EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT

DIRECTORATE H – Nuclear Energy
Radiation Protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

COFRENTES NUCLEAR POWER STATION

SPAIN

12 November to 16 November 2007

Reference: ES-07/6

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35
OF THE EURATOM TREATY

FACILITIES: Installations for monitoring and controlling radioactive discharges and for surveillance of the environment during normal operations of the Cofrentes nuclear power station; facilities of the Spanish national networks for the surveillance of environmental radioactivity.

SITE: Cofrentes, Spain

DATE: 12 November to 16 November 2007

REFERENCE: ES-07/6

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DATE OF REPORT: 5.11.2008

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ABBREVIATIONS AND ACRONYMS

CEDEX	*Centro de Estudios y Experimentación de Obras Públicas* (Experimentation Centre of the Ministry of Public Works)
CIEMAT	*Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas* (Public Research Institution attached to the Ministry of Education and Science)
CSN	*Consejo de Seguridad Nuclear* (Nuclear Safety Council)
DG TREN	Directorate-General Energy and Transport (European Commission)
EC	European Commission
ELGA	*Efluentes Liquidos y Gaseosos* (Liquid and Gaseous Effluent Database of CSN)
ENAC	*Entidad Nacional de Acreditación*
ETF	*Especificaciones Técnicas de Funcionamiento* (Technical Operating Specifications)
GM	Geiger-Müller (radiation detector)
HEPA	High Efficiency Particulate Air (filter)
HVAC	Heating - Ventilation - Air Conditioning
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ISO	International Organization for Standardization
KEEPER	Environmental radioactivity measurement database of CSN
LMA	*Laboratorio de Medidas Ambientales S.L.*
LSC	Liquid Scintillation Counting (radiation measurement)
MCDE	*Manual de Calculo de Dosis al Exterior* (Off Site Dose Calculation Manual)
NaI(Tl)	Sodium Iodide, Thallium activated (radiation detector)
NPP	Nuclear Power Plant
PROCER	*PROgrama de Control de Efluentes Radiactivos* (Radioactive Effluent Control Programme)
PROINSA	*Empresa de PROyectos de Ingenería SA* (Engineering Projects Enterprise)
PVRA	*Programa de Vigilancia Radiológica Ambiental* (Environmental Radiological Monitoring Programme)
PVRAIN	CSN independent environmental monitoring programme established as a control of the PVRA implemented by licensees
QA/QC/QM	Quality Assurance / Quality Control / Quality Management
RAR	*Red de Alerta de la Radioactividad (RAR) de la Dirección General de Protección Civil* (Radioactivity Warning Network)
REA	*Red de Estaciones Automáticas de Vigilancia Radiológica Ambiental del CSN* (Automatic Station Network)
REM	*Red de Estaciones de Muestreo* (Sampling Station Network)
REVIRA	*REd de VIgilancia Radiologica Ambiental* (Environmental Radiological Monitoring Network - not associated with installations)
RPSRI	*Reglamento sobre Protección Sanitaria contra las Radiaciones Ionizantes*

	(Regulation on sanitary protection against ionizing radiation)
SALEM	*Sala de emergencias del CSN* (CSN Emergency Centre)
TLD	Thermoluminescence Dosimetry/Dosimeter
UPS	Uninterruptible Power Supply
WHO	World Health Organisation
ZnS(Ag)	Zinc sulphide, silver activated (radiation detector)

1 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the basic safety standards [(1)].

Article 35 also gives the European Commission (EC) the right of access to such facilities in order that it may verify their operation and efficiency.

For the EC, the Directorate-General for Energy and Transport (DG TREN) and more in particular its Radiation Protection Unit (TREN H4) is responsible for undertaking these verifications.

For the purpose of such a review, a verification team from DG TREN visited the Cofrentes NPP [(2)]. The visit to the Cofrentes NPP included also meetings with the Spanish competent authority CSN [(3)] , and with *Generalidad de Valencia* [(4)], which, under contract with CSN, provides technical support to perform the sampling under the regulator's PVRAIN and the REVIRA programmes and the analyses of these samples through two university laboratories (*Laboratorio de Radiactividad Ambiental de la Universidad de Valencia* and *Laboratorio de Radiactividad Ambiental de la Universidad Politécnica de Valencia*).

Details of the programme of the verification are given under Section 2.3 below.

The present report contains the results of the verification team's review of relevant aspects of the environmental surveillance at and around the Cofrentes site. The purpose of the review was to provide independent verification of the adequacy of monitoring facilities for:

- Discharges of radioactivity into the environment.
- Levels of environmental radioactivity at the site perimeter and in the terrestrial and aquatic environment around the site, for all relevant exposure pathways.

With due consideration of the scope of the verification and taking into account the relatively short time available for the execution of the programme, it was agreed that emphasis would be put on:

- The operator's monitoring and control facilities for gaseous and liquid discharges of radioactivity into the environment.
- The implementation of the statutory environmental radioactivity monitoring programme as performed by the operator (PVRA) and by *Generalidad de Valencia* for the regulator (PVRAIN).
- The operator's effluent laboratories including aspects of quality assurance and control as well as document control.
- The national environmental monitoring programme as established by the competent authority (CSN) in the region of Valencia. The sampling for this programme (REVIRA) and the corresponding measurements are contracted by CSN to *Laboratorio de Radiactividad Ambiental de la Universidad de Valencia* and *Laboratorio de Radiactividad Ambiental de la Universidad Politécnica de Valencia* for REM (network of sampling stations) and to *Generalidad de Valencia* for REA (network of continuously measuring automatic stations).

1 Directive 96/29/Euratom, Council Directive of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionising radiation.
2 *Iberdrola*, *Central Nuclear de Cofrentes*, Paraje el Plano, s/n E-46625 Cofrentes (Valencia), España.
3 *Consejo de Seguridad Nuclear* /Nuclear Safety Council, Justo Dorado 11, 28040 Madrid.
4 *Generalidad de Valencia*, Avda. Camp de Túria, s/n, E-46183 L'ELIANA (Valencia).

The present report is also based on information collected from documents referred to in Chapter 2.2 and from discussions with various persons met during the visit, listed in Chapter 2.4 below.

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 INTRODUCTION

The Commission's decision to request the conduct of an Article 35 verification was notified to the Spanish authorities on 20 July 2007 (letter referenced TREN.H4/CG/cd D(2007)307719, addressed to the Spanish Permanent Representation to the European Union). Subsequently, practical arrangements for the implementation of the verification were made with the persons designated at the *Consejo de Seguridad Nuclear*, in particular with Ms. Lucila Ramos Salvador, Deputy Director for Environmental Radiological Protection.

2.2 DOCUMENTATION

In order to facilitate the work of the verification team, a package of information was supplied in advance by CSN. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 1 to this report. The information thus provided has been extensively used for drawing up the descriptive sections of this report.

2.3 PROGRAMME OF THE VISIT

The EC and CSN discussed and agreed upon a programme of verification activities, with due respect to the Communication of the Commission [5] and the Protocol (Memorandum of Understanding) between the Spanish authorities and the EC, setting out the framework and modalities within which Article 35 verifications are to be conducted.

During the opening meeting introductory presentations were given on the following topics:

- Cofrentes Nuclear Power Plant (Cofrentes NPP).
- *Consejo de Seguridad Nuclear* / Nuclear Safety Council (CSN).
- Environmental Radiological Monitoring Programmes (site related: PVRA and PVRAIN; national: REVIRA).
- Role of *Generalidad de Valencia* and the two university laboratories (*Laboratorio de Radiactividad Ambiental de la Universidad de Valencia* and *Laboratorio de Radiactividad Ambiental de la Universidad Politécnica de Valencia*).
- Role of CIEMAT and the LMA laboratory in the PVRA.
- Role of *Confederación Hidrográfica del Júcar*, *Centro de Estudies, Experimentación de Obras Publicas* (CEDEX) and *Subdirección General de Protección Civil y Emergencias del Ministerio del Interior* (RAR network).

The verification team notes the quality and comprehensiveness of all the presentations made and the documentation provided.

5 Commissioin Communication "Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty — Practical arrangements for the conduct of verification visits in Member States", Official Journal (2006/C 155/02), 4 July 2006

A summary overview of the programme of verification activities is provided in Appendix 2. The verifications were carried out in accordance with the programme.

2.4 REPRESENTATIVES OF THE COMPETENT AUTHORITIES, THE NPP OPERATOR AND OTHER ORGANISATIONS INVOLVED IN ENVIRONMENTAL RADIOACTIVITY MONITORING

During the visit the following representatives of the national authorities, the operator and other parties involved were met:

Nuclear Safety Council (CSN)

M. Juan Carlos Lentijo Lentijo	Radiological Protection Department, Technical Director
Ms. Lucila Ramos Salvador	Environmental Radiological Protection Department, Deputy Director
Ms. Rosario Salas Collantes	Head of Environmental Radiological Surveillance Area (AVRA)
M. José Ignacio Serrano Renedo	Head of Radiological Impact Evaluation Area (AEIR)
Ms. Elena López Vingolea	Scientist, AEIR
Ms. Carmen Rey del Castillo	Scientist, AVRA

NPP Cofrentes

M. Felipe Galán	Plant Manager
M. Eduardo Sollet	Radiation Protection Service, Manager
M. Ramiro Fragío	Radiation Protection Service, Deputy Manager
M. Pedro G. Vidal	Radiation Protection Service, Supervisor
M. Baltasar R. Quesada	Radiation Protection Service, Supervisor
M. Andrés Gallart	Radiation Protection Service, Technician
M. Fernando Miquel	Radiation Protection Service, Technician
M. Juan de Dios Moreno	Radiation Protection Service, Technician
M. Rafael Campos	Operation Section, Deputy Manager
M. Luís G. Delgado	Licensing Section, Manager
M. Julio Belinchón	Chemistry & Radiochemistry Section, Manager
M. José Carrasco	Chemistry & Radiochemistry Section, Supervisor
M. Lorenzo G. San Román	Chemistry & Radiochemistry Section, Supervisor
M. Antonio P. Molina	Chemistry & Radiochemistry Section, Supervisor
M. José G. Larios	Chemistry & Radiochemistry Section, Supervisor
M. Juan de Dios S. Zapata	Life Extension Management Section, Manager
M. Valentín Ramírez	Radiochemistry Section, Technician
M. Antonio Campos	Computational Section, Technician
M. Angel G. Valderrama	Configuration Control Section, Supervisor
M. Gregorio R. Bueno	Instrumentation & Control Group, Manager
M. José A. Mora	Instrumentation & Control Group, Supervisor
M. Jaime L. Pons	Operation off-site Environment Laboratory, Sampler
M. Rafael Moreno	Júcar River Water Authority, Resident Inspector
Ms. Josefa L. Lázaro	Translator
Ms. Belén S. Martínez	Translator

Generalidad de Valencia

M. Jose Peiró Juan	Radiological Installations, Inspector
Ms. Désirée Calvet Rodríguez	Radiological Safety Section, Technician
M. Luciano Soriano Hernández	Operation off-site Environment Laboratory, Sampler

SEAC Sociedad Española de Aplicaciones Cibernéticas SA (Spanish Society of cybernetic applications SC)

M. Mario Ruiz Llata	Head of Maintenance Department

Environmental Radioactivity Laboratory (LARAM), University of Valencia,

Ms. Elisa Navarro Anglés	Head of LARAM
M. Rafael Galera Diaz	Quality Department, Senior Scientist
Ms. Teresa Camara Garcia	Measurement Division, Senior Scientist
M. José Lorenzo Ferrero Calabuig	Instrumentation Division, Professor
M. Clodoaldo Roldan Garcia	Projects & Research Department, Professor

Environmental Radioactivity Laboratory, Polytechnic University of Valencia

M. Vicente Serradell García	Director
Ms. Josefina Ortiz Moragón	Technical and Quality Department, Supervisor
Ms. Luisa Ballesteros Pascual	Chemistry and Measurements Department, Supervisor
Ms. Marga López Marín	Chemist

Júcar River Basin District Authority (CHJ)

M. Manuel Torán Busutil	Water Quality Section, Responsible
Ms. Lorena Martínez Roser	Scientist
M. Jaime Blanes Garrido	Technician
M. Andrés Delgado	Driver
M. Laureano García	Driver

Centre for Studies and Experimentation of Public Works (CEDEX), Ministry of Public Works

M. Juan Payeras Socias	Programme Manager
Ms. Ángeles de Pablo Janmartín	Co-ordinator of Technical and Scientific Programme

Ministry of Public Administration

M. Francisco Gimeno Gimeno	Head of Department
Ms. Isabel Montón Abarca	Nuclear Hazards section, Senior Scientist
Ms. Silvia Miró Gómez	Scientist at Radioactivity Warning Network (RAR)

The verification team acknowledges the co-operation it received from all individuals mentioned. It also highly appreciated the excellent interpretation provided by the Cofrentes NPP through the permanent presence of two interpreters: Ms. Josefa L. Lázaro and Ms. Belén S. Martínez.

3 COMPETENT AUTHORITIES & LEGAL BACKGROUND

3.1 INTRODUCTION

In Spain, the facilities liable to generate radioactive waste must have effluent storage, treatment and removal systems. Radiological monitoring programmes must be based on site and discharge characteristics. The environmental radiological monitoring programme is composed of the network implemented by the NPP operators at the sites and in their zones of influence, as well as by a site-specific control programme implemented by the *Consejo de Seguridad Nuclear* (CSN) and nation wide monitoring networks managed also by CSN.

The operator of the nuclear power plant has to run the sampling, analysis and measurement programmes of radiation levels and radionuclides present in the environment within a 30 km radius. The main pathways of human exposure to radiation have to be monitored, as well as those ecosystem elements, which are good indicators of the behaviour of radionuclides in the environment. Table 1 details the analyses required in Spain for each type of sample in a nuclear power plant:

Table 1: NPP Radiological Environmental Monitoring Programmes [6]

Type of Sample	Analysis
Air	Gross beta, Sr-90, Gamma spectrometry, I-131
Potable water	Gross beta, Residual beta, Sr-90, Tritium, Gamma spectrometry
Rain water	Sr-90, Gamma spectrometry
Ground and surface water	Gross beta, Residual beta, Tritium, Gamma spectrometry
Soils, sediments and biota	Sr-90, Gamma spectrometry
Milk and crops	Sr-90, Gamma spectrometry, I-131
Meat, eggs, fish, seafood and honey	Gamma spectrometry

The site related independent monitoring programme of CSN includes the same sampling locations and types of samples and analysis as the operators' programmes.

The nation-wide radiological monitoring network established and managed by CSN is operational since 1992 (except for rivers, which are surveyed since 1984) and is independent from the network associated with nuclear facilities. It includes an Automatic Station Network (REA) for real-time measurement of ambient gamma dose rate and atmospheric radioactivity and a Sampling Station Network (REM) for sampling and analysis programmes for air, soil, rivers, coastal water, drinking water, milk and mixed diet.

3.2 COMPETENT SPANISH AUTHORITIES

3.2.1 *Consejo de Seguridad Nuclear* (Nuclear Safety Council)

The *Consejo de Seguridad Nuclear* (CSN), established in 1980, is the Spanish organisation responsible for nuclear safety and radiological protection. It is independent from Government and reports to the Parliament of Spain. CSN issues reports with binding content prior to the awarding of nuclear authorisations by the Ministry of Industry, Tourism and Trade and proposes regulations on nuclear safety and radiation protection.

CSN is an associated body formed by five members (a president/chairman and four commissioners) proposed by the Government and endorsed by the Congress of Deputies. Under the overall responsibility of the Secretary General, CSN is organised in two Technical Directorates, Nuclear Safety and Radiation Protection. The latter includes three Deputy Directorates: Emergencies, Operational Protection and Environmental Radiological Protection.

CSN maintains a strict control and monitoring programme for nuclear installations and facilities related to medical, industrial or research activities that are using radioactive substances. CSN has also to provide mandatory and binding documents for any modifications of such installations and facilities. On average, CSN carries out around 200 control inspections per year in nuclear power plants operating in Spain. It is also responsible for proposing regulations to the Ministry of Industry concerning radiological protection of workers and members of the public.

With respect to the environment, CSN has the following regulatory functions:

6 Cofrentes NPP Off-Site Dose Calculation Manual (MCDE) Rev. 18, October 2006.

- To control the radiological impact of nuclear installations on the environment, especially concerning radioactive discharges (aerial/liquid) into the environment, their accumulation in the surroundings of such installations and the evaluation of the resulting radiological impact.
- To run its own programmes of environmental radiological vigilance (both around nuclear installations and at national level) and to supervise all environmental radiological protection activities conducted by nuclear installations and by facilities using radioactive substances.

CSN also has regulatory functions concerning emergencies. It has the capability for immediate response to any nuclear or radiological incident. Its emergency room (SALEM) is fitted with redundant communication systems collecting information in real time and thus facilitating CSN's advisory function in case of an emergency. The emergency room has permanent automatic communications with all Spanish nuclear power plants and has 24-hour manned operation.

CSN also promotes research programmes in matters related to its competencies. It proposes regulations and informs the public through direct contact with the media, diffusion of publications, an internet web page (www.csn.es) and an information centre. CSN's annual report to Spain's Congress and Senate provides information on the results of the monitoring programmes, more detailed information about these results is published in an annual specific report; a summary of the results is posted on CSN's internet site to provide information to the public.

