IPSN QUALIFICATION CENTRES FOR NUCLEAR SAFETY EQUIPMENTS

Their contribution to the safety of nuclear facilities and protection of workers and environment

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Abstract

The **P**rotection and **N**uclear **S**afety **I**nstitute (IPSN) has set up testing centres for equipment connected with the safety of facilities and staff protection. These centres are responsible, each within its own field of activity, for the following main tasks : (1) approval of equipment, calculation techniques and processes ; (2) participation in national and international standardization work ; (3) specialized training activities ; (4) centralization and diffusion of available information.

Two qualification centres are presently operational, each of them with its specific field of activity :
- the Technical Qualification Centre for Nuclear Equipments (CTHEN),
- the Technical Qualification Centre for Radioprotection Instruments (CTHIR).

Résumé

*L'Institut de **P**rotection et de **S**ûreté **N**ucléaire (IPSN) s'est doté de centres de qualification pour les équipements liés à la sûreté des installations et à la protection des travailleurs. Ces centres ont pour missions principales, chacun dans son domaine d'activité : 1) l'homologation d'équipements, de moyens de calcul et de procédés, 2) la participation à la normalisation nationale et internationale, 3) les actions de formation spécialisée, 4) la centralisation et la diffusion de l'information disponible.*

Deux centres de qualification sont actuellement opérationnels, avec chacun leur domaine d'activité :
- *le Centre Technique d'**H**omologation des **E**quipments **N**ucléaires (CTHEN),*
- *le Centre Technique d'**H**omologation de l'**I**nstrumentation de **R**adioprotection (CTHIR).*

1. THE QUALIFICATION OF SAFETY NUCLEAR TOOLS AT CEA

The practice to qualify the materials, computation codes and processes, through different test types, is not a new concept : since a long time, many kinds of test facilities carry out such tests, requested either by designers - developers or by users.

The creation of IPSN qualification technical centres tooks place progressively, as along the needs and the possibilities. The main missions of these centres (which are explicited, as well as their activity in the next section) are :

- certification of equipments, computation means, and processes,
- participation to the national and international standardization,
- actions of specialized training,
- centralization and diffusion of available information.

The own means of the qualification centres are very reduced. They rely, when necessary, on external laboratories and experts.

A fundamental aspect of the action of these centres is that they operate for the benefit of all nuclear operators (CEA and its subsidiaries, EDF, Framatome,...).

The nuclear operator approach is moreover purely voluntary, and it is mainly due to their efficiency if the qualification centres are recognized.

2. THE QUALIFICATION TECHNICAL CENTRES

Two qualification centres are presently operational, each of them with its specific activity field :

- the Technical Qualification Centre for Nuclear Equipments (CTHEN),
- the Technical Qualification Centre for Radioprotection Instruments (CTHIR).

The main mission of the **CTHEN** is related to the following domains (see also figures 1 and 2) :

- protection against ionizing radiations,
- handling and transport of radioactive materials,
- decontamination and intervention in radioactive environment,
- safety and individual protection of persons on working sites,
- containment, ventilation and filtration,
- processing and management of radioactive waste.

The **CTHIR** mission is specially dedicated to the whole radioprotection instrumentation (see also figure 3).

The vocation of the qualification technical centres is **to evaluate the ability of protection and safety equipments to fulfill their function without failure**. In order to do that :

- they set up, if necessary, functional specifications or special technical specifications defining the characteristics and expected performances for these materials or equipments,
- they define the tests enabling to verify the characteristics and performances according to standardization texts and to the above specifications,
- they request to carry out the tests, according to approved operating modes,
- they analyze the obtained results and issue, in certain cases, after a regular survey, a qualification certificate,
- they request the necessary measures to be taken to ascertain the conformity of series devices or equipments to the prototypes they have investigated.

For their qualification action, both centres act in connection with the users and manufacturers of equipments in order to define the specific needs and the corresponding qualification programs with consultative commissions and sectorial working groups which write down the technical specifications and with test laboratories, internal or external to CEA group.

