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

## ASCÓ–1 NUCLEAR POWER STATION

## SPAIN

## 28 and 29 April 2008

**Reference: ES-08/3**

**VERIFICATIONS UNDER THE TERMS OF ARTICLE 35**
**OF THE EURATOM TREATY**

FACILITIES: Further to a radiological event that occurred at the Ascó-1 NPP, a team of three inspectors of DG TREN H4 visited the site on 28/29 April in order to obtain full information from the NPP operator and from the regulatory authority and to verify certain monitoring installations implied in the above mentioned event.

SITE: Ascó, Spain

DATE: 28 and 29 April 2008

REFERENCE: ES-08/3

INSPECTORS: C. Gitzinger (Head of team)
E. Henrich
K. Schnuer

DATE OF REPORT: 2008-09-18

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*[signed]*

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**TECHNICAL REPORT**

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| BOE | *Boletín Oficial del Estado* (Official Gazette) |
| 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) |
| GM | Geiger-Müller (radiation detector) |
| HEPA | High Efficiency Particulate Air (filter) |
| IAEA | International Atomic Energy Agency |
| ICRP | International Commission on Radiological Protection |
| ISO | International Organization for Standardization |
| KEEPER | Environmental radioactivity measurement database of CSN |
| 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) |
| 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) |
| SALEM | *Sala de emergencias del CSN* (CSN Emergency Centre) |
| TLD | Thermoluminescence Dosimetry/Dosimeter |
| WHO | World Health Organisation |

# 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.

Further to a radiological event that occurred at the Ascó–1 NPP, a team of three inspectors of DG TREN H4 visited the Ascó–1 NPP on 28/29 April in order to obtain full information from the NPP operator and from the regulatory authority and to verify a certain number of monitoring installations implied in the above mentioned event.

The visit to the Ascó NPP included also meetings with the Spanish competent authority *Consejo de Seguridad Nuclear* (CSN) [2]. Due to the limited time available, *Generalidad de Cataluña*, which, under contract with CSN, provides technical support to perform the sampling under the regulator's PVRAIN and REVIRA programmes and the analyses of these samples, could not be met during this mission.

The present report contains the results of the discussions with the NPP operator, CSN's resident inspectors and the Spanish competent authority CSN itself, as well as results of the verification team's review of some aspects of the environmental surveillance at and around the Ascó site in relation with the radiological event. The purpose of the review was to provide full information both from the operator and from the regulator concerning the event itself and the investigations and countermeasures put in place till now. Monitoring equipment related to the event was verified as well. The verification team witnessed also the localisation and capture of some radioactive particles released to the environment, by expert teams.

With regard to general radiological and environmental radioactivity and discharge monitoring aspects the present report is also based on information collected during the recent verifications of the NPPs Trillo and Cofrentes in Spain.

# 2 PREPARATION AND CONDUCT OF THE VERIFICATION

## 2.1 INTRODUCTION

The Commission's decision to conduct an urgent mission under the scope of Article 35 EURATOM was discussed with the Spanish authorities on April 24 and 25. On 25 April the Spanish competent authority invited the Commission services to come to the Ascó NPP on 28 and 29 April in order to receive full information and to verify the investigations, countermeasures and monitoring programmes implemented further to the radiological event. All practical arrangements for the implementation of

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 (OJ L 159, 29.6.1996, p. 1).

2 *Consejo de Seguridad Nuclear* /Nuclear Safety Council, Justo Dorado 11, 28040 Madrid.

this mission 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.

# 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**

| **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:

- 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 and 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.

## 3.3 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.

## 3.4 LEGAL PROVISIONS FOR ENVIRONMENTAL RADIOACTIVITY MONITORING

With regard to legal provisions reference is also made to the reports of the Article 35 EURATOM verifications to the NPPs at Trillo (2004) and Cofrentes (2007).

### 3.4.1 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. Partially amended by Law 14/1999 and Law 33/2007 of 7 November 2007
- 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.

### 3.4.2 Legislative acts regulating the radiological surveillance of foodstuffs

There are no specific regulations regarding the radiological surveillance of foodstuffs.

- *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.

### 3.4.3 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].
- WHO Codex Alimentarius Commission Guideline 5-1989: Guideline levels for radionuclides in foods following accidental nuclear contamination for use in international trade.

## 3.5 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 need to have Technical Operating Specifications, 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. It also specifies the individual discharge limits, equipment availability requirements and control procedures for the individual NPP site.

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.

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 are included in the *Especificaciones Técnicas de Funcionamiento* (Technical Operating Specifications) 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.

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 nuclear power plant sites on a permanent basis. It has defined effluent control programmes that encompass the following:

- Operational restrictions (discharge limits for gaseous and liquid effluents with a total limit of 0.1 mSv for 12 consecutive months);
- Site specific sampling and analysis programmes;
- 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.

# 4 ASCÓ-NPP SITE

The Ascó unit 1 NPP is a pressurized water nuclear power plant of 1033 MW (net 995 MW) designed by *Westinghouse* (USA). It is owned by *ENDESA S.A.*.

The Ascó Nuclear Power Plant is located on the right bank of the river Ebro, within the municipal boundary of Ascó, District of Rivera d'Ebre, Province of Tarragona, Autonomous Community of Cataluña.

The plant is located on a plain, close to the river and approximately 50 m above the mean water level of the river Ebro, occupying a total area of 243 hectares, including a double fenced zone of 33 hectares around Ascó unit 1.

Ascó is located at a straight line distance of about 150 km from the city of Barcelona (a region of high electricity consumption), in a sparsely populated area with little agricultural and industrial activity.