3.2.2 Ministry of Health and Consumer Affairs (Radiological surveillance of food stuffs)

The body responsible for the radiological monitoring of foodstuffs is the Ministry of Health and Consumer Affairs.

Radiological monitoring of water for human consumption, including bottled water, is required by *Real Decreto* [Royal Decree] *140/2003*, establishing the health criteria for the quality of water for human consumption and *Real Decreto 1744/2003*, amending *Real Decreto 1074/2002*, regulating the procedure for the preparation, transport and sale of bottled drinking waters.

The Ministry of Health and Consumer Affairs through the *Centro Nacional de Sanidad Ambiental* [National Centre for Environmental Health], analyses the radioactive content of imported food products and issues export certificates.

Radiological monitoring of foodstuffs in areas around installations which emit discharges externally is required of the proprietor of these installations in the corresponding regulations and directives.

In compliance with Articles 35 and 36 of the EURATOM treaty, CSN has established and manages the national Environmental Radiological Monitoring Network, which includes the sampling of foodstuffs (milk and mixed diet). The design and development of this network follows EC recommendations.

The *Conselleria de Agricultura y Pesca* [Agriculture and Fisheries Authority] of the *Generalidad de Valencia* operates a Radioactivity Control in Fresh Foods programme in the *Comunidad de Valencia*, through a contract with the *Universidad Politécnica de Valencia* [Polytechnic University of Valencia].

Emergency preparedness

In Spain, planning and preparation for nuclear emergency situations are governed by the Basic Nuclear Emergency Plan and by the regulations governing nuclear and radiological facilities. In addition, there are general provisions on nuclear emergencies in the law creating CSN (as amended by the law on public prices and tariffs for services rendered by CSN), in the Regulation on Protection against Ionising Radiations, in the Agreement of the Cabinet of Ministers on public information on healthcare measures and actions in the event of radiological emergency and in the Basic Defence Standard.

3.3 LEGAL PROVISIONS FOR ENVIRONMENTAL RADIOACTIVITY MONITORING

3.3.1 Legislative acts regulating environmental radioactivity monitoring

- Law 25/1964, of 29 April, on nuclear energy. Published in the *Boletín Oficial del Estado* [Official Gazette] (BOE) nº 107, of 4 May 1964.
- Law 15/1980 of 22 April, on the creation of CSN. Published in BOE nº 100 of 25 April 1980.
- Law 14/1999, of 4 May, on rates and public charges for services provided by the Nuclear Safety Council. Published in BOE nº 107 of 5 May 1999 and amended in BOE nº 131 of 2 June 1999.
- *Real Decreto* 783/2001, of 6 July, adopting the regulations on health protection against ionising radiations. Published in BOE nº 178, of 26 July 2001.
- *Real Decreto* 1836/1999, of 3 December, adopting the regulations on nuclear and radiological installations. Published in BOE nº 313, of 31 December 1999.

3.3.2 Legislative acts regulating the radiological surveillance of foodstuffs

The Ministry of Health and Consumers Affair is responsible for the radiological surveillance of foodstuffs, applying international standards, such as relevant European Regulations and WHO Codex Alimentarius Guidelines.

- *Real Decreto 140/2003*, of 7 February, establishing the health criteria for water quality for human consumption. Published in BOE nº 45 of 21 February 2003.

3.3.3 International Legislation and Guidance documents

- ICRP Publication 60. Recommendations of the International Commission on Radiological Protection 1990.
- IAEA International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. Safety Series Nº 115, 1996.
- Council Directive 96/29/Euratom of 13 May 1996 laying down basic standards for the protection of the health of workers and the general public against the damages arising from ionising radiation.
- Commission Recommendation of 8 June 2000 on the application of Article 36 of the EURATOM Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the populations as a whole. (2004/473/Euratom).
- Council Regulation (EC) n° 737/90 of 22 March 1990, on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station [Official Journal L 82 of 29.3.1990]. [7]
- WHO Codex Alimentarius Commission Guideline 5-1989: Guideline levels for radionuclides in foods following accidental nuclear contamination for use in international trade.

[7] Council Regulation 737/90 has been replaced by Council Regulation (EC) No 733/2008 of 15 July 2008 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station (Codified version), [OJ L201 of 30.7.2008, pg 1].

3.4 RADIOACTIVE DISCHARGE AUTHORISATIONS

Spanish legislation requires that facilities that may generate radioactive wastes be provided with adequate treatment and removal systems, in order to ensure that doses caused by discharges are lower than limits established in the administrative licences and that they are maintained at the lowest possible values.

Facilities have to have Technical Operating Specifications (ETF), which are official documents included in the operating permits of fuel cycle facilities. They contain the Radioactive Effluent Control Programme (PROCER) and the Environmental Radiological Monitoring Programme (PVRA) and require that both programmes are further developed in an official document called Off Site Dose Calculation Manual (MCDE). Furthermore, the MCDE contains a description of the main discharge channels, radiation monitoring instrumentation, and the methodology and parameters used to estimate doses to the population due to radioactive liquid and gaseous effluents.

The NPP operators provide CSN with data on liquid and gaseous discharges and the estimated doses resulting from these releases. These data are included in the monthly operating reports, stored on magnetic media and loaded into CSN's liquid and gaseous effluent database (ELGA). CSN evaluates this data, verifies compliance with established limits and conditions, and tracks discharge trends in order to detect operational occurrences and to verify that treatment systems are operative. For this purpose, internal reference values have been defined based on the NPP's operating experience. If these values are exceeded, information is requested from the NPP on the possible activities that could have caused the increased effluent radioactivity levels. Regulatory control of reported discharges is supplemented by the effluent inspections that CSN periodically performs at NPPs.

3.4.1 Certificates of authorisation for Cofrentes

The plant's current authorisation was granted for a period of ten years by Order of the Minister for the Economy on 19 March 2001.

3.4.2 Independent verification

In Spain, CSN is responsible for the independent control and verification of radioactive discharges from NPPs. It has defined effluent control programmes that encompass the following:

- Discharge limits (Table 2).
- Sampling and analysis programmes (Table 3).
- Calculations of the dose to the most exposed member of the critical group considering the discharges and site characteristics in order to verify compliance with the discharge limits.
- Operating conditions for effluent treatment and discharge operations.
- Requirements imposed on instrumentation for continuous monitoring of liquid and gaseous effluents.

Table 2 Discharge limits for nuclear power plants [8]

Limit	Effluent	Parameter	Limit
Operational Restrictions [9] (Discharge Limits)	Total	Effective Dose	0.1 mSv/12 consecutive months
	Gaseous	Effective Dose	0.08 mSv/12 consecutive months
	Liquids	Effective Dose	0.02 mSv/12 consecutive months
Instantaneous limits [10]	Gaseous	Noble Gases Activity Release Rate	1.78 E+9 Bq/s
	Liquids	Radioactive effluent system treatment and laundry waste system	≤1,59 E+07 Bq/m^3
		Service water system	≤1,9 E+06 Bq/m^3

Table 3 Radioactive effluents sampling and analysis programme for the Cofrentes NPP

Liquid Effluents			
Type of Release	**Sampling Frequency**	**Minimum Analysis Frequency**	**Type of Activity Analysis**
Batch releases	Before each release	Before each release	Gamma emitters
	Before each release	Monthly	Dissolved and entrained gases (gamma emitters)
	Before each release	Monthly composite	H-3
			Gross alpha
	Before each release	Quarterly composite	Sr-89/90
Continuous releases	Monthly	Monthly	Gamma emitters
	Monthly	Monthly	Dissolved and entrained gases (gamma emitters)
Gaseous Effluents			
Type of Release	**Sampling Frequency**	**Minimum Analysis Frequency**	**Type of Activity Analysis**
Continuous release [11]	Weekly grab sample	Weekly (Noble gases)	Gamma emitters
	Monthly grab sample	Monthly	H-3
	Continuous sampling	Weekly (Charcoal filter)	I-131
	Continuous sampling	Monthly (Charcoal filter)	I-133, I-135
	Continuous sampling	Weekly (Particulate filter)	Gamma emitters
	Continuous sampling	Monthly (Particulate filter)	Gross alpha
	Continuous sampling	Quarterly composite (Particulate sample)	Sr-89/90
	Continuous sampling	Continuous	Total Activity

8 Cofrentes NPP Off-Site Dose Calculation Manual (MCDE) Rev. 18, October 2006.

9 The total value (0,1 mSv per year) is the same for all Spanish NPPs but the distribution between liquids and gases depends on the specific characteristics of each plant.

10 Maximum values considered in establishing the effluent monitoring instrumentation alarm set points. The given values are Cofrentes NPP specific.

11 By requirement of CSN Carbon-14 is measured on a monthly basis since 2007 although it is not yet specified in the NPP Cofrentes gaseous sampling and analyses programme.

4 COFRENTES-NPP SITE

The Cofrentes NPP is a boiling water nuclear power plant of the BWR-6 type of 1092 MW designed by General Electric (USA). An overview scheme is presented in Appendix 3.

The Cofrentes Nuclear Power Plant is located on the right bank of the river Júcar, within the municipal boundary of Cofrentes, Province of Valencia.

The plant is located on a plain, close to the river and approximately 47 m above the mean water level of the river Júcar, occupying a total area of 300 hectares, including the exclusion zone.

Cofrentes is located at a straight line distance of 64 km from the city of Valencia (a region of high electricity consumption), in a sparsely populated area and an area of little agricultural and industrial activity.

The building authorisation for the Cofrentes NPP is dated 9 September 1975. The plant was connected to the electric grid on 14 October 1984 and commercial operation started on 11 May 1985. The plant is operated by *Iberdrola, S.A.*.

5 COFRENTES RADIOACTIVE DISCHARGES

5.1 INTRODUCTION

Spanish legislation requires that facilities that may generate radioactive waste be provided with adequate treatment and removal systems in order to ensure that doses caused by discharges are lower than the regulatory limits established in the administrative licences, and that they are maintained at the lowest possible values.

The specifications of the monitoring instrumentation for liquid and gaseous discharges are established in the power plant's Off Site Dose Calculation Manual (MCDE). Application of these controls by the proprietor guarantees compliance with the instantaneous concentration limits for liquid discharges and instantaneous dose rate limits for gaseous discharges.

The above mentioned MCDE controls establish the minimum number of operable channels required in each piece of equipment, the alarm/activation thresholds, the range of measurement and the applicable actions in the case of monitors being in a non-operational state. The equipment tests which must be carried out to guarantee the correct functioning are also defined together with the operating conditions and the frequency at which they should be carried out.

The inspections carried out by the regulatory body (CSN inspectors) are as follows:

Verification of fulfilment of the sampling and analysis programme established in the MCDE for liquid and gaseous discharges: Attendance at sampling and analysis carried out by plant staff in application of the MCDE. Additional sampling and analysis in the power plant laboratory. Independent analysis and interpretation of the spectra obtained by the proprietor with the tools available at CSN. Monitoring and reproduction of the calculations made. Verification of the fulfilment of the installation's procedures and of the administrative process associated with the carrying out of discharges in batches. Attendance at the periodic tests required in the MCDE and the carrying out of additional tests. Verification of fulfilment of the frequency and acceptance criteria established for the periodic tests. Verification of the thresholds and readings recorded by the radiation monitoring instrumentation. Monitoring of the actions associated with the non-operational status of the radiation monitoring instrumentation.

5.2 DISCHARGE AUTHORISATION

The Energy Department of the Ministry of Industry grants the authorised discharge limits for the nuclear power plants in Spain. CSN establishes the system of limitation, surveillance and control of radioactive effluents. It also evaluates the reported data and inspects the facilities. CSN has inspectors on the Cofrentes site on a permanent basis.

The regulatory framework involves discharge limits, sampling and analysis programmes, dose calculations, requirements for monitoring instrumentation and requirements for the effluent treatment systems. This framework has been developed into a comprehensive official document, the Off Site Dose Calculation Manual (MCDE), which specifies the individual discharge limits, equipment availability requirements and control procedures for the Cofrentes site.

5.3 DISCHARGE LIMITS APPLICABLE TO THE COFRENTES NPP

The current regulation *"Reglamento de protección sanitaria contra radiaciones ionizantes"*, which was published in July 2001, establishes 1 mSv per year as the effective dose limit for the protection of the public. The discharge limits (Table 2) are included in the ETF and in the MCDE. For the control of radioactive effluents, 0.1 mSv per 12 consecutive months is being applied as a discharge limit (also called operational restriction) since January 1997.

5.4 GASEOUS DISCHARGES

5.4.1 Emission channels

The principal contribution to the total activity emitted by the gaseous discharges of the Cofrentes NPP is through the radioactive gases release system (L05). The chimney of this system is located at a distance of 300 m from the reactor building, is 75 metres tall, with its base located at a height of 38 metres above the plant, representing a discharge point height of 113 metres above the level of the plant.

The standby gas treatment system has its own vent. Its 35 metre high chimney is located at the side of the reactor building. The contribution to the total activity emitted from the standby gas treatment system is of very little significance owing to the low number of hours during the year when the system is in operation. Besides for accident situations, the standby gas treatment system is used in normal conditions for mandatory tests and in case of determined operational events.

The detergents sub-system also has its own venting system located in the radioactive residues building. Its contribution to aerial radioactive discharges is not significant as well. This system collects and treats detergents from the staff showers, laundry and decontamination operations and water produced in surplus as the result of a non-standard situation. In general, detergent waste is collected in one or two detergent drain storage tanks and is treated in an evaporator, discharging into the atmosphere in the form of steam. If the storage capacity of the condensate storage tank is exceeded, the excess water is taken into the excess water storage tanks where it is stored for future dispatch to the condensate storage tank when capacity becomes available. If no such capacity exists, the excess water is treated, as far as possible, using the detergent evaporators and is discharged into the atmosphere in the form of steam.

An overview drawing of the systems is shown in Appendix 4.

5.4.1.1 Chimney of the L05 system

The stack of the L05 system channels the most significant radioactive discharges which are those from the:

a) Off-gas system.

b) Containment Purging.

c) Maintenance of vacuum of the shield ring.

d) Heating - Ventilation - Air Conditioning (HVAC) of the Fuel Building.

e) HVAC of the Auxiliary Building.

f) HVAC of the Radioactive Residues Building.

g) HVAC of the Turbine and Heater Building.

h) HVAC of the Services Building.

i) Extraction of gases from the turbine sealing system and mechanical condenser vacuum pump.

5.4.1.2 Other ventilation paths

The standby gas treatment system and the detergent subsystem have separate ventilation channels.

5.4.2 Monitoring of gaseous discharges

The form in which the activity discharged by the principal gaseous discharge emission channels is monitored is described below.

5.4.2.1 Chimney of the L05 System (main stack)

Situated in an isokinetic bypass of the main stack two devices (high range and Kaman Science Corp., Colorado Springs, low range) monitor all gaseous discharges which occur in normal operation through this emission channel, with the corresponding alarm indicators being located in the Control Room.

In addition, each of the inputs into the plant's chimney as described in 5.4.1.1 is monitored separately to allow quick decisions about the source of any elevated radiation levels and shutting off this path by automatically closing the corresponding valves. The one exception is the last item (gas extraction from the sealing system of the turbine and mechanical vacuum pump of the condenser) which has no separate monitor because contaminations in this path can only be minor.

In addition to the use of the monitoring provisions described above, monitoring of the activity released via the L05 chimney is performed by sampling and analysis of the noble gases, iodine, particulate matter, tritium and C-14 in the same isokinetic bypass system (C-14 determinations are currently in a testing phase; they will become obligatory as of 2008). In addition, six process auto samplers are located in the ventilation systems of the different buildings for routine monitoring of the levels of activity, the purpose of which is to identify if there is any increase in activity in the atmosphere of any of these buildings.

Several possibilities exist for sampling off-gas pre- and post-treatment, before being led into the main stack.

5.4.2.2 Standby gas treatment system

This system which, in normal operation, functions only during testing and start-up, is monitored separately with indication and recording in the Control Room.

For the purposes of the MCDE, only the low range monitor is considered as information source as this is the one which in normal operation monitors emission from the system.

Monitoring of the activity emitted by the chimney of the standby gas treatment system is supplemented with sampling and analysis of the noble gases, iodine, particulate matter, tritium and C-14 (C-14 determinations are currently in a testing phase; they will become obligatory as of 2008).

5.4.2.3 Detergent sub-system evaporator

This channel with its separate exhaust is monitored separately as well. It also has an alarm function on the Control Room panel.

5.5 LIQUID DISCHARGES

5.5.1 Emission channels

At the Cofrentes NPP there are three inputs to the discharge of radioactive liquid effluents, two of these, a) and b) being considered batch or non-continuous emissions and one, c) being considered a continuous emission:

a) Discharge of the contents of excess water tanks which take inputs from the low and high conductivity sub-system.

b) Discharge of the content of the detergents tank which is fed from the washing of personnel and of clothes, decontaminating solutions, etc.

   This sub-system has 2 possibilities in respect of emission of liquid discharges to the outside:

   1- Direct discharge of the contents of the detergents drainage tanks.

   2- Discharge of the condensate of the detergents distillate storage tanks coming from the detergents evaporators.

c) Input from the purging of the cooling towers of the services water system which, whilst not being radioactive in normal circumstances, is a possible channel of accidental radioactive discharges.

An overview drawing of the systems is shown in Appendix 5.

