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DIRECTORATE D - Nuclear energy, safety and ITER
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Technical Report of the Verification under the Terms of Article 35 of the Euratom Treaty

ITALY

ITREC
Treatment and Remanufacturing of Fuel Elements Facility

15 & 16 December 2015

Reference: IT 15-05

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITY:	ITREC - Treatment and Remanufacturing of Fuel Elements Facility
LOCATION:	Rotondella, Matera province, Italy
DATES:	15 & 16 December 2015
REFERENCE:	IT 15-05
TEAM MEMBERS:	Mr V. Tanner (team leader) Mr A. Ryan
REPORT DATE:	15 July 2016
SIGNATURES:	

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1 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish the facilities necessary to carry out continuous monitoring of the level of radioactivity in the 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 and the right to verify their operation and efficiency. The EC's Directorate-General for Energy (DG ENER) is responsible for undertaking these verifications. The EC's Joint Research Centre (JRC) provides technical support during the verification visits and the preparation of the reports.

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.
- 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.

Taking into account previous bilateral protocols, a Commission Communication[2] was published in the EU Official Journal on 4 July 2006 describing practical arrangements for the conduct of Article 35 verification visits in Member States.

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The EC's decision to conduct an Article 35 verification was notified to Italy by a letter addressed to Italy's Permanent Representation to the European Union. The Italian Government subsequently designated the Italian competent authority Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) to lead the preparations for this visit.

2.2 DOCUMENTS

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

2.3 PROGRAMME OF THE VISIT

The EC and ISPRA discussed and agreed upon a programme of verification activities, with due respect to the Commission Communication of 4 July 2006 setting out practical arrangements for the conduct of Article 35 verification visits.

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[1] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L-159 of 29.6.1996) which will be superseded by Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (OJ L 13 of 17.1.2014, p. 1)

[2] Commission Communication Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty. Practical arrangements for the conduct of verification visits in Member States (OJ C 155 of 4.7.2006, p. 2–5)

During the opening meeting, and subsequently during the visit to ARPAB in Matera, presentations were given on the following topics:

- ISPRA – environmental radioactivity monitoring in the vicinity of the ITREC plant;
- SOGIN – history of the ITREC site, current status of decommissioning, monitoring of liquid and gaseous discharges and the reclamation of Pit 7.1;
- ARPAB – regional radioactivity monitoring programme and the monitoring around the ITREC plant.

The verification team notes the quality and comprehensiveness of all presentations made and documentation provided. The verifications were carried out in accordance with the programme in Appendix 2. The verification team met with the following representatives of the national authorities and other parties involved:

ISPRA

Mr Lamberto Matteocci	Engineer, Head of Control of Nuclear Activities Division
Ms Rita Ocone	Physicist, Responsible for reliability control on effluents and environmental measurements at nuclear installations
Mr Francesco Paolo Michetti	Engineer, Responsible for Inspection on nuclear activities, Inspector
Ms Carmelina Salierno	Engineer, Responsible for environmental monitoring programmes verification

SOGIN

Mr Edoardo Petagna	Physicist, Site Manager
Mr Salvatore G. Bruno	Nuclear Engineer, Technical Director of the ITREC plant
Mr Vincenzo Stigliano	Mechanical Engineer, Supervisor
Mr Giuseppe Pastore	Mechanical Engineer, Supervisor
Mr Lucia Paradiso	Nuclear Engineer, Engineering Department
Mr Giovanni Varasano	Mechanical Engineer, Qualified Expert in Radiation Protection
Mr Giovanni Sorrentino	Physicist, Qualified Expert in Radiation Protection
Mr Pietro Tortorelli	Industrial expert, Head of Radiation Protection Department
Mr Salvatore Abate	Chemist, Head of Environmental Radiation Department
Mr Salvatore Padula	Civil Engineer, Head of Operations Department
Mr Donato Mazza	Nuclear Engineer, ITREC Technician

ARPAB

Ms Carmela P. Fortunato	Degree in Physics, Medical Physicist Responsible/Manager of CRR
Ms Michele Epifani	Degree in Physics, Ph.D., Expert for CRR lab measurement activities
Mr Rocco Marchese	Degree in Physics, Ph.D., Expert for indoor and outdoor radon monitoring and measurements
Mr Duilio Fossanova	Industrial technician, Expert for sampling and preparation of environmental matrices
Ms Filomena Ciarfaglia	Laboratory technician, Expert for acceptance, sampling and preparation of environmental matrices, Radio-chemistry expert

3 LEGAL FRAMEWORK FOR ENVIRONMENTAL RADIOACTIVITY MONITORING AND REGULATORY CONTROLS

3.1 INTRODUCTION

In Italy the legal provisions which regulate effluent discharges and environmental monitoring in the surroundings of nuclear installations are provided in Legislative Decree n. 230/1995 and subsequent modifications.

In particular,

- Art. 154 establishes that radioactive effluents discharged from nuclear installations must be regulated with specific technical specifications attached to the licence; in this regard it is also established that the 'non radiological concern' -criteria have to be assumed as discharge limits;
- Art. 50 defines the procedure for granting an operating licence, including the establishment of technical specifications;
- Art. 55 defines the licensing procedure for granting authorisation for decommissioning, including the establishment of technical specifications;
- Art. 54 establishes the obligation for the licensee to ensure environmental radiation monitoring in the installations and in its surroundings;
- Art. 10 assigns general inspection functions to ISPRA inspectors.

Technical specifications determine the effluents discharge composition and limits. They also establish that an environmental surveillance programme, approved by the Regulatory Authority, should be in place.

3.2 REGULATORY CONTROL OF NUCLEAR FACILITIES

Regulatory control functions on nuclear safety and radiation protection in Italy have been carried out for many years by the Nuclear Department of ISPRA. According to the Legislative Decree 45/2014 a new competent regulatory authority, called the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN) has been established. Additional legislative steps have to be undertaken to make the new inspectorate fully operative. In the meantime the competent regulatory authority duties and functions continue to be performed by the Nuclear Department of ISPRA, as established in the same Legislative Decree.[3]

Regulatory oversight performed by ISPRA also encompasses verifications on licensee compliance with effluent discharges limits established in the technical specifications of the licence and on licensee performance of an environmental monitoring programme as approved by ISPRA.

Control over nuclear activities, as defined by the law of 31 December 1962 No. 1860 and the Legislative Decree of 17 March 1995 No. 230, is aimed at ensuring the maintenance of a high level of nuclear safety and radiation protection in the regulated installations and to promote continuous improvement in this field.

The regulatory oversight is addressed to aspects of nuclear safety, radiation protection of workers and the population as well as the accountability of nuclear materials.

For nuclear installations, monitoring activities are conducted through:

[3] The Commission notes that the regulatory control of radiation protection needs to be in compliance with the relevant Euratom legislation also during the transition phase, in particular with Council Directive 96/29/Euratom and the Council Directive 2013/59/Euratom, which is due for transposition into national legislation in all EU Member States before 6 February 2018.

- checks and verifications of compliance with the operational and technical specification established in the authorisation;
- verification of compliance with specifications established for authorised projects and operational plans;
- overview of the technical and management organisation to conduct operations in the installations.

Oversight activities are conducted through inspections carried out by inspectors of the Institute, having the status of judicial police officers pursuant to paragraph 5 of Article 10 of the Legislative Decree of 17 March 1995 No. 230, with the possible support of other experts of the Institute. Inspectors have the authority to access any site and request any information or documents related to the installation and they can report to the public attorney of the jurisdiction to which the installation belongs.

Inspections are unannounced, unless they are addressed to oversight specific operations conducted at the sites. Dedicated control activities, related to technical checks of specific operations or authorised testing of new systems or structures, can also be carried out by ISPRA officers. As a result of the inspections and control activities performed, the institute can address to the operator a specific request for the implementation of corrective or improvement measures.

3.3 DOCUMENT VERIFICATIONS

On the basis of the technical specifications in the licence and the environmental monitoring programme, verifications are performed on the basis of the annual reports submitted by the licensee. In particular these verifications cover:

1. Compliance with discharge limits, verification of radiological impact;
2. Consistency of actual radionuclides concentration data in environmental samples (as derived from performed measurements) and data to estimate the associated radiological impact;
3. Data trends and differences from average data from regional and national environmental monitoring programmes (RESORAD Network).

Environmental and radiological impact assessment of effluent discharges is performed using the software FRAMES (Framework for risk analysis in multimedia environmental system), developed by the Pacific Northwest National Laboratories, valid both for routine and accidental releases. This software is used as a forecast model. It isn’t a calculation code, but framework software that supports and connects different simulation models. By using FRAMES it is possible to make an environmental impact assessment and calculate the dose to the population due to radioactive contaminant dispersion. FRAMES is the graphical interface of the calculation code GENII 2.0 whose approach is of the stochastic type and implements the calculation methodology “Sensitivity Uncertainty Multimedia Modelling Module” and also incorporates the internal dosimetry models 26, 30, 48, 56, and 72, with the radiation dose factors from the Federal Guidance Reports 12 and 13, recommended by the International Commission on Radiological Protection (ICRP).

These dosimetry and risk models have been adopted by most national and international organisations as their standard dosimetry methodology. It is important to underline that the considered dose factors are more conservative than what the Italian laws state. The simulation considers four independent atmospheric models, one surface water model, three independent environmental accumulation models, one exposure module, and one dose/risk module, each with a specific user interface code. The software estimates the impact on the different critical groups of the population, both for programmed (routine release) and incidental (accident release) conditions. The considered exposure pathways are water, soil, air, inhalation and ingestion; moreover for tritium an absorption model through the skin is also considered. The software encompasses various calculation algorithms regarding airborne and liquid releases that explain models of spread, transport, deposition, depletion and decay of the radionuclides in the biosphere. For the airborne releases, the framework code uses the Gaussian solution of the diffusion equation that foresees two assessment models where it is possible to choose between continuous or impulsive releases (the Gaussian plume model and the Lagrangian-puff model).

The framework is used by ISPRA to perform document verifications of the radiological impact associated to actual discharges as summarised in the licensee periodic reports of on-site environmental monitoring. Evaluations are also performed as a check of actual monitoring data of environmental samples with radioactivity concentration values as estimated by the code.

3.4 REGULATORY INSPECTIONS

During inspection activities, in addition to the compliance with discharge limits the correct registration of discharge data is verified as well as the sampling procedure. Verifications are also performed in relation to systems associated with the effluent discharge process, including monitoring instrumentation. Specific verifications on sampling activities and associated measurements are performed during the surveillance of emergency drills. A verification activity addressing the reliability control of effluent discharges and environmental measurements performed by the licensee is in progress, starting with installations for which an independent monitoring programme performed by regional agencies is not in place.

The activity includes on-site supervision, technical staff interviews, checks of documentation and visits to laboratories. It concerns the following specific aspects:

- evidence of ISO Quality System and other certifications/accreditations;
- sampling procedures, sample treatments, measurements geometry;
- radiochemical methodologies;
- instrumentation calibration, energy resolutions;
- calibration sources certification;
- background and blank measurements, control charts;
- characteristic limits and MDAs;
- algorithms and data analysis software;
- nuclear reference data, decay schemes;
- secular equilibrium description and calculations;
- measurement uncertainties budget analysis and coverage factors;
- cascade summing, self-absorption, spectral interferences corrections;
- sample identification and management;
- measurements registration, related documentation management;
- evidence of staff training and updating (courses, conferences, internal trainings, etc.);
- failures management, programmed maintenances, spare instrumentations, electrical back-up;
- method validations (UNI, ISO, internal validation with other validated methods);
- proficiency tests and intercomparisons network participation, etc.

As result of the above activity a specific request for improvements might be addressed to the licensee. The activity is documented either in inspection reports or in specific reports associated to the performed verification actions.