Construction of the NPP started on 16 May 1974. The plant was connected to the electric grid on 13 September 1983 and commercial operation started on 10 December 1984. The plant is operated by *Asociación Nuclear Ascó-Vandellòs A.I.E.*.

# 5 ASCÓ RADIOACTIVE DISCHARGES

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.

# 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, 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.

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.

**The owner** of an NPP 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.

A quality control programme has to be implemented by the NPP by handing a certain percentage of the samples over to CIEMAT for parallel analysis. Within the analysis laboratories 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 Ascó NPP the *Generalidad de Cataluña* has been commissioned for these tasks.

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 Ascó this independent control is assigned (by a contract) to the *Generalidad de Cataluña*.

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 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).**

Reporting to the authority (CSN) by the NPP, is basically done by a routine summary and detailed reports. Data are also transmitted in electronic way to be loaded into CSN's database.

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.

## 6.2 THE OPERATOR'S ENVIRONMENTAL CONTROL PROGRAMME (PVRA)

The current Environmental Monitoring Programme (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 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.

## 6.3 CSN'S SITE RELATED INDEPENDENT CONTROL PROGRAMME (PVRAIN)

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.

CSN carries out a control of the operator's PVRA by means of its own independent monitoring programme PVRAIN. In the case of the Ascó NPP, this programme is assigned to the Autonomous Community of Cataluña. For this programme sampling and measurements are performed independently from the NPP by the *Generalidad de Cataluña*, 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.

### 6.4 SPANISH NATIONAL ENVIRONMENTAL MONITORING PROGRAMMES

CSN runs a nation-wide radiological monitoring network. 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.

The Radioactivity Warning Network (RAR), which is managed by the Ministry of Public Administration, is composed of 900 gamma dose rate measurement points distributed all over Spain.

## 7 VERIFICATION ACTIVITIES

### 7.1 INTRODUCTION

Further to a radiological event that occurred at unit 1 of the Ascó NPP, a team of three inspectors of DG TREN H4 visited the Ascó-1 NPP on 28/29 April 2008 in order to obtain full information from the NPP operator and from the regulatory authority and to verify a certain number of monitoring installations implied in the above mentioned event.

The Commission's decision to conduct such an urgent mission under the scope of Article 35 was discussed with the Spanish authorities on 24 and 25 April 2008. On 25 April the Spanish competent authority invited the Commission services to come to the Ascó NPP on 28 and 29 April in order to receive full information and to verify the investigations, measures and monitoring programmes implemented further to the radiological event. Practical arrangements for the implementation of this mission were made with the persons designated at the *Consejo de Seguridad Nuclear (CSN)*.

### 7.2 INFORMATION BY THE OPERATOR AND CSN

According to the operator, on 26 November 2007, further to an outage for fuel element change, an event leading to radioactive contamination occurred. After the first notification to the competent authority on 4 April 2008 this event and its consequences were rated as INES 1, later upgraded to INES 2 on the International Nuclear Event Scale.

The chronological order of events according to the information received from the NPP operator and CSN and on the basis of further discussions is described below.

23 November 2007
Fuel movement operations during the outage tasks were terminated.

25 November 2007
Routine controls of the outside areas close to the reactor building were performed and showed no radioactive contamination of the investigated areas.

26 November 2007
After cleaning up the canal between the reactor and the spent fuel pond (which had been used during the outage) using a vacuum device, the container with the radioactive sludge, water and debris (some 50 litres) was dumped in the spent fuel pond. This had also been done at previous outages. The

verification team was informed that for this task no written procedure was available. It was performed by a contracted firm, obviously with a 'radiation expert' from this firm. It is also important to note that the persons involved this time were not the same performing this task on previous occasions.[3] Unlike at other such occasions before, the ventilation system above the fuel pond was not turned off (nor left on "automatic"[4]). Thus, radioactive material could be sucked into the ventilation system and could also contaminate the grid and the tubing. Under "automatic" regime, valves would have shut automatically further to a radioactive contamination and shut down the ventilation system, which also would have triggered an alarm[5] [6]. For still unclear reasons the ventilation system was working in 'emergency' mode when the container was dumped in the fuel pond[7]. During the following three days the contaminated air was pumped by the ventilation system still working in 'emergency' mode through HEPA and charcoal filters before being discharged by the stack of the auxiliary building.

Some time after 26 November a contamination of part of the ventilation system leading to the HEPA and charcoal filters was detected, however not notified to CSN. A decontamination process was initiated by the NPP operator, but apparently nobody was conscious that radioactive particles could be dispersed to the normal ventilation system (which was turned on again on 29 November). Apparently for decontamination work no written procedures were followed by the staff involved and there seems to have been a lack of communication between the various groups of the operator and subcontractors.

29 November 2007
The ventilation system was changed from the 'emergency' mode (i.e. passing through the HEPA and charcoal filter system) to 'normal' mode (i.e. with the filter system bypassed). This seems to have led to the release of radioactive particles (that had been sucked into the pipes of the system before) through the chimney of the auxiliary building (the 'main' stack). The verification team noted that this effect could have been even worsened by an additional sucking in of particles that were originally deposited in the piping system leading to the HEPA filters or on the HEPA filters themselves.

30 November 2007
A worker was found to have contaminated boots when passing through the body counter. The current procedure foresees that all contract workers have to perform a whole body monitoring before starting and after ending their work activities. The monitoring is done with a large surface gamma spectrometer aimed at identifying external and internal radioactive contamination.

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3 According to information the Commission received from the regulator after the verification visit ('additional information by regulator') experienced staff from the NPP was present witnessing the operations, but did not perform them directly because their dose credit was almost exhausted and the operations involved a dose that was foreseen to exceed it.

