EUROPEAN COMMISSION
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DIRECTORATE H – Nuclear Energy
Radiation Protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

TRILLO NUCLEAR POWER STATION

SPAIN

27 June to 2 July 2004

Reference: ES-04/2

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 Trillo nuclear power station.

SITE: Trillo, Spain.

DATE: 27 June to 2 July 2004.

REFERENCE: ES-04/2.

INSPECTORS: V. Tanner (Head of team)
C. Gitzinger
E. Henrich (national expert on secondment – Austria)
Y-H. Bouget (national expert on secondment – France)

DATE OF REPORT: 20 May 2005

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[signed] *[signed]*

E. Henrich **Y-H. Bouget**

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1. 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)
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)
HEPA	High Efficiency Particulate Air (filter)
ISO	International Organization for Standardization
KEEPER	Environmental radioactivity measurement database of CSN
LMA	Laboratorio de Medidas Ambientales S.L.
MCDE	Manual de Calculo de Dosis al Exterior (Off Site Dose Calculation Manual)
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
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)
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

2. 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 Trillo NPP[2] and its subcontracted laboratory LMA[3], (which is responsible for the measurement of the Trillo environmental samples). The visit also included meetings with the Spanish competent authority CSN[4] and with CIEMAT[5], which provides technical support to perform the analyses of samples. Details of the programme of the verification are given under Section 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 Trillo 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 to 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 aqueous discharges of radioactivity into the environment.
- The implementation of the statutory environmental radioactivity monitoring programme as performed by the operator.
- The operator's effluent laboratory as well as the subcontracted environmental laboratory (LMA), including aspects of quality assurance and control as well as document control.
- The environmental monitoring programme as established by the competent authorities and measured independently from the operator by CIEMAT.

The present report is also based on information collected from documents referred to under Section 3 and from discussions with various persons met during the visit, also listed under Section 3 below.

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 Central Nuclear Trillo, Cerrillo alto, s/n, Trillo, 19450 Guadalajara.
3 Laboratorio Medidas Ambientales, S.L., 09500 Medina de Pomar, Barrio Villacomparada.
4 Consejo de Seguridad Nuclear /Nuclear Safety Council, Justo Dorado 11, 28040 Madrid.
5 Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Avenida Complutense 22, 28040 Madrid.

3. PREPARATION AND CONDUCT OF THE VERIFICATION

3.1. Introduction

The Commission's decision to request the conduct of an Article 35 verification was notified to the Spanish authorities on 27 January 2004 (letter referenced TREN/H4/SVdS/ms D(2004) 458, 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.

3.2. 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.

3.3. Programme of the visit

The EC and the CSN discussed and agreed upon a programme of verification activities, with due respect to 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. The Spanish authorities accepted to widen the scope of the agreed framework to encompass technical installations for monitoring airborne and aqueous radioactive discharges to the environment. The EC appreciates this as it allows an overall assessment of the environmental monitoring, including the points of release of radioactive discharges as well as the methods of control put in place at those points.

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

- Trillo Nuclear Power Plant (Trillo NPP).
- Consejo de Seguridad Nuclear / Nuclear Safety Council (CSN).
- Environmental Radiological Monitoring Programme (PVRA).
- Role played by CIEMAT and LMA laboratory / PROINSA in the PVRA.

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

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

3.4. Representatives of the Spanish authorities and the operator

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

CSN

Mr. Julio Barceló Vernet	Commissioner
Ms. Lucila Ramos Salvador	Deputy Director for Environmental Radiological Protection
Ms. Rosario Salas Collantes	Head of Environmental Radiological Surveillance Area
Mr. María José Barahona Nieto	Specialist in radiological impact assessment
Mr. José Luis Martin Matarranz	Technical advisor in Environmental Radiological Surveillance

Trillo NPP

Mr. Aquilino Rodriguez Cases	Director
Mr. José Antonio Prieto Ibáñez	Head of radiological protection and environmental control
Mr. José Manuel Garces de Marcilla	Radiological protection and ALARA co-ordinator
Mr. Manuel Esteban	Head of license department
Ms. Emilia Bonet Cervantes	Security, licences and environment
Mr. Fernando Sordo	Sample taking supervisor
Mr. José Batanero	Sample technician

CIEMAT (Madrid)

Mr. Juan Palomares López	Director of the Environmental Radioactivity Laboratory

LMA (Medina de Pomar)

Ms. María José de Lucas de Rose	Director
Ms. Lidia Alonso Heras	Laboratory QC co-ordinator

Proinsa

Mr. Agustín Herrero Ordejón	Environmental expert engineer

The verification team acknowledges the co-operation it received from all individuals mentioned. It also highly appreciated the excellent interpretation provided by Trillo NPP through the permanent presence of two interpreters: Ms. Zoila Herranz Pintado and Mr. José Enrique Delgado Boci.

4. NPP TRILLO SITE

Trillo I Nuclear Power Plant contains a Pressurised Water Reactor (PWR) of 1066 MW_{el} designed by KWU-Siemens.

Trillo is situated on the river Tajo at the site called "Cerrillo Alto" within the municipality of Trillo (Guadalajara). It is located at approximately 40°42.1' N, 2°37.5' W, some 93 km north-east from Madrid, 47 km east from Guadalajara and some 80 km north-north-west from Cuenca. Grid connection of the power plant took place on 13.05.1988.

Commercial operation began on 06/08/1988.

5. COMPETENT AUTHORITIES & LEGAL BACKGROUND

5.1. 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 the 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:

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

Table 1 NPP Radiological Environmental Monitoring Programmes [6]

The independent monitoring programme of the 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.

5.2. Competent Spanish authorities

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 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, the 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.