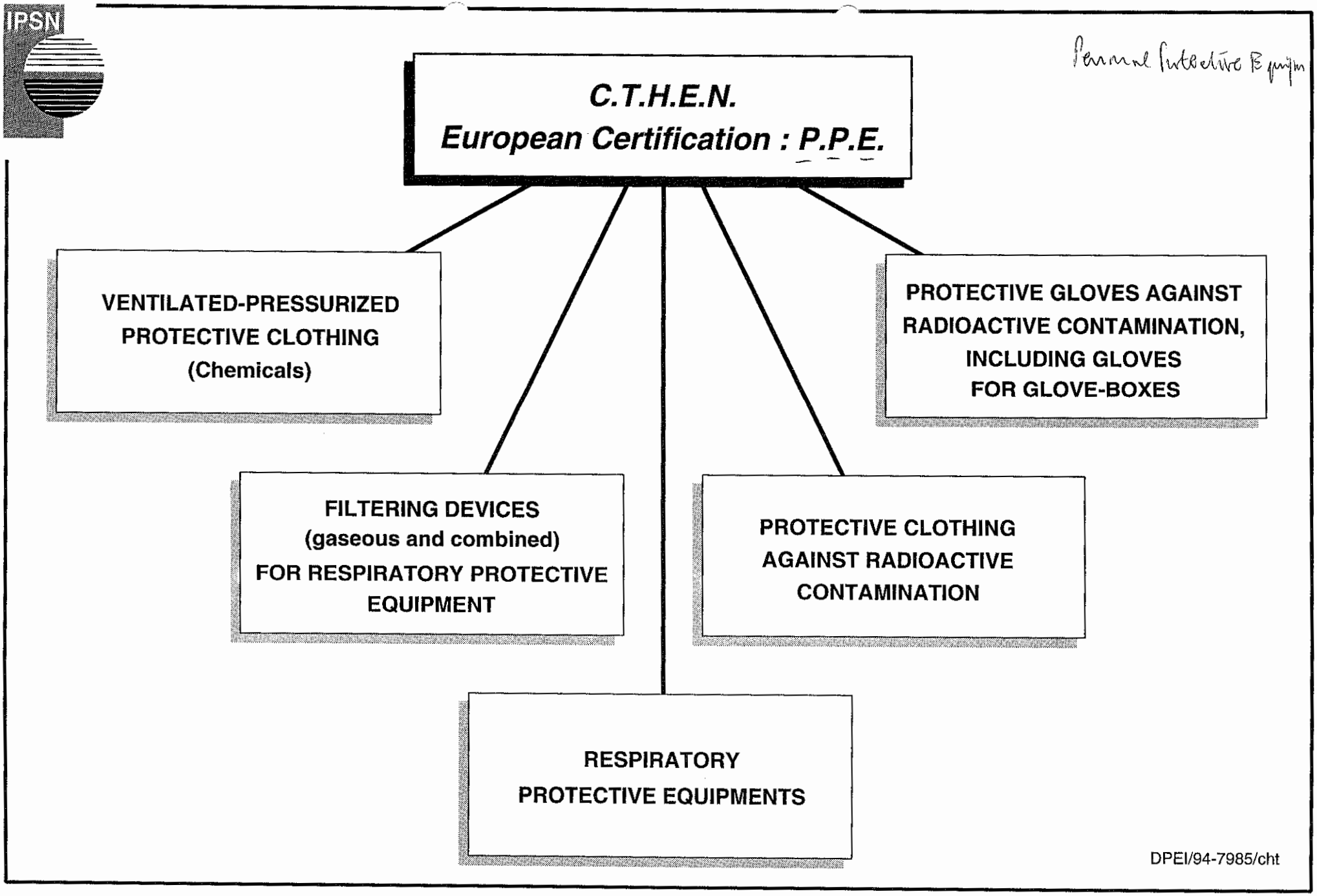

Personnel Protective Equipment
C.T.H.E.N.
European Certification : P.P.E.
VENTILATED-PRESSURIZED PROTECTIVE CLOTHING (Chemicals)
PROTECTIVE GLOVES AGAINST RADIOACTIVE CONTAMINATION, INCLUDING GLOVES FOR GLOVE-BOXES
FILTERING DEVICES (gaseous and combined) FOR RESPIRATORY PROTECTIVE EQUIPMENT
PROTECTIVE CLOTHING AGAINST RADIOACTIVE CONTAMINATION
RESPIRATORY PROTECTIVE EQUIPMENTS
DPEI/94-7985/cht

