The monitoring stations can be extended to include air sampling heads, detectors and pumps if power supplies can be provided at each station, as well as other sensors such as chemical agent monitors.

Other types of telemetry system can be used in place of the radio network; direct landlines, telephone lines (via modems) and optical fibre links are all in use on existing systems at other installations.

IAEA-SM-280/34P

EXPERIMENTAL STUDIES ON TECHNETIUM TRANSFER TO MAN, VIA THE ANIMAL FOOD CHAIN, FOLLOWING A CONTAMINATION OF THE SOIL SURFACE

R. KIRCHMANN*, E. FAGNIART*, M. VAN HEES*,
R. VAN BRUWAENE**, G. GERBER*,
J. COLARD*, M. COGNEAU**

* Département Radiobiologie,
Centre d'étude de l'énergie nucléaire (CEN/SCK),
Mol

** Laboratoire de chimie organique et nucléaire,
Université catholique de Louvain,
Louvain-la-Neuve

Belgium

1. SOIL TO PLANT TRANSFER STUDIES

Technetium-99 was deposited, as pertechnetate, in the upper layer (1 cm) of sandy soil plots located in the experimental field of the Belgian Nuclear Research Centre (CEN/SCK). The deposition was performed in early spring; the contamination attained a level of 1.46 MBq/m^2. *Zea mays* cultivation was done according to the usual practices in agriculture (soil preparation, fertilizer, irrigation, etc.). At crop maturity, the above-ground parts (leaves, stems and ear of grain) were separately harvested, and the ^{99}Tc content was measured by liquid scintillation counting, after wet mineralization. The mean levels of contamination (Bq/kg dry weight) observed were respectively: 432 for leaves, 72 for stems and 13 for grain. At the second harvest (the year after the deposition) the values were respectively 178, 25 and less than 3.6 Bq/kg. The corresponding transfer factors are shown in Table I.

TABLE I. TRANSFER FACTOR VALUES:
(Bq ^{99}Tc/g dry weight plant)/(Bq ^{99}Tc/g dry weight soil)

Plant part (*Zea mays*)	First harvest	Second harvest
Leaf	2.8	7.4
Stem	0.49	10

TABLE II. DISTRIBUTION OF ^{99}Tc IN VARIOUS EDIBLE ORGANS AND TISSUES OF SHEEP (IN % OF THE INGESTED DOSE/kg FRESH WEIGHT)

Organs/tissues	Time elapsed (days) since administration of *Zea mays* with bound technetium			
	1	3	7	28
Kidneys	2.2×10^{-1}	1.6×10^{-1}	1.9×10^{-1}	1.7×10^{-2}
Liver	2.4×10^{-2}	1.3×10^{-2}	1.5×10^{-2}	3.1×10^{-3}
Muscle	4.0×10^{-4}	2.6×10^{-4}	2.2×10^{-4}	4.0×10^{-5}

The results indicate that the observed increase in transfer factor with time can be explained by movement of technetium from the soil surface into the rooting zone and not by an actual increase in the uptake of Tc.

2. PLANT FORAGE TO ANIMAL TRANSFER STUDIES

A mixture of *Zea mays* leaves and stems, containing bound ^{99}Tc (1.28 nCi/g dry weight), labelled with ^{95}Tc^{m}, was introduced into the rumen as a unique dose to five sheep sacrificed respectively 1, 3, 7, 28 and 90 days after the application. About 1.7% of the technetium ingested is transferred to the body of the sheep and progressively eliminated afterwards. The concentration of ^{99}Tc in various edible organs and tissues of sheep sacrificed at different times after application is shown in Table II.

This table shows that the technetium concentration in kidneys is three orders of magnitude higher than in muscle. Comparison with data obtained earlier shows that the transfer of technetium via forage is almost as high as the transfer of the technetium injected intravenously [1].

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IAEA-SM-280/35P

COMPARATIVE STUDIES ON FOOD CHAIN PATHWAYS FOR TRITIUM TRANSFER TO MAN FOLLOWING ACCIDENTAL EXPOSURE TO TRITIUM OXIDE

R. KIRCHMANN, G. GERBER, E. FAGNIART
Département Radiobiologie,
Centre d'étude de l'énergie nucléaire (CEN/SCK),
Mol, Belgium

R. VAN BRUWAENE, J. VAN DEN HOEK
Animal Physiology Laboratory,
Wageningen, Netherlands

Tritium can reach man via the food chain directly in plants or through meat and milk. Organically labelled tritium with long retention time thereby plays an important and not yet fully explored role. The characterization of critical pathways and the elaboration of models for the consequences of accidental tritium release is the purpose of the experiments reported.