[6] Trillo NPP Off-Site Dose Calculation Manual (MCDE) Rev. 11, November 2003.

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 and to supervise all environmental radiological protection activities conducted by nuclear installations and by facilities using radioactive substances.

CSN is also in charge of 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 the 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; a summary of the results is posted on CSN's Internet site to provide information to the public.

5.3. 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). 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 the 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 incidents 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.

5.3.1. Certificates of authorisation for Trillo

The following authorisation certificates have been issued for the Trillo NPP:

- 4/12/1987 Licence to operate for 2 years provided by the Ministry of Industry.
- 1/12/1989 New exploitation licence for 2 years, provided by the Ministry of Industry and Energy. This license has been renewed every two years until 1999 when a five-year license was granted.

5.3.2. 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.

5.3.3. Discharge limits applicable to the Trillo site

In Spain discharge limits are the same for all Nuclear Power Plants and are fixed as shown in Table 2. The facilities' releases are kept at values well below such that the discharge dose limits, also called operational restrictions – 0.1 mSv for 12 consecutive months – are kept.

Limit	**Effluent**	**Parameter**	**Limit**
Spanish Regulatory Dose Limit for the protection of the public [7]	Total	Annual dose	1 mSv/a
Operational Restrictions [8] (Discharge Limits)	Total	Effective Dose	0.1 mSv/12 consecutive months
	Gaseous	Effective Dose	0.06 mSv/12 consecutive months
	Liquids	Effective Dose	0.04 mSv/12 consecutive months
Instantaneous limits [9]	Gaseous	Noble Gases Activity Release Rate	1.82 E+10 Bq/s
	Liquids	Activity Concentration	1.21 E+06 Bq/m^3

Table 2 Discharge limits for nuclear power plants [10]

[7] The authorisation limits are included in the ETF and in the MCDE. The current "Reglamento de protección sanitaria contra radiaciones ionizantes", that was published in July 2001, establishes 1 mSv per year as the effective dose limit for the protection of the public. 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 instantaneous limits are only used for operational purposes to estimate the effluent monitoring instrumentation alarm set points.

[8] 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.

[9] Maximum values considered in establishing the effluent monitoring instrumentation alarm set points. The given values are Trillo NPP specific.

[10] Trillo NPP Off-Site Dose Calculation Manual (MCDE) Rev. 11, November 2003.

Liquid Effluents			
Type of Release	**Sampling Frequency**	**Minimum Analysis Frequency**	**Type of Activity Analysis**
Batch releases	Before each release	Before each release	Gamma emitters
			I-131
	Before each release	Monthly composite	H-3
			Gross alpha
	Before each release	Quarterly composite	Sr-89/90
Continuous releases	Weekly continuous sample	Weekly	Gamma emitters
			I-131
	Weekly grab sample	Monthly composite	H-3
			Gross alpha
	Weekly grab sample	Quarterly composite	Sr-89/90

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
	Continuous sampling	Weekly (Charcoal filter)	I-131
	Continuous sampling	Weekly (Particulate filter)	Gamma emitters
	Continuous sampling	Monthly composite (Particulate filter)	Gross alpha
	Continuous sampling	Monthly (Tritium filter)	H-3
	Continuous sampling	Quarterly composite (Particulate sample)	Sr-89/90

Table 3 Radioactive effluents sampling and analysis programme for the Trillo NPP [12]

6. RADIOACTIVE DISCHARGES

6.1. 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.

[11] Although Carbon-14 is not specified in the gaseous sampling and analyses programme, Trillo NPP measures it monthly.

[12] Trillo NPP Off-Site Dose Calculation Manual (MCDE) Rev. 11, November 2003.

6.2. Discharge authorisation

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

6.3. Gaseous discharges

Trillo NPP gaseous radioactive effluents are discharged continuously through the general extraction system through a single stack of 100 meters height.

The extraction system channels the radioactive discharges stemming from the following sources:

- Containment purges.
- Ventilation of the containment building.
- Ventilation of the of the auxiliary building.
- Ventilation of the waste storage building.

The system receives also gases from the condenser continuous extraction system and from the treatment system of gaseous waste. The system is able to store radioactive gases for decay purposes, before releasing them into the environment in a controlled manner through the stack.

The plant ventilation system has three fans, which feed air from the buildings to the stack. In normal conditions one fan is in operation and two are on stand-by allowing one to be on maintenance. Ventilation lines located in the auxiliary building are equipped with isokinetic sampling systems (HEPA/Carbon, charcoal filters, noble gases, Tritium, C-14). There are two lines for each measurement in order to guarantee availability. Flow in each sampling line is about 11 m^3/h at the minimum, whereas a typical flow in the stack is about 250 000 m^3/h. The lines are equipped with flowmeters and heating systems in order to prevent deposits and condensation. Sampling charcoal filters are duplicated in order to guarantee continuous operation also during the weekly filter changing.

On-line readings (gas flow, noble gas, aerosol and iodine activity) are available in the control room on paper plotters. If high values appear, the control room is able to locate the leak by closing room isolation valves one by one.

In addition to on-line measurements and sampling filters, a 7 litre gas sample (7 bar) of the stack flow is collected by the laboratory weekly for a nuclide specific measurement (gamma spectroscopy).

Trillo NPP also measures C-14 (as the only plant in Spain), although there is no national regulation concerning C-14 releases in Spain [13]. The stack is equipped with activity monitors, which can be used in accident situations in case the routine operation system capacity is exceeded. These readings are available on separate plotters in the control room. The operations department archives all paper plots (one month's data on one plotter paper sheet) for possible future control.

[13] The CSN has recently required C-14 determination by all NPPs in Spain.

