A MANAGEMENT INFORMATION SYSTEM TO SUPPORT THE RADIOLOGICAL PROTECTION INSTITUTE OF IRELAND'S EMERGENCY RESPONSE ROLE

Design And Implementation

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Abstract: A recent review of the procedures covering the RPII's responsibilities under the National Emergency Plan for Nuclear Accidents has shown the need for a management information system (MIS) to support the organisation's operational plan for emergency preparedness and response. This paper describes the design objectives and the development of a prototype version of this system. Specific functions of the MIS are highlighted along with a description of the motivation behind their development. This very simple MIS has already helped RPII staff members to operate more efficiently. Finally, some ideas for future development are outlined.

1 INTRODUCTION

In Ireland a national plan has been developed to deal with the consequences of contamination reaching the country from an accident at an overseas nuclear facility. This plan, which is the responsibility of the Minister for the Environment, Heritage and Local Government, is known as the National Emergency Plan for Nuclear Accidents (NEPNA) (Department of Public Enterprise, 2002) and covers emergency notification and alerting, responsibilities of the relevant State bodies, interagency coordination, implementation of countermeasures and communication with the public.

The Radiological Protection Institute of Ireland (RPII) has been assigned particular functions under this plan covering early warning, technical assessment of the incident, technical advice on countermeasures and monitoring of the environment and the food chain. All organisations with responsibilities under the NEPNA are required to have in place an operational plan setting out procedures to meet those responsibilities. A review of the RPII's emergency procedures, following a large-scale test of the NEPNA in November 2001, demonstrated the need for a simple and robust in-house management information system (MIS) to support the RPII's operational plan by facilitating the collection and distribution within the RPII of information critical to emergency response.

Before describing the MIS, the responsibilities of the RPII under NEPNA are first described in more detail. These can be categorised under two headings: those related to emergency preparedness and those related to emergency response in the event of an accident.

1.1 Emergency Preparedness Responsibilities Assigned to the RPII Under the NEPNA

The RPII acts as the National Competent Authority (NCA) for the ECURIE (European Community Urgent Radiological Information Exchange) (De Cort, De Vries and Galmarini, 2003a) and the EMERCON (International Atomic Energy Agency, 1987) early notification systems for nuclear emergencies. ECURIE operates within the European Union and is based on EU Council Decision (87/600/Euratom). ECURIE covers both accident notification and the exchange of information between all States on monitoring and countermeasures. EMERCON is a worldwide system operated by the International Atomic Energy

Agency (IAEA) based on the 1986 Convention on Early Notification of a Nuclear Accident**.**

The RPII operates an on-call system to facilitate a rapid response to a notification concerning a nuclear accident. Arrangements are in place so that a duty officer, a senior member of RPII staff, can be contacted 24 hours a day, 7 days a week in the event of a notification from ECURIE, EMERCON or other sources such as bilateral contact from a neighbouring State. The notification will be forwarded to the duty officer by the designated National Contact Point (NCP) for radiological emergencies, which is the national police service, An Garda Síochána.

The RPII operates and maintains a national network of Permanent Monitoring Stations (PMS). The network comprises gamma dose rate stations, which are intended to provide early indication of elevated ambient gamma dose rates and air sampling stations which allow the concentration of radioactivity in the air to be assessed. The network operates continuously and would be expected to provide the first measurements in the event that a radioactive plume reaches Ireland.

The RPII participates in the European Radiological Data Exchange Platform (EURDEP) (De Cort, De Vries, Galmarini, 2003b), whereby monitoring data are routinely exchanged between Member States. In the event of an emergency the rate of exchange of data would be increased.

The RPII has established an emergency response centre and maintains the facilities necessary for fulfilling its functions in the event of a nuclear accident. It maintains and distributes up-to-date lists of all the key personnel involved in the NEPNA, ensures the availability of a pool of suitably trained personnel for crisis response, participates in national and international exercises and assists in the organisation of national exercises.

The RPII also provides advice to Government departments and local authorities for the development and update of their arrangements for dealing with nuclear accidents.

1.2 Emergency Response Responsibilities Assigned to the RPII Under the NEPNA

Arrangements are in place so that the RPII duty officer can, in consultation with other key Government staff, quickly activate emergency response procedures on receipt of international notification of an accident with actual or potential consequences for Ireland. In accordance with the NEPNA, once the emergency response procedures have been activated the RPII is charged with a number of critical functions. These include: gathering together all available information relevant to the accident so as make a technical assessment of the potential consequences for Ireland, formulating technical advice to Government on protective measures and assessing the levels of radioactive contamination in the environment and the food chain.