Figure 1

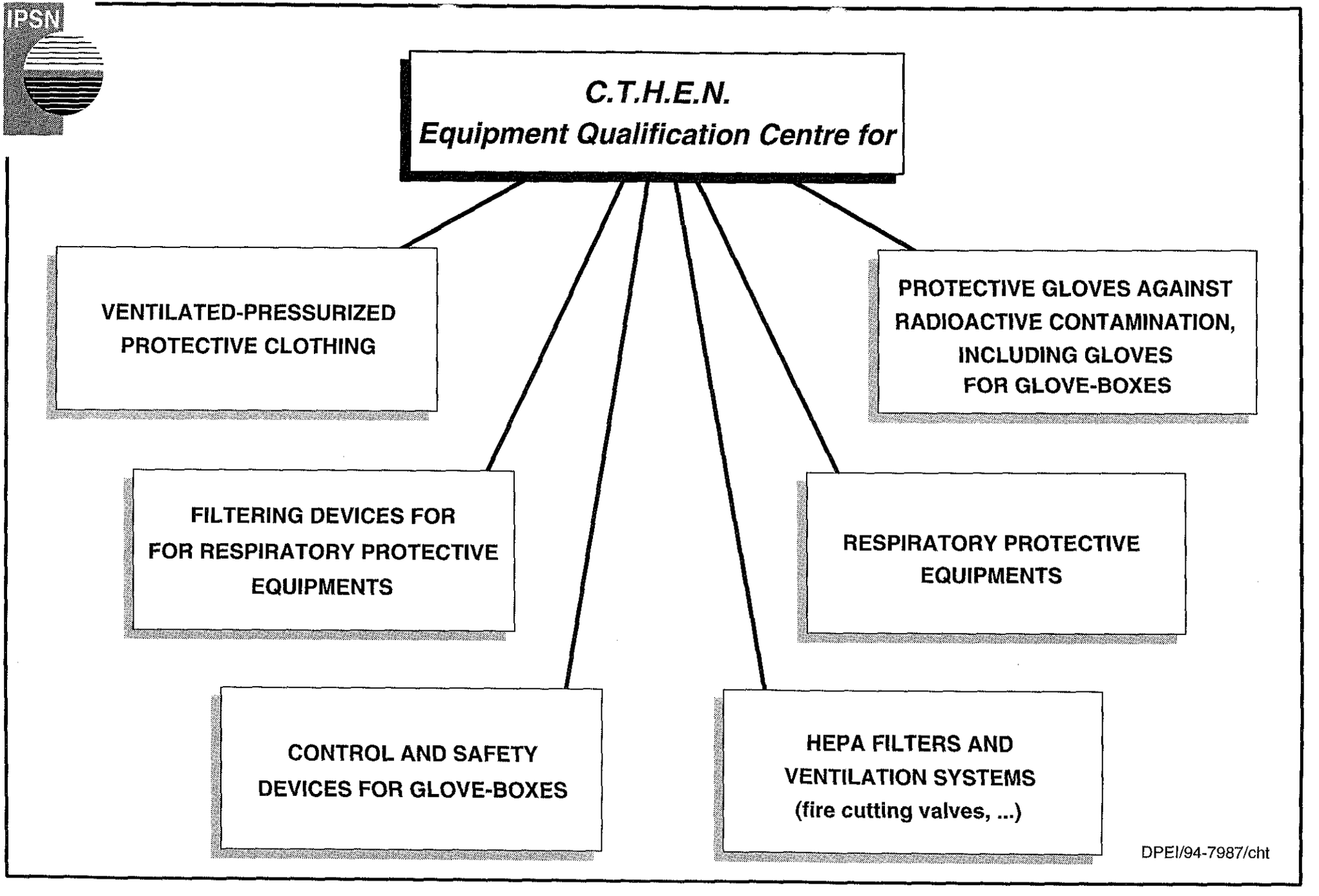

IPSN
C.T.H.E.N.
Equipment Qualification Centre for
VENTILATED-PRESSURIZED PROTECTIVE CLOTHING
PROTECTIVE GLOVES AGAINST RADIOACTIVE CONTAMINATION, INCLUDING GLOVES FOR GLOVE-BOXES
FILTERING DEVICES FOR FOR RESPIRATORY PROTECTIVE EQUIPMENTS
RESPIRATORY PROTECTIVE EQUIPMENTS
CONTROL AND SAFETY DEVICES FOR GLOVE-BOXES
HEPA FILTERS AND VENTILATION SYSTEMS (fire cutting valves, ...)
DPEI/94-7987/cht