CONTAMINATION OF PLANTS BY TRITIUM

Recent experiments [1] under controlled conditions have shown that uptake by the above-ground parts of plants immediately after exposure is about ten times greater when exposure to tritium oxide occurs as a spray than when it occurs as vapour. These observations emphasize the importance of rain after accidental release of tritium oxide. The activity of long-lived organic substances in plants, formed mainly by photosynthesis, depends, in addition to specific activity and residence time of water in leaves and stems, on species, etc. These factors are subject to a large uncertainty concerning climatic conditions prevailing when accidental releases take place. In order to develop models for such releases and to study which additional parameters need to be measured for prediction of accident consequences, transfer of tritium oxide to agricultural plants has been studied under natural conditions in Mol, Cadarache and Corsica [2]. These data,

TABLE I. TRITIUM CONTENT OF VARIOUS CROPS AND TRANSFER FACTOR AFTER A UNIQUE DEPOSITION OF TRITIATED WATER (1 MBq/m^2)[a]

Plant species	Period or age when deposited	Nature	Time elapsed since deposition	^3H content kBq/kg food	^3H distribution (%) Tissue-free water tritium	^3H distribution (%) Organically bound tritium	Transfer factor ($m^2 \cdot kg^{-1}$)
Vineyard	June	Wine	6 months	0.5		76[b]	1.5×10^{-5}
Olive-tree	June	Oil	6 months	0.7	–	100	2.0×10^{-5}
Orange-tree	February	Fruit	5 months	10.0	20	80	2.7×10^{-4}
Potato	63 d	Tuber	65 days	75.1	86	14	2.0×10^{-3}
Pea	42 d	Grain	52 days	8.1	5	95	2.2×10^{-4}
Barley	63 d	Grain	49 days	34.4	11	89	9.3×10^{-4}
Carrot	83 d	Root	81 days	2.6	48	52	7.9×10^{-5}
Beet	102 d	Sugar	65 days	15.2		100	4.1×10^{-4}

[a] Ratio of ^3H in crop ($MBq \cdot kg^{-1}$)/^3H deposition ($MBq \cdot m^{-2}$).

[b] Dry matter only (alcohol excluded).

TABLE II. TRANSFER OF TRITIUM IN ORGANS OR ANIMALS AFTER INGESTION OF TRITIATED FEED (ORGANICALLY BOUND TRITIUM)

Species	^{3}H-feed	Organ or product	Sacrifice (days after ingestion)	Transfer factor $\left(\frac{\text{fresh tissue activity}}{\text{daily dose}}\right)$	% of activity present as organically bound tritium in fresh tissue
Calf	^{3}H-milk powder	Liver	30	1.8×10^{-1}	51.16
		Muscle	30	1.2×10^{-1}	28.80
		Brain	30	1.5×10^{-1}	42.50
Pig	^{3}H-milk powder	Liver	27	5.1×10^{-1}	47.66
		Muscle	27	3.2×10^{-1}	17.47
		Brain	27	3.3×10^{-1}	14.74
Pig	potatoes (fresh)	Liver	27	3.2×10^{-1}	49.6
		Muscle	27	2.9×10^{-1}	29.06
		Brain	27	2.3×10^{-1}	33.16
Pig	potatoes (dry)	Liver	21	2.3×10^{-1}	17.54
		Muscle	21	2.1×10^{-1}	11.39
		Brain	21	2.3×10^{-1}	9.03
Cow	^{3}H-hay	Milk	26	1.22×10^{-2}	46.4

together with those from other experiments simulating tritium transfer under different conditions, have been normalized and are shown in Table I. It can be seen that transfer factors in particular to long-lived forms of tritium can vary by two orders of magnitude, dependent for example on whether exposure occurs at the beginning of the period of fructification of perennial crops.

TRANSFER OF TRITIUM TO FARM ANIMALS

Experiments where monogastric or ruminant farm animals have been exposed to tritium oxide or organic tritium in food have provided information on transfer factors into meat and milk. These data have been supplemented by studies on experimental animals. Table II presents selected data on transfer of different types of organically labelled food which show the importance of long-lived organic compounds in meat and milk after tritium contamination.

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IAEA-SM-280/38P

DEVELOPMENT OF A COMPUTERIZED SUPPORT SYSTEM FOR THE EMERGENCY TECHNICAL ADVISORY BODY IN JAPAN*

K. KOBAYASHI, T. TOBIOKA, K. FUJIKI, A. KOHSAKA,
M. ISHIKAWA
Japan Atomic Energy Research Institute,
Tokai-mura, Ibaraki-ken,
Japan

If an accident should occur at a nuclear facility and if it affects or is anticipated to affect the environment, the chairman of the Nuclear Safety Commission (NSC) convokes the Emergency Technical Advisory Body (ETAB), the members of which

* Work performed under the auspices of the Science and Technology Agency of Japan.

