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

TEMELIN NUCLEAR POWER PLANT

CZECH REPUBLIC

14 to 18 March 2005

Reference: CZ-05/2

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

FACILITIES:	Installations for monitoring and controlling radioactive discharges and for surveillance of the environment in Czech Republic during normal operations of the Temelín nuclear power plant site.
SITE:	Temelín
DATE:	14 to 18 March 2005.
REFERENCE:	CZ-05/2.
INSPECTORS:	Mr C. Gitzinger (Head of team) Mr S. Van der Stricht Mr Y-H. Bouget (national expert on secondment – France) Ms A. Godeanu Metz (trainee)
DATE OF REPORT:	28/02/2006 (draft), final report agreed upon with the Czech authorities on 12/06/2006.

SIGNATURES:

[signed]	***[signed]***
C. Gitzinger	**S. Van der Stricht**
[signed]	***[signed pp]***
A. Godeanu Metz	**Y-H Bouget (absent)**

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1. ABBREVIATIONS

ČEZ	Czech Power Company (Czech acronym)
CHMI	Czech Hydrometeorological Institute
ČHMÚ	Czech Hydrometeorological Institute (Czech acronym)
DG TREN	Directorate-General for Transport and Energy of the EC
EC	European Commission
EPZ	Emergency Planning Zone
ERML	Environmental Radiation Monitoring Laboratory of the Temelín NPP
ERMS	Environmental Radiation Monitoring Stations
ETE	Temelín Nuclear Power Plant (Czech acronym)
EWN	Early Warning Network
TNPP	Temelín Nuclear Power Plant (ETE in Czech)
NRPI	National Radiation Protection Institute (SÚRO in Czech)
RMN	Radiation Monitoring Network
RP	Radiation Protection
SONS	State Office for Nuclear Safety (SÚJB in Czech)
SONS RC	Regional Centre of the State Office for Nuclear Safety
SÚJB	State Office for Nuclear Safety (Czech acronym)
SÚJCHBO	National Nuclear, Chemical and Biological Protection Institute (Czech acronym)
SÚRO	National Radiation Protection Institute (Czech acronym)
SVÚ	State Veterinary Institute (Czech acronym)
TLD	Thermo-luminescent dosimeter
VÚV T.G.M.	T. G. M. Water Management Research Institute (Czech acronym)

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 (14 to 18 March 2005) the site of the Temelín nuclear power plant located in the South of the Czech Republic[2]. 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 SÚJB (the State Office for Nuclear Safety - hereafter SONS) in Prague.

The present report contains the results of the verification team's review of relevant aspects of the environmental surveillance at and around the Temelín 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 the Czech Republic to the European Union by letter TREN.H4 CG/iw D(2004)6152. Subsequently, practical arrangements for the implementation of the verification were made with the

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).

2 It should be noted that this is a second visit to the Temelín NPP, a first verification mission having been conducted on 9 June 2004 with a much more limited scope.

Czech competent authorities at a meeting held at the European Commission, DG TREN H4 offices in Luxembourg (31 January – 01 February 2005).

At this meeting the EC delegation presented the scope and conduct of its verification activities. The Czech competent authorities provided preliminary information on the Czech legislation and its implementation with respect to radiation protection, as well as an overview of the Temelín nuclear power plant site. A Memorandum of Understanding, establishing the basis for the future Article 35 verifications in the Czech Republic, was signed by the Commission services and the Czech competent authority.

3.2. Programme of the visit

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

The agreed programme comprised:

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

    i. The Temelín NPP Environmental Radiation Laboratory (ERML), located in České Budějovice (25 km south from the NPP).
    ii. The Laboratory of the SONS Regional Centre, located in České Budějovice.
    iii. The SÚRO (the National Radiation Protection Institute - hereafter NRPI), located in Prague.
    iv. The SONS headquarters, located in Prague.

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

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

The verification activities were carried out in accordance with this programme.

3.3. Documentation

The Czech authorities provided an excellent information dossier in advance to the verification in order to facilitate the preparation of the EC team for this verification. Additional documentation was provided during and after the visit. The verification team notes the quality and comprehensiveness of all presentations made and documentation provided.

During the visit the following presentation were given (the titles are quoted):

By the SONS:

- Czech Republic introductory information for the Art.35 Euratom Treaty verification activities
- Radiation Monitoring Network
- SÚJB Regional Centre České Budějovice - Radiation Monitoring Network
- Information System of the Radiation Monitoring Network - Software

- Organisation and responsibilities within the National Radiation Monitoring Network
- Inspectors' Activities Performed at Temelín NPP
- Control of Public Exposure from Environmental Radioactivity - Monitoring programme of Temelín NPP
- Monitoring of Temelín NPP Vicinity

By the NRPI:

- Article 35 Euratom Treaty Verification Activities
- Monitoring of the air effluents on the nuclear installations performed by SÚRO

By the operator:

- Verification of article 35 of the Euratom Treaty at Temelín NPP
- Organisational and technical aspects of effluents and environmental monitoring

By the Czech Hydrometeorological Institute

- Participation of the Czech Hydrometeorological Institute in the Early Warning Network

By the Sate Veterinary Institute:

- Laboratory of Gamma Spectrometry

By the T.G. Masaryk Water Management Research Institute:

- The National Monitoring Network - Hydrosphere

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

All documentation received is listed in Appendix 2 to this 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:

The SONS:

Ms. Věra Starostová	Head of the Emergency Response Centre
Mr. Jan Matzner	Head of the Fuel Cycle Radiation Protection Department
Mr. Ladislav Vávra	Head of the Regional Centre at České Budějovice
Mr. Libor Urbančík	Head of the Regional Centre at Brno
Mr. Emil Fiala	Radiation Protection Inspector
Mr. Milan Hort	Radiation Protection Inspector
Ms. Eva Šindelková	Radiation Protection Inspector

The operator:

Mr. Milan Sýkora	Head of the Nuclear Safety Section
Mr. Josef Koc	Head of the Radiation Protection Supervision Unit
Mr. Jiří Pospíchal	Head of the Environmental Radiation Monitoring Laboratory
Ms. Marie Fechtnerová	Head of the Environment Unit
Ms. Zdeňka Pávkova	Team leader at the NPP laboratory
Mr. Milan Šnedar	Team leader at the Environmental Radiation Monitoring Laboratory
Mr. Miroslav Martykán	Radiochemistry Technician
Mr. Daniel Janovský	Spectrometry Technician

Mr. Dušan Hanzal	Radiation Protection Technician
Mr. Marek Kurfiřt	Radiation Protection Technician
Mr. Jiří Trávníček	Radiation Protection Technician
Mr. Jiří Vokálek	Radiation Protection Technician

The NRPI:

Mr. Radim Filgas	Director
Mr. Zdeněk Prouza	Deputy-Director
Ms. Irena Malátová	Head of the Research Group
Ms. Irena Češpírová	Head of the Mobile Group
Ms. Věra Bečková	Deputy Head of the Radiochemical Department
Ms. Daniela Ekendahl	Head of the TL Dosimetry Department
Mr. Petr Kuča	Head of the Information Systems Department
Mr. Petr Rulík	Head of the Monitoring Section Department
Mr. Josef Tecl	Monitoring Section Department Technician

The Czech Hydrometeorological Institute:

Ms. Eva Červená	Data Representation Expert

The T.G.M. Water Management Research Institute:

Ms. Diana Ivanovová	Head of the Reference Laboratory

The State Veterinary Institute:

Mr. Alexander Vagy	Gamma Spectroscopy Laboratory Expert
Mr. Jiři Pluhař	Gamma Spectroscopy Laboratory Expert

3.5. The Temelín Nuclear Power Plant

3.5.1. Geographical location

The Temelín Nuclear Power Plant (hereafter TNPP), operated by the ČEZ Power Company, is located in South Bohemia, near to the Temelín village in the northern part of the České Budějovice district (app. 120 km south of Prague).

TNPP is located 45 - 50 km from the state borders with Austria and Germany, its geographical co-ordinates being: 14°22’42” E and 49°10’52” N.

3.5.2. Summary description of the power plant

The TNPP consists of two VVER-1000 type V-320 reactors of Russian design. Construction started in 1982, was then delayed, and resumed in the mid 1990s when Westinghouse instrument and control systems were incorporated. The reactors were started up in 2000 and 2002 respectively.

A schematic drawing and detailed technical attributes of the TNPP are given in Appendices 3 and 4.

4. LEGISLATION AND COMPETENT AUTHORITIES

4.1. Primary legislation: the Atomic Act

The Czech Republic adopted new legislation regulating nuclear and radiation protection matters in 1997. One of the basic documents has been Act Nr. 18/1997 Coll. 1997, on Peaceful Utilisation of Nuclear Energy and Ionising Radiation (the Atomic Act), which entered into force on 24 January 1997.

The Atomic Act regulates:

- The use of nuclear energy and ionising radiation (practice regulation).
- The protection of workers, the population and the environment from the dangers of ionising radiation.
- Interventions to reduce exposure from natural sources and in case of radiological accidents.
- Civil liability in case of nuclear damage.
- Management of radioactive wastes.
- National administration and supervision (renewed definition of the competencies of the SONS).

Since its adoption, the Atomic Act has been amended several times. The most important amendment has been brought by Act Nr. 13/2002 Coll. which transposed (together with new derived legislation) relevant parts of the EC legislation into the Czech legislation.

The Atomic Act is the cornerstone upon which all derived legislation is based.

4.2. Derived legislation

The Atomic Act entitles the SONS (and some other government bodies) to issue decrees and regulations that implement the provisions of the Act (derived legislation).

In the framework of this report the following legislative acts are the most relevant:

4.2.1. SONS Decree Nr. 307/2002 Coll. of 13/07/2002 on Radiation Protection.

This Decree is compliant with Council Directive 96/29/Euratom of 13 May 1996 (basic safety standards) and Council Directive 97/43/Euratom[3] of 30 June 1997 and regulates, *inter alia*:

- The scope and methodology of radiation protection at workplaces (exposure to man-made as well as natural sources)
- The rules for the preparation or implementation of remedial action to avert or reduce exposures.
- Exemption and clearance levels, exposure limits, dose constraints.
- Maximum permitted levels of natural radionuclide concentrations in building materials.
- Maximum permitted levels of radioactive contamination of foodstuffs.
- Classification of ionising radiation sources.
- Categorisation of exposed workers and workplaces.

[3] Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure (OJ L-180 of 09/07/1997 page 22).

- Technical and organisational requirements, procedures and guidance for radiation protection optimisation.
- Methodology for radioactive sources management, radioactive waste handling and provisions for discharges of radionuclides into the environment (discharge authorisation / licensing).
- Conditions of medical exposure and diagnostic reference levels.
- Reporting obligations.

4.2.2. SONS Decree Nr. 319/2002 Coll. of 13/07/2002 on the National Radiation Monitoring Network.

This Decree defines the scope, structure and organisation of the National Radiation Monitoring Network (RMN). The SONS is responsible for managing the RMN. Various ministries participate in the implementation of the RMN. The operator of the TNPP has a statutory obligation to also participate in the RMN.

Without going into detail, the following bodies, organization and institutes have, in various degrees, responsibilities in the area of radiation protection, more in particular with respect to the National Radiological Monitoring Network:

-	Ministry of the Environment	The Czech Hydrometeorological Institute
-		The T.G.M. Water Management Research Institute
-	Ministry of Agriculture	The State Veterinary Institute
		The State Agriculture and Food Inspection Authority
		The Forestry and Game Management Research Institute
		The Central Institute for Supervising and Testing in Agriculture
-	Ministry of Defence	Army of the Czech Republic
-	Ministry of Finance	General Directorate of Customs
-	Ministry of the Interior	General Directorate of Fire Rescue Brigade
		Police of the Czech Republic

The responsibilities (and their implementation) are formally laid down in contracts between the central regulatory body (the SONS) and the ministries defined by the Atomic Act, as well as in contracts between the SONS and directly participating institutions of individual ministries.

4.2.3. Government Order Nr. 11/1999 of 9/12/1998 on the Emergency Planning Zone.

This Order lays down that the licensee of a nuclear installation shall submit to the SONS a proposal to establish a geographically delimited emergency planning zone (EPZ) and all actions the licensee will take in case of an emergency situation (emergency preparedness). Within the said EPZ the licensee has the obligation to participate in the national Radiation Monitoring Network. This participation and resulting responsibilities, apart from those that would occur under emergency situations, also covers the monitoring under normal (routine) operation of the said nuclear installation. This routine (and continuous) monitoring addresses the source term (radioactive discharges of airborne and liquid effluents) as well as the impact thereof (monitoring of environmental indicators). The aim of routine monitoring is to demonstrate that the nuclear installation is operated in compliance with the requirements for the radiological protection of the population and the environment as established in the Atomic Act.

The TNPP EPZ is divided into an inner zone with a radius of 5 km around the site's central point, and into an outer zone limited at 13 km from the central point (see Appendix 10).

The TNPP statutory obligations for discharge and environmental monitoring are discussed in section 5 below.

Note: Appendix 2 lists further derived legislation applicable to nuclear matters and radiation protection in the Czech Republic.

4.3. The regulatory authority: the State Office for Nuclear Safety (SONS)

The competencies of the SONS are laid down in Article 3 of the Atomic Act. Basically the Atomic Act defines and empowers the SONS as the national regulatory authority in matters of nuclear safety and security, radiation protection and emergency preparedness.

This entails that the SONS, between others:

- Issues derived legislation that implements the provisions of the Atomic Act.
- Issues licences for all practices as defined in the Atomic Act.
- Implements regulatory control over licensees through, *inter alia*:
    i. Verification whether the obligations arising from the Atomic Act are adhered to.
    ii. Approval of the quality assurance programmes of the licensees (partially in conjunction with the Czech Accreditation Institute).
    iii. Approval the radiological monitoring programmes of the licensees.
- Approves on-site emergency plans, in conjunction with regional and municipal authorities. On-site emergency plans must take account of (and be fully coherent) with, the off-site emergency plans.
- Co-ordinates and manages the national Radiation Monitoring Network.

An overview of the structure of the Office is given in Appendix 5.

The SONS also acts as the managing authority of the National Radiation Protection Institute (see 4.4 below) and the National Institute for Nuclear, Chemical and Biological Protection (SÚJCHBO). Taking into account that the SÚJCHBO mainly has responsibilities in matters of chemical and biological safety, this topic is not further elaborated upon in this report.

4.4. The National Radiation Protection Institute (NRPI)

The NRPI was created in 1995 by decision of the SONS' chairman. The NRPI, formerly the Centre of Radiation Hygiene, had been handed over to the SONS by the Ministry of Public Health.

The scope of NRPI activities is laid down in its statute dated 15 November 1995. The Institute's basic function is to provide the SONS with technical/scientific support and specialised expertise in the field of radiation protection in the Czech Republic.

Within the context of this report the following tasks and responsibilities of the NRPI are relevant:

- Ensure continuous availability of high-level laboratory and field measurement capabilities.
- Ensure permanent staffing of the national Radiation Monitoring Network (RMN).
- Collect data from the RMN components.
- Manage the RMN Information System (and its central database): verification of data quality and analysis of data.

- Organise intercomparison exercises between RMN laboratory groups handling environmental samples.
- Perform an independent check monitoring programme on airborne discharges from the TNPP. This independent monitoring is discussed in section 5.6 and 6 below.

An overview of the structure of the Institute is given in Appendix 6.

5. RADIOACTIVE DISCHARGE MONITORING

5.1. Airborne discharges - legal provisions

Legal provisions regulating the discharges of gaseous radioactive effluents from the TNPP are laid down in SONS Decision Nr. 16920/2002 of 5 November 2002.

In the Decision the discharge limits are not given as annual activity or concentration limits for nuclide groups or individual radionuclides, but in terms of committed effective dose from internal exposure and effective dose from external exposure (hereafter referred to as dose) to a member of the critical group. This limit is set at 40 μSv/year.

The following conditions apply when calculating the dose:

- The critical group consists of individuals permanently residing within a perimeter of 5 km from the central point of the TNPP site.
- The yearly dose assessment (comparison between the actual values and the authorized limit) must be performed using a dedicated software package (RDETE), approved by the SONS as per SONS´ VDS 030 guideline(4).
- For the purpose of controlling discharges of activity during the calendar year, any estimation of dose (as a sum of external and internal exposure) shall be based on the sum of radionuclide-specific activities released for the period under scrutiny, whereby every radionuclide is weighted with a conversion coefficient. These coefficients are given in Appendix 7.

  Radionuclides that contribute less than 1% of effective dose may be left out of the estimation procedure. However, the summed contributions of radionuclides in this way discarded may not exceed 10% (limit of underestimation).

  For those radionuclides that return values below the detection limit, the discharge value shall be set equal to one half of the detection limit achieved.

The operator must implement a statutory discharge monitoring and sampling programme that has to be approved by the SONS (see section 5.3 below).

5.2. Liquid discharges - legal provisions

Legal provisions regulating the discharges of liquid radioactive effluents from the TNPP site are laid down in Decision Nr. 6804/1993/Si of 15 December 1993, issued in accordance with the Water Act Nr. 138/1973 Coll. by the Environmental Department of the District Authority in České Budějovice(5).

4 Guideline VDS 030 for evaluation of calculation codes for the assessment of nuclear safety. Mandatory instructions of the State Office for Nuclear Safety for accreditation process for software packages.