4 The regulator later informed that it was in automatic mode.

5 All along these manoeuvres, the ventilation system was operating in “emergency mode”, i.e., “normal” ventilation (not filtered) isolated, and the sucked air passing across filters (HEPA, active charcoal) that prevented adequately any release to the environment. However, the suction pipe is shared by both normal and emergency trains. When normal ventilation was connected on November 29th, the contamination remaining in the shared suction pipe stopped being retained at the emergency filters and made its way to the exhaust stack and the environment. *(Additional information by regulator)*

6 The operation in emergency mode is automatically triggered by any of the two area radiation monitors (TR2605/2606), located in the fuel storage building, when one of their alarm set-points is reached. Although the ventilation system was actually operating in emergency mode when the incident took place, the TR-2606 monitor alarm was activated when the radioactive contamination in the building reached the alarm set-point value. *(Additional information by regulator)*

7 According to CSN the reasons are clear: this manual operation was made to avoid the automatic start of the system on high radiation signal and consequently preventing a licensee event report to CSN. *(Additional information by regulator)*

It is not clear to the verification team why the identification of this external contamination case was not reported to CSN (e.g. via the resident inspector) and no immediate inquiry was launched for identification of the origin of this contamination.

December 2007, January 2008: Cleaning of the air circulation system
The verification team was informed that during December 2007 and January 2008 decontamination of the air ventilation system piping was carried out. The team wonders if the operator has made a thorough investigation on the procedures of the decontamination work.

It can be questioned why the initial event and the cleaning-up work was not notified to CSN.

The verification team was shown by CSN diagrams of the NPP operator's monitoring results (e.g. for various ventilation systems, stack monitor, air stream flow rate in the stack, air pressure in some buildings, ambient dose rate), in particular for December 2007. Several peaks could be recognized concerning the radioactivity in the "stack particulates measurement channel". With a level of 17 $Bq/m^3$ at one stage, one of these peaks obviously lay above the alarm threshold of 13 $Bq/m^3$. The verification team did not receive an answer why this exceeding of the alarm level had not been thoroughly investigated, followed up and notified to CSN by the NPP operator.

From the presented monitoring results in the fuel element building a direct correlation between measured dose rates and operational values of the ventilation system could be seen. Also other data showed unusual trends, e.g. the air flow rate and the dose rate in the ventilation duct showed several correlated decreases respectively peaks.

The verification team was shown by CSN data from the ambient dose rate monitor operated by the regional government of Catalonia (*Generalidad de Cataluña*), within the frame of the REVIRA system on behalf of CSN, for December 2007. The concerned measuring device is situated within the fenced area of the NPP, close to a similar device operated by the NPP, a few hundred metres downwind of the main stack. On the time graph for 13 to 19 December several 'peaks' could be seen (reaching from a 'normal' level of 120 up to 185 nSv/hr), giving an impression of an 'oscillation' (see figure 1). This unusual effect was communicated by CSN in a press statement on 7 April. It is not clear to the verification team at what moment these facts had been notified to CSN. However, for reasons that are not clear to the verification team, an immediate thorough investigation of this effect seems not to have been performed. [8]

Filter material collected during that same time period, with an air sampler also operated by the regional government of Catalonia in the very close vicinity of the gamma monitor, could have lead to

[8] CSN has a specific agreement with the *Generalidad de Cataluña* on this subject to access this data.

- The *Generalidad* carried out an investigation with the NPP operator who discarded the relationship between the NPP and these values: On 13 December 2007 the Generalidad de Cataluña sent a letter by fax to the plant manager communicating the increase detected in the values measured in their monitoring network around Ascó NPP, specifically in the dose rate monitor located next to the similar device operated by the NPP called “Almacén tuberías” and in the automatic water sampling station called Ebro-Sur; and asking if any industrial radiography had been performed or any other incident had occurred that could justify these values. At the same time the Generalidad de Cataluña called the operator.
- The operator both by telephone and also in a written note signed by the radiological protection manager sent by fax to the Generalidad de Cataluña on the same day (13 December 2007) answered that no radiography had taken place and no other incident had occurred in the plant. The operator also informed that the dose rate device operated by them showed no unusual results.

Additionally, on 15 December 2007 the Generalidad de Cataluña collected a river water sample in the vicinity of the automatic water sampling station Ebro-Sur; this sample was measured by an accredited university laboratory. The results were below the detection limit which in the case of cobalt-60 was 0.02 Bq/L.

