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

PAKS NUCLEAR POWER PLANT

HUNGARY

8 to 12 November 2004

Reference: HU-04/4

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 in Hungary during normal operations of the Paks nuclear power plant site.
SITE:	Paks, (Hungary).
DATE:	8 to 12 November 2004.
REFERENCE:	HU-04/4.
INSPECTORS:	Mr C. Gitzinger (Head of team) Mr S. Van der Stricht Mr E. Henrich (national expert on secondment – Austria) Mr Y-H. Bouget (national expert on secondment – France) Ms A. Godeanu Metz (trainee) Mr J. Jehee (trainee)
DATE OF REPORT:	8 September 2005.

SIGNATURES:

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C. Gitzinger	**S. Van der Stricht**
[signed]	*[signed]*
E. Henrich	**Y-H. Bouget**
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1. ABBREVIATIONS

ADUKÖFE (or) ADvKF	Lower Danube Valley Environmental Inspectorate (of the Min. of Environment) (Hungarian acronym)
AECC	Atomic Energy Co-ordination Council
AEKI	Atomic Energy Research Institute (of the KFKI) (Hungarian acronym)
ÁNTSZ Tolna	County Institute for Public Health and Medical Officer's Services (located at the town of Szekszárd in Tolna County) (Hungarian acronym)
CMOS	Chief Medical Officer of the State (of the State Public Health and Medical Officer Service)
CRL	Central Radiohygiene Laboratory (of the NRIRR)
DCR	Dosimetry Control Room (at the Paks NPP)
DG TREN	Directorate-General for Transport and Energy of the EC
EC	European Commission
ERMAH	Radiological Monitoring and Data Acquisition Network Environmental network of the Minstry of Health (Hungarian acronym)
HAEA	Hungarian Atomic Energy Authority (**OAH** in Hungarian)
HAEA NSD	Hungarian Atomic Energy Authority Nuclear Safety Directorate (**OAH NBI** in Hungarian)
IAEA	International Atomic Energy Agency
JERMS	Joint Environmental Radiation Monitoring System (**HAKSER** in Hungarian)
KFKI	Central Physical Research Institute (Hungarian acronym)
MARD	Ministry of Agriculture and Rural Development (short: Min. of Agriculture) (**FVM** in Hungarian)
MEW	Ministry of Environment and Water (short: Min. of Environment) (**KvVM** in Hungarian, formerly **KöM**)
MH	Ministry of Health (**EüM** in Hungarian)
MHSFA	Ministry of Health, Social and Family Affairs (**ESzCsM** in Hungarian - the former name of the current Min. of Health)
MNRFE	Monitoring Network for Radioactivity in Food and Environment (of the Min. of Agriculture) (**REH** In Hungarian)
MTA ATOMKI	Institute of Nuclear Research of the Hungarian Academy of Sciences (Hungarian acronym)

NEKISE	Nuclide specific noble gas analyser (system for airborne discharge monitoring) at the Paks NPP (Hungarian acronym)
NERMS	National Environmental Radiation Monitoring System (**OKSER** in Hungarian)
NFII	National Food Investigation Institute (central laboratory of the Min. of Agriculture) (**OÉVI** in Hungarian)
NPHMOS	National Public Health and Medical Officer Service
NPP	Nuclear Power Plant
NRIRR	'Frédéric Joliot-Curie' National Research Institute for Radiobiology and Radiohygiene (**OSSKI** in Hungarian) (part of the OKK)
OKK	'Fodor József' National Public-Health Centre (Hungarian acronym)
PERMS	Plant Environmental Radiation Monitoring System (**ÜKSER** in Hungarian)
PING	Particulate, Iodine and Noble Gas (system for airborne discharge monitoring) at the Paks NPP
PURAM	Public Agency for Radioactive Waste Management (Hungarian acronym)
RMWSS	Radiological Monitoring, Warning and Surveillance System (of the Min. of the Interior)
VFCS	Veterinary and Food Control Station (regional laboratories of the Min. of Agriculture)

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 Transport and Energy (DG TREN) and more in particular its Radiation Protection Unit (TREN H4) is responsible for undertaking these verifications.

The main purpose of verifications performed under Article 35 of the Euratom Treaty is to provide an independent assessment of the adequacy of monitoring facilities for:

- Liquid and airborne discharges of radioactivity into the environment by a site (and control thereof).
- Levels of environmental radioactivity at the site perimeter and in the marine, terrestrial and aquatic environment around the site, for all relevant pathways.
- Levels of environmental radioactivity on the territory of the Member State.

A verification team from DG TREN visited (8 to 12 November 2004) the site of the Paks nuclear power plant located in the south of Hungary. The team consisted in two sub-teams, one dealing with radioactive discharges (Team 1) and the other with environmental matters (Team 2).

The visit also included meetings with representatives of various national authorities having competence in the field of radiation protection. A closing meeting was held, with all parties involved during the visit, at the headquarters of the Hungarian Atomic Energy Authority (HAEA), in Budapest.

The present report contains the results of the verification team's review of relevant aspects of the environmental surveillance at and around the Paks site, as well as the national surveillance in general.

The present report is also based on information collected from documents received and from discussions with various persons met during the visit.

3. PREPARATION AND CONDUCT OF THE VERIFICATION

3.1. Preamble

The Commission's decision to request the conduct of an Article 35 verification was notified to the Mission of Hungary to the European Union by letter TREN.H4 CG/iw D(2004)8726. Subsequently, practical arrangements for the implementation of the verification were made with the Hungarian competent authorities at a meeting held at the Hungarian Permanent Representation in Brussels (15 September 2004).

At this meeting the EC delegation presented the scope and conduct of its verification activities. The Hungarian competent authorities provided preliminary information on the Hungarian legislation and its implementation with respect to radiation protection, as well as an overview of the Paks nuclear power plant site.

1 Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation. (OJ L-159 of 29/06/1996 page 1).

3.2. Programme of the visit

At the preparatory meeting held in Brussels, a programme of verification activities under the terms of Art.35 was discussed and agreed upon with the Hungarian delegation.

The agreed programme comprised:

- The verification of liquid and gaseous radioactive discharges from the Paks NPP (sampling and monitoring systems, analytical methods, quality assurance and control aspects, reporting).
- The verification of the environmental radiological monitoring programmes as implemented by:

  i. The Paks NPP.
  ii. The Regional Laboratory for the Radiological Monitoring and Data Acquisition Network of the Ministry of Health, located at Szekszárd (near Paks).
  iii. The National Research Institute for Radiobiology and Radiohygiene of the Ministry of Health, located at Budapest.
  iv. The Radiochemistry Laboratory of the National Food Investigation Institute of the Ministry of Agriculture, located at Budapest.
  vi. The Nuclear Emergency Information and Analysis Centre of the National Directorate General for Disaster Management of the Ministry of the Interior, located at Budapest.

  At these locations the verification addressed technical aspects of monitoring and sampling activities, analytical methods used, quality assurance and control, archiving and reporting.

On 8 November an opening meeting was held at the Paks site where the operator and the competent authorities made presentations on the following topics:

- The radiological monitoring and data acquisition network systems of the Ministry of Health and of the Ministry of the Interior.
- The radiation monitoring programme of the Ministry of Agriculture.
- The environmental sampling and monitoring programme as performed by the Lower-Danube Valley Environmental Inspectorate of the Ministry of the Environment.
- The Hungarian nuclear emergency preparedness and the national radiological surveillance system under the responsibility of the Ministry of the Interior.

A summary overview of the programme of verification activities is provided in Appendix 1 to this report.

The verifications were carried out in accordance with the programme.

3.3. Documentation

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Hungarian authorities. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 2 to this report. The verification team notes the comprehensiveness of all presentations made and documentation provided.

The information thus provided has been extensively used for drawing up the descriptive sections of the report.

3.4. Representatives of the competent authorities and the operator

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

Hungarian Atomic Energy Authority:

Mr. László Koblinger	Deputy Director General
Mr. Attila Farkas	Chief Councilor

Paks Nuclear Power Plant:

Representatives mainly interfacing with the Discharge Team:

Mr. László Daróczi	Head of Laboratory
Mr. Tibor Ranga	Workshop Leader
Mr. Árpád Nényei	Radiation Protection Engineer
Mr. Péter Halász	Interpreter

Representatives mainly interfacing with the Environmental Team:

Mr. Endre Germán	Head of Laboratory
Mr. Tibor Bujtás	Head of Radiation Protection Department
Ms. Ildikó Lengyel	Interpreter

EüM Regional Laboratory (ÁNTSZ Tolna):

Dr. László Hidasi	Head of the Regional Centre for Radiohygiene
Ms. Mária Kelemen	Head of Laboratory

EüM National Research Institute for Radiobiology and Radiohygiene (NRIRR-OSSKI):

Mr. Andor Kerekesz	Head of the Radiohygiene Department
Ms. Agota Ugron	Radiohygiene Department
Mr. Sándor Szakács	Radiohygiene Department
Mr. Nándor Fülöp	Section Head
Ms. Gyopár Bányász	Radiohygiene Department
Ms. Judit Guczi	Radiohygiene Department
Mr. Gyula Szabó	Radiohygiene Department
Mr. Nándor Glavatszkih	Radiohygiene Department
Ms. Edit Bokori	Radiohygiene Department

Ministry of Environment and Water:

Mr. Bálint Dobi	Deputy Head of Department
Mr. Péter Rozmanitz	ADUKÖFE

Ministry of Interior: Nuclear Emergency Information and Analysis Centre, National Directorate General for Disaster Management:

Mr. Atilla Szántó	Head of Centre
Mr. Viktor Hák	Deputy Head of Centre
Mr. Ferenc Inkovics	Senior Desk Officer
Ms. Krisztina Tóth	Senior Desk Officer
Ms. Krisztina Szakály	Environmental Engineer

Ministry of Agriculture: the Radiochemistry Laboratory of the National Food Investigation Institute:

Dr. Sándor Tarján	Head of Department
Ms. Beáta Varga,	Deputy Head of Department
Ms.Tünde Ádámnésió	Chemist
Mr. Imre Gelencsér	Electrical Engineer
Ms. Ágnes Benczéné Banka	Technician
Mr. László Krizsik	Technician
Ms. Gizella Vajdáné Horváth	Technician

Hungarian Permanent Representation, Brussels

Mr. Andrej Sík	Energy Attaché

3.5. The Paks nuclear power plant

3.5.1. Geographical location

The Paks NPP is situated about 115 km south of Budapest. The nuclear power plant is situated 5 km to the south of the town of Paks and 1 km to the west of the Danube. Its geographical co-ordinates are 46°34'24" N and 18°54'53" E.

Adjacent to the site of Paks NPP, the Public Agency for Radioactive Waste Management (PURAM) operates an Interim Spent Fuel Storage Facility. The modular design of this facility enables periodic extensions in order to accommodate all the irradiated assemblies during the 30-year operating lifetime of all 4 Paks units. This facility is under separate management by PURAM with a dedicated discharge monitoring system. This facility is not subject of this verification.

3.5.2. Summary description of the power plant

The Paks Nuclear Power Plant includes four operating units, which were commissioned and came into operation between 1982 and 1986. The units are of the WWER-440/V-213 (second generation) type, moderated and cooled with light water.

Main technical attributes (per unit) of the Paks NPP:

Thermal reactor power	1375 MW
Electric power output	468 MW 471 MW
Number of primary loops	6
Volume of the primary circuit	237 m^3
Pressure in the primary circuit	123 bar
Average temperature of the primary coolant	282 ± 2 °C
Height/diameter of the pressure vessel	11.8 m / 4.27 m
Fuel enrichment	2.4 - 3.82%
Fuel quantity	42 tons U in 349 fuel assemblies
Number of turbines per unit	2
Pressure in the secondary circuit	46 bar

4. NUCLEAR LEGISLATION AND COMPETENT AUTHORITIES

4.1. The Act on Atomic Energy (primary legislation)

4.1.1. General provisions

Nuclear legislation in Hungary is based on the Act on Atomic Energy (Act CXVI 1996) that came into force on 1 June 1997.

The Act on Atomic Energy (hereafter referred to as the Act) establishes the basis for the development of a legislative and regulatory system for the safe application of nuclear energy. The Act specifies that the tasks of control and surveillance of the safe application of nuclear energy are the responsibility of the Government.

The Act was modified by Parliament in 2003 and, in compliance with the recommendations of the European Union, the independence of the regulatory authority was strengthened. To that effect the then Hungarian Atomic Energy Commission was dissolved and the role and independence of the Hungarian Atomic Energy Authority (HAEA) reinforced.

The Act stipulates that atomic energy can only be used in ways identified by (derived) legal instruments (governmental and ministerial decrees) and shall be subject to regular supervision by designated competent authorities.

The Act can be downloaded from the HAEA web site (www.haea.gov.hu).

4.1.2. The Hungarian Atomic Energy Authority

The HAEA is a government-directed, public administrative organisation with its own general scope of authority and its own tasks and regulatory competence.

With regard to its responsibilities the HAEA is required to perform regulatory tasks related to the safe application of atomic energy, particularly those related to nuclear safety and the safety of nuclear installations (licensing) and nuclear materials.

The Director General of the HAEA and his deputies are appointed and dismissed by the Prime Minister. The Government exercises supervision over the HAEA through a minister - appointed by the Prime Minister - acting independently of his ministerial duties. Since 10 November 2004 the Minister of Justice has been performing this task.

4.1.3. Responsible Ministers

The Act names the following ministers as having major responsibilities:

- The Minister of Health (MH - EüM in Hungarian) - through his/her National Public Health and Medical Officer Service - is the national Radiation Protection Authority. The latter is responsible for *inter alia* defining dose constraints and carrying out the central collection, processing, recording and evaluation of data relating to the national radiation situation (centralisation of the data of the various Hungarian environmental monitoring programmes). See also sections 4.2.2 and 4.2.3 below.
- The Minister of Environment and Water (MEW - KvVM in Hungarian) for *inter alia* defining the maximum quantity of radioactive materials that may be released to the atmosphere and into water bodies (discharge limits). See also section 4.2.2 below.
- The Minister of Agriculture and Rural Development (MARD - FVM in Hungarian) for the inspection of radioactivity in soil, flora, fauna and produce of both vegetable and animal origin.

Other ministers and organisations that participate in radiological protection are: the Minister of the Interior (more in particular with respect to matters of early warning and emergency preparedness in case of radiological incidents), the Minister of Economy and Transport, the Minister of Defence, the Minister of Culture and Public Education, and the Hungarian Mining Office. An overview of the bodies involved in nuclear legislation is given in Appendix 3 to this report.

4.1.4. The Atomic Energy Co-ordination Council

The activities in the field of nuclear safety and radiation protection of the above mentioned ministries and organisations are co-ordinated by the Atomic Energy Co-ordination Council (AECC). The AECC is appointed by government and is composed of executive officers of the said ministries and administrative bodies. The AECC is chaired by the Director General of the HAEA.

4.2. Decrees (derived legislation)

The Act on Atomic Energy provides the legal basis for issuing decrees and regulations aiming at the implementation and enforcement of the requirements listed therein.

The following decrees are worth mentioning in the framework of this report. A number of relevant topics are briefly presented.

4.2.1. Decree 16/2000 (VI.8) EüM - on the implementation of the provisions of the Act CXVI of 1996 on Atomic Energy

This Decree by the Minister of Health introduces basic standards in accordance with international references such as publication ICRP 60 (International Commission on Radiological Protection) and the IAEA SS-115 (safety standards) and transposes Council Directive 96/29/EURATOM into national law. This Decree lays down the basis of radiation protection in Hungary.

A radiation protection service shall be set up in all installations applying nuclear energy. All users are obliged to prepare an internal radiation protection standard, which must be approved by the competent authority. The competent authority is the National Public Health and Medical Officer Service (NPHMOS) of the EüM.

4.2.2. Decree 15/2001 (VI.6) KöM - on discharges of airborne and liquid radioactivity and their monitoring when using atomic energy

4.2.2.1 <u>With respect to radioactive discharges</u>

It is specified in this Decree by the Minister of the Environment that the user of atomic energy (i.e. the Paks NPP) shall derive its annual limits of discharge of radioactive effluent in accordance with the methodology (based on dose constraint) as specified by the National Public Health and Medical Officer Service (NPHMOS) of the EüM.

The dose constraint for the Paks site is set by the NPHMOS at 100 µSv/y (90 µSv/y for the NPP itself and 10 µSv/a for the adjacent spent fuel interim storage facility).

The derived discharge parameters and limits shall be submitted to the regional Lower Danube Valley Environmental Inspectorate [(2)], hereafter referred to as the ADUKÖFE (Hungarian acronym), for validation and approval. Upon validation the HAEA Nuclear Safety Directorate (HAEA NSD - OAH NBI in Hungarian) issues the license to operate.

It is stipulated that the Paks NPP shall assess its radioactive discharges (gaseous and liquid) for all possible release pathways by continuous on-line monitors.

It is also stipulated that the Paks NPP shall assess its radioactive discharges (gaseous and liquid) for all possible release pathways by representative sampling methodologies and adequate analytical procedures. To that effect the decree also requires that the Paks NPP analytical laboratory must seek accreditation for specified analyses and must have a quality assurance system in place.

2 Full name is: Lower Danube Valley Environmental Protection, Nature Conservation and Water Inspectorate.

ADUKÖFE is to supervise that the Paks NPP operator acts in compliance with its statutory obligations as regards radioactive discharges and their monitoring and reporting of results.

The currently applicable discharge limits for the Paks NPP are given in Appendix 4 to this report.

The current statutory discharge samples measurement programme is given in Appendix 5 to this report. This discharge measurement programme is integral part of the statutory Plant Environmental Radiation Monitoring System (PERMS - ÜKSER in Hungarian).

The measurement results are to be transferred to the Data Collection and Evaluation Centre of the National Environmental Radiation Monitoring System (NERMS - OKSER in Hungarian), operated by the National Research Institute for Radiobiology and Radiohygiene (NRIRR - OSSKI in Hungarian) of the Ministry of Health.

The ADUKÖFE has to perform an independent sampling and analysis programme to confirm the results obtained by the Paks NPP operator (Appendix 11 to this report).

4.2.2.2 With respect to environmental surveillance

Nuclide-specific measuring methods shall be applied when determining activity concentrations in environmental samples. Gross-beta measurement results may only be used for trending purposes.

Detection limits shall correspond to international and national quality levels.

Paks NPP is to monitor continuously the external gamma-dose rate as well as the atmospheric concentration and deposition of radionuclides around the facility. Periodical monitoring through sampling and analysis is to be applied to river water, sediment, ground water, soil, grass, feeding stuffs and indicator plant samples in several locations.

The decree also requires that the NPP environmental laboratory must seek accreditation for specified analyses and must have a quality assurance system in place.

The current statutory environmental monitoring programme is given in Appendix 6 to this report. This environmental monitoring programme is integral part of the statutory Plant Environmental Radiation Monitoring System PERMS.

The environmental monitoring results are to be transferred to the Data Collection and Evaluation Centre of NERMS.

The ADUKÖFE is to supervise that the Paks NPP acts in compliance with its statutory obligations as regards environmental surveillance and the reporting of results thereof.

The ADUKÖFE has to perform an independent sampling and analysis programme (see Appendix 11). This sampling programme around the Paks NPP is performed in conjunction with the Ministries of Agriculture and Health: the Joint Environmental Monitoring Programme (JERMS - HAKSER in Hungarian). To complete the JERMS the Paks NPP is required to provide meteorological and operational data (including information about discharges of radioactive effluents into the environment).

JERMS is further discussed in section 7 below.

4.2.3. Decree 8/2002 (III.12) EüM - on the operation and structure of the radiological monitoring and data acquisition network of the health sector

This Decree by the Minster of Health describes the legal background and principles of operation of its own radiological monitoring network (ERMAH - Hungarian acronym).

The ERMAH network is laboratory based (environmental sampling and analysis) and its structure comprises one central high-level laboratory located on the premises of the NRIRR, 7 regional centres and 3 local laboratories.

The central laboratory of the NRIRR has been accredited.

The NRIRR submits the programme of ERMAH for approval (on a yearly basis) to the Chief Medical Officer of the State (CMOS of the Ministry of Health). By approving the programme the CMOS accepts his final responsibility in this matter. Upon approval the programme is distributed to the various laboratories for implementation.

The sampling/monitoring programme focuses on air, surface waters, soil, drinking water and essential components of the food chain for human consumption. Analytical procedures performed are mainly of gross beta and gamma spectrometric nature. The results are published annually in the "Egészségtudomány" (Health Science) Journal.

ERMAH is further discussed in sections 7 and 9 below.

4.2.4. Decree 275/2002 (XII.21) Korm - on the monitoring of the national environmental radiation situation and levels of radioactivity

This Government Decree describes the legal background and principles of operation of the National Environmental Radiation Monitoring Systems NERMS. It defines the structure of the monitoring systems and networks as well as the monitoring and reporting requirements. The decree also stipulates that the scope of the monitoring is to include the radiological surveillance of the food chain for human consumption (this part is operated by the Min. of Agriculture and the Min. of Health). The national environmental monitoring shall be organised by a steering committee represented by members of all ministries and/or organisations involved and shall be chaired by the HAEA. The decree requires the NRIRR to operate the Data Collection and Evaluation Centre of the system.

