

LONE WORKER ALARM

FEASIBILITY STUDY

SUMMARY REPORT

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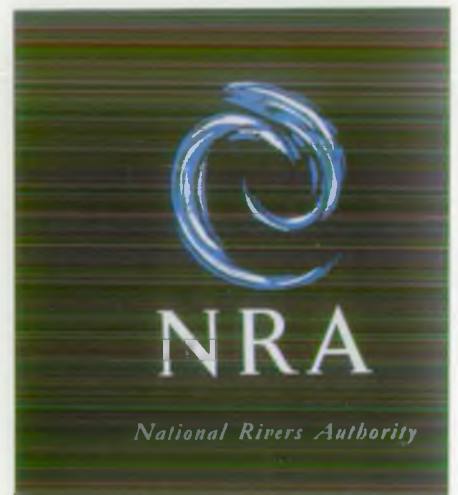


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1 INTRODUCTION

Advances in communications technology have prompted the National Rivers Authority to initiate a study into the feasibility of providing a means by which employees working alone could summon assistance in the event of accident, illness or other sudden emergency. The facility is referred to as a Lone Worker Alarm (LWA).

Kennedy & Donkin Systems Control Ltd (KDSC) were commissioned in September 1990 to undertake the study in response to a brief issued by the NRA, Anglian Region office. NRA commissioned a subsidiary study from the Centre for Communications Research (CCR) at Bristol University for certain technical aspects of the study.

This summary report has been produced subsequent to the main study report to highlight the main features of the two methods proposed for further development, and the costs and recommendations of the study. Some details of the proposals have changed since the study report, reflecting further development with relevant authorities. Version 2 of the report incorporates modifications resulting from a discussion with regional representatives at a meeting on 23 April 1991.

Further details on the study and recommendations can be found in the study report entitled 'National Rivers Authority, Lone Worker Feasibility Report' KDSC Document No 65360/420/00003, Issue 2, 25 March 1991.

2 USER REQUIREMENTS

For this study staff in every region of the Authority, chosen to represent a cross section of potential users, were interviewed to determine the user requirements for a Lone Worker Alarm.

There was wide agreement amongst those interviewed that a LWA would be required in the next 1-2 years. The motivation was a response to a changing public and legal climate in matters of safety and the need to provide safer systems as technology permitted them. The motivation was not for immediate provision in response to any actual known deaths or serious injuries. There was thus seen to be a time of 1 to 2 years for a development to meet the Authority's needs.

There was wide agreement that the LWA should be as unobtrusive as possible, highly reliable (in alarm use and to avoid nuisance calls) and simple. In short its design should encourage use.

The basic scenario of use was for a person working alone, out of, but within approximately 2-3 km of a vehicle. It is assumed that the person may be unable to walk and is likely to be sitting or lying on the ground, possibly in some pain.

The basic method of use would be for the user (Lone Worker) to summon help if a personal emergency occurred.

There was a range of views on the need for voice communications for a LWA. Systems currently available use voice, and most users were initially of the opinion that voice was required for a LWA. However, on further questioning many changed to the view that some applications for the LWA would require voice communications. Where voice was said to be a requirement, it was generally a preference that the LWA should not require a separate piece of LWA equipment to be carried by the user in addition to the voice equipment.

In addition to this basic scenario many optional features were identified including passive detection of an immobile user, 'prompting' to require the user to make periodic confirmation that all was well, an audible attack alarm (especially for lone women workers) and special provision for bailiffs to summon police.

The estimated number of LWA devices required varied between 90 in Northumbrian Region and 500 in Thames Region. Overall indications were for a total of approximately 2000 for the whole Authority. This number will be reviewed in the light of the feedback now given to Regional consultees.

3 VOICE COMMUNICATIONS

The possible provision of voice communications to lone workers has a major influence on the provision of alarm facilities. It is assumed that nearly all lone workers will be provided with voice communications equipment in their vehicles. There are however some lone workers who also need voice communications when away from their vehicle in order to perform their duties.

The voice communications equipment, using Private Mobile Radio (PMR) or cellular telephone is a candidate for a LWA role. There are however substantial drawbacks to this approach.

In many emergency circumstances the lone worker may be able to use the system to dial his base and report his identity and the fact of an emergency. This does not however address emergencies when the user is unable to dial and talk due to incapacity, lack of time, panic, etc. which are typical in emergencies. The dialling difficulty might be overcome by the addition of a large emergency button to trunked PMR equipment. Such a feature is unlikely to be possible on cellular telephones, and a 'short code' facility (still using the very small buttons) is the only aid. In both cases time is needed to establish the call and the user would need to identify himself by speech.