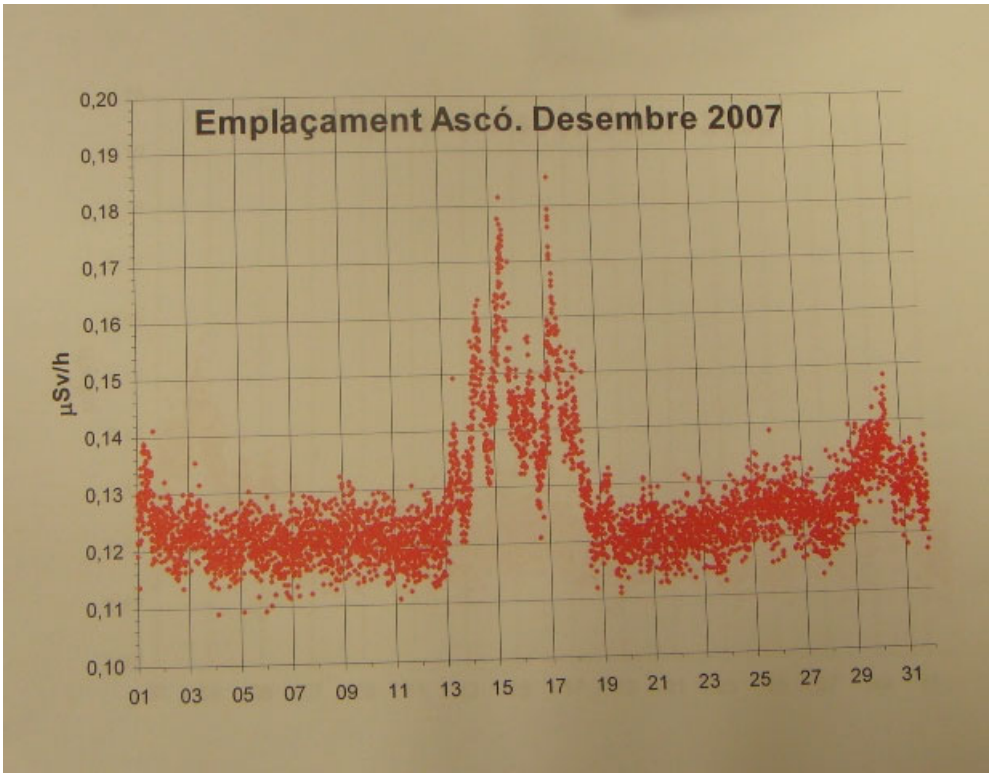
The increase in the dose rate values, up to 50%, was similar to increments detected when there is rainfall; it was thought this could be explained by a microclimate in the area with a situation of fog and thermal inversion; it was not considered as important to develop any further investigation since the NPP operator did not report any incident.

*(Additional information by regulator)*

some clarification. Unfortunately, it seems that this material has meanwhile been used for preparing the annual strontium sample and is thus not anymore available for complete analysis.

The verification team did not receive information whether the similar devices operated by the NPP at the same location also showed unusual results in December 2007.

Figure 1: Time trend of dose rate measurement at the "on-site" measuring station operated by the *Generalidad de Cataluña*




14 March 2008
In the context of weekly radiological checks, NPP staff found points with radioactivity near the equipment lock of the containment building, outside the building. Apparently the operator interpreted the contamination as being the result of an insufficient decontamination of the site after the refuelling outage. The operator increased the surveillance frequency in this area but did not immediately notify his findings to CSN.

25 March 2008
CSN's resident inspector was informed about the particles found on 14 March, but no link with the outage of November was made.[9]

2 and 3 April 2008
The operator extended the search for contamination to other areas, in particular the roofs ('terraces') of the fuel building, the auxiliary building and other buildings nearby and the ground "on site" within the double fence. A number of radioactive particles were found and immediately removed.

The verification team was informed that one of the resident inspectors of CSN realised on 3 April 2008 the unusual "ongoing activities" and was informed "about them". He immediately informed CSN in Madrid.

[9] In response to the resident inspector's questions, the licensee informed that this finding was well below the reporting threshold. *(Additional information by regulator)*

4 April 2008
The NPP officially notified CSN about the event, giving a first estimate of the activity of the particles found (some 235.000 Bq). The event is provisionally classified INES 1. CSN set up an action plan that included: dispatch of additional inspectors to gather information on the event; perform independent measurements; make estimates of the radiological impact. The first measurement campaigns downwind, outside the fenced area of the NPP, near the Ebro River, did not lead to detection of radioactive particles.

5 April 2008
CSN conducted a first inspection mission (ending on 8 April) with 6 technical specialists (2 on nuclear safety and 4 on radiological protection) plus all Ascó resident CSN inspectors.

9 April 2008
CSN required the operator to perform a monitoring programme aimed at measuring internal radioactive contamination of potentially affected persons (workers and visitors that had been on the site since the event). Until 29 April almost 1500 persons were monitored (of some 2400 foreseen by that date). The main system used was a bed type NaI(Tl) whole body counter in order to be able to manage the large number of persons. The verification team was informed that additional independent checks were performed using other systems and other measuring institutions to complement the Ascó measurement system. None of these controls led to the detection of internally deposited radioactive substances. A detailed description of these controls can be found in the Chapter 'Radiological Protection Aspects' on page 22ff.

14 April 2008
CSN decided to up-rate the event to INES 2. Level 1 was for losing control of radioactive material and had been made on 7 April; the up-rate was for delivering incomplete, deficient and misleading information to the regulatory body.

The operator informed CSN about a significant increase in the estimated total activity value of the particles found from some 235.000 Bq (as given in the first reports that were used by CSN and Greenpeace for tentative dose estimates) to ca. 85 MBq. It seems that this information had been known by the operator already on 9 April 2008.

The verification team received an explanation for these different activity values. Apparently the most important reason was the use of gamma dose rate monitors in close contact to the particles (leading to large measuring value deviations) and using measuring devices in an improper way: Any value read from the device was used as 'true' value. High values outside the measuring range of the device, which due to over-modulation effects were shown at or even below the display limit of the measuring device, were interpreted too low. Taking this effect into account leads to a significant increase of the first particle activity estimates (ca. a factor 10). A second effect was the consideration of the half lives of the detected radio-nuclides (see list in table 2) and taking end of November 2007 as reference date. This increased the initial values (that were not decay corrected) by a factor of nearly 4. A third effect was the finding of more particles. This effect was less dominant.

21 April 2008
The radiation detection gate monitor of the recycling company *HIDESA* (Selva del Camp, near Reus) gave alarm when a truck coming from the Ascó NPP passed the gate. The radiological surveillance unit of CIEMAT which was working in the area being part of the radioactive particle search programme performed a check and detected particles with Co-60 contamination in four bags of the truckload. Contact doses ranged between 0.5 and 20 µSv/hr.

