The Case For Remote Monitoring

Introduction

The current HTM 02-01, in its Operational Management Part B, summarises warning and alarm systems, by stating ‘Warning and alarm systems are provided to give information to the staff who are responsible for operating the MGPS, changing cylinders, responding to plant faults, and to the medical staff responsible for the administration of medical gases and clinical users.’ Because only standard alarm panels have been available until very recently, there is little to consider the advantages of remotely monitored alarms as part of the medical gas operational policy. This white paper aims to discuss the importance of monitoring medical gases and how new technology can promote a change in emphasis from in-house monitoring to remote monitoring, with its facility for shared system responsibility.

More information is now available to personnel defined in HTM 02-01 by way of accurate and timely data. Hence, why would a hospital want to use the services of remotely sited monitoring personnel, however well qualified? What are the benefits of such a system? How will these systems mean safer environments for patients?

In this paper we consider the use of current technology to enhance monitoring systems already in place. However, this does not mean that new technology will, or should, take over from existing equipment. This white paper also examines the case for maintaining status quo, except where procedures are not in accord with HTM 02-01. However, if the next HTM 02-01 or any addendum proposes the adoption of contemporary technology to increase benefits and cut costs, then this white paper should provide you with the necessary arguments for ‘upgrading’ your MGPS monitoring systems.

Paragraph 12.2 of Part A of the HTM 02-01 opens the door for technology to play an increasing role in the monitoring of medical gas alarms:

‘To date, practice has been to have a “dedicated” medical gas warning and alarm system and this approach will remain in many situations. With the development of computer-based integrated patient/management systems, nurse call and other alarm systems, however, there is considerable scope for including medical gas system information, including text action prompts etc. Additionally, building management IT-based systems will play an increasing role in the operation and management of an MGPS.’

In order to fully appreciate the significance (in 2009), of the concept and strategies behind remote monitoring, we offer some comparisons; examining products available today for functionality. This exercise serves to highlight only some of the better known systems. It is not intended to be an exhaustive compilation, nor will it provide any conclusive evidence of fitness-for- purpose. Instead, the product matrix serves to illustrate emerging solutions.

As with most new things, there are arguments for and against. Hence, in order to stimulate discussion, we provide the reader with an opposing view to the acceptance of remote monitoring.
We asked many questions about operational procedures and how a remote monitoring system would impact on these. The consensus was steeply in favour of implementing a remote monitoring system although some significant caveats were extended “not an imperative right now”, “will be ideal for new hospital build”, “won’t make any difference to our response times”, (needless to say we proved this one wrong), “it will be implemented as part of our PPM contract” – and many more in a similar vein. However, having researched current technology in a good sample of hospitals, and found this to be generally compliant with guidance, it is very basic for a good reason – many monitored systems and, indeed, monitoring systems, are at least 10 to 25 years old. Only now that technology has improved can monitoring systems be shown to do a more efficient job. Now that a monitoring system is not vulnerable to a computer crash, or a major world-wide software house is not holding the user to ransom for an operating system upgrade, or that a website is down, such intrusions into the quality of service (QoS) should no longer keep new technology out of monitoring medical gases.

Section 1 – Records and People

Record-keeping

We are all used to keeping records of events, diaries and other business and operational paperwork on a computer. Sometimes we have to record events with handwritten notes prior to entering the data into a computer database. There are many examples where these handwritten logs have been digitised – delivery slips from couriers, for instance, are now replaced by the recipient “signing” an Electronic Signature Pad. The need to keep records has been driven in recent times by compliance issues and litigation. These two areas are becoming ever increasing intrusions into our work practices.

It is essential that accurate records of work on medical gas systems are retained. It is a possibility, with decreased costs of hand-held data entry pads, that, for example, Permits to Work, could be stored on such handheld devices in the same way that courier delivery slips are being replaced. Permits are, however, a well accepted form of data entry, to be found in every hospital in the UK. By comparison, there is little doubt that recording of medical gas alarm indications is almost non-existent. Given a trend towards increasing litigation, the advantages of a well documented alarm record should be self evident. Remote monitoring offers the potential for producing and retaining accurate, dated medical gas alarm records without the need for manual intervention. Accurately kept records can also offer benefits to Estates Managers needing to make a case for upgrading plant or components of their medical gas pipeline systems. Additionally, with automatically retained and analysed records, fault trends can be identified. Remedial action timelines can be recorded and acted upon. The remedial actions and ‘back to normal’ status times can also be documented.
An engineer may feel that any new record-keeping system to be implemented will cause him to be responsible for its upkeep and accuracy, adding to and not decreasing his workload. In view of this, any new system has to take the man on the ground into account – to make his life easier not harder. I remember when the laptop computer was first produced. Many salesmen said they would never use one, as this would detract from their sales effort and would provide them with very little in return. They also said their secretaries were tasked with keeping their records. Well, what salesman today doesn’t have some version of a portable record-keeping device – be it a laptop or smart phone.

