to assist in sorting the catch as required by the observer and preparing any fish for sale. Standard Cefas methods for sorting and measuring commercial fish catches at sea will be carried out. The entire catch should be available to the observer for sampling, and none discarded without being recorded.

DATA TO BE RECORDED BY SKIPPER

The observer will provide recording sheets on which the skipper will record the following details for each tow:

Date

Tow number

Shooting and hauling times

Shooting and hauling positions (latitude and longitude)

Time and position at any significant change in tow direction

Other relevant information e.g. tidal state, weather conditions, seabed type (hard or soft).

Depth

Estimate of total bulk catch by weight
A tally (count) of retained cod, along with a weight estimate
A tally (count) of discarded cod, along with a weight estimate
Weight estimates of all other retained catch.

The skipper should provide full details of the gear and rigging. At the end of the survey, the skipper should provide an electronic copy of the tow tracks from the plotter.

DATA TO BE RECORDED BY OBSERVER

The observer shall be given the opportunity to weigh all bulk catch prior to sorting by crew. Similarly, all retained catch must be made available to the observer for weighing prior to being stowed in the fish room.
All cod caught (both retained and discard portions of the catch) must also be made available to the observer prior to processing and/or discarding.

Signed:

..... (skipper)(date)

.....(CEFAS)(date)

Appendix 2:

	tow	ICES rect	Date shot	time shot	shot latitude	shot longitude	shot EW	date haul	time haul	haul latitude	haul longitude	haul EW	duration mins
OBS	1	38E9	23-Sep-09	07:06	54 06	05 36	W	23-Sep-09	10:43	53 59	05 44	W	217
VID	1	38E9	23-Sep-09	07:00	54 06	05 36	W	23-Sep-09	10:42	53 59	05 44	W	222
OBS	2	38E9	23-Sep-09	10:56	53 59	05 44	W	23-Sep-09	15:10	54 08	05 29	W	255
VID	2	38E9	23-Sep-09	10:54	53 59	05 44	W	23-Sep-09	15:07	54 08	05 29	W	254
OBS	3	38E9	24-Sep-09	07:06	54 10	05 22	W	24-Sep-09	11:11	54 15	05 13	W	245
VID	3	37E9	24-Sep-09	07:03	54 10	05 22	W	24-Sep-09	11:06	54 15	05 13	W	243
OBS	4	37E9	24-Sep-09	11:28	54 15	05 13	W	24-Sep-09	14:38	54 06	05 15	W	190
VID	4	37E9	24-Sep-09	11:26	54 14	05 13	W	24-Sep-09	14:36	54 06	05 15	W	190
OBS	5	37E9	24-Sep-09	15:00	54 06	05 15	W	24-Sep-09	17:50	54 04	05 27	W	170
VID	5	37E9	24-Sep-09	14:56	54 06	05 16	W	24-Sep-09	17:46	54 04	05 27	W	170
OBS	6	37F0	25-Sep-09	07:10	54 04	05 21	W	25-Sep-09	10:48	54 05	05 06	W	218
VID	6	37F0	25-Sep-09	07:07	54 04	05 21	W	25-Sep-09	10:46	54 05	05 07	W	219
OBS	7	38E9	25-Sep-09	11:11	54 05	05 06	W	25-Sep-09	14:22	54 04	05 19	W	191
VID	7	38E9	25-Sep-09	11:08	54 05	05 07	W	25-Sep-09	14:23	54 04	05 19	W	195
OBS	8	38E9	26-Sep-09	09:47	54 05	05 22	W	26-Sep-09	13:02	54 04	05 08	W	195
VID	8	38E9	26-Sep-09	09:43	54 05	05 21	W	26-Sep-09	13:00	54 04	05 08	W	197
OBS	9	38E9	26-Sep-09	13:24	54 04	05 08	W	26-Sep-09	14:07	54 03	05 11	W	43
VID	9	38E9	26-Sep-09	13:20	54 04	05 08	W	26-Sep-09	14:04	54 03	05 11	W	44
OBS	10	38E8	26-Sep-09	14:31	54 03	05 11	W	26-Sep-09	17:33	54 03	05 24	W	182
VID	10	38E9	26-Sep-09	14:28	54 03	05 12	W	26-Sep-09	17:30	54 03	05 24	W	182
OBS	11	38E9	27-Sep-09	07:08	54 06	05 28	W	27-Sep-09	10:57	53 57	05 24	W	229
VID	11	38E9	27-Sep-09	07:05	54 06	05 28	W	27-Sep-09	Not recorded	--	--	--	--
OBS	12	38E9	27-Sep-09	11:20	53 57	05 24	W	27-Sep-09	15:33	54 04	05 24	W	253
VID	12	39F0	27-Sep-09	11:17	53 57	05 24	W	27-Sep-09	15:30	54 04	05 24	W	253