6.4. Liquid discharges

6.4.1. Introduction

At the Trillo NPP, liquid radioactive effluents are discharged after treatment to the river Tajo. These effluents result from:

- Effluents stemming from the primary circuit.
- Used waters from the nuclear island (blowdown from steam generators, laundry, chemicals).
- Effluents stemming from the secondary circuit.

Liquid effluents can be divided in continuous and non-continuous discharges. A control of the radioactivity level is performed prior to each non-continuous discharge to the river. The effluents from the secondary circuit are passed through a transfer reservoir and, after control of the radioactivity level, discharged directly to the river Tajo on a continuous basis. If the water flow in the river is below a certain limit, the plant is not allowed to discharge liquid effluents.

6.4.2. Continuous liquid discharges

Continuous liquid discharges from the Trillo NPP originate from the secondary circuit drain pumped to the turbine building collection wells and from there to the plant discharge channel. The collection well is equipped with a continuous activity monitoring system, which automatically stops the discharge pump if a control value is exceeded. In addition a weekly bulk composite sample is collected with an automatic sampling system (sample every 30 minutes) for laboratory analysis.

Other controlled, but usually not radioactive sources of continuous discharge, are the essential cooling water systems and the condenser flow during plant shut down.

6.4.3. Non-continuous liquid discharges

Liquid effluents from the plant are stored in five dedicated reservoirs. After adequate treatment, adapted to their nature, characteristics and origin, these effluents are transferred to three control tanks for effluents ready for discharge. For safety reasons these three tanks have a “back up connection” to three additional safety storage reservoirs, which are not used under normal conditions.

When a control tank is full the Operations department makes an application to the Radiation protection department for a tank discharge permission. Before discharge the activity of the tank is controlled. A two-litre sample is taken (one litre for total gamma measurement and one litre for gamma spectroscopy). Before the sample is taken the liquid in the tank is recirculated for 4 hours in order to guarantee homogeneity. The sample line is drained for 1 minute before taking the sample. The sample is analysed in the effluent laboratory in order to determine the isotopic composition and the dilution factor in the discharge channel. If the sample activity is too high for discharge (more than $7.5x10^5$ Bq/m^3 total gamma activity), the tank content is redirected to the wastewater treatment plant. Based on the sample result, the Radiation protection department controls the discharge parameters against the constraints of the plant discharge authorisation and approves the discharge, taking into account also the current amount of continuous liquid discharge.

Typically a discharge takes one to one and a half hours. The number of individual discharges is about 7 or 8 per month. During the discharge the control room is able to control the flow and thus the dilution factor in the discharge channel. There is also an activity monitor in the discharge line, so the control room is able to monitor the actual discharge activity. If this activity deviates more than 50% from the activity result based on the tank sample, the discharge is stopped. An alarm is given at 1.0×10^7 Bq/m^3. There is an automatic discharge cut-off if the activity is too high (greater than 3.7×10^7 Bq/m^3). If the monitor is not functioning, the discharge is automatically stopped.

After a high activity discharge there is a possibility to clean the tank with a demineralised water flush. Also the discharge line activity measurement system can be cleaned if active deposits appear.

CSN site inspectors verify the control tank levels and monitor readings daily. They can also perform spot checks on discharges without advance notification to the operator. Trillo NPP is required to report all discharges monthly to the CSN.

7. VERIFICATION ACTIVITIES – RADIOACTIVE DISCHARGES

7.1. Introduction

The verification included control of the discharge monitoring facilities and the effluent monitoring laboratory on the Trillo 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.

7.2. Gaseous discharges

The team verified that the gaseous discharge monitors and sampling filters in the auxiliary building and the stack monitors were available and operational. The team saw the mobile system for taking the weekly gas sample from the stack flow for nuclide specific analysis. In addition the team visited the control room to verify that the gaseous discharge data are available on a continuous basis and that the control room staff is aware of the system information. The procedure documentation for changing the filters was made available to the team.

The team acknowledges the measurement of C-14 at the Trillo NPP.

Verification does not give rise to recommendations.

7.3. Continuous liquid discharges

The team visited the turbine building and verified the activity monitoring system for continuous discharge monitoring in the effluent collection well and the automatic sample collection system for the weekly composite sample.

Verification does not give rise to recommendations.

7.4. Non-continuous liquid discharges

The verification team was able to follow an actual discharge of one control tank being performed. The team verified compliance with the authorisation procedure (sampling, measurement and analysis) prior to discharge and witnessed monitoring of the activity and flow rate in the control room during the discharge. The team also witnessed the controls performed by the radiation protection section of the NPP in order to ensure compliance with the discharge limits.

The team was informed that it is possible to discharge in case of abnormal situation even if the monitoring system did not function if a special procedure is applied. This is described in the procedure CE-A-CE-9601 [14]. In such a case, two independent samples are taken and analysed by two specialists. Similar results have to be obtained in both measurements and the discharge needs to be specifically authorised by the Head of Radiological Protection. In any case, such discharges can only be done during a limited period of time because, also according to the MCDE, the inoperable

[14] Descarga de efluentes líquidos radiactivos, Rev. 4 (December 2003), item “Descargas especiales” (6.3.1).

instrumentation has to be restored to operable status within 30 days. Additionally, while the discharge is taking place, an operator continuously verifies coherence between the readings on the control room plotter and the sample analysis results.

The team noted that calculation of total activity was done manually by the Radiation Protection department, which may be prone to errors. The operators later informed that the normal procedure is to do the calculation by hand and using PC software. In addition the team noted that the nuclide activity results, which were below the limit of detection (LLD) were noted as zero in the discharge report form. The value for the LLD is regulated by CSN, so in practice this procedure should not lead to an important underestimation of the total activity released.

Verification does not give rise to recommendations; nevertheless, the above observations should be taken into account.