It must be noted that NERMS is currently being built up: the data resulting from the tasks and responsibilities of various ministries involved in radiological environmental monitoring will, in future, be centralised into one database under NRIRR supervision. This database will also become the single repository of data to be transmitted to the European Commission under the provisions of Art.36 of the Euratom Treaty.

Finally, it is worth mentioning that this decree incorporates Commission Recommendation 2000/473/Euratom [(3)] into national law.

4.2.5. Decree 114/2003 (VII.29) Korm - on the scope of duty, the authority and jurisdiction of imposing penalties of the HAEA; and on the activities of the AECC

This Government Decree defines the duties and obligations of the HAEA as an independent regulatory body. It also defines the composition (members) of the Atomic Energy Co-ordination Council (AECC) and stipulates that the AECC shall co-ordinate the activities of ministries and other bodies vested with regulatory powers under the Act on Atomic Energy. The AECC shall make recommendations, present its opinion and request investigations where and whenever deemed necessary.

3 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 population as a whole. (OJ L-91 of 27/07/2000 page 37).

4.3. Paks NPP - provisions for discharge monitoring

Decree 15/2001 stipulates that the Paks NPP is to assess airborne and liquid releases of radioactivity into the environment by representative sampling (and analysis) and continuous on-line monitoring. These assessments shall be implemented in accordance with a set of regulations at plant level.

The cornerstone of these regulations is the 'Approved regulation on the monitoring of emissions': it is a technical implementation document from the operator, approved by the ADUKÖFE and validated by the Nuclear Safety Directorate of the HAEA, which sets out how the operator will discharge himself from its regulatory obligation (4).

This regulation describes the means, methods and tools for assessment and reporting, as well as the criteria for ensuring efficiency and effectiveness of these operations.

The other relevant documents are: the Technical Operating Regulation (of the NPP), the Plant Radiation Protection Code, the Operating Manual for the monitoring systems (internal ref. 01-02SV04) and the Quality Manual for the analytical laboratory. The latter is based on the MSZ EN ISO/IEC 17025:2001 standard of the National Accreditation Body. Some of these documents must be approved by the ADUKÖFE.

Provisions for airborne and liquid discharges of two adjacent units are shared, i.e. unit 1&2 (block 1) and unit 3&4 (block 2) have identical discharge systems and procedures in place.

4.3.1. Airborne discharges

For each block the various ventilation/extraction systems join into one central duct. Before joining the central duct the extraction systems are fitted with HEPA and/or charcoal filter banks (depending on the origin of the extract and thus the potential presence of radioactive contaminants).

This central duct is horizontal, connects to twin stacks (that discharge at a height of 120 m) and houses the discharge sampling line nozzles and flow meters. The sampling lines are operated by frequency controlled pumps. The sampling lines continuously feed the statutory monitoring and sampling equipment that is installed in a separate room below the central duct.

The nominal air flow through the horizontal duct amounts to 550 000 m^3/h but, depending on the number of operating ventilators, this flow may vary between 400 000 m^3/h and 700 000 m^3/h.

The technical details of the various monitoring and sampling systems for airborne discharges are described in section 5.1 of this report.

4.3.2. Liquid discharges

Discharges of liquid effluents (potentially) containing radioactivity are performed batch-wise into the outbound leg of the cooling channel feeding the NPP's condenser cooling systems.

Under normal operation (potentially) radioactive liquid discharges originate from two sources:

- Low-active process system waters (5).
- Potentially low-active sanitary waters (laundry, showers, toilets etc.).

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4 At the time of the verification visit: Approved regulation on the monitoring of emissions [at the Paks NPP], ref. RE-3603/00310/4 dated 29 January 2004 *(Kibocsátás ellenörzési szabályzat).*

5 During outage periods, the cleaning of the secondary side of the steam generators is an additional source of liquid effluent to be discharged. This type of effluent and its discharge are controlled in a similar fashion as the low-active process waters

These two effluent streams are fully separated with distinct handling, treatment and storage facilities. Discharge lines towards the outbound leg of the cooling channel are also separated. Discharge lines are equipped with gamma radiation monitors.

Every batch-wise discharge of liquid effluents (i.e. the emptying of a tank containing such effluent into the discharge line) is subject to authorisation by (a) duly authorised person(s).

Such an authorisation to discharge is granted after having assessed whether the activity contained within the batch (tank) to be discharged does not transgress radiological and chemical limits that are laid down in Water Discharge Procedure ELJ-ÜZVT-03-04.

Assessment of the activity to be discharged is done through representative sampling of the discharge tank and subsequent analysis of the sample at the effluent laboratory.

The technical details of the various monitoring and sampling systems for liquid discharges are described in section 5.2 of this report.

4.4. Paks NPP - provisions for environmental monitoring

Decree 15/2001 stipulates that the Paks NPP is to assess levels of environmental radioactivity (in air and water) that are related to the plant's discharges of airborne and liquid radioactivity into the environment. This assessment shall be performed through representative sampling (and analysis) and on-line monitoring of both media, and shall be implemented in accordance with a set of regulations at plant level.

The cornerstone of these regulations is the 'Approved regulation on radiation protection monitoring for the environment at Paks Nuclear Power Station': it is a technical implementation document from the operator, approved by the ADUKÖFE and validated by the Nuclear Safety Directorate of the HAEA, which sets out how the operator will discharge himself from its regulatory obligation [(6)].

This regulation describes the means, methods and tools for assessment and reporting, as well as the criteria for ensuring efficiency and effectiveness of these operations.

The other relevant documents are: the Operating Manual for the monitoring systems (internal ref. 00SV05) and the Quality Manual for the analytical laboratory. The latter is based on the MSZ EN ISO/IEC 17025:2001 standard of the National Accreditation Body. All these documents must be approved by the ADUKÖFE.

The details of the environmental monitoring programmes by the Paks NPP, but also those programmes that are implemented by the various competent authorities are described in section 7 of this report.

5. CONTROL OF RADIOACTIVE DISCHARGES

This section of the report succinctly describes the technical and organisational provisions that are in place at the Paks NPP to comply with its legal obligations.

At the time of the verification visit two parallel sets of airborne discharge sampling and monitoring devices were in place at block 1: the old system (partially decommissioned) and one of recent manufacture. The latter was fully operational but still under commissioning. The competent authority

6 At the time of the verification visit: Approved regulation on radiation-protection monitoring for the environment at Paks Nuclear Power Station, ref. RE-3603/00301/4 dated 29 January 2004 (*A Paksi Atomerőmű környezetének sugárvédelmi ellenörzési szabályzata*).

notified the verification team that final acceptance and validation of the new equipment was scheduled for September-October 2005. The team was also notified that a similar refurbishment was ongoing at block 2.

Note: with respect to airborne discharges, the new monitoring/sampling system is focussed upon in the following section.

5.1. Airborne discharges

The sampling system for airborne discharges consists of two parallel and redundant systems. One of them acts as a back-up and can be activated whenever a technical failure occurs. Each system comprises 1 primary and 3 secondary sampling circuits. A simplified schematic of the system is provided in Appendix 7 to this report.

The design of the sampling systems ensures that the sampling error due to sedimentation, diffusion, impaction and absorption, is small (in accordance with the recommendations of industry norms DIN 25423-1:1999:12 and ANSI/HPS N13.1-1999). Technical drawings are provided in Appendix 8 to this report.

5.1.1. The primary sampling line

This sampling line collects the discharge effluent in the horizontal duct through 4 sampling nozzles. A frequency controlled pump ensures the aspiration of the effluent. The pumping frequency is steered by an electronic device (type Kálmán KS-411-S, air velocity/volume flow rate measuring system) that is linked to various air flow detection probes. The measurement results of these probes are used to continuously ensure an isokinetic and proportional sampling of the effluent stream.

Appendix 8, Figs. 1, 2 and 3 show:

- A system of 9 air velocity meters in a 3x3 grid in the horizontal duct and two reference flow meters before each of two more or less centrally placed sampling tubes (equipped with 4 sampling nozzles each).
- Two primary sampling circuits equipped with two air pumps with frequency controlled motors to ensure isokinetic and proportional sample taking.

5.1.2. The secondary sampling lines

Three secondary sample lines tap into the primary sampling line through dedicated sampling nozzles. See Appendix 8, Figs. 4 and 5.

Of the three secondary sampling lines, two lines are feeding on-line monitors (called PING-1 and PING-2) whilst the third line feeds 9 sampling devices.

The flow rate within the secondary sampling is set in such way (approximately 10 m^3/h) that during normal operation conditions (exhaust air flow of 550 000 m^3/h) the secondary sample taken is practically isokinetic (sampling error kept within ± 1%).

During off-normal operation, with enhanced or reduced ventilation air flow, near isokinetic sampling cannot be fully ensured. However, calculations by the Atomic Energy Research Institute (AEKI) of the Central Physical Research Institute (KFKI) have shown that under off-normal operation the error can be kept within ± 5%.

5.1.3. Sampling devices

The sampling devices number 9 in total, of which 3, although operated by NPP staff, take samples for the regulator. See Appendix 7.

5.1.3.1 The sampling devices for the operator are:

- Filters for aerosols and iodines (elemental and organic) - daily exchange of filters.
- Filters for aerosols and iodine (elemental) - weekly exchange of filters.
- Tritium bubbler (tritiated water and gaseous) - fortnightly exchange of bubbler bottles.
- Carbon-14 (CO_2 and C_nH_m) - fortnightly exchange of bubbler bottles.
- Noble gases - daily exchange of sampler (10 dm^3 collecting bag).
- Krypton-85 - monthly exchange of sampler (26 dm^3 collecting bag).

5.1.3.2 The sampling devices for the regulator are (see also section 5.4):

- Filters for aerosol and iodine (elemental) - weekly exchange of filters.
- Tritium bubbler (tritiated water and gaseous) - fortnightly exchange of bubbler bottles.
- Carbon-14 (CO_2 and C_nH_m) - fortnightly exchange of bubbler bottles.

5.1.4. Monitoring devices - PING system

The monitoring system is called PING (Particulate, Iodine and Noble Gas emissions monitor) and comprises the following three on-line measurement devices:

5.1.4.1 An aerosol measuring unit, type ABPM 201-L (by MGPI).

The detector is a 450 mm^2 double silicon PIPS (passivated implanted planar silicon).
Integration time: 60 minutes.
The measurement range for beta is 1 Bq/m^3 to 10 MBq/m^3.
The system's warning level is set at 2.3E+07 Bq/hour, the alarm level at 7E+07 Bq/hour.

5.1.4.2 An iodine measuring unit, type IM 201-L (by MGPI).

The detector is a NaI(Tl) scintillator.
Integration time: 60 minutes.
The measurement range is 3.7 Bq/m^3 to 3.7 MBq/m^3.
The system's warning level is set at 9.1E+06 Bq/hour, the alarm level at 2.7E+07 Bq/hour.

5.1.4.3 A noble gas measuring unit, type NGM 204-L (by MGPI).

The detector is a 450 mm^2 double silicon PIPS.
Integration time: 10 minutes.
The measurement range is 3.7 kBq/m^3 to 3.7 GBq/m^3 (for Kr-85).
The system's warning level is set at 1.5E+11 Bq/10min, the alarm level at 4.4E+11 Bq/10min.

All the components of PING raise audible and visible alarms at the Dosimetry Control Room (DCR) when set thresholds are transgressed. PING will also raise alarm at the DCR in case of malfunctioning of one of its components.

5.1.5. Monitoring devices - NEKISE system

NEKISE is a continuously operating on-line gamma-spectrometer for noble gas (after aerosol and iodine filtration) located in a separate room and fed by a dedicated sampling line. The system is equipped with two HPGe detectors. The detector is located in a steel vessel in which are also present two reference sources (Am-241 and Cs-137).

This system determines the activity concentration of Argon, Krypton and Xenon radioisotopes, integrated over 10 minute periods with a measurement range between 1E+02 and 1E+08 Bq/m³.

Measured values are displayed at the DCR where warning and alarm thresholds (Bq/h) are set for individual isotopes (Ar-41, Kr-85m, Kr-87, Kr-88, Xe-133 and Xe-135).

5.2. Liquid discharges

At Paks NPP two distinct discharge lines are present, one originating from radioactive process waters, the other from potentially active waste waters (laundry, cleaning, showers and toilets). Appendix 9 to this report gives an overview of these discharge lines.

5.2.1. Radioactive process waters

Paks NPP has 4 discharge tanks for radioactive process waste waters. These are the TM50-type sentencing tanks with a capacity of 75 m³ each. Before discharge the tanks must be sampled and depending on the analysis results (indicating that the activity concentration and pH discharge criteria are met - see section 5.2.4) one of two discharge routes is chosen:

- Via the sewage drain monitored by detector V3 [(7)], directly into the outlet channel for dilution before mixing with Danube waters.
- Via the 'hot' condenser cooling loop, for pre-dilution, and then into the outlet channel for further dilution before mixing with Danube waters. The discharge line connects downstream from detector D [(8)] monitoring the 'hot' condenser cooling loop. Detector V2 is the second-level monitoring device controlling the (combined) discharge from TM50 tanks and/or condenser cooling water.

In case that the discharge criteria are not met, the content of the tank must be returned to the effluent treatment plant for further processing.

All samples taken to establish whether the discharge criteria are met, are further analysed to retrospectively provide details on the the radioisotopes emitted. These data are compiled into monthly discharge accountancy reports that are subsequently transmitted to the regulatory body.

5.2.2. Potentially radioactive waste waters

Paks NPP has 4 discharge tanks (+ one back-up capacity) for potentially radioactive process waste waters. These are the XZ01-type tanks (sanitary waters) and the XZ12-type tanks (laundry). Before discharge the tanks must be sampled and if the analytical results indicate that the discharge criteria are met, the tank can be emptied into the sewage drain (monitored by detector V3).

In case that the discharge criteria are not met, the content of the tank must be returned to the effluent treatment plant for further processing.

All samples taken to establish whether the discharge criteria are met, are further analysed to retrospectively provide details on the the radioisotopes emitted. These data are compiled into monthly discharge accountancy reports that are subsequently transmitted to the regulatory body.

7 Detectors V1, V2 and V3 are on-line gamma radiation monitors belonging to the environmental surveillance programme of the Paks NPP.

8 The denomination 'D' summarises two serial sets of multiple gamma detectors (for operations control).

5.2.3. On-line monitoring provisions

5.2.3.1 Environmental monitors

Detectors V1, V2 and V3 have the following technical characteristics:

- NaI(Tl) scintillation detector, centrally positioned in a shielded 400 dm^3 tank with overflow weir (for V3 this tank is smaller: 30 dm^3).
- Tank filled by two alternatively operating diving pumps.
- Continuous operation with uninterruptible power supply.
- Integration time: 590 seconds.
- Measurement range: appr. 1 kBq/m^3 to 1 GBq/m^3 (Cs-137 equivalent).
- Data analysis 10 seconds.
- Data (gross gamma activity concentration) transmitted to the DCR (spectral information only locally available - to be retrieved manually).
- Data transmission alarmed, alarm thresholds are:

Detector	Warning level (kBq/m^3)	Emergency level (kBq/m^3)
V1	10	20
V2	10	20
V2-V1	5	10
V3	100	500

- Systems' fault alarms relayed into the DCR.
- Continuous inlet channel, outlet channel and sewage drain flow rate monitoring.
- Continuous proportional sampler, 24 hour sampling period (collecting 5-7 dm^3), operated by Environmental Laboratory staff.

5.2.3.2 Operation monitors

Two additional detectors, F1 and F2 (both are gamma monitors), are installed on the sewage drain. These monitors are installed for on-line operational control and provide discharge activity concentration information downstream from the discharge tanks.

Monitors F1 and F2 are equipped with NaI(Tl) scintillation detectors with a measurement range between 2 kBq/m^3 and 2 GBq/m^3 (measured values are compensated for background).

5.2.4. Discharge criteria

5.2.4.1 Criteria for the effluent tanks

Tank type	Beta activity (Bq/l)	pH	Alpha activity (Bq/l)	Discharge
TM50	0 - 100	5 - 10	0 - 0.5 or 0.5 - 5 (*)	yes
	> 100 - ≤1000 (*)	5 - 10	0 - 0.5 or 0.5 - 5 (*)	yes
	> 1000 (**)	5 - 10	> 5	no
	< 1000 (**)	< 5 or > 10	> 5	no
XZ12	0 -500	> 5		yes
	> 500 -1000 (*)	> 5		yes
XZ01	0 -500	> 5		yes
	> 500 -1000 (*)	> 5		yes

(*) In these cases the permission to discharge must be given not only by the engineer on duty (operations) but also by the director of the Paks NPP Radiation Protection Department (or his deputy).

(**) In these cases the tank cannot be discharged and its contents must be returned to the water treatment plant for further processing.

5.2.4.2 Criteria for the condenser cooling circuits

The activity concentration, due to liquid discharges from the NPP condenser cooling systems, shall not exceed 85 Bq/dm³ in the covered part of the hot water channel (detectors D [9] - see appendix 9) and shall not exceed 10 Bq/dm³ in the open part of the outlet (detector V2). The operator must immediately eliminate the discharge source and shut down the plant if, for a given Unit, both detectors present at D simultaneously signal more than 85 Bq/dm³ and, at the same time, the difference measured between V1 and V2 exceeds 10 Bq/dm³. The ADUKÖFE must also immediately be notified if a limit transgression occurs.

5.2.5. Discharge authorisation and procedure

The authorisation of the discharge consists of the following steps:

- Operations fill the tank to its maximum level and notify the Dosimetry Control Room (DCR).
- A member of operations staff manually closes the inlet valve of the tank and the DCR duty officer puts a seal on it.
- Operations start the homogenisation of the tank (by recirculating its contents for half an hour.
- Effluent laboratory staff takes a sample from the homogenised tank contents, after having drained the sample line for 10 minutes.
- The sample is measured at the effluent laboratory and the results forwarded to operations.
- If the analytical results of the sample show that the discharge criteria are met, permission for discharge is granted by the duly authorised person(s).
- The DCR duty officer removes the seal from the outlet valve and a member of operations staff starts the discharge by manually operating the valve.
- When the tank is emptied, a member of operations staff closes the outlet valve and the DCR duty officer puts a seal on it. The seal from the inlet valve is then removed and the valve opened, making the tank available for filling.

5.3. Effluent laboratory

The laboratory is accredited under Nr. NAT-1-1195/2003, according to MSZ EN ISO/IEC 17025:2001. Aspects of quality assurance and control for laboratory equipement, analytical procedures and data management are ensured through a written Quality Manual and its related compilation of written operating instructions. The Manual also lists the equipment the laboratory must possess in order to be able to discharge the Paks NPP from its regulatory obligations with regard to the statutory sampling and analysis programmes. The Manual is subject to yearly revisions.

5.4. Independent control by the regulator

The independent regulatory control is performed by the ADUKÖFE. Details of the regulator’s control programme are given in Appendix 11 to this report. Samples collected are analysed at the ADUKÖFE laboratory that is accredited under Nr. NAT-1-1266/2004, according to MSZ EN ISO/IEC 17025:2001.

Discharge data are compared between the regulator and the operator (consistency checks and trend analysis) on a yearly basis. This verification exercise then leads to validation (or correction if deemed necessary) and final acceptance by the regulator of the operator’s discharge data. During the exercise

9 Note that for each Unit, at position D, two detectors are present.

the operational status of the sampling/monitoring equipment for the previous year is also discussed and assessed (continuity of operation, representativeness of samples taken, calibration of devices etc.). After final acceptance by the regulator, the Radiation Protection Department of the Paks NPP issues its yearly report on radiation protection matters.

This independent control is part of the Joint Environmental Radiological Monitoring System (JERMS) that is further discussed in section 7.3 of this report.

6. VERIFICATION ACTIVITIES - RADIOACTIVE DISCHARGES

6.1. Airborne discharges

6.1.1. Verification activities

The verification team visited:

- The central duct where the various ventilation/extraction systems of the plant come together. The verification team observed the sampling lines put in place.
- The room in which the various monitoring and sampling devices are located. The team verified the existence and functionality of all the monitoring and sampling provisions as defined in the regulatory obligations.
- The Dosimetry Control Room (DCR) where the team observed the systems and provisions available for discharge control.

6.1.2. Verification findings

6.1.2.1 The sampling lines in the central duct

The verification team confirmed the existence of the sampling systems as described in section 5.1 above (and illustrated in Appendix 8).

The verification team noted that:

(1) The reference flow detection probes and their support pillars (see Appendix 8, figs. 1, 2 and 3) are positioned in front of the primary sampling nozzles. The distance between the sampling nozzles and the detection probes is less than 2 metres. The flow detection probes and their support pillars are bound to create turbulences in front of the sampling nozzles. The proximity between probes and nozzles might have as a consequence that the nozzles are sampling in a non-laminar environment. If this is the case the sampling might not be fully representative.