3.5 REGULATORY CONTROL OF THE ITREC FACILITY

As for other nuclear installations, regulatory control activities for the ITREC plant are conducted according to the procedures outlined above. In addition, an environmental monitoring programme performed by the Regional Agency for Environmental Protection of Basilicata (ARPAB), is in place.

Furthermore, between ISPRA and ARPAB, a specific agreement on radiometric control activities and environmental radioactivity monitoring specifically related to ITREC plant has been established. In particular,

- ISPRA and ARPAB evaluate the environmental radioactivity surveillance programme of SOGIN;
- ARPAB informs ISPRA on the regional environmental radioactivity surveillance programme;
- ISPRA and ARPAB define specific environmental sampling and measurements to be performed by ARPAB;
- ARPAB carries out independent measurements on the liquid effluents sampled in the ITREC facilities and communicates the results to ISPRA;
- ISPRA and ARPAB can agree on independent measurements on environmental samples inside the installation.

ISPRA, on the basis of the specific agreement with ARPAB, uses these programmes and their results as references for its oversight activity on licensees environmental monitoring. In addition, on the basis of the above mentioned agreement, ISPRA can avail of the cooperation with ARPAB for independent measurements on effluent discharges. In particular cases independent measurements are also performed by the ISPRA laboratory located in Rome.

4 ITREC PLANT - GENERAL

4.1 INTRODUCTION

The ITREC plant (Impianto di Trattamento e Rifabbricazione Elementi di Combustibile) is located inside the Trisaia Research Centre, close to the town of Rotondella, in the south of Italy near the Ionian Sea. Built as a pilot plant for reprocessing and refabricating nuclear fuel elements, it aimed to demonstrate the feasibility of closing the Thorium-Uranium (Th-U) fuel cycle. This would be done by reprocessing spent Th-U fuel elements from the US Elk River reactor and refabricating new Th-U fuel assemblies. The ITREC plant's main facilities were the fuel receiving area and fuel storage pond, reprocessing hot cell, refabricating cell and the waste storage tanks (Waste-1 and Waste-2).

4.2 HISTORY OF THE SITE

The plant and its associated buildings were constructed under an agreement between Italy (ENEA) and the USA (USAEC); the construction of the plant started around 1965. In 1969-1970, the ITREC plant received 84 spent mixed oxide uranium-thorium fuel elements from the US Elk River reactor. Following the outcome of the post-Chernobyl referendum in Italy, research and development work continued until 1987. At this time all activity was suspended and the facility was placed in safe conservation conditions.

ENEA managed the ITREC plant until August 2003, after which the existing license was transferred to SOGIN. In 2006 a new license was granted for waste treatment and conditioning activities together with preparatory activities for decommissioning.

4.3 PAST OPERATIONS

Twenty fuel assemblies were dismantled and reprocessed in the period 1975-1978. The remaining 64 spent fuel assemblies are still stored in the plant's fuel pond.

The reprocessing campaign generated three distinct liquid streams: low-level radioactivity (LLW), high-level radioactivity (HLW) and Th-U nitrate solution, known as “Prodotto Finito”. Each of these three streams was placed in interim storage in three separate tanks in the Waste-1 building. Between 1995-1997 and 1999-2000, the LLW and HLW liquid wastes were conditioned by cementation. The “Prodotto Finito” stream is still stored in the W-120 tank in the Waste-1 building.

As a side product of the nuclear activities, solid radioactive waste was also produced. The majority of this was disposed of in metal drums and grouted with concrete in an underground irreversible pit, called “Pit 7.1”. Secondary low level solid radioactive waste from operation and maintenance of the plant has largely already been packed and conditioned for final disposal, and safely stored in the plant storage buildings.

4.4 CURRENT STATUS OF THE PRELIMINARY DECOMMISSIONING ACTIVITIES

The ITREC plant is currently implementing projects related to dry storage of spent fuel assemblies, remediation of solid waste buried in Pit 7.1 and cementation of the Th-U nitrate solution.

More details about the projects are reported in the Project Reports IT 10 00480, IT 71 02004 and IT 9 00152. The plant has also filed a global decommissioning plan (IT D 00007, IT D 00008 and IT D 00009) with the authorities in order to receive the related authorisation. In compliance with the technical specifications attached to the license and the legislative provisions, SOGIN ensures the following:

- management of radioactive wastes;
- care and maintenance of systems, structures and components related to nuclear safety;
- health physics and radiation protection;

- plant radiological monitoring and surveillance;
- liquid and aerial discharge monitoring;
- environmental radiological surveillance programme.

5 ITREC PLANT - DISCHARGE MONITORING

5.1 REGULATIONS ON LIQUID AND AIRBORNE EFFLUENTS

Radioactive liquid and airborne effluents are regulated by the Ministerial Decree of July 26, 2006 (ITREC plant operation license and related attachments). In particular, the technical specification 3.11 of the APAT RIS ITR 02/2006 document (“*Prescrizioni per l’esercizio ai fini del mantenimento in sicurezza dell’impianto ITREC e per l’esecuzione delle attività propedeutiche alla disattivazione*”), regulates discharges of radioactive liquid and airborne effluents by defining and imposing limits in the discharge formulas, based on compliance with the 'no radiological relevance' criterion i.e. the effective dose of 10 µSv per year to individuals of the population not being exceeded. After monitoring, liquid and airborne effluents are released to the environment by discontinuous and continuous discharge respectively.

The authorised discharge formula for liquid effluents is the following:

$^{3}H/500 + {}^{90}Sr/2.5 + (\beta - \Upsilon_{emit.})/2.5 + \alpha/0.025 < 37$ GBq/year

$^{3}H/500 + {}^{90}Sr/2.5 + (\beta - \Upsilon_{emit.})/2.5 + \alpha/0.025 < 18.5$ GBq/quarter

$^{3}H/500 + {}^{90}Sr/2.5 + (\beta - \Upsilon_{emit.})/2.5 + \alpha/0.025 < 3.7$ GBq/day

The authorised discharge formula for airborne effluents is the following:

^{85}Kr	$< 1.48\ 10^{5}$ GBq/year
^{85}Kr	$< 7.40\ 10^{4}$ GBq/quarter
^{85}Kr	$< 3.70\ 10^{3}$ GBq/day
$\beta - \Upsilon_{emit.}$	< 2.96 GBq/year
$\beta - \Upsilon_{emit.}$	< 1.48 GBq/quarter
$\beta - \Upsilon_{emit.}$	< 0.56 GBq/day

5.2 AERIAL DISCHARGES

5.2.1 Plant ventilation system

The dynamic containment of the ITREC plant is composed of two elements: a dynamic containment for buildings (ventilation system) and a separate dynamic containment for the chemical process tanks and storage of liquid solutions arising from the process itself (off-gas system). The ITREC facility ventilation system for buildings aims to ensure a unidirectional flux, thanks to a cascade of depressions, from external areas to internal areas, from buildings with no contamination to buildings with possible contamination. The number of air changes for buildings is adapted to maintain the concentration of possible contamination below a prefixed safety limit. The ventilation system is divided in three sub-systems:

- “Hot ventilation” ensures dynamic containment for the process area and inaccessible areas (high contamination level) of the ITREC facility;
- “Tepid system” ensures dynamic containment for operative areas normally occupied by operators (very low contamination level);
- “Cold System” ensures dynamic containment for areas with no contamination, e.g. offices.

Air from the hot ventilation system of the ITREC facility crosses absolute filters and is conveyed to a plenum and then to the stack (height 60 meters), where an on-line monitoring system is positioned.

The hot ventilation system covers:

- hot cell G32 and associated tanks;

- decontamination cell G33;
- refabricating cell G30;
- basement areas;
- pool building G45,
- analytic cell H.A.F.;
- service corridor 115;
- nuclear magazine 104.

Waste-1 facility buildings, Waste-2 facility buildings, Pit 7.1, SIRTE-MOWA facilities, glove boxes and hoods in the environmental laboratories (celle attrezzate), have an independent ventilation system with absolute filters, which carries the air to the same stack.

Dynamic containment for tanks of the chemical process and tanks for the storage of liquid solutions is also ensured. All the tanks are depressurised. There are three different collection circuits:

- Dissolver Off-gas (DOG) ensures dynamic containment of tanks implemented in the dissolution section of the chemical process. These tanks are located in the hot cell.
- Vessel Off-gas (VOG) ensures dynamic containment of tanks used for interim storage of liquids from the chemical process. These tanks are located in the hot cell.
- Waste Off-gas (WOG) ensures dynamic containment of tanks used to store liquors arising from the chemical process completed inside the hot cell. These tanks are located in the Waste-1 and Waste-2 facilities.

The gases drawn from the DOG, VOG and WOG collectors are carried to the scrubber where they are purified before crossing an absolute filter and being sent to the stack, where an on-line monitoring system is positioned.

The conceptual scheme for the ventilation system is given in Figure 1 below.

Details on measurements performed by the aerial discharge monitoring systems are reported in the following documents, currently under revision:

- IT G 0003 Rev. 2 Rapporto finale di sicurezza - 10.3.3 Sistema monitoraggio effluenti aeriformi al camino;
- IT GI 0084 - Controllo degli scarichi radioattivi effluenti aeriformi (under revision) Manuale utente del Monitoraggio al camino Impianto ITREC Trisaia.

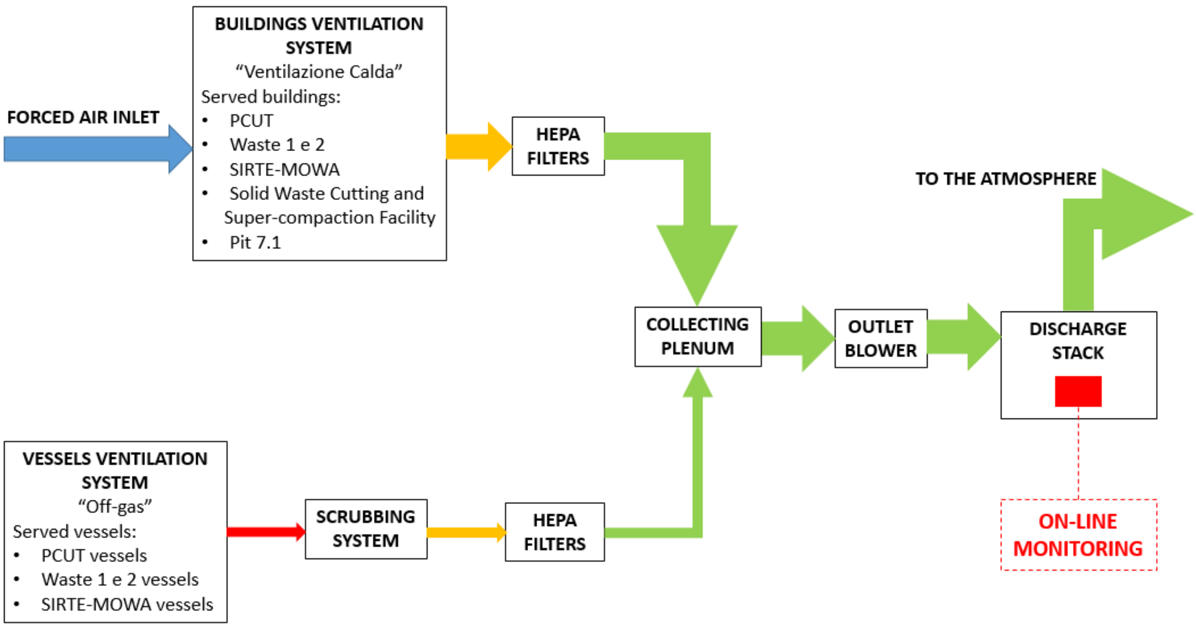

Figure 1. Ventilation system conceptual diagram

The aerial discharge monitoring system information flow is described in the following documents, currently under revision:

- Manuale utente del Monitoraggio al Camino Impianto ITREC Trisaia *ITREC Plant Stack Radiological Monitoring System User Manual;*
- Manuale utente per il Sistema di Monitoraggio Locali Impianto ITREC *ITREC Plant Radiological Area Monitoring System User Manual;*
- Manuale utente del Sistema di Gestione degli Allarmi Impianto ITREC *ITREC Plant Warnings and Alarms Management System User Manual.*

Control procedures and calibration of the aerial discharge monitoring instrumentation are described in the following documents:

- IT GI 0079 - Verifica e prova funzionale del sistema di monitoraggio continuo degli effluenti aeriformi (espulsione camino e locale piscina);
- IT GI 0080 - Calibrazione (taratura) del sistema di monitoraggio continuo degli effluenti aeriformi (espulsione camino e locale piscina).