7.5. Trillo NPP effluent laboratory

7.5.1. Introduction

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

The verification team visited the laboratory 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).

7.5.2. Liquid sample preparation

Typically there are about 7-8 tank discharges per month. When a sample is taken from a control tank, the sample information (type, date and time) is written on the bottle. Before measurement the sampling bottle is wiped outside and the sample is poured into an unmarked Marinelli beaker for measurement. After the measurement the sample is poured back into the original marked sampling bottle. For monthly measurement of Tritium, total alpha and Sr-90 one tenth of each sample (100 ml) is separated and mixed to get a monthly two litre composite sample.

The team notes that using an unmarked Marinelli beaker involves a small possibility of error in sample identification. This procedure is acceptable only as long as the number of samples is very low; i.e. there is no possibility of losing track of the sample origin.

Verification does not give rise to recommendations; nevertheless, the above observation should be taken into account.

7.5.3. Total gamma measurement on liquid samples

Liquid samples are measured for total gamma (5×10 minutes) and nuclide specific activity (gamma spectroscopy / 60 minutes). Total gamma measurement is performed using a NaI detector. Several 10-minute measurements are used in order to make sure the possible measurement system instability does not lead to measurement errors. Total gamma measurement system calibration is done with a commercial Cs-137 standard. Background is subtracted using the results of a weekly background check. The measurement is done on a gamma energy window from 0 to 2.0 MeV.

The team noted that the gamma energy window was set by Canberra technicians during system maintenance and the laboratory personnel was not fully aware of this setting. It is suggested to make sure the window upper and lower energy values are mentioned in the measurement instruction in order to facilitate control by the laboratory personnel if needed.

The team notes that using a Cs-137 calibrated system for measurement of a multi-nuclide sample is likely to lead to a systematic error due to the energy dependence of the NaI detector efficiency. However, since the purpose of the measurement is only to make sure the total activity is below the upper decontamination treatment value of 7.5×10^5 Bq/m^3, the error is unlikely to be significant.

Verification does not give rise to recommendations; nevertheless, the above observations should be taken into account.

7.5.4. Gamma spectroscopy measurement on liquid sample

Each sample is measured in a gamma spectroscopy system for one hour. Sample identification data is typed manually on the measurement PC. The system is calibrated using an Amersham multi-energy liquid standard. A detector efficiency Q/A plot is produced on a weekly basis in order to control system stability. The system performs an automatic background correction based on a weekly background measurement. The background spectrum is not identified in the spectroscopy report sheet.

The team witnessed the gamma spectroscopy measurement procedure and checked the efficiency calibration and the Q/A-plot. Efficiency calibration standard documentation was made available to the verification team.

Verification does not give rise to recommendations.

7.5.5. Measurement of charcoal filters

Charcoal filters in the gaseous discharge system are replaced weekly. The team verified the existence of the relevant laboratory procedure document.

Verification does not give rise to recommendations.

7.5.6. Tritium, total alpha and Sr-90 measurements

For the measurement of Tritium, total-alpha and Sr-90 a composite two-litre sample of individual tank samples is prepared monthly. One litre is used for the analysis and one litre is stored. Handling of samples is described in the procedure 6040 [15] and the measurement in the procedure 1010 [16]. The laboratory is equipped with a Berthold LB 770-2 Low Level Counter, which is calibrated using standards prepared by the CIEMAT laboratory (Sr-90/Y-90 in radioactive equilibrium for beta, Am-241 for alpha). There is also a liquid scintillation counter Packard 1500 Tri-Carb, which is functional, but due for replacement because of old age (as soon as possible).

Verification does not give rise to recommendations.

[15] CE-T-QU-6040 Vigilancia radioquímica de efluentes radiactivos.
[16] CE-T-QU-1010 Determinación de radioisótopos en el refrigerante primario y sistemas auxiliares.

7.5.7. Sample storage and data archiving

Liquid control tank samples and monthly liquid composite samples are stored for one year in the original sample bottle. The gas filter papers are kept for one month. Gas samples from the stack are not stored. The team verified the sample storage facilities and labelling of the stored samples.

Verification does not give rise to recommendations.

7.6. Data management and reporting

The verification team performed a spot-check on randomly chosen historical samples in order to verify the data transmission chain between the initial measurement of the sample and the final reporting to the competent authority. The team performed this check on the archived data on liquid discharges in March 2000, starting from the gamma spectroscopy result sheets and ending at the monthly discharge reporting. There were altogether five tanks discharged in March 2000. The team was able to follow the chain of data transmission and the relevant documents were made available to the team.

Verification does not give rise to recommendations.

7.7. Intercomparisons

The Trillo NPP laboratory has participated in intercomparison exercises organised among Spanish nuclear plants, external laboratories and CIEMAT. The intercomparison results were made available to the verification team.

The team wishes to support further participation in intercomparison exercises.

Verification does not give rise to recommendations.

8. ENVIRONMENTAL MONITORING PROGRAMMES

8.1. Introduction

One of the conditions of the authorisation to discharge radioactive effluents and wastes is that an environmental monitoring programme must be carried out to determine the effects of these discharges on the environment. 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. However, comparison with dose limits is based on discharge data. 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.

The current PVRA is based on the Nuclear Safety Guideline 4.1 (published by CSN in 1993) and is developed in detail in the operator's Off Site Dose Calculation Manual (MCDE). 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 the CSN and undertake a study to determine a possible relationship with the plant's discharges.

8.2. Responsibilities

Trillo plant operator carries out a part of the PVRA and manages the associated sampling. Laboratory analysis of the samples is subcontracted to LMA at Medina de Pomar. The analysis results are used by the operator for reporting to the authorities.