Although isokinetics are ensured the verification team questions the representativeness of the samples taken by the primary sampling nozzles.

It is suggested that the competent regulatory authority undertake investigative action and enforce remediation if necessary, so as to satisfy itself that the primary sampling line is taking representative airborne discharge samples.

6.1.2.2 The monitoring and sampling devices for airborne discharges

Note: At the time of the verification visit two parallel sets of airborne discharge sampling and monitoring devices were in place: the old system (partially decommissioned) and one of recent manufacture. The latter was fully operational but still in a testing phase. The verification activities focussed upon the new system.

The verification team confirmed the existence and functionality of all the monitoring and sampling provisions as described in sections 5.1.3 and 5.1.4 above.

The verification team noted that:

(1) The new monitoring and sampling system are state-of-the-art.

(2) Continuous monitoring and sampling is ensured.

(3) Back-up power supply is available (inverter).

(4) A spare frequency controlled pump (for the primary sampling lines) was present in the monitoring and sampling room for immediate replacement in case of need.

(5) Monitors are calibrated once a year by the Paks NPP (certified) Metrology Department.

(6) The programme of airborne effluent sampling by the operator (as described in Appendix 5, section 2) is satisfactory.

(7) Quality control is implemented through a compilation (the Quality Manual) of comprehensive written working instructions.

(8) Independent control by the regulator: the sampling devices for H-3 and C-14 (as mentioned in section 5.1.3.2 above) although operational, are not yet in use. The verification team was informed that the regulator intends to take up H-3 sampling and measurement in the 2005 control programme. Also that C-14 sampling will be implemented when the regulator's laboratory will have obtained an extension of its accreditation to include C-14 measurements (expected end 2006 - beginning 2007).

With respect to (8):

> *It is suggested that the competent regulatory authority take advantage of its sampling systems for airborne C-14 and H-3 as early as possible.*

6.1.2.3 The Dosimetry Control Room

The verification team noted that:

(1) The PING activity concentration readings displayed in the DCR were in general agreement with those observed at the monitoring devices.

(2) The NEKISE system was not operating as all readings in the DCR were equal to zero. Only the reference source peaks were visible on the spectrum display. Upon enquiry the team was told that the system was under maintenance. If the NEKISE system is unavailable, discharges of noble gas are determined through analysis of samples, according to regulatory requirements.

(3) The operational status of the primary sampling lines and their components is displayed on a PC screen (mimic diagram). It was observed that the mimic diagram colors (red/green) indicating the operational status of the various components are not coherent. Upon enquiry the DCR staff said that the mimic diagram still required some adjustment. Staff also admitted that, based on the information provided by the mimic diagram, they could not unambiguously declare how the sampling system was configured.

With respect to (3):

> *<u>It is suggested</u> that the mimic diagram for the monitoring and sampling systems be overhauled so as to correctly reflect the physical situation present on plant. Such a mimic diagram is integral part of the control systems in place and, if not adequate, is liable to create confusion that may interfere with efficient control room operations.*

6.2. Liquid discharges

6.2.1. Verification activities

The verification team visited:

- The locations of the discharge tanks (TM50 and XZ-types). The team verified the existence and functionality of the sampling provisions as defined in the regulatory obligations. The team also checked the sampling procedures.
- An office where it could observe a display with the on-line data of the F1 and F2 gamma monitors.

6.2.2. Verification findings

6.2.2.1 <u>The TM50-type tanks</u>

The verification team confirmed the existence of the sampling provisions as described in section 5.2 above.

The verification team noted that:

(1) The procedure of taking a sample, as described in section 5.2.5 above, and laid down in quality assurance document ELJ-ÜZVT-03-04 (release rules for contaminated effluents), was not correctly implemented by DCR staff. The verification team observed that, contrary to procedural requirements, discharge valve 02TM55S002 was not sealed. Sealing of valves is integral part of the discharge control rules.

> *<u>It is suggested</u> that the competent regulatory authority, through its inspectorate, ensures that any slackening in the application of the operator's internal quality assurance and control rules for discharges of activity into the environment be promptly detected and remedied.*

6.2.2.2 <u>The XZ-type tanks</u>

The verification team confirmed the existence of the sampling provisions as described in section 5.2 above.

> *The verification activities performed do not give rise to particular remarks.*

6.2.2.3 <u>The F1 and F2 monitors</u>

The verification team noted that:

(1) These gamma detectors seem to have no well-defined purpose. Paks NPP staff, upon enquiry, could not clearly state whether these monitors are installed for operational discharge control, environmental control or emergency situation control.

(2) An on-line demonstration of the F1 monitor and a review of logged data indicated that its detection sensitivity is insufficient to measure routine discharges. The detector is only instrumental for detecting high-activity releases. The verification team therefore believes that the system's purpose is emergency control.

(3) Monitor F2 was not operational at the time of the verification visit due to overhaul activities**.**

The verification activities performed do not give rise to particular remarks.

6.2.2.4 Discharge control

The verification team noted that Paks NPP operations have no automatic means to interrupt a discharge in case an activity concentration above defined discharge limits should occur.

Currently, the monitors installed, if operational (see F2), would only raise an alarm that starts an operational decision taking procedure. This in turn may then possibly lead to a manual intervention to close the discharge valve of the tank in question (if this tank would still have some contents left within it). The verification team takes the point of view that such a procedure is slow and lacks efficiency. The verification team believes that should such an alarm occur this would inevitably lead to a full discharge into the environment.

Restricting liquid discharge control to sample analysis and decision taking is not fully satisfactory. Nowadays, it is generally considered to be good practice to have a second level of discharge control on liquid effluents. Such a second level discharge control is installed on the discharge line immediately after the discharge valve and consists of a continuously operating gamma monitor. This monitor, when the alarm level is reached, induces an automatic closure of the discharge valve of the tank. At the same time the system closes the discharge line downstream of the monitor. In order to be fully operational such a system also provides for the necessary pipes and pumps that allows the recuperation of the discharged volume between the tank and the valve downstream of the monitor.

It is suggested that the competent regulatory authority considers the benefit of the Paks NPP installing additional means of liquid discharge control. Current provisions are unsatisfactory insofar that the absence of automated emergency closure of discharge tank valves may lead to uncontrolled release of activity into the environment.

6.3. The effluent laboratory

6.3.1. Verification activities

The verification team visited the effluent laboratory where it verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

6.3.2. Verification findings

The verification team noted that:

(1) The laboratory is adequately equipped for fulfilling its regulatory obligations with respect to effluent samples analysis. The analysis of Kr-85 samples is outsourced to MTA ATOMKI (the accredited Institute of Nuclear Research of the Hungarian Academy of Sciences).

(2) Quality control is implemented through a compilation (the Qualty Assurance Handbook) of comprehensive written working instructions and source documents.

(3) The chain of custody of sample taking, sample analysis and data handling is well defined (labeling of samples throughout, responsibilities of individuals, bookkeeping).

(4) Accountancy of the various radioisotopes discharged is assessed retrospectively.

(5) Values below detection limit for aerosol and iodine samples are handled in the following manner:

The operator having 2 types of sample to analyse (daily and weekly samples) will compare the values obtained and will, when all values are below the detection limit, officially report the smallest detection limit value obtained from the entire set of samples collected during the week. It should be noted that, in a similar fashion, when all values are above the detection limit, the highest value will be booked and reported to the regulator. Finally it is noted that at the end of the month and year the values declared by the operator are compared with those obtained by the regulator with the aim to validate the operator's results.

(6) Internal quality control, despite findings (2) and (3), is not giving full satisfaction.

When verifying data consistency between source documents and archived (reported) values the team noted that although it is the lab leader's responsibility to sign off (and thus validate) registered results, that clerical errors are not systematically detected. This signature and validation is done on a monthly basis and initiates the procedure of reporting to the regulator.

The clerical error the team discovered (by randomly choosing a historical sample) finds its origin in a mistake by a member of staff when entering the sampling period in the PC that calculates the end results. The same member of staff corrected his mistake and hence a second result was generated in the system. This correction was not duly registered and has finally led to the reporting of the erroneous value.

With respect to (5):

> *It is reminded that the European Commission issued Recommendation 2004/2/Euratom [(10)] wherein substitution rules for values below the detection limit are presented. Such rules are proposed to avoid unnecessary over- or underestimation of discharged activities. These substitution rules are in line with ISO standard 11929-7:2005.*
>
> *It is suggested that the competent regulatory authority consider the benefits of revising its regulatory requirements for substitutions of analytical results below detection limits by bringing these requirements in line with Commission Recommendation 2004/2/Euratom and ISO standard 11929-7:2005.*

With respect to (6):

> *It is suggested that the competent regulatory authority advises its on-site inspectorate to submit the quality assurance and control procedures of the Paks NPP Effluent Laboratory to an audit and to require remedial action wherever deemed necessary.*

[10] Official Journal L 002, 06/01/2004 P. 0036 - 0046

7. ENVIRONMENTAL MONITORING

7.1. Introduction

Radiological environmental monitoring in Hungary is complex due to the involvement, besides the Paks NPP, of many ministries with their specific responsibilities and scopes of monitoring programmes.

In summary the following monitoring programmes/networks exist that are relevant in the context of Article 35 of the Euratom Treaty:

- The Paks NPP with its statutory Plant Environmental Radiation Monitoring System (PERMS).
- The Ministries of Health, of Agriculture and of Environment with their independent site-related check monitoring around the Paks NPP, called Joint Environmental Radiation Monitoring System (JERMS). Paks NPP participates in JERMS by providing own environmental data.
- The Ministry of Health with its Radiological Monitoring and Data Acquisition Network (ERMAH).
- The Ministry of Agriculture with its Monitoring Network for Radioactivity in Food and Environment (MNRFE).
- The Ministry of the Interior with its Radiological Monitoring, Warning and Surveillance System (RMWSS).

The data from the above mentioned radiological environmental monitoring programmes shall, in the future, be centralised in the National Environmental Radiation Monitoring System (NERMS) database.

7.2. PERMS - Paks NPP

7.2.1. Scope of the programme

The Plant Environmental Radiation Monitoring System PERMS (ÜKSER in Hungarian) is the statutory monitoring programme that is implemented by the Paks NPP. The legal basis of this programme is provided by Decree 15/2001 of the Minister of the Environment.

The programme addresses liquid and airborne discharges of radioactivity into the environment (source term) as well as levels of radioactivity in the environment around the Paks site (impact).

PERMS consists of on-line systems and off-line systems that are located on-site as well as within a 1.5 km zone around the NPP (see Appendix 10).

On-line: telemetric systems the units of which are situated:

- At the stacks, monitoring of discharges.
- At the water sampling stations V1, V2 and V3.
- At the meteorological tower [11].
- On-site, 18 dose rate probes [12].
- Off-site, 11 dose rate probes.

[11] Data from the meteo tower are also continuously fed to the Budapest headquarters of the National Meteorological Service.

[12] It must be noted that all gamma dose rate probes also feed into the Nuclear Emergency Information and Analysis Centre of the National Disaster Prevention Authority.

- At the off-site environmental monitoring stations A1 to A9, and B24.

Data from the on-line systems (the Dosimetry Information System, DIS) are transmitted to the central data processors of the NPP Dosimetry Control Room (DCR) through an underground cabling network (with a radio transmission capability as back-up). Acquired data are transmitted every 10 minutes and displayed at the DCR, with auditive warning signals in case of transgression of pre-set levels of detected activity concentrations (alarm and emergency levels).

Off-line: sampling programme and assessment of the samples with laboratory measurements. Such samples are taken from the airborne and liquid discharges (by the Effluent Laboratory) as well as from the environment (by the Environmental Laboratory).

The statutory programme is summarised in Appendix 6 and the locations of the various sampling stations are presented in Appendix 10 to this report.

Reporting obligations are as follows:

- Internal reports must be established on a weekly, monthly, quarterly and yearly basis. Additional reports must be drafted after outages and special reports after such events that may have influenced the source term.
- Reporting to the competent authorities:
    i. Monthly: to the ÁNTSZ (Tolna County Institute of the State Public Health and Medical Officer Service [Min. of Health]) and the ADUKÖFE (Min. of Environment)
    ii. Quarterly: to the HAEA
    iii. Annual summaries: to the ÁNTSZ, the ADUKÖFE and to the HAEA.

7.2.2. Paks NPP Environmental Monitoring Stations

7.2.2.1 <u>Water monitoring stations V1 to V3</u>.

The water monitoring stations V1 to V3 (see sections 5.2.2 and 5.2.3 above), are post-discharge reassurance monitors and are considered as environmental monitors. Total activity to be released into the environment is established at the various tanks prior to discharge through sample taking and analysis.

7.2.2.2 <u>Environmental monitoring stations type A</u>.

All stations are situated within a fenced-off area.

All stations house on-line systems as well as sampling systems. Instrumentation is sheltered inside a locked aluminium container. This container is heated in winter and cooled in summer. Power supply is delivered by direct line from the Paks NPP, back-up power supply is ensured by local battery packs that allow approximately 24 hours of operation. The on-line systems communicate the data they have acquired to the DCR every 10 minutes. The systems also transmit their operating status to the DCR.

Stations A1 to A9 are equipped with:

- A continuously operating on-line aerosol monitor equipped with a plastic scintillation detector for gross beta measurements and a continuously operating on-line iodine (elemental and organic) measurement system with a NaI(Tl) scintillation detector (temperature stabilised) which has a 6x1 cm tube geometry (after the aerosol monitor). A multichannel analyser allows for the assessment of the activity concentration of four iodine isotopes: I-131, I-132, I-133 and I-135.

  Measurement ranges:
    i. aerosol and elemental iodine gross beta 6E+02 to 5E+07 Bq/m^3

ii. iodine isotopes (organic and elemental) 6E+03 to 5E+07 Bq/m³

The sampling line is temperature controlled and has a nominal flow of 0.2-0.4 m³/h.

Sample filters are exchanged weekly and are stored only when their activity exceeds detection thresholds (aerosols). The iodine filters may be further assessed with gamma spectroscopy if deemed necessary.

- An on-line proportional gamma dose rate probe (type BITT RS03/X) with a detection range between 30 nSv/h and 10 Sv/h and an integration time of 10 minutes. The probe is located within the fenced area around the instrument container.
- A high-volume air sampler (40 to 50 m³/h) taking aerosol and iodine samples for laboratory analysis (weekly exchange of the aerosol filter, monthly exchange of iodine filters [elemental and organic]). The measured throughput is corrected for air pressure and temperature. The pumps can be remotely controlled from the DCR. Sample filters are exchanged weekly.
- An ALNOR Al_2O_3 thermoluminiscent dosemeter (monthly integration and reading at the laboratory).
- A wet/dry deposition collector (monthly laboratory analysis of the sample).

Additionally, stations A1, 4, 6 and 8 are equipped with tritium and carbon samplers. Tritium (HT and HTO) is sampled using an adsorption column containing a molecular sieve (monthly replacement of sampler). Carbon-14 (CO_2 and C_nH_m) is sampled with a NaOH bubbler (monthly replacement of the sampler).

Furthermore, positioned in between the A type stations are 11 additional proportional gamma dose rate probes (type BITT RS03/X) operating in continuous mode. The probes are powered by solar panels and have battery back-up, integrate over 10 minutes, and send the acquired data via radio link to the DCR for display.

7.2.2.3 Environmental monitoring station type B

The B station is identical to an A type station with H-3 and C-14 sampling, except that it communicates with the DCR via a radio link. It is located further away from the Paks NPP (at approximately 22 km) and acts as a control station under the prevailing wind direction.

7.2.2.4 On-site dose rate probes

The 18 on-site early warning ambient dose rate probes are Geiger-Müller counters (type BDMG-02) with a measurement range from 0.1 to 100 µGy/h. The warning level of these probes is set at 1.1 µGy/h, the alarm level at 2.3 µGy/h. These probes are linked via an underground cabling network to the DCR for display.

7.2.3. Paks NPP Environmental Laboratory

The laboratory is situated in the town of Paks, at approximately 5 km north of the NPP.

The laboratory is accredited by the Hungarian Accreditation Board, the current accreditation is in accordance with standard MSZ EN ISO/IEC 17025:2001, accreditation number NAT-1-1135/2003, valid until 1 July 2006.

The laboratory's activities, equipment, staff, testing capacity and methods, links with authorities, data provision and reporting responsibilities, and arrangements for coordination of duties in emergency situations are set out in detail in the Paks NPP environmental radiation protection monitoring regulations (June 2003) and the Paks NPP written Quality Manual and its related compilation of written operating instructions. The Manual also lists the equipment the laboratory must possess in order to be able to discharge the Paks NPP from its regulatory obligations with regard to the statutory sampling and analysis programmes.

7.3. JERMS - Ministries of Agriculture, Environment and Health

7.3.1. Scope of the programme

The Joint Environmental Radiation Monitoring System JERMS (HAKSER in Hungarian) is the independent site-related check monitoring programme of the authorities. Although the Radiation Protection Department of the Paks NPP participates in it, it should not be confounded with PERMS that is solely within the responsibility of the NPP.

The legal basis of JERMS is provided by Government Decree 275/2002 (XII.21).

The main goals of JERMS are to monitor radioactive effluents from the Paks NPP, to monitor the levels of radioactivity in the environment, storage and evaluation of data collected, estimation of the dose to the public and information of the public (annual reports published in printed form and on the web sites of the NRIRR and the HAEA).

JERMS takes place in a 30 km zone around the NPP (see Appendix 10) and involves 4 actors. These are the NPP itself and three ministries: Health, Environment and Agriculture. The scope of JERMS, and any reviews thereof are subject to prior validation by the HAEA.

7.3.2. Distribution of tasks and responsibilities

Tasks and responsibilities are distributed as follows between the four actors:

- Paks NPP has to provide relevant plant operation data including discharge values and environmental and meteorological data from PERMS.
- The Ministry of Health, through its ÁNTSZ (County Institute for Public Health and Medical Officer’s Services) laboratory located at Szekszárd in Tolna County. The tasks and responsibilities of the ÁNTSZ are detailed in Appendix 12 to this report.
- The Ministry of Environment, through its regional inspectorate ADUKÖFE. The tasks and responsibilities of the ADUKÖFE are detailed in Appendix 11 to this report.
- The Ministry of Agriculture: through its county Veterinary and Food Control Stations (VFCS) located at Szekszárd (Tolna County) and at Kecskemét (Bács-Kiskun County). The tasks and responsibilities of these laboratories as well as the central laboratory in Budapest are detailed in Appendix 16 to this report.

JERMS data are centralised and processed (including the estimation of dose to the population, due to the operation of the Paks NPP) in a dedicated JERMS application located at the Data Collection and Evaluation Centre of the NRIRR.

7.4. ERMAH - Min. of Health

7.4.1. Scope of the programme

Decree 8/2002 (III.12) EüM of the Minister of Health provides the legal basis for the Radiological Monitoring and Data Acquisition Network (ERMAH). However, ERMAH is operational since the mid 1970’s.

ERMAH covers the entire territory of Hungary and monitors air, surface waters, soils, drinking waters, vegetation and the major foodstuffs for human consumption.

The ERMAH programme must be submitted for approval to the Chief Medical Officer on a year to year basis.

The network is structured around a central institute, the NRIRR (the 'Frédéric Joliot-Curie' National Research Institute for Radiobiology and Radiohygiene) located at the OKK ('Fodor József' National Public-Health Centre), and more in particular its Central Radiohygiene Laboratory (CRL).

7.4.2. The National Research Institute for Radiobiology and Radiohygiene

The NRIRR (and thus the CRL) are accredited under Nr. NAT-1-0969/2002, according to MSZ EN ISO/IEC 17025:2001.

The NRIRR is legally defined as an "other establishment" under Decree 15/2001 (VI.6) KöM, hence not needing a discharge authorisation and therefore not required to routinely monitor discharges of (potentially) radioactive effluents, or to implement a compulsory environmental monitoring programme.

However, the NRIRR:

- Is obliged to submit annual discharge estimates to its supervisory authority (Inspectorate of the Ministry of Environment). These discharges originate from research activities and production of radiopharmaceuticals.
- Has voluntarily developed a site-related environmental monitoring programme (for details see Appendix 13 to this report). This monitoring programme is integral part of ERMAH.

7.4.3. The network

The network, apart from the central high-level CRL, consists of 7 intermediate-level regional and 3 low-level local laboratories. The laboratories have responsibilities (and are equipped) according to their ranking within the system.

The network collects approximately 4200 environmental and food samples a year. These entail about 8000 measurements (mainly gross beta and gamma-spectrometry). On average the environmental samples (air, soil, water and vegetation) represent 50% of the total taken. Foodstuff categories that are covered by the network include cereals, meats, milk products, eggs, vegetables and fruit.

The 2004 monitoring programme for the regional laboratories is given in Appendix 14 to this report.

The CRL, as the only accredited lab of the network, is responsible for network intercalibration and intercomparison runs.

The data and results from the network are centralised in a dedicated data and information centre at the NRIRR. Results on the contamination levels in environmental and food samples as well as dose to the population due to man-made radionuclides are published annually.