There are also significant transmission and radio coverage problems with this solution. 'Hand held' devices to be used away from the vehicle, have typically one tenth the power of vehicular units, and the much bulkier 'transportable' devices half or less the power of vehicular units. The locations in which they are used tend also to be less favourable to radio coverage than those where users park their vehicles. Out of vehicle voice communications therefore have substantially more areas where contact is not possible, than the 'in vehicle' equipment. Cellular telephone has the additional limitation that it is designed for use in towns and major roads and outside these has many 'black spots' where communication is not possible even with vehicular units.

There is an additional technical disadvantage for cellular radio. This system provides no guarantee of connection, even where coverage is possible. If more simultaneous calls are attempted in an area than there are available frequencies, the connection will not be possible. This is a particular problem during road traffic problems, and severe weather, or other emergency events.

The Consultants consider that these factors taken together mean that out of vehicle voice communication systems, even where they are adequate for the normal performance of duties, may not be adequate for a safety critical role such as a LWA.

Where voice communications are provided for operational purposes and can be shown to be highly reliable, including during events, it may be appropriate to use these for LWA.

However, the elimination of voice requirements has a significant bearing on the size and reliability of any personal emergency transmitter. The Consultants have concluded that where voice is not essential, greatly improved performance can be provided by other technologies and at a lower cost. The remainder of this report considers these circumstances and means.

4 SELECTED TECHNOLOGIES

The study considered the Authority's existing and proposed communications systems, commercially available alarm equipment, manufacturers research and development programmes and other organisations with lone workers. No existing or planned system could be found which was currently available to meet the Authority's requirements.

Two technologies have however been identified as the basis for developing a Lone Worker Alarm system, and are described below.

4.1 Trunked Private Mobile Radio

The trunked Private Mobile Radio (PMR) which is being planned and implemented for the UK water industry offers the communications infrastructure necessary for the LWA.

Users would carry a small body worn device, which in its final form is expected to be the size of a pager. In an emergency the user would press an alarm button and a message would be sent via a specially designed radio links, back to the user's vehicle parked up to 3km from the place of work. This link would be optimised for a small amount of data and would provide very much higher coverage than a speech link. A special receiver in the vehicle would then feed the message into the standard trunked PMR set in the vehicle.

The regional control room would receive the alarm data from the radio system and alert the operators. In its simplest form this would be by just displaying codes, one for each alarm unit, on the radio console. To interpret these codes and provide user personal information and other facilities, additional equipment in the form of a Personal Computer (PC) could be provided. In either case the system would undertake regular automatic checks to ensure that it is working correctly.

The LWA control room role is expected to place little additional burden on staff in say an existing 24 hour manned Regional control or communications centre. In the absence of LWA alarms, the only operator action would be to log users on and off the system. In the event of an alarm the operator would read from the screen the appropriate action to be undertaken and alert those responsible for the action.

Trunked PMR offers the communications infrastructure necessary for the LWA. The main area of development necessary would be the optimised worker to vehicle link. A LWA system based on trunked PMR offers low risk, with low development, capital and operating costs and a substantial growth path for future enhancement of the features of the LWA. The system could be easily managed with the NRA's existing organisation. PMR suffers from less than 100% geographical coverage. Although the coverage of trunked PMR is expected to be greater than the existing PMR or cellular phone, unsupported areas will remain especially in mountainous areas and steep valleys.

4.2 Search and Rescue Satellites

COSPAS/SARSAT is an international satellite system for Search and Rescue. It consists of a constellation of satellites in low altitude polar orbits. The system is used primarily for emergencies at sea but with procedural changes might be used for LWA.

Again users would carry a small device and press a button in an emergency. The device would transmit a radio message which would be received, after a delay of from 30 seconds to 45 minutes, by the next COSPAS/SARSAT satellite passing over. The maximum delay time is dependent upon the number of satellites and the particular position of satellites within their orbits. The 45 minute figure is an upper limit and actual receipt times are typically much shorter. Reliable communications to the satellite are made possible by the use of a similar optimised data link to that proposed for the PMR option. The satellite would relay the message to the Ministry of Defence control room at Plymouth. That control room would decode the message to identify the user, and a telex or fax message would be sent to a national or regional NRA control room, where the operator would initiate recovery action.

The COSPAS/SARSAT satellite system could provide the simple 'alarm only' LWA in a short timescale requiring little development, but with no growth path for future enhancements. Hand held size beacons are commercially available and a smaller pager size could be packaged. The system is expected to provide almost 100% geographical coverage.