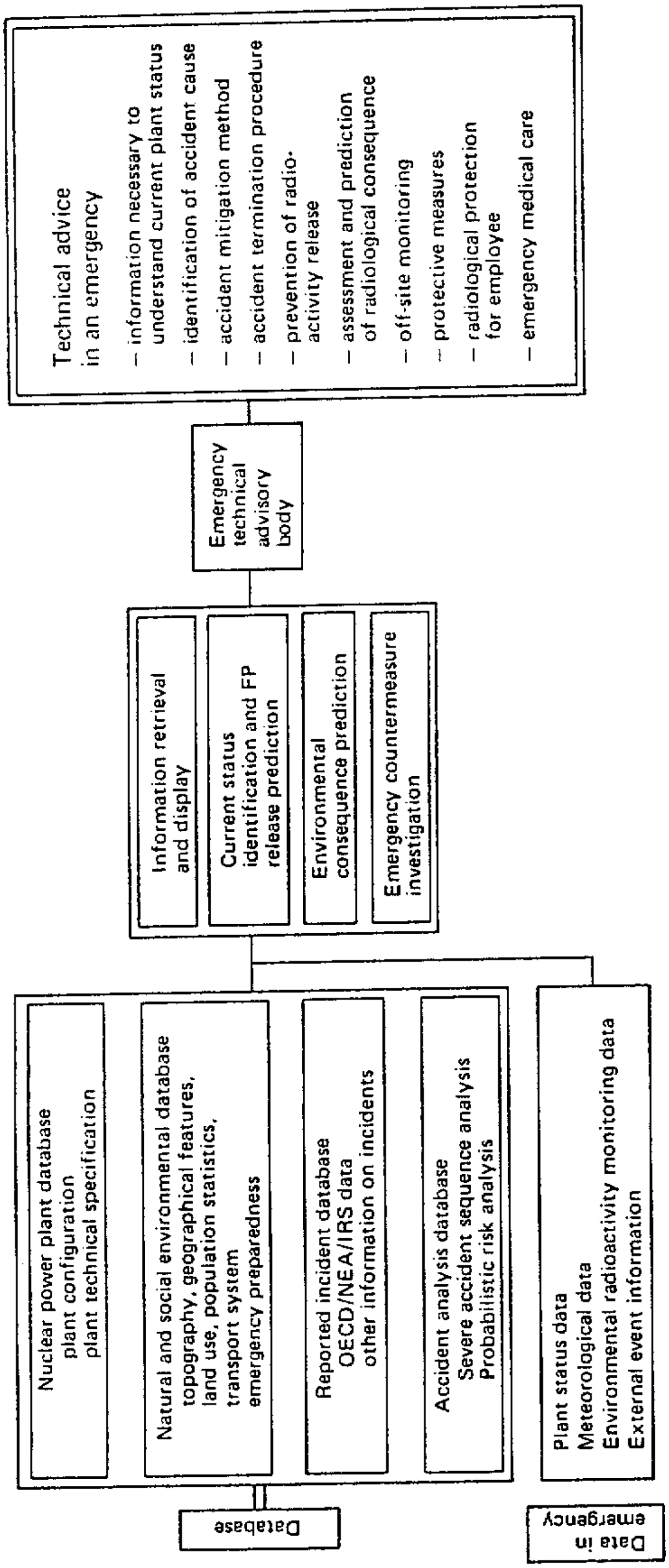

FIG. 1. Schematic diagram of computerized support system for ETAB.

consist of experts on nuclear reactor physics, nuclear reactor engineering, operation, meteorology, medical care, etc.

The Science and Technology Agency (STA) entrusted the Japan Atomic Energy Research Institute (JAERI) with development of a computerized support system for the ETAB in fiscal year (FY) 1984. JAERI made a program to develop this over three years, starting in 1985.

The capabilities of the system are as follows:

(1) information retrieval and display
(2) identification of plant status and prediction of fission product (FP) release to the environment
(3) prediction of radiological consequences
(4) investigation of emergency countermeasures.

Figure 1 provides an overview of the system.

INFORMATION RETRIEVAL AND DISPLAY

A significant amount of material necessary for the ETAB to provide technical advice has been prepared in the NSC. It includes

(1) nuclear power plant information such as plant configuration and plant technical specification, and
(2) natural and social environmental data including topography and population statistics.

In order to retrieve necessary information from the data quickly in an emergency, it is necessary for them to be computerized.

Some data can be transcoded into a tabular form. However, other data have to be treated as an image. Therefore, a relational database suitable for storing tabular form information and an electronic filing system suitable for treating image information are used for storage.

IDENTIFICATION OF PLANT STATUS AND PREDICTION OF FP RELEASE TO THE ENVIRONMENT

Using data on abnormal plant status sent by utilities and radiological monitoring data sent by utilities and local governments, the ETAB has to identify the current status of FP barrier integrity and predict the possibility of FP release to the environment in the future. To achieve this, an inference engine and a knowledge base will be developed. The inference engine is designed to identify the current plant status and predict the possibility of environmental fission product release. It is being developed by using the program language LISP, which is suitable for the manipulation of symbolic data. The knowledge base is created from the calculated results of various transients and incident information.