5.5.2 Monitoring of liquid discharges

Liquids to be discharged come from three areas:

a) The radioactive waste treatment system – three closed excess water tanks (180 m^3 each; with ventilation system with carbon filters that are changed annually);

b) The laundry system – two detergent tanks (7.5 m^3 each);

c) Spillage of the discharge of the purging of the forced draught towers (approx. 20 m^3 per hour; no significant radioactivity expected).

Prior to every discharge from the excess water and detergents tanks (i.e. a) and b) above), samples are taken for analysis, for determination of the principal gamma emitters, noble gases which have been dissolved and/or entrained, H-3, alpha emitters, Sr-89 and Sr-90 ('MCDE' control, i.e. the control of discharges as requested by CSN).

The liquids from a) and b) are mixed in a pipe and monitored with a NaI(Tl) based gamma measuring device (process radiation monitor in bypass). This monitor prevents the discharge of water by

activation of a valve when the gross gamma activity is above a certain threshold. The monitor has alarms to indicate high radiation and failure of the monitor. It is routinely checked and calibrated.

The spillage of discharge of the purging of the forced draught towers is monitored by a gamma scintillation detector. The monitor prevents the discharge of water by activation of a valve when the activity is above a certain threshold. Furthermore samples are taken for analysis required in the "MCDE".

After this control liquid discharges are fed into one of three 'intermediate' open concrete tanks of 5373 m^3 each. Before any discharge from such a tank to one of the open 'final' concrete ponds of nearly 130000 m^3 each, according to the authorisation (the part concerning releases to waters) granted by the *Comisaría de Aguas del Júcar,* a sample has to be taken and analysed. Taking into account the procedure, the transfer may only take place when the 'potability factor' (i.e. a factor comprising gamma emitter, total alpha, total beta and tritium activity) is below a value of 20.

Prior to a discharge from one of the final ponds to the river Júcar again a sample has to be taken and analysed according to the authorisation. Taking into account the procedure, in case the 'potability factor' is below 1, the local representative of the Júcar River Authority unlocks the release valve. In normal situations the valve (situated in a key-locked cabin) is locked with a key; only the above mentioned representative has access to this key.

6 ENVIRONMENTAL MONITORING PROGRAMMES

6.1 INTRODUCTION

One of the conditions of the authorisation to discharge radioactive effluents and wastes is that an environmental monitoring programme is carried out to determine the effects of these discharges on the environment.

The Technical Operating Specifications (ETF), which is an official document included in the operating permits of fuel cycle facilities, contain the Radioactive Effluent Control Programme (PROCER) and the Environmental Radiological Monitoring Programme (PVRA) and require that both programmes are further developed in the Off-Site Dose Calculation Manual (MCDE). The MCDE contains, relating to the PVRA, a description of the monitoring programme, of the quality control programme and the requirement to update every three years the census on land and water usage.

The current PVRA is based on the Nuclear Safety Guideline (published by CSN) and is developed in detail in the operator's Off Site Dose Calculation Manual. The MCDE also defines the notification levels for activity concentrations in environmental samples, established by CSN on the basis of the discharge dose limits (0.1 mSv per year). If a notification level is reached or surpassed the operator must report to CSN and undertake a study to determine a possible relationship with the plant's discharges.

The primary purpose of the Environmental Monitoring Programme (PVRA) is to estimate the total radiation dose received by a member of the public in the surroundings of the NPP. Samples for the PVRA are taken from the environment and from the food chain. In this context the term sampling includes the collection of samples from the environment for laboratory analysis (which is mainly directed at food pathways), and also selective direct measurement of dose using TLD devices in the environment to assess external exposure pathways. The PVRA results are compared with the discharge limit of 0.1 mSv per year through the 'notification levels'. Gamma dose rate monitoring using GM counters is performed with a view on emergency situations (baseline determination).

The PVRA provides reassurance that permitted discharges are estimated correctly and that unusual discharges to the environment are recognised early. One of the objectives of the operator's PVRA is

also to demonstrate that the allowed discharges have a minimal effect on the population in the surroundings.

6.2 RESPONSIBILITIES

Radiological monitoring of the environment in Spain is achieved through a system of networks, constituted by a monitoring network in the area of the installations and a national network.

In the case of the Cofrentes NPP, **the owner** is responsible for carrying out their Environmental Radiological Monitoring Programmes (PVRA) following CSN's directives, in accordance with the type of installation and certain characteristics of the location, such as demography, land and water use and habits of the population.

The Cofrentes plant operator carries out the PVRA, contracting LMA (*Laboratorio de Medidas Ambientales S.L.*) at *Medina de Pomar* to perform the associated sampling and analysis of the samples. The analysis results are used by the operator for reporting to the authorities.

A quality control programme has been implemented by the NPP by handing a certain percentage of the samples over to CIEMAT for parallel analysis. Within the analysis laboratories (LMA and CIEMAT) internal quality control programmes are applied, as defined by the certification and accreditation system in place.

The regulator (CSN) exercises regulatory control through periodic inspections, evaluation of data obtained and the conducting of independent programmes, either directly or by commissioning the Autonomous Communities to carry them out, thus allowing confirmation that these have been undertaken and to monitor the quality of the results. In the case of the Cofrentes NPP the *Generalidad de Valencia* has been commissioned for these tasks.

So, in parallel to the operator's PVRA, the competent authority (CSN) runs a **complementary (*site related*) environmental monitoring programme (PVRAIN)**, partly with the aim to verify the operator's results. In the case of Cofrentes this independent control is assigned (by a contract) to the Autonomous Community of Valencia.

CSN has the power to inspect the NPP and the contracted laboratories regarding the implementation of the quality control measures.

Since 1978 the Civil Works Studies and Experimentation Centre (CEDEX) of the Ministry of Public Works (*Ministerio de Fomento*) is carrying out a radiological **monitoring of Spain's major rivers**.

In addition, under the lead of the CSN directorate for Radiation Protection a **nation-wide environmental radioactivity monitoring programme** is carried out (REVIRA).

The Ministry of Public Administration - Directorate General of Civil Defence and Emergencies also has a **Radioactivity Warning Network (RAR).**

6.3 THE OPERATOR'S MONITORING PROGRAMME

6.3.1 Introduction

The number and location of sampling points, the type of samples to be collected and the required analyses have been defined in the pre-operational phase of the NPP, and they have been updated through the years of plant operation. The main pathways of human exposure to radiation are monitored, as well as those ecosystem elements that are good indicators of the behaviour of radionuclides in the environment.

6.3.2 The operator's PVRA-programme

At the moment, in addition to the measurement of ambient gamma dose, this site related surveillance programme covers the following:

- air (particulate, iodine)
- deposition (precipitation, soil)
- drinking water
- spring water
- lake and river surface water
- sediments
- water indicator organisms (*Typha*, *Scirpus* (rush), others, ..)
- milk (goat)
- agricultural products (lettuce [*lechuga*], wheat [*trigo*], olive [*aceituna*], almond [*almendra*], peach [*melocotón*], orange [*naranja*], grape [*uva*])
- meat (lamb, chicken, rabbit, wild boar)
- eggs
- fish
- honey

An overview over this programme is given in Appendix 6.

6.3.3 Sampling, sample preparation and measurements

Sampling is done by the analytical laboratory (*Laboratorio de Medidas Ambientales S.L.* at *Medina de Pomar* (Burgos) – LMA), under the supervision of dedicated NPP staff, based on sampling procedure documents that are permanently available to the staff. Special samples are taken or prepared by local experts (e.g. milking of goats and butchering of animals for meat samples).

Sampling campaigns are scheduled from Wednesday to Tuesday. Samples that quickly deteriorate (e.g. milk) are stabilised and/or cooled before sending to the analytical laboratory.

Wednesday samples are prepared for transport and transported to the contracted analysis laboratory LMA at *Medina de Pomar* by a contracted carrier, and to CIEMAT in Madrid (quality control programme) by the internal courier service.

(LMA – *Laboratorio de Medidas Ambientales S.L.*, Medina de Pomar, and CIEMAT – *Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Laboratorio de radiactividad ambiental* [Centre for Energy, Environmental and Technological Research, Environmental Radioactivity Laboratory], Madrid, have been verified in 2004 during the Trillo verification and are therefore not included in this verification. Detailed information may be found in the report of that verification.)

In the analysis laboratories sample pre-treatment and sample preparation for measurement follow generally accepted routines and Spanish standards where available.

6.3.4 Reporting and quality control

Reporting to the authority (CSN) by the Cofrentes NPP, is basically done by a monthly summary and an annual detailed report. Data are also transmitted by e-mail, diskette, CD or telematic system to be loaded into CSN's database.

Every three years all the Spanish NPPs send information about the new census on land and water usage.

If the notification levels set by CSN (which are relatively low and of no radiological significance) are exceeded the analysis laboratory immediately has to inform the NPP, which then immediately will

inform CSN. The operator also must undertake a study to determine a possible relationship with the plant's discharges.

A quality control programme has been implemented by the NPP by handing a certain percentage of the samples over to CIEMAT for parallel analysis.

6.3.5 On-site environmental monitoring

A description of the locations and devices for air sampling (aerosols, iodine), precipitation sampling, gamma dose rate and gamma dose monitoring, spring water and soil sampling is given in Chapter 9.2.1.

6.3.6 Off-site environmental monitoring

A description of the locations and devices for air sampling (aerosols, iodine), precipitation sampling, gamma dose rate and gamma dose monitoring, waters, soil and food sampling is given in Chapter 9.2.2.

6.3.7 Meteorological station

A meteorological station is located inside the NPP fence and can be reached by a sand road. The site is located some 0.7 km from the reactor (direction SW).

In September 1983 a 100 m mast was erected with three principal measurement levels: 10, 60 and 100 m.

The following meteorological variables are measured:

10 m level:	Wind speed and direction, absolute temperature and dew point.
60 m level:	Wind speed and direction, temperature differential relative to the 10 m level (all redundant).
100 m level:	Wind speed and direction, dew point and temperature differential relative to the 10 m level (all duplicated).
Ground:	Rain gauge and pyranometer (180° solar radiation flux density measurement)

The meteorological signals are processed in real time using a computer controlled digital system; they are also collected in analogue form in the meteorological station and in the Control Room (in this latter, only the 60 m signals representing the height of discharges through the standby gas treatment system).

6.4 THE COMPETENT AUTHORITY'S (CSN) SITE RELATED INDEPENDENT CONTROL PROGRAMME (PVRAIN)

6.4.1 Introduction

Every year the Spanish NPPs send the results of their monitoring programmes and corresponding quality controls to CSN. Every three years the NPPs send the new census on land and water usage. These PVRA data are stored in CSN's environmental radioactivity measurement database (KEEPER), together with data obtained from nation wide radiological monitoring programmes. CSN evaluates these results, considering the data obtained during the pre-operational phase and the values from previous years, and analyses their evolution during the facility's operational period. The results of the quality control programme are also examined in relation to the PVRA data.

6.4.2 PVRAIN: An independent site related control programme for the Cofrentes NPP

CSN carries out a control of the operator's PVRA by means of its own independent monitoring programme PVRAIN. In the case of the Cofrentes NPP, this programme is assigned to the Autonomous Community of Valencia. For this programme sampling and measurements are performed independently from the NPP by the *Generalidad de Valencia*, which reports directly to CSN. CSN also performs periodic inspections and audits of the NPP's PVRA. The PVRAIN programme is based on a subset of some 5 to 50%, depending on the sample type, of the samples taken by the operator. Analysis of these samples is done by two laboratories: the Environmental Radioactivity Laboratory of the Valencia University (UVC) and the Environmental Radioactivity Laboratory of the Valencia Polytechnic University.

A description of the locations and devices for air sampling (aerosols, iodine), precipitation sampling, gamma dose rate and gamma dose monitoring, waters, soil and food sampling is given in Chapter 9.2.2, together with a description of the operator's PVRA off-site monitoring programme.

6.5 SPANISH NATIONAL ENVIRONMENTAL MONITORING PROGRAMMES

6.5.1 Introduction

CSN runs a nation-wide radiological monitoring network (REVIRA). This national monitoring network is independent from the networks associated with nuclear facilities. It includes almost all autonomous regions and accounts for features such as coastal lines when establishing the number and characteristics of the sampling points. For its part, the *Red de Vigilancia Radiológica Ambiental no asociada a instalaciones* [Environmental Radiological Monitoring Network not associated with installations] (REVIRA), is distributed throughout the national territory and is managed by CSN. It is formed from a network of sampling stations (REM) and a network of continuously measuring automatic stations (REA). REVIRA provides nationwide radiological information on the radioactivity of the atmosphere, soil, water (drinking, continental and sea) and of foodstuffs.

Autonomous administrations of *Valencia, Catalunya, País Vasco and Extremadura* run their own regional automatic monitoring networks.

In addition, the Ministry of Public Administration - Directorate General of Civil Defence and Emergencies has a Radioactivity Warning Network (RAR) composed of 900 gamma dose rate measurement points distributed all over Spain. In the CSN Emergencies Room (SALEM) there is a computer connected to a RAR control centre which provides real-time information.

6.5.2 The national monitoring network (REVIRA), managed by CSN

REVIRA is composed of:

- The Network of Sampling Stations (**REM**), where monitoring is achieved through sampling and analysis programmes carried out by different laboratories. It consists of:
  - The atmospheric and terrestrial environment monitoring programme (which includes air, ground, drinking water, milk, mixed diet; see table 4).
  - The aquatic environment (continental and coastal waters) monitoring programme.
- The Network of Automatic Stations (**REA**), enlarged with the connection to the autonomous administrations automatic networks of *Valencia, Catalunya, País Vasco and Extremadura* under specific agreements, which carries out continuous measurement and provides information in real time on activity concentrations in the atmosphere and in water and on environmental radiation levels in different areas of the country.

The REVIRA network is operational since 1992 (rivers since 1984). It has the following functions:

- Ascertain the distribution and evolution of radioisotopes present in the environment and the levels of environmental radiation.
- Provide an environmental database to be able to obtain reference levels at any time.
- Provide experimental data for estimating the potential radiological impact on the population as a result of possible radioactive contamination of the environment.
- Provide data for reporting to the Congress, Senate and to the public on the radiological quality of the environment in Spain.

The implementation of Article 35 of the EURATOM Treaty regarding nation-wide radioactivity monitoring in Spain is done by setting-up (i.e. logically defining) a 'Dense' and a 'Sparse' Network as follows:

- The ***Dense Network*** is composed of numerous sampling points all over the territory. The required detection levels of that network are of low sensitivity. This network is currently composed of 25 REA points, 18 air sampling points, some 85 inland surface water points, 15 seawater points along the Spanish coastal perimeter and 15 drinking water points. The analysis of most milk samples is also implemented within this network.
- The ***Sparse Network*** is composed of very few sampling points with a very high sensitivity of detection. This network currently has 5 high-volume air sampling stations, 5 drinking water and mixed diet sampling points and 4 milk sampling points.

Table 4: REM. Programme of sampling and analysis of the atmosphere and the terrestrial environment

Type of sample	Frequency of sampling	Dense network		Sparse network	
		Type of analysis	Frequency of analysis	Type of analysis	Frequency of analysis
Aerosols	Continuous sampling Weekly change of filter	Total alpha Total beta Gamma spectr. Sr-90	Weekly Weekly Monthly Quarterly	Cs-137 (gamma spectr.) Be-7 (gamma spectr.)	Weekly Weekly
Radioiodines	Continuous sampling Weekly change of activated carbon cartridge	I-131	Weekly		
Soil (Total deposit)	Annual	Total beta Gamma spectr. Sr-90	Annual Annual Annual		
Drinking water	Monthly	Total alpha Total beta Gamma spectr. Sr-90	Monthly Monthly Monthly Quarterly	Total alpha Total beta Residual beta H-3 Sr-90 Cs-137 Natural isotopes	Monthly Monthly Monthly Monthly Monthly Monthly Biennial
Milk	Monthly	Gamma spectr. Sr-90	Monthly Monthly	Sr-90 Cs-137 (gamma spectr.)	Monthly Monthly
Mixed diet	Quarterly			Sr-90 Cs-137 (gamma spectr.)	Quarterly Quarterly

The sampling points closest to the Cofrentes nuclear power plant, within the nation-wide REVIRA monitoring programme, form part of the *Dense Network* and are:

- Environmental Radioactivity Laboratory of the University of Valencia -
  - Valencia, Burjassot: Air, soil and drinking water;
  - Valencia, Ayora: Soil;
- Environmental Radioactivity Laboratory of the *Universidad Politécnica de Valencia* -
  - Valencia, Camino de Vera s/n: Air and drinking water;
- Valencia, Villanueva de Castellón: Soil.

6.5.2.1 *Generalidad de Valencia* – Monitoring programmes

On behalf of CSN the *Generalidad de Valencia* runs two different programmes:

Firstly, the PVRAIN programme which consists on the independent sampling of some 5% to 50%, depending on the sample type, of the operator's PVRA and the analysis of these samples in the two Valencia laboratories.

Secondly, ***Generalidad de Valencia*** **runs the regional part (region of Valencia) of the nation-wide REVIRA programme, which is described below**. This monitoring network is designed to check, in real time at the Cofrentes-NPP, the radiological parameters of the air and water (on-site and off-site).

In order to measure the radiological parameters in the air it has four own automatic stations located in: Cofrentes, Cortes de Pallás, Jalance and Pedrones. The characteristics of these stations are similar to those of the other REA stations of the REVIRA nation-wide network. They are connected to the REA Supervision and Control Centre, located in the Emergencies Room (SALEM) of CSN at Madrid. The SALEM emergency room at CSN-Madrid, comprising the automatic monitoring system of the REA network had already been verified in 2004 (Trillo verification). Therefore it was not included in this verification.