Appendix 2:

Fish Catch Monitoring System (FCMS) Notes for inclusion in CEFAS final project report

**Supplied by Via Infinita Limited
December 2009**

Introduction

System Application

The Fish Catch Monitoring System (FCMS) is a rugged, remote self-contained system specified by CEFAS and designed to work at sea on commercial fishing vessels of any size down to the smallest boat. It is designed to monitor the catches taken by fishing crews by making video recordings using up to 4 low-light capable video cameras which may be placed at various strategic locations on the deck area.

GPS latitude and longitude is recorded as an on-screen overlay. In this way both the catch composition and its geographical location are captured in order to be able to make informed fishery decisions.

The FCMS will record optimal video footage at sea in a harsh marine environment through using the best available technologies. In the CEFAS prototype version, recording was started when a button was pressed and stopped when pressed again. Other ways of activating the recorder are outside the scope of this model but could certainly be developed for a more autonomous version of the FCMS system.

Description

Cameras

The system can have up to four harsh-environment deck monitoring video cameras (type MD800K). These cameras are capable of functioning in the often difficult visual environments found on board fishing vessels (poor lighting, harsh conditions etc). The cameras are weatherproof and water resistant to IP68 (see specifications). Three cameras were used with the CEFAS prototype FCMS unit.

Cables

Each MD800K video camera is linked to a central recording unit by a 10 metre cable which carries DC power and video. The cables are specifically designed for use in a marine environment and are terminated with waterproof Wet-Con™ connectors. Since cable failures are the single most probable cause of problems with marine electronics, special attention has been paid to the design and construction of the cables used in the FCMS.

Solid-state Digital Video Recorder (DVR)

The heart of the system is a solid-state digital video recorder which has no moving parts. Video is securely recorded on to 32GB Compact Flash™ cards (CF cards) and the video recorder has ten of these cards. Video compression is MPEG2 and conforms to DVD standards for simple and ultra-reliable distribution and sharing of video files. On the

command of an external record trigger, the unit starts recording to the first available card. When that card becomes full, video recording is automatically switched to the next available card until all cards become full. Each slot has a status LED so it is easy to see which cards are full, which are part full and which are empty. When recording, it is possible to “hot swap” cards for viewing. It is also possible to clear all cards via the unit’s *Format All* button. The CF cards may be quickly removed at any time for viewing or downloading onto a PC. The frame rate and video compression are user configurable using a PC connected via a serial RS 232 control port.

GPS Latitude and Longitude

The video recorder will display on-screen and record GPS latitude and longitude, together with time and date. The GPS data is sourced from an external Garmin™ portable GPS marine antenna. This antenna may be quickly positioned on a wheelhouse roof or on the top surface of a deck shelter. The antenna draws its power supply from the FCMS unit.

Housing case

The video recorder is housed in a waterproof Peli™ case (type 1430). This case has the shape aspect ratio of a coolbox which makes it easy to use in confined spaces. The case has a custom fitted anodised aluminium alloy fascia giving access to all equipment and controls. All electrical connectors which pass through the sidewall of the case are watertight Wet-Con™ units which are rated for marine service. The lid of the case is rated to IP68 and, when the lid is properly closed, the case is completely watertight.

Power Supply

DC power is supplied by 2 x 12V sealed lead/acid (SLA) battery packs of nominally 12Ah capacity each. The FCMS can run either on its own internal battery pack or on its external 12V power supply / battery charger unit when connected to a mains AC supply (worldwide 110-230V AC, 50-60Hz). The batteries give approximately 3 days use of self-contained power before charging or external power is required.

LCD monitor

The output from the cameras may be monitored on the 5.6” (142mm) colour LCD flat panel display (4x3 screen aspect ratio) incorporated into the FCMS case. The LCD screen assists the initial setting up and testing of each of the video cameras. The screen can be turned off after this is completed, to save power.

Programmable Quad-Video Display Module

The MPEG2 video can be recorded in one of two ways:

1. A montage of normal video

Video can be composed into a permanent montage of up to 4 camera images from each of the cameras and this permanent montage can be recorded as a simple video stream. This preserves the frame-rates of each camera at 25 frames per second and the recorded video may be replayed on a computer using any software player capable of playing a video DVD.