In the Decision the limits are expressed in dose as well as activity concentrations.

Dose limits:

- For the discharge of tritium: the dose to a member of the critical group shall not exceed 0.32 μSv/year.
- For the discharge of activation and fission products (summed): the dose to a member of the critical group shall not exceed 0.004 μSv/year (one unit in operation) or 0.006 μSv/year (both units in operation).

Activity concentration limits:

Indicator	**Limit (in Bq/litre)**	**Limit (in Bq/year)**
Total beta activity (excluding tritium)	21	1E+9
Tritium	34 800	4E+13

These limits apply not only during normal operation of the TNPP, but also for emergency situations within the power plant.

Further operational limitations apply:

The discharge sentencing tanks (DST) may only be emptied into the waste water discharge mixing pit (DMP) if:

- the total tritium content (per tank) does not exceed 2.5 E+11 Bq

  and

- the total beta/gamma emitter content (per tank, excluding H-3) does not result in a dose exceeding 1/20th of the dose limits specified above

  and

- that the discharge rate of the DMP ≥ 150 dm³ per second.

In addition SONS adds a legally binding condition for discharges of liquid radioactive effluents. This condition is laid down in document 1(2) Tl 001 Limits and Conditions (section A.4.4 Limits for radioactive substances discharged to waters): liquid discharges of tritium and activation and fission products (excluding tritium), produced during one calendar year, shall not result in a 50 years committed effective dose higher than 0.2 μSv (one unit in operation) or 0.4 μSv (both units in operation) for an adult individual of the population[6].

The operator must implement a statutory discharge monitoring and sampling programme that has to be approved by the SONS (see section 5.4 below).

[5] In March 2005, when the EC verification team was in the Czech Republic, a SONS decision on liquid discharges based on the Atomic Act was under preparation. Decision Nr. 8096/2005 was issued on 5 April 2005. In it, the limit (immission limitation) is expressed in dose to a member of the critical group and is set at 3 μSv/year (see Appendix 16). *Additional information received in May 2006.*

[6] After issuing Decision Nr. 8096/2005, document 1(2) Tl 001 has been amended by Decision Nr. 12677/2005 of 3 June 2005 so as to achieve compliance with the new decision. *Additional information received in May 2006.*

5.3. Airborne discharges - monitoring and sampling provisions

5.3.1. Stacks

The gaseous effluent sources within TNPP are:

- 1 Joint chimney stack on each reactor building (RB).
- 1 Stack on the common ancillaries building (CAB).

The RB ventilation stacks are so called joint chimney stacks that consist of an internal and an external ventilation duct (stack-in-stack chimney type). The stacks operate in three different modes (with distinct flow rates):

- RB operating at nominal output (app. 325 days a year).
- During outages (app. 40 days a year).
- During emergency and post-emergency operation.

Flow rates in function of the operating mode:

Stack / mode	**Nominal (m^3/h)**	**Outage (m^3/h)**	**(post) emergency (m^3/h)**
RB internal stack	app. 95 000	app. 95 000	app. 91 000
RB external stack	0	app. 125 000	80 000 (*)
CAB stack	app. 420 000		

(*) post-emergency situation

5.3.2. Scope of monitoring and sampling activities in a RB stack (summary overview).

5.3.2.1 <u>On-line monitoring</u>

- Continuous measurement of volumetric aerosol (Cs-137 equivalent), iodine (I-131 equivalent) and noble gas (Xe-133 equivalent) activities by PIG (particulate-iodine-gas) monitors (internal and external duct).

PIG measurement ranges:	Particulate matter (aerosol):	3.7 - 3.7 E05 Bq/m³
	Iodines:	1.9 - 1.0 E05 Bq/m³
	Noble gas:	1.3 E04 - 7.4 E08 Bq/m³
Filter effectiveness:	Particulate matter:	99% for aerosol size 0,003 mm
	Iodines:	≥ 95 % (elemental and organic)

- Continuous gamma spectrometric measurement of noble gas - balance measurement (internal and external duct). This monitoring system (type MVP2000) is situated downstream of the PIG monitor and is equipped with a 9,5 dm³ Marinelli pressure tank for sample analysis. Measurement range: 75 - 1 E08 Bq/m³ (for Xe-133).
- Continuous measurement of air flow is performed by two measurement units connected to the respective PIG monitors (internal and external duct). The signals from these flow meters are linked into the PIG monitors to control the isokinetic and proportional sampling of the iodine, aerosol, H-3 and C-14 samplers, as well as the noble gas gamma spectrometry system. In case the flow rate signal is lost, the system automatically returns to operate with a nominal sampling rate of 74 dm³/minute.

5.3.2.2 Sampling

- Continuous sampling of aerosols (high-volume particulate sampler - HVPS) onto a fixed filter; filter exchanged weekly for laboratory analysis - retrospective spectrometric balance measurement (internal and external ducts). Measurement range: 2 E-05 - 50 Bq/m³ (for Co-60). Yearly bulk samples are also assessed for alpha emitters and Sr-90.
- Continuous sampling of iodines onto a fixed cartridge; cartridge exchanged weekly for laboratory analysis - retrospective spectrometric balance measurement (internal and external ducts). Measurement range: 2 E-04 - 500 Bq/m³ (for I-131).
- Continuous sampling of H-3 and C-14 onto silicagel and NaOH respectively, weekly exchange of media and laboratory analysis - retrospective LSC balance measurement (internal and external ducts). Measurement ranges: 0.5 - 2000 Bq/m³ (C-14) and 0.2 - 1 E04 Bq/m³ (H-3).

5.3.2.3 Other provisions

- Continuous measurement of volumetric noble gas activity under emergency or post-emergency conditions by a medium to high-range gas monitor (HRGM). The system can switch its sampling mode from inner to outer duct and vice-versa. HRGM measurement range: 6.6 E06 - 7.4 E15 Bq/m³.
- Periodic manual sampling of noble gases into pressure bottles for additional laboratory analysis (internal and external ducts).
- Periodic manual high-volume sampling of aerosols onto a cascade impactor for additional laboratory analysis (internal and external ducts) - assessment of particulate distribution and size.

Note: The discharge monitoring programme details and reporting obligations are given in Appendix 7.

5.3.3. Scope of monitoring and sampling in the CAB stack (summary overview).

5.3.3.1 On-line monitoring

- Continuous measurement of volumetric aerosol (Cs-137 equivalent), iodine (I-131 equivalent) and noble gas (Xe-133 equivalent) activity by a PIG monitor.
- Continuous measurement of air flow is performed by a single flow meter, connected to the PIG monitor, the high-volume particulate sampler (HVPS) and the H-3 and C-14 samplers (to control isokinetic and proportional sampling modes).

5.3.3.2 Sampling

- Continuous sampling of aerosols onto a fixed filter; filter exchanged weekly for laboratory analysis - retrospective balance measurement.
- Continuous sampling of H-3 and C-14 onto adapted media, weekly exchange of media and laboratory analysis - retroactive balance measurement.

Note: The discharge monitoring programme details and reporting obligations are given in Appendix 7.

5.4. Liquid discharges - monitoring and sampling provisions

5.4.1. Operational control

There are 7 discharge sentencing tanks (DST) within the site's water treatment plant (see Appendix 8). These tanks are connected with pipelines into the waste water discharge mixing pit (DMP - 500 m³) where the discharged volumes are diluted with return water from the cooling towers before final discharge towards river Vltava (via 2 final discharge lines).

The contents of any DST must be sampled (after homogenisation) in a representative manner (appropriate draining of sampling line), the sample analysed at the laboratory so as to establish whether the DST activity content abides by the regulatory discharge limits. If limits are respected the DST can be emptied towards the DMP.

The same samples are then further analysed for retrospective (detailed) discharge accountancy purposes (balancing). Gamma isotopes and H-3 are systematically assessed on each sample taken. Proportional bulk samples are created for the quarterly assessment of Sr-89 and Sr-90 as well as transuranium isotopes.

The two discharge lines link the various DST to the DMP. Each line is equipped with a continuously operating on-line gamma monitor (items 0TZ00R001 and 0TD33R001 - see the appendix). These monitors (with a detection range between 2 E03 and 1 E08 Bq/m³ for Cs-137) are alarmed and will automatically close the release valves if pre-set activity concentration limits are breached. The warning threshold is set at 700 Bq/dm³, the alarm threshold itself at 850 Bq/m³.

5.4.2. Environmental monitoring

The final discharge lines, downstream of the DMP, are also equipped with a gamma monitor (item 0XQ15R001 - see the appendix) with a detection range between 1 E03 and 1 E08 Bq/m³ (for Cs-137). The monitor is located on the sampling line of a continuously operating proportional sampler in the "water discharge control building".

The sampling rate varies with the total volume discharged, between 1.5 dm³/day (flow of 38 dm³/sec) and 20 dm³/day (at maximum flow).

Two 160 dm³ tanks are available to collect the sample, one tank for every 24 h sampling period with automatic switch over.

Weekly proportional samples thus collected are subject to radiochemical analysis.

If the monitor detects an activity concentration above 1E05 Bq/m³, it triggers the sampler to modify it sampling frequency and routes the sample taken in a dedicated tank. Meanwhile the daily proportional sampling continues. The weekly proportional sampling is however interrupted until concentrations levels return below the limit.

Note: The discharge monitoring programme details and reporting obligations are given in Appendix 7.

5.5. Discharge samples handling

The responsibilities with respect to discharge samples handling are split between two laboratories: the on-site radiochemical laboratory and the off-site Environmental Radiation Monitoring Laboratory (ERML).

The quality assured document describing the responsibilities of both laboratories is document PP 139 (rev.00) dated 13/8/2004 on the environmental monitoring of the impact of radioactive discharges in the surroundings of the Temelín NPP.

The on-site laboratory is in charge of performing the analysis of the discharge sentencing tank samples upon which the discharge authorisation is based.

The ERML is in charge of additional analytical assessments that will allow detailed retrospective discharge balancing as well as dose impact assessment.

A summary overview of the above separation of responsibilities is given in Appendix 15.

5.6. Regulatory control of discharges

5.6.1. By the SONS

The SONS (through its RC) implements a systematic paper-based verification (in depth audit) of the results of the statutory discharge monitoring programme as implemented by the operator. To that effect the operator has the obligation to submit all monitoring/sampling results (and subsequently calculated dose impacts) to the RC (reporting obligations - see Appendix 7). These paper audits encompass airborne as well as liquid discharges.

The regulator's routine on-site audit is implemented on a monthly basis and generates a monthly report. The summary findings from these audits are published annually.

Besides this audit of the operator's data, the regulatory control function is also implemented through the validation and formal acceptance by the SONS of, *inter alia*, the monitoring programme itself, the equipment and methodologies used, the calibration and maintenance of the equipment as well as the entirety of the quality assured documentation.

Three basic levels of quality assured documentation are present at TNPP:

- Implementation documents (transcription of regulatory requirements).
- Management documents (process control principles).
- Working procedures.

Furthermore the SONS has an independent check-monitoring programme in place (as defined in document VDMI 095 of 1 September 2004 and elaborated in methodologies VDMI 096 and VDMI 101 both of 1 September 2004). The programme consists of regularly taking samples from the discharge streams for independent analysis (samples are taken by operator and are split between operator and regulator). Results from these analyses allow the regulator to validate the discharge values as declared by operator.

In accordance with this monitoring programme, the NRPI (in conjunction with the operator) takes spot samples of the gaseous effluent stream to determine discharged noble gases (Kr-85 in particular) and Carbon-14. Similarly, a part of the aerosol filters from continuous sampling (continuous sampling is provided by operator) is taken to determine the discharged radionuclides in aerosols (gamma emitters, transuranium isotopes, Sr-90) in quarterly combined samples.

As to liquid discharges, SONS weekly obtains from the operator proportional samples from the DMP and monthly bulk samples of discharged DST. If necessary, the SONS inspector may request that the operator takes a sample from a single DST (under the inspector's supervision) for further analysis in the SONS laboratories.

In the frame of environmental monitoring, SONS also takes samples of water from the Vltava River (see below).

5.6.2. By the Water Authority

In execution of the water management supervision, the water authority may request the co-operation of professional institutions monitoring the quality and wholesomeness of water. In case of the TNPP, it is the Czech Environmental Inspectorate that performs random sampling and analyses. Besides this, the operator is obliged to submit regularly its reports on liquid discharges monitoring to the Water Authority.

6. ENVIRONMENTAL MONITORING

Note: the following descriptions and related appendices only address routine environmental monitoring; monitoring under emergency situations is not within the remit of Article 35 verification activities.

6.1. The National Radiation Monitoring Network

SONS Decree Nr. 319/2002 Coll. of 13/07/2002 on the national Radiation Monitoring Network (RMN) stipulates that the RMN shall consist of two parts: a continuously operating component for routine conditions and a component that is activated only in case of a suspicion or an actual occurrence of a radiological emergency.

The RMN components for routine surveillance shall, *inter alia*, consist of:

- An on-line early warning network covering the national territory, continuously measuring dose rates.
- A TLD network, covering the national territory (dose assessment).
- Monitoring points for airborne contamination (aerosol and wet/dry deposition).
- Foodstuffs contamination monitoring.
- Laboratory groups that take environmental samples, perform spectrometric and/or radio-chemical analyses of these samples for the purpose of radionuclide concentration determination. Aerosol filters are analysed in weekly intervals, fallouts once a month, surface water, drinking water, milk and meat samples every three months, and samples of cereals, potatoes, fruits, vegetables and mushrooms at least once a year after the harvest or picking.
- The monitoring network central laboratory coordinates the activities of both the NRPI laboratory and mobile groups. This central lab shall also provide high-end analytical capabilities for specific samples (determination of Sr-90, Pu-239/240, H-3 and C-14).
- Mobile groups that map the levels of surface contamination on the national territory using ground level and airborne monitoring devices. They also ensure the distribution of the TLDs, perform qualitative and quantitative evaluation of radionuclide activities by in-situ spectrometry, and collect various environmental samples.

The main responsibility for the implementation of the routine RMN is with the SONS, through activities implemented by the NRPI (see also section 4.4 above). Other Ministries participate in the

RMN in accordance with the Atomic Act and on a contractual basis. As regards the licensees of nuclear sites (Temelín NPP) the participation in the RMN is a statutory obligation.

An overview of the items to be monitored (under routine conditions) and respective monitoring requirements is presented in Appendix 9.

6.2. Environmental monitoring around the TNPP site (by the operator)

Site-related environmental monitoring is performed by the TNPP operator. To that effect the operator has described the implementation of its statutory environmental monitoring obligations in a quality assured document approved by the SONS´ Decision Nr. 828/2000 of 18.01.2000: Working Procedure 27.08.02.01, in force since January 2000. This document describes in detail how the operator will implement his obligations resulting from:

- SONS Decree Nr. 184/1997 on radiation protection requirements.
- Governmental order Nr. 11/1999 on the Emergency Planning Zone (EPZ).

The environmental monitoring programme must be approved by the SONS[7].

The EPZ is the area around the TNPP to which the monitoring obligations apply. An overview of the EPZ (inner zone at 5 km, outer zone at 13 km) is given in Appendix 10.

Basically, within the EPZ the operator has put in place the following monitoring/sampling provisions:

- A TLD network of 54 units ($CaSO_4$ and LiF types).
- A dose rate monitoring network of 24 probes on the TNPP perimeter fence (Eberline FHZ 621).
- Seven Environmental Radiation Monitoring Stations (ERMS), one within the TNPP site perimeter, 5 within the EPZ inner zone (circular distribution around the TNPP) + 1 at Týn nad Vltavou (under the main wind direction).
- A sampling programme with subsequent laboratory analysis.

In summary, the sampling part of the programme encompasses:

- Volumetric activity of airborne particulate matter.
- Volumetric activity of airborne radioiodine.
- Surface activity in dry/wet depositions (fallout).
- Soil contamination.
- Volumetric activity of surface and ground waters as well as drinking water.
- Mass activity in sediments.
- Volumetric or mass activity in milk, agricultural products, fruits and wild crops.
- Mass activity in fish.

Outside the EPZ there are two additional ERMS, one located on the premises of the Environmental Radiation Monitoring Laboratory (ERML - situated at České Budějovice, 25 km South from the NPP), and one located in the municipality of Písek (app. 20 km North-West from the NPP). The latter ERMS is only activated in case of an emergency situation.

The ERMS are equipped by the following monitoring/sampling systems:

- 1 high-volume aerosol sampler (VF Černá Hora VOPV 200-04).
- 1 dose rate monitoring probe (Eberline FHZ 621)
- 1 large-scale atmospheric fallout collector (JMK 100).

[7] A new environmental monitoring programme was approved by the SONS in its Decision Nr. 19552/2005 of 12 September 2005. *Additional information received in May 2006*.

The ERMS located at the ERML and at Týn nad Vltavou contain an additional monitoring/sampling system for airborne radioiodine (VF Černá Hora VOPV 200-10).