In order to measure the radiological parameters in the water it has two automatic stations located in: Salto de agua de Cofrentes and Embalse de Embarcaderos.

The Agriculture and Fisheries Council of the *Generalidad de Valencia* carries out a programme of control of radioactivity in fresh foods in the *Comunidad de Valencia*, through a contract with the *Universidad Politécnica de Valencia*.

6.5.2.1.1 Network of Automatic REA stations

The automatic REA station network has been established for performing real-time monitoring of atmospheric radioactivity in different zones in Spain. Most of the CSN-managed network stations are located in measurement stations of the National Meteorology Institute and are connected through the switched telephone network to a supervision and control centre located in the CSN headquarters. Table 5 shows the parameters monitored by the automatic stations.

Table 5: On-line monitoring network parameters

Radiological Data	Meteorological Data
Gross alpha activity Gross beta activity I-131 Rn-222 Gamma dose rate	Wind velocity Wind direction Air temperature Air humidity Rain intensity Air pressure

The network of automatic measuring stations is made up of 25 stations spread throughout Spain and one in Portugal (Penhas Douradas). In addition, under specific agreements with the autonomous administrations responsible for these networks, CSN has integrated stations in the *Valencia*, *Catalunia*, *Pays Vasco* and *Extremadura* networks into the REA management and operation system.

Each station in the network has instrumentation to measure the gamma dose rate and concentrations of radon, radio-iodine and alpha and beta emitters in air. The stations take measurements continuously and the information obtained is received and analysed in the REA Supervision and Control Centre, located in the Emergencies Room (SALEM) of CSN.

By agreement between the *Instituto Nacional de Meteorología* [National Meteorology Institute] (INM) and CSN, the REA stations are located next to automatic INM stations, sharing the communications system with these, with the exception of the REA stations in Madrid, located in CIEMAT, and in Penhas Douradas (Portugal).

CSN's web site provides information on the daily average dose rate value and the average dose rate value for the previous thirty days at each REA station, as well as a historical file of the same data.

The characteristics of the equipment making up the REA-Valencia are:

A **measurement of ambient gamma dose rate in air** is obtained using double chamber Geiger-Müller probes (measuring range 10^{-2}-10^{7} μSv/h).

Measurement of aerosol activity: The equipment consists of a *Berthold BAI 9100-D* device with a ZnS(Ag) scintillation detector which, through a system of pseudo-coincidence, permits artificial radioactive aerosols to be measured in the presence of natural radioactivity. Filter material is glass fibre. The devices provide information on α, β and radon activity. The measuring range for alpha and beta activity is 0.2 to 0.5x10^{7} Bq/m^{3}.

Measurement of radioiodine in air: Using a *Berthold BAI-9103* monitor, gaseous iodine is adsorbed on an activated carbon filter. Gamma emissions are analysed by a NaI(Tl) detector, mono-channel, fixed at the energy of I-131, symmetrically paired with a second channel which permits a dynamic background subtraction. The measuring range is 0.5 to 10^{7} Bq/m^{3}.

All the above described systems are designed to work in the presence of high radiation fields, with the detectors, except the GM probes, being protected by lead shields of up to 5 cm.

The monitors installed in each station are incorporated into a single piece of equipment, which has its own electronics for processing communication and data dispatch management.

The equipment from each station is connected by switched telephone network, regular subscriber's line, to a central computer installed in the Emergencies Co-ordination Centre (SALEM, in Madrid; verified during the Trillo verification of 2004), a unit which has the appropriate software for archiving and processing the data transmitted by the stations and, in turn, acting as communications manager. This unit also has an alarm function which alerts in the event of the detection of anomalous measurements.

A map indicating the monitoring locations of the telemetric network in the region of Valencia is included in Appendix 7.

Automatic water sampler: The automatic water sampling station (in a container close to the NPP cooling towers outside the fence) consists of a *Berthold* water monitor *BAI 9125* with a NaI(Tl) detector immersed in a cylindrical stainless steel container through which water from the Júcar river reservoir flows. The device is shielded by some 5 cm Pb. Measurement, data logger and data communication electronics are also from *Berthold*. Data transfer to *Generalidad de Valencia* is every 10 minutes.

6.5.2.1.2 Network of REM sampling stations

The sampling station network includes monitoring programmes for the aquatic medium, the atmosphere, soil, drinking water and foodstuffs. An overview map with the stations in the region of Valencia is contained in Appendix 8.

To execute the national programmes, CSN has entered into specific collaboration agreements with the following organisations:

- Civil Works Studies and Experimentation Centre (CEDEX) of the Ministry of Public Works (*Ministerio de Fomento*) which has been carrying out a radiological monitoring of Spain's major rivers since 1978;
- 19 university laboratories, which conduct the sampling programmes on university campuses (among them the *Laboratorio de Radiactividad Ambiental de la Universidad de Valencia* and *Laboratorio de Radiactividad Ambiental de la Universidad Politécnica de Valencia* are included);
- CIEMAT.

CEDEX conducts a programme for monitoring the rivers of the major Spanish hydrographic basins with more than 80 sampling points and the coastal waters. It also provides CSN with the results of radiological controls of drinking water in different areas in the country.

6.5.2.1.2.1 Air samplers

The equipment used in the **dense network** for the collection of samples of dust particulate material operates at aspiration rates between 1.8 and 3 m^3/hour (low volume), with weekly gross alpha and gross beta analysis on each filter, monthly gamma spectrometry analysis and quarterly strontium-90 analysis on all the filters accumulated in each sampling station. Cellulose and in some cases glass fibre filters are used.

The samples corresponding to the **sparse network** are collected using equipment with a high flow rate, the rate of aspiration of which is approximately 900 m^3/hour (high volume), with the filters being analysed by gamma spectrometry on a weekly basis with extended measurements being taken over approximately 72 hours. The filters used are of polypropylene.

The collection of samples is the responsibility of the laboratories, which have the necessary equipment to carry this out. Sampling is carried out in accordance with written procedures which must be adjusted to the requirements established in the agreements.

The analyses are also carried out in accordance with written procedures which guarantee the detection levels required for these programmes.

In the case of gamma spectrometry measurements, the isotopes on which information must be supplied are, as a minimum:

- Natural isotopes: Be-7, K-40, Tl-208, Pb-212, Bi-214 and Pb-214.
- Artificial isotopes: Cr-51, Mn-54, Co-58, Co-60, Fe-59, Zn-65, Nb-95, Zr-95, Ru-103, Ru-106, I-131, Cs-134, Cs-137, Ba-140, La-140 and Ce-144.

The laboratory must also provide information on other isotopes if above the detection limit.

A map with the location of the sampling devices in the region of Valencia can be found in Appendix 8.

6.5.2.1.2.2 Surface water sampling programme

CSN has signed a specific agreement with the *Centro de Estudios y Experimentación de Obras Públicas* (CEDEX), under the Ministry of Public Works to participate in the programme for the radiological monitoring of the waters of all the basins of Spanish rivers which was established by that Body and operational since 1978 and monitoring of coastal waters.

The sampling stations for the continental waters are located along the rivers of the various hydrographic basins, both in zones potentially affected by the nuclear and fuel cycle installations and in areas at a distance from these, currently including more than eighty points. CEDEX undertakes the sampling, with the collaboration of the Hydrographic Confederation's personnel, and analyses the samples.

The collection of the samples is generally manually, with a frequency of collection and analysis at each station which can be quarterly, monthly or fortnightly. In the latter case continuous proportional collection equipment is used.

The determinations made in respect of the samples collected are as follows:

- Gross alpha activity
- Gross beta activity
- Residual beta activity
- Tritium
- Gamma spectrometry

In the area of the Cofrentes nuclear power plant, as part of this monitoring programme, monthly grab samples are taken at four stations:

- Alcalá del Júcar - Júcar
- Cofrentes Abajo - Júcar
- Villatoya - Cabriel
- Picassent - Canal Júcar-Turia

The coastal waters monitoring programme currently includes 15 sampling stations, with quarterly sample collection, with the same analytical determinations being made as for the continental waters' samples.

6.5.2.1.2.3 Drinking water sampling programme

Tap water samples are collected monthly, about 5 l in the dense network and up to 1000 l in the sparse network in order to low the gamma spectrometry detection limit. The determinations made in respect of the samples collected are shown in table 4.

6.5.2.1.2.4 Soil sampling programme

Within an area of one square meter, five samples of 25x25x5 cm each (at each corner and in the middle of the square) are taken. These five samples are pooled in a plastic bag and provided to the laboratory for analyses. If the soil surface does not permit the previously described sampling methodology, the 5 samples can also be taken in one row. Soil sampling at REM sites is performed once per year and is in accordance with the procedure described in a published regulation.

6.5.2.1.2.5 Foodstuffs sampling programme

Milk

Milk sampling is performed under the REM scheme in the provinces or autonomous regions of Cantabria, Léon, Cataluña, Sevilla, La Coruña and Oviedo, but not in the province of Valencia.

Mixed diet

The standard diet sample is collected in the refectories of universities or institutions charged with the programme and it consists of the complete diet of one person over five consecutive days. The sample is prepared leaving solely the comestible parts. [12]

Individual foodstuffs

The *Conselleria de Agricultura y Pesca de la Generalidad Valenciana* runs a programme for the control of radioactivity in fresh foodstuffs in the *Comunidad de Valencia*, through a contract with the *Universidad Politécnica de Valencia*.

The principal types of foodstuffs grown in the area are collected.

Specifically, in the programme carried out in the year 2006, the following foodstuffs were sampled: artichoke, lettuce, orange, mandarin, olives, barley, almond, cauliflower, pear, tomato, peach, cherry, grape, wine, chard, watermelon, rice, potato, honey, apricot, kaki (persimmon), medlar, lemon, pepper,

[12] Up to 2007 mixed diet was only sampled in the sparse network, but in 2008 it has been included in the dense network which includes the two sampling stations of Valencia.

melon. There were 29 sampling points distributed throughout the 14 regions into which the *Comunidad Valenciana* is divided. Sr-90 and gamma spectrometry analysis was carried out on each of the samples.

6.5.2.2 Transmission of monitoring data and records

Monitoring data from the automatic network (REA) are continuously transmitted to CSN and available in the emergency centre SALEM. Data from the REM system are transmitted by e-mail, diskette or telematic system and biannual reports to CSN. Additionally data from the sparse network are transmitted by e-mail as soon as they are available. All of them are stored in the KEEPER data base together with data from environmental radioactivity measurements.

6.5.2.3 Quality assurance arrangements

CSN requires technical documentation to be provided by each of the laboratories participating in the sampling station network (REM). This documentation must include the following:

- A description of sampling, detection and measurement equipment.
- Sampling, analysis and measurement procedures used by the laboratory.
- A quality assurance programme for the measurements made.
- Results of participation in analytical inter-comparison exercises organised by CSN.

Quality systems which integrate the organisation's structure, responsibilities, procedures, processes and resources required for suitably managing quality have been implemented. In 1997 CSN requested also that participants in REM develop quality manuals and programmes for establishing and implementing them.

In order to verify that the established quality assurance programmes are properly enforced, internal controls are introduced into the organisations. Proper external actions are taken, such as comparative inter-laboratory studies and audits. Since 1992, CSN in collaboration with CIEMAT, has been undertaking annual analytical inter-comparison campaigns among Spanish laboratories measuring environmental radioactivity, using samples similar to those analysed in the environmental radiological monitoring programmes.

6.5.3 Mobile Measurement Systems

CSN has mobile environmental radiological monitoring units for use in cases of an emergency, through agreements signed with:

- CIEMAT
- Junta and University of Extremadura

6.6 RAR NETWORK

The RAR network is an emergency network operated by the Ministry of the Interior. In the Valencia region it has 108 measuring stations. An overview over the stations in the Valencia area is contained in Appendix 9.

7 LABORATORIES PARTICIPATING IN THE (DISCHARGES AND ENVIRONMENTAL) SURVEILLANCE OF THE NPP SITE AND IN THE NATIONAL REVIRA NETWORK

The following analytical laboratories are involved:

- The NPP's radio-chemical and effluent laboratories;
- The Environmental Measurements analytical laboratory, located in Medina de Pomar (Burgos) which undertakes the PVRA [Environmental Radiological Monitoring Programme];
- CIEMAT (*Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas. Laboratorio de radiactividad ambiental* [Centre for Energy, Environmental and Technological Research. Environmental Radioactivity Laboratory]), Madrid, which undertakes the quality control of the PVRA;
- *Laboratorio de Radiactividad Ambiental* [Environmental Radioactivity Laboratory] of the *Universidad de Valencia* [University of Valencia], with regard to the regulator's PVRAIN and REVIRA programmes;
- *Laboratorio de Radiactividad Ambiental* [Environmental Radioactivity Laboratory] of the *Universidad Politécnica de* Valencia, *Servicio de Radiaciones* [Radiation Section], *Departamento. de Ingeniería Química y Nuclear* [Chemical and Nuclear Engineering Department], with regard to the regulator's PVRAIN and REVIRA programmes;
- CEDEX (*Centro de Estudios y Experimentación de Obras Públicas del Ministerio de Fomento* [Centre for Studies and Testing of Public Works of the Ministry of Public Works]).

7.1 THE OPERATOR'S LABORATORIES FOR DISCHARGE SAMPLES

Iberdrola operates three laboratories on the site of the NPP that are dealing with discharge samples, the 'hot' laboratory (located within the controlled area), the 'cool' laboratory (located in the water treatment and chemical laboratory building) and the 'water' laboratory (located in the vicinity of the final discharge ponds). The latter only deals with low activity samples, mostly from the intermediary discharge tanks and the final discharge ponds.

The laboratories are not accredited to ISO 17025 but they follow a very strict QA/QC programme. The laboratory set-up, the devices, the methods and the procedures are kept as similar as possible, which helps in an efficient management. For example, calibration is using the same sources and the same methods; new equipment is first placed in the 'hot' laboratory and the replaced tool is moved to the 'cool' laboratory. Customisation of analysis tools is done by Cofrentes NPP in a similar way for all its laboratories. Files and documentation are generally kept in the 'cool' laboratory (including such for the 'hot' lab) to allow easier access without the restrictions of the NPP's access control system to the controlled area.

7.1.1 The 'Hot' Laboratory

The 'hot' laboratory is located in the controlled area and primarily deals with the NPP's liquid discharges ('MCDE' samples). Due to its higher level of priority at renewal of equipment this lab always receives the best.

Sample receipt and preparation

Samples received are placed in a sample (bottle) holder by the sampling technician. Generally the sampling technician also prepares the sample and starts measurement.

The measuring devices are installed in a counter room; a small adjacent room contains the balances and a microscope.

Gamma spectrometry

The laboratory owns 3 Germanium detectors of 10, 42, and 46% relative efficiency and ca. 2 keV resolution. NIM devices (high voltage, amplifiers etc.) are from *Canberra*, *Silena*, *Ortec*, *Tennelec*,

and *Nuclear Data*. The shields use 15 cm of pre-world war-II steel (one device), or 10 cm Pb with Cd and Cu lining. The PCs (one for each detector) for spectrum management are currently running under *Windows XP*. *Canberra Genie 2000* is used as spectrum acquisition and analysis software.

Alpha / Beta measurement

The laboratory operates a *Berthold LB1026* 1 sample and a *Berthold LB770-2* 10-channel low level counter for (gross) alpha and beta measurements (50 mm diameter planchettes).

LSC

A *Canberra Packard TriCarb 1900TR* with built-in PC is available for measurement of H-3, C-14, Sr-89 and Sr-90.

7.1.2 The 'Cool' Laboratory

The 'cool' laboratory is located in the water treatment and chemical laboratory building; it deals primarily with the stack (L05) samples. Basically the same procedures and types of devices are used as in the 'hot' lab, in particular with regard to calibration, checks, background measurement.

All detector data sheets are available in this lab, as are the procedures, graphic follow-ups; manuals, archiving CD's etc.

Gamma spectrometry

The laboratory operates a *Canberra* HPGe detector with 25% relative efficiency. The shield consists of 5 cm Pb. NIM electronics come from *Nuclear Data*, *Canberra* and *Ortec*.

7.1.3 The 'Water' Laboratory

The 'water' laboratory is located in the Training Centre building, near the final discharge water ponds. It generally analyses samples for the river water authority (samples from the concrete tanks and the ponds) and some very low activity samples.

The laboratory performs gamma spectrometry, total alpha and total beta (after evaporation) and tritium measurements (after distillation).

The laboratory also performs non-radiological analysis of the samples.

Basically the same procedures and types of devices are used as in the 'hot' lab, in particular with regard to calibration, checks, background measurement.

Sample preparation

Sample volume generally is 10 l (plus 1 l for chemistry). Pond samples (1060 ml taken from the original) are evaporated in a *Büchi Rotavapor*® device for concentration to 106 ml. The distillate is used for H-3 analysis (ion exchange and then 10 ml in vial plus 10 ml *Perkin Elmer Ultima Gold*® scintillation cocktail for LSC). Of the concentrate, 100 ml are transferred to 12 cm planchettes and dried for alpha counting, 6 ml to 6 cm planchettes and dried for beta counting.

From the original sample 1000 ml are concentrated to 100 ml for gamma spectrometry.