The system also provides geographical location of the worker within approximately 2 - 5 km. Point location at sea is possible through a second 'homing' transmission which might also be used by land-based search and rescue organisations.

The primary constraints on the use of COSPAS/SARSAT for LWA are the licencing and operating restrictions that may be imposed by the international and UK authorities. The COSPAS/SARSAT Secretariat has been encouraging but the position of the UK authorities (Departments of Trade and Transport) is not yet clear although negotiations are continuing. Additionally, discussions have commenced with North Yorkshire police who are preparing a national view on the use of satellite beacons by the public for recreational safety purposes. The key issues are licencing, control and response procedures.

If arrangements were made it is probable that they would be for use in the most remote areas only - those not coverable by PMR.

5 COSTS & BENEFITS

Indicative cost estimates and cash flow forecasts have been prepared for the development phases and the implementation capital and revenue of both the PMR and COSPAS/SARSAT system of LWA.

These are shown in the Appendix and summarised in Table 1. For the PMR based system the estimated cost of development is approximately £140,000. Initially, the commitment could be limited to approximately £15,000 for the production of a specification and establishing whether suppliers would be prepared to support the development. Assuming that 2000 units were eventually procured, the capital costs of development and purchase discounted and amortised over five years, plus the revenue costs of maintenance, licences etc. give rise to an annual cost per unit of approximately £320.

For the COSPAS/SARSAT system the estimated cost of development is approximately £53,000. Initially this commitment should be limited to approximately £5,000 to cover the technical and organisational negotiations with the DTp for agreement in principle to use the system. Assuming that 500 units were eventually procured (for use only in locations where there was no PMR coverage) the capital cost of development and purchase discounted and amortised over five years, plus the revenue costs of maintenance, licences etc. give rise to an annual cost per unit of approximately £220.

These costs compare with about £570 per unit per year for cellular radio if this were provided specifically for use as a LWA and with only one 60 second call per working day to test coverage.

In financial terms the benefits of issuing alarms to lone workers can be measured in terms of the avoidance of double manning. The provision of say 2000 LWA units at £320 per year gives a total annual cost of £640,000. If only 2% of the covered staff (ie. 40 persons) are thereby relieved of double manning, the annual financial saving to the Authority would be £600,000 (at £15,000 per year employment cost). If the percentage rose to 10% of staff not requiring double manning, the financial saving would be £3 M.

TABLE 1: SUMMARY OF COSTS

| Based on 2000 Units | PMR | COSPAS |
|---|---------------------------|-------------------------|
| | £ | £ |
| Development cost (of which initial commitment) | 140,560.00 (15,000.00) | 53,310.00 (5,000.00) |
| Implementation capital cost | 2,620,000.00 | 325,000.00 |
| Annual revenue cost | 234,000.00 | 46,000.00 |
| (Number of alarm units) | 2,000.00 | 500.00 |
| NPV per alarm year (5 year life) | 321.69 | 218.15 |

6 SUMMARY

All Regions of the NRA have indicated a demand for a Lone Worker Alarm (LWA) motivated not by a poor accident record but by the need to enhance safety where technology now permits. There is a range of functional requirements from the simple alarm button, to coded messages, speech, automatic position finding, etc. Initial indications are that up to 2000 units might be required nationally.

No existing equipment has been found which meets the NRA particular requirements (especially for geographical coverage) and regions have not expressed an urgent requirement for immediate provision of a system. In circumstances where lone workers are provided with voice communications equipment for use out of vehicles, this could be used or adapted for LWA. There are however substantial deficiencies in this approach.

Two major technological options have been identified for developing a LWA to meet the NRA's needs. The new Private Mobile Radio (PMR) being planned for the UK water industry would provide the basis of a system within the existing technological and organisational bounds of the NRA and with a growth path for enhancing functionality. The system would not have 100% geographical coverage and could not be implemented for about two years. The forecast of the equivalent annual cost of the unit is approximately £320 inclusive of development costs.

The use of satellites is a definite possibility. Existing search and rescue satellites may be usable if regulatory agreement and agreement of their operators can be obtained. These could provide excellent geographical coverage and rapid implementation, but very limited functionality. Their continuing use would depend on the goodwill of the satellite operators. The forecast of the equivalent annual cost of the unit is approximately £220.

The two technologies may provide complementary facilities and both should be progressed to a preliminary stage.

7 RECOMMENDATIONS

7.1 The Authority should undertake the initial development work for a Lone Worker Alarm system using an optimised data link to trunked private mobile radio or cellular telephone equipment in vehicles. To this end the Authority should undertake the following.