Responsibilities linked to aerial and liquid discharge monitoring systems are described in the following document:

- IT Q 0008 – Gestione della strumentazione di fisica sanitaria, chimica e radioattività ambientale (under revision).

5.2.2 Monitoring of aerial discharges

All gaseous effluents are continuously monitored on-line at the gaseous effluents stack. Particulate beta-gamma measurements and ^{85}Kr measurement are carried out. The particulate is measured directly on the collecting filter and subsequently measured again after five days in order to reduce the influence of natural radioisotopes. Based on these measurements, compliance with the discharge formula for gaseous effluents is assessed.

The system of on-line monitoring in the stack consists of an isokinetic sampling probe and a measurement system for ^{85}Kr and particulate beta-gamma emitters. A shielded plastic scintillator detector performs the ^{85}Kr measurement. A mobile filter with timed progression (every 24 hours) collects the particulates. A NaI(Tl) type gamma detector, placed above the filter portion being sampled performs an immediate measurement on particulates collected on that portion of the filter below. The ^{137}Cs peak at 662 keV is assessed in order to measure ^{137}Cs activity on particulates expelled from the stack. A plastic detector equipped with discriminatory electronics performs the delayed total beta particulate measurement. The detector is placed on the portion of a filter which collected particulates 5 days earlier, so the measurement is not affected by short lived natural radioisotopes. A PC with data processing software handles the instrument. The measurement results are acquired and processed locally. The management of alarms and malfunctions is also local. An Ethernet cable connects the two base units to a PC (concentrator) placed in the health physics office and in the control room. Every second the two installed programmes (particulate and gas) acquire data coming from the detectors and display them in numerical form on the main panels. The data are processed and the results are compared with alarm thresholds. If thresholds are exceeded or in case of malfunctions visual and audible alarms are activated. The instrumentation is checked weekly and tested every six months. According to internal procedures calibration is carried out annually. The detector characteristics are summarised in Table I below.

Detector type	Efficiency	Operation range	Pre-alarm Threshold	Alarm Threshold	Position
NaI(Tl) scintillator on emission γ ^{137}Cs (in time)	2,25 %	MAR: 0,2 Bq/m^3 Max Activity: 1,31 *10^4 Bq/m^3	10 % of the discharge formula's day limit	50 % of the discharge formula's day limit	Stack
Plastic scintillator on emission β ^{90}Sr (delayed)	36,5 %	MAR: 6,5 *10^{-3} Bq/m^3 Max Activity: 838 Bq/m^3	10 % of the discharge formula's day limit	50 % of the discharge formula's day limit	Stack
Large Surface Plastic scintillator (gas) (^{85}Kr) , type R877-01 HV +1250V	2,15 %	MAR: 2*10^{-2} Bq/m^3 Max Activity: 3,78 *10^8 Bq/m^3	10 % of the discharge formula's day limit	50 % of the discharge formula's day limit	Stack
NaI(Tl) scintillator ETL 2" type 9266 E. resolution 7,7% HV +540V	-	10^{-2}-10^4 MBq/m^3	1 MBq/m^3	1 MBq/m^3	SU-13

Table I. Detectors of the ITREC on-line gaseous and liquid discharge monitoring systems

5.3 LIQUID DISCHARGES

5.3.1 Liquid discharge collection system

Liquid discharges emerging from the whole ITREC plant are composed, for the most part, of water drawn by pumps from the ground water located below the plant. Other streams are a minor part of the total and are composed of drainage water from floors, emergency showers and water from the tepid laundry. All these liquids are sent to the SU-13 sump. Drainage water reaches SU-13 by gravity force, while ground water is pumped by the following pumps:

- P2 (located in I18);

- P3 (located in I30);
- P4/1 and P4/2 (located in I30);
- P7/1 (located in I11);
- P7/2 (located in I12);
- Pozzo A (in G45).

Liquids from SU-13 are dispatched to three 600 m^3 basins. When the discharge of a basin is authorised the water is conveyed to the sea discharge line by a system of pumps. The containment of the sea discharge line is guaranteed by a double steel pipe. The liquid flows through the inner one and, in case of loss, the outer pipe ensures the containment. A system to control losses is implemented as follows: the valve at the end of the sea discharge line is closed and one of the three smaller 40 m^3 basins is connected with the line. The basin is filled with water until a pressure of 3 bar is reached inside the line. At the end of the line, before the closure valve, a manometer is installed and the pressure value is read. The stability of the pressure value is an indicator of the sea discharge line's integrity.

The liquid discharge monitoring system is described in the following documents:

- IT G 0003 Rev. 2 Rapporto finale di sicurezza – Cap. 10.3.2 Sistema monitoraggio effluenti liquidi (under revision);
- IT GI 0081 - Verifica e prova funzionale del sistema di monitoraggio degli effluenti liquidi (under revision).

Liquid discharge sources and the discharge path are summarised in Figure 2 below. Appendix 3 shows the locations of the system components.

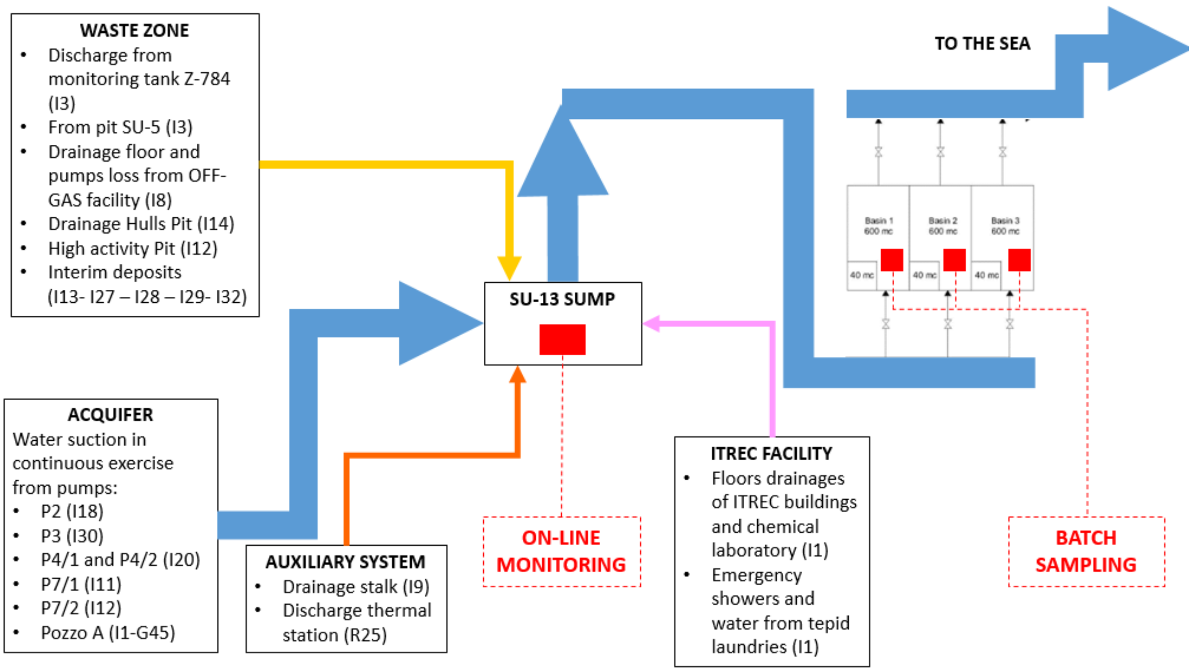

Figure 2. ITREC site drainages

5.3.2 Monitoring of liquid discharges

Before being transferred to the discharge basins, all liquid effluents are conveyed in a collecting sump (SU-13), where a system for continuous on-line monitoring is installed. From there the liquid effluents are sent to three 600 m^3 liquid effluent basins. Each discharge batch is sampled, measured and the overall calculated activity is compared with technical specification limits in the discharge formula. After that, a discharge authorisation is granted. In the event of an activity higher than the upper technical limit set up for the SU-13 monitoring system, liquids will be not discharged as effluent.

The SU-13 on-line monitoring system is a continuous sampling and measuring system. Through dedicated pumps, the sample is conveyed to a shielded 1 litre Marinelli beaker in order to perform a total beta-gamma measurement using a scintillation detector (SCIONIX ETL 2”NaI(Tl) scintillator type 9266 for β/γ measurement). Calibration and checking procedures on liquid discharge monitoring instrumentation are described in the following documents, under revision:

- IT GI 0081 - Verifica e prova funzionale del sistema di monitoraggio degli effluenti liquidi;
- IT GI 0082 - Calibrazione (taratura) del sistema di monitoraggio degli effluenti liquidi.

All the involved instrumentation is checked weekly, tested every six months and calibrated every year according to internal procedures.

To ensure the representativeness of the sample taken from the basins, homogenisation of each basin is implemented using a suction head that captures water from the depth, in a corner, and carries the same to the opposite corner surface. Two litre samples are taken from each basin when a pre-established level is reached. The radiochemical analyses are carried out in the plant laboratory. Total beta/gamma, total alpha, tritium and ^{90}Sr measurements are performed by using liquid scintillator counters and gas proportional counters.

5.4 BACK-UP POWER SUPPLY

In case of an electric grid failure, three 400 kVA emergency generators provide the ITREC plant with an emergency power supply. Two emergency generators will be brought into operation, whilst the third is available for maintenance or to be started manually, in case of failure of the other two. The switching of the supply for privileged utilities (i.e. on-line discharge monitoring system), for the Nuclear Safety and Radiation Protection, from the grid power to the emergency power is implemented through remote control switches (one for each power line), electrically and mechanically interlocked with each other. To guarantee power continuity to privileged utilities, with “No break” absolute continuity, there are two UPS systems (Uninterruptible Power System).

5.5 DISCHARGE SAMPLE ANALYSIS LABORATORY

5.5.1 Introduction

The ITREC plant laboratory analyses both discharge and environmental samples in different sections of the laboratory. The laboratory is located outside the controlled area in a separate laboratory building.

5.5.2 Sample reception and preparation

A plant operator collects the discharge samples. The sample identification procedure is reported in document IT GI 00186; the sampling and registration procedures are reported in paragraph 4 of document IT GI 00001. The reception of a sample in the laboratory is described in document IT RA 00020 paragraph 2.

Sample preparations are described in procedure IT RA 0020. In particular, on discharge samples the following preparations are performed:

- gamma spectrometry (^{137}Cs): no treatment;
- alpha/beta total measurement: the residual particulate from liquid exsiccation are put on a planchette for alpha/beta total counting;
- tritium measurement: a distillation sample fraction is mixed with scintillation cocktail for low-energy scintillation counting;

- ^{90}Sr measurement: from a portion of the sample, Sr is purified with a precipitation step; when ^{90}Y/^{90}Sr are almost at radioactive equilibrium the measurement is performed by counting ^{90}Y.

5.5.3 Measurement devices

Measurements are performed on individual samples using the following measurement devices:

- Gamma spectrometry system (HPGe ORTEC with relative efficiency higher than 30 %) to measure ^{137}Cs with a counting time of 86400 s;
- Liquid scintillator system (Quantulus 1220 PerkinElmer) to measure ^{3}H with a counting time of 86400 s;
- Proportional alpha/beta counter (Berthold LB 770) to measure total alpha/beta emitters and ^{90}Sr with a counting time of 57600 s.