Gamma spectrometry

The lab operates a 25% relative efficiency HPGe detector with a 10 cm Pb shield that has a 1 mm Cd-Cu liner. NIM electronics is from *Tennelec*, *Ortec*, and *Canberra*. There is only one geometry calibrated (the one for the 100 ml samples). Measuring time for discharge water samples is 1 hour.

Alpha measurements

For alpha activity measurements on the 12 cm planchettes the lab uses 3 *Ortec digiBASE* devices (photomultiplier tubes with integrated detector bias voltage supply, pre-amplifier, and multi-channel analyser for low resolution spectrometry) that are connected to a PC with spectrum acquisition and display software. The laboratory uses a *Scionix* ZnS scintillation detector, reference number: 127 AM 0,1/3-ZNS-PX with the following features: demountable photomultiplier; *Mylar* entrance window; 127 mm scintillation diameter; 0.1 mm height of crystal and 3 inches diameter of photomultiplier. Helium is used to purge radon. The measuring time is 2 hours. Calibration is performed once per year using Am-241, to select the relevant spectral window; the activity calculation programme was developed by the Polytechnic University of Valencia.

Alpha plus beta / beta measurements

For gross activity measurements of tank samples (alpha plus beta) and pond samples (beta) a *Berthold LB-1026* counter using 6 cm diameter planchettes is available. Measuring time is one hour.

LSC

Tritium measurements are done on a *Perkin Elmer TriCarb 3170TR/SL* liquid scintillation counter with spectrum display.

Result calculation

The calculation of the final result of discharge water measurements (with regard to the 'potability' factor) is done on a separate PC with manual input.

7.2 THE OPERATOR'S LABORATORY FOR ENVIRONMENTAL SAMPLES (ENVIRONMENTAL MEASUREMENTS LABORATORY, MEDINA DE POMAR, BURGOS)

This laboratory has already been verified in 2004 (Trillo Art.35 verification visit). Therefore it was not included in this verification. The documentation received from the Spanish authorities in preparation of this verification demonstrated that the laboratory has implemented the 2004 recommendations.

7.3 CIEMAT - *CENTRO DE INVESTIGACIONES ENERGÉTICAS, MEDIOAMBIENTALES Y TECNOLÓGICAS; LABORATORIO DE RADIACTIVIDAD AMBIENTAL* [CENTRE FOR ENERGY, ENVIRONMENTAL AND TECHNOLOGICAL RESEARCH; ENVIRONMENTAL RADIOACTIVITY LABORATORY], MADRID

CIEMAT, the Research Centre for Energy, Environment and Technology, is a public organisation for research and technological development. It works under the Ministry of Education and Science. Its main objectives are to develop alternative energy sources, to find solutions to improve the use of resources and energy generation systems and to solve the problems of the Spanish companies regarding energy and its effects on the environment.

In connection with the Cofrentes NPP, CIEMAT does sample laboratory analysis on a contract basis for the operator (quality control programme). The verification team visited the CIEMAT Environmental radioactivity laboratory during the Trillo verification in 2004. Therefore CIEMAT was not included in this verification programme.

7.4 THE REGULATOR'S LABORATORIES FOR ENVIRONMENTAL SAMPLES STEMMING FROM THE PVRAIN PROGRAMME AND FROM THE NATIONAL ENVIRONMENTAL MONITORING PROGRAMME REVIRA.

CSN contracted the implementation of the PVRAIN and of the REVIRA (region of Valencia) programmes to *Generalidad de Valencia*. In order to undertake the environmental radiological monitoring in the area of the Cofrentes nuclear power plant, independent of the monitoring carried out by the proprietor of the installation, on 27 November 1986 the Nuclear Safety Council (CSN) and the *Generalidad de Valencia* (GV) signed an Agreement of Commissioning of the Performance of Duties.

The laboratories participating under the responsibility of *Generalidad de Valencia* in the PVRAIN and in the REM sampling networks in the area surrounding the Cofrentes Nuclear power plant and in the province of Valencia are:

- Environmental Radioactivity Laboratory of the *Universidad de Valencia*, Research Building.
- Environmental Radioactivity Laboratory of the *Universidad Politécnica de Valencia*, Radiations Section, Department of Chemical and Nuclear Engineering.
- CEDEX, Centre for Public Works Studies and Experimentation of the Ministry of Public Works. (CEDEX was not included in the verification programme.)

7.4.1 Environmental Radioactivity Laboratory of the Polytechnic University of Valencia

The *Laboratorio de Radiactividad Ambiental* of the *Universidad Politécnica de Valencia*, *Servicio de Radiaciones* [Radiation Section], *Dpto. de Ingeniería Química y Nuclear* [Chemical and Nuclear Engineering Department] has been contracted by *Generalidad de Valencia* to perform the measurements of environmental samples from the PVRAIN and by CSN to perform the measurements of environmental samples from the REVIRA-networks. The laboratory handles about 400 samples per year.

The laboratory is in a very advanced state of accreditation. Accreditation according to ISO 17025 is expected within some weeks time.[13] The laboratory personnel consists of a director and three technicians. There is in-house training specific for each work place.

Sample reception and registration, data handling

Samples taken by staff from *Generalidad de Valencia* (PVRAIN) or by its own staff (REM) arrive at the laboratory together with a filled-in sampling sheet.

An internal data base is used for storing and retrieving all sample and measurement related data, as well as partly for data analysis. Samples are kept for one year.

Laboratory equipment

Alpha total

The laboratory operates a ZnS detector from *Canberra*. The counting time for drinking water samples is 3000 to 4500 minutes and for dust particles in aerosol samples 1000 minutes. Calibration is performed once per month using an Am-241 (*AMZ240 Amersham*) standard.

13 The laboratory has got the accreditation in February 2008.

Beta total

An *LB 770-2* 10 channel low level counter from *Berthold* is used for total beta measurements and measurement of Sr-90/Y-90. Calibration is performed once per month using Sr-90 standards from *Amersham* (*SIZ24 Amersham*).

Liquid Scintillation Counting

The laboratory operates one *Packard TriCarb 2550 TR/LL* device, which is only used for measurement of tritium. H-3 standards (*TRY 44 Amersham*) are used for calibration.

Gamma spectrometry

For gamma spectrometry two high purity Germanium detectors are installed, both supplied by *EG&G Ortec* - one GMX type for gamma energies 30 to 2000 keV and one GEM type for gamma energies 50 to 3000 keV. Electronic modules and the *GammaVision*® 5.1 PC based gamma spectrum analysis system come from *Ortec* as well. Calibration is performed with mixed standards (*QCY48 Amersham*). A weekly efficiency control and accuracy control of the width of the peak is performed using a Eu-152 standard. A weekly control of the background is performed also.

Environmental dosimetry

Lithium fluoride TLD dosimeters are used for environmental dosimetry. The dosimeters are exposed for 3 months and read out using a *Thermo 4500* reader from *Thermo Electron Corp.*. Calibration is performed by an authorised laboratory (*INTE-UPC*) using a Cs-137 standard.

Reporting and archiving

The PVRAIN software automatically produces monthly reports; there is a revision process in place prior to sending the reports to CSN.

"Outside installations"

Air sampling

On the roof of the laboratory an old *Eberline G21DX/RAS-1* low volume air sampler is installed, with a flow rate of 10 to 70 litres/minute, using nitrocellulose filters *Millipore AAWP 047 00 08 µm, White*, 47 mm diameter for particulate and a charcoal-cartridge (*Tega 45*) for iodine sampling. Filters are changed once per week.

A *precipitation sampler* and a *TLD device* which are also installed at this site are not part of the Article 35 related installations.

7.4.2 University of Valencia: Environmental Radioactivity Laboratory; research building

Sample reception and preparation

The samples are taken by *Generalidad de Valencia* (PVRAIN) and by its own staff (REM).

Samples are stored in a refrigerator at a temperature between 1 and 5 degrees Celsius.

The Laboratory has a certification (ISO 9001) since 2005, and is waiting for accreditation according to ISO 17025.

Laboratory equipment

Gamma spectroscopy laboratory

The gamma spectroscopy laboratory has three high purity germanium detectors, one of 70% efficiency, one of 40% suitable for low energy measurements, and another, portable one (*EG&G ORTEC, digiDART*) of 30% efficiency. About fifteen measurements are performed per month. The electric power supply is guaranteed, using a UPS system (30 minutes).

Alpha/beta laboratory

The laboratory has one liquid scintillation counter (*Packard 1550 TriCarb*), which is used for alpha and beta activity measurements, as well as an alpha/beta low level counter (*Berthold LB530/LB770*) with 10 measurement chambers and several ZnS detectors for alpha measurement.

Reporting

The laboratory produces (manually) semestrial reports to CSN (REM). It also reports directly to *Generalidad de Valencia* on a trimestrial basis for control purposes, and also via an annual document describing the objectives in the frame of quality control since the laboratory is ISO 9001 certified. The *Generalidad de Valencia* sends the quarterly and annual reports (PVRAIN) to CSN.

"Outside installations"

Air sampling

On the roof of the main building an old *Eberline G21DX/RAS-1* low volume air samplers is installed, with a typical flow rate of 30 m^3 per hour using nitrocellulose filters *Millipore AAWP 047 00 08 µm, White*, 47 mm diameter for particulate and a charcoal-cartridge (*Tega 45*) for iodine sampling. Filters are changed once per week.

8 VERIFICATION ACTIVITIES – RADIOACTIVE DISCHARGES

8.1 INTRODUCTION

The verification included control of the discharge monitoring facilities and the effluent monitoring laboratory of the Cofrentes NPP site in order to verify their adequacy and effectiveness. In addition a spot check on archived data was made in order to verify procedures for data management and archiving.

8.2 GASEOUS DISCHARGES

The team verified that the main stack gaseous discharge monitor and the sampling facilities were operational. It observed sampling of particulates, gaseous iodine, noble gases, tritium and C-14. The team received an explanation of the isokinetic sampling system. The system is heated, insulated and has a condensate sump.

In addition the team visited the control room and was shown all displays and paper recording devices for this monitoring path. The procedure for calibration was described in detail. Calibrations of all process monitors (radiological and non-radiological) are performed by the Maintenance Department – having some 33 staff, working also in shifts – according to an established schedule. Depending on the type of radiation measurement calibration may be in two steps: a simulator producing a current or voltage signal or pulses is used to calibrate the display; the detector itself is calibrated in a separate irradiation room or in the measuring position using a calibrated radiation source.

For aerial discharge monitors the calibration interval is 18 months, for all, low and medium and high dose rate channels; calibration data are stored on computer; two months before the planned calibration date automatically an information is produced by the system ('*aviso*'); in parallel a work order is created under *Iberdrola's SAP* system. If the foreseen date cannot be kept CSN's local inspector has to be informed. Small deviations are accepted but may influence the date of the next calibration.

The team could verify such a calibration demand management on signed printouts.

If a calibration does not lead to satisfactory results the shift supervisor is informed and if necessary the device is repaired. Restrictions and boundary conditions for such cases are defined in the documents.

The team received a copy of relevant procedure documentation. The verification team acknowledges the profound knowledge of the staff involved in the procedures and methods to be applied.

The team acknowledges the measurement of C-14 at the Cofrentes NPP that will become obligatory as of 2008.

Verification does not give rise to recommendations.

8.3 LIQUID DISCHARGES

The verification team visited the following liquid discharge related facilities: automatic gamma monitor, radioactive waste tanks, intermediate concrete tanks, final ponds, release valve cabin.

The team noted that the on-line liquid discharge monitor is a 2" NaI(Tl) detector in a lead shield with the electronics devices close to detector; the system generally is at a stable temperature. At the time of the visit additional lead shield aprons were mounted. These had been used as additional shield during the last NPP outage because contaminated material had been intermediately handled outside. The aprons were removed during the visit. The team observed a pump test. When the discharge pump starts water is taken through the measuring device in a bypass (20 l/min). The measuring signal is transmitted to the control room. If the measurement value is above a preset value the release valve (to the intermediate tanks) automatically closes and an alarm signal is triggered in the control room. Background measurements are performed routinely; the calibration of the system is done using a Cs-137 liquid source (after calibration the liquid goes to the laboratory; the ducts are cleaned with distilled water).

With regard to sampling from the radioactive waste tanks the team received full documentation and information. When a tank is full the contents are stirred for 2 hours, then 1 litre is taken manually through the sampling line and is transferred to the laboratory for analysis. Sampling follows a complex procedure: A 1 litre sample is taken for checking discharge limits; a second 1 litre sample is taken for composite samples (3 ml per m^3 discharge volume go to a monthly composite sample for measuring alpha emitters and H-3; 10 ml per m^3 discharged go to a quarterly composite sample for measuring Sr-89 and Sr-90). The local CSN inspector occasionally witnesses the sampling. If the measurements show agreement with the given limits, the discharge to one of the intermediate tanks is performed. Currently there are some 10 to 30 discharges per month.

The team was shown the sampling technique for the open concrete tanks: Before discharging to one of the ponds samples are taken (no stirring) at 4 levels. The mechanism for lowering the sampling device to the intended depths is operated manually from outside. The samples go to the water laboratory for analysis. If the result is acceptable valves are opened and the discharge to one of the ponds is started (flow by gravity).

The verification team visited the two discharge ponds consisting of large concrete basins. The method of sampling before discharge was explained to the team: sampling takes place in the 4 corners at 4 levels using a special gliding device. The samples are transferred for measurement to the water laboratory. Part of the samples has to be stored for control purposes. If the values are acceptable the local representative of the water authority unlocks the discharge valve that is situated in a key-locked

cabin. The emptying of a pond takes approximately 40 hours. Formerly a faster system (6 hours) had been used which caused problems with regard to 'conventional' pollutants. The new system operates in a small bypass (both sides having locked valves). All discharge is by gravity. Since a considerable time only one of the ponds is used because the volume of discharges is rather low. The ponds are cleaned every two years, the cleaning wastes going back to the NPP's waste treatment facility.

Verification does not give rise to recommendations.

8.4 COFRENTES NPP EFFLUENT LABORATORIES

8.4.1 Introduction

The effluent laboratories at the Cofrentes NPP perform the analysis of the samples collected from the liquid and gaseous discharge systems. There is no system for parallel analysis, but CSN can perform spot analysis on selected samples.

The verification team visited the laboratories where it checked:

- The presence of working instructions (sample management).
- The adequacy of measurement systems, including calibration and quality control procedures.
- Document control procedures (data management and filing systems).

The laboratories do not have ISO 17025 accreditation however, the QA/QC system closely follows according procedures. In particular, the laboratories participate in international inter-comparison exercises co-ordinated by CIEMAT as part of *Iberdrola*'s quality control programme. Foreign NPPs are also part of the programme. The verification team was informed about the intercomparison exercises NPP Cofrentes laboratories participated in since 1990. Since 2000 *UNESA* (The Spanish Association of Electrical Industry) takes part in organising these exercises.

The verification team was informed about the analogous set-up of the laboratories with a view to simplify and accelerate performance of tasks.

The personal basis for the laboratories consists in 10 (chemical) analysts, 4 supervisors and 1 deputy (department) head. All involved staff has corresponding professional qualification and training. Technicians are working either as 'shift' or as 'office' technicians in the labs; they rotate between tasks. Normally the analyst that takes the samples also makes the analysis. This could lead to a break in the chain of custody if the analyst is not available. However, to avoid confusion, if a sample is not yet finished with measurement at shift change, the analyst leaves a remark in a logbook.

Quality control procedures for all equipment (calibration, tests) are centrally stored and available at all laboratory working places.

Currently, the NPP does not operate a laboratory information management system that would cover all stages from sampling to measurement and validation and that also could include automatic data transfer from measuring devices etc.

All measurement results are validated and then stored in a data base (main results in the 'MCDE' part; a local *EXCEL* data base is set-up in the 'water' laboratory).

Calibrations for all three labs are centrally organised and follow the same method. The originals of source certificates are with the Radiation Protection Group, but copies are locally available. Only *Amersham* (UKAS certified) sources are used; the individual standards are produced at Cofrentes. For gamma spectrometry the mixed radionuclide source *QCY.48* has been purchased (altogether 7 geometries for 5 detectors; however, not all detectors are calibrated for all geometries). Beta calibration is performed with Sr-90, alpha calibration with Am-241.

For gamma spectrometry all laboratories use *Canberra Genie 2000* software albeit without its QM option. For radionuclides with several peaks the analysis programme uses the most prominent one with the highest yield (lowest uncertainty); it does not calculate weighted averages.

With regard to measuring and analysis equipment, service with *Canberra* is not organised on a service contract basis, but when needed. Service with *Berthold* is organised via its Spanish representative – *LAMSE S.L.*

> *The verification team recommends exploring the possibilities of introducing a laboratory information management system. This would allow access to all relevant measurement data within a computerized network and thus give access to important information to the laboratory itself as well as to other relevant organisational structures. This recommendation is generally valid for the NPP's on-site laboratories.*

8.4.2 NPP Cofrentes 'Hot' Laboratory

The 'hot' laboratory primarily deals with the NPP's liquid discharges ('MCDE' samples).

The verification team visited the counter room which currently is under reorganisation (separating computers to avoid excessive heat) and the adjoining sample preparation rooms.

The team notes that material to be counted is kept in a shielded location (5 cm Pb bricks); samples, e.g. bottles for liquids, are well labelled.

There is no specific UPS; however electric power comes from the NPP's secured emergency electric supply system and a voltage stabiliser is available.