Figure 2

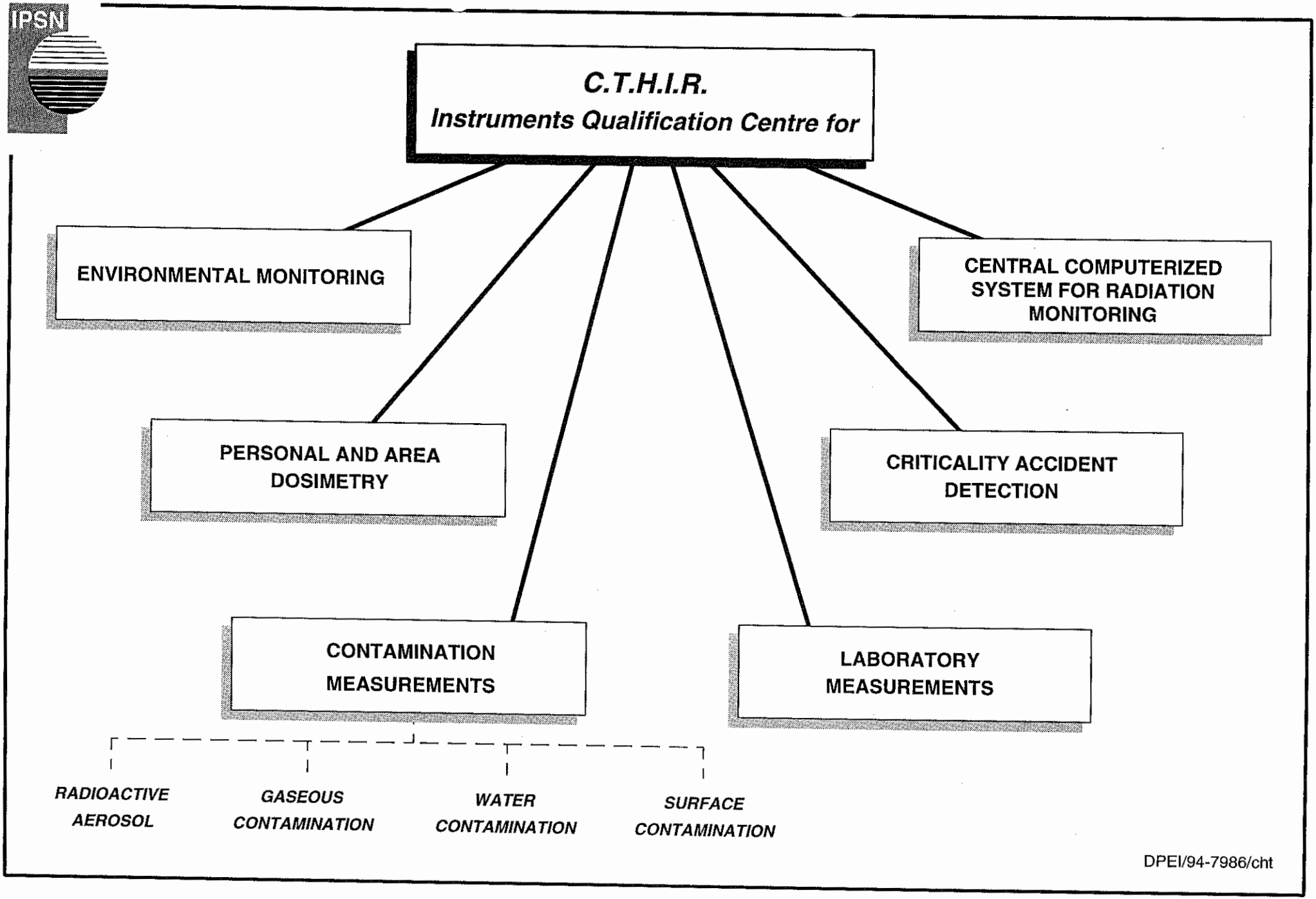

IPSN
C.T.H.I.R.
Instruments Qualification Centre for
ENVIRONMENTAL MONITORING
CENTRAL COMPUTERIZED SYSTEM FOR RADIATION MONITORING
PERSONAL AND AREA DOSIMETRY
CRITICALITY ACCIDENT DETECTION
CONTAMINATION MEASUREMENTS
LABORATORY MEASUREMENTS
RADIOACTIVE AEROSOL
GASEOUS CONTAMINATION
WATER CONTAMINATION
SURFACE CONTAMINATION
DPEI/94-7986/cht

Figure 3

3. CONTRIBUTION OF THE QUALIFICATION CENTRES TO NUCLEAR SAFETY AND TO FACILITY RADIOPROTECTION

3.1 Quality of equipments, computation means and processes

The french practice concerning the quality of nuclear facilities relies on the implementation of IAEA good practice code whose title is *Quality Assurance for Nuclear Power Plant Safety* (Safety collection, no 50-C-QA). This practice has been confirmed by a french regulation text.

This regulation specifies that the operator of a nuclear facility must demonstrate that the quality defined for the equipments which are safety relevant is achieved and maintained.

The qualification certificate, issued after independent tests, whose quality is also proved, is an essential element of such a demonstration. However, the experience showed that, even on very good equipments, corrective actions are necessary on particular points, and the operating study in real situation is an indispensable complement to qualification tests. In order to integrate and ensure the efficiency of these actions, the final qualification certificate is given only one year after the strictly speaking qualification tests.

The qualification centres do not have the aim to qualify the whole safety equipment used at CEA, but as a priority the newly developed materials, and then the already used materials for which there are some doubts about the level maintaining of a delivery, or if new criteria are taken into account.