7.5. MNRFE - Min. of Agriculture

MNRFE, the Monitoring Network for Radioactivity in Food and Environment, consists of a central high-level laboratory and 19 regional laboratories. Additionally 7 quality control laboratories belonging to various agro-alimentary companies are also part of the network.

The central laboratory is part of the Department of Radiochemistry of the National Food Investigation Institute (NFII). The regional laboratories are located within the Veterinary and Food Control Stations (VFCS) of the MARD.

The central laboratory is accredited under Nr. Nat-1-1160/2003, according to MSZ EN ISO/IEC 17025:2001.

The network's principal goal is to verify that levels of radiological contamination in food and feed are within legally defined limits. The second main task is radiological surveillance through trend analysis of data collected. To that effect a national monitoring (sampling) programme is in place, resulting in approximately 3000 samples taken every year. Sampling covers produced food (meat, milk and dairy products, vegetables, fruits and cereals), bio-indicators (moss, mushrooms and game), soil, pasture, and fodder. Data are stored centrally at the NFII.

The programme is regularly reviewed and, when deemed necessary, adapted to evolving consumption habits and modifications in the country's agricultural structure.

Appendix 16 to this report gives an overview of the national monitoring programme as well as the site related check monitoring programme.

7.6. RMWSS - Min. of the Interior

RMWSS, the Radiological Monitoring, Warning and Surveillance System, is the Hungarian emergency preparedness system in case of radiological incidents.

RMWSS consists of various sub-systems:

- The Radiological Monitoring and Warning System (dose rate monitors).
- A network of radiological laboratories (sampling and analysis).
- Mobile radiological laboratories.
- Reconnaissance and monitoring units (operated by the Civil and Home Defence Forces).

The Radiological Monitoring and Warning System comprises:

- 78 automatic on-line measuring stations spread over the Hungarian territory. All stations are linked into the Nuclear Emergency Information and Analysis Centre (NEIAC [(13)]) of the National Directorate General for Disaster Management (NDGDM)
- Each station is equipped with a proportional gamma dose rate probe (type BITT RS03) with a detection range between 30 nSv/h and 10 Sv/h.
- The alarm threshold is set at 500 nSv/h. In case of transgression of this value, the system increases its data transfer rate to once every 10 minutes.

8. VERIFICATION ACTIVITIES - ENVIRONMENTAL MONITORING

8.1. Introduction

The verification team visited:

- The Environmental Monitoring Laboratory of the Paks NPP.
- Monitoring and sampling stations installed by the Paks NPP in the framework of PERMS.

[13] In case of an emergency NEIAC also receives information from the Ministries of Defence and of Education, the Paks NPP and the National Meteorological Service.

- The ÁNTSZ (Public Health and Medical Officer's Services) laboratory located at Szekszárd in Tolna County (activities related to JERMS and ERMAH).
- The Central Radiohygiene Laboratory (CRL) of the NRIRR (the 'Frédéric Joliot-Curie' National Research Institute for Radiobiology and Radiohygiene) - Ministry of Health, Budapest.
- The Central Laboratory of the Department of Radiochemistry of the National Food Investigation Institute (NFII) - Ministry of Agriculture, Budapest.

It also visited:

- The Nuclear Emergency Information and Analysis Centre (NEIAC) of the National Directorate General for Disaster Management (NDGDM) - Ministry of the Interior, Budapest. The verification team was given exhaustive presentations on, and a demonstration of, the national emergency preparedness provisions in case of radiological incidents.

8.2. The Paks NPP Environmental Monitoring Laboratory

8.2.1. Verification activities

The team verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

8.2.2. Verification findings

8.2.2.1 Analysis equipment

The team verified the presence and operability of the following laboratory instruments:

- The gamma spectrometric measuring systems with shielded measuring places, measurement electronics, PCs, and evaluation software.
- A low background beta counting system Thermo Electron FHT-770T with PC and evaluation software.
- A low background liquid scintillation counter Packard Tri-Carb-2550.
- A thermo luminescent dose assessment system for measuring TLDs, with measurement controller and evaluation software.

The team noted that:

(1) Working instructions and procedures are readily available at all workstations.

(2) Calibration of the various instruments is well documented (traceability).

(3) Simple means of checking the stability of the gamma spectrometers are not available (missing software component). Nevertheless checking procedures are carried out regularly and if necessary settings are modified. The procedure used is accepted by the National Accreditation Board.

With respect to (3):

> *It is suggested, in order to enhance quality assurance and control capability, that the spectrometry software be upgraded with a tool that allows an easy follow-up and thus early spotting of a resolution deterioration of a detector.*

Furthermore the verification team was given a demonstration of:

- A radiation protection van for *in-situ* examinations. The vehicle is equipped with a HPGe gamma spectrometer system, a surface contamination monitor, a dose rate meter, a Global Positioning System (GPS) and a radio telephone, a personal computer and various instruments for sampling air, water and soil.
- An all-terrain vehicle for collecting samples and making simple *in-situ* measurements. The vehicle is equipped with sampling devices, a dose rate meter, a surface contamination monitor and electronic dose meters.

The team noted that both vehicles are adequately equipped for their intended purpose.

The verification activities related to the radiation protection vehicles do not give rise to particular remarks.

8.2.2.2 Sample management

The team verified the procedures for sample receipt and sample preparation.

The team noted that:

(1) Sample receipt and sample preparation are performed in accordance with the Quality Manual and its related compilation of written operating instructions.

(2) Working instructions and procedures are readily available at all workstations.

The verification activities performed do not give rise to particular remarks.

8.2.2.3 Analytical procedures

The team studied the analytical procedures for the following samples:

- Aerosol and iodine filters from the A-type station on-line monitoring devices.
- Aerosol and iodine filters from the A-type station sampling devices.
- Airborne tritium (HT and HTO) from the A-type station sampling devices.
- Airborne C-14 (CO_2 and C_nH_m) from the A-type station sampling devices.
- Precipitation samples.
- Milk samples.
- Fish samples.
- Groundwater samples.
- Surface water samples.
- Soil samples

The verification activities performed do not give rise to particular remarks.

8.2.2.4 Recording of results, reporting and archiving of data

The team verified how data are handled within the laboratory and randomly chose historical samples for which the trackability and consistency of the data was verified (from source document to final archiving).

The team noted that:

(1) Sample details are duly recorded on dedicated sample forms/ledgers (type of sample, place and date of sampling, sampling period, sample quantity etc.). Entries must be signed by the laboratory assistant that took the sample.

(2) Sample preparation information is duly recorded on dedicated sample forms/ledgers. Entries must be signed by the laboratory assistant that prepared the sample.

(3) The paperwork and corresponding electronically stored data for two randomly chosen samples (one aerosol and one water sample from the year 2000) were requested and quickly provided by the lab personnel. All documents were properly archived and the data and results were consistent with the values reported to the regulator.

(4) Sample information and analytical results are manually transferred into electronic supports. Depending on the end-user of the data (type of report for instance), this transfer is done into a word processor, spreadsheet or a database application. In a number of cases such a transfer is done twice on two different supports. The risk to unwittingly introduce clerical errors is clearly present. The member of staff transferring the data is not registered in the system. Reports, when generated, are only countersigned by the laboratory leader, the person having drafted the report is not registered.

(5) When sample measurements are outsourced to third parties, this is duly recorded (name of third party, identity of staff etc.).

(6) The reporting obligations as stipulated in the Quality Handbook are respected.

(7) Paper documents (forms, ledgers etc.) are archived for five years.

(8) Electronic data are archived on CD-ROM every quarter.

With respect to (4):

> *It is suggested, in the general framework of quality assurance and control, that automated data transfer routines be implemented wherever possible. The current situation that requires (repeated) manual transcription of data onto and between electronic support(s) is not fully satisfactory.*
>
> *It is suggested, in the general framework of quality assurance and control, that the chain of custody with respect to data handling and subsequent reporting be kept intact: staff that generate reports should countersign these before final acceptance (signature) by the duly authorised person / laboratory leader.*

8.2.2.5 Intercomparison exercices

The verification team received copies of the results of the most recent international intercomparison exercises in which the environmental laboratory participated.

> *The verification activities performed do not give rise to particular remarks.*

8.3. PERMS - monitoring and sampling stations

8.3.1. Verification activities

Note: due to the restricted amount of time available and the workload resulting from the verification programme, the team decided to focus on the monitoring and sampling provisions listed below.

The verification team visited:

- Station A6 and station A8, where it verified the existence and functionality of the monitoring and sampling provisions as defined in the regulatory obligations. The team also checked the adequacy of the local sampling procedures as well as their compliance with the Quality Handbook.

- The fishing pond next to the A8 station where fish samples are taken.
- Hydrometer V1, where it verified the existence and functionality of the monitoring and sampling provisions as defined in the regulatory obligations. The team also checked the adequacy of the local sampling procedure as well as its compliance with the Quality Handbook.
- The Gerjen sampling location for surface water and sediment.
- The Gerjen sampling location for milk.

8.3.2. Verification findings

8.3.2.1 Stations A6 and A8

The verification team confirmed the existence and functionality of the monitoring and sampling equipment as described under section 7.2.2 above.

The team noted that:

(1) The monitoring and sampling systems are state-of-the-art.

(2) The on-line monitoring systems for aerosols and iodines are part of the Paks NPP emergency assessment and response provisions.

(3) Sampling and monitoring procedures are adequate and abide by the Quality Handbook.

(4) H-3 and C-14 sampling and assessment is performed by the operator, although this is not a regulatory requirement.

(5) C-14 sample assessment is outsourced to MTA ATOMKI (the accredited Institute of Nuclear Research of the Hungarian Academy of Sciences).

The verification activities performed do not give rise to particular remarks.

8.3.2.2 Fishing pond

The verification activities performed do not give rise to particular remarks.

8.3.2.3 Hydrometer V1

The verification team confirmed the existence and functionality of the monitoring and sampling equipment as described under section 7.2.2 above.

The team noted that:

(1) The monitoring and sampling systems are adequate.

(2) Sampling and monitoring procedures are adequate and abide by the Quality Handbook.

The verification activities performed do not give rise to particular remarks.

8.3.2.4 Surface water and sediment sampling at Gerjen

The verification activities performed do not give rise to particular remarks.

8.3.2.5 Milk sampling at Gerjen

The verification activities performed do not give rise to particular remarks.

8.4. The ÁNTSZ regional laboratory

8.4.1. Verification activities

The verification team verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

8.4.2. Verification findings

The verification team noted that:

(1) The laboratory is adequately equipped for fulfilling its tasks within both the JERMS and ERMAH monitoring programmes. Assessment of H-3 in samples must however be performed at the NRIRR.

Laboratory equipment must comply with requirements decided centrally at the NRIRR; equipment if funded through the operating budget of the Ministry of Health.

(2) The laboratory is not accredited yet. The process of obtaining accreditation is under way. To that effect the laboratory started putting in place the necessary quality assured documentation. The already existing documents were shown to the team. The verification team was however told that the process to accreditation is slow due to lack of budgetary means (reduced number of staff). It is further noted that the operating budget is decided and granted by the local County Institute.

(3) The laboratory participates in intercomparison exercises with the other laboratories belonging to the network of the Min. of Health, and laboratories of the Min. of Agriculture and the Min. of the Environment.

With respect to (2):

The verification team endorses the intention of the ÁNTSZ laboratory to obtain accreditation.

It is suggested that the competent authority provides the ÁNTSZ laboratory with the means necessary to obtain accreditation, especially since this laboratory is not only responsible for the regional part of the ERMAH monitoring programme but also for the surveillance, in part, of the Paks NPP through the JERMS programme.

8.5. The Central Radiohygiene Laboratory of the NRIRR

8.5.1. Verification activities

The verification team:

- Visited the Central Radiohygiene Laboratory (CRL) where it verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).
- Visited the site-related environmental monitoring programme set up by the NRIRR.

8.5.2. Verification findings

8.5.2.1 The Central Radiohygiene Laboratory (CRL)

The verification team noted that:

(1) The vertical audit it performed on data management for a randomly chosen water sample (ref 3173 - 10/636), sent by the regional ÁNTSZ laboratory for tritium analysis, did not reveal any shortcomings.

In this context the team welcomes the CRL internal policy that each member of staff is responsible for the whole chain of custody for a given type of sample and related analytical procedure(s) and that those responsibilities are redistributed in a yearly rota.

(2) The CRL, and by extension, the whole ERMAH network is currently not equipped with the means to measure C-14 in mixed diet samples. This type of measurement is proposed by Commission Recommendation 2000/473/Euratom on the application of Article 36 of the Euratom Treaty.

(3) Data and results received from the regional laboratories are not submitted to a formal validation. Validation is currently the responsibility of the senders (the regional laboratories of the ERMAH network).

(4) The environmental database acting as a repository for data from the ERMAH and JERMS monitoring programmes is a home-made application. The developer of this application is the only member of staff having the necessary knowledge to maintain the tool. In this the situation, with respect to data management, although back-ups are performed regularly, is not fully satisfactory.

With respect to (2):

> *It is suggested that the competent authority provides the NRIRR with the means to implement C-14 measurement on mixed diet samples that are taken within the ERMAH network.*

With respect to (3):

> *It is suggested that the NRIRR, in the context of general quality assurance and control, implements a system of formal validation of the monitoring programme results it receives from its regional, non-accredited, ERMAH laboratories.*

With respect to (4):

> *It is suggested that the NRIRR, in order to ensure the durability of the environmental data it collects, should consider the benefit of acquiring a professional database. Such a database should, ideally, provide automated data exchange (and validation) facilities between the CRL and its depending regional laboratories. Streamlined data exchange with other data providing bodies should also be envisaged. Finally such a database should contain automated reporting facilities, at national as well as at international level.*

8.5.2.2 Site-related environmental monitoring

The verification team noted that:

(1) The NRIRR has voluntarily developed a site-related environmental monitoring programme (for details see Appendix 13 to this report). This monitoring programme is integral part of ERMAH.

(2) Monitoring and sampling systems are located on the NRIRR campus.

(3) All monitoring and sampling systems as described in Appendix 13 were present and functional.

(4) The on-line alpha and beta aerosol monitoring system was at the time of the visit in a test phase, awaiting approval to replace the outdated low-volume air sampler. The new system will become, when approved, one of the monitoring devices of the national 'sparse' network (compliance with Commission Recommendation 2000/473/Euratom on the implementation of Art.36 of the Euratom Treaty).

The team also noted that back-up power supply is provided by the site's diesel generator that needs a manual start-up. It was furthermore noted that the system relays (function) alarms to a PC in one of the offices of the CRL but that these are not transmitted to an on call member of staff. In order to become a state-of-the-art continuously operating system it should be equipped with a guaranteed non-interruptable power supply and 24/24 hour alarm raising capability.

With respect to (4):

> *<u>It is suggested</u> that the competent authority provides the NRIRR with the necessary means to equip its on-line alpha and beta aerosol monitoring system with a guaranteed non-interruptable power supply and 24/24 hour alarm raising capability.*

8.6. The National Food Investigation Institute

8.6.1. Verification activities

Due to time constraints the verification team could only pay a short visit (less than 2 hours) to the radiological laboratory of the institute. The team focussed on the sample preparation procedure for water samples and on gamma spectrometry and liquid scintillation counting procedures. The team also visited the high-volume air sampler and precipitation collector that are installed on the roof of the laboratory building.

8.6.2. Verification findings

8.6.2.1 <u>Sample preparation procedure</u>

> *The verification activities performed do not give rise to particular remarks.*

8.6.2.2 <u>Analytical procedures</u>

The verification team noted that:

(1) The laboratory is sufficiently equipped for fulfilling its tasks.

(2) The number of staff is reduced to its strict minimum. In case of absence of one of the staff, the continuity of measurement capability, system maintenance and data management is lost. This is especially true for liquid scintillation counting: one single member of staff has the knowledge to operate the system.

(3) Gamma spectrometry: staff performs manual peak definition instead of using commercially available analysis systems. This may lead to overestimation of activity content. Also, because subjective parameters are involved in spectrum analysis, this may lead to insufficient reproducibility of the results obtained.

(4) Liquid scintillation counting: the single member of staff that is responsible for this type of measurement, performs a manual setting of analysis parameters based on personal experience. This may lead to overestimation of activity content. Also, because subjective parameters are

involved in spectrum analysis, this may lead to insufficient reproducibility of the results obtained.

With respect to (2):

> *<u>It is suggested</u> that the competent authority provides the radiological laboratory of the National Food Investigation Institute with sufficient means to ensure permanent availability of such competence that is necessary to implement the laboratory's statutory sample analysis programme.*

With respect to (3) and (4):

> *<u>It is suggested</u>, whilst the expertise of the members of staff of the laboratory is acknowledged by the verification team, that the competent regulatory authority provides the laboratory with the means to acquire commercial software for gamma and liquid scintillation spectrum analysis.*

8.6.2.3 <u>Sampling devices</u>

The high-volume air sampler is a home-designed system using a HEPA-5300-type filter; the filter is exchanged weekly and measured with an HPGe detector.

The precipitation collector has a surface of 1 m²; the collected sample is evaporated using infra-red lamps and subsequently measured for Be-7, Pb-210, K-40 and Cs-137 using gamma spectrometry.

> *The verification activities performed do not give rise to particular remarks.*

9. FURTHER VERIFICATION FINDINGS

9.1. Quality assurance and control at the Paks NPP

The verification team received, during and after its mission in Hungary a large number of documents (see Appendix 2). These documents were of various types such as source documents, explicative notes, reports; but also copies of quality assured documents and documents explaining regulatory requirements.

When studying the quality assured documentation it received, i.e. excerpts of the Quality Handbook, the team noted that the information provided therein was not always consistent. Such inconsistencies occur between the various departments of the plant that are at the origin of the documents. Examples of such inconsistencies can be found with respect to technical characteristics of monitoring and sampling equipment. This seems to indicate that the management of quality assurance and control documentation is not fully mastered. The team, although acknowledging that the monitoring and sampling provisions are in a transition phase - and thus require overhaul of the QA/QC documentation - takes the point of view that quality assurance and control management at the Paks NPP, with regard to discharge control and environmental monitoring and respective laboratories, is not sufficiently robust.

The above, in conjunction with the remarks and recommendations made under section 6 of this report, leads to the following:

> *<u>It is suggested</u> that the competent regulatory authority undertakes the necessary steps to enforce the Paks NPP to strengthen its control over - and improve its management of - internal QA/QC procedures and documentation with respect to*

discharges of radioactivity into the environment and related environmental monitoring.

9.2. Organisation of ERMAH

The Central Radiohygiene Laboratory (CRL) of the NRIRR, as top level laboratory of the ERMAH network, is accredited. The regional laboratory at Tolna County is trying to obtain accreditation but faces budgetary problems that slow the process. The verification team endorses the efforts made to obtain accreditation, all the more since the Tolna County laboratory not only has statutory duties within ERMAH, but also plays a major role in the independent check monitoring around the Paks NPP.

The NRIRR, and through it the competent authority, centrally regulates and finances the number and type of analytical equipment the various laboratories of the ERMAH network must possess. The same is true where it concerns the scope of ERMAH: the monitoring and sampling programme is reviewed each year and must be validated by the competent authority before the tasks can be distributed to the various laboratories.

Taking note that with respect to Article 36 of the Euratom Treaty, the implementation of which seems to devolve to the NRIRR, the verification team would like to encourage the competent authority to consider whether it should not also centralise QA/QC for its ERMAH laboratories. The verification team takes the point of view that it would be beneficial should the NRIRR take the responsibility to ensure that sampling and analysis methodologies as well as the related QA/QC documentation would be unified throughout the network.

> *It is suggested that the competent authority, taking into account that the monitoring programme and laboratory equipment are already centrally managed, should investigate whether it would not be beneficial for the ERMAH network if sampling and analysis methodologies as well as related QA/QC documentation would be unified and centrally managed by the NRIRR.*

9.3. The National Environmental Radiation Monitoring System NERMS

NERMS (Decree 275/2002 (XII.21) Korm on the monitoring of the national environmental radiation situation and levels of radioactivity) is a legally based project that aims at integrating the results from the various environmental monitoring networks into a single, consolidated database. Such integration is necessary to efficiently comply with Commission Recommendation 2000/473/Euratom on the application of Article 36 of the Euratom Treaty.

Article 36 of the Euratom Treaty stipulates that "The appropriate authorities shall periodically communicate information on the checks referred to in Article 35 to the Commission so that it is kept informed of the level of radioactivity to which the public is exposed."

It is understood that the Ministry of Health, through the NRIRR, should become the designated body that will discharge Hungary from this responsibility. However, in order to perform this task, the NRIRR will become heavily reliant on relevant information it must receive from other bodies that operate under various ministries having their own and specific monitoring programmes. This transmission of information is essential because the Ministry of Health's monitoring programme, ERMAH, does not cover all the topics that are listed in Recommendation 2000/473/Euratom.