Table II below provides further information concerning the devices.

DEVICES	***Model/Type***	***Manufacturer***	***N° pz***	***Serial Number***	***Use, Calibration, Maintenance, Functional-Surveillance Procedures***	***Standards used***	***Radionuclides assessed***	***Building R-26 (locations)***
10-channel α/β Gas Proportional Counter	Berthold LB 770	Berthold T.	1	6234	**IT RA 00077** "Manutenzione, taratura, controllo di taratura e utilizzo del rivelatore alfa/beta Berthold LB770".	Sorgenti certificate: ^{90}Sr ^{137}Cs ^{238}U	Alfa totali Beta totali ^{90}Sr/^{90}Y	Lab. n° 103
Gamma Spectrometry System	HpGe detector Mod. GEM30P4	ORTEC	2	44-TP50028A 44-TP21962C	**IT RA 00072** "Manutenzione, taratura, controllo di taratura e utilizzo delle catene per spettrometria gamma".	Sorgenti multigamma certificate (tipo: QCRB)	^{137}Cs ^{60}Co	Lab. n° 107
	HpGe detector mod. GEM50P4-83	ORTEC	2	48-TP50357A 48-TP50408A				
	HpGe detector mod. GMX50P4-83-CW	ORTEC	1	48-TP50408A				
Liquid Scintillator Counter	Wallac Quantulus 1220	PERKINELMER	1	DG06129337	**IT RA 00106** "Manutenzione, taratura, controllo di taratura e utilizzo dello spettrometro per la scintillazione liquida".	Sorgenti certificate di ^{3}H	^{3}H	Lab. n° 103

Table II. ITREC laboratory systems for measurements of discharge samples

5.5.4 Data handling and reporting

Analysis of results is carried out by the GammaVision software or by using internal calculation datasheets (for total alpha-beta, ^{90}Sr and tritium). The algorithms used are reported in the document IT RA 00109 for total alpha beta and tritium measurements and in the document IT RA 00073 for ^{90}Sr.

The procedure for recording and archiving discharge sample results are included in the document IT RA 00020. Results below detection limits are registered as MDA (Minimum Detectable Activity) values. The results registered as MDA values are used in subsequent calculations e.g. in the assessment of the discharge percentage.

A special data handling and reporting tool, based on the File Maker Pro 5.0 software called “LARA Vasche” elaborates the data concerning the discharge samples analysis. The document IT RA 00110 contains the operational instructions for the compilation of “LARA Vasche”.

Responsibilities, frequencies, operating modes, compilation and conservation of discharges register are reported in the document IT Q 00023.

5.5.5 Sample storage

One litre of each water sample is stored in a plastic bottle for one year following the year of sampling. For sample storage there is a separate container facility.

5.5.6 Quality assurance and control

The laboratory does not have quality certification, but SOGIN is working to achieve this. At present all procedures adopted by the laboratory are listed in the “Index of the operational manual” (document IT Q 00031, paragraph 3.4).

In 2014 the laboratory participated in a national inter-comparison proficiency test on "alpha, beta and gamma determination on a water sample" organised by ENEA (in particular the National Institute of Ionising Radiations Metrology) and ISPRA for the laboratories involved in the national surveillance on environmental radioactivity.

All measurements on discharge samples are performed in the plant laboratory. In some cases samples may be sent to other laboratories within SOGIN, particularly in case of defective devices, or where the laboratory is unable to perform specific analyses.

6 ITREC PLANT - ENVIRONMENTAL RADIOACTIVITY MONITORING

6.1 INTRODUCTION

The current statutory site-related environmental radioactivity monitoring programme is reported in the official documents 'Proposta di rete di sorveglianza ambiantale' (ENEA RTI COMB-IRITR(87) 21 Rev1) and 'Rapporto Finale di Sicurezza' (IT G 0003, Paragraph 7.2). The monitoring programme, articulated around 34 sampling points is summarised in table III below. For each radionuclide a Minimum Detectable Activity (MAR) and Investigation Limits (LI) are indicated.

SAMPLED MEDIA	N° MAP	IDENTIFICATION	SAMP. FREQ	SAMPLE SIZE	MEASUR. FREQ.	Unit.	RADIONUCLIDES	M.A.R. Bq/Unit.	L. I. Bq/Unit.
Ground Water	31 (2, 3, 5, 9, 11)	Pozzi piezometrici intorno alla fossa rifiuti solidi a bassa attività contras-segnati con: P2, P3, P5, P 9, P11.	Quarterly	10 l	Quarterly	l	Sp. Gamma (Cs-137)	3,70E-02	2,50E+01
	33	Pozzo piez. lato EST					Beta tot. (Cs-137+Sr-90+Y-90)	3,33E-01	1,48E+00
	34	" " " "							
	32 (1, 2)	Scarpata Sinni (pozzi di irrigazione n° 1 e n° 2).	Quarterly	10 l	Quarterly	l	Sp. Gamma (Cs-137)	3,70E-02	2,50E+01
							Beta totale (Sr-90+Y-90)	3,33E-01	4,44E+00

SAMPLED MEDIA	N° MAP	IDENTIFICATION	SAMP. FREQ	SAMPLE SIZE	MEASUR. FREQ.	Unit.	RADIONUCLIDES	M.A.R. Bq/Unit.	L. I. Bq/Unit.
Air	7	Interno Centro (Edificio Fisica Sanitaria)	Daily	250 m³	Daily	m³	Beta tot.	7,40E-04	1,48E-01
					Monthly		(Cs-137+Sr-90+Y-90) Sp. Gamma (Cs-137)	7,40E-05	1,23E+00
					Yearly		Pu-239	2,22E-06	7,40E-05
Fruits	2	Mass. Acinapura	Harvest season	3 kg	Harvest season	kg	Sp. Gamma (Cs-137) Sr-90	1,48E-01	2,50E+01
	6	Mass. Battifarano						7,40E-02	5,00E-01
	4	Mass. Pastore							
Vegetables	2	Mass. Acinapura	Harvest season	3 kg	Harvest season	kg	Sp. Gamma (Cs-137) Sr-90	1,48E-01	2,50E+01
	6	Mass. Battafarano						7,40E-02	5,00E-01
	4	Mass. Pastore							
	3	Azienda Jonia							
Fodder	8	Mass. Lunati	Yearly	3 kg	Yearly	kg	Sp. Gamma (Cs-137) Sr-90	9,25E-01	2,50E+01
	5	Mass. Pugliese						7,40E-02	5,00E-01
Milk	1	Mass. Marta	Monthly	1 l	Monthly	l	Sp. Gamma (Cs-137)	3,70E-01	2,50E+01
	5	Mass. Pugliese			Quarterly	l	Sr-90	7,40E-02	5,00E-01
Soil	2	Mass. Acinapura	Yearly	200 cm² x 2cm h	Yearly	kg	Sp. Gamma (Cs-137)	5,55E-01	1,55E+02
	6	Mass. Battafarano							
	4	Mass. Pastore							
	3	Azienda Jonia							
Fall-Out	7	Interno Centro	Monthly	2 m²	Monthly	m²	Sp. Gamma (Cs-137)	3,33E-01	6,14E+03
Sea Water	10	Policoro lido	Quarterly	15 l	Quarterly	l	Sp. Gamma (Cs-137)	3,70E-02	2,50E+01
	12	Sbocco cond. lido					Th nat.	**0,02 (µg/l)**	**675 (µg/l)**
	11	Nova Siri lido					Sr-90	7,40E-02	5,00E-01
							H-3	2,59E+01	3,70E+03
Mussel	9	Bocca di scarico condotta (Aprile o maggio)	Yearly	5 kg (tot.)	Yearly	kg	Sp. Gamma (Cs-137) (parte edule)	7,40E-01	2,50E+01
Fish	10	Policoro lido	Quarterly	2,5 kg	Quarterly	kg	Sp. Gamma (Cs-137)	1,48E-01	2,50E+01
	11	Nova Siri lido							

SAMPLED MEDIA	N° MAP	IDENTIFICATION	SAMP. FREQ	SAMPLE SIZE	MEASUR. FREQ.	Unit.	RADIONUCLIDES	M.A.R. Bq/Unit.	L. I. Bq/Unit.
Sediment	9	Bocca di scarico condotta	Biannual	1 kg	Biannual	kg	Sp. Gamma (Cs-137)	5,55E-01	1,55E+02
Sabbia / *Sand*	10	Policoro lido	Sem.	1 kg	Sem.	kg	Sp. Gamma (Cs-137)	5,55E-01	1,55E+02
	12	Sbocco cond. lido							
Sand (dose-rate measurement)	10	Policoro lido	Yearly	----	Yearly		Irr. Diretto	0,01 (µSv/h)	0,2 (µSv/h)
	12	Sbocco cond. lido							
	11	Nova Siri lido							
	13	Rocca Imp. lido							
	14	Scanzano J. lido							
	15	Pisticci lido							
	16	S. Teodoro lido							
	17	Metaponto lido							
	18	Ginosa lido							
	19	Riva dei Tessali lido							
	20	Castellaneta lido							
	21	Taranto lido Azzurro							
	22	Taranto lido S. Vito							
Loam	23	Canale bonifica Centro.	Quarterly	1 kg	Quarterly	kg	Sp. Gamma (Cs-137)	5,55E-01	1,55E+02
	24	Scarichi pluviali verso S.S. 106							
	25	Scarichi pluviali verso S.P. per Rotondella.							
	26	Scarichi pluviali verso Sinni							
	27	Scarichi Oxigest.							
	28 (1,2,3,4)	Pozz. ispez. cond. mare.							
	29	Sinni - conf. f. Granata.							
	30	Sinni - scarico rete acque bianche.	Yearly	1 kg	Yearly	kg	Pu-239	1,48E-02	1,85E-02
							Sp. Gamma (Cs-137)	5,55E-01	1,55E+02

Table III. ITREC site environmental monitoring programme

In addition to the regular programme, there is physical surveillance at the plant by TLD air dose monitoring (Thermo Luminescent Dosimeter) distributed along the plant fence. The TLDs measure for 8 periods of 45 days per year.

An annual report on environmental radioactivity is issued and transmitted to the regulatory authority. In 2014, the environmental programme, following a national regulatory authority request, was strengthened with 7 additional investigation points for groundwater along the pipe which conveys the liquid discharges to the sea. A revision of the environmental programme integrating the above mentioned new sampling points is envisaged.

6.2 ON-SITE AND OFF-SITE SAMPLING AND MONITORING LOCATIONS

Overview maps below (Figures 3 to 5) indicate the on-site and off-site sampling/monitoring locations with respective media sampled and/or monitored at these locations. They show the positions of the sampling points listed in section 6.1 above.

Figure 3. Aerial control points

Figure 4. Liquid effluent control points

Figure 5. Aquifer control points

6.3 METEOROLOGICAL MONITORING

The weather station at the plant main stack consists of three thermistors measuring the temperature, two anemometers, one humidistat and a data logger which collects the data. The station sends the data to the operative sanitary physics computer. The instruments are checked and tested every six months following internal procedures, described in document IT GI 0085.

6.4 ENVIRONMENTAL SAMPLE ANALYSIS LABORATORY

6.4.1 Introduction

All the measurements on environmental samples are performed in the plant laboratory. Document IT RA 00107 summarises the laboratory monitoring devices with a reference to internal procedures for calibration, utilisation, maintenance and functional surveillance. Calibrations are usually performed every six months. The functional surveillance is usually performed weekly. The maintenance programme consists of preventive check-ups twice a year and extraordinary check-ups in case of malfunction. Both check-ups are performed by the manufacturer device company, duly formalised by a contract.