In parallel to the operator's PVRA the competent authority (CSN) runs a complementary environmental monitoring programme (PVRAIN), partly with the aim to verify the operator's results. This 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 CIEMAT, which reports directly to CSN.

Under the lead of the CSN Directorate for Radiation Protection a nation-wide environmental radioactivity monitoring programme is carried out. The programme consists of an automated system REA and a laboratory based system REM.

8.3. The operator's monitoring programme

8.3.1. 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. 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.

8.3.2. Programme

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

- air (particulate, iodine)
- deposition (precipitation, soil)
- drinking water
- spring water (rock filtered water)
- lake and river surface water
- ground and lake shore sediments
- water indicator organisms (bulrush [anea], watercress [berro], green laver [ova])
- milk (goat, sheep)
- agricultural products (lettuce [lechuga], cabbage [col] or white cabbage [repollo], cucumber [pepino], tomato, oats [avena])
- meat (lamb, chicken)
- eggs
- fish
- honey

8.3.3. Sampling, sample preparation and measurement

Sampling is done by 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 from Wednesday to Monday. Samples that quickly deteriorate (e.g. milk) are stabilised and/or cooled at the NPP.

On Tuesdays samples are prepared for transport (e.g. milling, mixing, splitting into sub-samples) and transported to the contracted analysis laboratory LMA at Medina de Pomar by a contracted carrier, and to CIEMAT in Madrid by the internal courier service.

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

8.3.4. Reporting and quality control

Reporting to the authorities (CSN) is basically done by monthly summary and annual detailed reports.

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. Within the analysis laboratories (LMA and CIEMAT) internal quality control programmes are applied, as defined by the certification and accreditation system in place. CSN has the power to inspect the NPP and the contracted laboratories regarding the implementation of the quality control measures.

8.4. The competent authority's monitoring programme

8.4.1. 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. The PVRA data are stored in the 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 monitoring programme PVRAIN. For this programme sampling and measurements are performed independently from the NPP by CIEMAT. Reporting is directly from CIEMAT to CSN. CSN also performs periodic inspections and audits of the NPP's PVRA.

8.4.2. Quality assurance arrangements

In nuclear facilities effluents and environmental monitoring programmes are integrated into the quality system of the plants. CSN requires the operator to implement the MCDE. This includes a list of all applicable procedures for developing effluent control and environmental radiological monitoring programmes.

Technical documentation has 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 intercomparison exercises organised by the CSN.

Quality systems which integrate the organisation's structure, responsibilities, procedures, processes and resources required for suitably managing quality have been implemented. In 1997 the CSN requested also that participants in the 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, the CSN, in collaboration with CIEMAT, has been undertaking annual analytical inter-comparison campaigns among Spanish NPPs using samples similar to those analysed in the environmental radiological monitoring programmes.

8.4.3. Environmental monitoring

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 limits when establishing the number and characteristics of the sampling points. This 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.

In order to achieve these goals, an Automatic Station Network (REA) for real time measurements of atmospheric radioactivity and a Sampling Station Network (REM) for sampling and analysis programmes of the atmosphere, ground, drinking water, milk, mixed diet, rivers and coasts have been implemented.

8.4.3.1 Automatic Station Network (REA)

The Automatic Station Network has been established for performing real-time monitoring of atmospheric radioactivity in different zones around Spain. Most of the CNS-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 4 shows the parameters monitored by the automatic stations.

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

Table 4 On-line monitoring network parameters

REA includes also other air monitoring networks not operated by the CSN, such as the networks of the Autonomous Regions of Catalonia, Valencia, Extremadura and Basque Country. The Valencia, Catalonia and Basque Country stations are connected to the CSN, which also receives data from one Portuguese station (Penhas Douradas). The Directorate General of Civil Defence also has a Radioactivity Warning Network (RAR) composed of 900 gamma dose rate measurement points.

The CSN's Web site provides information on the daily average 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.

8.4.3.2 Sampling Station Network (REM)

The sampling station network includes monitoring programmes for the aquatic medium, the atmosphere and the soil. To execute these programmes, the CSN has entered into specific collaboration agreements with the following organisations:

- Civil Works Studies and Experimentation Centre (CEDEX) of the Ministry of Public Works, 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.
- 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 and also provides the CSN with the results of radiological controls of drinking water in different areas around the country.

Implementation of Article 35 of the EURATOM Treaty regarding nation-wide radioactivity monitoring in Spain is done by setting-up 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 interior surface water points, 14 seawater points along the Spanish coastal perimeter and 15 drinking water points. The analysis of 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-flow air sampling stations, 5 drinking water and mixed diet sampling points and 4 milk sampling points.

8.4.4. 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 or diskette and biannual reports to CSN and stored in the KEEPER data base together with data from environmental radioactivity measurements.

9. VERIFICATION ACTIVITIES – ENVIRONMENTAL MONITORING PROGRAMMES

9.1. Introduction

The verification team visited measuring and sampling sites near the Trillo NPP and in the further surroundings and the sample measurement laboratories LMA at Medina de Pomar and CIEMAT at Madrid. In addition, spot checks on archived data were made in order to verify the procedures for data management and archiving.

9.2. Sampling and direct measurements at Trillo NPP site and surroundings

The verification team visited the following sampling and measurement sites:

9.2.1. Meteorological Station (C.N. Trillo 1; Torre Meteorológica; site code TRI3)

The station is located outside the NPP fence but can be reached by a sand road only from within the site (40°41.8116'N, 2°38.0748'W). The site is located some 1.2 km from the reactor (direction SW). It contains devices for air sampling (aerosols, iodines), precipitation sampling, gamma dose rate and gamma dose measurement. The station itself is fenced in and the door is locked. Power supply has redundancy built in: external and from the NPP with automatic switching if needed.