PREDICTION OF RADIOLOGICAL CONSEQUENCES

In an emergency, it is necessary to predict radiological consequences to the public by using evaluated data of FP release to the environment and meteorological data. To this end, the SPEEDI system developed by JAERI is implemented in the system.

INVESTIGATION OF EMERGENCY COUNTERMEASURES

Based on the predicted radiological consequences, it is necessary to investigate emergency countermeasures. To this end, a database is created from the results calculated from evacuation analysis.

IAEA-SM-280/41P

ASSESSMENT OF COLLECTIVE DOSES DUE TO CONTAMINATED FOOD CAUSED BY A SEVERE REACTOR ACCIDENT

J.P. PARTANEN, J. ROSSI, I. SAVOLAINEN
Nuclear Engineering Laboratory,
Technical Research Centre of Finland,
Helsinki, Finland

The importance of the ingestion dose pathways and their seasonal variation in collective effective dose after severe reactor accidents are evaluated by studying two different radioactive accidental releases. Typically, if no countermeasures are taken, ingestion pathways cause considerably more than half of the collective effective dose in the long term, and the consumption of milk is the most important pathway. Also, the season when the release occurs has great effect on the doses and on the areas where food products should be interdicted. The developed model can be used, for example, for the planning of countermeasures in accident situations.

Late health effects due to the radioactive release from a severe reactor accident are mainly caused by small individual radiation doses to the population over vast areas [1]. The main dose pathways are direct radiation from the release plume, inhalation of radioactive material, direct radiation from the contaminated ground and ingestion of contaminated food products. The last two pathways are the most important ones in the long term.

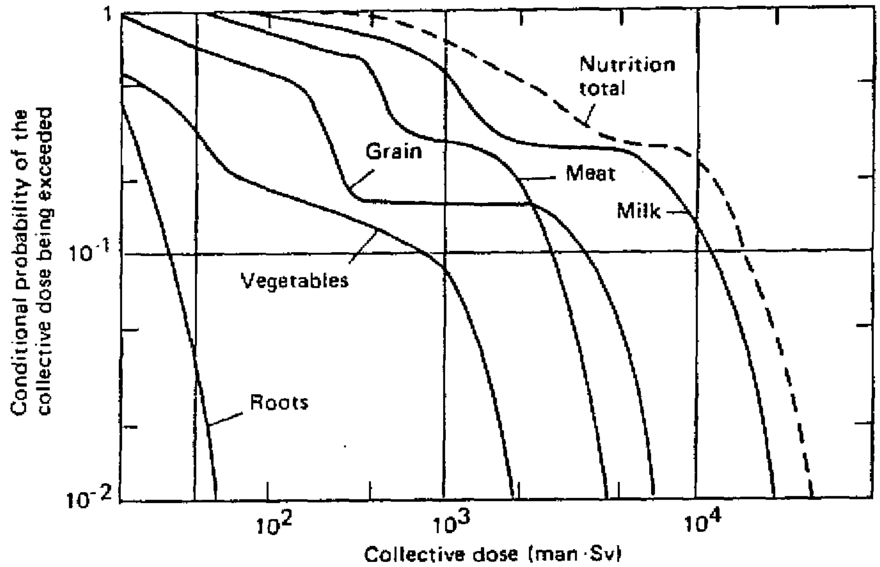

FIG. 1. Complementary cumulative distributions for collective effective dose via nutrition pathways due to an FK-2 release.

The doses from a reactor accident via ingestion pathways depend markedly on the season of the year in which the release occurs. If radioactive material is released to the atmosphere in winter, it can reach foodstuffs only in the next growing period mainly by root absorption from soil. On the other hand, if the accident occurs in summer, a fraction of fallout is deposited directly on the surface of plants and a much larger amount of activity reaches foodstuffs. The newly developed ingestion pathway model AGRID [2] for the reactor accident consequences code ARANO [1] takes into account seasonal variations in doses via ingestion of contaminated foodstuffs. There are five exposure pathways in the AGRID model: milk, meat of cattle, green vegetables, grain and roots.