- (a) Establish formally with the DTI the licence arrangements and costs to be applied to LWA's on the PMR.
- (b) Commission functional and performance specifications for the pager to vehicle link, the vehicle interface to the PMR and the control centre equipment.
- (c) Liaise with PMR Local Management Committees and suppliers to agree the interface specification and select probably two Regions for field trials.
- (d) Commission the development and demonstration of a pager and vehicle unit, and the supply of approximately 15 prototypes of each.
- (e) Commission the development and demonstration of the alarm data handling capacity of the PMR; and two prototype control centre equipments.
- (f) Undertake controlled field trials in two Regions representative of a range of PMR coverage conditions.

7.2 The Authority should undertake a programme to assess the regulatory and operational feasibility of using the COSPAS/SARSAT satellite system for LWA. To this end the Authority should undertake the following.

- (a) Negotiate with the DTp for agreement in principle to the system, and the technical and operational guidelines for such use.
- (b) Procure and register approximately 15 small commercially available beacons.
- (c) Specify control room procedures, and if necessary procure equipment for two control rooms.

- (d) Undertake controlled field trials in two Regions where PMR coverage is expected to be least comprehensive.

7.3 The Authority should commission an organisation to project manage the above activities and to plan the later implementation of LWA.

This should include an immediate verification of the numbers of LWA's required and subsequently a refined survey of user's requirements.

8 COMMERCIAL FUNDING FOR DEVELOPMENT

The PMR option will require the involvement of a commercial radio supplier at some stage between development of prototypes and final production.

Discussions are taking place with a limited number of suppliers to determine the most cost effective stage at which commercial involvement should be sought.

A proven system, in production with the Authority, is considered to have wider market potential which, if managed skillfully, may produce financial savings against the investment proposals detailed above.

APPENDIX 1

| UNIT | NUMBER | TOTAL COSTE | 191/91 | 92/93 | 93/94 | 94/95 | 95/96 | 96/97 | 97/98 | Total |
|------|--------|-------------|--------|-------|-------|-------|-------|-------|-------|-------|
|------|--------|-------------|--------|-------|-------|-------|-------|-------|-------|-------|

| DEVELOPMENT | | | | | | | | | | |
|--------------------------|--------------|--------------|--------------|----------|----------|----------|----------|----------|----------|--------------|
| Control Room Software | 1 | 10000 | 10000 | | | | | | | 10000 |
| Possible Mod Costs | 1 | 15000 | 15000 | | | | | | | 15000 |
| Trials Equipment | 0 | 0 | | | | | | | | 0 |
| Alarm Units(Beacons) | 10 | 7500 | 7500 | | | | | | | 7500 |
| -Control Room Equip. | 2 | 5000 | 5000 | | | | | | | 5000 |
| -Control Room Instl. | 2 | 0 | 0 | | | | | | | 0 |
| Licences * | 27 | 810 | 810 | | | | | | | 810 |
| Project Management | 1 | 15000 | 15000 | | | | | | | 15000 |
| DEVELOPMENT total | 53310 | 53310 | 53310 | 0 | 0 | 0 | 0 | 0 | 0 | 53310 |

| IMPLEMENTATION - CAPITAL | | | | | | | | | | |
|-----------------------------------|----------|----------|----------|---------------|---------------|--------------|--------------|--------------|--------------|---------------|
| Alarm Unit | 650 | 500 | 325000 | 130000 | 195000 | 0 | 0 | 0 | 0 | 325000 |
| IMPLEMENTATION - REVENUE (Annual) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alarm Licence | 27 | 500 | 13500 | 5400 | 13500 | 13500 | 13500 | 13500 | 13500 | 72900 |
| Alarm Maintenance | 65 | 500 | 32500 | 13000 | 32500 | 32500 | 32500 | 32500 | 32500 | 175500 |
| IMPLEMENTATION Total | 0 | 0 | 0 | 140400 | 241000 | 46000 | 46000 | 46000 | 46000 | 573400 |

| CASH FLOW | | | | | | | | | | |
|-----------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Annual Undiscounted Total | 53310 | 140400 | 241000 | 46000 | 46000 | 46000 | 46000 | 46000 | 46000 | 626710 |
| Annual Discounted Total | 53310 | 139496 | 212947 | 38206 | 35914 | 33759 | 31734 | 30171 | 28568 | 545368 |
| Cumulative Discounted Total(Inpr) | 53310 | 192806 | 405753 | 443960 | 513634 | 545368 | 573400 | 601838 | 626710 | 626710 |

| IMPLEMENTATION - Numbers | | | | | | | | | | |
|--------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| alarms - tot. det. | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| alarms - det. cumx. | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| centres - det. det. | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| centres - det. cumx. | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