2. A stream of multiplexed video

Up to 4 camera images can be multiplexed together into a new video stream and this stream can be recorded. In this way the original image size of each camera image is preserved and the recording from each camera can be later extracted from the multiplexed video stream and viewed separately. This is done using field-based video interlacing. The process uses one video field sequentially taken from each of up to 4 cameras in turn. This gives a playback rate of 12.5 fields per second. Each field is line-doubled to give one reconstructed full-sized video frame at a rate of 12.5 frames per second (i.e. quarter frame-rate at half native image resolution). Multiplexed video can only be replayed using a demultiplexing software player, but all recovered video streams may be exported in uncompressed format for re-purposing. Video image sizing, positioning and multiplexing is done by an on-board programmable quad-video display module. For ease of use the system has 16 pre-set display modes which can be reconfigured with a PC connected via a serial RS232 control port. The unit provides excellent picture quality coupled with real-time update per channel. Camera ident plus date and time can be shown on-screen and the text position is fully controllable.

Separate hard drive and card reader

A 1 terabyte (1TB = 1000GB¹) USB hard disk and a 4-way Compact Flash™ card reader was used to facilitate the downloading of the video from the Compact Flash™ cards.

Storage Media

There are three broad options available for choice of storage media:

1. Hard Disk Drive (HDD)
2. Solid State Disk (SSD)
3. Compact Flash Cards (CF) and other related memory card technologies

Currently (2009-10) hard disk drives (HDDs) easily offer the best value for money for video data storage². However, HDDs have the disadvantages of having moving parts and therefore potential unreliability in harsh environments unless cushioned from shock. These storage devices have high current consumptions compared to alternatives and their use in a small, self-contained battery powered system is limited by this. However, they could be used in a permanently installed video system with shock-cushioning built in to the cabinet. This would allow the video to be removed on a single memory unit. Use of cheap 1 terabyte HDDs is a future consideration for development

Solid state disks (SSDs) offer the least value for money³ as a storage medium. However, they have the advantage of very low current consumptions and could easily be removed as a single unit. It is expected that the prices of these devices will fall over the next few years; if this happens then they may become economic for use in this application.

Compact flash cards (CF) offer relatively good value for money⁴. CF cards have no moving parts and so shock is not a consideration. They are easily available and can be used with nearly all office computers. It is for these reasons that this memory option was chosen for the FCMS. However, CF cards are not readily available in capacities greater than 32GB (although

¹ Kilo	1000 ¹	10 ³	1,000
Mega	1000 ²	10 ⁶	1,000,000
Giga	1000 ³	10 ⁹	1,000,000,000
Tera	1000 ⁴	10 ¹²	1,000,000,000,000
Peta	1000 ⁵	10 ¹⁵	1,000,000,000,000,000

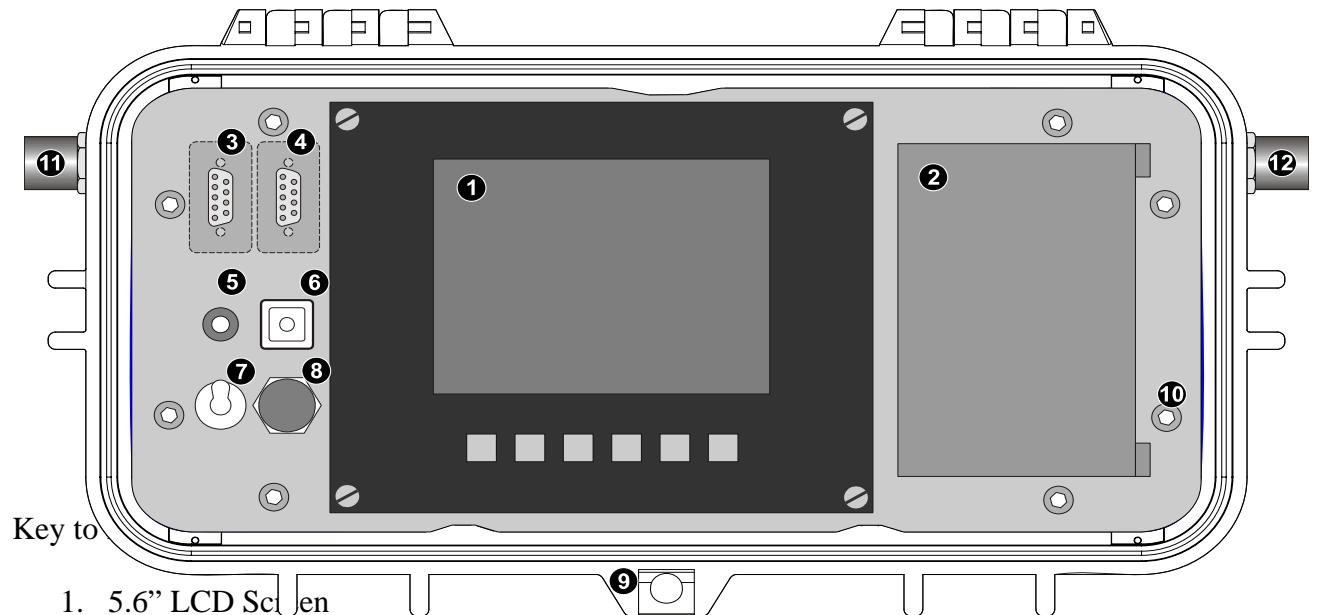
² Approx. GBP 120.00 per terabyte (September 2009)