Collective doses due to two hypothetical radioactive releases from severe nuclear power plant accidents are considered. The site of the nuclear power plant is assumed to be on the sea coast of southern Finland, and corresponding distributions for frequencies of the atmospheric dispersion conditions and distributions for population and agricultural production are employed. The electrical output of the reactor is assumed to be 1000 MW. The radioactive releases considered are the BWR-2 category from WASH-1400 and preliminary results for the FK-2 category from Phase B of the German Reactor Safety Study [3]. The complementary cumulative probability distribution (CCDF) curves for all the nutrition dose pathways due to an FK-2 release are presented in Fig. 1. The results of the growing season and dormant season have been combined for each pathway. Milk is the most important pathway, and all nutrition pathways except roots have a plateau in the CCDF curve due to the direct

TABLE I. CONDITIONAL EXPECTED VALUES OF THE COLLECTIVE EFFECTIVE DOSES [man·Sv] FROM THE FK-2 RELEASE CATEGORY

	Release during the growing season	Release during the dormant season	Average over the whole year
Plume-γ			1.7×10^2
Fallout-γ			1.8×10^3
Inhalation			2.1×10^2
Milk	9.8×10^3	8.0×10^2	3.3×10^3
Meat	2.6×10^3	4.7×10^2	1.1×10^3
Vegetables	1.0×10^3	5.8×10^1	2.1×10^2
Grain	4.0×10^3	1.8×20^2	8.1×10^2
Roots	5.0×10^1	4.1×10^1	4.3×10^1
Nutrition total	1.7×10^4	1.5×10^3	5.4×10^3
Total			7.5×10^3

deposition on crops or on forage during the growing period and the short duration of the period. In the case of roots, the direct deposition on plants is not assumed to affect the radionuclide concentration in the edible parts of the plant.

If all exposure pathways are considered in the case of an FK-2 release, the ingestion pathways are found to be most important (Table I). Direct radiation from the ground (fallout-γ) is also of some importance, but inhalation and direct radiation from the plume have very small effect on the total collective effective dose. Further, the expected values of collective 30a doses in the case of dormant season and growing season seem to differ by a factor of the order of 10. In the first-year doses the difference would be larger, a factor of about 100.

In the case of the BWR-2 release the gamma dose from the ground and the nutrition pathways are found to be of similar importance in the collective dose. However, in this case the relocation and interdiction criteria have very pronounced effect on the results.

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IAEA-SM-280/42P

RADIATION DOSE RATE ARISING FROM AIRBORNE RELEASE IN THE VICINITY OF THE SOURCE

L. RANTALAINEN
Imatran Voima Oy, Helsinki,
Finland

By measuring the radiation dose rate in the vicinity of a nuclear power plant, the quantity of radioactive release can be assessed. In the case of ventilation stack release, the dose rate in the vicinity can be well assessed with the help of a line source or plume line source model. Reliable assessment of release from low height can be done only by 3-dimensional calculation, because the geometry of the release plume affects the distribution of the radiation dose rate. Near the release point the plume geometry changes strongly, and power plant buildings often cause turbulence. This is why exactness is required when assessing the radiation dose rate.

A computer code called AMAPI has been drawn up for the assessment of the dose rate distribution in the vicinity of the source. Effects of release height, stability class, wind velocity and energy distribution of the release are considered in the model.

The AMAPI program has been applied to a hypothetical loss-of-coolant accident in the Loviisa Nuclear Power Station resulting in the release of noble gases up to 100% and of iodines up to 25% into the containment building. Mainly noble gases are released to the environment. The nuclide distribution of the release changes in the course of time, resulting in corresponding changes to the gamma energy spectrum and to the dose rate distribution caused by the release. The model has been used to calculate the radiation dose rate caused by noble gas gamma radiation of the release at a distance of 1200 m from the plant at eight points of time (1 to 192 h from occurrence of the accident). Twelve energy classes, two release heights and three groups of stability classes are used. The method and results have been compared with methods and results presented in the literature. The compatibility was good and the reasons for non-conformity have been clarified.

With the help of the calculated radiation dose rate distribution, the most suitable energy class was selected from twelve energy classes at each point of time, stability class and release height, respectively, to describe the radiation dose rate distribution caused by the noble gas release. The use of 0.85 MeV gamma energy at each point of time was further studied to describe the dose rate distribution of the noble gas release.

Finally, the release rates were changed into ^{133}Xe equivalent rates. Each activity was multiplied with the equivalent coefficient, which describes the dose rate ratio of various activities in comparison with the dose rate caused by ^{133}Xe, the concentration being uniform in semi-infinite space. The use of equivalent rates considerably reduced the effect of the nuclide distribution on the dose rates, but did not completely eliminate the time-dependence of the dose rate. Before the use of equivalent rates, the radiation dose rate changed as much as a decade at the centreline at various points of time, the release rate being constant. When using equivalent rates, the dose rate changed less than 30% at the centreline at various points of time, the equivalent release rate being constant.

IAEA-SM-280/44P

USE OF A REMOTE MONITORING SYSTEM OF NUCLEAR POWER PLANTS FOR EARLY RECOGNITION AND ASSESSMENT OF NUCLEAR ACCIDENTS

K. NOWAK
Institute for Accident Research and Ergonomics,
TÜV Rheinland, Cologne

H. WOLF
Division for Safety in Nuclear Power,
Ministry of Economies and Technology of the
Federal State North Rhine-Westphalia,
Düsseldorf

Federal Republic of Germany

The Federal State of North Rhine–Westphalia has set up a remote monitoring system for nuclear power plants (RMS–NRW). This serves as an instrument of the nuclear surveillance authorities, who in the Federal Republic of Germany are responsible to the Federal States. The RMS–NRW also serves as an alterting system in the case of an event which does not arise under normal operating conditions.