9.2.1.1 Air sampling

The air inlet is positioned at a height of approx. 3.5 m above ground. The pipe is then forked to go to the two external pumps (50 l/min) and the samplers (Herfurth) belonging to the main programme and the quality control programme, all mounted in a large screen box. Sampling is on cellulose filter and on a carbon cartridge. The sampling interval is one week.

9.2.1.2 Precipitation sampling

On top of the large screen box in a height of ca. 3.5 m a flat steel tray (ca. 67.5 cm x 62 cm x 5 cm) is situated for the collection of rain. A pipe leads to the sample bottle which is situated on the ground. Sample changing takes place at least once per month or when the container is full. The sampling device is then thoroughly cleaned, the cleaning water being part of the sample.

The verification team suggests the operators check if the precipitation bottle at site TRI3 could be mounted in such a way that it is located in a shaded position to avoid excessive vaporisation.

9.2.1.3 Dose and dose rate measurement

In approximately 1.2 m height a dose rate meter (Alnor Gammameter 2414A) and a dose meter (Alnor DB2414) are located. Dose rate is recorded on a continuous paper strip. Dose is recorded manually. Every 6 months there is a 'verification' with a radioactive source, every 2 years the device is dismounted and re-calibrated. The procedure is described in the radiation protection manual. There is no automated data transfer. The device is part of the surveillance system for emergency situations.

9.2.1.4 Long-time TLD dose measurement

The TLD device is changed every 3 months. Analysis is done at LMA, Medina de Pomar.

9.2.2. Tajo river water (site code TRI82)

A 'continuous' river water sampler ('Tajo – Muestreador Continuo) is situated 1.4 km downstream from the effluent inlet into the River Tajo, at a point where for the whole range of possible water levels complete mixing is given (40.41.5146'N, 2°35.7600'W). Sub-samples of 50 cm^3 are taken in intervals of 60 minutes (58 minutes waiting, 2 minutes for sampling procedure, time controlled by switches) and are discharged into 2 bottles (one for the NPP and CIEMAT and the other for the REM laboratory CEDEX). The sample bottles are changed every 15 days; each sample consists of about 16 l. Electric power is supplied by solar panels. The system is designed to withstand extreme flood conditions.

9.2.3. Sacecorbo (site code TRI40)

At this site goat's milk samples are taken. The site for goats' milk sampling is located some 22 km NE of the NPP, near the village of Sacecorbo (40°50.0874'N, 2°24.9186'W). The herd of goats (some 300 goats; accompanied by the herdsman and the herd's dog) roaming the area was visited by the verification team. Generally these goats are not milked but are raised for meat production. The herdsman takes the goats' milk sample on the pasture. As many goats (randomly chosen) are milked as are necessary to obtain 10 litres of milk (usually 3 to 4 animals). 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.

9.2.4. Cifuentes (Eatim Moranchel, Matadero poca capacidád)

A short visit was paid to the local butcher who serves as supplier of lamb' meat samples for the NPP. The animals come from local farms (the region is selected according to the needs of the NPP's sampling programme) and have a certificate of origin and age. Only edible parts are handed over as samples. Meat samples are homogenised before subdividing and transporting to the measurement laboratories.

9.2.5. Manantial de la Lagunilla – Sacedón – Embalse de Entrepeñas (site code TRI86)

The site for sampling filtrated water from the reservoir (which is fed by the River Tajo) is located at the foot of the reservoir's dam, some 26 km SSW from the NPP, close to the village of Sacedón near the bottom of the dam of the Embalse de Entrepeñas (reservoir), which is fed by the River Tajo (40°29.6700'N, 2°45.0966W'). Water from the reservoir that is filtrated by the sandstone bed is collected from a framed spring.

9.2.6. Chillarón (near site code TRI43)

This site where vegetable and fruit samples are taken, is situated on a peninsula stretching into the Embalse de Entrepeñas (some 16 km SSW from the NPP, ca. 40°34.4940'N, 2°43.5402'W) and is irrigated with water from the reservoir. The site contains a small field with various patches of vegetables and cereals (at the time of the visit e.g. onion, tomato, artichoke, pumpkin, peppers, potato, chard, chicory, beans, oat, turnip, zucchini, lettuce, peas, strawberry), vine and fruit trees (pear, apple, quince). The garden is irrigated with water from the reservoir Embalse de Entrepreñas. Samples consist of seasonal vegetables.

9.2.7. El Olivar (site code TRI15)

At this site which is located at the bridge over the Embalse de Entrepeñas reservoir (some 14 km SW from the NPP) surface water and sediment samples are taken. The site for taking lake water samples is slightly up-lake of the bridge over the reservoir (40°35.9454'N, 2°43.1160'W). Sample volume is 25 litres; the samples are taken directly using the sample bottle. Sediment samples (approx. 500 g) are taken directly from the bridge using a grab sampler.

9.2.8. Camino perimetral (NE) (site code TRI20)

This soil sampling site is located close to the fence of the NPP (40°42.2568'N, 2°37.0758'W). For sampling a 20 cm x 20 cm x 5 cm frame is used. 5 such subsamples are taken in an area of 2 m x 2 m, combined and then split for further analysis.

Verification found that the equipment at the various sites was in good shape, sampling and measurement procedures were available. The involved personnel were well aware of the tasks and the procedures to follow.

Verification does not give rise to recommendations.

9.3. Laboratory measurements - Medidas Ambientales S.A. (LMA)

The verification team visited the analysis laboratory Medidas Ambientales S.A. at Medina de Pomar which has been contracted for analysis of environmental samples by the Trillo NPP.

The laboratory has ISO 9001:2000 certification, which valid until 9 December 2006. It also handles environmental samples from other NPPs as well as other analysis programmes. Laboratory personnel consists of chemists, biologists and laboratory technicians. There is in-house training specific for each work place.