It is noted that the various environmental monitoring programmes that are currently implemented in Hungary are in many cases overlapping if not partially redundant. The ministries involved are thus sometimes unnecessarily duplicating efforts. The means that Hungary devolves to radiological monitoring of the environment are thus not optimally put into effect. In this context it does not seem appropriate to require that ERMAH be developed and extended to cover the full scope of Recommendation 2000/473/Euratom (added duplication of effort).

The role the HAEA can play in the integration process is restricted. Decree 114/2003 (VII.29) Korm stipulates that the HAEA should act as co-ordinator in these matters, without however explicitly providing the HAEA with the necessary powers to enforce such an integration. The success of the integration will therefore more or less depend on the goodwill of the ministries that are currently involved in environmental monitoring.

> *It is suggested that the Hungarian Government addresses the current complexity of ministerial responsibilities in the area of environmental surveillance in relation to Articles 35 and 36 of the Euratom Treaty.*

10. CONCLUSION

All verifications that had been planned by the verification team were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received before the start and during the verification, was useful. The information provided and the outcome of the verification activities led to the following observations:

(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 Paks site are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) A number of topical recommendations are formulated. These recommendations aim at further improving some aspects of the environmental surveillance around the Paks site. The recommendations do not discredit the fact that environmental monitoring around the Paks site is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) The verification findings and ensuing recommendations are compiled in the 'Main Findings' document that is addressed to the Hungarian competent authority through the Hungarian Permanent Representative to the European Union.

(4) The present Technical Report is to be enclosed with the Main Findings.

APPENDIX 1

VERIFICATION PROGRAMME

Monday 08/11

1. Site access formalities
2. Opening meeting: introduction and presentations.
3. Team-1 (discharges) starts verification activities (airborne discharges monitoring and sampling and liquid discharges monitoring and sampling).
4. Team-2 (environmental) starts verification activities (monitoring and sampling devices put in place by the operator in the 3 km perimeter - PERMS).

Tuesday 9/11

5. Team-1 continues verifying monitoring and sampling devices and visits the effluent laboratory.
6. Team-2 continues with the operator's systems and starts verifying the environmental monitoring (JERMS) put in place by the regulator, 30 km perimeter.

Wednesday 10/11

7. Team-1 continues with the effluent laboratory verification (AM) and visits the authority's regional laboratory for environmental samples (ÁNTSZ laboratory, at Szekszárd).
8. Team-2 visits the operator's environmental samples laboratory (AM) and travels to Budapest (PM).

Thursday 11/11

9. Team-1 travels to Budapest and visits the NRIRR head laboratory.
10. Team-2 visits the Ministry of Agriculture laboratory, and the Ministry of Interior data collecting centre (emergency planning).
11. Closing meeting (at the HAEA headquarters) with all parties involved.

APPENDIX 2

DOCUMENTATION

1. Legislation

1 Act CXVI of 1996 on Atomic Energy (as amended)

2 Decree No. 16/2000 (VI.8) EüM on the Implementation of certain provisions of the Act CXVI of 1996 on Atomic Energy

3 Decree No. 15/2001 (VI.6) KöM on radioactive releases to the atmosphere and into waters in the course of using atomic energy and their monitoring

4 Decree No. 8/2002 (III.12) EüM on the operation and structure of the radiological monitoring and dat acquisition network of the health sector

5 Decree No. 275/2002 (XII.21) Korm on the monitoring of the national environmental radiation situation and levels of radioactivity

6 Decree No. 114/2003 (VII.29) Korm on the scope of duty, authority and jurisdiction of imposing penalty of the HAEA and on the activities of the Atomic Energy Co-ordination Council

2. Hungarian Atomic Energy Authority

7 Presentation (slides) titled: Preparatory meeting of the EU mission in Hungary on Art.35 of the Euratom Treaty, Brussels, 15 September 2004.

8 National Report: "Document prepared in the framework of the Convention on Nuclear Safety, Second report, 2001."

9 National Report: "Document prepared in the framework of the Convention on Nuclear Safety, Third report, 2004."

10 Questions and Answers on the first National Report on the Joint Convention on Spent Fuel Management and Radioactive Waste Management, 2002.

11 Report: "On the Authority's investigation of the incident at Paks Nuclear Power Plant on 10 April 2003, Report to the Chairman of the Hungarian Atomic Energy Commission, 23/05/03."

12 Report (to Parliament): "Safety of nuclear applications in Hungary 2002." August 2003.

13 Nuclear Safety Directorate: Approved regulation on the monitoring of emissions [at the Paks Nuclear Power Station], ref. RE-3603/00310/4 dated 29 January 2004 (Kibocsátás ellenörzési szabályzat).

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3. Ministry of Health

15 Presentation (slides) by the NRIRR, titled "Radiological monitoring and data acquisition network of the Ministry of Health."

16 Communication to the verification team: Environmental monitoring programmes and measurements by the Regional Centres (2004).

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18 Hakser 2003, Annual review of the joint environmental radiation monitoring system (JERMS) around the Paks NPP. NRIRR, July 2004.

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4. Ministry of the Environment

22 Presentation (slides): overview of ADUKÖFE independent control programmes (discharges and environment) at and around the Paks NPP.

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23 Presentation (slides) by the Department of Radiochemistry of the National Food Investigation Institute, titled "Radiation monitoring activity of the Ministry of Agriculture and Regional Development."

24 Report: "Radioisotopes in Food and Environment - Budapest, 2002."

25 Report: "Environmental effect of incident in NPP at Paks, 10-14 April 2003 - Budapest, 2003."

26 Report: "Summary report on the activities of the MARD Radiology Monitoring Network in 2003 - National Food Investigation Institute, Budapest, 2004."

27 Intercomparison exercise "Biohumus 1998" for the MNRFE (Monitoring Network for Radioactivity of Food and Environment) of the MARD, organised by the National Food Investigation Institute's Radiochemistry Department.

6. Ministry of the Interior

28 Presentation (slides) by the National Directorate General for Disaster Management, titled "The radiological monitoring system in Hungary."

29 Final report, Moral-14 (14th Regular Workshop on Mobile Radiological Laboratories) Hungary, Intercomparison exercise 2002.

7. Paks NPP

Discharges control

30 Technical parameters of the Paks NPP (*A Paksi Atomerőmű Müszaki Jellimzöi*)

31 Monitoring of atmospheric releases (*Telepített légnemű kibocsátások ellenőrző rendszere, INFOBANK 01SV04*) dated 30/06/2000.

32 Release rules for contaminated effluents *(Eljárásrend ELJ-ÜZVT-03-04, Vízikibocsátási rend az Atomerőmű radioaktiv anyagokkal szennyezett hulladékvizeire)*, dated 05/08/2003.

33 Sampling procedures (*Mintavételi eljárások PA KIL Mv)*, dated 25/09/2003.

34 Preliminary manual "Environment and discharge monitoring system reconstruction" (*Előzetes kezelési utasítás, környezet-és kibocsátás ellenőrző rendszer rekonstrukció)*

- section 02SV07 sampling lines and sampling systems at the stack - dated 21/04/2004
- section 02SV08 PING on-line monitors (airborne discharges) - dated 16/03/2004
- section 02SV09 NEKISE on-line monitor (noble gas) - dated 26/06/2004

- section 02SV10 samplers (aerosol, iodine, noble gas, H-3, C-14) - dated 26/06/2004

35 Descriptive document by KFKI presenting the isokinetic design of the airborne discharge primary and secondary sampling systems.

36 Extract of the Technical Operating Regulations compendium (version 5.2 of 01/04/2002): section 5.5 on the "radiation status of the nuclear power plant and its environment, radiation protection limits during its operation."

37 Quality Assurance Manual (excerpt): list of laboratory instruments (*Minöségirányítási kézikönyv*), issue of 25/09/2003.

38 Paks NPP effluent samples laboratory: overview list of accredited analytical procedures.

39 Certificate of classification nr 2004/12 (calibration substitution) for the iodine scintillation detector of the KALINA system - 08/01/2004.

40 Efficiency tests of the TN system aerosol filters (*Aeroszol szűrő hatásfokmérés TN rendszerben)*, dated June 2004.

41 Report by the Paks System Technology Department on the results of iodine filter efficiency tests performed throughout the Paks NPP ventilation systems to establish their compliance with the rulings. Technical drawings of the ventilation/extraction systems.

42 Liquid and airborne radioactivity releases from the Paks NPP in the period 2000-2003.

43 Report by the operator and the ADUKÖFE: "Assessment of the 2003 measurement data for radioactive liquid and airborne releases from the Paks NPP." - 22/04/2004.

44 Various source documents and internal reports with respect to discharge sample analysis results.

Environmental monitoring

45 On-site environmental monitoring systems (*Telepített környezeti sugárvédelmi ellenőrző rendszerek, INFOBANK 00SV05/INFO*) dated 11/05/2001.

46 Instruments for laboratory analysis of environmental samples (*A környezetellenőrző Laboratóriumban a minták mérése használt berendezések*)

47 Working instructions for:

- TRI-CARB 2750 Liquid scintillation counter (for H-3 and C-14)
- Gamma spectrometer system
- Gross beta counting system - FHT 770 T proportional counter
- Gross beta counting system- scintillation counter

48 Accreditation certificate (*Akkreditálási okirat*) for Paks NPP Laboratory - ISO/IEC 17025:2001 standard, July 2003 – July 2006

49 Paks NPP environmental samples laboratory: overview list of accredited analytical procedures.

50 Main data measured at the Paks NPP Environmental Monitoring Laboratory *(A PA Rt. környezetellenörzö Laboratórium föbb nukleáris környezetellenörzési adatai 2000-2003 év között*)

51 Various source documents and internal reports with respect to environmental sample analysis results.

52 Report by the operator and the ADUKÖFE. Subject: approval (harmonisation) of measurement results of radioactive discharges at the V1, V2 and V3 monitors in 2003.

53 Paper published by J.S. Jánosy, S. Deme and E. Láng: "Modeling of Potential Air Dispersants from Normal and Incidental Nuclear Power Plant Operations."

54 Radiation protection activities at the Paks NPP in 2003 (full report by the Paks Radiation Protection Department) - March 2004.

55 Radiation protection activities at the Paks NPP in 1994 (summary report by the Paks Radiation Protection Department) - March 1995.

8. IAEA

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9. Other sources

58 Science & Technology in Hungary, special edition, October 2000 "Nuclear Energy in the New Millennium."

59 http://www.haea.gov.hu

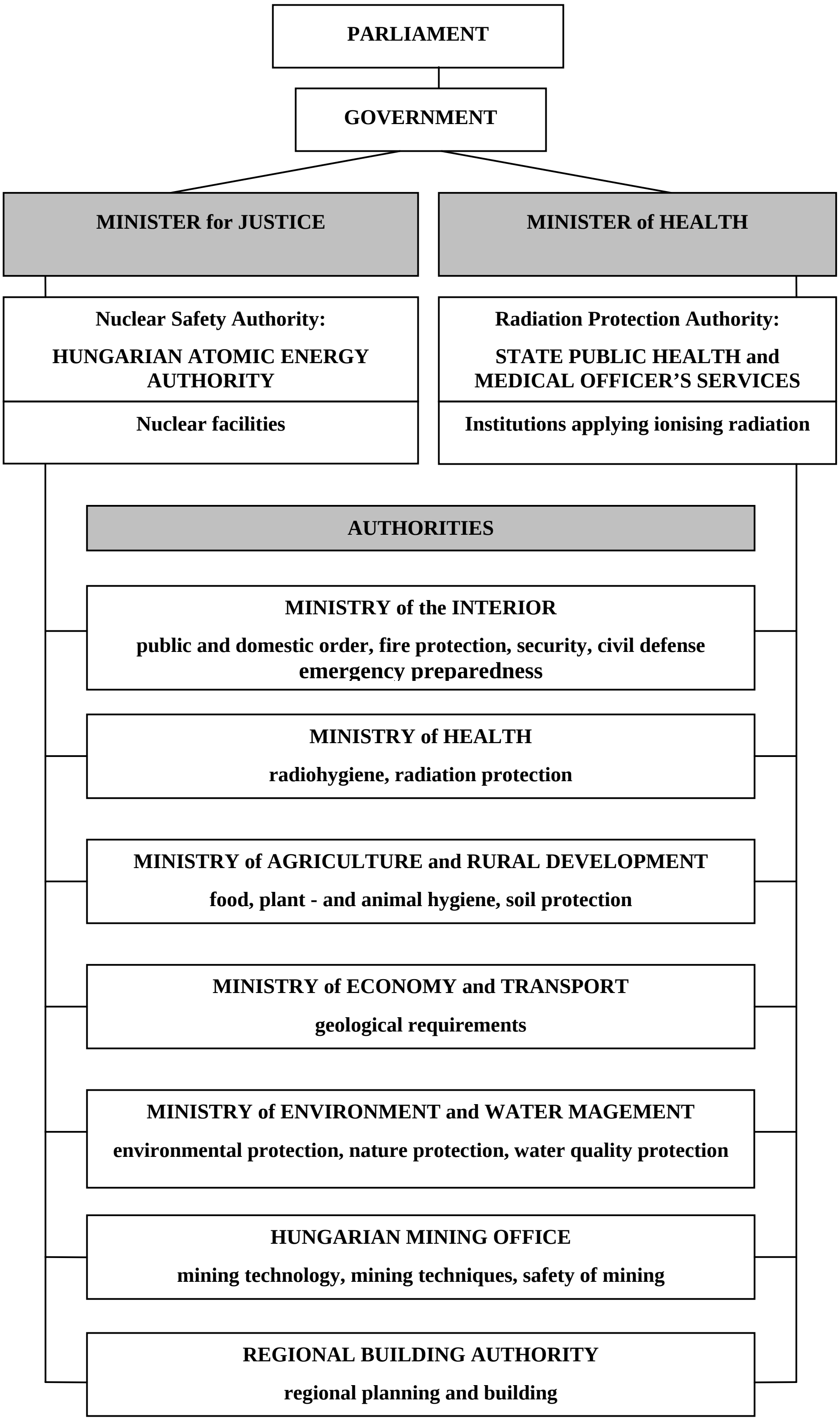
60 http://www.atomeromu.hu

61 http://www.osski.hu

62 Information provided to the European Commission in the framework of the "Questionnaire on the implementation of Article 35 of the Euratom Treaty" - reference DG TREN A/5895 dated 07 March 2005.

APPENDIX 3

HUNGARIAN AUTHORITIES



APPENDIX 4

PAKS AIRBORNE AND LIQUID RADIOACTIVE DISCHARGES

1. Discharge limits

Limit	Airborne				Liquid		
	Noble gases (total)	Aerosol $T_{1/2}$>24 h	Iodine I-131 eq.	Sr-89/90	Total beta	Sr-90	H-3
Before 2004 (1)	1.9 E+13	1.1 E+09	1.1 E+09	5.6 E+04	14.8	0.148	30
	Bq/day for 1000 MWe				GBq/year	GBq/year	TBq/year
					for the 4 units		
Since 2004	see table below						

(1) The values for airborne discharges apply to discharges averaged over a 30-day period.

In February 2004 a new discharge limitation system came into force, based on the obligations laid down in Decree 15/2001 (VI.6.) KöM. In this system both liquid and atmospheric discharges are compared against isotope-specific discharge limits that are derived from the 90 µSv dose constraint imposed upon the Paks NPP.

The new limits are:

Liquid discharge limits since 2004:

Isotope	annual limit (Bq)	Isotope	annual limit (Bq)	Isotope	annual limit (Bq)
^{3}H	2.90 x10^{16}	^{89}Sr	1.20 x10^{13}	^{137}Cs	9.00 x10^{11}
^{7}Be	3.00 x10^{14}	^{90}Sr	2.20 x10^{12}	^{140}Ba	5.50 x10^{13}
^{14}C	3.10 x10^{12}	^{95}Nb	2.10 x10^{12}	^{141}Ce	2.10 x10^{13}
^{51}Cr	2.70 x10^{14}	^{95}Zr	8.50 x10^{12}	^{144}Ce	1.00 x10^{13}
^{54}Mn	1.00 x10^{13}	^{99}Mo	1.30 x10^{14}	U-group	7.50 x10^{11}
^{55}Fe	4.30 x10^{13}	^{103}Ru	9.00 x10^{11}	Pu- group	1.00 x10^{12}
^{58}Co	3.20 x10^{12}	^{106}Ru	1.10 x10^{12}	Am- group	1.10 x10^{12}
^{59}Fe	2.30 x10^{12}	^{110m}Ag	2.00 x10^{13}	Cm- group	2.60 x10^{11}
^{59}Ni	4.00 x10^{14}	^{124}Sb	9.50 x10^{12}	Cf- group	1.90 x10^{11}
^{60}Co	9.50 x10^{11}	^{131}I	2.70 x10^{12}	---	---
^{65}Zn	1.40 x10^{12}	^{134}Cs	6.50 x10^{11}	---	---

Airborne discharge limits since 2004:

Isotope	annual limit (Bq)	Isotope	annual limit (Bq)	Isotope	annual limit (Bq)
^{41}Ar	4.60 x10^{16}	^{54}Mn	1.80 x10^{13}	^{110m}Ag	4.80 x10^{12}
^{85}Kr	1.20 x10^{19}	^{58}Co	2.10 x10^{13}	^{124}Sb	8.90 x10^{12}
^{85m}Kr	4.10 x10^{17}	^{59}Fe	1.10 x10^{13}	^{125}Sb	1.40 x10^{13}
^{87}Kr	7.30 x10^{16}	^{60}Co	2.40 x10^{12}	^{131}I aer.	3.70 x10^{12}

Cont'd

^{88}Kr	2.90 x10^{16}	^{65}Zn	2.30 x10^{12}	^{131}I elemental	7.80 x10^{11}
^{133}Xe	2.00 x10^{18}	^{75}Se	2.90 x10^{12}	^{131}I organic	9.50 x10^{13}
^{135}Xe	2.40 x10^{17}	^{76}As	1.10 x10^{15}	^{133}I elemental	3.70 x10^{14}
^{3}H (HT)	2.20 x10^{17}	^{89}Sr	4.30 x10^{12}	^{134}Cs	8.20 x10^{11}
^{3}H (HTO)	1.70 x10^{17}	^{90}Sr	3.70 x10^{11}	^{137}Cs	1.00 x10^{12}
^{14}C (CO_2)	1.30 x10^{14}	^{95}Nb	4.90 x10^{13}	^{138}Cs	2.10 x10^{16}
^{14}C (CH_4)	1.50 x10^{21}	^{95}Zr	2.30 x10^{13}	^{140}Ba	2.90 x10^{13}
^{24}Na	1.50 x10^{15}	^{99}Mo	1.90 x10^{15}	^{141}Ce	4.60 x10^{13}
^{42}K	1.70 x10^{16}	^{103}Ru	8.70 x10^{12}	^{144}Ce	3.50 x10^{12}
^{51}Cr	8.80 x10^{14}	^{106}Ru	2.30 x10^{11}	---	---

2. Discharges in the period 2000-2004 (for the 4 units)

Year	Airborne				Liquid		
	Noble gases (total)	**Aerosol $T_{1/2}$>24 h**	**Iodine I-131 eq.**	**Sr-89/90**	**Corrosion and fission products**	**Sr-90**	**H-3**
	[TBq]	[GBq]		[MBq]	[GBq]	[MBq]	[TBq]
2000	77.2	0.26	0.14	0.18	1.14	2.4	18.4
2001	90	0.53	0.38	0.18	1.25	2.2	18.7
2002	55.7	0.23	0.086	0.097	1.25	1.92	21.9
2003	519	6.85	405 (*)	6.9	0.92	9.46	16.4
2004	33.5	1.31	0.19	0.07	1.59	1.62	16
Regulatory limit before 2004	**13 000**	**750**	**750**	**38**	**15**	**150**	**30**
	These data apply to all units with a combined generating capacity of 1865 MW_e.						

(*) The 30-day averaged airborne emission after the incident of 10 April 2003 [14] exceeded the 30-day limit for unit 1&2 by a factor of 13.

14 On 10 April 2003, while fuel assemblies were routinely being cleaned during scheduled maintenance shutdown of Unit-2, fuel assembly damage occurred resulting in the release of radioactivity (mainly radioactive iodine) in amounts that exceeded the regulatory discharge limit (incident rated 3 on the INES scale). Doses to members of the public from this incident were estimated to be less than a day's natural background radiation (source: IAEA expert mission report on the incident).