On 22 April 2008 this event was reported by the NPP to CSN; it was provisionally rated as INES 1.

Table 2: Half life of radionuclides detected in radioactive particles. (This radionuclide 'vector' gives an indication that the particles are corrosion products and thus a clear link to the refuelling outage.)

| Radionuclide | Half life | remark |
|---|---|---|
| Co-60 | 5.27 years | |
| Co-58 | 70.8 days; | |
| Mn-54 | 312 days | |
| Cr-51 | 27.7 days | |
| Zr-95 | 64 days | |
| Nb-95 | 35.15 days | also formed by decay of Zr-95 |
| Fe-59 | 44.6 days | |

The verification team was informed that apparently non radioactive material from the outage work was stored in the area close to the stack in an open scrap metal container and was contaminated with particles by the event from November/December 2007. According to normal procedures all non radioactive metallic scrap material is brought to one site in the NPP premises outside the double fenced area for storage before delivery to a scrap metal firm. The contamination was not detected because for this task no contamination control procedure is foreseen. Together with uncontaminated material a small amount of contaminated earths were transported to *HIDESA*.

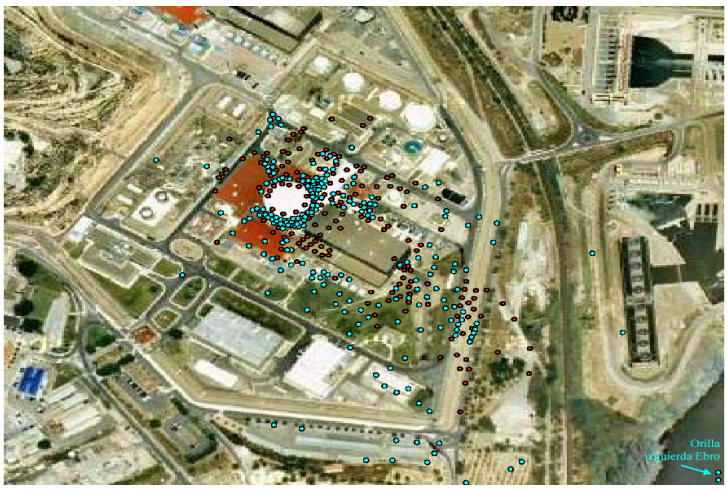
CSN has instructed the NPP operator not to undertake any movements of materials from the facility without 'complete control'.

27 April 2008
After 8 April up to 27 April another more than 220 particles were found on site of the NPP within the fenced area totalling an activity (decay corrected to 11 April 2008) of ca.15 MBq.

Meteorological data for the time period November 2007 to April 2008 show that during the presumed emission day(s) the wind was very calm; afterwards some days with heavy winds in direction to the river Ebro could be noted. The particle search took into consideration these meteorological data.

The almost totality of radioactive particles found until 27 April was located within the fenced area of the NPP (see figure 2).

Figure 2: Aerial view of the Ascó-1 NPP site showing the locations of the radioactive particles found until 27 April 2008. Red (dark) colour: particles found before 8 April 2008; blue colour: particles found after 8 April 2008. Photo by the operator.



28 April 2008
CSN started a second inspection mission.

Ongoing interviews with involved NPP staff.

Interviews by CSN representatives are conducted with all Radiation Protection staff of the NPP, with management involved and with all personnel of the operation shifts of the relevant time period in November 2007.

29 April 2008
Altogether four radioactive particles were found outside the fenced area, near River Ebro[10]. The activity of these particles (several kBq per particle) was much lower than the activity of the particles found in the fenced area.

The verification team would like to stress that there are still studies ongoing to explain the event in detail. Some of the above information are assumptions based on the best current knowledge of the parties involved.

*The verification team encourages CSN performing a full and thorough investigation on the reasons and the development of the event and the reactions of the operator in the aftermath. It highly recommends timely and open reporting on this subject.*

*The operator is recommended developing detailed procedures for all work that has a potential to lead to discharges of radioactive material. The team recommends regular meetings and discussions among teams involved in such tasks with the presence of a "radiation protection" officer of the NPP management.*

*The verification team recommends the operator setting up a system of notifying faulty events on a 'no-blame' basis to hierarchy, i.e. reporting issues that evolved during a task and that were not foreseen and have not been handled in an optimal way or have even been dealt with in an erroneous way, without risking punishment for the person responsible for the error. For each such report management should immediately initiate a discussion meeting involving persons from all concerned departments as well as a representative of the regulator with a view of better understanding the issues and their possible consequences. The regulator then should inform other groups that may be affected by a similar event, in an appropriate way. The verification team recommends the regulatory body demanding all operators of installations that may be likewise affected to implement such an approach.*

## 7.3 VERIFICATION OF SAMPLING/MEASUREMENT FACILITIES AND ARRANGEMENTS

### 7.3.1 Particle search

During the verification visit the search team from CSN found outside the fenced area of the NPP another two particles close to the bank of the River Ebro (in addition to a particle found on 22 April and one found on 25 April).

The verification team witnessed the search methodology and particle recovery procedure used by the walking team: three staff members in light protective suits walk in a very small distance (approximately 50 cm between each person), each operating a measuring device close to the ground. The measuring devices used by the walking team were one *Canberra Inspector 1000*, one *Tema 3100* and one *Exploranium Gr-135*. Occasionally also a *Rotem PM-10* device was used. If one person detects an unusual elevated value, the others are checking that location with their equipment as well. If

[10] As of 9 June 2008 5 radioactive particles were found off-site.

the finding is confirmed, the location is marked and the top surface layer (leaves, dust, twigs etc.) is collected in a plastic bag. This bag is measured from the outside. If the measurement is positive the soil location is again measured and in case of background value the bag is tightly closed, marked and kept. A negative result leads to discarding the first sample and removing the next top soil layer. The sampling/controlling procedure is repeated as long as necessary to "capture the identified and localised radioactive particle, which then is removed from the environment and "deposed" in a safe location. These results are immediately reported to CSN.