The sampling devices are always double, one for ordinary operation and the second as a reserve. Internal technicians perform the maintenance of sampling devices. Table IV below summarises the laboratory equipment for environmental analyses.

DEVICES	*Model/Type*	*Manufacturer*	*N° pz*	*Serial Number*	*Use, Calibration, Maintenance, Functional-Surveillance Procedures*	*Standards used*	*Radionuclides assessed*	*Building R-26 (locations)*
Rateometer	Scintillator 6150 AD-b/H Geiger Muller 6150 AD6/H	AUTOMESS	3	121821 120464	Calibrations are performed by Accreditated Laboratory.	Fascio prodotto da sorgenti certificate: ^{60}Co,^{137}Cs,^{241}Am e raggi X	Emettitori γ e X con energia compresa tra 20 KeV e 7 MeV	Container n° 8
	Scintillator 6150 AD-b/H Geiger Muller 6150 AD6/H			121820 120463				
	Scintillator 6150 AD-b/H Geiger Muller 6150 AD6/H			121822 120465				
Mass Spectrometry	ICP-MASS SPECTROMETER ELAN DRC-e	PerkinElmer	1	1530501	**IT RA 00008** "Analisi diretta di Torio nell'acqua di mare tramite ICP-MS"; **IT RA 00009** "Applicazioni numeriche e Sperimentali della metodica SOGIN - IT-RA-008 per la detereminazione del Torio in acqua di mare tramite ICP-MS".	Soluzioni certificate: Th U	Th - U	Lab. n° 103
Alfa Spectroscopy	Octête	ORTEC	1	260	**IT RA 00028** "Manutenzione, taratura, controllo di taratura e utilizzo del sistema per spettrometria alfa OCTETE PLUS".	Sorgenti certificate: ^{239}Pu ^{241}Am ^{244}Cm, ^{238}Pu	^{239}Pu	Lab. n° 103
10-channel α/β Gas Proportional Counter	Berthold LB 770	Berthold T.	1	6234	**IT RA 00077** "Manutenzione, taratura, controllo di taratura e utilizzo del rivelatore alfa/beta Berthold LB770".	Sorgenti certificate: ^{90}Sr ^{137}Cs ^{238}U	Alfa totali Beta totali ^{90}Sr/^{90}Y	Lab. n° 103
Scintillator ZnS(Ag) alfa counter	Total alfa ALBA/A	ELSE	2	101 102	**IT RA 00029** "Manutenzione, taratura, controllo di taratura e utilizzo delle catene di conteggio alfa/beta a basso fondo ALBA".	Sorgenti certificate: ^{238}U	Alfa totali	Lab. n° 107
Plastic Scintillator beta counter	total beta ALBA/LLB	ELSE	2	101 102	**IT RA 00027** "Manuale operativo per l'uso della strumentazione beta"; **IT RA 00029** "Manutenzione, taratura, controllo di taratura e utilizzo delle catene di conteggio alfa/beta a basso fondo ALBA";	Sorgenti certificate: ^{90}Sr ^{137}Cs	Beta totali ^{90}Sr/^{90}Y	Lab. n° 107
Gamma Spectrometry System	HpGe detector Mod. GEM30P4	ORTEC	2	44-TP50028A 44-TP21962C	**IT RA 00072** "Manutenzione, taratura, controllo di taratura e utilizzo delle catene per spettrometria gamma".	Sorgenti multigamma certificate (tipo: QCRB)	^{137}Cs ^{60}Co	Lab. n° 107
	HpGe detector mod. GEM50P4-83	ORTEC	2	48-TP50357A 48-TP50408A				
	HpGe detector mod. GMX50P4-83-CW	ORTEC	1	48-TP50408A				
Whole **B**ody **C**ounter	HpGe detector Mod. GEM40	ORTEC	2*	45-TP41508B 45-TP22028A	**IT RA 00023** "Istruzioni di calibrazione ed analisi WBC adottate presso l'impianto itrec"; **IT RA 00072** "Manutenzione, taratura, controllo di taratura e utilizzo delle catene per spettrometria gamma".	Sorgente multigamma certificata (tipo: BOMAB PHANTOM)	^{137}Cs ^{60}Co	Lab. n° 109
Liquid Scintillator Counter	Wallac Quantulus 1220	PERKINELMER	1	DG06129337	**IT RA 00106** "Manutenzione, taratura, controllo di taratura e utilizzo dello spettrometro per la scintillazione liquida".	Sorgenti certificate di ^{3}H	^{3}H	Lab. n° 103

Table IV. ITREC laboratory systems for measurements of environment samples

6.4.2 Sample receipt and preparation

Laboratory technicians collect the environmental samples; the sample identification procedure is reported in IT RA 00103; the registration procedure is reported in IT RA 00104.

After sampling, before measurement, environmental matrixes undergo chemical and physical treatments (weighting, drying, ashing, etc.) as appropriate.

6.4.3 Data handling and reporting

Results analysis is carried out by Gamma Vision Software and by hand using internal calculation datasheets. The algorithms used for results calculation are reported in the documents:

- IT RA 00027 for total beta measurement,
- IT RA 00008 for ^{232}Th measurement,
- IT RA 00106 for ^{3}H measurement,
- IT RA 00073 for ^{90}Sr measurement,
- IT RA 00108 (paragraph 8.2) for ^{239}Pu measurement.

Procedures for recording and archiving environmental samples results are in document IT RA 00108. Results below detection limits are registered as MDA (Minimum Detectable Activity) values. The results registered as MDA values are accepted if they are below the one reported in Table III and are used in subsequent evaluation.

A special data handling and reporting tool (based on the software File Maker Pro 5.0) called “LARA Routine” elaborates data concerning the environmental samples analysis. The document IT RA 00108 contains the operational instructions for the compilation of the LARA Routine.

Environmental sample measurement results are collected in the annual report on environmental radioactivity surveillance of the plant, which is sent to the national regulatory authority as described in paragraph 2.7 of document APAT RIS ITR 02/2006 (“Prescrizioni per l’esercizio ai fini del mantenimento in sicurezza dell’impianto ITREC e per l’esecuzione delle attività propedeutiche alla disattivazione”). The report is also sent to the local authorities.

6.4.4 Sample storage

As reported in the document IT RA 00012 samples are stored for one year following the year of sampling. The sampled media are stored in dedicated containers.

6.4.5 Outsourced measurements

SOGIN outsources the TLD reading to the ENEA institute, regulated by a contract. It receives the TLD dosimeters from ENEA, which are placed at various points on site for measurement. After about 45 days the TLD dosimeters are sent back to ENEA for processing. Finally SOGIN collects, registers and archives the results.

6.4.6 Quality assurance and control

Please refer to section 5.5.6.

7 ITREC PLANT - REMEDIATION OF PIT 7.1

7.1 BACKGROUND

Pit 7.1, also called 'The Monolith', is a reinforced concrete structure, composed of four square section wells (Figure 6). Near the monolith a drainage system with a pump was installed to catch groundwater. In the ’70s and ‘80s, ILW generated by 'Nuclear Tests' of the ITREC plant was disposed of in metallic drums. In particular, materials disposed of in the monolith consisted of heads and tails from the dismantled fuel assemblies, technological waste from hot cells decontamination and pool water purification system filters and resins for a total activity of about 10 TBq. After the disposal was completed the Monolith was completely buried and a concrete slab was built on top. The characteristics of the Monolith are as follows:

- width 1.56 m, length 5.81 m, depth 6.45 m (total 59 m^3);
- weight 130 t;
- well dimensions: width 1.1 m, length 1.0 m, depth 6.0 m;
- concrete thickness between the wells: 45 cm.

Construction and filling of the Monolith is described in the ITREC Safety Report (IT G 0003).

Figure 6. The Monolith

7.2 PREPARATORY ACTIVITIES

Remediation of the buried waste pit is one of the most important activities to be performed in the framework of the general plant decommissioning programme, which is included in the current plant operating license. The purpose of the operation is to remove all underground radioactive waste before decommissioning the site.

Preparatory activities undertaken in view of reclaiming the pit were as follows:

2007 Hydraulic isolation of the monolith by a series of secant foundation piles placed deep in the clay layer, to limit the groundwater around the monolith;

2008 Completion of a capping beam;

2012 Construction of a static and dynamic containment composed of:

- A steel structure to support the PVC tent;

- A ventilation system to ensure the necessary depression to prevent possible leakage of contamination. This system ensures a constant depression of 50 Pa in the work area.
- Radiological monitoring system comprising an environmental gamma monitoring system together with an α/β/γ-monitoring system for the off-gas on the ventilation system extraction pipe.

7.3 DIGGING AND INVESTIGATION ACTIVITIES

Digging and investigation activities in view of reclaiming the pit were as follows:

2013 The regulatory authority authorised (ISPRA letter 11/04/2013) the operational plan (IT 71 02003) to carry out digging activities to uncover the monolith, and investigation activities to ascertain the structural characteristics of the monolith and the drums internal positioning.

2014 The digging activities started, after which the Pit 7.1 containment structure obtained the practicability certificate.

2014 During the excavations support beams ("knees”) were installed to stabilise the monolith. To investigate the mechanical properties of the monolith a partial scarifying of the plaster was needed. This activity was authorised by ISPRA (ISPRA letter 17/06/2014). During investigations there was seepage of liquid from inside the Monolith.

7.4 ANOMALOUS EVENT OF 2014 AND ANALYSIS RESULTS

The liquid release from the Monolith took place on 21 August 2014. The liquid was collected and analysed. The results showed that the liquid was radioactive; chemical analysis showed that the liquid was most likely residual water in the stored waste, e.g. from the resin used for purification of the spent fuel pond. The soil, affected by the percolation, was removed representing 1 x 2 m and a height of 1.65 m.

The radiometric analysis results of the soil, air and liquid samples taken following the event are given in the table below:

Sample	Activity of ^{137}Cs
Liquid	4.44E+04 Bq/l
Soil	7.60E+03 Bq/kg
Air (counting time of 3600 sec)	≤1,49E-02 Bq/m^3

The radiometric analysis results of the soil sample taken after removal of the contaminated soil are the following:

Sample (at the point most affected by the contamination of 21/08/2015)	Activity of ^{137}Cs	Activity of ^{90}Sr
Soil	5.44E+00 Bq/kg	1.81E+01 Bq/kg

An extraordinary environmental monitoring of Pit 7.1 was implemented to evaluate the radiological situation near the pit. Immediately after the seepage event, the following measurements were carried out:

- Measurements of ^{137}Cs and total beta on the water in the Pit 7.1 drainage pit;
- Immediate measurements of aerial discharges on 20, 21 and 22 August 2014, and subsequently measured again after five days;
- Measurements of total alpha and beta on the filter from the building which encloses the monolith (counted after 5 days).

On the basis of these measurement results, comparable with previous measurements, it was concluded that the event was without any radiological significance. After the event the operation plan was modified, with new documentation authorised by ISPRA (ISPRA letter 22/06/2015), and new investigation activities were introduced to probe the liquid inside the monolith and plan the draining of the free liquids. On 21 October 2014 the regulatory authority authorised the resumption of excavation works and investigation activities.

7.5 INDIRECT INVESTIGATIONS

After the anomalous event, the hypothesis of the absence of free liquids was no longer true. Different indirect investigations were carried out to define the different materials (steel, concrete, water) inside the monolith. The chromatographic map in Figure 7 below gives indications about the nature of the materials:

- the positioning of drums;
- the concrete and steel reinforcing bars, showing the separation between the wells and the boundary structures (brown colour);
- the possible presence of water (violet colour).