APPENDIX 5

PAKS STATUTORY DISCHARGES SAMPLING PROGRAMME

1. Liquid releases

Type	Frequency	Preparation	Geometry	Method	Time of meas. [s]	Det. limit [Bq/dm^3]
Gross-beta	daily	evaporation	Ø 50 mm tray	beta-counting	3 000	3.0
Isotope composition	weekly	evaporation	100 cm^3 vial	gamma-spectroscopy	50 000	0.5
Tritium	weekly	distillation	20 cm^3 vial	liquid scintillation	2 000	10.0
Radiostrontium	quarterly	chemical separation	20 cm^3 vial	liquid scintillation	36 000	0.01
Radiocarbon	quarterly	chemical separation	20 cm^3 vial	liquid scintillation	25 000	0.05
Alpha emitters	quarterly	evaporation	Ø 150 mm tray	alpha-counting	20 000	0.01
Alpha emitters	quarterly	electrolysis	Ø 50 mm tray	alpha-spectroscopy	50 000	0.0001
X-ray emitters	quarterly	chemical separation	Ø 50 mm tray	X-ray spectroscopy	40 000	0.5

2. Atmospheric releases

Type	Frequency	Preparation	Geometry	Method	Time of meas. [s]	Det. limit [Bq/dm^3]
Aerosol	daily	72 h conditioning	Ø 50 mm tray	beta-counting	3 000	0.001
Aerosol	weekly	72 h conditioning	Ø 50 mm tray	beta-counting	3 000	0.0001
Aerosol	daily	---	Ø 50 mm tray	gamma-spectroscopy	5 000	0.01
Aerosol	weekly	---	Ø 50 mm tray	gamma-spectroscopy	50 000	0.001
Radioiodine	daily	---	Ø 50 mm tray	gamma-spectroscopy	5 000	0.01
Radioiodine	weekly	---	Ø 50 mm tray	gamma-spectroscopy	50 000	0.001
Radiostrontium	quarterly	chemical separation	20 cm^3 vial	liquid scintillation	36 000	0.00001
Noble gases	daily	---	10 dm^3 bottle	gamma-spectroscopy	5 000	500
Tritium	weekly	---	20 cm^3 vial	liquid scintillation	1 800	4.5
Radiocarbon	weekly	chemical separation	20 cm^3 vial	liquid scintillation	1 800	0.1

APPENDIX 6

PAKS STATUTORY ENVIRONMENTAL SAMPLING PROGRAMME

Sample	Location Sampling frequency	Preparation	Geometry	Method	Measuring time (seconds)	Detection limit
Aerosol (small volume sampler)	A1-A9 and B24 weekly	-----	Ø 25 mm	Gross-beta	6 000	0.3 mBq/m^3
Iodine filter (cartridge)	A1-A9 monthly	-----	Ø 60 x 25 mm	Gamma-spectroscopy	20 000	1 mBq/m^3
Aerosol (high volume sampler)	A1-A9 and B24 weekly	solution in acetate	Ø 40 x 4mm	Gamma-spectroscopy	50 000	1 $\mu Bq/m^3$
Iodine filter (PACI filter)	A1-A9 and B24 monthly	-----	50 x 50 x30 mm	Gamma-spectroscopy	20 000	0.01 mBq/m^3
Dry + wet deposition	A1-A9 and B24 monthly	evaporation	35 x 35 x 5 mm	Gamma-spectroscopy	50 000	0.1 $Bq/(m^2$ month)
Air: HT and HTO	A1, 4, 6, 8 and B24 monthly	desorption	20 cm^2 vial	Liquid scintillation	60 000	1 mBq/m^3
Air: CO_2 and C_nH_m	A1, 4, 6, 8 and B24 monthly	chemical separation	proportional chamber	Beta-counting	50 000	0.1 mBq/m^3
Soil	A1-A9 and B24 0-5 and 5-10 cm annually	drying, grinding, homogenisation, radiochemistry (^{90}Sr)	Marinelli (~1-2 kg) Ø 50 mm tray	Gamma-spectroscopy Beta-counting	20 000 10 000	0.5 Bq/kg 0.5 Bq/kg

Cont'd

Grass	A1-A9 and B24 2nd and 4th quarter	drying, grinding, homogenisation, radiochemistry (^{90}Sr)	Marinelli (~0.4 kg) Ø 50 mm tray	Gamma-spectroscopy Beta-counting	80 000 10 000	0.5 Bq/kg 0.5 Bq/kg
Milk	1 monthly	-----	Marinelli (1.5 dm^3)	Gamma-spectroscopy	50 000	0.5 mBq/dm^3
Fish	1 quarterly	raw fish measurement	Marinelli (~1 kg)	Gamma-spectroscopy	50 000	0.5 Bq/kg
TLD dose	A, B, C, SFISF (*) monthly	-----	Al_2O_3 chip	TL reading	300	5 µGy/month
Surface contamination	A1-A9 and B24 annually	-----	In-situ	Gamma-spectroscopy	5 000	30 Bq/m^2
Ground level dose rate	A1-A9 and B24 annually	-----	In-situ	Ion/scint. Chamber	5 000	5 nGy/h
Water (inlet and outlet channels)	V1, V2 and V3 daily	evaporation (300 cm^3) monthly average radiochemistry (^{90}Sr) distillation (^3H)	Ø 60 mm tray Ø 30 x 30 x 5 mm Ø 50 mm tray 20 cm^3 vial	Gross-beta Gamma-spectroscopy Beta-counting Liquid scintillation	10 000 50 000 50 000 18 000	0.05 Bq/dm^3 0.005 Bq/dm^3 0.001 Bq/dm^3 1.0 Bq/dm^3
Ground water	40 wells monthly	distillation (^3H) ion exchange sep. ion exchange sep. (^{14}C)	20 cm^3 vial Ø 60 x 30 mm proportional chamber	Liquid scintillation Gamma-spectroscopy Beta-counting	18 000 50 000 50 000	1.0 Bq/dm^3 0.005 Bq/dm^3 0.001 Bq/dm^3
Fishing ponds water	4 ponds quarterly	evaporation (500 cm^3) distillation (^3H) + yearly average (4 dm^3)	Ø 60 mm tray 20 cm^3 vial Ø 30 x 30 x 5 mm	Gross-beta Liquid scintillation Gamma-spectroscopy	10 000 18 000 50 000	0.05 Bq/dm^3 1.0 Bq/dm^3 0.01 Bq/dm^3

Cont'd

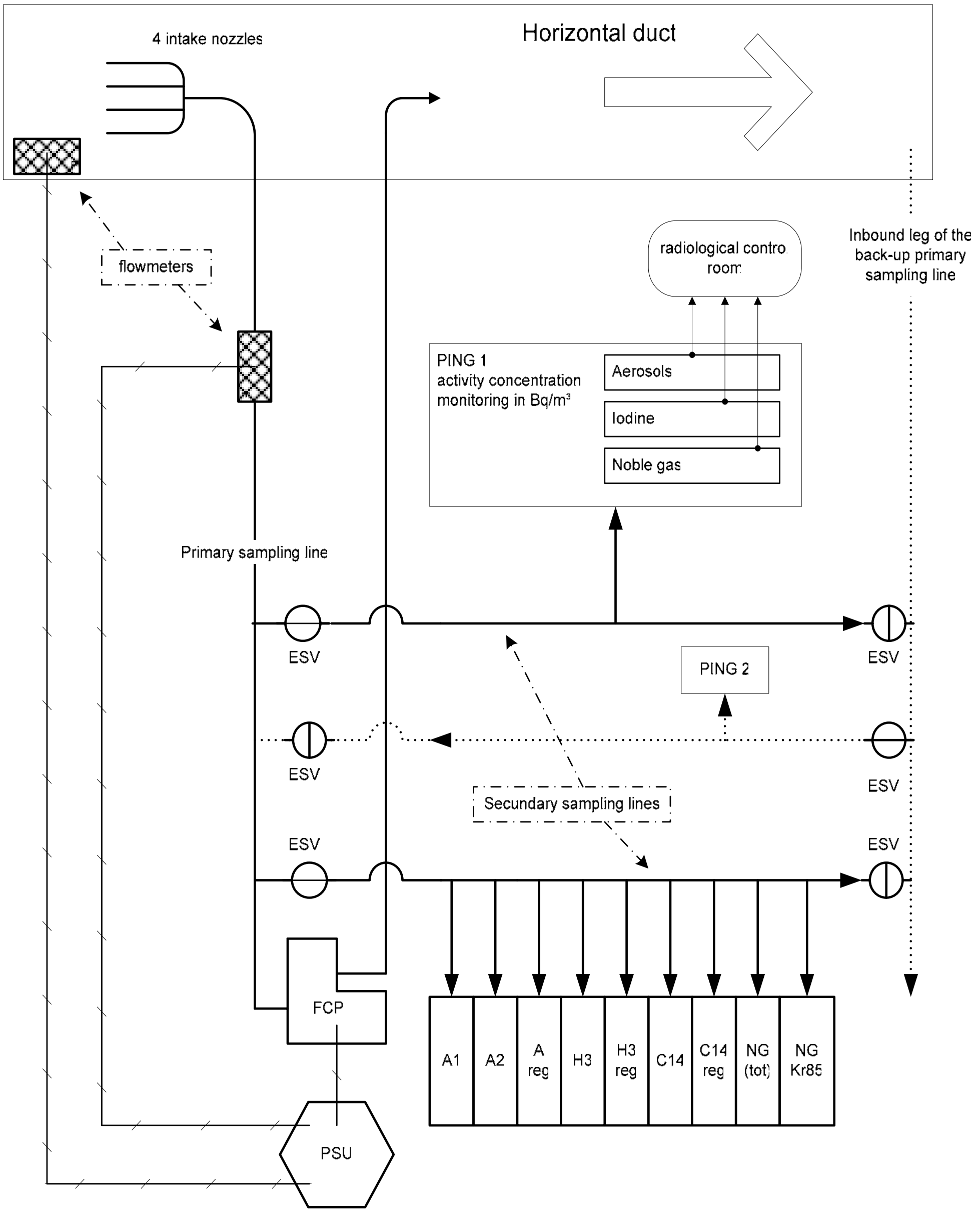
(*) SFISF: spent fuel interim storage facility (at Paks).

Water	ditch ring (4 loc) quarterly at Fadd monthly	evaporation (500 cm^3) distillation (^3H) + yearly average (4 dm^3)	Ø 60 mm tray 20 cm^3 vial Ø 30 x 30 x 5 mm	Gross-beta Liquid scintillation Gamma-spectroscopy	10 000 18 000 50 000	0.05 Bq/dm^3 1.0 Bq/dm^3 0.01 Bq/dm^3
Water	lime mud ponds 2 locations quarterly	evaporation (500 cm^3) distillation (^3H) + yearly average (4 dm^3)	Ø 60 mm tray 20 cm^3 vial Ø 30 x 30 x 5 mm	Gross-beta Liquid scintillation Gamma-spectroscopy	10 000 18 000 50 000	0.05 Bq/dm^3 1.0 Bq/dm^3 0.01 Bq/dm^3
Danube sediment	3 locations semi-annually	drying, grinding, homogenisation, radiochemistry (^{90}Sr)	Marinelli (~2 kg) Ø 50 mm tray	Gross-beta Beta-counting	20 000 10 000	0.5 Bq/kg 0.5 Bq/kg
Fishing pond sediment	4 ponds annually	wet homogenisation	Marinelli (~2 kg)	Gamma-spectroscopy	20 000	0.5 Bq/kg
Sediment	ditch ring, Fadd drain (4 loc) semi-annually	wet homogenisation	Marinelli (~2 kg)	Gamma-spectroscopy	20 000	0.5 Bq/kg
Lime mud ponds	2 ponds semi-annually	wet homogenisation	Marinelli (~2 kg)	Gamma-spectroscopy	20 000	0.5 Bq/kg
Defecation mud	10 dehumidifiers before removal	homogenisation	Marinelli (~2 kg)	Gamma-spectroscopy	5 000	2 Bq/kg

APPENDIX 7

SAMPLING PROVISIONS FOR AIRBORNE DISCHARGES - OVERVIEW

Note: this schematic drawing does not represent the NEKISE system for noble gas spectrometry



Legend:

FCP: frequency controlled pump
PSU: pump steering unit
ESV: electronically steered valves (for switching between the two primary sampling lines in case of failure of FCP)
A1: aerosol + iodine [elemental + organic] sampler (daily exchange of filters) - operator
A2: aerosol + iodine [elemental] sampler (weekly exchange of filters) - operator
A reg: aerosol + iodine [elemental] sampler (weekly exchange of filters) - regulator
H3: Tritium [tritiated water + gaseous] sampler (two-weekly exchange) - operator
H3 reg: Tritium [tritiated water + gaseous] sampler (two-weekly exchange) - regulator
C14: Carbon-14 [CO_2 and C_rH_π] sampler - operator
C14 reg: Carbon-14 [CO_2 and C_rH_π] sampler - regulator
NG tot: noble gas sampler (daily exchange) - operator
NG Kr85: Krypton-85 sampler (monthly exchange) - operator

APPENDIX 8

SAMPLING LINES FOR AIRBORNE DISCHARGES - DETAILS

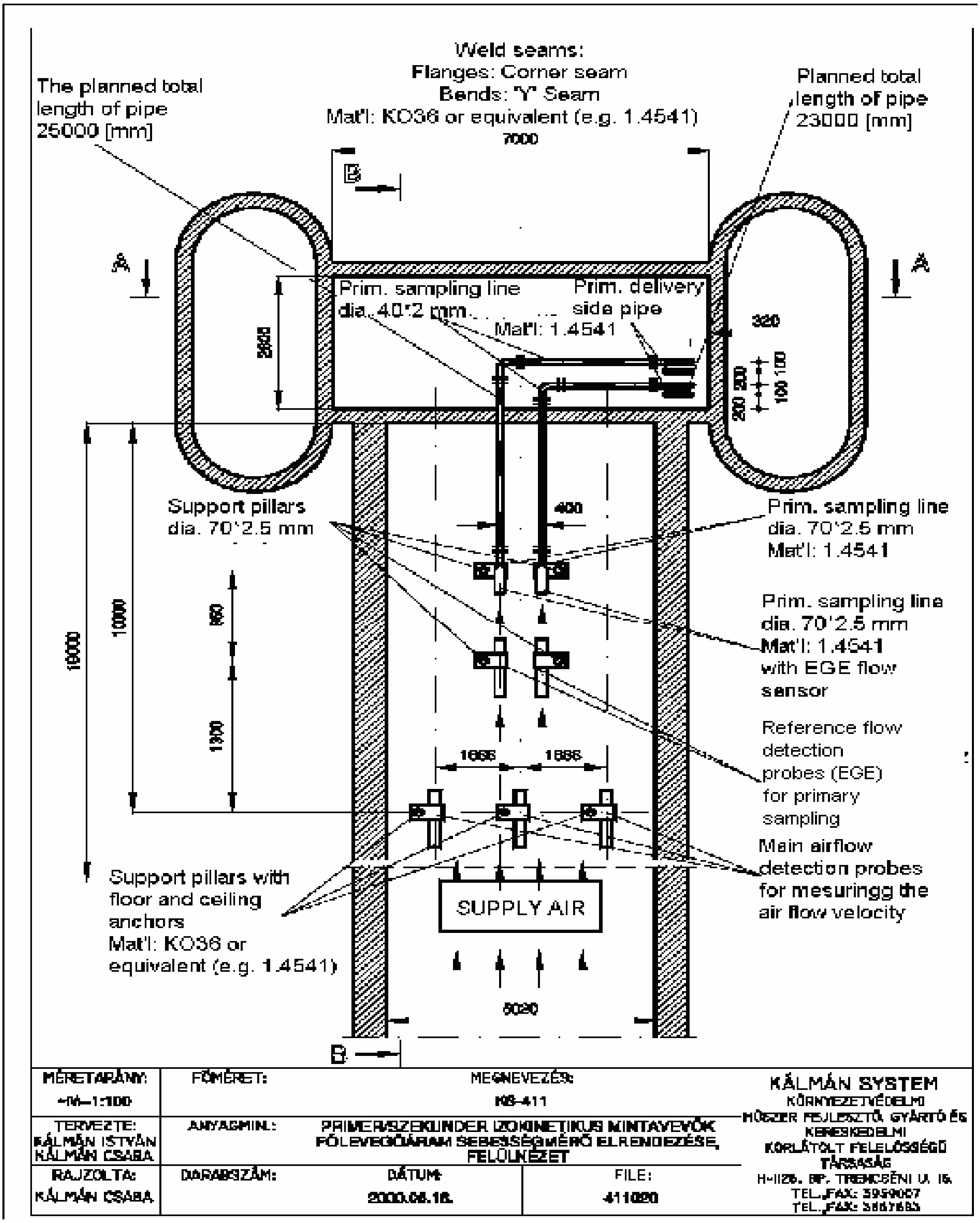


Figure 1
The main airflow velocity measuring configuration of the primary/secondary isokinetic sampling units (top view)

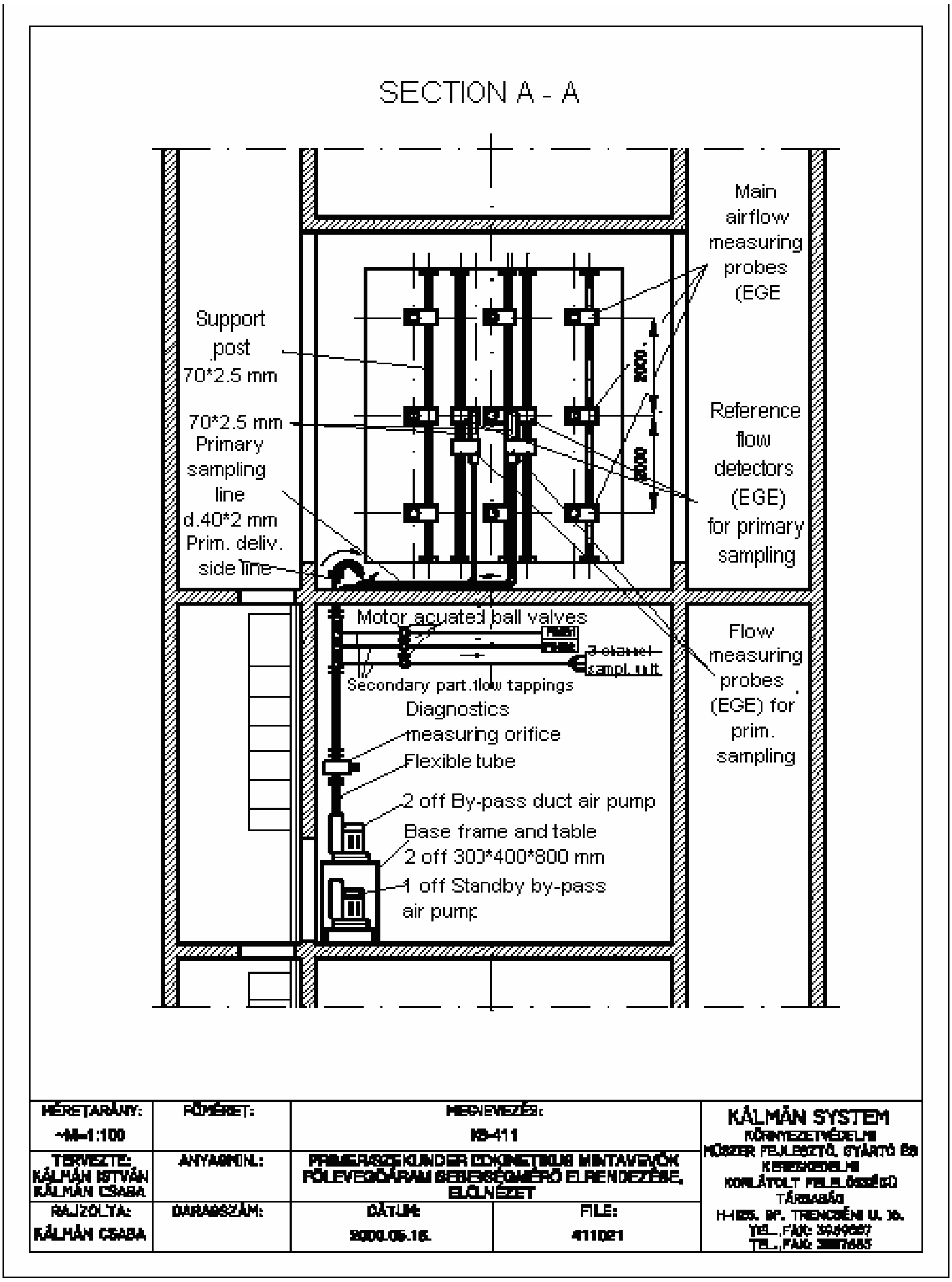


Figure 2
The main airflow velocity measuring configuration of the primary/secondary isokinetic sampling units (front view)