Radioactive sources (for calibration) are stored in a locked room.

Sample reception and preparation:

All equipment is kept in good conditions. The balances available carry gauging labels showing that they are controlled once per year (*Mettler*, Toledo).

Gamma spectrometry

The verification team was informed that one of the three HPGe detectors currently was out of order due to loss of vacuum. The laboratory uses sample centering devices to have reproducible counting geometries and plastic protection to avoid detector contamination. There are intentions to change the PC operating system.

LN_2 filling is twice per week, using an outside tank, which is filled on call, as source (the manual is available on site).

Calibrations (well marked on the measuring devices) are performed once per year (for all efficiencies). Energy and resolution checks are done daily. The team was informed that performing such checks routinely has led to early detection of the above mentioned detector problem. Efficiency checks are performed weekly (using a dedicated standard source). Background measurements are done daily during night; the measurement is valid for the next day. Background files are archived to allow later re-analysis of a gamma spectrum with the correct background of the measurement day.

The NPP does not use *Canberra's Genie 2000* QC programme but has its own programme and data base (*Oracle*) for QC purposes.

Alpha / Beta

The devices are basically used for gross activity measurements. At the time of the verification visit both were measuring background (measuring time 1 hour). Calibration is done annually (the last one having been performed the day before the visit); calibration data are registered on labels on the devices.

The laboratory has a central counting gas supply.

Currently the measurement results are printed out and manually input in a PC to calculate activities.

LSC

Calibration sources come from Amersham; background water is from the NPP (the team noted that there is no specific need for extremely low level water); the laboratory uses standard 20 ml vials. All procedures are locally available in copy.

Reporting and Archiving

All data are given to the supervisor who introduces them into the data base. The chemical analyst informs the supervisor immediately when a value is above a given limit.

Archiving of samples is well organised, e.g. for filters from the main stack the archiving period is 3 months.

The team performed two sample measurement tracings. One concerned a sample from one of the laundry tanks *'Destillado Detergente B'* from 19.10.07. Although the laboratory does not operate a suitable laboratory information management system, since the gamma spectrometry file name contains the date of measurement (11.11.07) the spectrum could be found. For the second sample (discharge date 27 March 2006) the spectrum was already archived on a CD which was stored in the 'cool' lab and thus not immediately accessible. The team notes that a sophisticated laboratory information management system could have avoided such a difficulty.

Documentation and logs were available in the laboratory, detector data sheets are kept in the 'cool' lab for easier access.

> *The verification team notes that for some measurements manual input of raw data into a calculation programme is necessary to achieve the final result. It suggests replacing such equipment at the earliest convenience with devices that allow interfacing to a computer with an appropriate calculation and data management tool. This could avoid any inputting errors.*
>
> *The team encourages exploring the consequences of any changes of the PC operating system for gamma spectrometry before implementation, in particular performing extensive tests with regard to user surface and system performance.*

8.4.3 NPP Cofrentes 'Cool' Laboratory

Since the NPP's laboratories are set-up and operated in a very similar way, this part of the verification report focuses on items that differ from the other laboratories. The general reflections of the verification team and the corresponding recommendations are given above (see 'hot' laboratory).

The verification team performed the tracing that could not be accomplished in the 'hot' lab using the archive CD (3 copies are made for archiving purposes). Analysis of the original spectrum and comparison with the measurement log and the report showed agreement. The measurement log is electronic and on paper (signed with initials); if a measurement is still pending it is finalized at shift change in the morning. A daily log of work of the work of the chemistry lab exists as well.

With the exception of the recommendations and remarks mentioned above the verification does not give rise to other recommendations or remarks.

8.4.4 NPP Cofrentes 'Water' Laboratory

Since the NPP's laboratories are set-up and operated in a very similar way, this part of the verification report focuses on items that differ from the other laboratories. The general reflections of the verification team and the corresponding recommendations are given above (see 'hot' laboratory).

The verification team was assured personally by the representative of the water authority that all decisions with regard to releases to the Júcar river are made and the unlocking of the relevant locks before discharge is done by him.

The team noted that for the *ORTEC* alpha measuring system calibration labels were attached to the device. Procedures, logs etc. were available in the laboratory.

Discharge water samples (ca. 1 litre each) are kept for 5 years as a sample archive: 1 for the NPP, 1 for the river water authority, 1 for the CEDEX lab (i.e. for CSN) and 1 for the Polytechnic University of Valencia. The archive is kept very orderly; the samples are sealed by the representative of the water authority. If they are not used for control measurements they are disposed of.

With the exception of the recommendations and remarks mentioned above the verification does not give rise to other recommendations or remarks.

9 VERIFICATION ACTIVITIES – ENVIRONMENTAL MONITORING PROGRAMMES

9.1 INTRODUCTION

The verification team visited sampling sites of the PVRA and PVRAIN programmes at the Cofrentes NPP site and of the REVIRA programme in the province of Valencia. The team verified also the Environmental Radioactivity Laboratory of the University of Valencia, Research Building, and the Environmental Radioactivity Laboratory of the Polytechnic University of Valencia, Radiation Section, Chemical and Nuclear Engineering Department, which, under contract with *Generalidad de Valencia*, handle the samples stemming from the PVRAIN and from the REVIRA programmes. In addition, spot checks on archived data were made in both laboratories in order to verify the procedures for data management and archiving.

The Environmental Measurements analytical laboratory (LMA), located in Medina de Pomar (Burgos), and CIEMAT at Madrid were visited at the occasion of the "Trillo"-NPP verification in 2004 and thus not verified during this verification.

9.2 SAMPLING AND DIRECT MEASUREMENTS AT THE COFRENTES NPP SITE AND SURROUNDINGS

The verification team visited the following sampling and measurement sites:

9.2.1 Cofrentes NPP: ON-SITE

9.2.1.1 Air sampling at the meteorological station site

At this station three different low volume air samplers were installed. One was allocated to CIEMAT's quality control programme (Type: *RAdēCO*, New England, Model *HD 28/B*; quarterly samples); one of the *Generalidad de Valencia*, allocated to the PVRAIN programme (Type: *F&J Specialty Products Inc.*, Florida, Model *DF28BE*) which was at the moment of verification in a test phase and a third one allocated to the NPP-operator's PVRA programme (Type: *F&J Specialty Products* Model *FJ28BE*) with a typical flow rate of 10 to 100 litres per minute.

The team witnessed the weekly change of the filter (nitrocellulose filter: *Millipore AAWP 047 00 08 µm, White*, 47 mm diameter) and of the iodine charcoal cartridge (*Tega 45*) of the operator's device. All samplers were mounted in a common metal housing, situated at about 2 m above ground. All details of sampling were registered in a book by the person performing the sampling.

Verification does not give rise to recommendations.

9.2.1.2 Precipitation sampling at the meteorological station site

A precipitation sampler (belonging to the operator) of 1x1 m and a height of 5 cm was situated on the roof of the housing of the air samplers. It was connected to a plastic bottle of ~10 litres situated inside the (closed) housing. Sampling is monthly.

Aside of the housing of the air samplers another precipitation sampler was located (circular; diameter ~30 cm). This one belongs to *Generalidad de Valencia* and is part of the independent control programme of the regulator (PVRAIN).

Verification does not give rise to recommendations.

9.2.1.3 Long-time TLD dose measurement at the meteorological station site

The team witnessed the presence of a TLD fixed inside the (sheet metal) housing of the air samplers. This TLD is changed every three month.

The verification team suggests estimating any shielding effects by the construction material of the housing and fixing the TLDs outside the housing if deemed useful.

9.2.1.4 Soil sampling at Fuente Grande

The verification team witnessed a demonstration of soil sampling by the operator. Within an area of one square meter, the operator takes five samples of 15x15x5cm each (at each corner and in the middle of the square) using a metal frame. These five samples are pooled in a plastic bag and sent for analyses to LMA lab. If the soil surface does not permit the previously described sampling methodology, the 5 samples can also be taken in one row. Soil sampling at this site is performed once per year.

Verification does not give rise to recommendations.

9.2.1.5 Spring water sampling at Fuente Grande

One litre of spring water continuously flowing out of the mountain through a plastic pipe is sampled every three months by the operator. The verification team was shown the sampling location.

Verification does not give rise to recommendations.

9.2.2 Cofrentes NPP "OFF-SITE"

9.2.2.1 Casas de Soto ambient gamma dose rate (TLD)

The team witnessed the presence of a TLD (Lithium fluoride thermoluminescent dosimeter) fixed at an electricity mast at a height of 3 m above ground. This TLD is changed every three months.

Verification does not give rise to recommendations.

9.2.2.2 Cortes de Pallas (drinking water)

The team was shown the sampling location for drinking water (a public fountain situated at the public place close to the village church). Sampling is performed every two weeks.

Verification does not give rise to recommendations.

9.2.2.3 Cofrentes, Presa Embarcaderos

At this site, surface water, sediments, indicator organisms (plants) and fish are sampled. The verification team was shown the sampling site.

9.2.2.3.1 Surface water

Every three months 3 litres of surface water are sampled.

9.2.2.3.2 Sediments

Twice a year, a sample of 5 kg of sediments is taken close to the border of the lake, by using a shovel.

9.2.2.3.3 Indicator organisms

Twice a year, indicator organisms (rush, reed and "typha") are sampled along the border of the lake.

9.2.2.3.4 Fish

Twice a year, fish from the lake are caught around of this sampling place (typically: pike, carp, pike-perch or sheatfish).

Verification does not give rise to recommendations.

9.2.2.4 Cofrentes village sampling sites

9.2.2.4.1 Drinking water

The team witnessed the sampling of 3 litres of drinking water from the public fountain by the operator. The sampling is done every two weeks.

Verification does not give rise to recommendations.

9.2.2.4.2 Air sampling

At this station two different low volume air samplers were installed, inside of a closed metal housing suspended at about 3 m above ground on the side of an electricity house of *Iberdrola*. One of the samplers was allocated to CIEMAT's quality control programme (type: *RAdēCO*, New England, Model *HD 28/B*); the other one belonged to the NPP-operator's PVRA programme (type: *F&J Specialty Products Inc.*, Florida, Model *FJ28BE*) with a typical flow rate of 10 to 100 litres per minute.

The team witnessed the weekly change of the particle filter (nitrocellulose filter: *Millipore AAWP 047 00 08 µm, White*, 47 mm diameter) and of the iodine charcoal-cartridge (*Tega 45*) by the operator. All details of sampling were registered in a book by the person performing the sampling.

Verification does not give rise to recommendations.

9.2.2.4.3 Precipitation sampling

On the roof of the housing of the air samplers, a precipitation sampler (run by the operator) of 1x1 m and a height of 5 cm was situated. It was connected to a container of ~10 litres situated inside the (closed) housing. Also on the roof of the housing of the air samplers another precipitation sampler was located (circular; diameter ~ 30 cm) connected to another ten litre plastic bottle located also inside of the housing. This one belongs to *Generalidad de Valencia* and is part of the independent control programme of the regulator (PVRAIN).

Verification does not give rise to recommendations.

9.2.2.4.4 Soil sampling

The verification team was explained that soil sampling is performed at this site in an identical way as at the "Fuente Grande" site. Within an area of one square meter, the operator takes five samples of 15x15x5 cm each (at each corner and in the middle of the square). These five samples are pooled in a plastic bag and sent for analyses to the LMA lab. If the soil surface does not permit the previously described sampling methodology, the 5 samples can also be taken in one row. Soil sampling at this site is performed once per year.

The verification team witnessed the location of this soil sampling site of the operator.

Verification does not give rise to recommendations.

9.2.2.4.5 Meat and egg sampling

Chicken, rabbit, wild boar, moufflon or sheep meat is sampled as appropriate twice per year in the Cofrentes area by the operator; eggs are sampled twice per year.

9.2.2.4.6 Ambient gamma dose (TLD)

The team witnessed the presence of a TLD fixed inside the sheet metal housing of the air samplers at a height of about 3 m above ground. This device is changed every three months.

The verification team suggests estimating any shielding effects by the construction material of the housing and fixing the TLDs outside the housing if deemed useful.

9.2.2.5 Teresa de Cofrentes: Goat milk sampling

This site for goats' milk sampling is located some 15 km SW of the NPP, near the village of Teresa de Cofrentes. The herd of goats (some 500 goats producing about 600 litres of milk per day) was visited by the verification team. These goats are milked but also raised for meat production. The herdsman takes the goats' milk in the stables. The milk is stored in a stainless steel tank of about 1000 litres. Before taking a sample of 5 litres from the tank to be measured at the LMA laboratory, the milk is stirred for some minutes.

The herd is fed on the surrounding pastures or in winter by locally grown hay and grains. The frequency for sampling depends on the lactation periods of the goats. Generally from April to September sampling is biweekly and from October to March monthly.

The sample is mixed with NaOH before shipping to the LMA laboratory and cooled during transport.

Verification does not give rise to recommendations.

9.2.2.6 Jarafuel sampling site

9.2.2.6.1 Air sampling

At this station two different low volume air samplers were installed, inside of a closed metal housing suspended at about 3 m above ground on the side of an electricity house of *Iberdrola*. One of the samplers was allocated to CIEMAT's quality control programme (Type: *RAdēCO*, New England, Model *HD 28/B*); the other one belonged to the NPP-operator's PVRA programme (Type: *F&J Specialty Products Inc.*, Florida, Model *FJ28BE*) with a typical flow rate of 10 to 100 litres per minute.

The team witnessed the weekly change of the particle filter (nitrocellulose filter: *Millipore AAWP 047 00 08 µm, White*, 47 mm diameter) and of the iodine charcoal-cartridge (*Tega 45*) by the operator. All details of sampling were registered in a book by the person performing the sampling.

Verification does not give rise to recommendations.

9.2.2.6.2 Precipitation sampling

On the roof of the housing of the air samplers, a precipitation sampler (run by the NPP operator) of 1x1 m and a height of 5 cm was situated. It was connected to a container of ~10 litres situated inside the (closed) housing.

Also on the roof of the housing of the air samplers another precipitation sampler was located (circular; diameter ~ 30 cm) connected to another ten litre plastic bottle located inside of the housing. This one belongs to *Generalidad de Valencia* and is part of the independent control programme of the regulator (PVRAIN).

Verification does not give rise to recommendations.

9.2.2.6.3 Ambient gamma dose (TLD)

The team witnessed the presence of a TLD fixed inside the housing of the air samplers at a height of about 3 m above ground. This device is changed every three months.

The verification team suggests estimating any shielding effects by the construction material of the housing and fixing the TLDs outside the housing if deemed useful.

9.2.2.6.4 Soil sampling

The verification team was explained that soil sampling is performed at this site in an identical way then at the "Fuente Grande" site. The verification team witnessed the location of this soil sampling site of the operator.

Verification does not give rise to recommendations.

9.2.2.7 Sampling site for vegetables, and fruits located close to the Cofrentes NPP (at ~ 1 km)

This site where vegetable and fruit samples are taken is situated close to the Cofrentes NPP. The site contains a small field with various patches of vegetables, peach, olive trees and almond trees. The garden is irrigated with water from the lake. Samples consist of seasonal vegetables and fruits.

The verification team visited the location of this sampling site.

Verification does not give rise to recommendations.

9.3 NPP EMERGENCY PREPAREDNESS STATION (CLOSE TO FUENTE GRANDE; WITHIN THE FENCED AREA; NOT ARTICLE 35)

Emergency preparedness not being an Article 35 topic, the verification team would just like to mention that it noticed that the gamma probe was mounted inside of the concrete built housing of the sampling and measurement devices (air sampler with particle filter and iodine cartridge and gamma dose rate).

The verification team would like to point to the considerable shielding effect due to the rather thick concrete construction.

9.4 REVIRA PROGRAMME (REA, REM NETWORKS)

9.4.1 REA automatic stations

9.4.1.1 Cortes de Pallas

This is one of the four automatic REA stations belonging to *Generalidad de Valencia*. The team got detailed explanations on the different elements and the functioning of the REA station.

CSN has a service contract with an independent company (*SIAC*) for the maintenance of the REA stations. A complete revision of the stations is performed by *SIAC* every four months. Once per year a re-calibration is performed using standard sources. In addition the functioning of the four REA stations is checked 60 times per year.

The team visited the station and concerning dose rate, witnessed that two Geiger Müller probes were mounted on the wall of the building, aside of the edge of the (slightly pitched) roof, approximately 8 m above ground. One device belongs to the RAR and the other one to the REA network.

Concerning the automatic air sampling part of the station the team was explained that:

After passing through the automatically moved particle filter the sampled air passes a heater before going to the iodine filter (charcoal cartridge). The charcoal cartridge is changed once per month. A complete revision is done every 4 months. Once a year, a calibration and verification of the sensors (parameters) is performed.

In case the facility is out of electricity, only gamma dose rate continues running powered by a battery (8 hours backup time).

The data are sent twice a day to the Emergency Center of the *Generalidad de Valencia*, and every hour to the Emergency room of CSN in Madrid.

The verification team suggests discussing the installation of the ambient dose rate probes (i.e.: the possibility to install the probes at one meter above soil or above a flat surface without any obstacles).

9.4.1.2 Cofrentes town hall

The team verified the automatic REA station of *Generalidad de Valencia* station that is located in the building of the Cofrentes town hall together with an automatic meteorological station and noticed that:

Two Geiger Müller probes were mounted on the edge of the (slightly pitched) roof of the town hall, the RAR probe at one metre above a flat wall and the REA probe directly sitting on this wall.