Environmental radiation monitoring stations of Temelin NPP				
ERMS identification	**Eberline FHZ621 (dose rate)**	**VOPV 200-04 or VOPV 12 model K215 (particulate sampler)**	**VOPV 200-10 or VOPV 12 model K215-10 (iodines sampler)**	**telemetric link**
Bohunice	y	y	n	y
Sedlec	y	y	n	y
Litoradlice	y	y	n	y
Zvěrkovice	y	y	n	y
Nová Ves	y	y	n	y
TNPP on-site	n	y	n	n
Čes. Budějovice	y	y	y	y
Týn nad Vltavou	y	y	y	y
Písek	n	other device, JAP0090	n	n

Remarks: y=yes, n=no

The above on-site and off-site monitoring and sampling provisions are further detailed in Appendices 11 and 12 respectively.

The samples arising from the monitoring programme are analysed at the ERML. The equipment of the laboratory and the minimal detectable activities it must achieve are detailed in Appendices 13 and 14 respectively.

6.3. Environmental monitoring around the TNPP site (by the regulator)

Environmental surveillance is implemented by the SONS' Regional Centre (laboratory) located at České Budějovice. The laboratory is an integral part of the national Radiation Monitoring Network. It collects and analyses samples not only from the TNPP surroundings (the Emergency Planning Zone-EPZ) but also from the wider region of South Bohemia.

The surveillance is performed in accordance with SONS Decree Nr. 319/2002 Coll. of 13/07/2002 and implemented as specified in VDMI 095 (normal operations) and VDMI 094 (emergency situations).

The environmental part of surveillance programme that specifically applies to the TNPP EPZ comprises the following items:

- Sampling and analysis of surface waters (4 sampling locations on Vltava River).
- Sampling and analysis of surface waters (6 ponds sampled).
- Sampling and analysis of aerosols and iodines (one JL-150 Hunter sampling device).
- Sampling and analysis of fallout (6 sampling locations, 0.2 m² collectors).
- Sampling and analysis of various components of the food chain (6 sampling locations) - basically the following items are collected: milk, potatoes, vegetables, fruit, corn and wild crops).

Additionally, the surveillance is also ensured by:

- A TLD network (TLD exchange on a quarterly basis)
- A dose rate probe network (continuously operating on-line early warning network linked into the SONS' Emergency Response Centre in Prague).

7. VERIFICATION FINDINGS - DISCHARGE MONITORING

7.1. Airborne discharges

The monitoring and sampling provisions for both TNPP units being identical, the verification team decided that a visit of one reactor stack (Unit 1) was sufficient and representative for both units. The team also visited the stack of the common ancillaries building.

7.1.1. Verification activities

The verification team visited:

- The rooms 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 on-line systems and provisions available for discharge control (including liquid discharges).

7.1.2. Verification findings

7.1.2.1 The monitoring and sampling devices for airborne discharges

The verification team confirmed the existence and functionality of all the monitoring and sampling provisions as described in section 5.3 above. See also Appendix 7.

The verification team noted that:

(1) The monitoring and sampling systems are state-of-the-art.
(2) Continuous on-line monitoring (and sampling) is ensured - see below.
(3) Back-up power supply systems are present: batteries for app. 30 minutes and a diesel generator.
(4) The verification team requested and the operator provided technical drawings demonstrating the isokinetic design of the sampling lines (technical drawing reference nr. 2219, issue 2.3.2.1). It is noted that the SONS validated the design of the sampling lines.
(5) For the reactor building stacks, redundancy of monitoring/sampling provisions is ensured by the possibility to switch the inner stack sampling line to the outer stack monitoring/sampling devices and vice-versa.
(6) Spare detectors are present in the equipment room in order to allow quick exchange in case of need.
(7) All systems are equipped with functionality alarms that are relayed into the DCR. The alarm is also relayed to the cellular phone of the shift manager.
(8) Systems are calibrated every two years by the Czech Metrological Institute. Calibration certificate labels with expiry date are attached to all system components that are subject to calibration.
(9) Maintenance of the equipment is outsourced to a contractor (GiTy company). Depending on the type of equipment maintenance is performed monthly or half-yearly.
(10) The follow-up of the calibration and maintenance status of the equipment is managed by a dedicated operational unit of the TNPP (centralised responsibility) and is based upon a quality assured documentation system (as if accredited).
(11) All system components are clearly labelled with plant item identification numbers.
(12) The programme of airborne effluent sampling by the operator is satisfactory (see Appendix 7).
(13) Quality assurance and control is implemented through a compilation of comprehensive written working instructions. The team received a copy of two working instructions: for the exchange

of the aerosol filter and for the exchange of the iodine filter (both documents are quality assured and are referenced V04-501rev00 and V40-502rev00 respectively - 03/03/2005 as date of entry into force).

With respect to (2):

The continuity of sampling of aerosols, iodine, H-3 and C-14 is not entirely achieved. During the operation of exchanging the filters the continuity of the sampling process is necessarily interrupted (for several minutes). The presence of a parallel sampling line and its set of filters would not only avoid such an interruption (switching over between lines before exchange of filters) but also provide additional redundancy in case of a functional failure.

It is suggested (with the aim to fully ensure sampling continuity) that the competent regulatory authority should consider whether the commissioning of parallel sampling provisions (during normal operations) would not be beneficial.

7.1.2.2 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) Monitoring data are recorded into a database called CHEMIS. The operator demonstrated the system. The history of all on-line measurements is easily retrievable.
(3) The functionality alarms of the monitoring/sampling systems, if raised, provide visual as well as auditive signals (this is also applicable for the monitoring/sampling systems present on the liquid effluent stream).
(4) With respect to liquid discharge control: the data from the on-line discharge monitors were demonstrated. Data were in agreement with those read locally at one of the monitors.

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

7.2. Liquid discharges

7.2.1. Verification activities

The verification team visited:

- The discharge sentencing tanks' sampling locations. The team verified the existence and functionality of the sampling provisions as defined in the regulatory obligations. The team also checked the sampling procedures.
- The on-line gamma monitors controlling the discharge lines towards the waste water discharge mixing pit.
- The waste water discharge mixing pit (DMP). The team verified the existence and functionality of the sampling and on-line monitoring provisions as defined in the regulatory obligations. The team also checked the sampling procedures.

7.2.2. Verification findings

7.2.2.1 The discharge sentencing tanks

The verification team confirmed the existence and functionality of the sampling provisions as described in section 5.4 above.

The verification team noted that:

(1) Representative sampling of the tanks is ensured through preliminary homogenisation of the content of the tank, followed by adequate draining of the sampling line before filling the sample bottle.
(2) Quality assurance and control is implemented through a compilation of comprehensive written working instructions. As an example the team received a copy of quality assured document B08 ME 440 (rev.02) dated 4/3/2005 on the use of waste waters arising in controlled areas of the Temelín NPP.
(3) The chain of responsibility in giving the green light for a discharge is well controlled. Upon request the team received two copies of written discharge authorisations, duly named and signed (laboratory results - activity and dose impact) and named and countersigned (authorisation). These documents applied to discharges performed on 4/02 and 10/02/2005.

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

7.2.2.2 The on-line discharge monitors

The verification team confirmed the existence and functionality of the monitoring provisions as described in section 5.4 above.

The verification team noted that:

(1) The monitoring systems are state-of-the-art.
(2) Continuous on-line monitoring is ensured.
(3) Back-up power supply systems are present: batteries for app. 30 minutes and a diesel generator.
(4) All systems are equipped with functionality alarms that are relayed into the DCR. The alarm is also relayed to the cellular phone of the shift manager.
(5) Maintenance and calibration of the systems is subject to the same regime as noted under section 7.1.2.1 above

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

7.2.2.3 The discharge mixing pit

The verification team confirmed the existence of the sampling and monitoring provisions as described in section 5.4 above. See also Appendix 7.

The verification team noted that:

(1) The monitoring and sampling systems are state-of-the-art.
(2) Continuous on-line monitoring and sampling is ensured.
(3) The proportional sampler takes a sample every 15 minutes. The volume of the sample taken is function of the flow within the discharge channels and is electronically steered via readings from the flow meters within the channels.
(4) Back-up power supply systems are present: batteries for app. 30 minutes and a diesel generator.
(5) All systems are equipped with functionality alarms that are relayed into the DCR. The alarm is also relayed to the cellular phone of the shift manager.
(6) Maintenance and calibration of the systems is subject to the same regime as noted under section 7.1.2.1 above
(7) Quality assurance and control is implemented through a compilation of comprehensive written working instructions.

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

7.3. The TNPP radiochemical laboratory

7.3.1. 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.).

7.3.2. 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 the NRPI.
(2) Quality control is implemented through a compilation of comprehensive written working instructions and source documents.
(3) The chain of custody of sample taking, sample analysis and data handling is well defined (labelling of samples throughout, responsibilities of individuals, bookkeeping).

However,

With respect to (1):

In order to determine Kr-85 activity, a single spot sample is collected during steady nominal output of the units (one sample between outages). The sample analysis results obtained by the NRPI are then extrapolated over the period of the campaign. This discontinuous sampling and the methodology for the balancing of Kr-85 are part of a regulatory requirement. The team however noted that the operator has all the means in place to perform a continuous on-line assessment of this radioisotope. The efforts that are currently made to quantify a radioisotope of minor importance in airborne discharges of a nuclear power station are commendable. If the assessment of Kr-85 should remain a regulatory requirement, the use of the operator's monitoring capabilities should be beneficial (significant enhancement in representativeness of the results obtained).

<u>It is suggested</u> that the competent regulatory authority consider whether the current practice of quantifying Kr-85 in gaseous discharges should be maintained and if in the affirmative, to consider whether the use of the operator's monitoring capabilities would not be the preferred solution, especially with regards to obtaining representative data.

7.4. The TNPP Environmental Radiation Monitoring Laboratory

7.4.1. Verification activities

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

7.4.2. Verification findings

The verification team noted that:

(1) The laboratory is adequately equipped for fulfilling its regulatory obligations with respect to effluent samples analysis.
(2) Quality control is implemented through a compilation of comprehensive written working instructions and source documents. The verification team had the opportunity to review the written procedures for liquid scintillation counting.
(3) The laboratory is in the process of getting its accreditation.
(4) Within the ERML, the chain of custody of sample taking, sample analysis and data handling is well defined (labelling of samples throughout, responsibilities of individuals, bookkeeping and archiving). The team performed a vertical audit on a C-14 sample taken in the year 2004, without encountering any shortcomings.
(5) For the purpose of total discharge calculations (balancing) the volumetric activity concentrations (expressed in Bq/dm^3) are multiplied by the respective volumes discharged from the sentencing tanks expressed in cubic meters, without decimals. This rounding to the nearest cubic meter is not appropriate as it generates an unnecessary - and easily avoidable - lack of precision.
(6) When reviewing the procedures for the preparation of quarterly bulk samples (for the routine assessment of Sr-90 and transuranium isotopes in liquid discharges): the methodology used to define the quantity of the aliquots to be taken from the individual samples is not entirely satisfactory. The quantification is not fully proportional to the volumes discharged. As a consequence the resulting dose impact assessment is subject to a bias.
(7) The transmission procedures for liquid discharge samples between the on-site radiochemical laboratory and the ERML are not duly formalised. The chain of custody is not fully controlled at this point (absence of formal handing-over of responsibility).
(8) Discharge sample values below detection limit are handled in the following manner: for airborne discharge samples the analytical results below the limit are substituted with ½ the value of the detection limit; for liquid discharge samples the analytical results below the limit are substituted with a zero.
(9) The dose calculation procedures are subject to a high degree of conservatism. The current definition of the critical group leads to an over-estimation of the radiological impact of the TNPP discharges. The team was informed that the regulator was considering a possible revision of the statutory dose assessment procedures.
(10) The ERML regularly participates in intercomparison exercises.

With respect to (3):

> *The verification team welcomes the efforts made by the TNPP Environmental Radiation Monitoring Laboratory to obtain accreditation. It is suggested that the laboratory be given the means to achieve its accreditation under the best possible conditions.*

With respect to (5) and (6): see comment on (9) below.

With respect to (7):

> *It is suggested, in the framework of general quality assurance and control that the competent regulatory authority requires the operator to ensure that the chain of custody for discharge samples, when transferred between the on-site radiochemical laboratory and the ERML, be fully traceable. To that effect formal hand-over procedures should be implemented.*

With respect to (8):

It is reminded that the European Commission issued Recommendation 2004/2/Euratom [8] 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 (5), (6) and (9):

The verification team endorses any revision of statutory dose calculation procedures that the regulator will undertake with the aim of reducing the current levels of conservatism and that will result in the obtention of more realistic dose impact assessment values for the population.

8. VERIFICATION FINDINGS - ENVIRONMENTAL MONITORING

The verification team visited:

- The TNPP Environmental Radiation Monitoring Laboratory (EMRL) located in České Budějovice.
- The Environmental Radiation Monitoring Stations (ERMS) located within the Emergency Planning Zone around the TNPP.
- The Regional Centre (laboratory) of the State Office for Nuclear Safety (SONS RC) located in České Budějovice.
- The National Radiation Protection Institute (NRPI) laboratory located in Prague.
- The SONS headquarters located in Prague.

8.1. The TNPP Environmental Radiation Monitoring Laboratory

8.1.1. Verification activities

The verification team visited the 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.).

8.1.2. Verification findings

8.1.2.1 Instrumentation

The team established the presence and operability of laboratory instrumentation for dose and dose rate assessment, liquid scintillation counting, alpha spectrometry, gamma spectrometry, gross alpha+beta counting, and in-situ gamma spectrometry.

The team noted that:

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(1) The presence of guaranteed power supply: UPS batteries and diesel generator servicing the entire ERML building and systems within.
(2) Written working instructions and procedures are available at all workstations.
(3) Written calibration verification procedures are available at all workstations. The procedures used are compliant with the Czech Accreditation Institute requirements.
(4) Calibration verification of the various instruments is well documented (spreadsheets). Easy traceability of calibration verification results is ensured.
(5) For the TLDs the calibration is performed by the laboratory itself.
(6) For the other measuring devices the calibration is performed by the Czech Institute of Metrology (every two years + delivery of certificate). Certificates are kept in a database. Copy of certificates is sent to the SONS.
(7) The reference/calibration sources (mostly stemming from the Czech Institute of Metrology) are verified and validated on a yearly basis by the Institute.

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

8.1.2.2 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 on-line and as hard copies at all workstations.

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

8.1.2.3 Analytical procedures

The team was given the opportunity to consult and review the written analytical procedures for the following samples:

- Aerosol and iodine filters from monitoring stations equipped with on-line monitoring devices.
- Precipitation samples.
- Fallout samples.
- Groundwater samples.
- Surface water samples.
- Drinking water samples.
- Milk samples.
- Soil samples.
- Sediments samples.

The team noted that all written working instructions and procedures are quality assured documents.

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

8.1.2.4 Recording of results, reporting and archiving of data

The team assessed data handling procedures within the laboratory. The team randomly chose historical samples for which the traceability and consistency of the data was verified (from source document to final archiving).

The team noted that:

(1) Sample details and preparation are duly recorded in a dedicated hand-written sample register: type of sample, place and date of sampling, sample quantity, registration number, etc.). Entries must be signed by the laboratory assistant that took the sample.
(2) The sample registration numbers are also introduced in a computerised database for all incoming samples. Each sample is identified and receives a unique code automatically generated by the computer. The code includes between others the coordinates of the sampling point. These data are archived every day and backed-up on a separate server.
(3) All sampling instructions are available on paper and on-line for all laboratory staff.
(4) The paperwork and corresponding electronically stored data for one randomly chosen sample (one aerosol filter taken at the Nová Ves sampling point in 2001) were requested and provided by the lab personnel. All documents were properly archived and the data and results were consistent with the values reported to the regulator.
(5) The aerosols filters, soil and sediment samples are archived for 50 years. The dried milk samples are archived for one year. Surface, precipitation, drinking, fallout, ground and underground waters and the agriculture products including the wild berries, do not require sample archiving.
(6) Paper documents (forms, ledgers etc.) are archived for a period up to 10 years.
(7) The reports are archived electronically on CD-ROM every quarter. The regulator, for verification purposes, has access to the computer network of the operator.

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

8.1.2.5 Intercomparison exercises

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

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

8.2. Monitoring and sampling provisions within the Emergency Planning Zone

8.2.1. 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 as listed below.

- The Environmental Radiation Monitoring Stations (ERMS) at the locations of Nová Ves and Týn nad Vltavou.
- The ERMS and other environmental surveillance provisions located on the site of the ERML.
- The river water and sediment sampling point at Hladná village.
- The drinking water sampling point at Temelín village.
- The ground water sampling and dose rate monitoring provisions on the TNPP site.
- The site of the Meteorological Institute at Temelín village.

At these locations the team 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, and addressed aspects of quality assurance and control.

8.2.2. Verification findings

8.2.2.1 The ERMS at Nová Ves and at Týn nad Vltavou

The verification team confirmed the existence and functionality of the monitoring and sampling equipment and procedures as described under section 6 above as well as in appendices 11 and 12.

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

8.2.2.2 The environmental surveillance provisions on the ERML site

The verification team confirmed the existence and functionality of the monitoring and sampling equipment and procedures as described under section 6 above as well as in appendices 11 and 12.

The team noted that:

(1) The continuous operation of all devices is guaranteed through back-up power supply systems.
(2) The operational status of all devices is electronically transmitted into the laboratory (on-line failure alarm).

Furthermore:

- The ERML staff demonstrated the equipment and procedures used for snow, sediment and soil sampling.
- The three radiation protection vehicles and their equipment for in-field surveys and assessment of levels of environmental contamination were also demonstrated. The team noted that the vehicles are adequately equipped for their intended purpose.