The RPII uses the decision support tool ARGOS (Accident Reporting and Guidance Operational System) (Danish Emergency Management Agency, 1997) as its primary platform for handling environmental data in an emergency. ARGOS has been jointly developed by the Danish Emergency Management Agency (DEMA) and the software company Prolog Development Centre (PDC). The on-going development of ARGOS is managed by an international consortium of which the RPII is a member. The ARGOS system integrates a range of data types relevant for nuclear emergency response including PMS data, EURDEP data, environmental radioactivity measurements and meteorological data. ARGOS includes the atmospheric dispersion model RIMPUFF, which allows the dispersal of a radioactive plume to be calculated in order to forecast when and where contamination is likely to arrive over the country. RIMPUFF atmospheric dispersion projections use numerical weather prediction data which are generated by Met Éireann (the Irish National Meteorological Service) using a model called HIRLAM (High Resolution Limited Area Model).

In the event of an incident resulting in widespread environmental contamination the RPII's environmental laboratory, which is the principal national centre for radiochemical analysis, will be required to test a wide range of environmental and food samples. The RPII's operational plan includes procedures for sample handling and prioritisation. Given the extent of agricultural production in Ireland, it is inevitable that this function will place considerable demands on resources. Efficient monitoring of foodstuffs is essential to the implementation of effective foodstuff controls, where necessary, and to maintaining confidence in Irish goods in the longer term.

The timely provision of accurate information and advice for public reassurance is a vital function of the NEPNA. Even in the case of an accident with no direct consequences for Ireland there will still be heightened public awareness and a demand for information. In accordance with the NEPNA the Government press office is responsible for coordinating provision of information and advice to the public from various arms of Government. In the event of a major radiological incident it is clear that

considerable demand would be placed on the RPII Information Service both directly from the media and via the Government press office.

2. DESIGN OBJECTIVES AND SYSTEM ARCHITECTURE

Before commencing development of the MIS, a detailed analysis of requirements was undertaken. This resulted in the identification of a number of underlying design objectives, which influenced the system architecture. These are described below.

In order to minimise software management and distribution demands, it was decided that the MIS should be web-based and that personnel should have the same MIS functionality, whether using their own office PC, a response centre PC or a PC in their home. Secure off-site access was therefore also required and the MIS was designed to accommodate this.

The choice of technology used to host and develop the MIS was influenced by two factors. Firstly it was decided to employ the Nuclear Information System, NucInfo 4.12 (Danish Nuclear Inspectorate, 1997), as a developmental starting point. NucInfo is a virtual information centre designed by DEMA and PDC to support nuclear emergency response in Denmark. It features interfaces for the presentation and distribution to a wider audience of the data output from the specialist tools contained in ARGOS. NucInfo utilises Microsoft technologies including NT server, IIS, ASP and SQL Server. Certain NucInfo modules were used directly; some were configured for the RPII's specific requirements while others were developed from scratch.

The second factor influencing the choice of technologies was the requirement that the development tools be as open and as non-developer specific as possible. It was planned to use widely available, off-the-shelf software and simple scripting languages where possible, in order to effect updates easily and to minimise development complexity. For this reason Microsoft technologies, and specifically ASP (Active Server Pages) in the main, were employed.

These technologies ensure that the MIS complied with a further requirement that it would be robust and scalable, capable of handling potentially large increases in information flow during the response to an emergency.

In order that the MIS could be easily maintained and upgraded it was a requirement that all information be stored in a relational database. The system is modular in design so that new functionality can be added or existing functionality upgraded without adversely affecting existing applications. Similarly the MIS has been flexibly coupled with NucInfo so that new versions of the latter can be installed transparently.

It is necessary, that the MIS is easy to use under emergency circumstances and that extensive user training is not required. This has been achieved by providing simple forms for the user to add, edit or delete content. Simple formatting tools are provided where necessary. All information has been made easily retrievable via menus and search applications. Page design has been made as attractive and uncluttered as possible and best-practice interactive design techniques have been employed.

In designing the system it was decided that routine non-emergency applications should be incorporated in order to promote familiarity with the MIS through regular use. These are described in more detail in Section 3.3.