The team witnessed a demonstration of the computer programme of the data centre of *Generalidad de Valencia* on a "note book". Data of the different REA stations could be visualised graphically on the PC. Actual values could be checked.

The verification team suggests discussing the installation of these probes (i.e.: the possibility to install the probes at one meter above soil or above a flat surface without any obstacles).

9.4.1.3 Automatic REA-water monitoring station (situated close to the cooling towers at 100 m from the fenced area of the NPP)

The team verified this automatic water measuring device *Berthold* "Water-monitor *BAI 9125*" (NaI(Tl) detector plus data logger) situated inside of a fenced and locked metal housing. The water from the lake is pumped through the device. Measurement values are transmitted every 10 minutes to *Generalidad de Valencia* and transferred from there once daily to CSN Madrid.

Verification does not give rise to recommendations.

9.4.2 REM sampling sites

9.4.2.1 Júcar river (river water sampling): Picassent – Canal Júcar-Turia

The team witnessed the sampling of 5 litres of water from the canal in presence of a member of the "river water authority" *(Comisaría de Aguas del Confederación Hidrographica del Júcar)*, that reports to the Ministry of Environment. There is an annual report for the Júcar river water quality.

The team witnessed the sealing of the sample bottle with a seal of the Confederation. The bottle was also provided with a label containing all sampling data (temperature of water, 15.8°C this day; name of sampling person; exact location, date etc.). Water sampling follows a protocol valid for all surface waters under control of the river authority. One sample is sent each month for analysis to the laboratory of CEDEX in Madrid. In case of an emergency, a sample is sent every 48 hours. An automatic station to measure pH, temperature, nitrate concentration, flow rate etc., is situated upstream of the sampling point.

Verification does not give rise to recommendations.

9.4.2.2 REM network sampling at the Environmental Radioactivity Laboratory of the Polytechnic University of Valencia.

9.4.2.2.1 Soil sampling

The verification team was explained the soil sampling as performed by staff from the laboratory at Villanueva de Castellón. Within an area of one square meter, five samples of 25x25x5 cm each (at each corner and in the middle of the square) are taken. These five samples are pooled in a plastic bag and measured in the laboratory. Soil sampling at this site is performed once per year.

Verification does not give rise to recommendations.

9.4.2.2.2 Air sampler

The team witnessed the existence and the functioning of the *Eberline* air sampler. The change of the particle filter (nitrocellulose filter: *Millipore AAWP 047 00, 08 µm, White*, 47 mm diameter) and of the iodine charcoal-cartridge was not performed during the verification. Both are changed once per week by staff from the laboratory.

Verification does not give rise to recommendations.

9.4.2.3 REM network sampling at the Environmental Radioactivity Laboratory of the University of Valencia.

9.4.2.3.1 Air sampler

The team witnessed the existence and the functioning of the *Eberline* air sampler. The change of the particle filter (nitrocellulose filter: *Millipore AAWP 047 00, 08 µm, White*, 47 mm diameter) and of the iodine charcoal-cartridge was not performed during the verification. Both are changed once per week by staff from the laboratory.

Verification does not give rise to recommendations.

9.5 RAR NETWORK

For the RAR network the team verified the stations in Cortes de Pallas and in Cullera as well as the regional data centre in Valencia.

9.5.1 Cortes de Pallas

The verification team witnessed the existence of an RAR station of the Civil Protection in the same room where the automatic REA Station is located.

The team visited the station and concerning dose rate, witnessed that two Geiger Müller probes were mounted on the wall of the building, aside of the edge of the (slightly pitched) roof, approximately 8 m above ground, one belonging to the RAR and the other one to the REA network.

The verification team suggests discussing the installation of these probes (i.e.: the possibility to install the probes at one meter above soil or above a flat surface without any obstacles).

9.5.2 Cullera

The station is located inside of the building of the Civil Protection (*Guardia Civil*) of Cullera. Data are transmitted every night to the regional data centre in Valencia located in Valencia. In case of an "event", an alarm is triggered and sent once per minute to the regional centre until acknowledgement. The alarm level is 0.575 μSv/h.

Verification does not give rise to recommendations.

9.5.3 Valencia regional data centre of the RAR network.

The verification team visited the local data centre at *Delegación del Gobierno de la Comunidad Valenciana* in Valencia and witnessed a demonstration of the database system. Every night, the data centre automatically calls all stations for data transmission. The stations which are not answering are marked "white" on the computer screen, those transmitting data are marked "blue" and those out of function are marked "black" by the system. If a station reports a value above 0.575 μSv/h, an alarm is triggered every minute. The data base permits checking of data for all stations in real time, but also at a certain date in the past.

The regional data centre can ask for data transmission every 10 minutes.

Monthly and yearly reports are produced by the centre and sent to the general directorate of Civil Protection in Madrid as well as to the Civil Protection authorities of all three provinces of Valencia (Castellón, Alicante and Valencia). All monthly reports are archived.

Verification does not give rise to recommendations.

9.6 LABORATORY MEASUREMENTS:

9.6.1 Environmental Radioactivity Laboratory of the Polytechnic University of Valencia

The verification team visited this environmental radioactivity measuring laboratory, which has been contracted for analysis of environmental samples from PVRAIN and the REVIRA-network.

Sample reception and registration, data handling

The verification team found the procedures for sample registration and storage well documented and in order. The team witnessed that samples were registered upon arrival receiving special sample codes.

The team was informed that the samples are stored for measurements on a shelf. Those marked with a red point have to be analysed quickly. After measurement they are (if not destroyed for measurement) archived and stored for at least one year after the running year.

Verification does not give rise to recommendations.

Analysis procedures and equipment, QA

The laboratory is in an advanced state of accreditation according to ISO 17025 (see footnote 13).

The verification team had a close look at various sample treatment methods, all very well documented on paper.

Background measurements for gamma spectrometry are done weekly, efficiency calibration and width of the peak accuracy checks are performed weekly using a Eu-152 source. Marinelli beakers are used

for soil, flasks for liquid samples. All geometries used are efficiency calibrated using certified standards. Specific checks on energy, detector resolution and efficiency are done ex post (via sample analysis, e.g. using the K-40 and Pb-214 peaks for energy checks). If a peak shift occurs, a re-calibration with a Eu-152 source is performed. Samples are measured for 60 000 seconds.

Verification does not give rise to recommendations. The team encourages the ongoing accreditation process.

Archiving and Reporting

The verification team witnessed that all sample registration and measurement data are archived, both, on paper as well as on PC. Every week a security copy is generated on a CD-ROM. All calibration data are stored for an eventually necessary re-calculation at a later re-measurement.

The verification team performed the tracing of a drinking water sample from 27 May 2004 (inclusive gamma spectrum, gamma analysis and report) and found everything complete and coherent.

Verification does not give rise to recommendations.

General technical matters and procedures

Electric power in the counting room is guaranteed by the use of a UPS.

The verification team found that the equipment in the laboratory was in good shape. Sample treatment, measurement, calibration and checking procedures were available and at hand. The involved personnel were well aware of the tasks and the procedures to follow and generally had good knowledge of the background to the analysis methods applied.

The verification team noted that the procedures for the various working areas are comprehensive and generally stored close to the workplace. Copies are with the personnel performing the work.

Verification does not give rise to recommendations.

9.6.2 University of Valencia: Environmental Radioactivity Laboratory; research building

Sample reception and preparation

The verification team visited the analytical laboratory of the University of Valencia. It verified the sample registration and preparation. The samples are tagged with unique identifiers upon their arrival in the sample registration room where they are registered.

The team checked the sample register book and noticed that samples are correctly labelled. The registration information includes data on sample type, sampling period, date and time of sample arrival, sampling location, sample volume (or mass) etc..

Written sample preparation procedures were available and all sample preparation steps are documented in the laboratory logbook, which contains also the measurement results.

The verification team could check procedures for tritium measurements.

Samples are directed to the sample preparation unit and are treated physically and/or chemically. The parameters and results of the treatment are added to the sample registration document. After that, the sample goes to the radioactivity measurements department.

Verification does not give rise to recommendations.

Gamma spectroscopy laboratory

The team was informed that about fifteen gamma spectrometric measurements are performed per month. Background is measured at least once per month. Calibration is performed once every three years, calibration sources coming from CIEMAT in Madrid. For electronic equipment and detectors there is no service contracts in place, but some replacement units are stored in the laboratory. Energy and peak width checks are performed on every measurement and monthly using a standard.

Calculations are done using *ORTEC GammaVision®*.

Electric power supply is guaranteed, using a UPS system (30 minutes).

Verification does not give rise to recommendations.

QA and archiving

The laboratory is in an advanced state of accreditation according to ISO 17025. It participates regularly in inter-comparisons (IAEA; CSN).

The verification team found that the equipment in the laboratory was in good shape. Sample treatment, measurement, calibration and checking procedures were available and at hand. The involved personnel were well aware of the tasks and the procedures to follow and generally had good knowledge of the background to the analysis methods applied.

The verification team noted that the procedures for the various working areas are comprehensive and generally stored close to the workplace.

The team performed the tracing of a historical sample (air filter of September 2003). The filter itself was available from the archives, as well as the gamma spectrum and all measurement values.

Verification does not give rise to recommendations. The team encourages the ongoing accreditation process.

Reporting

The laboratory produces (manually) semestrial reports to CSN as well as an annual report. It also reports directly to *Generalidad de Valencia* on a trimestrial basis for control purposes. An annual document describing the objectives in the frame of quality control (the laboratory is ISO 9001 certified) is produced.

Verification does not give rise to recommendations.

10 CONCLUSIONS

All verification activities that had been planned were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, was useful.

The information provided and the verification findings led to the following conclusions:

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil around the site of Cofrentes NPP as well as in the province of Valencia are adequate. The Commission could verify the operation and efficacy of a representative part of these facilities.

(2) A few minor observations and suggestions are formulated, mainly in relation to quality control issues and GM detector siting. These aim at improving some aspects of the environmental surveillance in and around the Cofrentes NPP site. They do not detract from the general conclusion that discharge and environmental radioactivity monitoring at the Cofrentes NPP site as well as in the region of Valencia is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) The main suggestions are detailed in the 'Main Findings' document that is addressed to the Spanish competent authority through the Spanish Permanent Representative to the European Union.

(4) Finally, the verification team acknowledges the excellent co-operation it received from all persons involved in the activities it performed.

APPENDIX 1

REFERENCES AND DOCUMENTATION

COFRENTES NPP

1. PVRA- sampling locations and specifications, Cofrentes
2. *Tratamiento de residuos radioactivos*, EFS, Cofrentes NPP (information and schemes for aerial and gaseous discharges)
3. Cofrentes – Operation and Maintainance Instructions, Environs Radiation Monitoring System, Boiling Water Reactor Systems Department, San José, California, 1978.
4. Cofrentes Central Nuclear – Presentation Broshure, *Iberdrola*
5. *Manual Técnico de Química (MTQ), Producción Nuclear*, *Iberdrola* (gaseous and liquid effluents)
6. *Manual de cálculo de dosis al exterior (MCDE), Iberdrola*
7. Plans and maps of Cofrentes NPP and its surroundings
8. *Plan de calidad medidas ambientales, Edición 15, Medidas Ambientales S.L.*
9. *Programa de vigilancia radiológica ambiental independiente (PVRAIN) del CSN en el entorno de la central nuclear de Cofrentes* – Information
10. *Servicio de muestreo y análisis del PVRA, su control de calidad y del PVRE. C.N. Cofrentes. Año 2007" (Ref. MAS09CO-1, ed. 15).*
11. *Gestión de los sistemas informáticos (Ref.: MGPMA-14, ed. 0)*
12. *Procedimientos generales de la calidad (MGPMA), Medidas Ambientales, S.L.*
13. Effluents and the environment, Powerpoint Presentation, Cofrentes NPP, *Iberdrola*

CSN

14. List of the Waypoints Valencia (RAR, REA, REM networks)
15. List of the Waypoints Cofrentes
16. *Programa de vigilancia nacional (REVIRA)* – Information
17. Information of: emergency preperdeness, mobile units, PENVA teams.

OTHER

18. Questionnaire on the implementation of Art. 35 of the EURATOM Treaty in the Kingdom of Spain, 2005.
19. Verification activities under the terms of Art. 35 of the Euratom Treaty, preliminary information questionnaire addressed to the Spanish national competent authority in view of preparing the Art. 35 verification in Spain 12-16 November 2007.
20. Art.35. Euratom verification report, Trillo NPP, 27 June – 02 July 2004.

Web sites consulted

CSN	http://www.csn.es/plantillas/index.jsp
CIEMAT	http://www.ciemat.es/portal.do?TR=C&IDR=820

APPENDIX 2

THE VERIFICATION PROGRAMME – SUMMARY

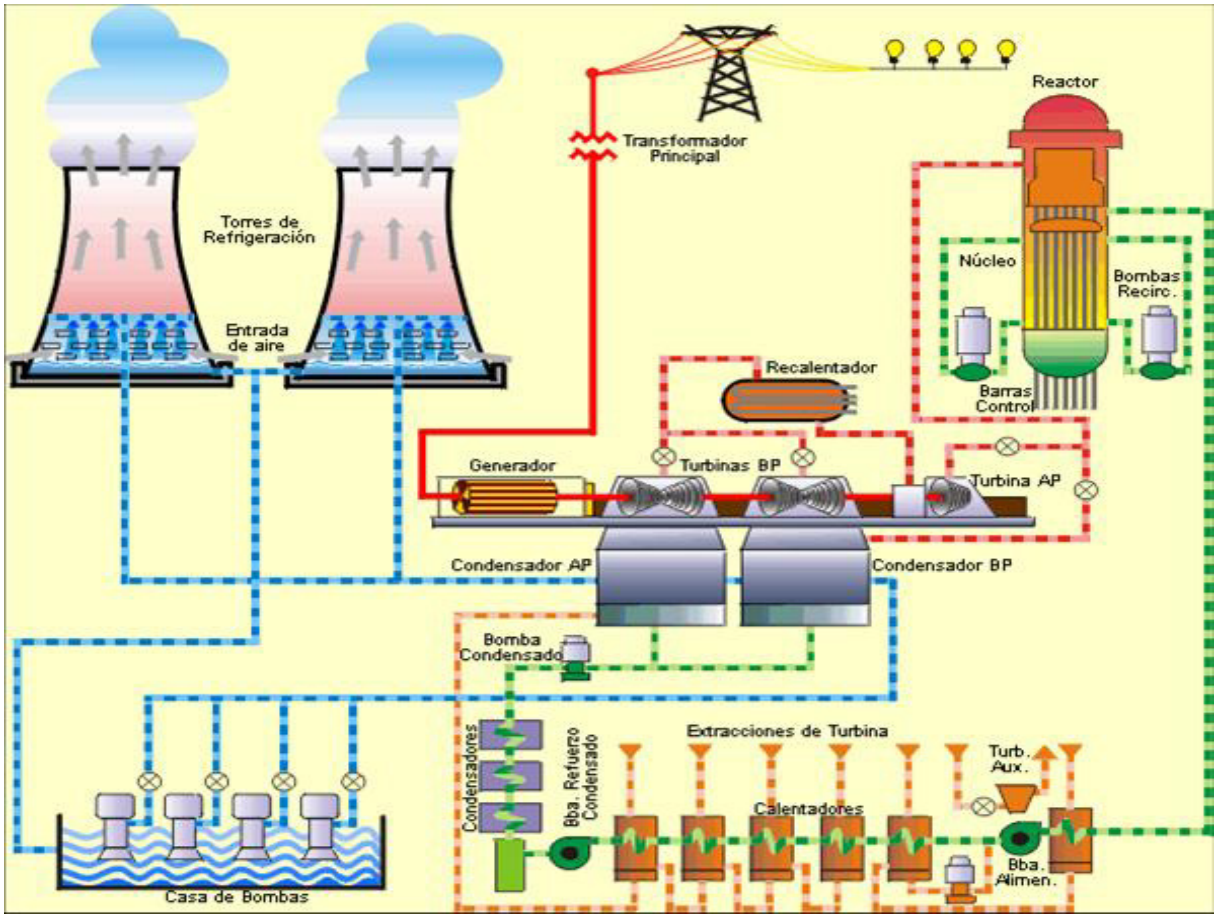
Monday 12 November 2007	• Access to Cofrentes NPP site - administrative procedures. • Opening meeting - Introduction of delegations. - Adoption of the programme of verification activities. - Presentations by the operator and the Spanish authorities: Cofrentes NPP overview, review of discharge authorisations, review of the statutory/independent environmental monitoring programmes. • Team 1: Verification of the regulatory provisions for monitoring and sampling of radioactive discharges of the Cofrentes Reactor (aerial and liquid) and visit of the reactor's operations control room. • Team 2: Verification of a representative selection of the site-related provisions for environmental monitoring and sampling (**on**-site Cofrentes NPP) put in place by the operator (statutory obligations) as well as by the regulator (check monitoring).
Tuesday 13 November 2007	• Team 1: Verification of the **aerial** discharges from Cofrentes NPP • Team 2: Verification of a representative selection of the site-related provisions for environmental monitoring and sampling (**off**-site Cofrentes NPP) put in place by the operator (statutory obligations) as well as by the regulator (check monitoring).
Wednesday 14 November 2007	• Team 1: Verification of the **liquid** discharges from Cofrentes NPP • Team 2: Verification of the national environmental monitoring network installation in the regions around Cofrentes and Valencia.
Thursday 15 November 2007	• Team 1: Verification of the operator's laboratory for discharge samples. • Team 2: Verification of the laboratories executing CSN's environmental control, programme; discussion of any changes concerning the telemetric network management centre and data centre.
Friday 16 November 2007	• Closing meeting at Cofrentes NPP premises. Preliminary verification findings.