**Why is MGPS alarm data important?**

Up until recently, when SHJ launched both its remote monitoring service and its intelligent plant control system, Estates Managers were not interested in, or indeed, it can be argued, had no reason to be interested in, keeping accurate records of plant alarms for medical gases. Alarm statistics did not play a significant role in their working day. So what has changed? First there is an increase in litigation against hospitals. Some of this litigation has centred on non-availability of medical gases at life-critical moments. Second, hospital management are keen to provide statistics for availability, consumption, and procedural effectiveness. In other words – How efficient are their Portering and Estates Management facilities when delivering medical gas services? This data is not kept at present, because it would add huge workloads to an already under funded area of hospital management.

**People**

Estates Managers juggle with many different aspects of estates management during their working day. Medical gases personnel working with them are also tasked with other duties. It is therefore an imperative prerequisite that any remote monitoring system should be securely managed without further workload on these people.

Medical Gases are an important part of any hospital’s future plans for growth. Sadly, even though the latest HTM 02-01 state that a Medical Gas Committee, led by the (Principal) Pharmacist, should meet at least once a year, this is not the situation in every NHS Trust.

A monitoring system of any kind will eventually require a person at the ‘business end’ to take action. The most cost effective method of communication with that person could be bleeper, walkie talkie, or mobile phone. Mobile phones cannot communicate when they don’t have a signal and bleepers sometimes can’t be heard above the noise of plant and machinery in plant rooms.

So what is the best method of communicating a medical gas alarm to the right person? We argue that the best method is to transmit an automatic signal to an outside contractor who lacks the constraints of noise or loss of signal. This contractor can then decide on the criticality of the alarm and act accordingly. Of course, to make that decision, the contractor has to be trained in medical gases. There would be little point in having unqualified call-centre staff monitoring alarms.
Remote monitoring is not new and is certainly not unique but it is not widely used in the medical gas environment because technology has not been dedicated to the task until recently. Additionally, web-based systems which work well for environmental controls such as air conditioning plants are not considered robust or accurate enough for medical gas pipeline system monitoring. Where life critical systems are concerned it is imperative that a response protocol is in place, is followed, and that there can be no margin for error. That is why we fully endorse HTM 02-01 in stating that Building Management Systems should NOT incorporate MGPS alarm systems, rather only their indications. Medical Gas Alarms MUST be kept separate from other alarms for safety reasons. Our experience of installations of remote medical gas alarm indications to-date have shown that those already monitoring medical gases along with other in-house systems frequently do not want them embedded within a BMS, theatre display panel etc. Conversely, however, this does not mean there is a desire to take away in-house MGPS alarm monitoring from any of the locations defined within HTM 02-01.

Changes are being brought about by forward thinking Estates Departments, Health & Safety Regulators and the innovative use of technology: the very same thing happened in the late eighties, when salesmen said they didn’t need laptop computers. Change will happen because it’s frequently recognised that it’s cheaper to change than to remain the same. Data produced automatically provides Estates Managers with valuable information and gives the more astute managers the leverage of credible business cases for provision of new plant and better planning of system upgrades. Data also provides management with projected usage information, enabling managers to budget properly for increasing plant capacity and pipework provision. Projections make financial planning easier; so the more accurate the data, the better the case for investment.
Section 2 – Convergence of Remote and in-house Monitoring

In-house monitoring of medical gas alarms will always be available at some level or other. Remote monitoring is not a replacement. Fire alarms are monitored internally but are also sometimes monitored at a fire station. So shouldn’t medical gas alarms be remotely monitored by a suitably qualified on-call contractor?

Lines of communication are very robust these days but any organisation would not put all their eggs in one basket when it comes to life support systems such as medical gas alarms. The need for duplication of supplies is very obvious when considering medical air, oxygen and vacuum plant but less so when it comes to monitoring of these systems.

People monitor alarms. Alarms can be monitored by systems too but the result of an alarm should be actions by the relevant people. How and when those relevant people receive that alarm message is critical to their reaction time. We should consider the statements: -

‘When an alarm is set off, what is the quickest and most effective response mechanism? Is what we are doing now the most effective method of transmission, given that technology can play an important role?’