3.2 Operating quality

The operating quality of a nuclear facility relies on many factors; among them, the adequation of the equipments related to operation, the training of personnel and the experience return.

The training of personnel necessitates several aspects. Unless some punctual actions for which the qualification centres participate directly to the formation of safety equipment users, the general principle taken is preferably to train the trainers.

For instance, with the Compagnie Générale des Matériels Nucléaires (COGEMA) a training system has been developed for the operators handling the shielded transfer devices for waste coming from high activity cells. The training courses are entirely performed by COGEMA agents, but the qualification centre participated to the formation of trainers, to the definition of the training program, and supplied the documentation. Periodic meetings allow the follow-up and experience return.

The later point is also a constant concern for the qualification centres, which develop relationships with the manufacturers and with the users and favourize the contacts between manufacturers and users, and between users.

The results of this concertation appear in the publications made by the centres, whose some examples are given hereafter, as well as in the support brought to the national and international standardization effort.

3.3 Intervention quality in accidental and post-accidental situation

The Protection and Nuclear Safety Institute is a technical support for the Government in case of accident, in particular thanks to its intervention resources.

These means must be operational without delay when their utilization becomes necessary, whether they are already on site when the accident occurs (for instance iodine traps, broad range irradiation or contamination detectors), or they are used by intervention teams (radioprotection instruments, remote intervention and remote operation means, personal protective equipments, etc.).

The different qualification centres are concerned and the following actions may be mentioned, as examples :

3.3.1 For the CTHEN

The following equipments were qualified :

- HEPA filters intended to equip the last level of filtration of nuclear ventilation facilities. The qualification procedure has specially taken into account the dynamical thermal resistance of the filter submitted to a hot air flux to simulate the behaviour during a fire (test temperature 200°C).

- cartridges for gaseous iodine sampling used to determine the activity of the iodine components released in the gaseous effluents. This trapping is carried out by TEDA impregnated active carbon.

- a series of computation codes related to the ventilation of nuclear facilities ; these codes may be used for the design of the facilities, the parameters adjustment and the safety analysis. They apply to the studies describing the equilibrium states of nuclear ventilation networks, in normal regime or after disturbances of aeraulic and/or thermal origin.

- a series of filtering devices for respiratory equipment, of nuclear P3 type (particles filters only) and of IP3 type (combined particules and iodine filters). These filters fulfil the requirement specified by the européen standards in force.

- a series of ventilated-pressurized protective clothing against radioactive contamination. (see exemple on figure 4). These clothings have been qualified according to the european standards in force.

- fire cutting valves intended to equip the ventilation networks for rooms having risks of dissemination of radioactive contamination in case of fire (rooms classified 'fire and containment sector'). These fire cutting valves are classified *2 hours fire cutting*, and their particularity is to be gas-tight and operable in high temperature conditions.

Other materials are under investigation :

- protective gloves against chemical, bacterial or radioactive hazards, including gloves for glove boxes,