It is vital that users have confidence that data accessed via the MIS are accurate and up to date. Hence a number of tools have been included in the system to control the way records are updated. For each record the date when it was added or last modified is displayed with the data wherever they appear in the MIS. Users are encouraged to directly correct inaccurate information using the content management forms described above. Flexible security controls and group profiles allow access to certain classes of information to be restricted to certain user types. Users with the appropriate authority can configure these permissions from the MIS itself. This also allows any permutation of applications contained in the MIS to be configured for any user. This is a major advantage over the use of client-server software in the (usual) case when an individual is a member of several response teams, each having different software requirements.

3. SPECIFIC FUNCTIONS OF THE MIS

The main motivation behind the design and implementation of the MIS is to support the organisation's emergency response arrangements by providing simple tools for the collection and distribution of incoming information, by streamlining data retrieval and by enhancing communication between RPII response personnel in various teams and locations. Some specific components of the MIS that facilitate these objectives are now described.

3.1 Response Management

A simple message board application has been developed for use during a crisis response situation whereby users can enter information relevant to the decision making process. The identity of the user adding the item of information, the time it was added to the MIS and the rationale for advice issued are recorded. File attachments can also be added. Broad subject headings are used. For the first implementation no threading of messages has been deemed necessary; the information is simply entered within one of several categories and sorted by the date entered.

The current categories are:

- Technical assessment of the consequences of the incident for Ireland,
- Media information issued to the Government press office,
- Countermeasure advice issued by the RPII,
- Requests for and prioritisation of monitoring samples,
- Pertinent items from incoming information sources (including news agencies, ECURIE and EMERCON),
- Answers to frequently asked questions for use by the RPII Information Service.

This application is designed to help facilitate efficient exchange of information between groups tasked with different aspects of the emergency response. The information entered will also form an incident diary and a record of events, which can be used to monitor the evolution of the response. This is especially useful for monitoring the effectiveness of the response and for providing feedback after exercises and tests.

The MIS can also be used to generate press releases, in HTML and PDF format, using a simple form. These can be previewed, forwarded to authorised staff for approval and automatically uploaded to the RPII's external website.

3.2 Management of Duty Officer Arrangements

A monthly on-call duty officer schedule with contact information is generated and sent by fax or email to the NCP and other relevant parties. The generation and distribution of this document has been automated via the MIS. Using a simple HTML form, the contact details of the appropriate duty officer can be linked to the on-call dates and the contact list generated as a PDF document. The MIS also clearly displays the on-call duty officer, with a link to contact details, in a prominent position on the MIS homepage. It is intended to further employ this contact information in order to direct information messages to the on-call duty officer by SMS (Short Messaging Service).

3.3 Routine Non-emergency Applications

In order to maintain on-going familiarity with the system a number of routine non-emergency applications have been incorporated.

On a daily basis, the RPII Information Service scans selected newspapers and online sources for articles relevant to the organisation's work and distributes links to these articles to all staff. This process has been incorporated into the MIS so that all staff members use the MIS as a portal for viewing the articles, while the press office staff use it to maintain a database of press articles. Articles are stored with keywords so providing a searchable historical archive.

A database of emergency contact details has also been developed and is already widely used. A web-based contact management tool, modelled on Microsoft Outlook, has been provided for its maintenance. Printable PDF lists can be generated in addition to HTML display with the MIS.

3.4 International Notification Arrangements

ECURIE notifications are sent to the NCP by fax and to the NCA via ISDN and received by the dedicated client-server coding/decoding software CODECS. The MIS monitors the message database used by CODECS and records new notifications and exercise messages of various levels. All users can then monitor these.

All EMERCON communications are sent by fax. Messages are also posted to IAEA's secure ENAC (International Atomic Energy Agency, 2002a) website. The MIS provides the URL and access details to this site. It is also possible to display incoming fax images on screen. Options to parse the text from incoming faxes and to automatically monitor the ENAC database are being investigated.

The RPII has in place a number of bi-lateral agreements for information exchange. The communication from these channels is usually by direct person-to-person contact and on receipt is entered into the MIS by an operator.

3.5 Portal to Monitoring Systems and Environmental Data

Gamma dose rate measurements from PMS are continuously transferred to a database and can be viewed on the MIS. A map showing all gamma dose rate stations with dynamic status indicators is also featured. Each station icon is linked to current and historical data. Both of these functions are achieved by using ActiveX components directly from NucInfo.

Air filters are sent routinely from the PMS to the RPII's environmental laboratory for testing. Arrangements are in place to increase this sampling frequency in the event of an incident. The MIS monitors the database used by the laboratory to record filter measurements, which can then be read from the MIS. Options are being considered for integrating measurements from soil and food sampling in the same way.