The detectors for particle search had been calibrated using "real" particles. Blind tests for the search methodology were successful.

Until the time of the verification visit all particles found outside the fenced area of the NPP were of tiny size (unlike the ones found by NPP staff close to the stack) and had activities in the order of several kBq.

The verification team assumes that, due to the local circumstances (high trees, dense underbrush, bushes and reed close to the river bank) and the difficult access to these places, a systematic full area search is impossible and thus not all particles may be easily found.

The verification team witnessed also the car based search system of the second mobile team from CIEMAT which had covered larger areas (accessible by a car) in the vicinity of the NPP including the town of Ascó, schools, the stadium, and agricultural areas close to the river. This team had not yet found radioactive particles outside the fenced area of the NPP.

> *The verification team encourages any further reasonable search operation. It recommends CSN being prepared for future findings of radioactive particles outside the fenced area of the NPP.*

### 7.3.2 Environmental monitoring facilities on site

The verification team verified the sampling/measuring site some several 100 metres southeast of the reactor building. The site is located within a key locked fenced area.

#### 7.3.2.1 Air sampling

Two air samplers (one operated by the regional authority of Catalonia; one operated by the NPP) are mounted in 'Stevenson screen' type shelters. The screen operated by the NPP could be opened, the one run by the *Generalidad de Cataluña* within the frame of the independent environmental radiological monitoring programme (PVRAIN) system was key locked and not accessible since no representative of that organisation was present. CSN carries out a control of the operator's environmental radiological monitoring programme (PVRA) by means of its own independent monitoring programme PVRAIN. In the case of the Ascó NPP, this programme is assigned to the Autonomous Community of Cataluña. For this programme sampling and measurements are performed independently from the NPP by the *Generalidad de Cataluña*. 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. During the second semester of 2007 no air samples were collected, the period established for this sampling was the first semester.[11] The verified air sampler is of the type *RADēCO HD28/B* constant flow. It contains a 47 mm diameter *Millipore* filter and a *TEGA45* active carbon iodine cartridge. During the visit the airflow was stable and measured using a rotary flow meter. The total air throughput was measured with a gas counter type *Actaris Gallus 2000* (measuring range 0.04 to 6 $m^3$/h; last checked on 18 July 2007, next control foreseen for 18 July 2008; correction factor marked). Filter change (at both devices) is done weekly, generally on Monday.

[11] The results corresponding to gamma spectrometry carried out in the filters collected from January to March 2008 did not show values above the limit of detection for artificial radionuclides. *(Additional information by regulator)*

#### 7.3.2.2 Dose

Both air sampler screens also contain TLDs.

#### 7.3.2.3 Ambient gamma dose rate

The site also includes ambient gamma dose rate monitors operating with GM counters, the one from the *Generalidad de Cataluña* about 5 m apart from the one operated by the NPP. It was the detector from the *Generalidad*, which in December registered peaks ('oscillations', see figure 1) that did not give rise to any serious investigation by the *Generalidad* itself respectively by the contracted measuring laboratory (see footnote 8). In a statement CSN recognized to know about these 'minor oscillations' and stated that they 'were judged to be insignificant' (citation taken from press release by CSN from 7 April 2008). The verification team thinks that these 'oscillations' were quite remarkable and should not have been qualified to be 'insignificant', in particular since their shape was not typical for a rainfall event. The team is of the opinion that such an effect should have been investigated in order to explain it, be it a technical problem or a 'real' event.

#### 7.3.2.4 Precipitation

Placed on the top of each air sampler screen, precipitation samplers with a surface of ½ $m^2$ each are operated by the NPP and by the *Generalidad de Cataluña*.

> *With regard to environmental monitoring the verification team suggests setting up a detailed procedure how a measuring laboratory or a contracted agency should act in case of any unusual measurement result with a view to avoid delays in the reporting process or in initiating further investigations. Such a procedure should include detailed comparisons (under the responsibility of the regulator) with all relevant measurements performed by the operator.*[12]

### 7.3.3 Aerial discharge control facilities

The verification team visited the stack leading up along the wall of the containment building, through which the "emission of the particles" took place and the site of the stack air sampling and measuring devices.

#### 7.3.3.1 Stack of the auxiliary building

The stack coming from the auxiliary building ends at elevation 83.5 metres which is several metres below the containment building top. It is mounted close to the containment building and receives gaseous effluents from the auxiliary building, the control building, the fuel building and any

[12] In the case of environmental radiological monitoring programmes around NPPs, an early notification system which also gives rise to investigation is implemented through notification levels established in the Technical Specifications and Offsite Dose Calculation Manual. None of the values measured in the different types of samples collected either in the routine environmental radiological monitoring programme or in the special monitoring programmes set up for the follow up of the incident have reached these notification levels. *(Continued on next page)*

The *Generalidad de Cataluña* has a non written protocol of action in case results reach an established value. After the peaks detected in December the *Generalidad de Cataluña* proceeded according to this protocol.

*(Additional information by regulator)*

containment purging (for this a separate monitor is in installed). An isokinetic sampling device using heating and insulated tubing starts at elevation approximately 70 metres.