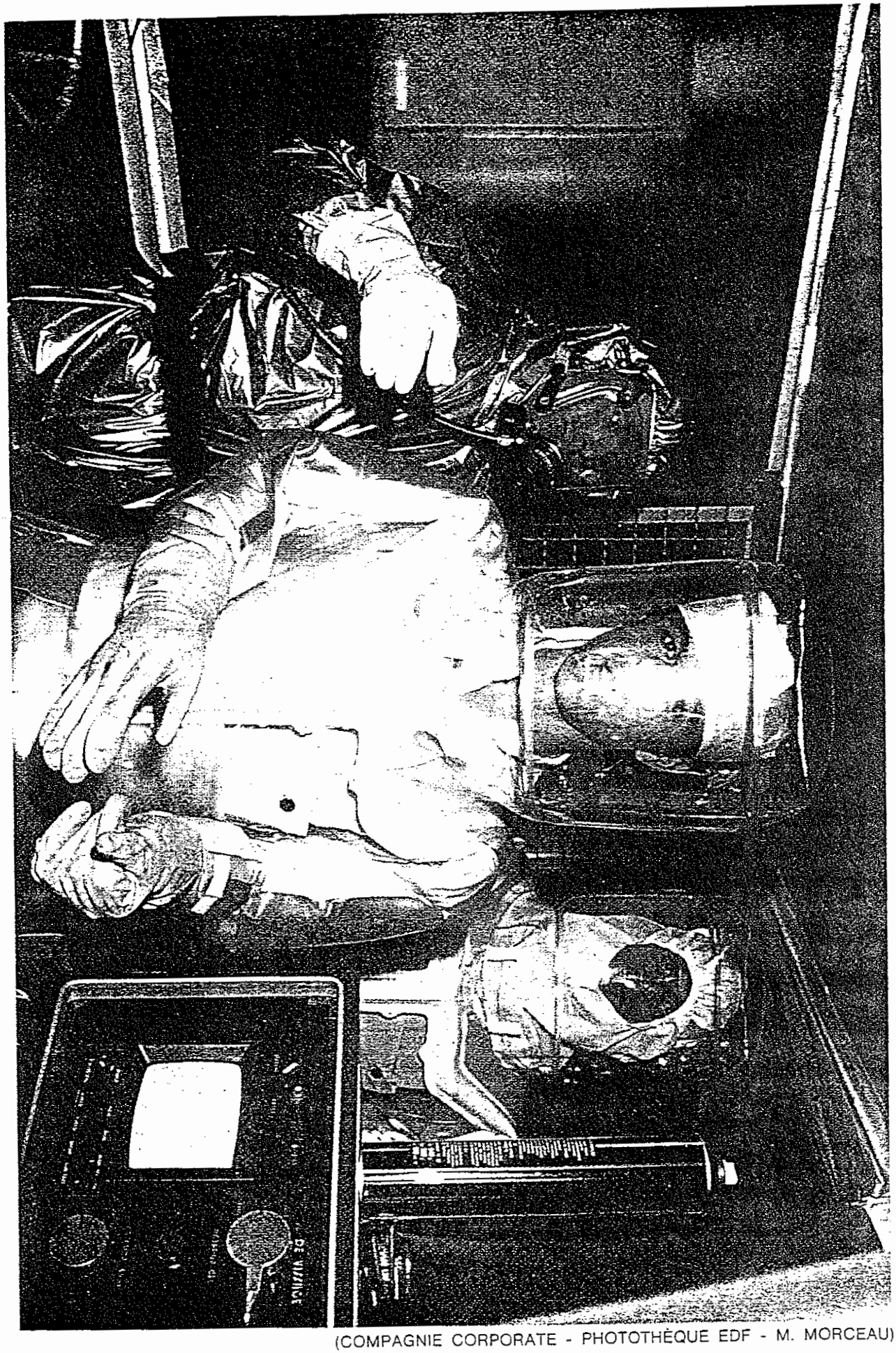
- regulation and safety devices for glove boxes (hydraulic valves, regulation valves, ...).

3.3.2 For the CTHIR

The following instruments were qualified :

1) Instruments for environmental monitoring :

- γ GONIO, an orientation and environmental gamma air kerma rate meter (see figure 5). The purpose of this instrument is to guide a vehicle to find a lost γ source, or for measurements following a nuclear accident. The instrument was designed by IPSN. It consists essentially on an aluminium sphere, of 10 cm diameter, equipped with six detectors at 1 cm depth. The count rate detected by the detectors is processed by an algorithm implemented in a microprocessor which displays by cycles : the orientation of the γ source in terms of azimuth and elevation angles, the air kerma rate at the sphere location and the effective energy of the γ beam incident to the sphere. The orientation and effective energy displays are also tested in order to verify their accuracy.



(COMPAGNIE CORPORATE - PHOTOTHÈQUE EDF - M. MORCEAU)

Figure 4 : Ventilated-pressurized protective clothing against radioactive contamination.