Certainly, we want a two way conversation – to verify criticality, location, and type of alarm, along with what areas could be affected by the cause of the alarm. If critical, we also want to know quickly what remedial action is to be undertaken and by whom. If an off-site engineer has received this information without any hindrance from plant noise or lack of signal, then it means his information is up-to-date, accurate and that he can react with confidence. In-house alarms can be monitored and reacted to in the same way as at present. Current procedures are not affected. The additional information provided by the remote system, however, can afford the in-house team some breathing space to coordinate personnel. The off-site engineer can be on his way and communicating via mobile phone to the in-house team, in order to verify that he has responded and will provide on-site assistance shortly.

It is not the current monitoring method that is in question; it is the response time and detail of information provided to the right person at the right time that distinguishes a remote monitoring system from an in-house system. We have discussed the adequacy and purpose of record-keeping. The automation of call logs has also been covered in Chapter 1; but people will inevitably become more pressed to produce statistics and timesheets for remedial actions, and an automated system is ideal for this mundane but essential function.

The two areas of monitoring – in-house and remote - should be designed to work together not against each other, as part of integrated processes that are easy to administer.

In-house monitoring and response can also take the lead role when an alarm is non-critical. In such instances the remote service performs the mundane recording tasks, and leaves to the human (in-house) element the business of resolving the non-critical issue – for example: changing cylinders on a manifold.
The responsibility has not been taken away from the in-house team, but the responsibility for record-keeping has been shared with the remote monitoring service.

System sophistication is such that responsibility for critical alarm responses can be left entirely to the remote service team if the Trust so wishes or that too can be shared. Should a critical alarm be triggered, then the remote service will notify the appropriate service engineer, copy the in-house team so that they are not left in the dark, and provide them with a remedial notification when normal status has been resumed.

The remedial notification is an important part of a remote monitoring service for areas such as Theatres. For instance, it is in the interests of Theatre Porters to have cylinder changing services notified directly to them automatically. This practice contributes to making the patient experience much safer.

Shared responsibility is not new – companies have been providing monitoring systems for some time on other services and they have worked well within such areas as building management, air-conditioning and fire and water services. Medical gases have a unique reputation in that there are many variables but a prescribed method of operation (HTM 02-01).

Currently, there are only minor precedents for remote monitoring – such as the BOC and Air Products remote systems for monitoring liquid oxygen consumption from VIEs - and a pre-conceived attitude that all monitoring should be handled in-house.

These systems are based on modem technology, where an automatic dial-up facility alerts the supplier to oxygen levels that require replenishing. The telemetry for BMS systems relies on Internet connections at both the hospital and the “supplier” or outside contractor, or e-mail for information recording.

With advanced telemetry and the use, not only of the above methods but also a direct data transfer from the hospital to the authorised MGPS monitoring service provider (using the NHS N3 gateway) a unique Secure Private Telemetry system is created.

Frequently ‘the lack of access to a budget for remote monitoring’ has been cited as the main stumbling block to investment in a remote monitoring system.

So, can installation costs be achieved by savings in either personnel or revenue expenses budgets for the Estates Department? Without being too explicit, because areas of cost savings differ from hospital to hospital – there are potential savings in several areas. Some may fall within the personnel budget. At one hospital used for evaluation purposes there were seven different monitoring stations for plant alarms. There were also plant alarms within each theatre but none in theatre reception! In another the in-house monitoring station had 15 main plant alarm panels showing a total of 42 gas and vacuum installations of one kind or another spread throughout many buildings on a 100 acre site. Identification of the plant function was from experience. The panels were mounted on a wall about 15 feet from the monitoring staff, who also had PC screens in front of them and were taking calls from the hospital and external sources. Five personnel were employed in this office.
Three non-critical alarms were being ignored at the time of our visit. Needless to say no records were being kept.

With an integrated remote system, a local touch screen would have provided these hospitals with central monitoring, and easy identification of the alarm and its location. Reaction to alarms would be dictated by their criticality.

By integrating the effective use of internal man-hours with those of the on-call contractor, much time can be saved and personnel costs reduced.

So, what are the incentives for change?

Take a look at how funding for a remote monitoring system can be allocated categories of costs based on your experience.

Here are just a few that were identified for us during our research:

£> Time saved in writing reports on alarm responses.
£> Time spent by staff examining and categorising alarms - security, porters, estates management.
£> Not dependent on human response times (automated system) – hidden saving.
£> Critical alarm service contractor made aware immediately – (hidden saving).
£> Intelligent cascading of a series of non-critical alarms to a critical alert – automation saves time.
£> No learning curve – therefore no training costs – (hidden savings).
£> Central monitoring is an HTM 02-01 requisite – remote monitoring provides this with shared responsibility, which alleviates resource allocation – no extra costs involved.

