PROGRAM FOR FRENCH RADIOACTIVITY ALERT NETWORK MODERNIZATION

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Abstract:
French radioactivity alert networks, set up shortly after the Chernobyl accident, have today more than fifteen years of existence. Some components of these networks (computers, probes, etc) are growing old today and their replacement is becoming essential. Before beginning this programme, IRSN wished to benefit from the experience feedback of the European countries and began technical visits in 2006.
Since 2007, studies concerning the sensors allowing the measurement of the ambient gamma dose rate in the air, as well as the development of prototypes for airborne particulates and water radioactivity measurement were initiated.
In parallel, the development of a centralizing interface for all data was launched, with the aim of proving the technical feasibility of the adopted solution but also allowing the first tests of the various apparatuses.
IRSN intends to modernize the whole tools by the end of 2009.
This presentation deals with the results of the IRSN study, particularly concerning the European technical feedback synthesis and the first achievements of the modernizing project.

1 CONTEXT FOR MODERNISATION OF CONTINUOUS REMOTE RADIOACTIVITY MEASUREMENT NETWORKS

Radiological monitoring of the French environment is one of the fundamental missions of the IRSN (*Institut de Radioprotection et de Sûreté Nucléaire* – Institute for Radiological Protection and Nuclear Safety). In order to complete this mission, the Institute develops and operates four continuous remote radioactivity measurement networks; two networks dedicated to the atmospheric compartment and two networks dedicated to the aquatic compartment. The oldest of these networks, Téléray, has been in existence since 1991, measuring ambient gamma radiation. If a major radiological event occurs, the airborne path forms the preponderant vector for radioactivity dispersion and population exposure. Knowledge of air contamination is also necessary to make a prognosis about the amplitude of fallout to the soil, so as to decide upon any actions to protect or restrict consumption of foodstuffs. Therefore, networks will be required to participate in all phases of an accident (threat, urgency and post-accident) for a predictive evaluation of contamination and its characterisation until a return to the normal situation.

Internal studies carried out since 2005 about the redefinition of the IRSN monitoring strategy and the analysis of existing networks, have concluded that they must be renovated to achieve maximum efficiency under all circumstances; national coverage adapted to the environmental context and installation risks, sampling and metrology of magnitudes of interest, transfer and data processing efficiency.

In order to guide its choices about the organisation of the future alert network, the Institute wished to share operating experience from European countries. The study carried out in 2006 consisted of collecting information in Europe about the general organisation of networks for remote continuous monitoring of the dose rate and for making automated aerosol measurements. It collected technical information about the different elements forming part of the measurement acquisition system, starting from the type of detector used and any additional sensors (meteorological, spectrometers, etc.), until the centralisation system, including transmission and processing of data.

The results of this study were used to guide some of the Institute's choices to implement the network modernisation project. In the medium term, this modernisation should be able to provide reliable, reactive and sensitive alert networks capable of detecting radioactive contaminations in the atmosphere at relevant geographic points, at a very early stage.

2 TECHNICAL AND FUNCTIONAL ANALYSIS OF THE EXISTING SITUATION

At the moment, the organisation of remote monitoring networks is based on completely separate and monolithic networks. Each network has its own communication means, its own centralisation system and its own database. In some cases, the same company has provided all elements making up the network acquisition system, from the sensor to the centralisation system. This concept severely limits capabilities for upgrading and modernising tools.

Therefore, modernisation initiated by the Institute naturally turned towards the use of a single modular network. The selected idea was to use a single communication mode for all networks. A centralisation system will be used to collect information from the different types of sensors located in the environment. This technical orientation will guarantee the durability and upgradeability of the system.