When such an event occurs the RMS–NRW automatically gives an alarm as well as a detailed alarm report. This report must be evaluated with the objective of establishing whether the alarm represents a plant state which could have dangerous consequences outside the plant. In this case, the authorities responsible for emergency protection must be informed.

The evaluation of the alarm report and the plant status indicated by it proceeds in two stages. A person on call is automatically alerted by the RMS. By means of a portable terminal he obtains the alarm record and carries out a rough assessment. It the rough assessment indicates that no false alarm has occurred, a plant specialist is alerted, who carries out a detailed assessment of the alarm report.

In North Rhine-Westphalia the following requirements for the assessment are laid down:

(1) The person on call should, by means of a rough assessment, eliminate false alarms. False alarms in this sense do not necessarily mean system or transmission errors (although they are not excluded), rather they are alarms which although correct refer to an event which has no serious consequences. The rough assessment should

- be as systematic as possible
- be exclusively based on the RMS alarm report
- be on the side of safety.

(2) An alarm report which cannot be clearly attributed to a false alarm will be assessed in detail by a plant specialist. The detailed assessment has the aim of evaluating the alarm in terms of radiation protection and of categorizing it in terms of disturbance, incident or accident. These categories serve to determine the action to be taken by the authorities. In comparison to the rough assessment, the detailed assessment

- need not proceed systematically
- presupposes knowledge of the plant
- requires further information from the control room.

The detailed assessment is status- or symptom-based and does not attempt to cover the course of events.

(3) A handbook is provided as an aid for the assessor. A number of working aids for the assessment of RMS alarm reports have been especially developed for this handbook:

- Check-lists for the person on call and plant specialist
- Reference material and assessment framework for the person on call
- Reference material and assessment framework for the plant specialist
- List of questions for the person on call and/or plant specialist to ask the licensee.

The check-lists lay down the steps to be taken, which are to be rigorously followed and also serve as documentation. They provide only the sequence of actions; the assessment itself is provided by means of the other aids.

The assessment framework for the person on call is just as rigorously to be followed. It provides a scheme which automatically leads to the rough assessment 'inform plant specialist' (no false alarm) or 'inform the authorities on the next working day' (false alarm). The basis of the assessment framework is an analysis of the content of the alarm report which indicates that the set limits for the plant have been exceeded. If in exceptional circumstances the person on call has to ask the licensee for additional information, a detailed list of questions for this purpose is also provided. A question list has been prepared for every RMS triggering condition, which again has to be systematically worked through.

In the aids for the plant specialist the reference material is particularly emphasized. The extent of the spectrum, from disturbance to accident, prevents systematic work. The handbook gives information for every possible triggering condition, concerning what should happen in the plant when operation proceeds within the design limits. This information concerns primarily the results of analyses of design basis accidents. The plant specialist can draw his first conclusions for the detailed analysis on the basis of deviations from operation within the design limits as indicated by the RMS alarm record.

An evaluation of the functioning of the barriers to hold back radioactivity is essential for the assessment of the plant status as regards radiation protection. The plant specialist must therefore establish whether the following safety functions have been fulfilled:

- shutdown of the reactor
- heat removal from the core
- heat removal from the pressure vessel
- pressure limitation in the containment.

Further, increased activity accumulation, the type of radioactivity, and (possible) transfer paths in the plant must be checked and release paths and the extent of the release in the environment must be identified.

The assessment framework for the plant specialist provides a guide for the carrying out of the individual assessment steps:

(1) Evaluation of the RMS report itself
(2) Consideration of the plant status (revision, energy production, etc.)
(3) Checking the specified safety functions
(4) Localizing increased activity accumulation
(5) Identifying possible release paths and hazards outside the plant.

The plant specialist has a free hand in carrying out these assessment steps. The assessment framework provides information for the assessment and refers to further aids:

- Step-by-step ordered questions for the assessment of the safety functions; the individual questions are situation-specific and thus have no prescribed formulation.

– Groups of questions for the localization of increased activity accumulations as well as for the identification of transfer and release paths.

By means of the rapid alert through the RMS-NRW (within 10 minutes) supported by the aids given in the handbook it is possible quickly to inform the surveillance authorities if emergency conditions arise, so that suitable measures can be taken in the plant, the emergency authorities can be kept informed and advised, and emergency measures can be promptly taken off-site.