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

8.2.2.3 The river water sand sediment sampling point at Hladná village

The TNPP operator gave a demonstration of the sampling methodology and procedures.

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

8.2.2.4 The drinking water sampling point at Temelín village

The TNPP operator gave a demonstration of the sampling methodology and procedures.

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

8.2.2.5 The ground water sampling and dose rate monitoring provisions on the TNPP site

The TNPP operator gave a demonstration of the sampling methodology and procedures on a borehole (reference OTKA 24).

The verification team confirmed the existence and functionality of the dose rate monitoring probes located on the perimeter fence of the TNPP site.

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

8.2.2.6 The site of the CHMI at Temelín village

A presentation of the various meteorological instruments was provided. Data from these instruments are relayed (real time) into the TNPP control room as well as into the ERML. At the latter the data are stored in the TEDIS database.

The site is a regular part of RMN and serves for the gathering of various environmental samples (aerosols and wet/dry deposition) and the monitoring of dose (TLD) and dose rate (on-line probes).

8.3. The SONS' Regional Centre

8.3.1. Verification activities

The verification team visited the laboratory of the SONS´ Regional Centre in České Budějovice 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.).

At the same time the team checked the functionality of the monitoring and sampling provisions installed on the premises of the centre. The team also checked the adequacy of the local sampling procedures, and addressed aspects of quality assurance and control.

8.3.2. Verification findings

8.3.2.1 Laboratory instrumentation

The verification team noted that:

(1) The laboratory is adequately equipped.
(2) A quality assurance and control system is in place (written working instructions and procedures are available at every work station). All quality assured documents are also available in electronic format.
(3) All samples receive unique identifiers that are kept throughout the whole chain of custody.
(4) The quality assurance and control system has been validated by the SONS.
(5) The analysis methodologies have been validated by the SONS.
(6) Calibration of the instrumentation is performed by the Czech Metrological Institute (calibration certificates).
(7) Calibration checks are systematically performed (as part of the quality assurance procedures) by laboratory personnel. All results are systematically recorded.
(8) An efficient archiving system is in place (samples and documents).
(9) The laboratory participates in intercomparison exercises.

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

8.3.2.2 Data audit

The verification team performed a vertical document audit on a randomly chosen sample: (aerosol sample taken at České Budějovice in 2001). Laboratory staff retrieved all relevant documents forthwith from the archives. The audit, that also encompassed the available electronic data, demonstrated that the data and results were consistent with the values reported to the regulator.

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

8.3.2.3 Environmental monitoring and sampling devices

The verification team confirmed the presence and functionality of the following monitoring and sampling devices:

- A dose-rate probe, part of the on-line early warning network.
- A fallout sampling vessel.
- An air sampling device for aerosols as well as iodines (a JL-150 Hunter).

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

8.4. The NRPI laboratory at Prague

8.4.1. Verification activities

At the time of the visit the NRPI was in the midst of moving its laboratory and offices to the newly built premises. The verification team visited both locations:

- In the old NRPI building the team visited the laboratories and sections that still were operational: the TLD laboratory, the sample preparation section and the radiochemistry laboratory.
- At the new premises the team visited the NRPI's sample preparation section, the radiochemistry laboratory and the gamma and alpha spectrometry sections.

Because of the ongoing removal and related refurbishment activities the team decided to restrict itself to briefly review the equipment of the laboratory. During this review aspects of quality assurance and control as well as methodologies used were addressed to the extent possible. A random data audit was not performed.

The team checked the functionality of the monitoring and sampling provisions installed on the premises of the laboratory.

8.4.2. Verification findings

8.4.2.1 Laboratory equipment

The team noted that the laboratory is equipped, managed and controlled to standards that are identical to those that apply to the regional laboratory in České Budějovice (see section 8.3.2.1 above).

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

8.4.2.2 Environmental monitoring and sampling devices

The verification team confirmed the presence and functionality of the following monitoring and sampling devices:

- A dose-rate probe, part of the on-line early warning network.
- A fallout sampling vessel.
- A high-volume air sampling device for aerosols as well as iodines (a JL-900 Snow White).

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

8.5. The SONS' headquarters

The verification team received an extensive presentation on the national Radiation Monitoring Network system structure (software, components, functionalities, databases, communication links, reporting facilities, etc.).

Also a comprehensive on-line demonstration of the early warning part of the RMN was given. The verification team had the opportunity to interrogate on-line data (historical and real-time) from various telemetric dose rate probes.

Prior to the closing meeting held at the SONS´ Headquarters where the verification team presented its preliminary conclusions, presentations were given by the Czech Hydrometeorological Institute (on its participation in the Early Warning Network), by the State Veterinary Institute (on its gamma spectrometry laboratory) and by the T.G.M. Water Management Research Institute (on its participation in the National Monitoring Network).

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

9. CONCLUSIONS

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 Temelín 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 improving some aspects of the radioactive discharges monitoring. These recommendations, that in general address aspects of control, do not discredit the fact that environmental monitoring around the Temelín 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 Czech competent authority through the Czech Permanent Representative to the European Union.

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

ANNEX 1

THE VERIFICATION PROGRAMME

Monday 14/03

1. Site access formalities
2. Opening meeting: introduction and presentations.
3. The discharge team (Team 1) verifies airborne discharge monitoring and sampling provisions, liquid discharges monitoring and sampling provisions.
4. The environmental team (Team 2) verifies the environmental monitoring and sampling devices put in place by the operator, within the buffer (5km) and supervised (13 km) zones around the NPP site.

Tuesday 15/03

5. Team 1 continues with the verification of discharge monitoring and sampling devices and visits the NPP effluent laboratory.
6. Team 2 continues with the verification of the operator systems, and verifies the environmental monitoring and sampling devices put in place by the regulator (within the 5 and 13 km perimeters (AM). Visit the laboratory of the SONS´ Regional Centre in České Budějovice (PM).

Wednesday 16/03

7. Team 1 continues with the effluent laboratory verification (AM) and visits the Environmental Radioactivity Monitoring Laboratory (ERML) of the NPP, located in České Budějovice.
8. Team 2 visits the ERML (AM), and travels to Prague (PM)

Thursday 17/03

9. Team 1 travels to Prague (AM), verification activities with respect to the radiation monitoring network at the National Radiation Protection Institute (NRPI) in Prague (PM).
10. Team 2: verification activities at the NRPI.

Friday 18/03

11 Closing meeting held at the SONS´ headquarters with all parties involved; the verification team presents its preliminary conclusions (AM).

APPENDIX 2

DOCUMENTATION RECEIVED

1. SÚJB (State Office for Nuclear Safety - SONS)

1. The radioactivity monitoring report for the Czech Republic – 2002.
2. The annual SÚJB report – 2003.
3. Presentation (slides) titled "Czech Republic introductory information for the art.35 Euratom Treaty verification activities".
4. Presentation (slides) titled "Radiation Monitoring Network".
5. Presentation (slides) titled "SÚJB Regional Centre České Budějovice- Radiation Monitoring Network".
6. Presentation (slides) titled "Information System of the Radiation Monitoring Network – Software".
7. Presentation (slides) titled "Organisation and responsibilities within the National Radiation Monitoring Network".
8. Presentation (slides) titled "Inspectors' Activities Performed at Temelín NPP".
9. Presentation (slides) titled "Control of Public Exposure from Environmental Radioactivity - Monitoring programme of Temelín NPP".
10. Presentation (slides) titled "Monitoring of Temelín NPP Vicinity".
11. Written communication to the verification team titled "Short explanation of the legislative process of issuing the decision of the Ministry of the Environment on discharges of radionuclides from NPP Temelín into water".

Regulatory documents

12. Act Nr. 18/1997 Coll. of 24/01/1997 on the Peaceful Utilisation of Nuclear Energy and Ionising Radiation (the Atomic Act).
13. Government Order 11/1999 of 09/12/1998 on the Emergency Planning Zone.
14. SÚJB Decree Nr. 144/1997 Coll. on Physical Protection of Nuclear Materials and Nuclear Facilities and their Classification
15. SÚJB Decree Nr. 145/1997 Coll. on Accounting For and Control of Nuclear Materials and their Detailed Specification, amended by SÚJB Decree Nr. 316/2002 Coll.
16. SÚJB Decree Nr. 146/1997 Coll. specifying Activities directly affecting Nuclear Safety and Activities especially important from the viewpoint of Radiation Protection, Requirements on Qualification and Professional Training, on Methods to be used for the verification of Special Professional Competency and for the issue of Authorisations to Selected Personnel, and the form of Documentation to be approved for Licensing of Expert Training of Selected Personnel; amended by SÚJB Decree Nr. 315/2002 Coll.
17. SÚJB Decree Nr. 214/1997 Coll. on Quality Assurance in Activities related to the Utilisation of Nuclear Energy and in Radiation activities, and laying down Criteria for the Assignment and Categorisation of Classified Equipment into Safety Classes.
18. SÚJB Decree Nr. 215/1997 Coll. on Criteria for the Siting of Nuclear Facilities and Very Significant Ionising Radiation Sources.
19. SÚJB Decree Nr. 106/1998 Coll. on Nuclear Safety and Radiation Protection Assurance during Commissioning of and Operation of Nuclear Facilities.
20. SÚJB Decree Nr. 195/1999 Coll. on Basic Design Criteria for Nuclear Installations with respect to Nuclear Safety, Radiation Protection and Emergency Preparedness.

21. SÚJB Decree Nr. 324/1999 Coll. on Limits of Concentration and Amount Nuclear Material for which Nuclear Liability Requirements do not apply.
22. SÚJB Decree Nr. 307/2002 Coll. on Radiation Protection.
23. SÚJB Decree Nr. 317/2002 Coll. on Type Approval of Packaging Assemblies for Transport, Storage and Disposal of Nuclear Materials and Radioactive Substances, on Type Approval of Ionizing Radiation Sources and on Transport of Nuclear Materials and Specified Radioactive Substances (repeals SÚJB Decrees Nrs. 142/1997 Coll. and 143/1997 Coll.).
24. SÚJB Decree Nr. 318/2002 Coll. on Details of Emergency Preparedness of Nuclear Facilities and Workplaces with Ionizing Radiation Sources and on Requirements on the Content of On-site Emergency Plans and Emergency Rules.
25. SÚJB Decree Nr. 319/2002 Coll. on Performance and Management of the National Radiation Monitoring Network.
26. SÚJB Decree Nr. 419/2002 Coll. on Personal Radiation Passports.
27. SÚJB Decree Nr. 185/2003 Coll. on Decommissioning of Nuclear Installations or Category III. and IV. workplaces.
28. District Authority Decision Nr. 6804/1993/Si of 15/12/1993 laying down the conditions and limits for the use of water by the Temelín NPP (uptake and discharge of cooling water, activity discharge limits, etc.)
29. Comparative histograms of analytical results (liquid discharge samples) between operator and regulator (2003 and 2004).
30. A set of 34 SÚJB Methodologies (QA/QC documents), (including annexes listing and illustrating all TLD positions on the territory of he Czech Republic).

2. NRPI (National Radiation Protection Institute)

31. Presentation (slides) titled “Article 35 Euratom Treaty Verification Activities”.
32. Presentation (slides) titled “Monitoring of the air effluents on the nuclear installations performed by SÚRO”.
33. Written communication to the verification team titled “TLD Territorial Monitoring Network in the Czech Republic” + results for the year 2004 (spreadsheet).
34. 2003 Report on the results of the National Radiation Monitoring Network in the Czech Republic.
35. 1998-2003 Report on the activities of the National Radiation Protection Institute.
36. Various tables related to discharge sample taking and sample analysis results.

3. ČEZ (Operator)

37. Presentation (slides) titled “Verification of article 35 of the Euratom Treaty at Temelín NPP”.
38. Presentation (slides) titled “Organisational and technical aspects of effluents and environmental monitoring”.
39. QA/QC document PP 27.08.02.01 (rev.00) dated 15/12/1999 on the statutory environmental radiation monitoring programme for the area surrounding the Temelín NPP.
40. QA/QC document L-ETE 002 (rev.00) dated 28/4/2004 on the regulatory discharge monitoring programme for the Temelín NPP.
41. Written communication to the verification team titled “Installations from monitoring and controlling radioactive discharges and for the surveillance of the environment around Temelín NPP during normal operations”.

42. QA/QC document ME 440 (rev.02) dated 4/3/2005 on the use of waste waters arising in controlled areas of the Temelín NPP.
43. QA/QC document PP 139 (rev.00) dated 13/8/2004 on the environmental monitoring of the impact of radioactive discharges in the surroundings of the Temelín NPP.
44. Laboratory working instruction 501 (rev.00) dated 3/3/2005 on the sampling of aerosols from airborne discharges from the Temelín NPP.
45. Laboratory working instruction 502 (rev.00) dated 3/3/2005 on the sampling of iodines from airborne discharges from the Temelín NPP.
46. Schematic technical drawing representing the monitoring and sampling devices for airborne discharges from the Temelín NPP.
47. Schematic technical drawing representing the monitoring and sampling devices for liquid discharges from the Temelín NPP.
48. Various working papers and tables related to discharge sample taking, sample analysis and transmission of results.

4. State Veterinary Institute

49. Presentation (slides) titled “Laboratory of Gamma Spectrometry”.

5. Czech Hydrometeorological Institute

50. Presentation (slides) titled “Participation of the Czech Hydrometeorological Institute in the Early Warning Network”.

6. T.G.M. Water Management Research Institute

51. Presentation (slides) titled “The National Monitoring Network - Hydrosphere”.

7. Other sources of information

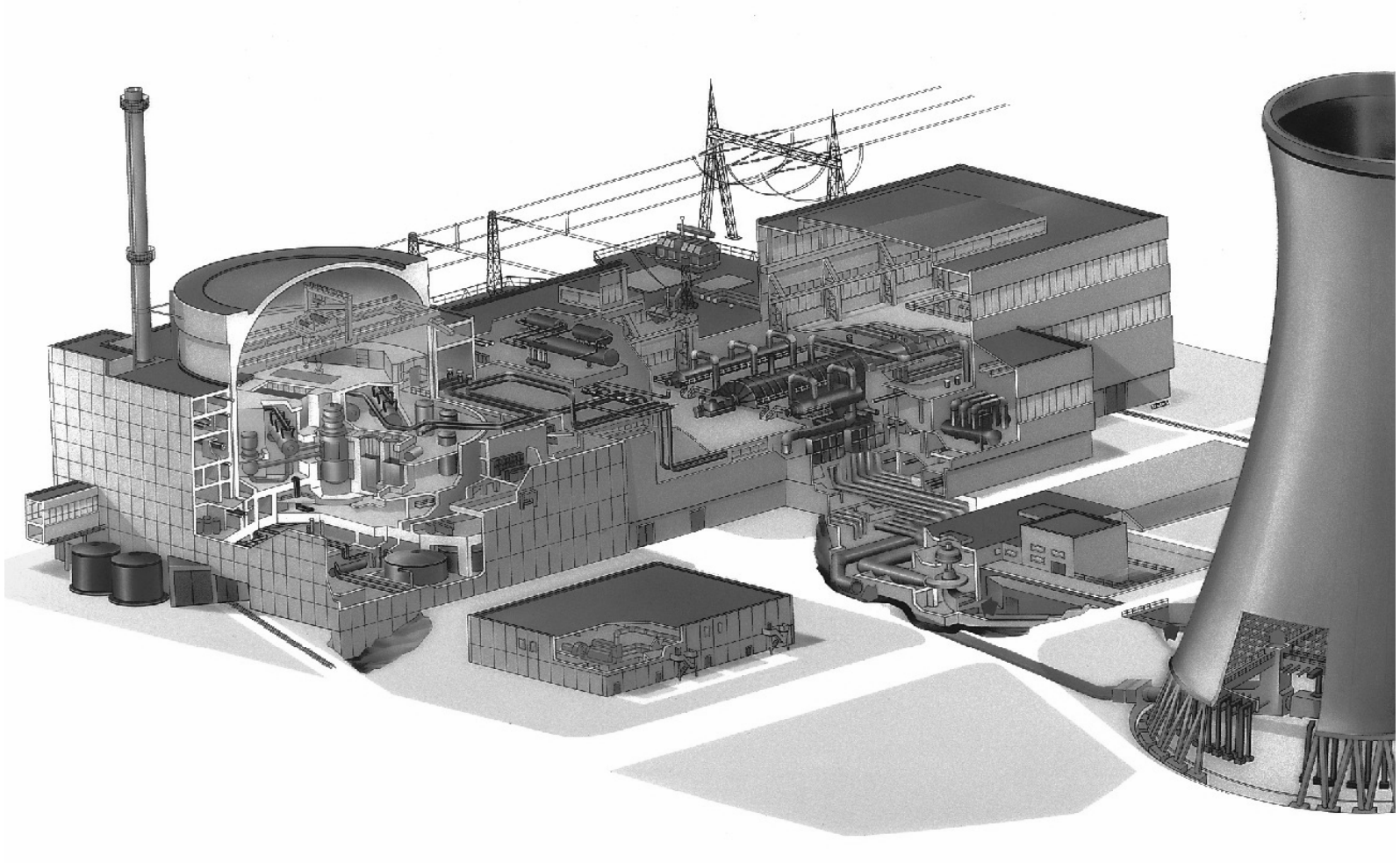
52. The websites of various Czech regulatory bodies and other organisations with competence in the field of radiation protection:

    www.cez.cz
    www.suro.cz
    www.sujb.cz
    www.sujchbo.cz
    www.chmi.cz
    www.svscr.cz