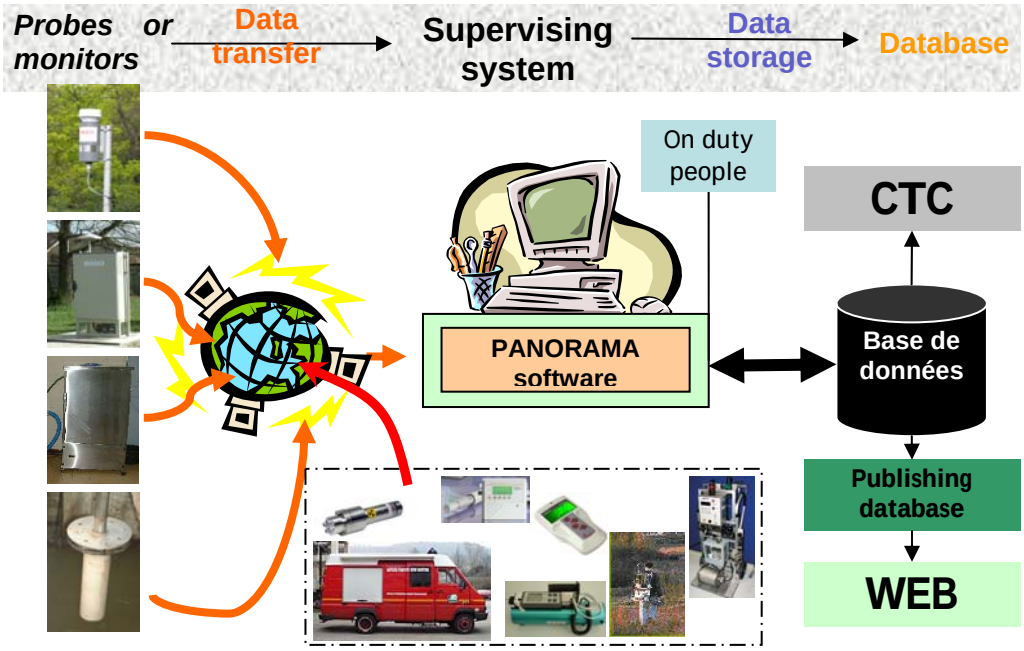

Figure 1 : Technical axis for modernization

3 REDEPLOYMENT STRATEGY

3.1 Deployment of dose rate probes

The main purpose of the automated dose rate measurement network is to trigger an alert if an abnormal radiological situation arises so that population protection actions can be taken. A uniform geographic coverage of probes over the entire country is necessary to achieve this. Thus, the way in which a radioactive plume varies can be monitored over the entire country in real time. The large urban centres (prefectures and sub-prefectures) will be given priority so as to concentrate monitoring close to populations, and also for ease in installing probes.

Monitoring of nuclear sites will also be reinforced. The installation of IRSN probes will take account of probes already installed by the operator. However, inter-comparison points will be set up to check the consistency of the operator's measurements. If operator data are available, they will be collected by the IRSN Supervisor, as is the case for example with EDF data.

Uniform coverage of the country shall enable good monitoring of frontier zones, particularly through maintenance of probes located on summits. The presence of these probes at high altitude would enable earlier detection of a far radiological event, since air mass circulation velocities are greater at these altitudes.
Probes located in adjacent countries shall be kept so as to have points for comparison with probes in European countries. Among other functions, this would be useful for checking the uniformity of radiological values in Europe.

Monitoring of populations in overseas territories and departments shall be continued, and probes located in prefectures in these overseas departments and territories shall be maintained.

3.2 Deployment of aerosol monitors

The purpose of automated aerosol monitoring is to quickly qualify and quantify radionuclides present in the atmosphere in the case of a radiological event, to contribute to determining the dose received by the population within the limits of equipment detection possibilities. To achieve this, all of France shall be covered as uniformly as possible, so as to monitor the geographic movements of a radioactive plume in real time.

To support these lines of reflection, the IRSN emergency situations and crisis organisation department is carrying out a retro-modelling study based on a catalogue of typical French nuclear accidents. The results of this study will provide valuable information about the most suitable number of stations and network typology to obtain an optimised network for better early detection of a radiological event.

In the organisation of the future network, it is envisaged to couple aerosol monitors with dose rate probes and possibly meteorological sensors. Thus, these proximity sensors will become genuine diagnostic assistance tools to justify an increase in radioactivity.

3.3 Advantages of transportable monitors

The choice of the number of dose rate probes or aerosol monitors making up these networks is a compromise between a good national coverage and an acceptable cost in purchasing probes and maintaining them. One alternative to the use of a large number of fixed monitors would be to use transportable monitors so as to densify a particular zone in case of crisis. Equipment would be deployed in the threat phase and could thus densify monitoring systems on the terrain in the case of a crisis.

These transportable monitors could also provide a solution to contamination of sensors in an emergency or post-accident situation because they could be deployed after the releases have stopped to notify when a normal situation has been restored.

4 MODERNISATION OF INSTRUMENTATION

Choices about replacement of radiological sensors in remote measurement networks cannot be made through a choice *a priori* based solely on technical documentation given by the supplier. All these sensors will have to be tested under real environmental conditions to obtain relevant comparison elements. This is why the IRSN considered it essential to set up a technical evaluation platform that will be used to perform synchronised tests of different types of sensors including dose rate probes, aerosol monitors, gamma spectrometry probes, meteorological sensors, etc.

Figure 2 : Platform of tests

4.1 Dose rate probes

The study of probe types used in different European countries demonstrates that the Müller Geiger counter is used in most networks continuously measuring the ambient gamma dose rate. The advantages of a Müller Geiger counter over a proportional counter are not clearly defined, except for a historical reason based mainly on cost.

The IRSN did not consider it useful to have a specific probe developed for replacement of probes in the Téléray network, considering that manufacturers of this type of unit have good operating experience which should not be questioned. Therefore the IRSN chose to acquire the principal dose rate measurement probes currently on the market, so that it could test them by performing a comparative study of their performances. By 2008, this study will be

used to select the detector(s) that will replace Rados RD02 probes currently used in the network. A first study will consist of characterising probes based on standard IEC-1017 to determine their behaviour during the different climatic, mechanical, electrical and radiological tests. Later, dose rate probes will be tested on an evaluation platform, more particularly so as to evaluate their reactivity and generally their behaviour when a radioactive source appears or disappears.