IAEA-SM-280/56P

SPATIAL DATA HANDLING CAPABILITIES IN THE ARAC SYSTEM*

Hoyt WALKER
Lawrence Livermore National Laboratory,
University of California, Livermore,
California, United States of America

The ability of organizations to respond effectively to emergencies requires the utilization of many types of data. In the case of an accidental release of a radioactive substance into the atmosphere, much of the data dealt with in the various decision processes are geographical in nature. The Atmospheric Release Advisory Capability (ARAC) at Lawrence Livermore National Laboratory (LLNL) actively responds to any such occurrences in the USA [1, 2] and as a result must concern itself with the handling of spatial data. ARAC provides real-time assessments of the consequences resulting from an atmospheric release of radioactive material. In support of this operation, a system has been created which integrates numerical models [3, 4], data acquisition systems, data analysis techniques, and professional staff. The ARAC system relies on spatial data of various kinds [5], two types being of particular interest. First, digital terrain data [6] are used as input to atmospheric models and, when presented in a graphical form, also serve to orient ARAC staff to unfamiliar areas. Second, other geographical data (roads, rivers, political boundaries) are used as a base map to provide a reference frame for the graphical output from the ARAC atmospheric models.

* Work performed under the auspices of the US Department of Energy by the Lawrence Livermore National Laboratory under contract W-7405-Eng-48.

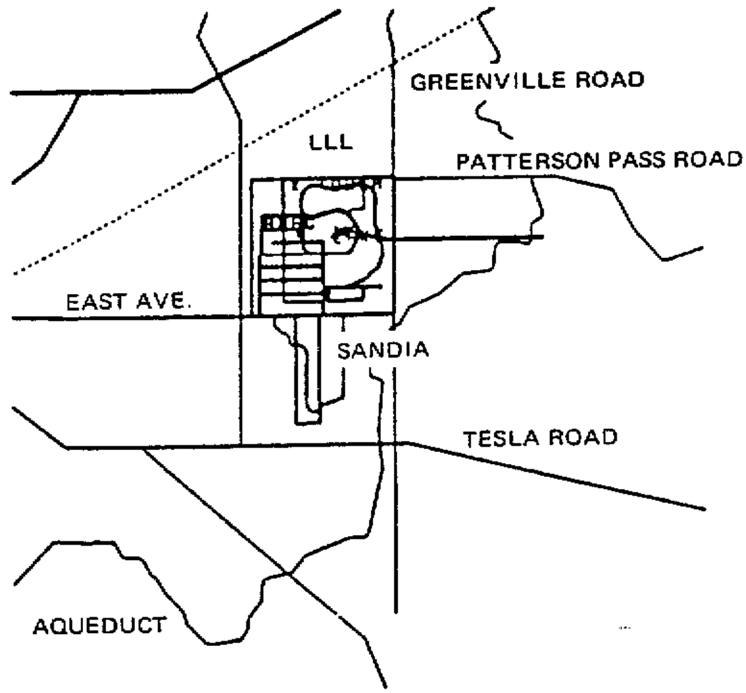

FIG. 1. A typical ARAC base map for the area around LLNL.

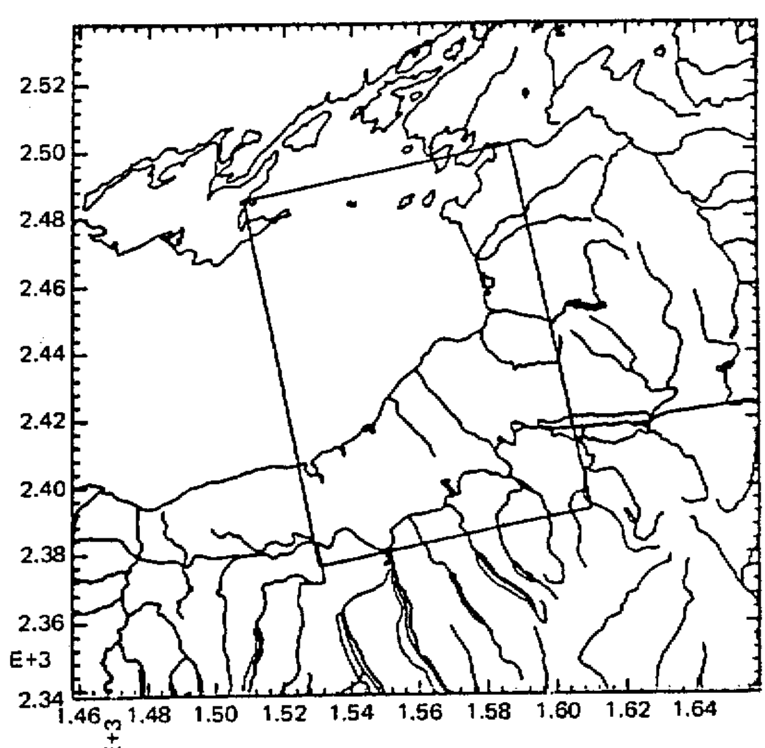

FIG. 2. Waterbodies and streams overlays from the data set for the eastern end of Lake Ontario.