53. Information provided by the Czech competent authorities 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

TNPP - SCHEMATIC DRAWING



APPENDIX 4

TNPP - TECHNICAL PARAMETERS

Number of reactor units:		2
Reactor type:		PWR type VVER 1000
Per unit:	Nominal thermal output:	3000 MWth
	Generator output:	981 MWe
	Net electrical output:	912 MWe

Reactor technical parameters

Rector height	10.9 m
Pressure vessel inner diameter	4.5 m
Cylindrical part wall thickness	193 mm
Thickness of pressure vessel cladding	7 - 18 mm
Empty pressure vessel weight	322 t
Reactor weight	app. 800 t

Reactor core

Number of fuel assemblies	163
Number of fuel rods per assembly	312
Number of control assemblies	61
Core height	3.1 m
Fuel enrichment (U-235)	max. 5%
Core loading (UO_2)	92 t
Fuel cycle	4 years

Reactor cooling system

Number of cooling loops	4
Coolant volume (primary circuit)	337 m³
Coolant pressure (primary circuit)	15.7 MPa
Inlet cooling temperature	app. 290 °C
Outlet cooling temperature	app. 320 °C
Coolant flow through reactor	84800 m³/h

Steam generators

Number per unit	4
Steam production per SG	1470 t/hour
Steam output pressure	6.3 MPa
Steam output temperature	278.5 °C
Steam generator weight	app. 416 t
Steam generator body diameter	4.2 m
Steam generator body length	14.5 m

Main coolant pumps

Number per unit	4
Nominal power consumption	5.1 - 6.8 MW
Operational capacity	app. 21200 m³/h
Rotor speed	1000 rpm
Pump weight	app. 156 t

Turbine

Number of high-pressure sections	1
Number of low-pressure sections	3
Rotor speed (nominal)	3000 rpm
High-pressure section weight	206 t
Low-pressure section weight	480 t

Generator

Rated power	1111 MW
Output voltage	24 kV
Nominal frequency	50 Hz
Cooling media	hydrogen - water
Weight	564 t

Condenser

Number per turbine	3
Number of pipes per condenser	app. 32000
Pipe length	12 m
Pipe material	Titanium

Cooling towers

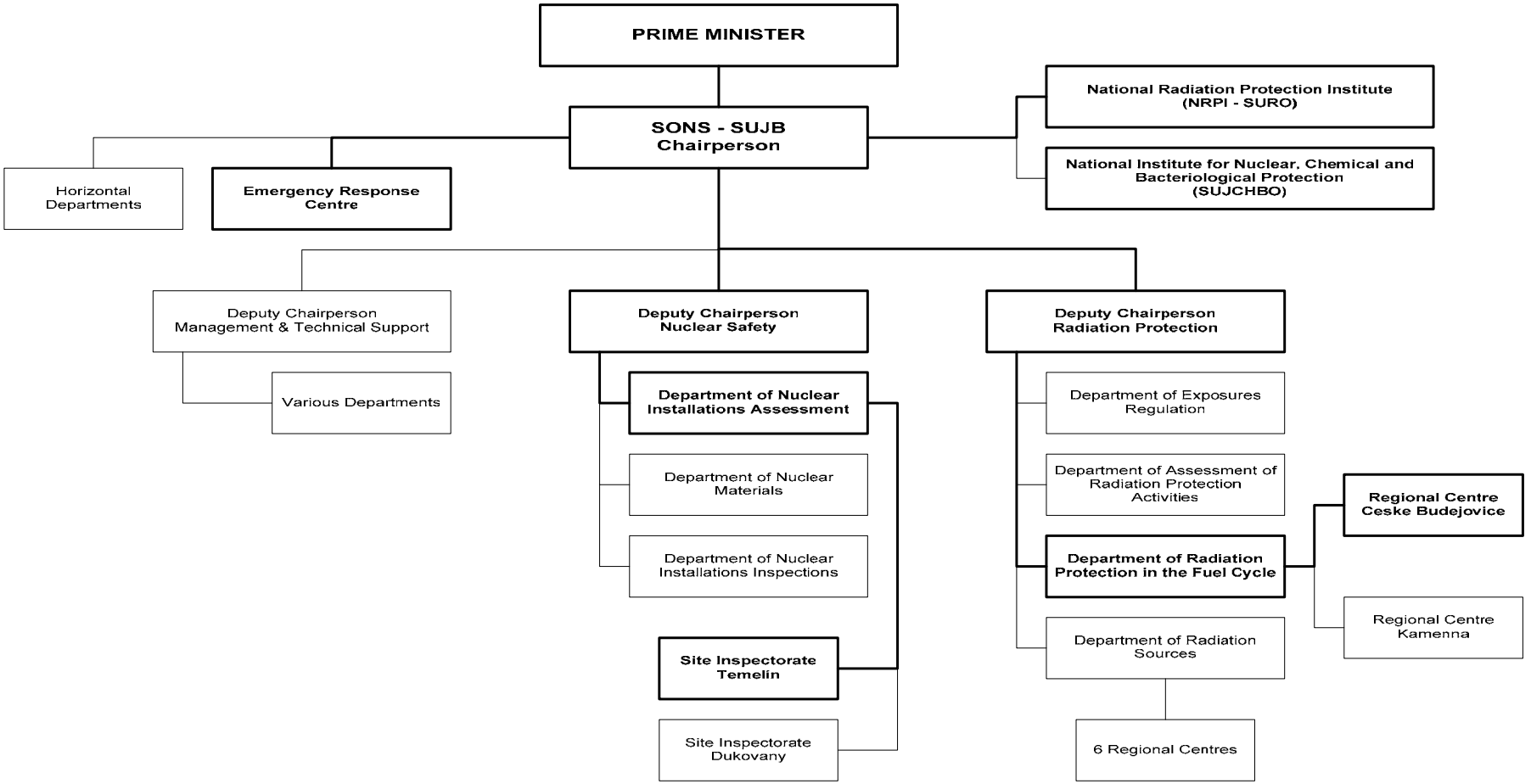
Number per unit	2
Height	154.8 m
Top diameter	82.6 m
Bottom diameter	130.7 m
Wall thickness	0.9 - 0.18 m
Water flow (per tower)	app. 17.2 m³/s
Volume evaporated steam (per tower)	max. 0.4 m³/s

Containment system

Height of cylindrical part	38 m
Inner diameter of cylindrical part	45 m
Wall thickness	1.2 m
Thickness of stainless steel liner	8 mm

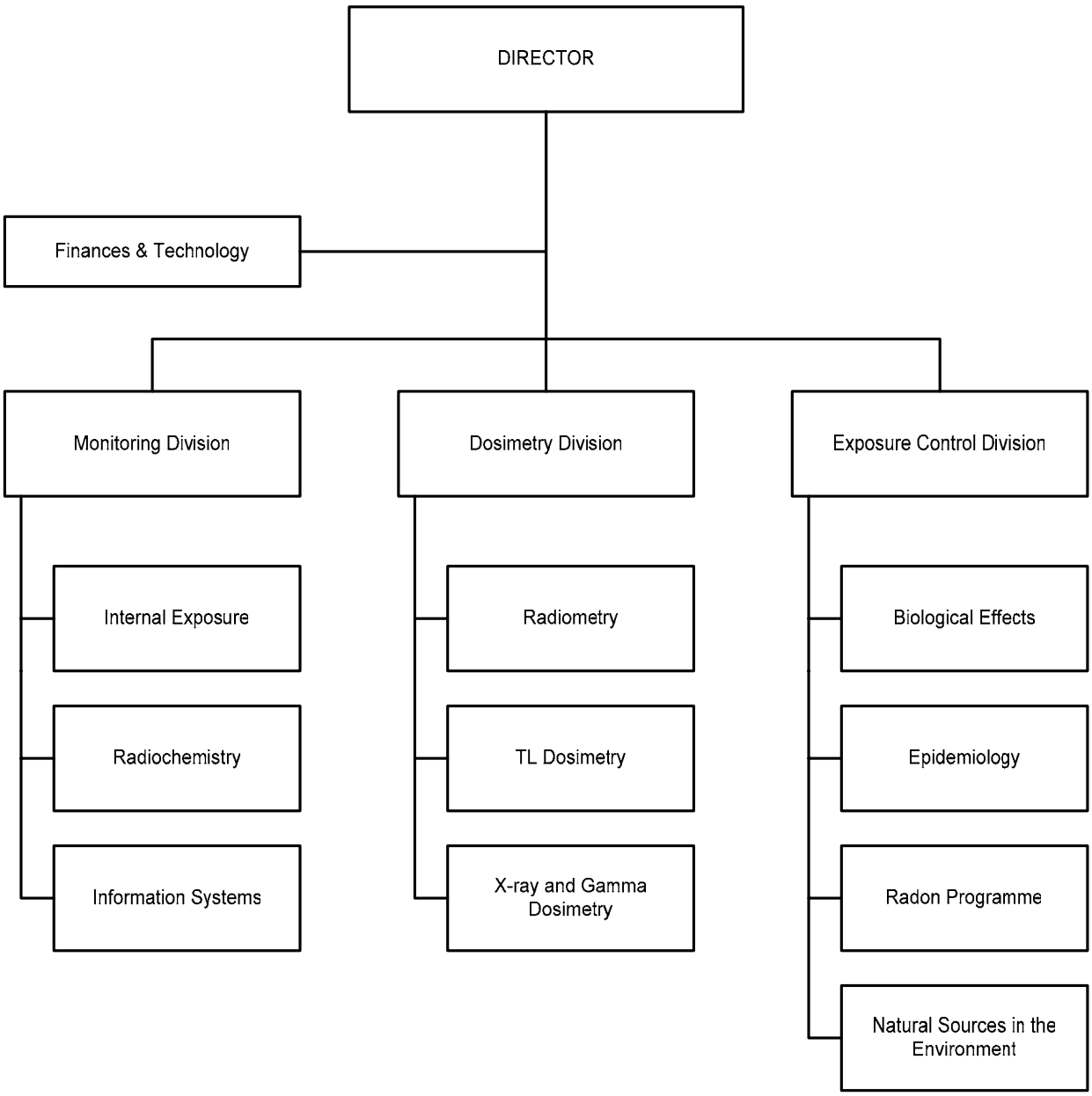
APPENDIX 5

SONS - STRUCTURE



APPENDIX 6

NRPI - STRUCTURE



APPENDIX 7

TNPP - DISCHARGE MONITORING AND SAMPLING PROVISIONS

1. DOSE ASSESSMENT CONVERSION FACTORS FOR RADIONUCLIDES IN AIRBORNE DISCHARGES (factor h, in Sv/Bq).

isotope	h (Sv/Bq)
^{3}H	5,05E-21
^{14}C	1,85E-18
^{41}Ar	1,87E-20
^{51}Cr	8,70E-20
^{54}Mn	2,05E-17
^{57}Co	3,15E-18
^{58}Co	5,60E-18

isotope	h (Sv/Bq)
^{60}Co	3,54E-16
^{76}As	9,70E-20
^{85m}Kr	2,73E-21
^{85}Kr	4,55E-23
^{87}Kr	1,15E-20
^{88}Kr	3,24E-20
^{95}Nb	2,22E-18

isotope	h (Sv/Bq)
^{95}Zr	3,99E-18
^{99}Mo	1,03E-19
^{103}Ru	1,77E-18
^{124}Sb	8,70E-18
^{131}I	1,19E-18
^{132}Te	1,75E-19
^{133}I	2,04E-19

isotope	h (Sv/Bq)
^{134}Cs	8,65E-17
^{137}Cs	1,47E-16
^{133}Xe	5,95E-22
^{135m}Xe	3,68E-21
^{135}Xe	4,44E-21
^{138}Xe	8,70E-21

2. STATUTORY REPORTING OBLIGATIONS WITH RESPECT TO RADIOACTIVE DISCHARGES.

Reporting obligation	Frequency	Transmission mode
Total noble gas activity discharged from each ventilation stack (daily value and cumulative value since the beginning of the current year).	Daily	Report (e-mail)
Attained percentage of the dose limit caused by gaseous discharges.	Daily	Report (e-mail)
Transgression of the investigation and intervention levels defined in the statutory discharge monitoring programme.	Daily (if applicable)	Report (e-mail)
Weekly total aerosol, iodine, tritium, and C-14 activities discharged from each ventilation stack. Corresponding dose values for the current month and year.	Monthly (summary of weekly values)	Report (e-mail)
Tritium activity and gross beta activity measured at the waste water discharge mixing pit (continuous sampling).	Monthly (summary of weekly values)	Report (e-mail)
Cumulative dose from gaseous discharges since the beginning of the current year.	Monthly	Report (e-mail)
Cumulative dose from liquid discharges since the beginning of the current year.	Monthly	Report (e-mail)
Total noble gas activity discharged from each ventilation stack (monthly cumulative value). Corresponding dose value since the beginning of the current year.	Monthly	Report (e-mail)
Total tritium activity and total gamma activity of fission and activation products released from the discharge sentencing tanks (monthly cumulative values). Corresponding dose value since the beginning of the current year.	Monthly	Report (e-mail)

Cont'd

Total alpha and total gamma activities measured at the waste water discharge mixing pit (continuous sampling).	Monthly	Report (e-mail)
Water volumes released from the discharge sentencing tanks.	Monthly	Report (e-mail)
Total activity of fission and activation products released from the discharge sentencing tanks (quarterly cumulative values including Sr-89 and Sr-90 as well as alpha spectrometry results). Corresponding dose values for the current quarter and year.	Quarterly	Report (e-mail) + Paper report
Total noble gas, aerosol, tritium, C-14 and iodine activities discharged from each ventilation stack (yearly cumulative values). Corresponding dose value.	Yearly	Paper report.
Total tritium activity and total activity of fission and activation products released from the discharge sentencing tanks (yearly cumulative values including Sr-89 and Sr-90 as well as alpha spectrometry results). Corresponding dose value.	Yearly	Paper report.

3. AIRBORNE DISCHARGES - SAMPLING AND ANALYSIS FOR DISCHARGE BALANCING

Acronyms used:

RB reactor building (Unit-1 and/or Unit-2)
CAB common ancillary building
DD any discharge duct within a stack
IDD internal discharge duct (within the stack of the RB)
EDD external discharge duct (within the stack of the RB)
MDA minimum detectable activity

Note: Measurements in the EDD of Unit-1 and Unit-2 are performed only during outage and during emergency and post-emergency states.

3.1 Discharge balance measurements of noble gases (RB).

Method	Collection, filtration, and compression of off-gas sampled from the DD in a pressure vessel and subsequent spectrometric measuring of gamma activity (10 minute integration).
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Assessment of discharged activity of individual gamma emitting radionuclides
Measurement range	1.5E8 Bq/day - 2E14 Bq/day for Xe-133 (for a flow rate of 2E6 m3/day)
Measured energy range	IDD 81 - 1291 keV EDD 81 - 723 keV
Measurement periodicity	Continuous on-line measurement (10 minute integration times)
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	5E11 Bq/day (gross activity discharged from one DD/day)
Intervention level	1.7E13 Bq/day (gross activity discharged from one DD/day)

Cont'd

Devices	Noble gas monitors: 1XS11R004B01, 1XS12R005B01 (for Unit-1) 2XS11R004B01, 2XS12R005B01 (for Unit-2) Flow meters: 1XS11F001, 1XS12F001 (Unit-1) 2XS11F001, 2XS12F001 (Unit-2)
Remark	In order to determine Kr-85 activity, a spot sample is collected during the steady nominal output of the unit within the framework of the running campaign. The procedure to determine the value is contracted out (currently to SURO).