#### 7.3.3.2 Sampling and measuring room

The verification team visited the room containing the sampling devices for particulates and iodine and the continuous monitoring devices TR-8102 (normal range) and TR-8104 (high range) for noble gases (dual silicon detectors and ionisation chamber respectively), TR-8101 for particulates ( dual silicon detectors) and TR-8103 for iodine (NaI(Tl) detector). The noble gas alert value is set to 1.44E07 Bq/m$^3$, the alarm level to 1.92E07 Bq/m$^3$. The NPP has a mobile air sampler available as well.

The verification team is not clear about which was the device that showed increased levels (there are some indications that this was on 22 December)[13]. The team pointed out that an isokinetic sampling system may not be able to manage relatively large and/or heavy particles in a representative way. Thus, based on the stack monitoring system used at Ascó-1 a release of such particles could easily be underestimated.

The sampling and measuring devices are not anymore the original versions (*Victoreen*); these have been replaced some 3 to 4 years ago by devices from *MGP Instruments* (*synOdys*), France.

> *The verification team recommends clarifying the characteristics of the isokinetic sampling system in this specific case with regard to the collection of particles. It suggests setting up a detailed procedure how staff should act in case of any unusual measurement result with a view to avoid delays in the reporting process or in initiating further investigations.*

## 7.4 RADIOLOGICAL PROTECTION ASPECTS

### 7.4.1 Introduction:

Article 35 of the Euratom Treaty normally does not foresee the verification of the effectiveness and efficiency of the implementation of the operational radiological protection measures for workers occupationally exposed to ionising radiation.

However, the particular situation following an uncontrolled release of radioactive substances from the Ascó nuclear power plant required such an assessment, because:

The European Commission department for nuclear safeguards employs inspectors who are classified as workers occupationally exposed to ionising radiation in the course of their work.

Under European radiation protection legislation, it is the responsibility of the employer of exposed workers to evaluate and identify the nature and the magnitude of the radiological risk and to implement appropriate radiological protection measures.

Three nuclear safeguards inspectors visited the Ascó nuclear plant in the period of the radiological event between the uncontrolled radioactivity release and the discovery of the radiological event. Hence, exceptionally the verifications under Article 35 of the Euratom Treaty were extended to radiation protection issues.

One member of the team, head of the Commission department responsible for the radiological protection of staff, therefore requested all information necessary for assessing relevant doses and for initiating, if necessary, specific health protection measures for the involved Commission staff.

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[13] The TR-8101 monitor showed increased levels, some of them above the set alarm point (13 Bq/m$^3$). The highest value (17 Bq/m$^3$) was measured on 22 December 2007. *(Additional information by regulator)*

### 7.4.2 General

In the event of an accidental release of radioactive substances the contamination levels and the subsequent radiation doses likely to be received by workers or members of the general public need to be assessed properly.

In the Ascó case the first reliable radioactive contamination measurements have been made only within a time period of a few months after the accident and the real activity of the released radioactive substances can only be estimated within an order of magnitude.

The exact knowledge about the physical, chemical and geometrical properties of the dispersed radioactive particles made it possible to estimate the radiological risk to the workers and members of the public.

The decision of CSN to launch a radiological monitoring program involving all workers and visitors of the Ascó nuclear power plant is a precautionary measure justified in view of the circumstances and the scope of the event.

### 7.4.3 Radiation Dose Measurements

At the meeting the Ascó operator presented the results of radiochemical analysis of the recovered radioactive particles (table 3). The gamma spectrometry results showed the absence of the more toxic radionuclides (such as plutonium or americium) and fission products. Furthermore, the particles are metallic compounds (corrosion products) and they are relatively big sized (>1 μm).

Table 3: Activity of particles identified before 8 April 2008[14]

| Location of material | Activity of identified radionuclides (MBq) | | | | | | | Total activity (MBq) *) |
|---|---|---|---|---|---|---|---|---|
| | Co-60 | Co-58 | Mn-54 | Cr-51 | Fe-59 | Nb-95 | Zr-95 | |
| Containment cupola | 2.869 | 0.908 | 1.514 | 0.478 | 0.048 | 0.527 | 0.261 | 6.605 |
| Roofs ('terraces') of Auxiliary, Fuel 'P.M.' building at +57 | 2.112 | 0.745 | 1.143 | 0.403 | 0.046 | 0.338 | 0.162 | 4.915 |
| 'Lens' | 2,358 | 0.706 | 1.269 | 0.352 | 0.049 | 0.013 | 0.000 | 4.747 |
| Roof of turbine building, 'CAS', 'AAA' and Diesel | 1.225 | 0.501 | 0.712 | 0.194 | 0.023 | 0.016 | 0.009 | 2.680 |
| Elevation +50 (75 particles) | 0.147 | 0.088 | 0.147 | 0.059 | - | 0.012 | 0.006 | 0.458 |
| Inside double fence | 0.0042 | 0.0011 | 0.00199 | 0.0006 | 0.0001 | 0.0013 | 0.0007 | 0.010 |
| Outside double fence | 0.00014 | 0.00004 | 0.00007 | 0.00002 | - | 0.00005 | 0.00002 | 0.034 |
| **TOTAL** | **8.716** | **2.949** | **4.786** | **1.485** | **0.166** | **0.907** | **0.439** | **19.449** |

*) reference date: 11.04.08

The Spanish authorities and the Ascó operator considered external and internal radiation exposures.

[14] As of 9 June 2008 the total activity of particles found outside the buildings has been estimated to 260 MBq (decay reference day 29 November 2007)

### 7.4.4 External radiation exposures

The Ascó operator and CSN demonstrated that the number of radioactive particles and their local scattering does not lead to external radiation exposures which may result in radiation doses significant from radiation protection point of view.

The approved dosimetry service of the Ascó operator is responsible for operating the passive regulatory personal dosimetry system. During the verification visit the operator provided all available information about individual monitoring, recording and reporting of radiation doses to workers.