³ Approx. GBP 9,600.00 per terabyte (September 2009)

⁴ Approx. GBP 2,625.00 per terabyte (September 2009)

64GB and 128GB devices are being released at considerable introductory costs in 2009). This means that several CF cards have to be used together in a recording system in order to build up a practical amount of useful storage memory. It is this method which is used in the FCMS.

FCMS Front Panel



Key to

1. 5.6" LCD Screen
2. Solid State Flashcard Digital Video Recorder (DVR) (10x 32GB Compact Flash™ cards)
3. Serial port for user configuring the Programmable Quad-Video Display Module
4. Serial port for user configuring the Flashcard Digital Video Recorder
5. Green LED Recording Indicator
6. Record Start / Record Stop button. This function is echoed on the remote thumbswitch
7. Power ON / OFF switch
8. Fuse holder with 2.5A quick-blow fuse
9. Peli case: Type 1430
10. Fascia fastening screw x8
11. Wet-mating waterproof connector x4 (3x cameras; 1x remote record start/stop thumbswitch)
12. Wet-mating waterproof connector x2 (1x external power; 1x external GPS antenna)

Specifications

Digital Video Recorder

Model: Flashback2-10 by Ovation Systems Ltd.

Physical

- Material: Hard black anodised aluminium alloy
- Size: 120mm long x 85mm wide x 89mm tall
- Recording Medium: Up to 10 Compact Flash™ cards. Recommended media: SanDisk™⁵ Extreme® III or Extreme® IV (16GB or 32GB capacity) or Pretec™ 32GB cards.

Electrical

- Power: 2.6 watts at 12V (215mA). Standard definition video (SD) D1 Flashback2™ by Ovation Systems Ltd. Configuration software supplied (PC). Software configurable to either PAL (625 lines) or NTSC (525 lines). OEM manual supplied.
- Video compression: MPEG2 with software configurable bitrates; maximum bitrate approx. 8Mbits.sec⁻¹. Configurable to lower bitrates and small frame sizes to extend record times.

Operational

Recording duration: For D1 full-screen 4:3 video:

- Maximum quality (with variable bitrate) = approx. 10-13mins/GB (depending on the video content)
- Very high quality = approx. 15-25mins/GB
- Low quality = approx. 60mins/GB.

Type MD800K Video Camera

Physical

- Weight: 0.34kg
- Dimensions: 100mm overall width; 95mm overall length; 100mm overall height (with bracket set at 90° to camera axis and excluding connector)
- Mounting: Wall or ceiling mounted; adjustable for pan, tilt and roll on supplied bracket
- Connection: Micro Wet-Con™ 3 pin connector

⁵ SanDisk and SanDisk Extreme are registered trademarks of SanDisk Corporation, registered in the United States and other countries.

- Construction: Marine grade 6082-T6 aluminium alloy enclosure
- Finish: Black anodised

Electrical & Electronic

- Power Supply: 12V DC (24V DC an option)
- Current consumption: 120mA
- Video Type: Analogue Composite, 1.0v P-P; 75 ohm connection
- TV System: PAL or NTSC versions
- Image sensor: 1/3 inch CCD; 470,000 pixels
- White balance: Switchable; Automatic (adjusts average white balance) / Auto Tracking (adjusts white balance in proximity to sodium or fluorescent lighting)
- Sensitivity: Switchable; Colour to 0.012 lux; monochrome to 0.0014 lux
- Backlight Compensation: Switchable ON / OFF
- Automatic Gain Control (AGC): Switchable ON / OFF
- SNR: 52dB min; 60dB typical (ref. AGC off)