* 15 licences for 2 years

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| | | | year no. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|--|------------|--------------|----------------|--------------|----------------|----------------|---------------|---------------|---------------|---------------|-----------------|
| PRIVATE MOBILE RADIO | | | | | | | | | | | |
| UNIT COSTS | NUMBER OFF | TOTAL COSTS: | 91/92 | 92/93 | 93/94 | 94/95 | 95/96 | 96/97 | 97/98: | Total: | |
| DEVELOPMENT | | | | | | | | | | | |
| Specifications | | 10000: | 10000 | | | | | | | | 10000: |
| Alarm & Link Development | | 70000: | 60000 | 10000 | | | | | | | 70000: |
| Control Room Software | | 10000: | 6000 | 4000 | | | | | | | 10000: |
| Trials Equipment | | | | | | | | | | | 0: |
| -Alarm Units | 500 | 15 | 7500: | 0 | 7500 | | | | | | 7500: |
| -Vehicle Units | 1000 | 15 | 15000: | 0 | 15000 | | | | | | 15000: |
| -Control Room Equip. | 2500 | 2 | 5000: | 0 | 5000 | | | | | | 5000: |
| -Vehicle Installation | 150 | 15 | 2250: | 0 | 2250 | | | | | | 2250: |
| -Control Room instl. | | | 0: | | | | | | | | 0: |
| Licences * | 27 | 30 | 810: | 54 | 405 | | | | | | 455: |
| Project Management | | | 20000: | 10000 | 10000 | | | | | | 20000: |
| DEVELOPMENT total | | | 130560: | 86054 | 54155 | 0 | 0 | 0 | 0 | 0 | 140209: |
| IMPLEMENTATION - CAPITAL | | | | | | | | | | | |
| Alarm Unit | 500 | 2000 | 1000000: | 25000 | 500000 | 475000 | 0 | 0 | 0 | 0 | 1000000: |
| Vehicle Unit(inc. i/f) | 800 | 2000 | 1600000: | 40000 | 800000 | 760000 | 0 | 0 | 0 | 0 | 1600000: |
| Control Room Computer | 1000 | 10 | 10000: | 2000 | 5000 | 3000 | 0 | 0 | 0 | 0 | 10000: |
| Control Room Software | 1000 | 10 | 10000: | 2000 | 5000 | 3000 | 0 | 0 | 0 | 0 | 10000: |
| IMPLEMENTATION - REVENUE (Annual) | | | | | | | | | | | |
| Alarm Licence | 27 | 2000 | 54000: | 1050 | 28350 | 54000 | 54000 | 54000 | 54000 | 54000 | 245700: |
| Vehicle Licence | 0 | 2000 | 0: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0: |
| Alarm Maintenance | 50 | 2000 | 100000: | 2500 | 52500 | 100000 | 100000 | 100000 | 100000 | 100000 | 455000: |
| Vehicle Mtncce & Calorts | 40 | 2000 | 80000: | 2000 | 42000 | 80000 | 80000 | 80000 | 80000 | 80000 | 368400: |
| IMPLEMENTATION Total | | | 0 | 74650 | 1432650 | 1475000 | 234000 | 234000 | 234000 | 234000 | 3684700: |
| CASH FLOW | | | | | | | | | | | |
| Annual Undiscounted Total | | | 86054 | 129065 | 1432850 | 1475000 | 234000 | 234000 | 234000 | 234000 | 3824900: |
| Annual Discounted Total | | | 86054 | 121265 | 1266066 | 1225111 | 182695 | 171734 | 161430 | 161430 | 3214355: |
| Cumulative Discounted Total(npv) | | | 86054 | 207319 | 1473385 | 2698496 | 2881192 | 3052925 | 3214355 | | |
| IMPLEMENTATION - Numbers | | | | | | | | | | | |
| alarms - no. new | | | | 50 | 1000 | 950 | | | | | 2000: |
| alarms - no. cum. | | | | 50 | 1050 | 2000 | 2000 | 2000 | 2000 | 2000 | |
| centres- no.new | | | | 2 | 5 | 3 | | | | | 10: |
| centres- no. cum. | | | | 2 | 7 | 10 | 10 | 10 | 10 | 10 | |

SCHEME NPV PER ALARM YEAR = 321.44

* 15 licences for 2 years