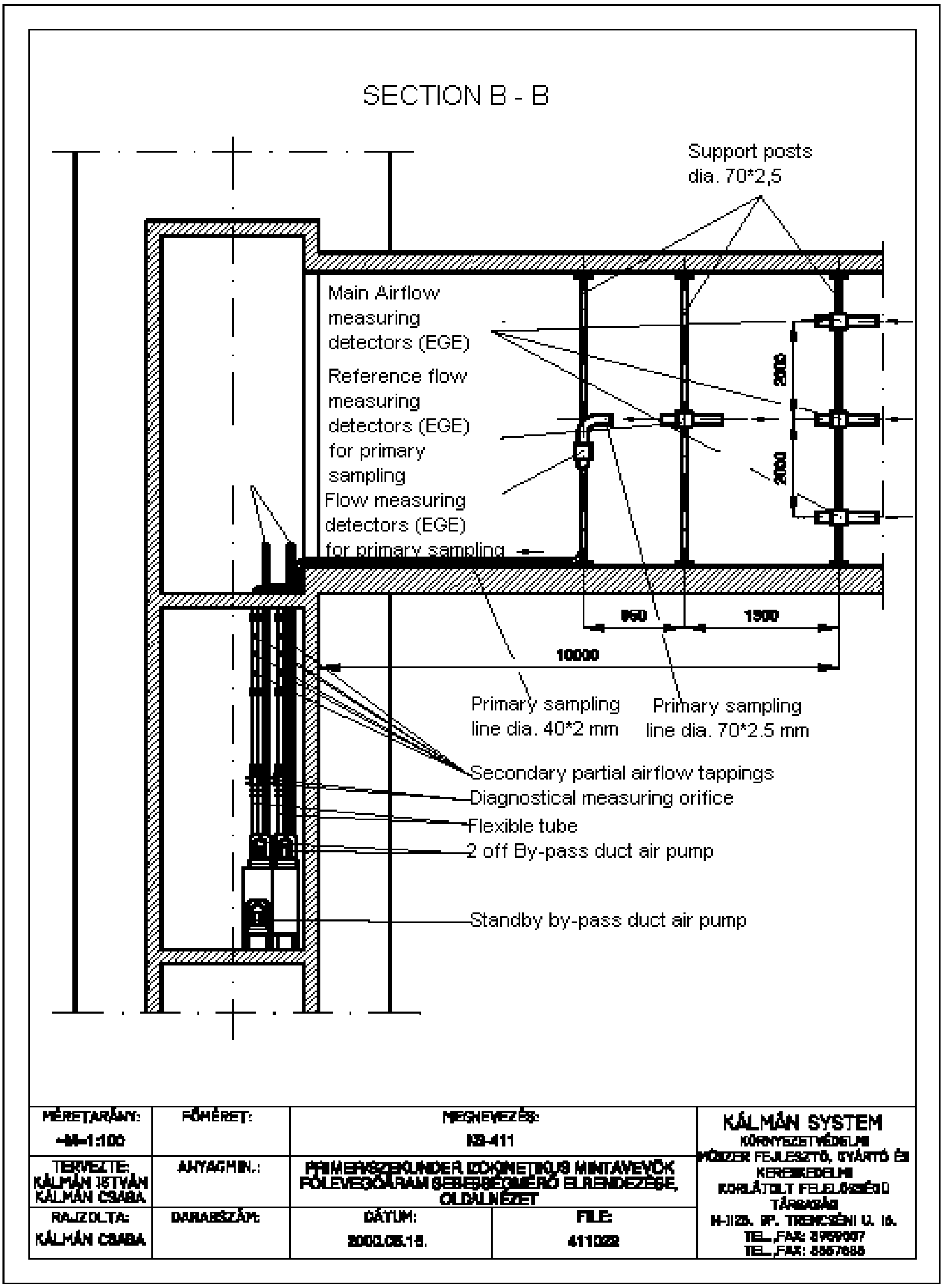


Figure 3
The main airflow velocity measuring configuration of the primary/secondary isokinetic sampling units (side view)

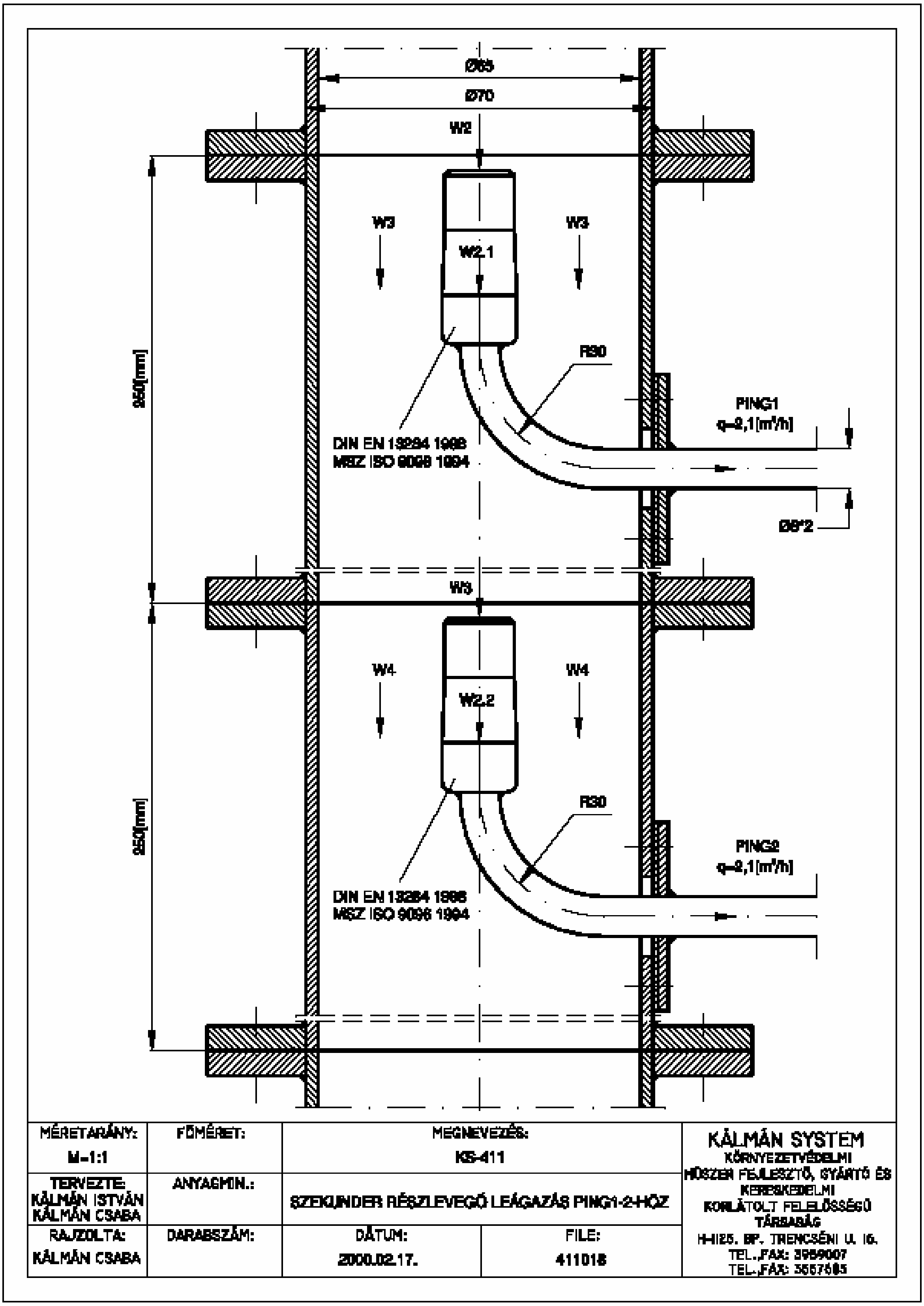


Figure 4:
Secondary partial airflow tapping for PING 1 and 2

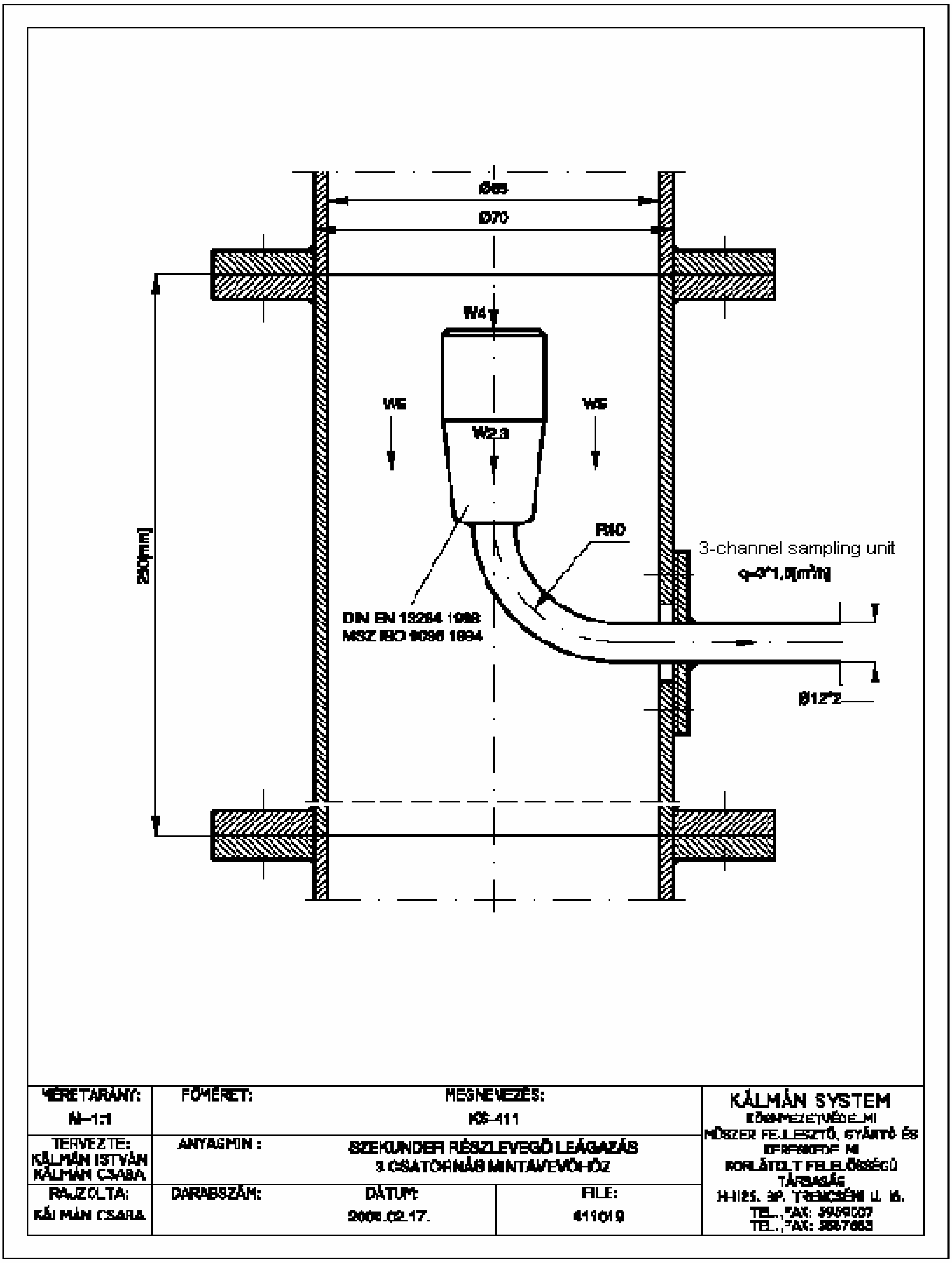
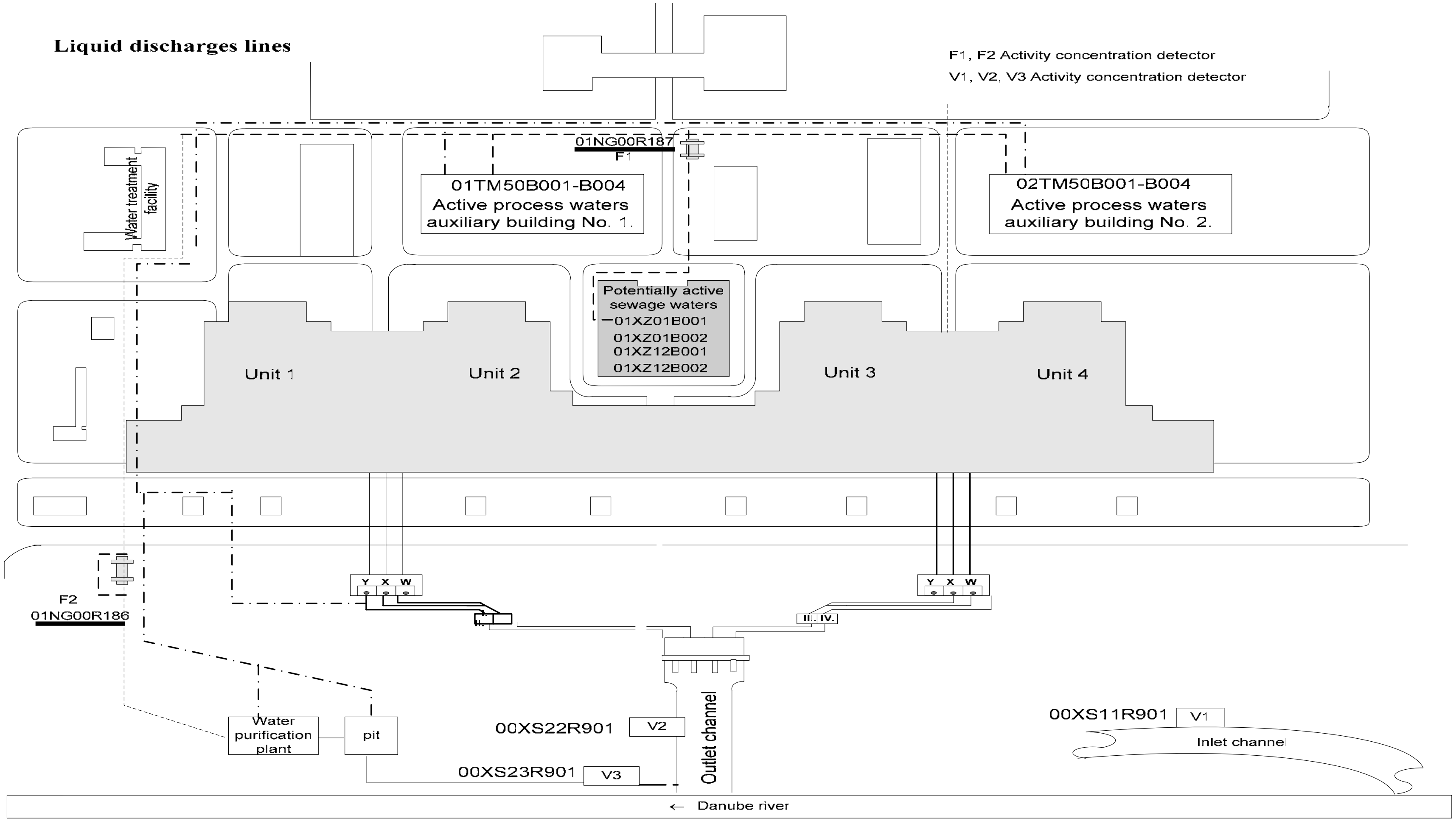


Figure 5
Secondary partial airflow tapping for the 3-channel sampling unit

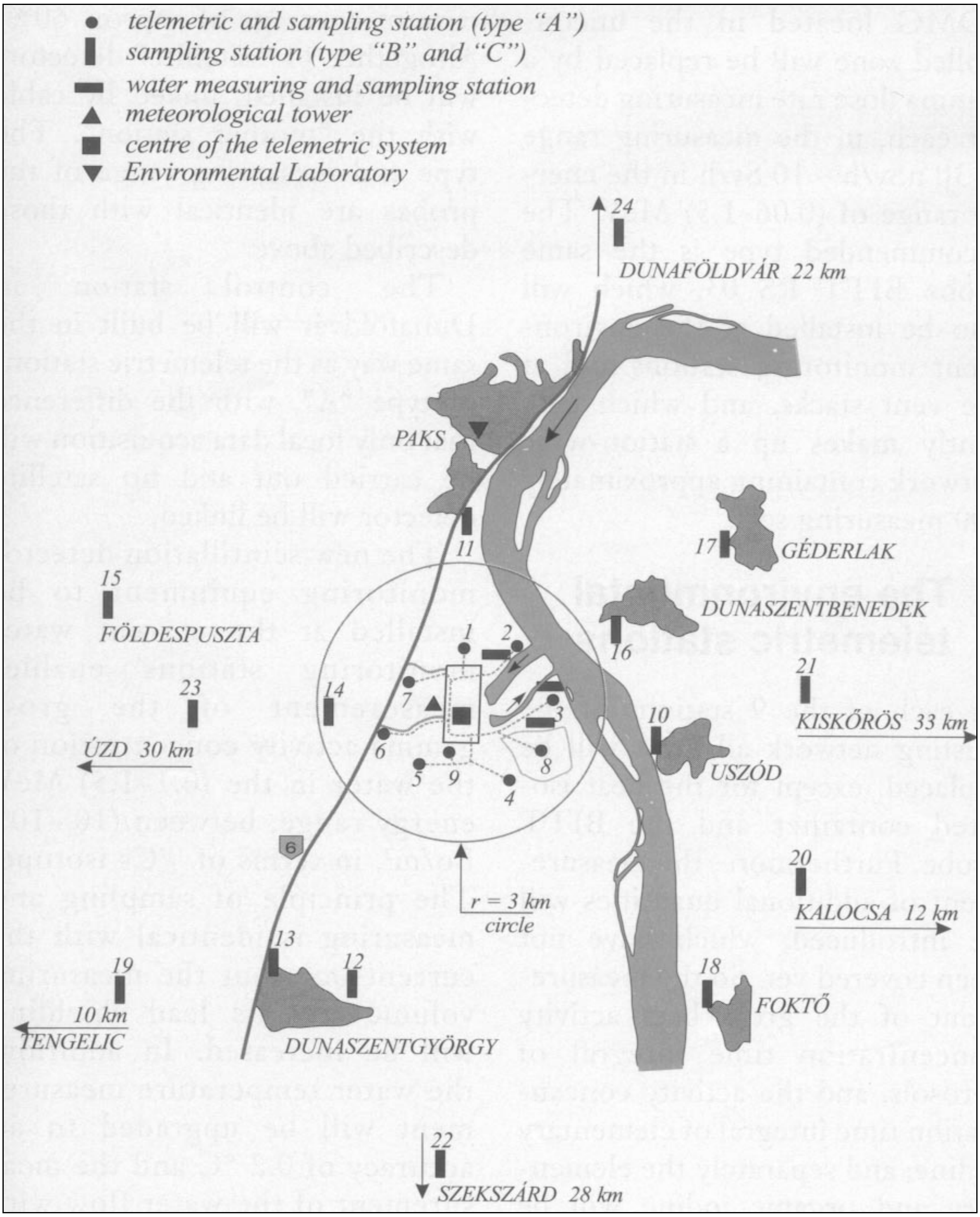
APPENDIX 9

PAKS NPP - OVERVIEW OF THE LIQUID DISCHARGES LINES



APPENDIX 10

PAKS NPP - ENVIRONMENTAL MONITORING STATIONS
PERMS (1.5 km zone) & JERMS (30 km zone)



APPENDIX 11

ADUKÖFE - SITE-RELATED INDEPENDENT CHECK MONITORING PROGRAMME (JERMS)

1. JERMS monitoring programme

Place of sampling	*Frequency of sampling*	*Type of measurement*
AIRBORNE RELEASES (1)		
Both stacks	Weekly	Aerosol: gross-beta gamma spectrometry Iodine: gamma spectrometry
	Quarterly bulk sample	Aerosol: Sr-90
	Two-weekly spot sample (random)	Noble gases: gamma spectrometry
LIQUID RELEASES (2)		
Discharge tanks		
TM and XZ type tanks	Weekly spot sample (random)	gross-beta
	Weekly bulk sample	gamma spectrometry and H-3
	Quarterly bulk sample	Sr-90
Other tanks	Weekly bulk sample	H-3
Discharge channels		
V1, V2, V3	Weekly bulk sample	For every channel: gross-beta
	Monthly bulk sample	For every channel: H-3, and gamma spectrometry
	Quarterly bulk sample	For every channel: Sr-90
V3	Monthly spot sample (random)	gross-beta
ENVIRONMENT		
Aerosol (3) (at A-type station)	Monthly bulk sample (weekly collection)	2 samples (2 stations): gamma spectrometry
Dry + wet deposition (3) (at A-type station)	Monthly	2 samples (2 stations): gamma spectrometry
Rainwater (3) (at A-type station)	Monthly	5 samples (5 stations) H-3 (HT and HTO)
Groundwater monitoring well	5 samples per month	H-3 (4)
Fishing-places (lakes)	Yearly 1 lake	Water sample: gross-beta gamma spectrometry H-3 Sediment sample: gross beta gamma spectrometry

(1) Aerosol samples (filters) are taken by the operator (and occasionally witnessed by an ADUKÖFE inspector). Noble gas samples must be taken by the inspector himself.

(2) Liquid discharge samples are taken by the operator (and occasionally witnessed by an ADUKÖFE inspector).

(3) Part of the programme since 2004.

(4) If H-3 levels are > 500 Bq/dm³, then gross-beta is also measured. If gross-beta exceeds 2 Bq/dm³, then the sample is analysed with gamma spectrometry.