9.3.1. Sample reception and registration, data handling

Samples arrive from Trillo every week on Wednesdays (the sampling programme reaching from Wednesday to Monday). The verification team found the procedures for sample registration and storage well documented and in order. LMA does not check contamination since this is done at the NPP in order to assure that conventional transport means can be used.

An internal data base (called PVRA) is used for storing and retrieving all sample and measurement related data, as well as partly for data analysis. If information has to be corrected the old data would be overwritten but marked as such. However, the verification team has the impression that a full 'history log' function is not built in, i.e. for any change there is no retrievable recording of date, time and name of person performing the change in the database (in addition to keeping the original information within the system).

Concerning data storage the verification team would encourage any developments that would lead to the implementation of a real 'history log' function that allows for retrievable and traceable recording of any changes in the data base.

The verification team had a close look at various sample treatment methods. Water is treated in an evaporator with manual feeding to concentrate to 50 ml. Soil samples are manually sieved with 2 mm sieve before drying; then dried at 120°C to constant weight; then sieved with a 0.5 mm sieve. Calcination is done at 500°C.

9.3.2. Analysis procedures and equipment

Atomic absorption (Varian Spectra AA) equipment is used for stable potassium (necessary for rest-ß) and for stable strontium determination (stable Sr is added as carrier for Sr-90 analysis).

For beta measurements three Berthold LB 770, 10 channel low level counters are in use. There is no direct transfer of counting results from the equipment to the data base possible. The actual data of counting, counting time, counts etc. have to be entered in the data base by hand, whereas background and calibration data come from tables included in the software that are updated manually. Calibration is performed every 3 years, efficiency checks are done every 4 to 6 months. Background checks are

done at least monthly; a reference background is used for the calculations. This background value is updated if necessary. Counting gas is Argon-Methane with a central supply from the Garoña NPP.

Liquid Scintillation Counting (LSC) (one Packard TriCarb 1600 CA) is used for measurement of ^{3}H only. Background measurement is done using water from Medina de Pomar since the former use of 'low background' water from another area did not show different results. Data are manually transferred to the PVRA system.

The verification team suggests that if new equipment is purchased the LMA should consider buying equipment with a data interface and to implement a link to the analysis and data storage software system to avoid manual input errors. This concerns in particular beta measurements (proportional counters and liquid scintillation counters).

For gamma spectrometry seven high purity Germanium (HPGe) detectors are installed, all supplied by Canberra (incl. electronics modules and Genie PC gamma spectrometry analysis system). Background measurements are done once per month, energy calibration checks are performed using a Eu-152 source every 4 to 6 months. Marinelli beakers are used for soil, flasks for liquid samples. All used geometries are calibrated for efficiency. The analysis software uses density correction factors supplied by the Garoña NPP. The verification team noted that all information regarding detector performance, procedures etc. is in easy reach in the measurement and analysis room. The liquid nitrogen supply is well organised. Gamma spectrometry analysis has a link to the internal data analysis and storage database (PVRA) via a dedicated programme. If analysis results that deviate from normal are obtained, manual checks on the spectrum and on the calculations are performed, which could lead to repeating the measurement. Specific checks on energy, detector resolution and efficiency are done ex post (via sample analysis). If a peak shift occurs a re-calibration with a Eu-152 source is performed.

The verification team suggests that LMA explores the possibility of doing daily ex-ante checks of energy and resolution of the gamma spectrometry devices. Such a procedure would help optimising the system. It could also serve as comparison with performance data contained in the detector data sheet, which would help early detection of any equipment malfunction.

The verification team suggests to check the possibility to have a gamma spectroscopy specialist in reach for any questions related to this analysis method and for problem solving that may become necessary (e.g. for verification of detector deterioration).

TLD dosimeters (Harshaw 4500) are used for environmental dosimetry. Lithium fluoride (LiF) dosimeters are exposed for 3 months at the NPP site, whereas one dosimeter remains in a shield at the NPP as a 'unexposed' reference. LMA and CSN are currently developing a common procedure regarding estimating the dose during transport and handling.

The verification team supports the development work, which is undertaken by LMA and CSN.

9.3.3. Reporting

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

9.3.4. General technical matters and procedures

Electric power in the counting room is guaranteed by the use of a UPS. LMA has no service contract regarding detectors and electronic equipment. All scales are calibrated with weights from a relevant, accredited source.

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 team recommends that the LMA consider participation in intercomparison exercises and interlaboratory proficiency tests. In addition the above mentioned observations should be taken into account.

9.4. Laboratory measurements CIEMAT Environmental radioactivity laboratory

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. It's 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.

CIEMAT Environmental radioactivity laboratory performs the samples' laboratory analysis only. It does not analyse or comment on the results. Some of the laboratory measurement procedures (tritium in liquid, alpha/beta total and Sr-90) are accredited to comply with the ISO 17025 quality standard; others are currently going through the accreditation procedure.

In connection with the Trillo NPP CIEMAT does sample laboratory analysis on a contract basis for the operator (quality control programme) and for the CSN independent programme PVRAIN.

The verification team visited the CIEMAT Environmental radioactivity laboratory 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).

9.4.1. Receipt of samples to the laboratory

The team verified the procedures for sample receipt and identification in the laboratory. Each sample is identified with a unique sample code, which follows it throughout the different stages of the analysis and data processing.

9.4.2. Sample preparation

Sample preparation involves possible washing, weighting, drying and/or ashing operations. The team verified the instrumentation and documentation for these operations.

9.4.3. Gamma spectroscopy laboratory

Gamma spectroscopy laboratory has several high purity germanium (HPGe) detectors of different sensitivities.