It is necessary when advocating a change in anything to promote the benefits and cost savings. It is also important to recognise the arguments for not adopting a new method of doing something.
## Section 3 – Product Matrix

Products identified that are capable of being used in a Remote Monitoring Environment

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Manufacturer</th>
<th>Dry contacts</th>
<th>Human / Machine Interface</th>
<th>Comms Protocols</th>
<th>Data Collection</th>
<th>Delivery of alarm method</th>
<th>HTM 02-01 Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mega₂</td>
<td>Beacon Medaes - USA</td>
<td>Yes</td>
<td>Panel</td>
<td>Via JC Metasys BAS</td>
<td>Database</td>
<td>BMS, PC</td>
<td>NO NFPA 99 2005 CSA Z-305.1</td>
</tr>
<tr>
<td>Totalalert2</td>
<td>Beacon Medaes - USA</td>
<td>Yes</td>
<td>Panel</td>
<td>Ethernet, Internet</td>
<td>Database</td>
<td>Printer, Text, PC, autodiallers, mobiles</td>
<td>NO NFPA 99 2005 CSA Z-305.1</td>
</tr>
<tr>
<td>MT-APN16</td>
<td>Meditek Systems - RSA</td>
<td>No</td>
<td>Panel</td>
<td>RS485/232</td>
<td>PC Software only</td>
<td>PC</td>
<td>NO RSA only</td>
</tr>
<tr>
<td>T-Net</td>
<td>Tri-Tek Medical - USA</td>
<td>Yes</td>
<td>Panel</td>
<td>Ethernet, Internet, wireless, RS485</td>
<td>Database PC Software</td>
<td>PC (panel clone image only)</td>
<td>NO NFPA 99 2005 CSA Z-305.1</td>
</tr>
<tr>
<td>XANADU</td>
<td>Amdar Electronics - Israel</td>
<td>Yes</td>
<td>Panel</td>
<td>Optional comms card, CAN bus Protocol</td>
<td>PC software</td>
<td>Panel only PC option</td>
<td>NO</td>
</tr>
<tr>
<td>EVOLUTION</td>
<td>SHJ - UK</td>
<td>Yes</td>
<td>Touch Screen, PC</td>
<td>Modbus over TCP, Internet</td>
<td>Database</td>
<td>Touch screen, PC, mobile, Text, e-mail</td>
<td>YES</td>
</tr>
<tr>
<td>SENTINEL</td>
<td>BOC Medical Systems - UK</td>
<td>Yes</td>
<td>SENTINEL Terminal, PC</td>
<td>Ethernet/Internet</td>
<td>Database</td>
<td>Email</td>
<td>Yes</td>
</tr>
<tr>
<td>Hi-Path DAKS</td>
<td>Siemens</td>
<td>Yes</td>
<td>DECT handset, PC screen</td>
<td>HiPath DAKS Digital Comms server</td>
<td>Database</td>
<td>Text and audible, prioritised alarms to DECT handsets Switchboard notified of responders</td>
<td>YES</td>
</tr>
</tbody>
</table>
Section 4 – An Alternative View

Many of the Estates Directors we spoke to were reluctant to establish a precedent. Some were ‘frightened’ of their IT department – “A system that encroached on their area was up to them to instigate”. Some thought the cost savings could be made in other ways with less disruption and others took the view that it would put too many noses out of joint to be effective.

More seriously, concerns about removing the responsibility for monitoring medical gases away from site have been more prevalent than any other. The main argument seems to be that personnel are already being paid to do the job around the clock. This argument appears self-defeating, because if it is possible to save staff wages by using an additional method of monitoring, the case for remote monitoring is promoted rather than denied. For instance, if a night security guard is tasked with monitoring medical gas alarms as well as other duties that might include floor walking, then immediately he steps outside his office, alarms are left unattended. The result of this scenario is, as is the case in many hospitals visited, a need for two security personnel on duty during the night. If gas monitoring was shared with the authorised contractor, a saving could be made.

