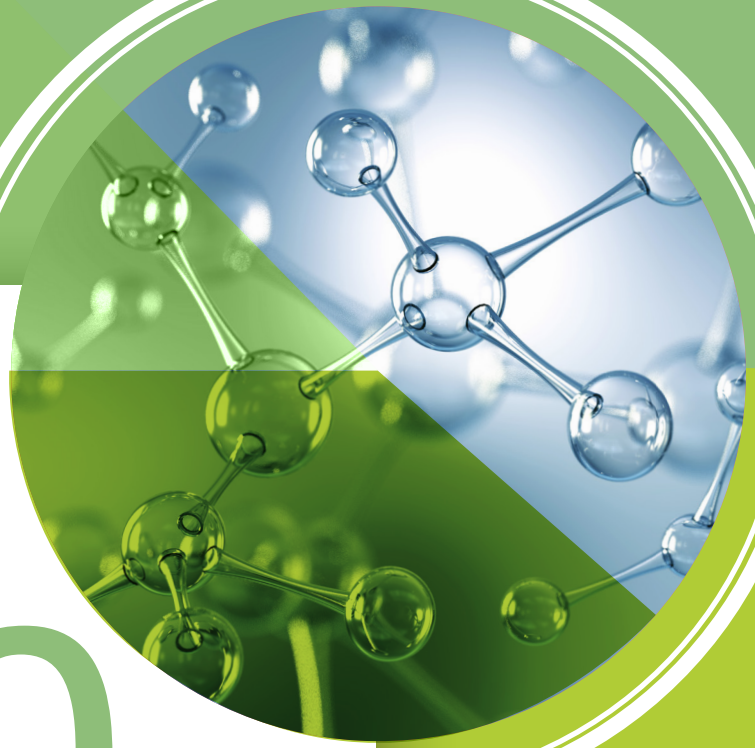
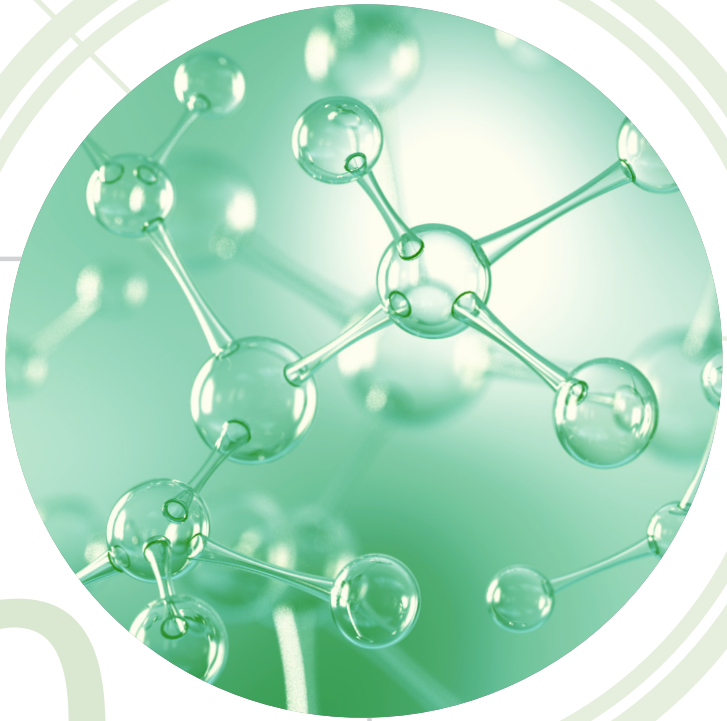