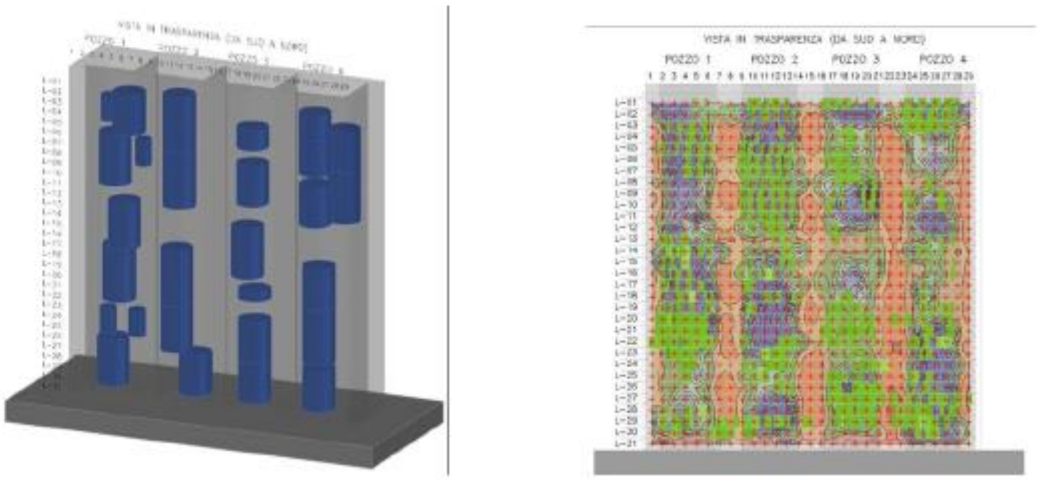

Figure 7. Chromatographic map of the Monolith

7.6 DIRECT INVESTIGATIONS

The investigation continued with direct surveys to ascertain the presence of free liquid inside the Monolith, notably:

- External visual surveys through partial scarifying of the plaster, the same activity which produced the leakage of liquid. Windows were made where the indirect investigations showed the possible presence of liquid.
- Internal visual surveys through holes drilled in the monolith to allow the insertion of a camera. During the drilling some valves were put into the holes in order to control the liquid leakage.

Based on the investigation results, drilling of holes was carried out as shown on Figure 8. In order to verify the absence of liquid in the vertical separations of the wells, investigation/drainage holes were drilled therein, which demonstrated the absence of liquid. Therefore, it has been possible to conclude that the future cutting activities can be safely undertaken.

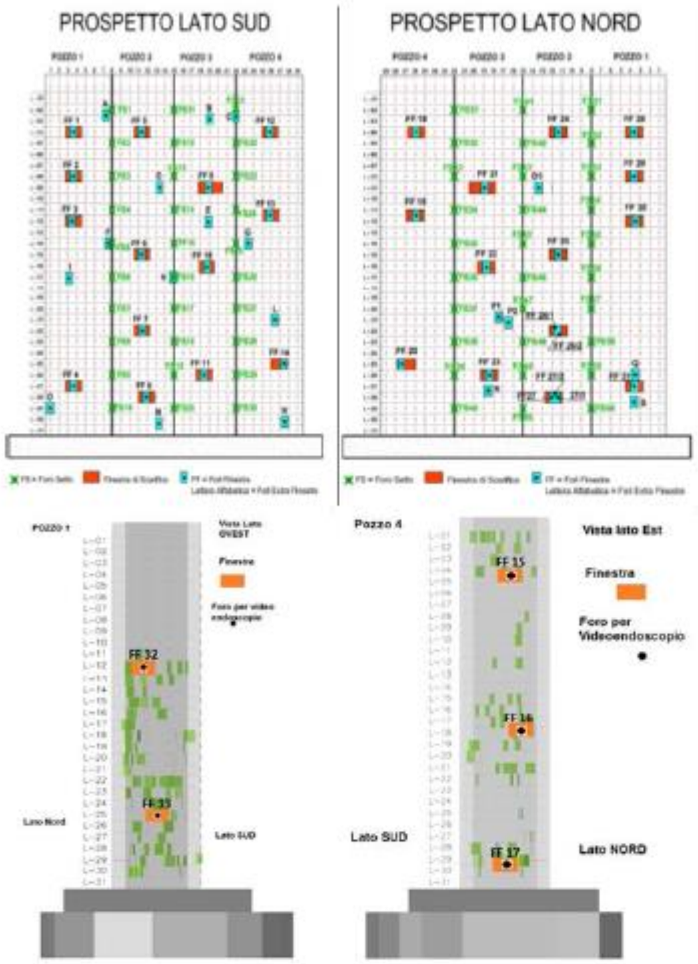

Figure 8. Scheme of the realised drilling holes

7.1 FUTURE ACTIVITIES

Future steps include longitudinally segmenting the monolith by diamond wire, cutting the basement horizontally, placing each well in a shielded and leak tight containment and transporting it to the onsite storage facility (building 9.3). Figure 9 illustrates these operations.

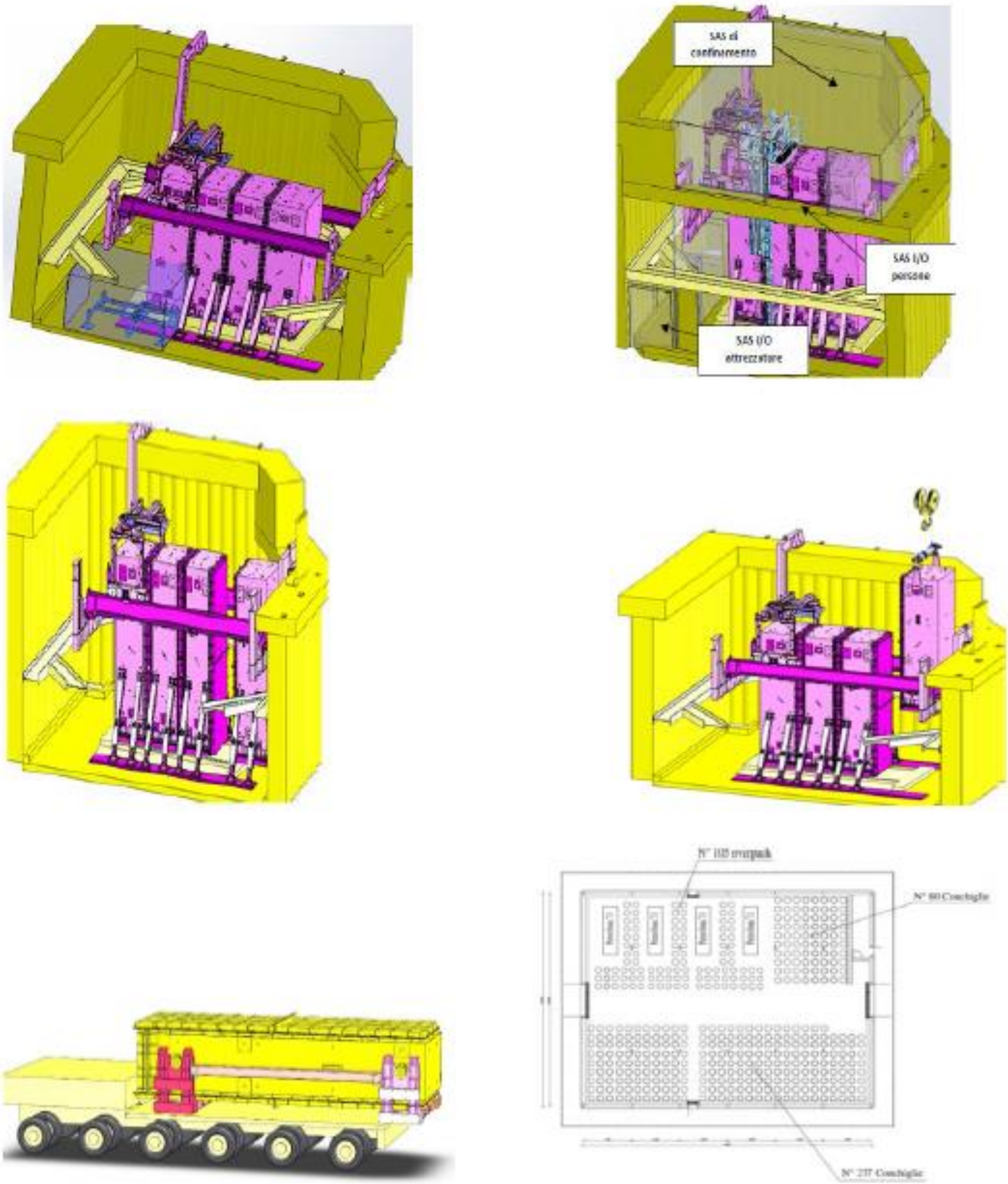

Figure 9. Cutting, lifting and transport of the wells

8 REGIONAL RADIOACTIVITY MONITORING

8.1 INTRODUCTION

In Italy the regional authorities are responsible for the radiological monitoring programme in their region. The analytical laboratory currently involved in the monitoring in Basilicata is the Regional Radioactivity Centre (CRR) of the ARPAB - Provincial Department of Matera (Via dell'Industria snc. 75100 Matera).

The Regional Agency for the Environmental Protection of Basilicata (ARPAB) was established in 1997 under regional Law No. 27/97. In accordance with this law, ARPAB is the organisation in charge of the management of the regional networks for the monitoring of foodstuffs and the environment.

8.2 ENVIRONMENTAL MONITORING PROGRAMME

Since 2006 ARPAB has carried out several radiometric measurements on environmental matrices and foodstuffs. A study on a regional scale has been carried out to investigate all the potential sources of contamination in the regional territory. The ITREC pilot reprocessing facility operated by SOGIN has been identified as a possible source of radioactive pollution for the region. For this reason ARPAB implemented a site-related monitoring programme. This programme was approved on 19 September 2008 through the ARPAB resolution No. 287.

The ARPAB environmental monitoring programme has been officially approved by the Regione Basilicata through a specific resolution (DGR No. 752 del 30/04/2010). This programme includes both the local network for ITREC monitoring (special environmental radioactivity surveillance plan in place for the ITREC plant) and the regional network, in application of the national law concerning radioactivity management (art. 104 D.Lgs. 230/95 e s.m.i.) devoted to environmental monitoring in Basilicata. The ARPAB monitoring programme has been updated several times as new devices became available and new methods were put in place. These updates have been submitted to Regione Basilicata's Department dealing with environmental and health protection (Ambiente and Sanità) for approval. The latest update has been officially submitted to Regione Basilicata on 18 March 2014 (nota prot. ARPAB N. 0002570). The programme relevant to the ARPAB's local network for the ITREC site-related monitoring programme, including environmental matrices, sampling locations, sampling frequencies and radiometric measurements, is summarised in Table V below. The monitoring locations are shown on the Figure 11 below.