Team 1 **Mr Eberhardt Henrich**
Ms Adriana Godeanu Metz

Team 2 **Mr Constant Gitzinger**
Mr Jean-Loup Frichet

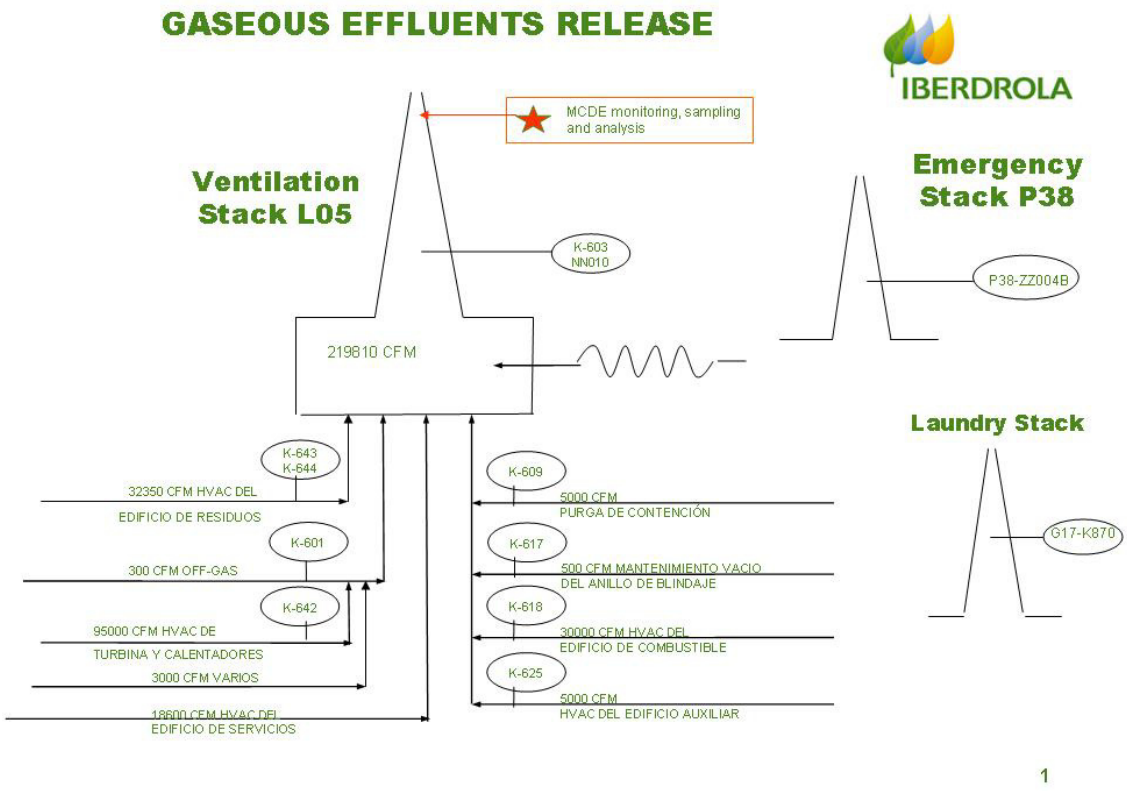
APPENDIX 3

COFRENTES NPP – Schematics



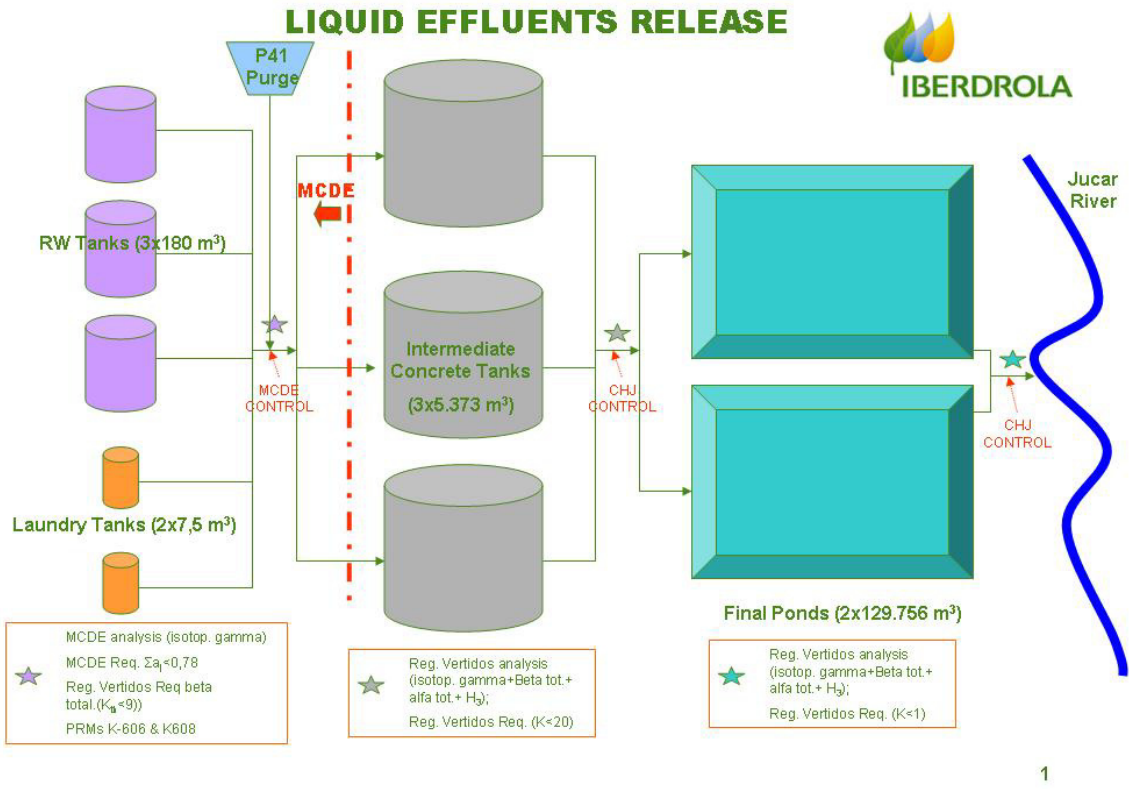
APPENDIX 4

COFRENTES NPP – Gaseous Discharges



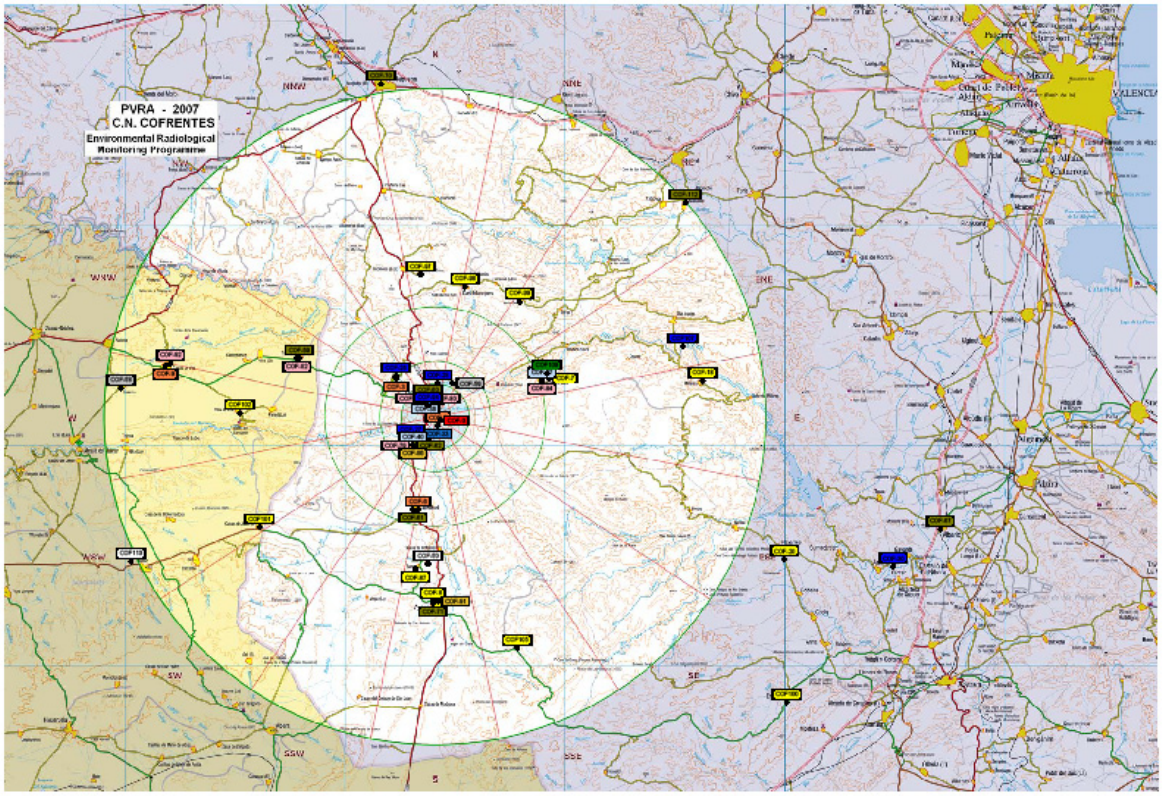
APPENDIX 5

COFRENTES NPP – Liquid discharges



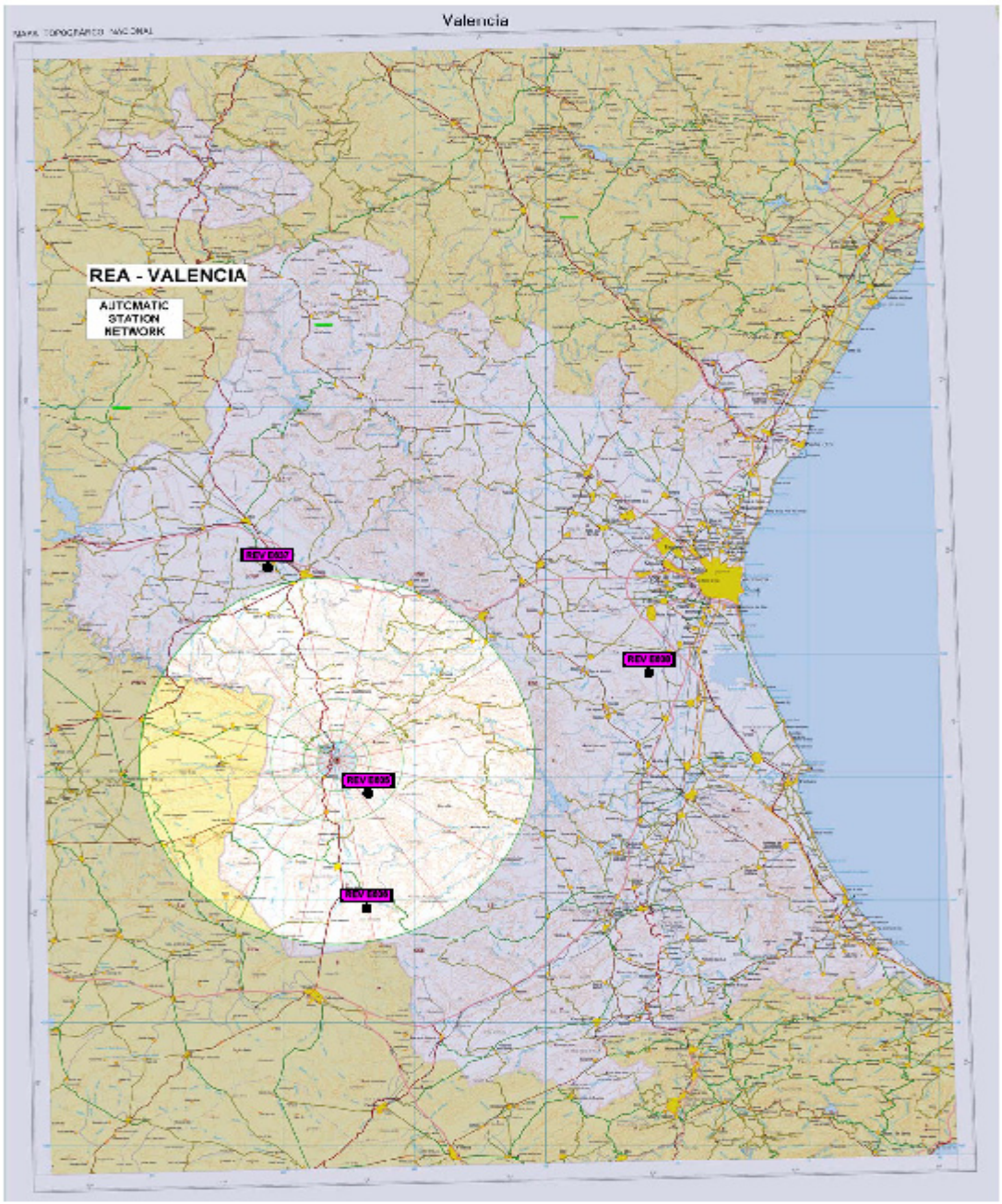
APPENDIX 6

COFRENTES Environmental Monitoring Programme



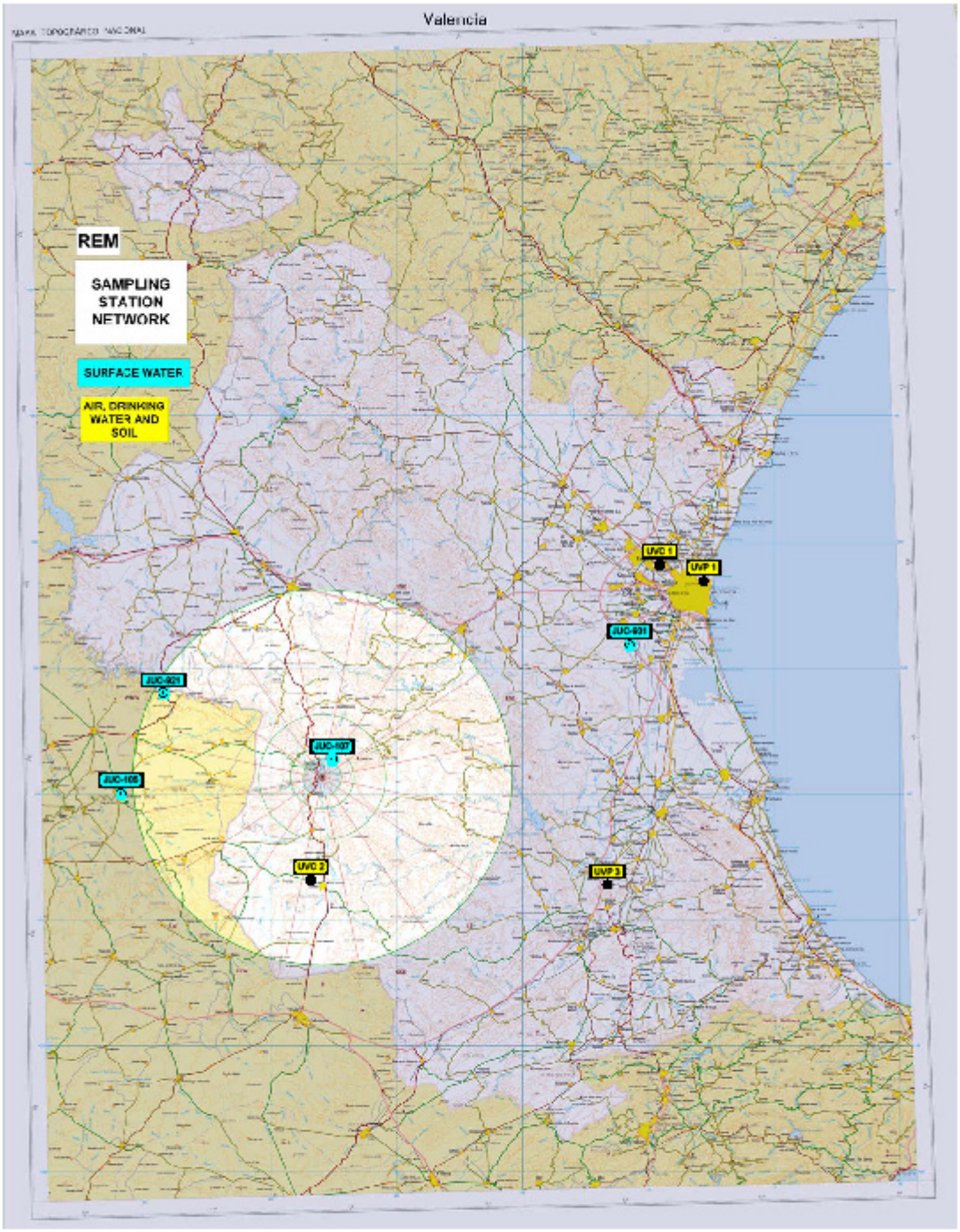
APPENDIX 7

REA Valencia Network



APPENDIX 8

REM Valencia Network -



APPENDIX 9

RAR Valencia Network