3.2 Discharge balance measurements of gaseous iodine (RB).

Method	Continuous collection of off-gas sampled from the DD, capturing iodine on a suitable filter, and subsequent gamma-spectrometric measurement of iodine radioisotope activity.
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Discharged activity of iodine radioisotopes
Measurement range	2.8E3 - 7E9 Bq/week for I-131 (for a flow rate of 1.4E7 m3/week)
Measured energy range	59 - 1836 keV
Measurement periodicity	Weekly
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	2E6 Bq/week (gross I-131 activity discharged from one DD/week)
Intervention level	Not defined
Devices	Sampling devices: - 1XS11R007, 1XS12R008 (Unit-1) - 2XS11R007, 2XS12R008 (Unit-2) Flow meters: - 1XS11F001, 1XS12F001 (Unit-1) - 2XS11F001, 2XS12F001 (Unit-2) Gamma spectrometer

3.3 Discharge balance measurements of aerosols (RB).

Method	Continuous collection of off-gas sampled from the DD, capturing aerosols on a suitable filter, and subsequent spectrometric measurement of individual gamma nuclide activities.
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Assessment of discharged activity of gamma emitting radionuclides
Measurement range	280 - 7E8 Bq/week for Co-60 (for a flow rate of 1.4E7 m3/week)
Measured energy range	59 - 1836 keV
Measurement periodicity	Weekly
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	6.0E7 Bq/week (gross aerosol activity discharged from one DD/week)
Intervention level	Not defined
Devices	Sampling devices: - 1XS11R002, 1XS12R003 (Unit-1) - 2XS11R002, 2XS12R003 (Unit-2) Flow meters: - 1XS11F001, 1XS12F001 (Unit-1) - 2XS11F001, 2XS12F001 (Unit-2) Gamma spectrometer

3.4 Discharge balance measurements of strontium in aerosols (RB).

Method	Bulking of weekly exchanged aerosol filters over 1 year. Bulk sample preparation and subsequent measurement of strontium radioisotopes.
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Assessment of discharged Sr-89 and Sr-90 activity
Measurement range	4E-5 - 4 Bq/m3 for Sr-90
Measured energy range	50 - 2500 keV
Measurement periodicity	1 year (combined weekly samples, or their parts, over this period)
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	Not defined
Intervention level	Not defined
Devices	Sampling devices: - 1XS11R002, 1XS12R003 (Unit-1) - 2XS11R002, 2XS12R003 (Unit-2) Flow meters: - 1XS11F001, 1XS12F001 (Unit-1) - 2XS11F001, 2XS12F001 (Unit-2) Beta spectrometer or gas flow proportional counter

3.5 Discharge balance measurements of alpha emitters in aerosols (RB).

Method	Bulking of weekly exchanged aerosol filters over 1 year. Bulk sample preparation and subsequent measurement of alpha emitters.
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Assessment of discharged Pu-238, Pu-239/240 and Am-241 activity
Measurement range	5E-7 - 5 Bq/m3
Measured energy range	4000 - 8000 keV
Measurement periodicity	1 year (combined weekly samples, or their parts, for this period)
Recording level	≥ MDA
Record	LVDIS database
Investigation level	Not defined
Intervention level	Not defined
Devices	Sampling devices: - 1XS11R002, 1XS12R003 (Unit-1) - 2XS11R002, 2XS12R003 (Unit-2) Flow meters: - 1XS11F001, 1XS12F001 (Unit-1) 2XS11F001, 2XS12F001 (Unit-2) Alpha spectrometer

3.6 Discharge balance measurements of aerosols (CAB).

Method	Continuous collection of off-gas sampled from the DD, capturing aerosols on a suitable filter, and subsequent spectrometric measurement of individual gamma nuclide activities.
Sampling location	Stack discharge duct
Purpose	Assessment of discharged activity of gamma emitting radionuclides
Measurement range	1400 - 3.5E9 Bq/week for Co-60 (for a flow rate of 7E7 m3/week)
Measured energy range	59 - 1836 keV
Measurement periodicity	Weekly
Recording level	≥ MDA

Cont'd

Recorded in	CHEMIS database
Investigation level	6.0E7 Bq/week
Intervention level	Not defined
Devices	Sampling device: 0XS11R003 Flow meter: 0XS11F001 Gamma spectrometer

3.7 Discharge balance measurements of tritium (RB).

Method	Continuous collection of off-gas sampled from the DD, capturing H-3 on silica gel, sample preparation and subsequent spectrometric measurement of H-3 activity.
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Assessment of discharged H-3 activity (sum of organic and inorganic components)
Measurement range	2.8E6 - 1.4E11 Bq/week (for a flow rate of 1.4E7 m3/week)
Measured energy range	4 - 20 keV
Measurement periodicity	Weekly
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	5E10 Bq/week (gross H-3 activity discharged from one DD/ week)
Intervention level	Not defined
Devices	Sampling devices: - 1XS11R006, 1XS12R007 (Unit-1) - 2XS11R006, 2XS12R007 (Unit-2) Flow meters: - 1XS11F001, 1XS12F001 (Unit-1) - 2XS11F001, 2XS12F001 (Unit-2) Beta spectrometer

3.8 Discharge balance measurements of tritium (CAB).

Method	Continuous collection of off-gas sampled from the DD, capturing H-3 on silica gel, sample preparation and subsequent spectrometric measurement of H-3 activity.
Sampling location	Stack discharge duct
Purpose	Assessment of discharged H-3 activity (sum of organic and inorganic components)
Measurement range	2.8E6 - 1.4E11 Bq/week (for a flow rate of 7E7 m3/week)
Measured energy range	4 - 20 keV
Measurement periodicity	Weekly
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	5E10 Bq/week (gross H-3 activity discharged from one DD/week)
Intervention level	Not defined
Devices	Sampling device: 0XS11R004 Flow meter: 0XS11F001 Beta spectrometer

3.9 Discharge balance measurements of carbon-14 (RB).

Method	Continuous collection of off-gas sampled from the DD, capturing C-14 in a solution of NaOH, sample preparation and subsequent spectrometric measurement of C-14 activity.
Sampling locations	Stack discharge ducts (internal and external ducts)
Purpose	Assessment of discharged C-14 activity (sum of organic and inorganic components)
Measurement range	7E6 - 2E10 Bq/week (for a flow rate of 1.4E7 m3/week)
Measured energy range	4 - 160 keV
Measurement periodicity	Weekly
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	1E10 Bq/week (gross C-14 activity discharged from one DD/week)
Intervention level	Not defined
Devices	Sampling devices: - 1XS11R006, 1XS12R007 (Unit-1) - 2XS11R006, 2XS12R007 (Unit-2) Flow meters: - 1XS11F001, 1XS12F001 (Unit-1) - 2XS11F001, 2XS12F001 (Unit-2) Beta spectrometer

4. AIRBORNE DISCHARGES - ON-LINE MONITORING

4.1 On-line monitoring of aerosols, iodine, and noble gases (RB).

Monitoring locations	Stack discharge ducts (internal and external ducts)
Purpose	Cs-137 equivalent aerosol activity I-131 equivalent iodine activity Xe-133 equivalent noble gas activity
Measurement range	3.7 - 3.7E5 Bq/m3 1.9 - 1.9E5 Bq/m3 1.3E4 - 7.4E8 Bq/m3
Energy range	70 - 3000 keV 344 - 390 keV 70 - 3000 keV
Measurement periodicity	Continuous
Recorded in	Database
Investigation level	6E1 Bq/m3 6E1 Bq/m3 4E5 Bq/m3
Intervention level	6E2 Bq/m3 6E2 Bq/m3 4E7 Bq/m3
Devices	Aerosols, iodine, and noble gas (PIG) monitoring systems: - 1XS11R001, 1XS12R002 (Unit-1) - 2XS11R001, 2XS12R002 (Unit-2)

4.2 On-line monitoring of aerosols, iodine, and noble gases (CAB).

Monitoring location	Stack discharge duct
Purpose	Cs-137 equivalent aerosol activity I-131 equivalent iodine activity Xe-133 equivalent noble gas activity
Measurement range	3.7 - 3.7E5 Bq/m3 1.9 - 1.9E5 Bq/m3 1.3E4 - 7.4E8 Bq/m3
Energy range	70 - 3000 keV 344 - 390 keV 70 - 3000 keV
Measurement periodicity	Continuous
Recorded in	Database
Investigation level	6E1 Bq/m3 6E1 Bq/m3 4E5 Bq/m3
Intervention level	6E2 Bq/m3 6E2 Bq/m3 4E7 Bq/m3
Device	Aerosols, iodine, and noble gas (PIG) monitoring system: 0XS11R001

5. AIRBORNE DISCHARGES - OTHER SAMPLING AND MONITORING PROVISIONS.

- Check measurement of C-14 (CAB)
- Check measurements of direct steam through PVPG and PSA
- Check measurements of steam-air mixture behind the air extractor reservoir of the main turbine condensers (RB)
- Measuring distribution and size of aerosols particles (RB)
- Dose rate (RB)
- Emergency monitoring of noble gases (RB)

6. LIQUID DISCHARGES - SAMPLING AND ANALYSIS FOR SENTENCING PURPOSES.

Acronyms used:

ST	storage tank
DST	discharge sentencing tank
DMP	discharge mixing pit
SVO	water treatment plant areas

6.1 Permission to discharge - gamma radionuclide activity

Objective	To verify that discharge conditions and limitations, as specified in LaP A.4.1 are fulfilled
Method	Representative sampling of specific tanks, sample analysis with semi-conductor spectrometry.

Cont'd

Plant item sampled	1. ST of laundry waste water 2. ST of rinsing waste water 3. DST of laundry waste water 4. DST of chemical sewer system 5. DST of conditional active sewer system 6. DST of the SVO-5 system 7. DST of the SVO-6 system 8. DST of the SVO-3 system 9. DST of rinse water of SVO-3 ion exchangers
Purpose	Assessment of gamma emitter activity concentration
Measuring device	Gamma spectrometer
Measurement range	1 - 6000 Bq/l
Energy range	59 - 1836 keV
Measurement periodicity	Before every discharge: as for 1. into the sanitary sewer system as for 2. into the sanitary sewer system as for 3. into the sanitary sewer system as for 4. for neutralisation as for 5. into the DMP as for 6. for neutralisation as for 7. into the DMP as for 8. into the DMP as for 9. into the DMP
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	400 Bq/l (applicable to DST)
Investigation	Detect the source of increased activity and record it in the operation diary.
Intervention level	1st level 700 Bq/l (applicable to DST) 2nd level 3E-10 Sv (applicable to DST)
Measures	as to 1st level: repeat sampling and analysis procedure as to 2nd level: deny discharge permission

6.2 Permission to discharge - Tritium activity

Objective	To verify that discharge conditions and limitations, as specified in LaP A.4.1 are fulfilled
Method	Representative sampling of specific tanks, sample analysis with scintillation spectrometry.
Plant item sampled	1. ST of laundry waste water 2. ST of rinsing waste water 3. DST of laundry waste water 4. DST of chemical sewer system 5. DST of conditional active sewer system 6. DST of the SVO-5 system 7. DST of the SVO-6 system 8. DST of the SVO-3 system 9. DST of rinse water of SVO-3 ion exchangers
Purpose	Assessment of Tritium activity concentration
Measuring device	Scintillation spectrometer
Measurement range	10 - 2E7 Bq/l
Energy range	5 - 20 keV

Cont'd

Measurement periodicity	Before every discharge: as for 1. into the sanitary sewer system as for 2. into the sanitary sewer system as for 3. into the sanitary sewer system as for 4. for neutralisation as for 5. into the DMP as for 6. for neutralisation as for 7. into the DMP as for 8. into the DMP as for 9. into the DMP
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	as for 1. 4.39E6 Bq/l as for 2. 8.93E6 Bq/l as for 3. 4.46E6 Bq/l as for 4. 1.25E7 Bq/l as for 5. 1.25E7 Bq/l as for 6. 3.47E6 Bq/l as for 7. 2.40E6 Bq/l as for 8. 1.97E6 Bq/l as for 9. 1.97E6 Bq/l
Investigation	Detect the source of increased activity and record it in the operation diary.
1st intervention level	as for 1. 8.77E6 Bq/l as for 2. 1.79E7 Bq/l as for 3. 8.93E6 Bq/l as for 4. 2.50E7 Bq/l as for 5. 2.50E7 Bq/l as for 6. 6.94E6 Bq/l as for 7. 4.81E6 Bq/l as for 8. 3.94E6 Bq/l as for 9. 3.94E6 Bq/l
2nd intervention level	2.5E11 Bq/DST
Measures	as to 1st level: repeat sampling and analysis procedure as to 2nd level: deny discharge permission

7. LIQUID DISCHARGES - SAMPLING AND ANALYSIS FOR DISCHARGE BALANCING.

7.1 Discharge balance measurements of gamma radionuclides

Objective	To assess whether the discharges do not transgress activity and (cumulative) dose limitations.
Method	Representative sampling of specific tanks, sample analysis with semi-conductor spectrometry, determination of discharged activity, and performing a balance calculation.
Plant item sampled	1. ST of laundry waste water 2. ST of rinsing waste water 3. DST of laundry waste water 4. DST of chemical sewer system 5. DST of conditional active sewer system 6. DST of the SVO-5 system 7. DST of the SVO-6 system 8. DST of the SVO-3 system 9. DST of rinse water of SVO-3 ion exchangers
Purpose	Assessment of gamma nuclide activities.

Cont'd

Measurement range	1 - 6000 Bq/l
Energy range	59 – 1836 keV
Measurement periodicity	Before every discharge: as for 1. into the sanitary sewer system as for 2. into the sanitary sewer system as for 3. into the sanitary sewer system as for 4. for neutralisation as for 5. into the DMP as for 6. for neutralisation as for 7. into the DMP as for 8. into the DMP as for 9. into the DMP
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	5E-10 Sv/month ***(what about Bq/month?)***
Investigation	Verification whether the discharge procedures were correctly fulfilled

7.2 Discharge balance measurements of Tritium

Objective	To assess whether the discharges do not transgress activity and (cumulative) dose limitations.
Method	Representative sampling of specific tanks, sample analysis with liquid scintillation spectrometry, determination of discharged activity, and performing a balance calculation.
Plant item sampled	1. DST of chemical sewer system 2. DST of conditional active sewer system 3. DST of the SVO-5 system 4. DST of the SVO-6 system 5. DST of the SVO-3 system 6. DST of rinse water of SVO-3 ion exchangers
Purpose	Assessment of Tritium activity.
Measurement range	10 - 2E7 Bq/l
Energy range	0 - 20 keV
Measurement periodicity	Before every discharge: as for 1. for neutralisation as for 2. into the DMP as for 3. for neutralisation as for 4. into the DMP as for 5. into the DMP as for 6. into the DMP
Recording level	≥ MDA
Recorded in	CHEMIS database
Investigation level	3.33E12 Bq/month
Investigation	Verification whether the discharge procedures were correctly fulfilled

7.3 Discharge balance measurements of Sr-89 and Sr-90

Objective	To assess whether the discharges do not transgress activity and (cumulative) dose limitations.
Method	Representative sampling of specific tanks, preparation of a bulk sample for the period under scrutiny, analysis with beta spectrometry or proportional gas counting, determination of discharged activity, and performing a balance calculation.

Cont'd

Plant item sampled	1. DST of chemical sewer system 2. DST of conditional active sewer system 3. DST of the SVO-5 system 4. DST of the SVO-6 system 5. DST of the SVO-3 system 6. DST of rinse water of SVO-3 ion exchangers
Purpose	Assessment of Sr-89 and Sr-90 activity.
Measurement range	0.1 Bq/l - 250 Bq/l
Energy range	60 -2500 keV
Measurement periodicity	Quarterly decanted and bulked samples (pro rata discharge volumes).
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	1 Bq/dm³
Investigation	Gamma spectrometry of bulked sample.

7.4 Discharge balance measurements of alpha radionuclides

Objective	To assess whether the discharges do not transgress activity and (cumulative) dose limitations.
Method	Representative sampling of specific tanks, preparation of a bulk sample for the period under scrutiny, analysis with alpha spectrometry, determination of discharged activity, and performing a balance calculation.
Plant item sampled	1. DST of chemical sewer system 2. DST of conditional active sewer system 3. DST of the SVO-5 system 4. DST of the SVO-6 system 5. DST of the SVO-3 system 6. DST of rinse water of SVO-3 ion exchangers
Purpose	Assessment of Pu-238, Pu-239/40 and Am-241 activities.
Measurement range	0.1 - 100 Bq/l
Energy range	4000 -8000 keV
Measurement periodicity	Quarterly decanted and bulked samples (pro rata discharge volumes).
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	Each value > MDA
Investigation	Gamma spectrometry of bulked sample.

8. LIQUID DISCHARGES - ON-LINE MONITORING.

8.1 On-line check measurements before the DMP

Objective	To prevent uncontrolled liquid discharges towards the DMP (for activity concentration values transgressing the reference levels)
Method	Continuous activity concentration measurement (Cs-137 equivalent activity)
Measurement devices	Plant items (monitors) 0TZ00R001 and TD33R001
Measurement range	2 - 1E5 Bq/l
Energy range	70 keV - 3.3 MeV
Recording level	All recorded values
Recorded in	Database of the corresponding RM2000
Investigation level	7.5E2 Bq/l

Cont'd

Investigation	Investigate discharged activities from the corresponding ST and DST
Intervention level	8.5E2 Bq/l
Measures	Automatic closure of the corresponding discharge valve.

8.2 On-line check measurements after the DMP (discharge channel)

Objective	To signal any transgression of discharge reference levels.
Method	Continuous activity concentration measurement (Cs-137 equivalent activity)
Measurement device	Plant item (monitor) 0XQ15R001
Measurement range	1.1E0 - 2.8E6 Bq/m³
Energy range	70 keV - 3.3 MeV
Recording level	All recorded values
Recorded in	Database of the corresponding RM2000
Investigation level	4E1 Bq/l
Investigation	Inform VRB (SI) and stop any DST discharge (if taking place) Take a DMP sample for further analysis.
Intervention level	1E2 Bq/l
Measures	Activate emergency sampling regime.

9. MONITORING PROVISIONS AFTER THE DMP (DISCHARGE CHANNEL).

9.1 Monitoring of total discharge of gamma radionuclide activity.

Monitored item	Final discharge channel (downstream of DMP).
Objective	To monitor the final discharges towards river Vltava
Method	Proportional sampler (on the discharge channel) combined with a semi-conductor gamma spectrometer
Purpose	Assessment of gamma radionuclide activity (Cs-137 equivalent)
Measurement device	Plant item (sampler + gamma spectrometer) 0XQ15R001S00
Measurement range	0.01 - 5000 Bq/l (for Cs-137)
Energy range	59 - 1836 keV
Measurement periodicity	Monthly (proportional sample)
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	0.1 Bq/l (for Cs-137)
Investigation	Detect the source/origin of increased activity.