Matrix	Number of locations	Sampling Location	Analysis	Sampling frequency	Measurement frequency
Ambient gamma dose rate (nSv/h)	2	Upstream and downstream of the plant compared to the prevailing wind direction	By fixed stations installed in the outside area of ITREC		Continuously
Soil	4	ROTONDELLA - NOVA SIRI/Az. Agricole ROTONDELLA2 /c/o Centralina	Gamma spectrometry	half-yearly	half-yearly
Sea water	1	Ionian Sea - ROTONDELLA c/o ITREC discharges	Gamma spectrometry	half-yearly	half-yearly
Sea sediment	2	Ionian Sea - ROTONDELLA c/o ITREC discharges (in points of SOGIN's environmental radioactivity surveillance plan)	Gamma spectrometry	half-yearly	half-yearly
Myl ilus galloprovincialis	1	Ionian Sea - ROTONDELLA Boa ITREC	Gamma spectrometry	half-yearly	half-yearly
Marine sand	2	Ionian Sea ROTONDELI.A c/o ITREC discharges	Gamma spectrometry	half-yearly	half-yearly
Groundwater	8-10	in/out area' close to ITREC plant (in points of SOGIN's environmental radioactivity surveillance plan)	Gamma spectrometry; Gross alpha and beta	quarterly	Quarterly
River water	2	"Sinni" River (upstream & downstream of ITREC)	Gamma spectrometry; Gross alpha and beta	quarterly	Quarterly
River sediment/ stream	3+3	"Sinni" River - ROTONDELLA	Gamma spectrometry	half-yearly	half-yearly
Drinking water	2	ROTONDELLA in area'' close to ITREC plant	Gamma spectrometry; Gross alpha and beta; H-3	half-yearly	half-yearly
ITREC's liquid discharge samples	3	ITREC - c/o vasche di raccolta	Gamma spectrometry; Gross alpha and beta; ^{3}H; ^{90}Sr	variable (agreed with ISPRA)	variable (agreed with ISPRA)
Fruit and vegetables/ Green salad	2-3	Farms close to ITREC plant	Gamma spectrometry	seasonal	seasonal
Wheat	2	Farms close to ITREC plant	Gamma spectrometry	annual	annual
Cow's milk	2	Livestock farms near the ITREC plant	Gamma spectrometry ^{90}Sr	monthly	Monthly Quarterly

Table V. ARPAB's local monitoring programme in the surroundings of the ITREC facility

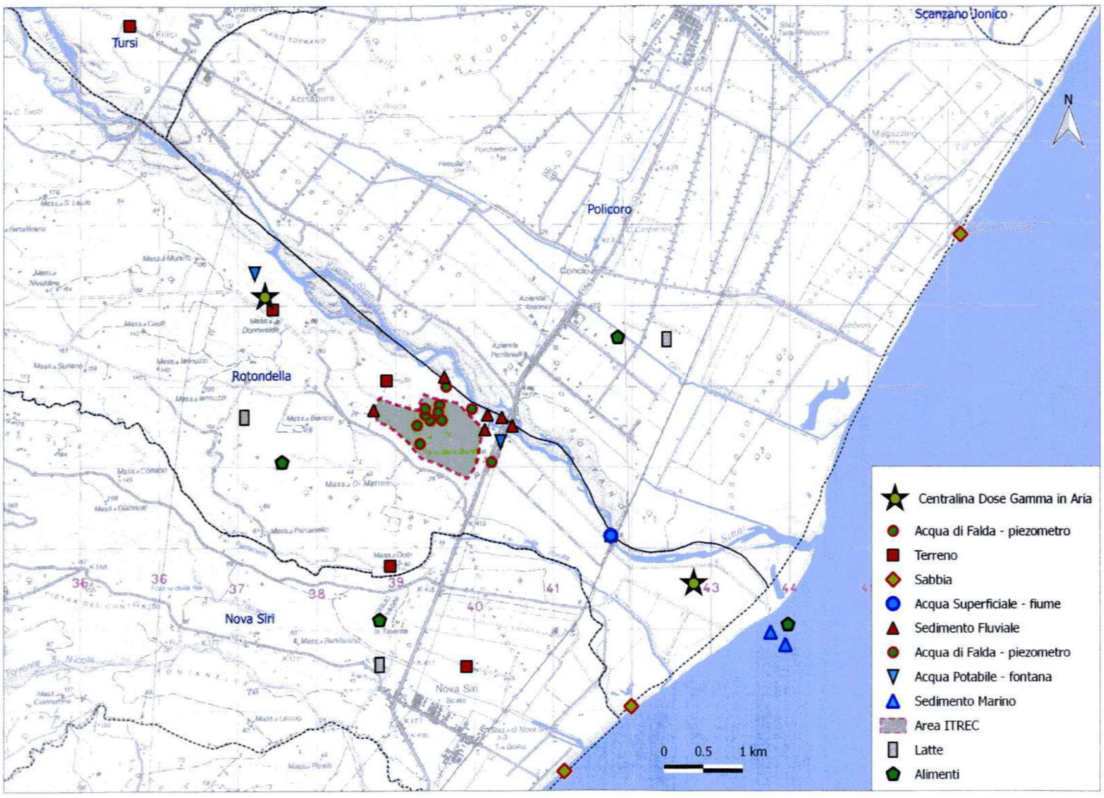

Figure 11. ARPAB monitoring locations in the surroundings of the ITREC facility

Gamma dose rate is monitored by two systems located in the vicinity of the ITREC plant, respectively upstream and downstream of the plant, depending on the prevailing wind direction. The air dose rate data are remotely acquired, stored and then sent to a dedicated PC located in the CRR laboratory in Matera. The stored data are analysed on a daily basis to check for anomalies/outliers and aggregated in view of the final annual reporting.

Some of the most significant sampling points belonging to the ARPAB local network correspond to some of those included in SOGIN's ITREC surveillance programme. This is to allow a direct comparison and cross check between the SOGIN's and ARPAB's measurements on samples taken in locations of particular interest or with an increased risk of pollution. In order to allow a comparison between ARPAB and SOGIN data ARPAB has requested SOGIN to improve the MDA levels of some measurements, also according to the local environmental background.

As both the ARPAB's local and regional network programmes are part of the national network for radioactivity monitoring handled by ISPRA (RESORAD), since 2006 the ARPAB data have been uploaded to the RADIA database on regular basis (the Italian national database of environmental radioactivity data).

The activity data coming from the networks are compared with the statutory regulatory levels, when available, or with the local background levels, computed for all the matrices using the whole ARPAB database. In case of a detected anomaly ARPAB immediately points out such an occurrence to ISPRA.

Furthermore, on an annual basis, the results of the ARPAB's monitoring networks are summarised in a document named "Rapporto sullo stato della radioattività in regione Basilicata", published on the ARPAB's official website.

8.3 ISPRA – ARPAB AGREEMENT

An official agreement has been in place between ISPRA and ARPAB since 2013. Under this agreement, more activities are undertaken by ARPAB, in addition to those foreseen in the framework of the local network, to provide support to ISPRA for its control activities. ARPAB is requested to provide independent radiometric determinations on a subset of matrices whose sampling is shared with SOGIN. Such a shared set includes samples of liquid discharges as well as samples of several matrices, potentially contaminated, coming from specific activities done inside the ITREC plant aimed at the recovery of the area. For all the programmed items, two samples are taken to be independently analysed by SOGIN and ARPAB. In particular, most of the measurements have been made on samples coming from the Pit 7.1, including soil from excavation works as well as groundwater coming from wells located in the neighbourhood of the site.

The amount of work entrusted to ARPAB has steadily increased after the event which occurred at the end of August 2014 when contaminated liquid leaked from the Monolith inside the Pit 7.1.

All the data collected by ARPAB in the framework of the Agreement are immediately submitted to ISPRA to be cross-checked with those analysed by SOGIN on the same matrices.

8.4 ARPAB LABORATORY

8.4.1 Introduction

The ARPAB radiological laboratory is located in Matera. Staffing of the laboratory is summarised below.

Personnel	Number	Man years
Director. PhD.	1	1
Graduate, PhD.	3[4]	3
Technician	2	2
Support	0	0

8.4.2 Measurement devices and techniques

The ARPAB laboratory is equipped with the devices summarised in table VI. The techniques employed, radionuclides assessed and counting times are summarised in table VII. Routine maintenance as well as planned preventative maintenance of the laboratory devices is carried out by the device supplier, according to the maintenance contract conditions. Emergency maintenance services are requested in case of severe failures or anomalies reported by the operator, that can't be resolved by remote support provided by the supplier.

To verify the health status of the devices as well as to identify suspected anomalies, a routine check is performed by the operator according to the relevant procedure. Such a routine health check procedure is repeated on an annual basis or whenever an anomaly is suspected.

[4] In September 2015 one of the physicists involved in radiometric measurements moved to another administration.

Measurement technique	In place	Programmed	No.	Manufacturer and device type
Gamma Spectrometry	X	X	2	1) ORTEC GMX40P4 2) ORTEC GEM50P4
Gamma dose rate	X	X	2	Rad Tech - integrated monitoring system Gammatracer
Liquid scintillation (LSC) **Gross alpha and beta; ^{3}H; ^{90}Sr; ^{226}Ra**	X	X	1	PerkinElmer QUANTULUS 1220
Gas Flow Proportional Counter (GFPC) **Gross alpha and beta; ^{90}Sr**	X	X	1	Berthold LB770
Mass spectrometry		X	1	

Table VI. Measurement devices available at the ARPAB laboratory

Measurement technique	Radionuclides assessed	Counting times (sec.)
Gamma Spectrometry	^{137}Cs, ^{134}Cs, ^{40}K, ^{60}Co, ^{131}I	72000 - 80000 (depending on the matrix)
LSC	Gross alpha and beta	36000
LSC	^{3}H	18000
GFPC	^{90}Sr	345600
GFPC	Gross alpha and beta	86400

Table VII. Measurement techniques used at the ARPAB laboratory

8.4.3 Data handling and reporting

Concerning the handling of the results below the detection limit, there isn't a need for any special procedure. This is because the instrument set-up adopted for each implemented method, has been designed according to the desired MDA value (Minimum Detectable Activity). The requirements for the MDA values come directly from the requirements set for the ITREC liquid discharge formula, ensuring that the total dose to the individuals in the population is below the threshold of 10 µSv/year.

As a general rule, the measurement/analysis reports are stored on a dedicated PC as well as printed, signed by the operator and archived in folders sorted by the year. For each device, all the data concerning a measurement (counting, data analysis, reports) are stored in folders by year and matrix. A backup of all the data stored on the PC is routinely done onto an external data storage support.

Furthermore, for each year an overall record of all the analysis is compiled and routinely updated as an Excel sheet containing the activity concentration and uncertainties and all the information useful to identify, describe and localise the sample, the detected radionuclides and the computed MDA. Such a record is used to build the reference radioactivity level for each nuclide and matrix.

At present, a Laboratory Information Management System (LIMS) is available in ARPAB, but the radioactivity data hasn't been implemented in it yet.

The results of the analysis concerning the liquid discharges by the ITREC plant are submitted to ISPRA as soon as the results are available. ARPAB draws attention to the occurrence of outliers as well as any suspected anomaly in the data (i.e. values above the variability range of all the previous measurements, for a specific matrix or location). An Annual Report containing a summary of all the samples analysed, aggregated per matrix, is published on the ARPAB official website.

8.4.4 Sample storage

In case of results above some statutory threshold or above the ARPAB variability range, the sample is classified as a "suspected anomaly" and stored in the laboratory until the completion of all the evaluation and verification activities concerning the relevance of such an event. If the anomaly is confirmed, according to the radioactivity level, the sample goes to disposal as "radioactive waste" following the relevant procedure. Otherwise, if the results are classified as "not noticeable" from the radiological point of view, the sample goes to disposal as non-radioactive waste following the relevant procedure.

8.4.5 Quality assurance and control

The ARPAB CRR laboratory is not accredited and there is no Quality Assurance (QA) implemented yet in ARPAB. However, some steps have been taken in this direction. For example, the laboratory has participated in several national as well as international intercomparison exercises.

At present, a LIMS is implemented in the main ARPAB premises in Potenza. Such a system is designed to handle the full sample lifecycle, from the acceptance to the emission of the analysis certificate or report. An upgrade of the LIMS system to include the handling of radioactivity data produced by the CRR is in progress and it is expected to be completed by the end of 2015.

In the CRR laboratory work is in progress to write down a set of internal procedures aimed to manage in a more efficient way all the activities of sample preparation and analysis. The following objectives have been identified as a guideline for implementing a QA philosophy in the lab:

- Standardisation of sample preparation and measurement procedures;
- Standardisation of the internal calibration procedures;
- Verification and updating plan of all the approved procedures;
- Plan for evaluating repeatability and reproducibility of the implemented methods, including sample preparation and measurements;
- Evaluation of the measurement error as Extended Composite Uncertainty, including the evaluation of all aspects of both preparation and measurement expected to contribute to the uncertainty;
- Definition of a check, maintenance and testing plan for all the devices;
- Definition of the roles and functions of the personnel involved;
- Definition of an education and training plan for the personnel involved concerning QA topics.