All workers entering the inner fence of the NPP are monitored for external exposures by a personal TLD dosemeter and routinely monitored for contamination before leaving the inner zone of the NPP site by passing through big surface plastic scintillator Alpha, Beta, Gamma portal monitors.

### 7.4.5 Internal radiation exposures

In the light of the above, whole body gamma spectrometry is the most appropriate method for identifying internally deposited radionuclides after inhalation or ingestion. CSN and the operator provided to the verification team the criteria for the monitoring program, which was based on factors such as:

localisation of the source,
radionuclide vector,
chemical forms and physical parameters,
selection of individuals to be monitored.

Furthermore, information was provided on training of the radiation protection staff and the management as well as on the information provided to the workers, the visitors and the public.

The team was informed that the radiation protection service and the whole body monitor of the neighbouring Vandellòs NPP were also involved in the monitoring program. The instrument used in Vandellòs NPP is similar to that used in the Ascó NPP.

It was recognised that the Ascó operator has a quality assurance programme in place for the whole body monitoring installations. Under the supervision of CSN a further quality assurance program was established. This program foresees the regular calibration of the whole body monitors with a standard phantom. These measures allow for a traceability of the monitoring results towards a secondary standard.

Additionally, CIEMAT confirmed measurements done by Ascó and Vandellòs by repeating measurements on some selected persons using their high resolution whole body monitor facilities. Until the date of the verifications 64 such additional high precision measurements were performed on 40 workers and 24 visitors (CSN inspectors) and confirmed the efficiency of the Ascó and Vandellòs whole body monitors.

The instrument type used for the whole body monitoring is a NaI(Tl) phoswich detector moving above the horizontally bedded person. The connected gamma spectrometer and the PC software are state of the art.

The presented combination of static and dynamic tests of the whole body monitors in use for the program was appropriate. The instruments in use have sufficient sensitivity to allow detection of very small amounts of deposited radioactive particles and the derived calculation of incorporated radionuclides.

Until the time of the verification visit, more that 1500 identified workers and visitors underwent the whole body monitoring procedure. The measurement results so far did not show any case of incorporation of radionuclides as a result of the uncontrolled release of radioactive particles from the Ascó nuclear power plant. The programs are to be continued.

### 7.4.6 Findings concerning Safeguards Inspectors

The presented information was sufficient for the envisaged purpose. The presented data on the sequence of the event, the origin of the radioactive particles and their chemical form and physical properties provided the basis for the evaluation of the radiological risks of the three involved nuclear safeguards inspectors. Meanwhile, the Commission Medical Service in Luxembourg and the Health Protection Cell had jointly decided to perform immediate whole body monitoring and bioassay analysis on the three involved colleagues. The assessment of external exposures of colleagues gave no reason for concern and the results of the whole body monitoring did not indicate any need for further analysis.

*The verification team noticed the installation of specific portal radioactive contamination monitors. All entries and exits for persons, goods and vehicles of the Ascò-1 reactor unit are now continuously monitored. This will prevent any unintentional spread of non-discovered radioactive particles.*

*The verification does not give rise to any recommendations with regard to the current approach to personal radiation monitoring.*

## 8 CONCLUSIONS

Further to a radiological event that occurred at the Ascó–1 NPP, a team of three inspectors of DG TREN H4 visited the Ascó–1 NPP on 28/29 April in order to obtain full information from the NPP operator and from the regulatory authority and to verify a certain number of monitoring installations implied in the above mentioned event.

All verification activities that had been foreseen by the team were completed successfully. In this regard, the information supplied during and after the verification activities, was useful.

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

(1) The verification team received detailed information about the event both from the operator and the Spanish Nuclear Safety Authority (CSN), with special focus on its sequence. This information pointed to several shortcomings of the NPP operator, particularly in the early phase after the event. The verification team took note of the shortcomings; in particular it marks the observations in (3) and (4).

(2) The programmes set up in response to the event by the NPP operator and in particular by CSN seem sound and effective to assess and to minimize the impact of the event. The team witnessed a part of the complex monitoring arrangements and verified administrative, operative and quality control measures. The information provided and the results presented to the Commission team were appreciated and the control and monitoring system put in place were considered to be appropriate.

(3) The verification team does not understand why the cleaning procedure (involving transfer channel, spent fuel pond, ventilation system) was executed with little attention to foreseeable radioactive contamination problems. It is not understandable that the exceeding of radiation alarm levels was not duly considered by the operator.

(4) The verification team identified a lack of communication between different operator's departments involved in the power station control, the radiation protection departments and the teams responsible for routine cleaning work. Furthermore, the inquiry demonstrated that routine and specific interventions are not sufficiently reviewed, monitored and recorded.

(5) The different radioactivity monitoring systems in place seem to be efficient and effective. However, procedures for systematic control of the results have to be urgently established.

(6) The measures introduced by CSN and the NPP operator after the event are in line with the provisions laid down under Article 35 of the Euratom Treaty.

(7) The verification team recommends the operator setting up a system of notifying faulty events on a 'no-blame' basis, i.e. reporting issues that have not been handled in an optimal way or have even been dealt with in an erroneous way, without risking punishment for the person responsible for the error. Each such report should immediately trigger a discussion meeting including all relevant departments and the regulator with a view of better understanding the issues and their possible consequences. The regulator then should inform other groups that may be affected by a similar event, in an appropriate way. The verification team recommends the regulatory body demanding all operators of installations that may be likewise affected to implement such an approach.

(8) The Commission Services request from the Spanish Competent Authorities to be kept fully informed about the results of the studies to explain the event in detail, as well as about any future findings relative to the Ascó event.

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