4.2 Aerosol monitors

In its monitoring network modernisation plan, the IRSN has identified a need to upgrade its automated network for continuous measurement of aerosols, to reduce constraints related to maintenance and particularly consumables. There are some operating difficulties with the existing network, particularly related to severe clogging of the filter.

Modernisation of this network shall make it possible to develop a new aerosol monitor concept. The Institute would like to make a compact monitor capable of beta counting and gamma spectrometry on aerosols. Gamma spectrometry is given priority considering that it is required to use this network mostly for identification of radionuclides.

The IRSN would like to have prototype monitors made based on received technical replies, so as to test them under real conditions. Technical adjustments will be necessary before series development of these monitors, so as to guarantee that the product made complies with the need.

Figure 3 : Aerosol monitor (exterior and interior view of the monitor)

4.3 Gamma spectrometry probes in air

Existing dose rate measurement probes are incapable of characterising radionuclides in a plume in real time. Moreover, during modernisation of aerosol monitors, the problem related to the measurement of iodine and more generally of halogens has deliberately been ignored, to exclude use of consumables in automatic monitors.

One possible way of overcoming these problems would be to envisage using a network of atmospheric gamma spectrometry probes. At the moment, new probes of this type are available on the market. They have better characteristics than any NaI detectors usually used for this type of measurement. In particular, these are $LaBr_3$, CZT or CsI probes. The

tests that will be carried out with these probes in the future will be used to validate the possibility of using them to qualify radionuclides present during an increase in radioactivity.

4.4 Gamma spectrometry probes in the aquatic surroundings

For monitoring the aquatic compartment, the IRSN has two automated networks of gamma spectrometry probes, one dedicated to monitoring of large French rivers and the other to monitoring of nuclear medicine wastes and for which the probes are located in waste water at the inlet into some treatment stations. The first network does not need to be modernised at the moment because it was set up fairly recently. On the other hand, operating experience with development and operation of the network dedicated to monitoring of nuclear medicine wastes now shows up a number of limits in terms of reliability of the equipment used, its maintenance and the rigidity of the technical architecture limiting the IRSN treatment autonomy. These limits make it necessary to redesign this network. The main purpose of this upgrade is to develop a lightweight and reliable system, particularly concerning metrology, but also the quality of materials used, to perform measurement campaigns at permanent fixed points or during isolated services.

The IRSN will study technical developments concerning the choice of materials and the choice of detectors used in this type of probe.

Figure 4 : Probe dedicated to the nuclear medicine wastes

4.5 Meteorological sensors

Meteorological data are essential in data analysis when radioactivity increases. Almost all European countries have associated meteorological sensors with dose rate probes and / or aerosol monitors. The main data collected apply to rain, humidity and wind.

Following this observation, meteorological sensors will also be qualified on the technical platform in order to evaluate their performance, their robustness and constraints related to their maintenance.

5 MODERNISATION OF TELEMATIC SYSTEMS

At the present time, the communication method used in France to import data from alert networks makes use of the Switched Telephone Network (STN). However, this network is not completely reliable because it could become saturated in a crisis period and therefore could not guarantee that data are transmitted.

It is necessary that the communication means selected for future remote measurement networks should be reliable, secure and that they tend towards communication in real time. In a crisis period, it is very probable that all communication networks would be saturated, particularly for example with the GSM network. This is why it is necessary to select a telematic system capable of operating under all circumstances, to import data. It is not impossible that this may be done using two communication modes, for example one ADSL for use in routine situations, and the second of the satellite type to enable a backup solution in a crisis situation.

Studies involving different technical and institutional partners have begun to define an appropriate tool to help define the choice of this telematic tool.

6 MODERNISATION OF SUPERVISION

The centralisation system must perform two main objectives. The first consists of automatically importing, validating and storing data. The second consists of efficiently managing alarms by making a relevant analysis of the data and a high performance real time information transfer.

The "Panorama" software package is selected for the future network supervision software. This tool must guarantee modularity of the network, the objective being to be able to interface it with any type of sensors in the environment: dose rate, meteorological, aerosol, etc. The evaluation platform using the "PANORAMA" supervisor has already confirmed the feasibility of a single supervisor supervising several types of dose rate probes and meteorological sensors through a connected network (IP /Ethernet type). The study will be continued for aerosol monitors, so as to reach a more general conclusion about this feasibility.

7 CONCLUSION

The main milestones in this modernisation allow for the choice of future dose rate probes for the Téléray network by the end of 2008. Before these new probes are deployed, it is planned to use the new PANORAMA supervisor to take control over importing data from existing Téléray probes to check the feasibility of such a project on a large scale. Deployment of new probes will begin starting from 2009.

Deployment of automated aerosol network monitors is planned to start in 2010, considering that the series production of this type of monitor will take longer because of the innovative nature of the monitor and consequently constraints related to its series manufacturing.