Optical

- Wide angle lens: 3.6mm; aperture F2.0; field of view approx. 51° vertical; approx. 63° horizontal
- Telephoto lens: 12mm; field of view approx. 17° vertical; approx. 23° horizontal; other lenses available
- Iris: Electronic
- Focus: Fixed; manually adjustable

Operational

- Resolution: 540 TV Lines
- Minimum illumination: Colour full-light mode; 0.012 lux @ F1.2 (20 IRE) with AGC=ON. Monochrome low-light mode; 0.0014 lux @ F1.2 (20 IRE) with Sensitivity=ON
- Low-light capability: When sensitivity=ON the camera will automatically adopt low-light operational mode if the light level falls below the colour threshold of approx. 0.012 lux

Environmental

- IP rating: IP68 (1m of sea water for 1 hour)
- Housing is double 'O' ring sealed
- Operating temperature: -20°C to +50°C

Video Processing Unit

- Model: Micro-FourSight by Ovation Systems™ (UK)

Physical

- Size: 82mm x 53mm x 11.5mm
- Weight: 60g
- Finish: Hard anodised aluminium alloy

Electrical & Electronic

- Operating Voltage range: 5-28V DC
- Current consumption: approx. 140mA
- Video Standards: PAL / NTSC (auto / manual configuring)
- Number of input channels: 4
- Video input type: Composite
- Digital sampling: PAL: 576 lines x 720 pixels; NTSC: 480 lines x 720 pixels

Operational

- Update rate: Real-time
- Operating temperature: -20°C to +65°C

Battery Packs

- Manufacturer: Yuasa
- Model: NP12-12
- Type: Sealed Lead Acid

Physical

- Weight (approx): 4 kg
- Standard Terminals: Quick disconnect 0.250"
- Sealed Construction: Can be operated in any position without leakage.
- Housing Material: Container/cover made from ABS Resin or optional; Flame Retardant ABS

Electrical

- Nominal Voltage: 12V
- Nominal Capacity: 20 hr. rate of 0.6A to 10.50V = 12.0Ah
- Charge Retention (shelf life) at 200C: 1 month 97%; 3 months 91%; 6 months 85%

Operational

- Life expectancy in standby use: 3 to 5 years
- Life expectancy in cycled use: 100% depth of discharge: 200 cycles; 50% depth of discharge: 550 cycles; 30% depth of discharge: 1200 cycles

Battery Charger / External Power Supply Unit

Physical

- Manufacturer: Mascot (Norway)
- Type: Model 2040; switch-mode
- Weight: 350g; Size 135mm x 80mm x 44mm

Electrical

- Universal AC input voltage (110-240V AC; 50-60Hz)
- Nominal Voltage: 14.7V DC (timed charging); 13.8V DC (float charge)
- Max.constant current: 4A
- Fuse protection (on FCMS system fascia): 2.5A, cylindrical, quick-blow, 6.3mm x 30mm

Operational

- 3 stage lead/acid battery charger
- Captive output cable
- Mains IEC 320 3 pin connector to AC mains cable

GPS Antenna

- Manufacturer: Garmin
- Model: GPS 17x HVS

Physical

- Size: 96.1mm diameter; 49.5mm height (excluding mount)
- Weight: 201g
- Case: White high-impact plastic alloy, waterproof to IEC529 IPX7
- Cable: 9.14m

Electrical

- Operating voltage: 8-33V DC; 40mA @ 12V DC
- Serial data output levels: 0V-3.3V DC (NMEA 0183)

Operational

- Operating temperatures: -30°C to +80°C
- Update rate: 1 record per second
- Accuracy: (a) Standard GPS <15m /0.1knot RMS; (b) when using WAAS <3m / 0.1knot RMS

Wet Mating Electrical Connectors & Cables

Physical

- Connector manufacturer: Seacon® Brantner
- Cable manufacturer: Bowtech Products Ltd.
- Connector type: Micro-Wetcon™ circular multipole; 3 pin and 4 pin types used
- Camera cable type: XX8024; Coaxial conductor + 2 shielded power conductors; Orange; 10m; male connectors used on cables with locking sleeves; bulkhead mount female connectors used on case housing

Electrical

- Connector max. voltage: 600V DC (units with 1 to 4 pins)
- Connector max. current: 19A per contact

Operational

- Connector & cable waterproofing: To 6,000m sea water (700bar) (when mated)
- Number of connector mating cycles: >1,000 cycles
- Connector operating temperature: -4°C to 60°C

FCMS System Design and Integration

VIA INFINITA LTD., 7 Drummond Road, ILKESTON, Derbyshire, DE7 5HA, United Kingdom