The emergency response environment in which ARAC functions has a number of characteristics which influence the nature of spatial data handling in the system. These characteristics and their implications include the following:

(1) Radiological incidents may occur at any location. As a result, databases must cover continental areas completely in order to allow a response at any point.
(2) Model results must be produced as quickly as possible. Therefore systems that produce spatial data for input into the models must be very fast.
(3) ARAC responds to many different types of problems covering a wide range of geographic scales. Acceptable base maps must be produced for any area from an arbitrary one kilometre square to an entire hemisphere.
(4) The quality of the data must be ensured at all times. This requires a heavy use of computer graphics to allow the fast detection and correction of any flaws in the data.
(5) Many different types of spatial data must be integrated within the system. A common grid reference system is therefore required.

ARAC now has the capability to produce terrain data and base maps in this stringent emergency response environment. A terrain system has been developed that provides terrain data at moderate resolution (500 metre) within ten minutes and at high resolution (65 metre) within thirty minutes for any point in the coterminous USA. This system includes graphical verification of the data before they are made available to the atmospheric models [7]. The ability to create an appropriate base map quickly also exists. The data required for such a base map come from two main sources: paper map products and digital map data. Appropriate features are extracted from paper maps via a digitizing process that produces map data in computer readable form (see Fig. 1). Digital geographic data produced by outside organizations have been acquired and are maintained in a database from which required subsets can be extracted (see Fig. 2). Interactive computer graphics is an essential part of the base mapping system and, in fact, is a fundamental component of both systems because it is the most effective means to view the large amounts of relevant data in a time-intensive environment. These techniques form an integral part of the ARAC emergency response capability, and as ARAC expands and refines its ability to advise local emergency response personnel, the utilization and display of spatial data will play an increasingly important role.

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SIMILARITIES AND DIFFERENCES IN THE TRANSFER OF TRITIUM AND CARBON-14 ALONG THE FOOD CHAIN

J. VAN DEN HOEK
Laboratory of Animal Physiology,
Wageningen, Netherlands

G.B. GERBER, R. KIRCHMANN
Department of Radiobiology,
Centre d'étude de l'énergie nucléaire (CEN-SCK)
Mol, Belgium

The transfer of tritium and carbon-14 along the food chain to man is quite different in some aspects from that of other radionuclides. This results from the fact that stable hydrogen and carbon occur widely in nature and make up an important fraction of the organic material in cells and tissues of all living organisms, including man. It may be expected that the radioisotopes of hydrogen and carbon will accompany the stable molecules. The question to be answered is to what extent there exists a constant ratio or specific activity between tritium and hydrogen, and between carbon-14 and stable carbon. The experiments reported here provide an answer to some of these questions.

The experiments have been carried out mostly on milk-producing animals since milk formation is an activity which is representative for the synthesis of proteins, carbohydrates and fats by the animal organism. In the case of carbon-14, the concept of a constant specific activity (pCi ^{14}C/g of carbon) appears to be valid in the case of milk formation by a cow. Results will be presented for an experiment in which corn silage labelled with ^{14}C was fed to a lactating cow for 33 days. These results show that, at equilibrium, a constant specific activity was found for milk protein, milk fat and carbohydrate although the actual ^{14}C levels were much higher in milk fat than in the other organic compounds.

The consequence of this finding for emergency situations is that a suitable product should be selected for prediction purposes in which this specific activity can be determined. Milk may be a valuable compound for this purpose because the total activity can be measured very easily and the specific activity can be readily determined in milk fat.

The situation for tritium, insofar as it is known, is not quite the same. Firstly, tritium is usually released as tritiated water (THO) which may be converted into organically bound tritium (OBT) by plants. Animals may ingest tritium either as THO or as OBT.

The metabolism of THO is well documented [1]. In man, THO turns over with a half-life of around 12 days. A small fraction of the THO becomes incorporated into organic material [2]. Our knowledge of the metabolism of OBT is much less complete. This will be illustrated by reporting some experiments on lactating animals which were kept on feed, the organic fraction of which was labelled with tritium. The feeding period lasted from about four weeks to about six months. At equilibrium, a substantial fraction of the ingested OBT was converted into THO in the animal cells and passed on to the body water pool. Another part of the OBT was used for synthesis of new proteins and fats but at different specific activities as judged by the ^{3}H activity in casein and milk fat. The carbohydrate fraction was labelled to only a limited extent but this may be different in monogastric animals. The newly synthesized proteins and fats may have a relatively long residence time in the animal and they may be used eventually for the synthesis of proteins and fats to be secreted into milk or to be incorporated in foetal tissues and organs when the animal becomes pregnant.

In the case of accidental release of tritium, and after determination of the THO activity, it is important to examine the question if, and to what extent, conversion of THO into OBT will occur. Subsequent measures should be taken on the basis of these findings.

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