9.2 Monitoring of total discharge of Tritium activity.

Monitored item	Final discharge channel (downstream of DMP).
Objective	To monitor the final discharges towards river Vltava
Method	Proportional sampler (on the discharge channel) combined with a liquid scintillation counter (LSC)
Purpose	Assessment of Tritium activity
Measurement device	Plant item (sampler + LSC) 0XQ15R001S00
Measurement range	3 - 1E4 Bq/l
Energy range	4 - 20 keV
Measurement periodicity	Weekly (proportional sample)
Recording level	≥ MDA

Cont'd

Recorded in	LVDIS database
Investigation level	1E4 Bq/l
Investigation	Detect the source/origin of increased activity.

9.3 Monitoring of total discharge of gross alpha radionuclide activity.

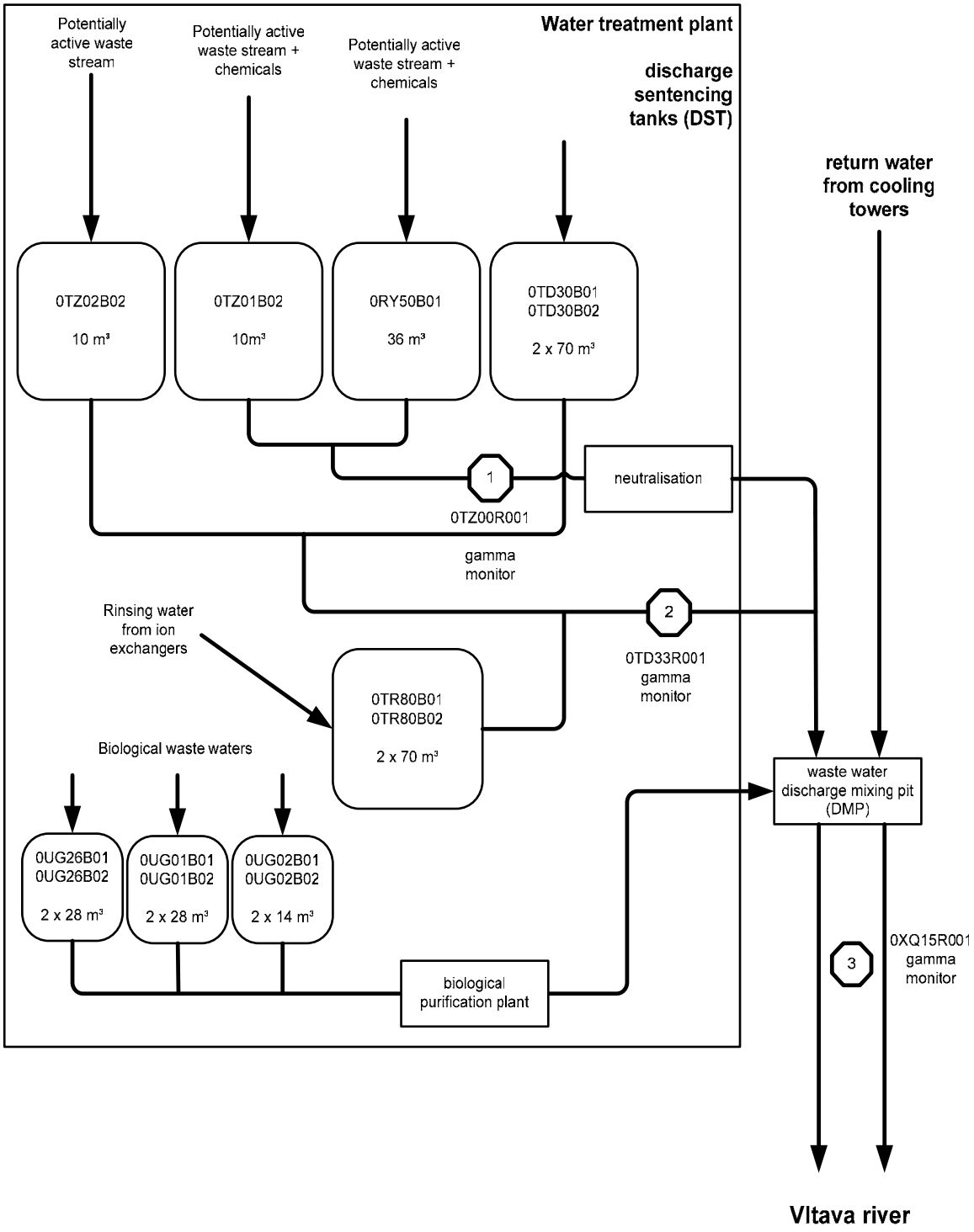
Monitored item	Final discharge channel (downstream of DMP).
Objective	To monitor the final discharges towards river Vltava
Method	Proportional sampler (on the discharge channel) combined with a gas proportional counter (GPC)
Purpose	Assessment of gross alpha activity
Measurement device	Plant item (sampler + GPC) 0XQ15R001S00
Measurement range	0.05 - 100 Bq/l
Energy range	4000 - 8000 keV
Measurement periodicity	Monthly (proportional sample)
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	0.33 Bq/l
Investigation	Detect the source/origin of increased activity.

9.4 Monitoring of total discharge of gross beta radionuclide activity.

Monitored item	Final discharge channel (downstream of DMP).
Objective	To monitor the final discharges towards river Vltava
Method	Proportional sampler (on the discharge channel) combined with a gas proportional counter (GPC)
Purpose	Assessment of gross beta activity
Measurement device	Plant item (sampler + GPC) 0XQ15R001S00
Measurement range	0.1 - 1000 Bq/l
Energy range	60 - 2500 keV
Measurement periodicity	Weekly (proportional sample)
Recording level	≥ MDA
Recorded in	LVDIS database
Investigation level	3.3 Bq/l
Investigation	Detect the source/origin of increased activity.

APPENDIX 8

TNPP - SIMPLIFIED OVERVIEW OF LIQUID DISCHARGE ROUTES



APPENDIX 9

THE RADIATION MONITORING NETWORK - OVERVIEW (annex A.1 to Decree Nr. 319/2002 Coll.)

Acronyms used: EWN (early warning network) MG (mobile group) ACMP (air contamination monitoring point) LG (laboratory group)
CMNL (central monitoring network laboratory) FCMP (foodstuffs contamination monitoring point) MS (meteorological service)

Monitored item		Sampling points	RMN component	Frequency (per year)	Required measurement sensitivity
External exposure					
1	Dose (rate)	Minimum 40	EWN	Continuous (10-minute integrations, hourly averages)	Measurement range from 50 nSv/hr to 1 Sv/hr
		On route about 50km long (measurements in vehicle)	MG	4 Continuous measurement on route	Measurement range from 50 nSv/hr to 1 Sv/hr
		150 to 200	TLD	4 Quarterly integration values	Photon dose equivalent > 30 μSv
Environmental components					
2	Aerosols	5 to 15	ACMP LG CMNL	52 (weekly average value) Continuous sampling	MDA < $1x10^{-4}$ Bq/m^3 for natural radionuclides MDA < $1x10^{-6}$ Bq/m^3 for ^{137}Cs
		1 to 2		4 (quarterly average value) Continuous sampling	MDA < $1x10^{-7}$ Bq/m^3 for ^{90}Sr MDA < $5x10^{-9}$ Bq/m^3 for ^{238}Pu and for ^{239,240}Pu
3	Fallout	5 to 15	ACMP LG CMNL	12 (monthly average value) Continuous sampling	MDA < 0.1 Bq/m^2 for ^{137}Cs
4	Soil and plants	5 to 15	MG LG CMNL	1	MDA <10 Bq/m^2 for ^{137}Cs
4a	Soil (in-situ)	7 to 15	MG CMNL	1	MDA <1000 Bq/m^2 for ^{137}Cs

Cont'd

5	Surface water	3 to 15	LG CMNL	1	MDA < 0.1 Bq/l	for ^{137}Cs
				4	MDA < 2 Bq/l MDA < 0.002 Bq/l	for ^{3}H for ^{90}Sr
6	Drinking water	5 to 15	LG CMNL	1	MDA < 0.01 Bq/l	for ^{137}Cs
				4	MDA < 2 Bq/l	for ^{3}H
		1		1	MDA < 0.002 Bq/l	for ^{90}Sr
7	Water sludge	5 to 15	LG CMNL	1	MDA < 1 Bq/kg	for ^{137}Cs
8	River sediments	5 to 15	LG CMNL	1	MDA < 1 Bq/kg	for ^{137}Cs
Food chain components						
9	Milk	10 to 20	FCMP LG CMNL	4	MDA < 0.1 Bq/l	for ^{137}Cs
		1			MDA < 0.03 Bq/l	for ^{90}Sr
10	Meat (pork)	5 to 15	FCMP LG CMNL	4	MDA < 0.1 Bq/kg	for ^{137}Cs
	Meat (beef)	5 to 15		4	MDA < 0.1 Bq/kg	for ^{137}Cs
	Meat (poultry)	5 to 15		4	MDA < 0.1 Bq/kg	for ^{137}Cs
	Meat (rabbit and mutton)	5 to 15		4	MDA < 0.1 Bq/kg	for ^{137}Cs
	Game (individual species)	5 to 15		1	MDA < 10 Bq/kg	for ^{137}Cs
	Fish	5		1	MDA < 0.1 Bq/kg	for ^{137}Cs
11	Potatoes	5 to 15	FCMP LG CMNL	1	MDA < 0.1 Bq/kg	for ^{137}Cs

Cont’d

12	Crop (wheat)	5 to 15	FCMP LG CMNL	1	MDA < 0.1 Bq/kg	for ^{137}Cs
		1		1	MDA < 0.05 Bq/kg	for ^{90}Sr
	Crop (barley)	5 to 15		1	MDA < 0.1 Bq/kg	for ^{137}Cs
		1		1	MDA < 0.05 Bq/kg	for ^{90}Sr
	Crop (oats)	5 to 15		1	MDA < 0.1 Bq/kg	for ^{137}Cs
	Crop (rye)	5 to 15		1	MDA < 0.1 Bq/kg	for ^{137}Cs
	Crop (maize)	5 to 15		1	MDA < 0.1 Bq/kg	for ^{137}Cs
13	Green vegetables	5 to 15	FCMP LG CMNL	1	MDA < 0.1 Bq/kg	for ^{137}Cs
	Root vegetables	5 to 15		1	MDA < 0.1 Bq/kg	for ^{137}Cs
	Fruit bearing vegetable	5 to 15		1	MDA < 0.1 Bq/kg	for ^{137}Cs
14	Fruit	5 to 15	FCMP LG CMNL	1	MDA < 0.1 Bq/kg	for ^{137}Cs
15	Wild crops	5 to 15	FCMP LG CMNL	1	MDA < 1 Bq/kg	for ^{137}Cs
16	Mushrooms	10 to 30	FCMP LG CMNL	1	MDA < 1 Bq/kg	for ^{137}Cs
17	Imported foodstuffs	1	FCMP LG CMNL	According to situation	MDA < 10 Bq/kg	for ^{137}Cs
Internal contamination						
18	Whole body count	20 to 40 persons	CMNL	1	MDA < 50 Bq	for ^{137}Cs
19	Urine (sampling)	50 to 300	CMNL	1	MDA < 0.05 Bq/day	for ^{137}Cs
Meteorological data						
20	Atmosphere	1 to 100	MS	Continuous	Not specified	

APPENDIX 10

TNPP - ENVIRONMENTAL MONITORING - EMERGENCY PLANNING ZONE

- ● TLD positions
- ▲ Environmental Radiation Monitoring Stations (ERMS)

APPENDIX 11

TNPP - ON-SITE ENVIRONMENTAL MONITORING PROVISIONS - under routine operation of the NPP -

Notes:

- All samples are analysed at the environmental radiation monitoring laboratory (ERML)
- Recording levels: ≥ MDA
- All results are to be recorded in the LVDIS database

1. Aerosols

1.1 Gamma activity (spectrometry)

Location measured	on-site environmental radiation monitoring station
Measurement periodicity	continuous collection, weekly filter exchange and measuring
Sample collection	continuous on filter
Sample volume	40 m^3/hour
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

1.2 Sr-90 activity

Location measured	on-site environmental radiation monitoring station
Measurement periodicity	quarterly
Sample collection	continuous on filter
Collection method	a sample after measurement of gamma activity will be used for the analysis
Sample volume	one half of the sample for the given quarter
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	NRR 610; or alternatively: Tricarb 2260XL – by Cherenkov radiation

2. Fallout: gamma activity (spectrometry)

Location measured	on-site environmental radiation monitoring station
Measurement periodicity	continuous collection, monthly measurement
Sample collection	continuous collection in JMK 401 fallout bin with a collection area of 0.5m^2
Sample volume	volume of precipitation
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

3. Surface waters

3.1 Gamma activity (spectrometry)

Location measured	safety tanks for precipitation
Measurement periodicity	quarterly
Collection method	collection without addition of sediments
Sample volume	45 l
Sample preparation	ČSN ISO 10703
Measuring device used	Silena laboratory gamma-spectrometric route

3.2 Tritium activity

Location measured	safety tanks for precipitation
Measurement periodicity	monthly
Collection method	collection without addition of sediments
Sample volume	100 ml
Sample preparation	ČSN ISO 9698
Measuring device used	Tricarb 2260XL

3.3 Gross alpha activity

Location measured	safety tanks for precipitation
Measurement periodicity	monthly
Collection method	collection without addition of sediments
Sample volume	2 l
Sample preparation	in accordance with ČSN 757611, method B
Measuring device used	NRR 610

3.4 Gross beta activity / gross beta activity after deducting K-40

Location measured	safety tanks for precipitation
Measurement periodicity	monthly
Collection method	collection without addition of sediments
Sample volume	2 l
Sample preparation	in accordance with ČSN 757612
Measuring device used	NRR 610

4. Groundwater

4.1 Gamma activity (spectrometry)

Location measured	boreholes: HV 615, RK 2, RK 25
Measurement periodicity	quarterly
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	45 l
Sample preparation	ČSN ISO 10703
Measuring device used	Silena laboratory gamma-spectrometric route

4.2 Tritium activity

Location measured	boreholes: HV615, RK 2, RK 25 drainage boreholes: OTKA 24, OTKA 82, OTKA 91
Measurement periodicity	boreholes: HV615, RK 2, RK 25 - quarterly drainage boreholes: OTKA 24, OTKA 82, OTKA 91 - monthly
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole in case of drainage boreholes, collection using a faucet
Sample volume	100 ml
Sample preparation	ČSN ISO 9698
Measuring device used	Tricarb 2260XL

4.3 Gross alpha activity

Location measured	boreholes: HV615, RK 2, RK 25
Measurement periodicity	quarterly
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	2 l
Sample preparation	in accordance with ČSN 757611, method B
Measuring device used	NRR 610

4.4 Gross beta activity / gross beta activity after deducting K-40

Location measured	boreholes: HV615, RK 2, RK 25
Measurement periodicity	quarterly
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	2 l
Sample preparation	According to ČSN 757612
Measuring device used	NRR 610

5 Bottom sediments and scrapings: gamma activity (spectrometry)

Location measured	safety tanks for precipitation
Measurement periodicity	once a year
Collection method	collection using a special collection device (or a scoop)
Sample volume	3 l
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

APPENDIX 12

TNPP - OFF-SITE ENVIRONMENTAL MONITORING PROVISIONS - under routine operation of the NPP -

Notes:
- All samples are analysed at the environmental radiation monitoring laboratory (ERML)
- Recording levels: ≥ MDA
- All results are to be recorded in the LVDIS database

1. Aerosols

1.1 Gamma activity (spectrometry)

Location measured	environmental radiation monitoring stations located at: Nová Ves, Litoradlice, Zvěrkovice, Bohunice, Sedlec
Measurement periodicity	continuous collection, weekly filter exchange and measuring
Sample collection	continuous on filter
Sample volume	40 m^3/hour
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

1.2 Sr-90 activity

Location measured	environmental radiation monitoring stations located at: Nová Ves, Litoradlice, Zvěrkovice, Bohunice, Sedlec
Measurement periodicity	quarterly
Sample collection	continuous on filter
Collection method	a sample after measurement of gamma activity will be used for the analysis
Sample volume	one half of the combined sample for the given quarter from all collection points
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	NRG 610; or alternatively: Tricarb 2260XL – by Cherenkov radiation

2. Fallout: gamma activity (spectrometry)

Location measured	environmental radiation monitoring stations located at: Nová Ves, Litoradlice, Zvěrkovice, Bohunice, Sedlec
Measurement periodicity	continuous collection, monthly measurement
Sample collection	continuous collection in JMK 401 fallout bins with a collection area of 0.5m^2
Sample volume	volume of precipitation
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

3. Precipitation

3.1 Tritium activity

Location measured	meteorological station Temelín; ERML České Budějovice
Measurement periodicity	monthly
Collection method	into a precipitation gauge
Sample volume	volume of precipitation
Sample preparation	ČSN ISO 9698
Measuring device used	Tricarb 2260XL (beta liquid scintillation spectrometry)