9 VERIFICATIONS

9.1 DISCHARGE MONITORING CARRIED OUT BY THE OPERATOR

9.1.1 Gaseous discharges

Gaseous discharges are monitored at the main stack of the ITREC plant which is the sole gaseous discharge point. Before being discharged to the environment the airflow from the plant ventilation systems passes through filters. The radioactivity monitoring is carried out on an isokinetic bypass flow taken at 15 m height, which represents 1/4000 of the total air flow in the stack. The monitoring consists of an on-line ^{137}Cs monitor (NaI detector) and delayed (5 days rolling 24h filter paper) gross-beta monitor. The system is manufactured by ELSE Nuclear. In addition there is a calibrated air flow meter (7.45m^3/h at the time of the verification) and a local display for monitoring information. The on-line monitoring information is available also at the plant control room. Filter paper rolls are archived for future reference.

The total flow in the stack is measured using a flow meter based on a heated wire. Using this technique involves fairly large measurement uncertainties, but is nevertheless sufficient for this type of application.

It was noted that the thermal insulation of the bypass line outside the stack was in poor condition. This may have an effect on the representativeness of the sample.

In order to guarantee good representativeness of the bypass airflow sample, the verification team recommends that the ITREC plant repairs the thermal insulation of the isokinetic sample bypass line.

9.1.2 Liquid discharges

ITREC plant liquid waste water is collected at the sump SU-13 and directed from there to three discharge basins.

On-line radioactivity monitoring is carried out in the sump SU-13. The system consists of a calibrated flow meter and sampling pump supplying a Marinelli sample chamber equipped with a NaI detector. The system automatically stops the discharge water flow to the discharge basins in the event of a high activity in sump SU-13.

The three discharge basins hold about 600 m^3 of water each. About 99% of this water comes from the ground water beneath the site. The basins serve as a discharge water storage system before the water is cleared for discharge from the plant area into the sea via a 5 km pipeline. The actual sea discharge point is about 700 m from the coast. A two-litre sample from the full basin is taken for laboratory measurement before each discharge. A mixing system is in place to guarantee homogeneity of the sampled water. When approved by the qualified expert, the plant control room is allowed to empty the basin into the sea. Typically this happens every 10 days.

Verification does not give rise to recommendations.

9.1.3 Discharges from the Pit 7.1 remediation project

The arrangements for monitoring liquid and gaseous discharges arising from the remediation of the Pit 7.1 were verified. The works carried out in this project involve a possibility of small liquid and gaseous discharges in the environment. The work area is covered with a temporary cover which maintains a depression within. Outgoing air is monitored by a continuous on-line monitor and by taking a filter sample for laboratory analysis. In addition there is sample-based monitoring of the groundwater collection sump.

Verification does not give rise to recommendations.

9.2 ENVIRONMENT MONITORING CARRIED OUT BY THE OPERATOR

The ITREC plant operator's programme for monitoring radioactivity in the environment surrounding the site consists of the following:

Medium volume air samplers

There are two medium-volume air samplers at the ITREC site. One sampler is located close to the laboratory and another near the canteen.

Fall out sampler (precipitation collector)

There are two precipitation collection systems at the ITREC site. The collected water is sampled for laboratory analysis (gamma spectroscopy) monthly.

Sea water sampling

Sea water samples are taken every three months on locations close to the coastline. The collected samples are analysed in the laboratory for U, Th, ^{3}H, ^{137}Cs and ^{90}Sr.

Mussels sampling

Mussels caught close to the end of the ITREC plant liquid discharge pipeline are monitored annually.

Sediment sampling

Marine sediments are sampled annually at 6 locations near the pipeline.

Dose rate measurement at the beach

Radiation dose rate is measured on the beach at 13 positions annually using a hand-held dose rate meter at 1 metre height.

Soil

An annual soil/mud sample is taken to monitor ^{239}Pu.

In addition there are 10 TLDs placed on the plant fence, some of which were seen by the verification team.

SOGIN's report of the 2014 measurement results was provided to the verification team [4].

Verification does not give rise to recommendations.

9.3 OPERATORS LABORATORY FOR ENVIRONMENT AND DISCHARGE SAMPLES

This laboratory analyses both discharge and environment samples. In addition it is also in charge of the ITREC staff whole body counting and urine analysis for occupational radiation protection purposes. The laboratory is well equipped and staffed (8 laboratory staff and 3 support staff). The facilities have sufficient electrical back-up arrangements.

The analysis equipment in the laboratory are very good and modern, including an ICP-mass spectrometer, liquid scintillation counter, low level counter, alpha spectrometer and gamma spectroscopy systems. Also the equipment for sample preparation, including radiochemical separation for ^{90}Sr analysis, is quite adequate.

The laboratory carries out environment and discharge analysis in separate areas (described in sections 5.5 and 6.4) to avoid any possibility of cross-contamination. The arrangements for sample receipt and treatment (scales, furnaces, dryers and equipment for radiochemical separation) before measurement are available.

The laboratory counting room is equipped with an ICP-MS (Perkin Elmer), a liquid scintillation counter (Perkin Elmer Quantulus 1220), a low-lever counter (LB 770) and an alpha spectrometer

(Ortec Octete). The second counting room (temperature controlled) houses five gamma spectroscopy systems (Ortec with digital electronics). The weekly control programme of these systems includes control of efficiency, energy and resolution stability (FWHM of the ^{60}Co peak at 1332 KeV and ^{137}Cs at 661 keV). The results are marked on log sheets and in a long-term trend graph but there is no practise of a graphical long-term trend analysis of FWHM.

The laboratory does not carry out commercial analysis and it is not accredited though an accreditation process has been initiated. The laboratory participates in Italian national intercomparison exercises and exercises organised among the other SOGIN company laboratories.

The laboratory has a container facility for storing archived samples. Analysed samples (air filters, soil, and water) are stored for one year after the sampling year, and then discarded.

> *Verification does not give rise to recommendations. As a matter of good laboratory practise, the verification team suggests initiating long-term trend analysis of the HPGe-detector stability control results. This can provide early indication of possible system degradation.*
>
> *Verification team supports the intention to achieve laboratory quality accreditation.*

9.4 REGIONAL AUTHORITY'S SITE RELATED MONITORING PROGRAMME

The environmental monitoring carried out by the ARPA Basilicata laboratory (ARPAB) was presented. This is an independent control programme, carried out in parallel with the operators programme.

The verification team was informed that during the verification neither of the two automatic radiation dose rate monitoring stations was working due to maintenance. They were expected to be replaced by two new state-of-art systems.

> *Verification does not give rise to recommendations. Verification team supports the modernisation of the ARPAB site radiation dose rate monitoring stations.*

9.5 REGIONAL AUTHORITY'S LABORATORY FOR ENVIRONMENT AND DISCHARGE SAMPLES

The ARPA Basilicata laboratory (ARPAB CRR), analyses the samples received as part of the ITREC site related monitoring programme. The lab carries out the following monitoring programmes:

- ISPRA-ARPAB agreement for the monitoring of ITREC liquid discharges and other matrices collected inside the plant area;
- Local network for the ITREC environmental monitoring;
- Regional environmental monitoring programme in the framework of the national network for radioactivity monitoring;
- Other control activities and other radioactivity screening for specific sources used in the region, for example in hospitals, in industrial areas, with NORM, etc.

In addition to its regulatory tasks, the ARPA Basilicata laboratory also performs commercial analysis, typically for issuing radioactivity certificates. The laboratory is not accredited. It has participated in a few national and international intercomparison exercises.

The laboratory's main equipment consists of two gamma spectroscopy systems, a liquid scintillation counter and a gas flow proportional counter. In addition there are hand-held gamma dose monitoring devices. Also the necessary sample preparation equipment (scales, furnaces, dryers, etc.) and electrical back-up systems (UPS) are available. There are plans to also acquire a mass spectrometer and an additional gamma spectroscopy system.

It was noted that there were no calibration certificates available for the laboratory scales. In addition the regular control of gamma spectroscopy system resolution (FWHM of the ^{60}Co peak at 1332 keV) is not part of the routine controls, although control of the system energy and efficiency stability is part of the regular maintenance programme.

Data handling is done on individual PCs – there is no common data base for the measurement data. Though ARPAB has a LIMS system, inclusion of radioactivity data is still in preparation.

The number of staff in the laboratory is fairly limited, especially in the view of new tasks emerging as the ITREC decommissioning advances and the laboratory receives new analysis capability.

> *The verification team recommends that ARPA Basilicata laboratory intensifies its participation in relevant laboratory intercomparison exercises and proficiency tests.*
>
> *In view of the future tasks and new equipment, the verification ream recommends ARPAB to consider options for increasing the qualified staff in the laboratory in order to maintain sufficient expertise.*
>
> *The verification team points out that there is a need to make sure that the equipment calibration procedures are adequate and well documented. In particular, the team suggests that the resolution control of the gamma spectroscopy systems should be carried out on a regular basis and monitored for early detection of any HPGe-detector degradation.*
>
> *The verification team supports the progress towards using an integrated laboratory database also at the radioactivity laboratory.*

10 CONCLUSIONS

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

The information provided and the verification findings lead 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 at the ITREC site and on its surroundings are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in gaseous and liquid discharges of the ITREC facility site are adequate. The Commission could verify the operation and efficiency of these facilities.

(3) A few recommendations are formulated, in particular as regards the ARPAB laboratory facilities. The recommendations do not discredit the fact that environmental monitoring is in conformity with the provisions laid down in Article 35 of the Euratom Treaty.

(4) The recommendations are detailed in the 'Main Conclusions' document that is addressed to the Italian competent authority through the Italian Permanent Representative to the European Union.

(5) The Commission services request a report on the implementation of the recommendations by the Italian authorities and about any significant changes in the set-up of the monitoring systems before the end of 2017. Based on this report the Commission will consider the need for a follow-up verification in the ITREC facility.

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

APPENDIX 1

REFERENCES & DOCUMENTATION

1. ITREC plant discharge and environmental monitoring, SOGIN, IT GI 00206, 4.12.2015

2. Description of the ARPA Basilicata's activity for site-related radioactivity monitoring, Carmela P. Fortunato, ARPAB, 2016

3. Monitoraggio Ambientale – Monitoraggio supplementare dell'acqua di falda, Anno 2014, IT RA 00098, SOGIN, 27.3.2015

4. ITREC, Rapporto sulla radioattività ambientale, Anno 2014, SOGIN, IT RA 00094, 17.11.2015

5. ARPA Preliminary information questionnaire in view of preparing the Euratom Treaty article 35 verification visit on 15 and 16 December 2015

6. Rapporto sulla Radioattivita' Ambientale in Basilicata, Anno 2014, Ufficio centro Regionale radioattività, ARPAB

APPENDIX 2

THE VERIFICATION PROGRAMME

ARTICLE 35 VERIFICATION

ITREC plant Discharge and Environmental Monitoring

15 – 16 December 2015

Day/date	Time	Activity
Tuesday 15 December	9.00 – 10.00	Opening meeting with representatives of SOGIN, ISPRA, ARPA Basilicata and the verification team
	10.00 – 12.00	Verification of the operator's liquid and gaseous discharge monitoring.
	13.00 – 14.00	Verification of the operator's environmental surveillance programme
	14.00 – 17.00	Visit to the operator's laboratories dealing with analysis of discharge samples
Wednesday 16 December	9.00 – 11.00	Visit to the operator's laboratories dealing with analysis of environmental samples
	11.00 – 12.00	Verification of the ARPA Basilicata's discharge and environmental surveillance programme related to the ITREC plant
	14.00 – 17.00	Visit to the ARPA Basilicata's laboratories dealing with analysis of discharge and environmental samples from the ITREC plant

APPENDIX 3

ITREC PLANT LIQUID DISCHARGE MAP