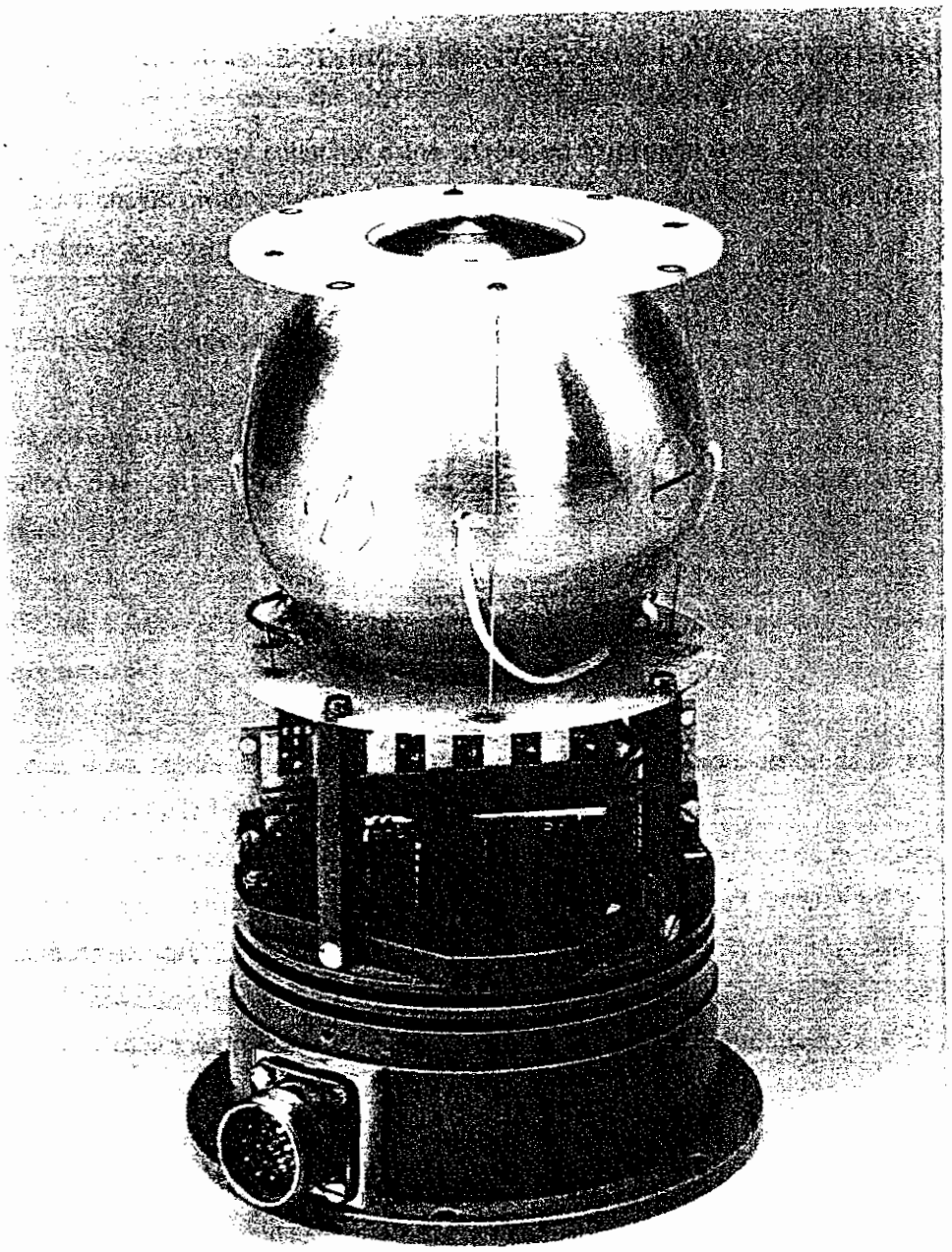


Figure 5

Tête de détection γ GONIO III A pour l'équipement de véhicules d'intervention

- RADTEST, a radiation tester (see figure 6 below). This instrument is designed in order :
  - to search hot spots of contaminated areas, after a nuclear accident; this function is called 'radiameter',
  - to measure solid or liquid sampled materials, such as soil or solid or liquid food, and to give a reading in terms of specific activity ($kBq.kg^{-1}$); this function is called 'contaminameter'.

  It is essentially an ICs detector which delivers pulse amplitudes classified in three windows corresponding to γ energies of ^{131}I, ^{137}Cs, ^{60}Co and one window from 150 to 1500 keV for gross counting.

  Thanks to an algorithm implemented in a microprocessor, after processing of the count rates detected in these windows during a preset time :

  - for radiameter function, the gross counting rate is displayed in counts per second or in $\mu Gy.h^{-1}$ by cycles of 200 ms, with trend arrows,
  - for contaminameter function, the specific activity due to ^{131}I, ^{137}Cs or ^{60}Co and that equivalent to ^{137}Cs are displayed in $kBq.kg^{-1}$ after a maximum preset time of 1 minute.

  To carry out these displays, the algorithm makes deconvolution and converts the count rates into specific activities using conversion coefficients depending on food type.