2. Danube sampling programme

medium	samples/year	measurements/year			
		gross-beta	**Sr-90**	**tritium**	**gamma spec.**
Water					
1433 rkm	62	62	12	18	48
1451 rkm	26	26	---	---	---
1480 rkm	52	52	4	52	4
1516 rkm	26	26	4	12	4
1560 rkm	3 x 26	3 x 26	4	12	4
Sediment				---	
1433 rkm	48	48	48	---	48
1480 rkm	4	4	4	---	4
1516 rkm	8	8	8	---	8
1560 rkm	4	4	4	---	4
Algae					
1433 rkm	12	12	---	---	12
1480 rkm	3	3	---	---	3
1560 rkm	3	3	---	---	3
Fish between 1433 rkm and 1560 rkm	24	24	24	---	24

Notes:

- The sampling location at 1560 rkm is the location upstream of the NPP, providing baseline data.
- Other water bodies (lakes and tributaries to the Danube) are also sampled for water and sediment, these are not listed here.

APPENDIX 12

ÀNTSZ - SITE-RELATED INDEPENDENT CHECK MONITORING PROGRAMME (JERMS)

Sample	Sampling location	Sampling frequency	Measurement method	Annual number of measurements
Aerosol (low volume sampler)	Szekszárd	daily	gross-beta	365
	Csámpa	weekly	gross-beta	52
	Dunaföldvár	weekly	gross-beta	52
	Kalocsa	weekly	gross-beta	52
Aerosol (medium volume sampler)	Szekszárd	weekly	gamma spectrometry	52
Wet precipirarion	Szekszárd	monthly	gross-beta gamma spectrometry	12 12
	Csámpa	monthly	gross-beta gamma spectrometry	12 12
	Dunaföldvár	monthly	gross-beta gamma spectrometry	12 12
	Kalocsa	monthly	gross-beta gamma spectrometry	12 12
Dry precipitation	Szekszárd	monthly	gross-beta gamma spectrometry	12 12
	Csámpa	monthly	gross-beta gamma spectrometry	12 12
	Dunaföldvár	monthly	gross-beta gamma spectrometry	12 12
	Kalocsa	monthly	gross-beta gamma spectrometry	12 12
Drinking water	Szekszárd	monthly	gross-beta gamma spectrometry H-3	12 12 12 (at the NRIRR)
	Paks NPP	monthly	gross-beta gamma spectrometry H-3	12 12 12 (at the NRIRR)
	Paks (Kápolna street)	monthly	gross-beta gamma spectrometry	12 12
	Dunaföldvár	monthly	gross-beta	12
	Kalocsa	monthly	gross-beta	12
	Szekszárd	quarterly bulk sample	Sr-90 Cs-137	4 4
	Paks NPP	quarterly bulk sample	Sr-90 Cs-137	4 4
Cont'd	Paks (Kápolna street)	quarterly bulk sample	Sr-90 Cs-137	4 4

Drinking water	Dunaföldvár	quarterly bulk sample	Sr-90 Cs-137	4 4
	Kalocsa	quarterly bulk sample	Sr-90 Cs-137	4 4
Surface water (Danube River)	Gerjen	monthly	gross-beta H-3	12 12 (at the NRIRR)
	Paks	monthly	gross-beta	12
	Dunaföldvár	monthly	gross-beta H-3	12 12 (at the NRIRR)
	Kalocsa	monthly	gross-beta	12
Surface water (lakes)	Paks-Kondor tó	monthly	gross-beta	12
	Dombori (Danube backwater)	monthly	gross-beta	12
	Szelidi tó	monthly	gross-beta	12
Surface water (Danube River)	Gerjen	quarterly bulk sample	Sr-90 Cs-137	4 4
	Paks	quarterly bulk sample	Sr-90 Cs-137	4 4
	Dunaföldvár	quarterly bulk sample	Sr-90 Cs-137	4 4
	Kalocsa	quarterly bulk sample	Sr-90 Cs-137	4 4
Surface water (lakes)	Paks-Kondor tó	quarterly bulk sample	Sr-90 Cs-137	4 4
	Dombori (Danube backwater)	quarterly bulk sample	Sr-90 Cs-137	4 4
	Szelidi tó	quarterly bulk sample	Sr-90 Cs-137	4 4
Sediment	Gerjen-Duna	monthly	gross-beta gamma spectrometry	12 12
	Paks-Duna	monthly	gross-beta gamma spectrometry	12 12
	Dunaföldvár-Duna	monthly	gross-beta gamma spectrometry	12 12
	Kalocsa-Duna	monthly	gross-beta gamma spectrometry	12 12
Sediment	Dombori (Danube backwater)	monthly	gross-beta gamma spectrometry	12 12
	Szelidi tó	monthly	gross-beta gamma spectrometry	12 12
	Gerjen-Duna	quarterly bulk sample	Sr-90	4
Cont'd	Paks Duna	quarterly bulk sample	Sr-90	4

Sediment	Dunaföldvár-Duna	quarterly bulk sample	Sr-90	4
	Kalocsa-Duna	quarterly bulk sample	Sr-90	4
	Dombori (Danube backwater)	quarterly bulk sample	Sr-90	4
	Szelidi tó	quarterly bulk sample	Sr-90	4
Soil	Csámpa	monthly	gross-beta gamma spectrometry	12 12
	Paks	monthly	gross-beta gamma spectrometry	12 12
	Dunaföldvár	monthly	gross-beta gamma spectrometry	12 12
	Dombori	monthly	gross-beta gamma spectrometry	12 12
	Kalocsa	monthly	gross-beta gamma spectrometry	12 12
Soil	Csámpa	quarterly bulk sample	Sr-90	4
	Paks	quarterly bulk sample	Sr-90	4
	Dunaföldvár	quarterly bulk sample	Sr-90	4
	Dombori	quarterly bulk sample	Sr-90	4
	Kalocsa	quarterly bulk sample	Sr-90	4
Milk (raw)	Szekszárd	monthly	gross-beta gamma spectrometry	12 12
	Duna-szentgyörgy	monthly	gross-beta gamma spectrometry	12 12
	Fajsz	monthly	gross-beta gamma spectrometry	12 12
	Szekszárd	quarterly bulk sample	Sr-90 gamma spectrometry	4 4
	Duna-szentgyörgy	quarterly bulk sample	Sr-90 gamma spectrometry	4 4
	Fajsz	quarterly bulk sample	Sr-90 gamma spectrometry	4 4
Dose rate	12 locations	quarterly	passive TLD	48

APPENDIX 13

NRIRR - SITE-RELATED ENVIRONMENTAL MONITORING PROVISIONS

1. Active dosimeters

Probe:	Automess 6150AD6/H dosimeter with 6150AD-b/H type scintillation detector
Measurement range:	5 nSv/h – 100 µSv/h
Frequency:	3 daily spot measurements (on working days)

2. Passive dosimeters

Detector material:	$CaSO_4$:Tm powder, in own-design capsules (teflon + copper)
Measurement range:	30 µSv – 5 mSv (calibrated)
LLD:	10 µSv
Frequency:	quarterly integration

3. In-situ gamma spectrometry

Frequency:	quarterly
Detector:	Inspector2000 gamma-spectrometer (HPGe)
LLD:	0.12 kBq/m^2 (for Cs-137)

4. Aerosols

4.1 Alpha (natural and artificial) and beta aerosol monitor (one device on site)

Type:	Thermo Electron FHT59Si computer controlled + datalogger on-line transmission of data (LAN coupling)
Operation:	continuous operation with uninterruptible power supply
Throughput:	8 m^3/h
Filter type:	step filter
Detector:	PIPS semiconductor
Measurement range:	0.1 Bq/m^3 – 1 MBq/m^3
LLD:	50 mBq/m^3 (alpha) 300 mBq/m^3 (beta)
Alarm thresholds:	80 Bq/m^3 (artificial alpha and beta) 150 Bq/m^3 (natural alpha)

4.2 Medium-volume air sampler (one device on site)

Type:	Senya JL-150 “Hunter”
Operation:	continuous with uninterruptible power supply
Throughput:	150 m^3/h
Filter type:	glass fibre filter with active carbon lining for iodine sampling
Frequency:	weekly exchange of filter (averaged over one year / depending on amount of deposition)
Laboratory:	assessment of gamma emitters (HPGe)
LLD:	5E-07 to 1E-05 Bq/m^3 (depending on radionuclide and counting time)

4.3 Low-volume air sampler (one device on site)

Operation:	near-continuous operation (manual switch-on/off of pump)
Throughput:	0.8 – 3.8 m^3/h (depending on deposition)
Filter:	Ø 5 cm Millipore

Frequency:	filter exchanged 4 times a week
Laboratory:	assessment of collected gross alpha and gross beta activity
LLD:	(1) for half-lives ≥24 hrs (after a 3 - 5 day interval, for a filtered volume of 60 – 80 m^3, counted over 50 minutes): 2 mBq/m^3 (2) for half-lives ≤24 hrs (counting without delay, applied to 1.4 m^3): 30 mBq/m^3

5. Dry/wet deposition

Devices:	one steel collector (+heater) of 0.2 m^2 one steel collector (+heater) of 1 m^2
Location:	1m above ground
Frequency:	monthly exchange of collector canisters
Laboratory:	assessment of gross beta and gamma-emitting isotopes
LLD:	(1) 1.3 - 6.7 Bq/m^2 (gross beta) (2) 0.1 - 0.3 Bq/m^2 (gamma emitters)

APPENDIX 14

ERMAH - MONITORING & SAMPLING PROGRAMME 2004 (PER REGIONAL CENTRE PER COUNTY)

1. The sampling programme

Notes
- 18 of the 19 Hungarian counties are distributed between 6 regional centres.
- The seventh regional centre is in charge of Budapest city + its surrounding county.

sample	1st quarter		2nd quarter		3rd quarter		4th quarter		annual total
aerosol	depends on the type of sampler (see section 2. below)								**40-365**
fall-out	monthly 1	3	monthly 1	3	monthly 1	3	monthly 1	3	**12**
surface water	monthly 1 river quarterly 1 lake	4	monthly 1 river quarterly 1 lake	4	monthly 1 river quarterly 1 lake	4	monthly 1 river quarterly 1 lake	4	**16**
soil	1 (cultivated or uncultivated)	1	1 (cultivated or uncultivated)	1	1 (cultivated or uncultivated)	1	1 (cultivated or uncultivated)	1	**4**
feeding stuff	1 hay	1	1 grass	1	1 grass	1	1 hay	1	**4**
cereals	1 wheat 1 corn	2	1 rice 1 rye	2	1 wheat 1 barley	2	1 corn 1 rye	2	**8**
vegetables	1 potato 1 onion	2	1 lettuce 1 cucumber	2	1 paprika 1 tomato	2	1 carrot 1 cabbage	2	**8**
fruit	1 apple 1 banana (*)	2	1 strawberry 1 sour cherry	2	1 peach 1 grapes	2	1 apple 1 orange (*)	2	**8**

Cont'd

milk (*)	monthly 3	9	monthly 3	9	monthly 3	9	monthly 3	9	**36**
dairy products (*)	1 cheese 1 curd cheese 1 milk powder	3	1 cheese 1 curd cheese 1 milk powder	3	1 cheese 1 curd cheese 1 milk powder	3	1 cheese 1 curd cheese 1 milk powder	3	**12**
meat	1 beef 1 pork 1 poultry	3	1 beef 1 pork 1 poultry	3	1 beef 1 pork 1 poultry	3	1 beef 1 pork 1 poultry	3	**12**
eggs	1	1	1	1	1	1	1	1	**4**
bread (*)	monthly 1	3	monthly 1	3	monthly 1	3	monthly 1	3	**12**
mineral water (*)	1	1	1	1	1	1	1	1	**4**
drinking water	1 March (H-3, Sr-90)	3	1	1	1 September (H-3, Sr-90)	3	1	1	**4** **2** **2**
mixed diet	March	1	-----	---	September	1	-----	---	**2**
total (without aerosol)		39		36		39		36	**150**

(*) for 10 counties

Cont'd

2. Sampling and measurement programme for aerosols and ambient dose rate.

2.1 <u>Regional Centres equipped with medium volume air samplers (type "Hunter")</u>

-	Sampling frequency:	weekly between 1 Oct and 30 March fortnightly or weekly between 1 May and 30 Sep
-	Sampling time:	2-7 days between 1 Oct and 30 March 5-14 days between 1 May and 30 Sep
-	Measurement:	Gamma-spectrometry with HPGe detector
-	Annual number of samples:	minimum 40

2.2 <u>Regional Centres equipped with low volume air samplers</u>

-	Sampling frequency:	at least weekly
-	Sampling time:	maximum 24 hours
-	Measurement:	gross-beta activity
-	Annual number of samples:	52-365

2.3 <u>Ambient dose rate</u>

-	Measurement frequency:	weekly (each Monday 9 AM) with a Berthold UMo LB123 probe, one measuring location, 1m height above ground level measurement range: 50 nSv/h - 10 mSv/h
-	Measuring time:	30 minutes

3. Data transmission requirements

3.1 <u>Data recording</u>: by the "OKSEU" recording and transmission software developed for the NERMS (OKSER) system in a local database

3.2 <u>Validation of results</u>: the measurement results and other monitoring data stored in the local database shall be validated by the head of laboratory responsible for the monitoring programmme before transmission to the central database of OSSKI (NRIRR).

3.3 <u>Back up of the local databases</u>: the local database shall be duplicated on CD, floppy diskette, etc. at least quarterly. The results and data of the local database shall be validated before safety duplication.

Cont'd

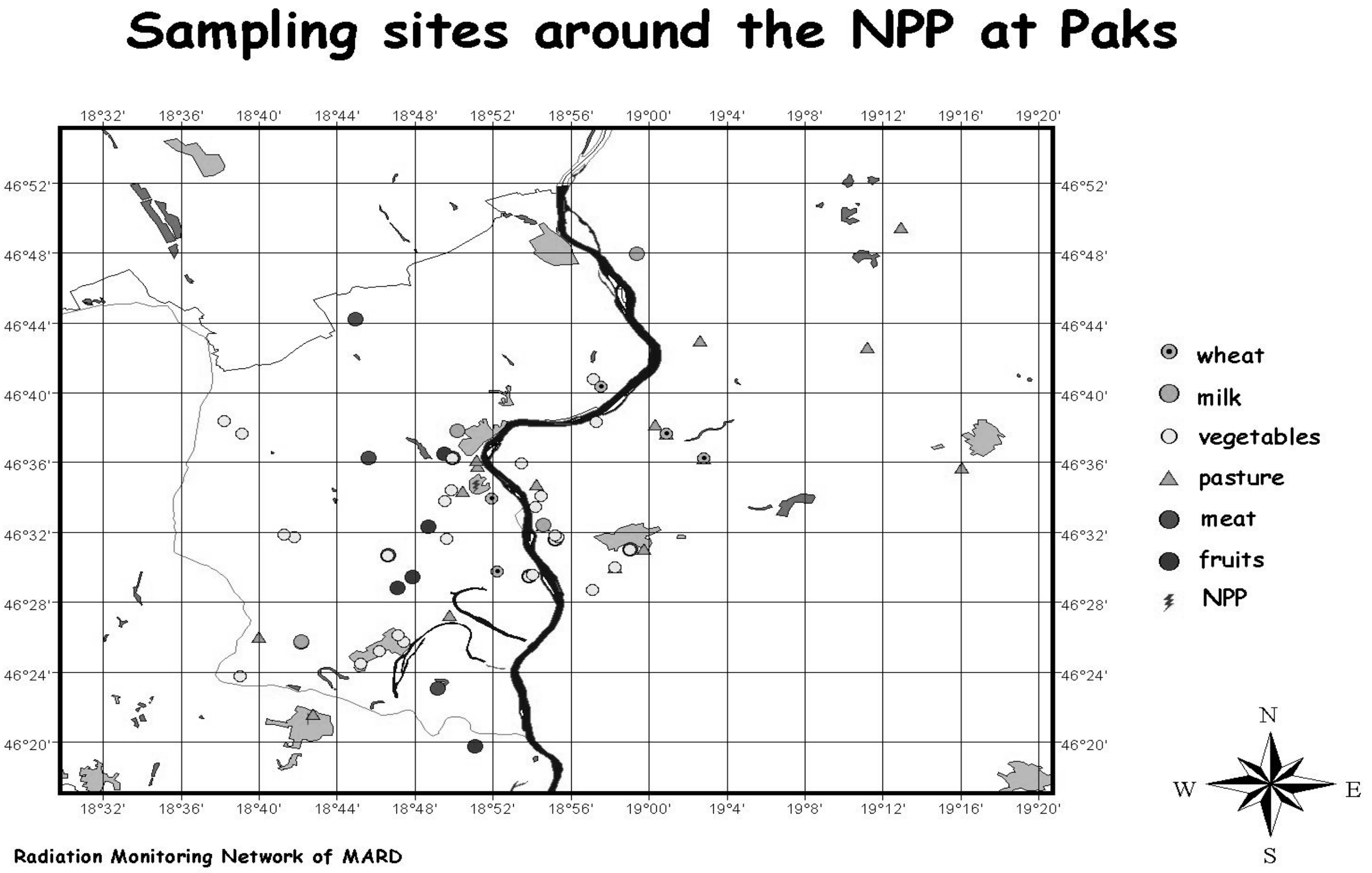
3.4 Data transmission tools: validated results and data shall be transmitted by the “OKSEU” software to the central database of ERMAH Information Centre of the OSSKI (NRIRR). In case of a technical problem of the on-line connection the local database shall be sent attached to an e-mail. If the laboratory has a permanent failure with the on-line or Internet connection the dataset can be send on CD or floppy, as well.

3.5 Deadline for data transmission: the laboratories of ERMAH shall transmit their validated results and data within 30 days following the measurement. The Information Centre shall transmit all monitoring results to the EU REM database (Joint Research Centre, Ispra) in the required form before 1 June of the following year.

3.6 Handling of erroneous data and results: if the laboratory detects an erroneous result or other wrong data after having transmitted these for incorporation into the database, the erroneous/correct data shall be reported in writing to the the ERMAH Information Centre.

APPENDIX 15

MARD - SAMPLING SITES AROUND THE PAKS NPP (JERMS)



APPENDIX 16

MARD - SAMPLING SCHEDULES

1. General sampling schedule for each county and the central laboratory.

Sample	Gross-beta	Gross-alpha	Fast Cs-137 determination by scintillation spectrometry	Gamma-emitters by high resolution spectrometry	Determination of radio-strontium
Milk	12	12	12	12	12
Fodder	12	12	12	12	12
Dried milk	6	6	6	6	6
Cheese	6	6	6	6	6
Meat (pork / beef)	6	-----	6	6	-----
Fish	1	1	1	1	-----
Poultry	5	-----	5	5	-----
Cereals	3	3	3	3	3
Potato	3	3	3	3	3
Sorrel / spinach	3	3	3	3	3
Root vegetables	2	2	2	2	2
Green pepper	2	2	2	2	-----
Tomato	2	2	2	2	-----
Green beans	1	1	1	1	-----
Cabbage	2	2	2	2	-----
Onion	1	1	1	1	-----
Apple	3	3	3	3	3
Sweet corn	1	1	1	1	-----
Mushroom	3	3	3	3	1
Moss	3	3	3	3	3
Pasture	6	6	6	6	6
Alfalfa	3	3	3	3	3
Nettle	3	3	3	3	3
Soil from agricultural area	1	-----	1	1	1
Soil from household area	1	-----	1	1	1
Soil from uncultivated area	1	-----	1	1	1
Game	3	-----	3	3	-----
Other significant sample for given county	12	12	12	12	12

In addition 600 samples are taken from exported/imported food and other agricultural products. These samples are measured for gamma emitters with high resolution gamma spectrometry.

2. Sampling schedule around the Paks NPP.

Sample	Location	Frequency	Sample volume	Type of radiochemical analysis					Number of samples
				radio strontium	Gross alpha	gamma spec.	^{3}H	alpha spec.	
NFII									
Aerosol		weekly	60000 m^3/week	---	+	+	---	---	52
Precipitation	At the laboratory	monthly	---	---		+	+		12
Drinking water		monthly	50 l	+	+	+	+	+	12
Grass	KFKI	weekly	0.5 kg	---	---	+	---	---	40
Grass	Püspökszilagy	quaterly	3-4 kg	+	+	+	---	+	4
Soil			1 kg	+	+	+	---	+	4
County Bács-Kiskun									
Milk		monthly	5 l	+	+	+	---	---	12
Fodder		monthly	3-4 kg	+	+	+	---	---	12
Fresh vegetables	Paks NPP 30km		4-5 kg	+	+	+	+	+	24
Pasture		during the gathering period	3-4 kg	+	+	+	+	+	6
Soil			1 kg	+	---	+	+	---	6
Danube water		monthly	1 l	---	---	---	+	---	32
County Tolna									
Milk		monthly	5 l	+	+	+	---	---	12
Fodder		monthly	3-4 kg	+	+	+	---	---	12
Fresh vegetables	Paks NPP 30km		4-5 kg	+	+	+	---	+	6
Pasture		during the gathering period	3-4 kg	+	+	+	---	+	6
Soil			1 kg	+	+	+	---	+	6

Note: alpha spectrometry is only required when the gross alpha measurement returns a value that is significantly higher tha the country-wide average.