National gamma dose monitoring data for each participating Member State are collected and aggregated by the EURDEP system. The aggregated dataset is then redistributed to the Member States. This routinely occurs once per day but the frequency would be increased in the event of an emergency affecting or with the potential to affect Europe. The RPII automatically downloads these data and stores it in the ARGOS database. These measurements can also be viewed via the MIS. A link is also provided to a secure server hosted by EURDEP on which data from the central aggregated database can be viewed directly.

The MIS acts as an interface to a Met Éireann application for displaying radar rainfall images. These are particularly important data since rainfall is a useful indicator of where deposition is likely to occur during the passage of a radioactive plume.

QA functions are included in the system, which alert an operator in the event that automated transfer of PMS, HIRLAM or EURDEP data has failed.

3.6 Publication of ARGOS Results

Predictions of radioactive plume trajectory and dispersion can be published to the MIS directly from ARGOS. Links from the MIS to the ARGOS database allow the source term (the estimate of the amount and chemical form of a contaminant released to the environment from the accident site over a certain period of time) and the source inventory to be displayed. The predictions published to the MIS can take the form of a single snapshot image or sequences of images over the duration of the model run.

3.7 Database of Emergency Information

A centralised repository of all emergency operating procedures and supporting technical documentation has been provided. Documents can be uploaded or removed from the server. The contact database and tools for its maintenance as described above have also been provided. In addition to contact details, form-based tools enable users to update other database-stored information such as web resources, glossary entries and links to press articles.

A site-wide search has been implemented, using Microsoft Index Server, which allows the user to easily retrieve emergency operating procedures and supporting technical documentation, glossary entries and links to relevant press articles. A nuclear facility search based on the IAEA Power Reactor Information System (PRIS) (International Atomic Energy Agency, 2002b, 2003) database provides general and design information on power reactors, and information about operating experience with nuclear power plants.

Other tools include links to online international news sources and emergency planning resources, and relevant European and national legislation.

4. CONCLUSIONS AND FURTHER DEVELOPMENT

The RPII has successfully developed a simple prototype MIS to support its operational plan for emergency preparedness and response in relation to overseas nuclear accidents. The MIS is a portal for the collection and distribution of information, both static and dynamic, and for resources related to the operational plan. It can be used as a robust event log for recording the evolution of the response to an incident or during an exercise.

The MIS is web-based and designed so that response personnel can operate from disparate locations and are not tied to a physical response centre. The RPII has been successful in promoting use of the MIS for day-to-day activities so that personnel will be familiar with the system in the event of an emergency. A 'culture change' has been initiated within the organisation whereby staff members use fewer paper records and store and amend information centrally. The profile of the 24-hour duty officer schedule has been raised throughout the organisation. As it can be published to the MIS, output from the specialist decision support tool ARGOS is now much more accessible to all response personnel. All staff members can

also view data from the national monitoring network.

The prototype version of the MIS can be accessed only by users on a LAN within the RPII. The RPII plans to implement a clientless SSL Virtual Private Network (VPN) infrastructure in order to address the security and hosting issues involved in remote access. When implemented, this set up will allow authorised users instant access to the MIS from any internet-connected location. However, as the web and database servers will still be protected by the RPII network firewall, server administration, database updates and access by the MIS to incoming information streams will remain both secure and easy to configure.

It is also planned to expand the role of the MIS in order to support emergency preparedness and response to other radiological incidents. These include local incidents involving discrete high activity sources, lost sources, transport accidents, and satellite re-entry.

The initial implementation of the MIS has been developed very much in line with the existing procedures and structure of the planned emergency response. It is intended that future versions will feature 'smarter' tools to further support the operational plan. The main areas in which it is felt that development is required include the following.

User management tools. These could be used by the coordinator of the response to view the staff members that are available to respond at any time. Details such as the background and expertise and the level of training in each aspect of the response of each staff member should be easily accessible. Dynamic contact details should also be available as it is likely for instance that they will be using a different phone number from normal.

Information tracking. Requests can be made using the existing MIS response management tools for certain measurements or other information. This request could be tracked by the MIS so that the requesting user or group can be alerted when it has been fulfilled. It should also be possible to link all information that is related within the system to ensure that all users are kept fully up to date.

Collective memory. Regular exercises and tests are an important aspect of emergency preparedness. It is planned to extend the MIS in order to include interactive exercises and training materials in the form of questionnaires or scenario games. The event log and feedback from exercises will be used in part to develop this material.

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