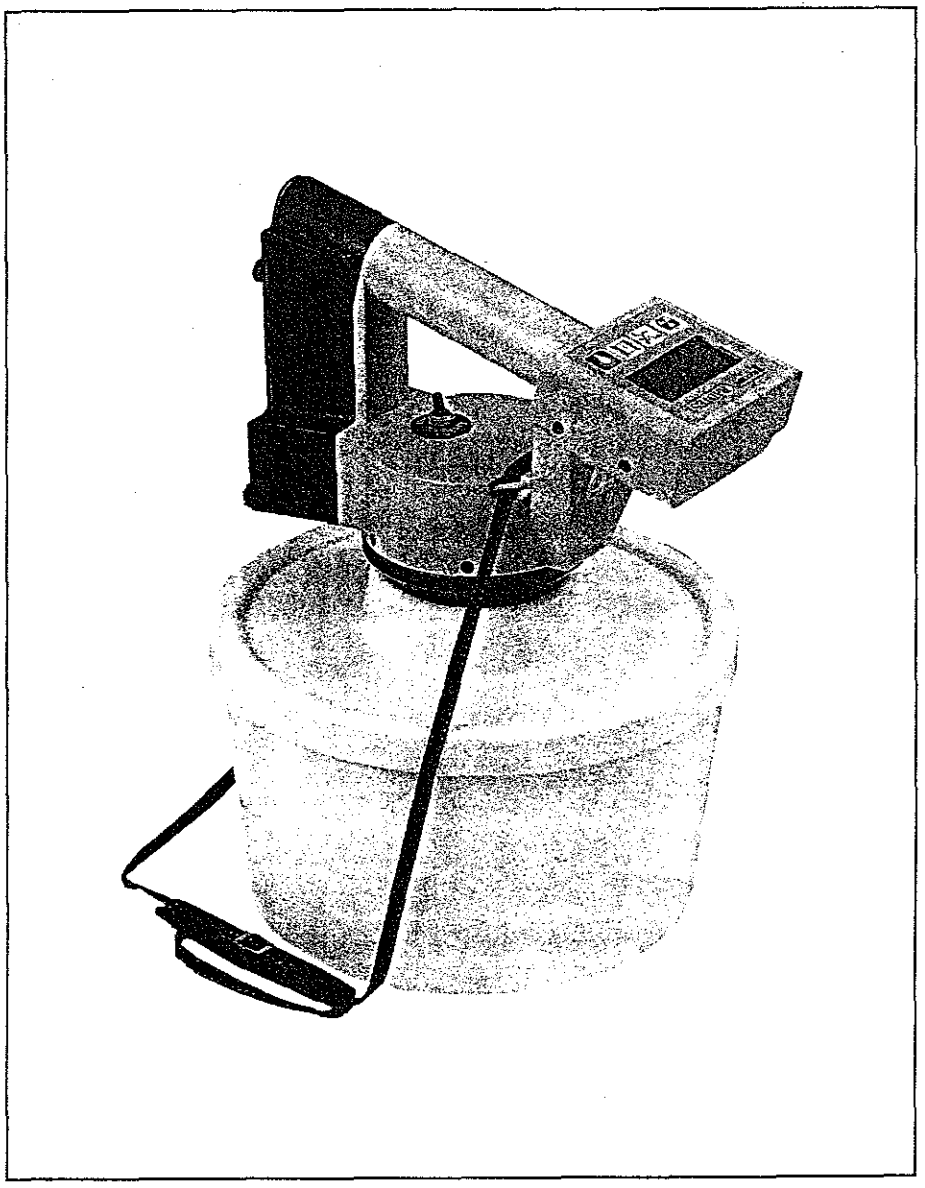


Figure 6 : RADTEST

2) Instruments for facility monitoring :

- EDAC, assembly for detecting criticality accident.The purpose of this instrument is to give an alarm when the following two conditions are fulfilled :
  - the total (neutron + γ) dose : D_T is lower than 25 μGy,
  - the total dose rate : $\mathring{D}_T$ is lower than 10 mGy.h^{-1}.

  It is composed of a detection sub-assembly (S/EDAC) which is equipped with two scintillators and an assembly which carries out the alarms of several units composed of 4 probes using the detected count rates.

  This assembly, in its recent version (EDAC II), stores the dose and alarm data during 60 minutes of the accident.

  The qualification tests were made in order to verify the compliance with IEC 860 and ISO 7753 standards. To achieve these tests, two criticality systems were used :
  - liquid system : SILENE for slow criticality ≥ 6 ms,
  - metallic system : CALIBAN for fast criticality ≤ 1 ms.

4. CONCLUSION

A light structure has been set up at IPSN to co-ordinate and improve the efficiency of qualification means for nuclear safety equipments.

This structure is available for all nuclear operators, its actions rely mainly upon the CEA laboratories, while keeping tight contacts with industrialists. One aspect of the system which has to be emphasized is that it works on a voluntary participation basis while implementing procedures and technical means which guarantee the quality of the interventions.

Both technical centres are now **national or international qualification organisms** :

- the **CTHEN** has been notified by the Ministère du Travail, de l'Emploi et de la Formation Professionnelle, as well as by the Ministère de l'Agriculture et de la Forêt, as qualification organism at european level for the Personal Protective Equipments (PPE) dealing with nuclear field,
- the **CTHIR**, like the CTHEN, asked its sub-contracting test laboratories (highly represented at IPSN) to set up their accreditation application file to the Test National Network (RNE), organism which is acknowledged by the european partners of qualification.

Thanks to the recognized quality of their procedures and implemented technical means, these qualification centres for nuclear safety and radioprotection contribute to demonstrate the quality of equipments, computation means and processes, particularly for the design and operation of facilities, maintenance and intervention.