4. Surface waters

4.1 Gamma activity (spectrometry)

Sampling location	Vltava – Hněvkovice (below the dam) Vltava – Hladná (combined sample from both banks) Vltava – Kořensko above the dam (combined sample from both banks) Bělohůrecký pond
Measurement periodicity	Vltava-Hladná and Vltava-Kořensko - monthly Bělohůrecký pond and Vltava-Hněvkovice - quarterly
Collection method	from the flowline, away from shore vegetation, without the addition of sediments
Sample volume	45 l
Sample preparation	ČSN ISO 10703
Measuring device used	Silena laboratory gamma-spectrometric route

4.2 Tritium activity

Sampling location	Vltava – Hněvkovice (below the dam) Vltava – Hladná (combined sample from both banks) Vltava – Kořensko above the dam (combined sample from both banks) Bělohůrecký pond
Measurement periodicity	Vltava-Hladná and Vltava-Kořensko - monthly Bělohůrecký pond and Vltava-Hněvkovice - quarterly
Collection method	from the flow line, away from shore vegetation, without the addition of sediments
Sample volume	100 ml
Sample preparation	ČSN ISO 9698
Measuring device used	Tricarb 2260XL

4.3 Gross alpha activity

Sampling location	Vltava – Hněvkovice (below the dam) Vltava – Hladná (combined sample from both banks) Vltava – Kořensko above the dam (combined sample from both banks) Bělohůrecký pond
Measurement periodicity	Vltava-Hladná and Vltava-Kořensko - monthly Bělohůrecký pond and Vltava-Hněvkovice - quarterly
Collection method	from the flow line, away from shore vegetation, without the addition of sediments
Sample volume	2 l
Sample preparation	in accordance with ČSN 757611, method B
Measuring device used	NRG 610

4.4 Gross beta activity / gross beta activity after deducting K-40

Sampling location	Vltava – Hněvkovice (below the dam) Vltava – Hladná (combined sample from both banks) Vltava – Kořensko above the dam (combined sample from both banks) Bělohůrecký pond
Measurement periodicity	Vltava-Hladná and Vltava-Kořensko - monthly Bělohůrecký pond and Vltava-Hněvkovice - quarterly
Collection method	from the flow line, away from shore vegetation, without the addition of sediments
Sample volume	2 l
Sample preparation	in accordance with ČSN 757612
Measuring device used	NRG 610

5. Drinking water

5.1 Gamma activity (spectrometry)

Sampling location	Kočín and Temelín – well Dříteň and Týn nad Vltavou – public water supply system
Measurement periodicity	once a year
Collection method	collection from the well – using a pump collection from the public water supply system – using a faucet
Sample volume	45 l
Sample preparation	ČSN ISO 10703
Measuring device used	Silena laboratory gamma-spectrometric route

5.2 Tritium activity

Sampling location	Kočín and Temelín – well Dříteň and Týn nad Vltavou – public water supply system
Measurement periodicity	Kočín and Temelín – public well – once a year Dříteň a Týn nad Vltavou – public water supply system – once a month
Collection method	collection from the well – using a pump collection from the public water supply system – using a faucet
Sample volume	100 ml
Sample preparation	ČSN ISO 9698
Measuring device used	Tricarb 2260XL

5.3 Gross alpha activity

Sampling location	Kočín and Temelín – well Dříteň and Týn nad Vltavou – public water supply system
Measurement periodicity	Kočín and Temelín – public well – once a year Dříteň a Týn nad Vltavou – public water supply system – once a month
Collection method	collection from the well – using a pump collection from the public water supply system – using a faucet
Sample volume	2 l
Sample preparation	in accordance with ČSN 757611, method B
Measuring device used	NRG 610

5.4 Gross beta activity / gross beta activity after deducting K-40

Sampling location	Kočín and Temelín – well Dříteň and Týn nad Vltavou – public water supply system
Measurement periodicity	Kočín and Temelín – public well – once a year Dříteň a Týn nad Vltavou – public water supply system – once a month
Collection method	collection from the well – using a pump collection from the public water supply system – using a faucet
Sample volume	2 l
Sample preparation	in accordance with ČSN 757612
Measuring device used	NRG 610

6. Groundwater

6.1 Gamma activity (spectrometry)

Sampling location	boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 4C, HV 5A, HV 5C, HV 6C
Measurement periodicity	borehole: HV4C - quarterly boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 5A, HV 5C, HV 6C once a year
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	45 l
Sample preparation	ČVSN ISO 10703
Measuring device used	Silena laboratory gamma-spectrometric route

6.2 Tritium activity

Sampling location	boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 4C, HV 5A, HV 5C, HV 6C
Measurement periodicity	borehole: HV4C - quarterly boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 5A, HV 5C, HV 6C twice a year (spring and autumn)
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	100 ml
Sample preparation	ČSN ISO 9698
Measuring device used	Tricarb 2260XL

6.3 Gross alpha activity

Sampling location	boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 4C, HV 5A, HV 5C, HV 6C
Measurement periodicity	borehole: HV4C - quarterly boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 5A, HV 5C, HV 6C twice a year (spring and autumn)
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	2 l
Sample preparation	in accordance with ČSN 757611, method B
Measuring device used	NRG 610

6.4 Gross beta activity / gross beta activity after deducting K-40

Sampling location	boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 4C, HV 5A, HV 5C, HV 6C
Measurement periodicity	borehole: HV4C - quarterly boreholes: HV 1A, HV 2B, HV 3A, HV 3C, HV 5A, HV 5C, HV 6C twice a year (spring and autumn)
Collection method	collection using a pump after the prior pumping-out of double the volume of the borehole
Sample volume	2 l
Sample preparation	in accordance with ČSN 757612
Measuring device used	NRG 610

7. Bottom sediments: gamma activity (spectrometry)

Sampling location	Vltava – Hladná Vltava – Kořensko (in the reservoir) Bělohůrecký pond
Measurement periodicity	once a year
Collection method	collection using a special collection device (or a scoop)
Sample volume	3 l
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

8. Soil (uncultivated)

8.1 Gamma activity (spectrometry)

Sampling location	Bohunice; Litoradlice; Nová ves; Sedlec
Measurement periodicity	once a year
Collection method	using a special collection device, allowing for the collection of layers 0 –5 cm and 5 – 10 cm thick
Sample volume	3 kg
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

8.2 Sr-90 activity

Sampling location	Bohunice; Litoradlice; Nová ves; Sedlec
Measurement periodicity	once a year
Collection method	a sample is used for analysis after prior measuring of specific gamma activity
Sample volume	1 kg – combined sample (a layer 0-5 cm thick) from all collection points
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	NRG 610; or alternatively: Tricarb 2260XL – by Cherenkov radiation

8.3 Pu-239/240 activity

Sampling location	Bohunice; Litoradlice; Nová ves; Sedlec
Measurement periodicity	once a year
Collection method	a sample is used for analysis after prior measuring of gamma activity
Sample volume	1 kg – combined sample (a layer 0-5 cm thick) from all collection points
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Alpha Analyst

9. Agricultural and other crops: gamma activity (spectrometry)

Sampling location	agricultural crops are collected in accordance with the seeding scheme, at least four species, of which at least two are kinds where the part above ground is used for fodder other crops apples - Temelín orchards blueberries - Všemyslice
Measurement periodicity	once a year
Collection method	the crop sample is collected evenly from several points at the collection location, the actual collection is performed in a manner suitable for the crop in question
Sample volume	1 – 10 kg depending on the type of sample and its treatment
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

10. Milk

10.1 Gamma activity (spectrometry)

Sampling location	VOD Všemyslice (cowshed located in Lhota pod Horami)
Quantity measured	specific gamma radionuclide activity
Measurement periodicity	2 weeks
Collection method	the sample is collected by VOD Všemyslice personnel
Sample volume	3 dm^3
Sample preparation	untreated, measuring in natural state
Measuring device used	Silena laboratory gamma-spectrometric route

10.2 Sr-90 activity

Sampling location	VOD Všemyslice (cowshed located in Lhota pod Horami)
Measurement periodicity	monthly
Collection method	a sample is used for analysis after prior measuring of specific gamma activity
Sample volume	monthly combined sample - 1 dm^3
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	NRG 610

11. Fish: gamma activity (spectrometry)

Sampling location	Orlík reservoir and Bělohůrecký pond
Measurement periodicity	once a year
Collection method	the sample is collected by fishery workers
Sample volume	3 kg of predatory and non-predatory fresh fish
Sample preparation	quality assured working instruction nr. 27.08.06.01
Measuring device used	Silena laboratory gamma-spectrometric route

12. Outdoor environment

12.1 Photon dose equivalent rate - TLD

Location measured	52 locations
Quantity measured	average photon dose equivalent rate
Measurement periodicity	34 TLD are changed on a quarterly basis 18 TLD are changed on a six-monthly basis
Measuring device used	Solaro -Vinten
Measurement geometry	dosimeter 1 metre above ground level

12.2 In-situ gamma-spectrometry: cultivated and uncultivated soil

Location measured	Bohunice, Litoradlice, Nová Ves, Sedlec, Zvěrkovice, Knín, Kočína, Křtěnov and Temelín
Quantity measured	surface activity
Measurement periodicity	Bohunice, Litoradlice, Nová Ves, Sedlec, Zvěrkovice - quarterly Knín, Kočína, Křtěnov a Temelín - once a year
Measuring device used	terrain gamma-spectrometric route, SNIP analyser alternatively: VARRO analyser
Measurement geometry	detector 1 metre above ground level

12.3 Dose rate - portable devices

Location measured	Bohunice, Litoradlice, Nová Ves, Sedlec, Zvěrkovice
Quantity measured	dose rate of gamma and x radiation
Measurement periodicity	quarterly, simultaneously with in situ gamma-spectrometry measurements
Measuring device used	NB 3201; alternatively: RSS 112
Measurement geometry	detector 1 metre above ground level

APPENDIX 13

TNPP - ENVIRONMENTAL LABORATORY MEASUREMENT EQUIPMENT

status as of March 2005

Device	Type	Manufacturer	Nr
TLD reader	HARSHAW 4500	Harshaw	1
Dose rate meters	RP 114	ZRUP	2
	RSS 131	Reuter Stockes	2
Dose and dose rate meters	NB 3201	TESLA	5
	FH 40 G-10	Eberline	6
Liquid scintillation counters	TRICARB 2260XL	Canberra	1
	TRICARB 3170TR/SL	Canberra	1
Alpha spectrometer	Alpha Analyst	Canberra	1
Gamma spectrometers	PIGC 50	PGT	1
	GC4018/ISX	Canberra	3
Gross alpha beta counter	FHT 770 T6	Thermo	1
In-situ gamma spectrometry	GC3018/ISX	Canberra	1
Surface contamination monitors	FHT 65LLX	Eberline	1
	CME11E	Saint - Gobain	1
	FHT 111 M	Eberline	6
Aerosol sampling devices	VOPV - 200	VF Černá Hora	2
	VOPV - 12-04	VF Černá Hora	1
Iodine sampling device	VOPV - 12-10	VF Černá Hora	1
Autonomous dose rate meters	SAMPDERP	AEL	9

APPENDIX 14

TNPP - ENVIRONMENTAL LABORATORY - MDA

Summary of Minimum Detectable Activity (MDA) applicable to environmental monitoring under routine conditions (at 95% reliability).

Medium	Unit	^{3}H	^{51}Cr	^{54}Mn	^{59}Fe	^{58}Co	^{60}Co	^{90}Sr	^{95}Zr	^{95}Nb	^{110m}Ag	^{131}I	^{134}Cs	^{137}Cs	^{144}Ce	^{124}Sb	Σ alpha	Σ beta
Aerosols	$\mu Bq.m^{-3}$	--	20	3	4	3	3	--	6	3	4	3	3	3	14	4	--	--
Gaseous iodine	$mBq.m^{-3}$	--	--	--	--	--	--	--	--	--	--	0.5	--	--	--	--	--	--
Fallout	$Bq.m^{-2}$	--	3.1	0.4	0.7	0.4	0.4	--	0.8	0.4	0.6	0.4	0.4	0.4	2.2	0.6	--	--
Surface water	$Bq.m^{-3}$	10 000	120	14	24	12	16	8	28	14	18	14	14	14	70	18	100	100
Drinking water	$Bq.m^{-3}$	10 000	120	14	24	12	16	8	28	14	18	14	14	14	70	18	--	--
Groundwater	$Bq.m^{-3}$	10 000	120	14	24	12	16	8	28	14	18	14	14	14	70	18	--	--
Rainfall	$Bq.m^{-3}$	10 000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sanitation	$Bq.m^{-3}$	10 000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sediments	$Bq.kg^{-1}$	--	1.5	0.2	0.3	0.2	0.2	--	0.4	0.2	0.3	0.3	0.2	0.2	1.1	0.3	--	--
Sludge	$Bq.kg^{-1}$	--	1.5	0.2	0.3	0.2	0.2	--	0.4	0.2	0.3	0.3	0.2	0.2	1.1	0.3	--	--
Soils	$Bq.kg^{-1}$	--	1.5	0.2	0.3	0.2	0.2	--	0.4	0.2	0.3	0.3	0.2	0.2	1.1	0.3	--	--
Agricultural crops (fresh substance)	$Bq.kg^{-1}$	--	0.56	0.08	0.1	0.08	0.08	0.03	0.2	0.1	0.1	0.1	0.08	0.08	0.4	0.1	--	--
Milk	$Bq.m^{-3}$	--	400	40	70	30	40	10	70	40	40	50	40	40	300	40	--	--
Fish	$Bq.kg^{-1}$	--	2.3	0.3	0.5	0.3	0.3	--	0.5	0.3	0.4	0.4	0.3	0.3	1.6	0.4	--	--
Soil (in-situ) Σ gamma activity	$Bq.m^{-2}$	--	400	75	100	75	60	--	80	75	75	60	80	80	240	75	--	--

APPENDIX 15

TNPP - DISCHARGE SAMPLE HANDLING - LABORATORY RESPONSIBILITIES

	Sampling	**Radiochemical separation and/or activity concentration measurement**	**Calculation of released activity and dose impact assessment**
Unit 1 and 2 stacks			
Noble gas	chemistry	chemistry	ERML
Iodines	chemistry	chemistry	ERML
Aerosols (gamma nuclides)	chemistry	chemistry	ERML
Strontium in aerosols	chemistry (routine sample) ERML (bulk sample)	ERML	ERML
Aerosols (alpha nuclides)	chemistry (routine sample) ERML (bulk sample)	ERML	ERML
Tritium	ERML	ERML	ERML
C-14	ERML	ERML	ERML
Ancillary building stack			
Aerosols (gamma nuclides)	chemistry	chemistry	ERML
Tritium	ERML	ERML	ERML
C-14 (check measurement only)	ERML	ERML	ERML
Discharge sentencing tanks			
Gamma nuclides	chemistry	chemistry	chemistry + ERML
Tritium	chemistry	chemistry	chemistry + ERML
Strontium (on bulk sample)	chemistry	ERML	ERML
Alpha nuclides (on bulk sample)	chemistry	ERML	ERML
Waste water discharge mixing pit			
Gamma nuclides	ERML	ERML	not applicable
Tritium	ERML	ERML	not applicable
Gross alpha activity	ERML	ERML	not applicable
Gross beta activity	ERML	ERML	not applicable

APPENDIX 16

SONS - DECISION ON LIQUID DISCHARGES Nr. 8096/2005 OF 5 APRIL 2005

The following conditions apply to when calculating the dose:

- The critical group consists of individuals living within a 3 km distance from the location where the discharges enter into the Vltava River.

- The yearly dose assessment (comparison between the actual values and the authorized limit) must be performed using a dedicated software package (RDETE), approved by the SONS as per SONS VDS 030 guideline.

- For the purpose of controlling liquid discharges during the calendar year, any estimation of dose (as a sum of external and internal exposure) shall be based on the sum of radionuclide-specific activities released for the period under scrutiny, whereby every radionuclide is weighted with a conversion coefficient *h*. These coefficients are given in the following table:

isotope	h (Sv/Bq)
H-3	4,0E-20
Na-24	9,5E-19
Cr-51	4,9E-19
Mn-54	6,9E-17
Fe-59	1,7E-18
Co-57	1,1E-17
Co-58	2,0E-17
Co-60	1,2E-15
Zn-65	4,7E-17

isotope	h (Sv/Bq)
Sr-89	1,1E-17
Sr-90	1,7E-16
Sr-92	7,1E-22
Zr-95	1,3E-17
Zr-97	5,3E-19
I-131	1,0E-16
I-133	4,8E-18
Nb-95	9,3E-19
Nb-97	4,6E-20

isotope	h (Sv/Bq)
Mo-99	6,5E-19
Ru-103	6,9E-18
Ru-106	2,0E-17
Ag-110m	4,2E-17
Sn-113	1,6E-19
Sb-124	4,3E-19
Cs-134	2,7E-16
Cs-137	4,5E-16
La-140	3,0E-19

isotope	h (Sv/Bq)
Ce-141	1,4E-18
Ce-143	4,9E-19
Eu-154	9,5E-16
Hf-175	5,2E-20
Pu-238	2,4E-18
Pu-239	2,4E-18
Pu-240	2,0E-17
Am-241	2,1E-18
Am-243	3,0E-20

Note: After Decision Nr. 8096/2005 was issued, the operator of TNPP applied to the Ministry of the Environment for a new decision on liquid discharges, so as to be in compliance with the SONS' decision. The MoE decision is under preparation and will also define the concentration limits for tritium in liquid effluents.