When pressed on this point, it appeared to be a departmental issue (with HR involvement) that dictated the boundaries laid down about decision-making on a project. One of the main reasons for having a medical gas committee is that MGPS has many disciplines that span from patient care to pharmacy, into estates management and through to Portering. To make this statement as clear as possible – Estates Directors are, understandably, not keen to upset the boat when it comes to removing staff from one department’s budget and allocating the associated savings to another department’s budget for a capital investment. The Medical Gases Committees in such hospitals should be given power to propose investment solutions that are acceptable to financial decision-makers when there is a clear case in terms of service provision and value for money. Inability to identify and/or accept such proposals has been highlighted on several occasions during our research period and we have found that, generally, the larger the hospital, the more layers of objection there are. This is also true for private industry and probably more so in the private healthcare sector (although this is anecdotal, as our research in this area was insufficient for comment).

A few (3) Estates Managers did not understand the need for remote monitoring per se. Providing a shared responsibility for monitoring and reacting to medical gas alarms, was not viewed as important. The priorities that were consuming their budgets didn’t include remote monitoring of MGPS alarms and were treated as insignificant. We accept that when launching a new product in any field, there will be people who do not see the point at that time. Their focus is on something entirely different. At one presentation, which was set up by the Estates Manager, to his medical gas committee, remote monitoring was only accepted because the committee members were distal to the Estates Manager’s day-to-day problems. He was not convinced of its relevance but was totally out-voted by the committee members, who saw immediately that it would make his life easier.
We also put down to apathy many of the non-responders. This might be a bit unfair, but as with any vote for something new and slightly unusual, there will be abstainers. Not all promotions hit their target. We took this lack of response, at first, as being negative but, when we followed up on a cross-section of responses, we found that they fell into one or other of the above categories—these Trusts were thus noted as followers rather than leaders.

If a revised HTM 02-01 describes in more detail how MGPS are to be monitored, remote monitoring and record-keeping might just figure in the recommendations. If that is the case, our initial research will be followed up by a series of presentations to medical gas committees to establish how those hospitals intend to meet these recommendations and what changes, if any, they would make to improve monitoring and record-keeping of MGPS alarms.

**Section 5 – Conclusion & the Next HTM 02**

There are always many reasons for not doing something and, just like salesmen of old, change came gradually to their way of working. It didn’t take the advent of computers or the realisation that selling was a process that could be replicated, that finally got salesmen to use laptops. It was the realisation that life was never going to be the same after the ‘90s recession—their secretaries, who kept their sales records for them, had gone for ever. It was easier to administer contacts from the salesmen’s point of view and it was less expensive from the organisations’ point of view.

The change from local to remote isn’t that drastic—you’ll be pleased to hear.

Because,

1. **By introducing remote monitoring for medical gas alarms in a hospital environment, no procedures need to change.**

2. **Remote monitoring is not a replacement for local monitoring—just a well thought-out additional benefit.**

3. **The added value of remote monitoring provides enormous benefits to Estates Management, facilities management companies and those responsible for medical gases in hospitals.**

Current standard alarm panels show a certain amount of grading of criticality of alarms. For instance:

The panel on the right below shows that a series of events have already taken place (Shown below left): first, the medical air ‘Plant Fault’ (yellow lamp) has been displayed, followed by the ‘Plant Emergency’ alarm (again, a yellow lamp). However, an intelligent local screen from a remote monitoring system, can work out that this combination is now a critical alarm and changes the yellow display to a red signal.
There will be a real need to keep records of alarms and all the remedial actions that accompany them. Current analogue systems cannot produce these records. Building Management Systems (BMS) could do the job of collecting data, but medical alarms are different from other types of building alarms – they are the life-critical system for patients – and are much more patient-focused than air conditioning alarms. This is a good reason why they should NOT be handled by BMS but kept separate in terms of monitoring, record-keeping and administration.

In common with fire alarms, Remote Monitoring of MGPS alarms operate in a similar fashion – viz. in tandem with local monitoring systems. The reason for both is speed of reaction.

As one Canadian company CEO put it, “It is clear that, given the combination of intelligent telemetry, the improved Quality of Service of Internet-based systems and wide area data networks, along with a real need to save money in the public sector, remote monitoring of medical gas systems will become the norm within the next decade.”

It is at this point that we should remember the essential HTM 02-01 proviso of an independent system that will always remain within and managed by the hospital. Whatever happens to the remote system, the in house system will always be there and some reassurance should be gleaned from this fact. We should also remember that, rarely, even a modern, highly reliable in-house system can fail. In such cases the remote system would provide valuable information on fault conditions and also provoke an emergency response of the service team.

Given trends towards increased data requirements in defence of potentially litigious situations, there is no doubt that the possible use of remote monitoring should be aired by Medical Gas Committees.

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SHJ Hospital Pipelines Ltd
Unit 4 Anglo Business Park
Ashridge Road
Chesham
Buckinghamshire
HP5 2QA
www.shj.co.uk