Efficiency calibration of the gamma spectroscopy system is based on a commercial two-litre multi-nuclide liquid standard. The standard is divided into several sub-standards in order to facilitate different measurement types (water, iodine, ashes) and ashed in order to achieve a geometry as close to a point source as possible. Usually one standard is bought every year for calibration purposes. A calibration check is performed on regular intervals.

The counting room is air-conditioned in order to minimise temperature deviations and the electric power supply is stabilised using UPS systems. The measurement electronics and analysis systems are located in another room on the second floor of the building above the counting room.

There are altogether eight gamma spectroscopy systems in the counting room. Four of these are using a hardware multichannel analyser system and four are coupled to a PC based gamma spectroscopy system (Canberra Genie software). In the future the intention is to replace also the remaining hardware multichannel analyser with a modern and more user friendly PC based analysis system.

The team verified the availability of the detectors and associated electronics and software. A spot sample control (composite quarterly drinking water sample 03-1024, NPP sample reference 25255) was performed to verify measurement data availability and traceability.

The team supports the intention to move altogether to a PC based analysis system.

Verification does not give rise to recommendations; nevertheless, the above observation should be taken into account.

9.4.4. Alpha/beta laboratory

CIEMAT laboratory has one Canberra and two Berthold liquid scintillation counters, which are used for alpha and beta activity measurements. The team verified the procedure for sample identification and data recording on the PC.

The team noted that the analysis results are not typed in into a database, but on a very large Excel sheet. This practice seems not very user friendly and may be prone to errors.

Verification does not give rise to recommendations; nevertheless, the above observation should be taken into account.

9.4.5. Sample storage

Samples are stored for five years in the laboratory building basement. After the storage period they are disposed of. Recent samples (2003-2004) are kept in a separate room with an own storage shelf for each laboratory client. Older samples are kept in labelled boxes, each sample retaining its original laboratory identification code.

There was a certain amount of disorganisation in the storage area of the older samples, although the verification team has no reason to doubt the storage system's functionality. The verification team notes that although sample labelling facilitates finding individual samples, the storage room organisation makes this a difficult task for possible non-experienced or new staff.

Verification does not give rise to recommendations; nevertheless, the above observations should be taken into account.

9.4.6. Laboratory documentation and intercomparisons

The team verified copies of the ISO 17025 accredited measurement instructions for sample preparation, Tritium measurement, Sr-90 measurement and scale calibration, issued by the Entidad Nacional de Acreditation (ENAC).

The verification team also received copies of the results of recent intercomparison exercises, in which the CIEMAT Environmental Radioactivity Laboratory has participated [4,5].

The team acknowledges the CIEMAT participation in several intercomparison exercises and wishes to encourage this activity also in the future.

Verification does not give rise to recommendations.

9.5. Sample documentation follow-up

For follow-up the sample SDF10 (sediment sample taken on 10.7.2003 at location TRI10) was selected by the verification team. At the NPP, all information concerning sample taking and reporting was quickly available, on paper. Also at the measurement laboratory LMA all necessary information including details of the gamma analysis of the sample could be supplied quickly, mostly on computer (gamma spectrometry system and the PVRA system) and as printout.

Concerning the follow-up of sample taking, treatment, analysis and reporting, the verification team chose an example and found all data, from sampling to annual report, to be accessible and without mismatches.

Verification does not give rise to recommendations.

9.6. Verification activities at CSN

At CSN, the verification team visited the emergency room SALEM, where access to the automatic monitoring system REA was demonstrated. This room is manned on a 24h basis.

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 Trillo NPP are adequate. The Commission could verify the operation and efficacy of these facilities.

(2) A number of recommendations, observations and suggestions are formulated, mainly in relation to general quality assurance and control. These aim at improving some aspects of the environmental surveillance in and around the Trillo NPP site. They do not detract from the general conclusion that the Trillo NPP site is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

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

APPENDIX 1

REFERENCES AND DOCUMENTATION

CSN

1. Manual de calculo de dosis al exterior (MCDE), DET-02.01, Revisión 11.
2. KEEPER: Informes sobre Definición de P.V.R.A.s – Muestras de las Instalaciones.

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APPENDIX 2

THE VERIFICATION PROGRAMME – SUMMARY

Monday **27 June 2004**	• Access to Trillo NPP site - administrative procedures. • Opening meeting - Introduction of delegations. - Adoption of the programme of verification activities. - Presentations by the operator and the Spanish authorities: Trillo NPP overview, review of discharge authorisations, review of the statutory/independent environmental monitoring programmes. • Team 1: airborne discharge monitoring and sampling provisions • Team 2: environmental monitoring and sampling provisions - Dose rate monitoring. - Air sampling. - Ground water.
Tuesday **28 June 2004**	• Team 1: liquid discharge monitoring/sampling provisions. • Team 2: environmental monitoring/sampling provisions - Surface waters (vicinity of site). - Milk, grass & soil (vicinity of site).
Wednesday **29 June 2004**	• Team 1: Effluent samples laboratory - Quality assurance and control programmes. - Traceability of discharge sample data 1999-2003. • Team 2: Environmental monitoring/sampling provisions - Completion of previous day's programme.
Thursday **1 July 2004**	• Team 1: CIEMAT (Madrid) - Independent monitoring programmes. - National monitoring system. • Team 2: LMA laboratory (Medina de Pomar) - Quality assurance and control programmes. - Traceability of environmental sample data 1999-2003.
Friday **2 July 2004**	• Wrap-up meeting at CSN - Preliminary verification findings. - Visit to the emergency room SALEM.

Team 1 **Mr Vesa Tanner**
Mr Yves-Herve Bouget

Team 2 **Mr Constant Gitzinger**
Mr Eberhardt Henrich