2019

ENVIRONMENTAL REPORT

ALMARAZ TRILLO



2019

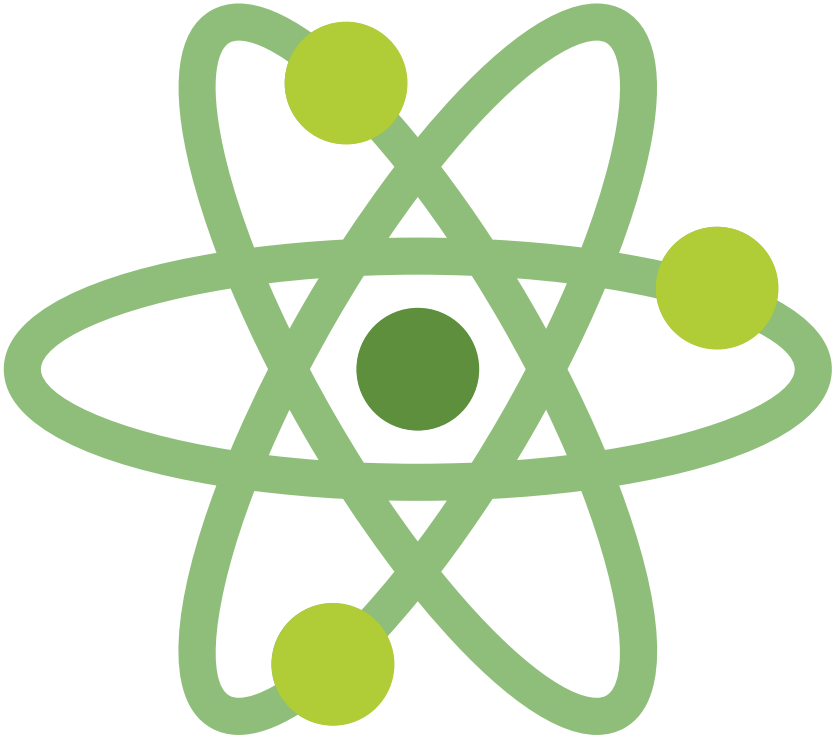
ENVIRONMENTAL REPORT

AENOR Gestión Ambiental UNE-EN ISO 14001

excelencia efr certificado en conciliación 1000-1 ES – 096 / 2010 / AENOR

CERTIFIED IQNet MANAGEMENT SYSTEM

ALMARAZ TRILLO



Edition: **© Centrales Nucleares Almaraz-Trillo May/June 2020**

Coordination: **CNAT Communication**

Design and Layout: **Cambio de Sentido**

Photographs: **CNAT Photographic Archive**

1 ALMARAZ AND TRILLO NUCLEAR POWER PLANTS

2 ENVIRONMENTAL QUALITY MANAGEMENT

3 ACTION PLANS

4 ENVIRONMENTAL MANAGEMENT RESULTS

5 LEGISLATION

6 ENVIRONMENTAL AUDITS

7 ENVIRONMENTAL MONITORING PROGRAMMES

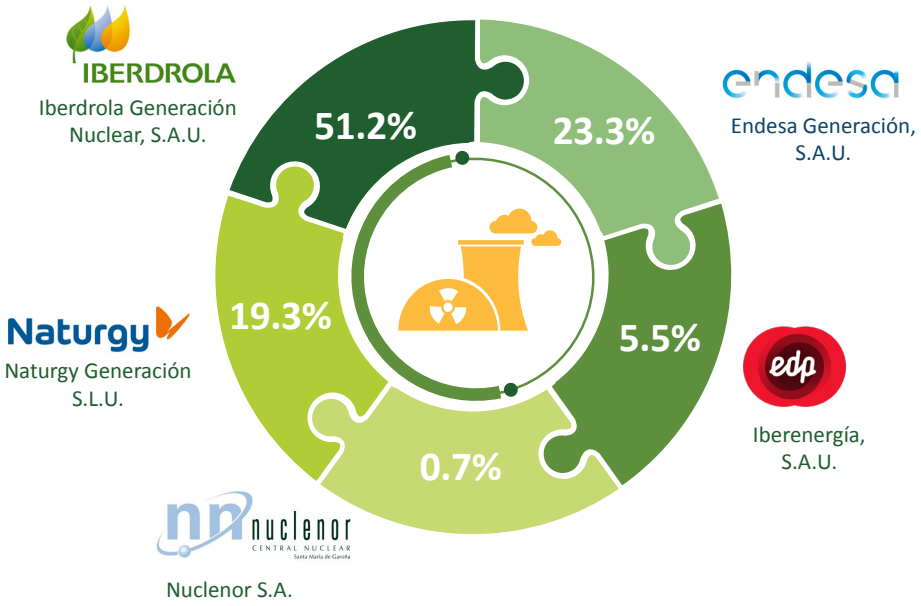
8 RELATIONSHIP WITH STAKEHOLDERS

ALMARAZ AND TRILLO NUCLEAR POWER PLANTS

OWNER COMPANIES

The companies owning the Almaraz and Trillo Nuclear Power Plants formed the Economic Interest Grouping in November 1999, called Almaraz Trillo Nuclear Power Plants AIE, for the integrated operation, management and administration of both plants, and their shares in the assets of each have remained unchanged. Currently, pursuant to Royal Decree Law 13/2014, Almaraz-Trillo Nuclear Power Plants AIE also holds the Operating Permits for the installations.

The shares of the owner companies in the installed capacity, at both plants, is as follows:

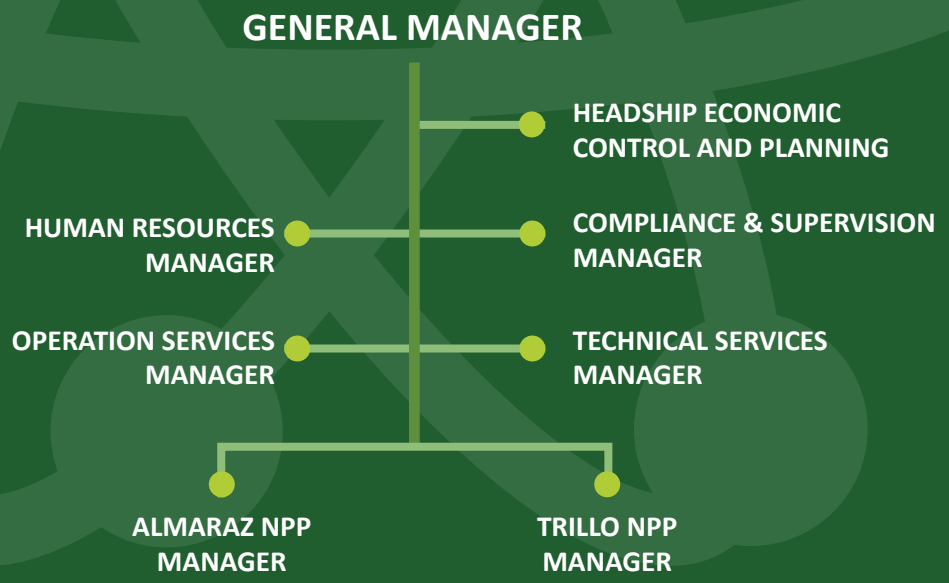


ORGANISATIONAL STRUCTURE

The structure of A.I.E. Almaraz-Trillo Nuclear Power Plants is based on the development of a single organisation, with clearly defined unitary control, and the unambiguous assignment of functions and responsibilities.

The organisation's governing body is the General Meeting of Members, which brings together the owner companies, and the Management Board, and contains representatives of both.

The current basic organisational chart for Almaraz Trillo Nuclear Power Plants AIE is detailed below:



KEY FEATURES OF THE PLANTS

ALMARAZ NUCLEAR POWER PLANT (UI-UII)

The Power Plant is located in Almaraz de Tajo (Cáceres). The land belonging to the plant occupies an area of 1,683 hectares, located in the Almaraz, Saucedilla, Serrejón and Romangordo municipalities.

The Power Plant consists of two nuclear reactors, each equipped with a cooling circuit formed by three loops. Each loop in turn incorporates one cooling pump and one steam generator. Both cooling circuits are contained in their respective containment enclosures in each Reactor building.

Steam from the generators is directed to the turbine building which houses both turbogroups in the same room, but independently. The cooling inlet is common for both installations from the cold source which consists of the Arrocampo reservoir constructed for this purpose.

During 2019, gross production of electrical energy generated by the Almaraz nuclear power plant was 16,966.11 GWh, and net production was 16,325.62 GWh.

Gross electricity production for Unit I was 8,983.99 GWh, and 7,982.12 GWh for Unit II.

The main technical characteristics of the Plant are listed in the following table:

OWNERS:

Iberdrola Generación Nuclear, S.A.U. (52.687%)

Endesa Generación, S.A.U. (36.021%)

Naturgy Generación S.L.U. 11.292%

LOCATION:

Almaraz (Cáceres)

TECHNICAL SPECIFICATION:

Reactor Type: Pressurized Water Reactor (PWR)

Supplier: Westinghouse

Thermal Power: 2,947 MWt (U-I) - 2,947 MWt (U-II)

Fuel: Enriched Uranium Dioxide (UO2)

No. of fuel elements 157

Gross Electrical Output: 1,049.43 MWe (U-I) - 1,044.45 MWe (U-II)

Net Electrical Output 1,011.30 MWe (U-I) - 1,005.83 MWe (U-II)

Cooling: Open Circuit. Arrocampo Reservoir

COMMENCEMENT OF COMMERCIAL OPERATIONS:

1 September, 1983 (UI) - 1 July, 1984 (U-II)

CURRENT OPERATIONAL AUTHORISATION:

08/06/2010 for a period of 10 years

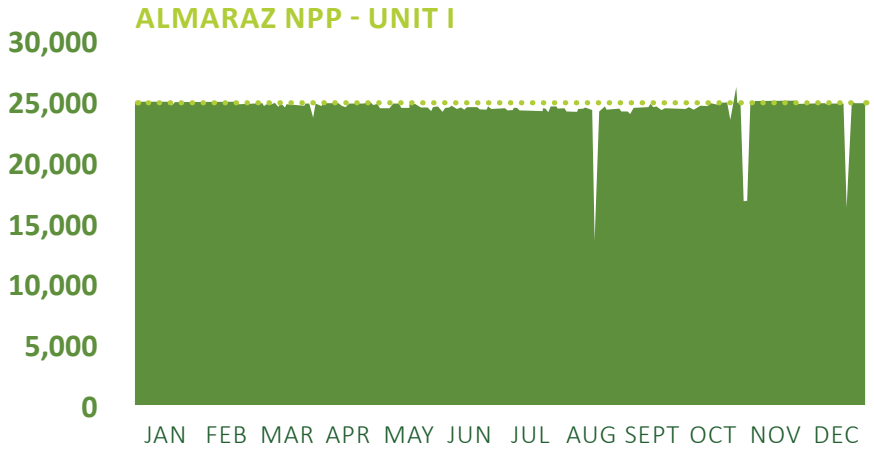
CYCLE DURATION:

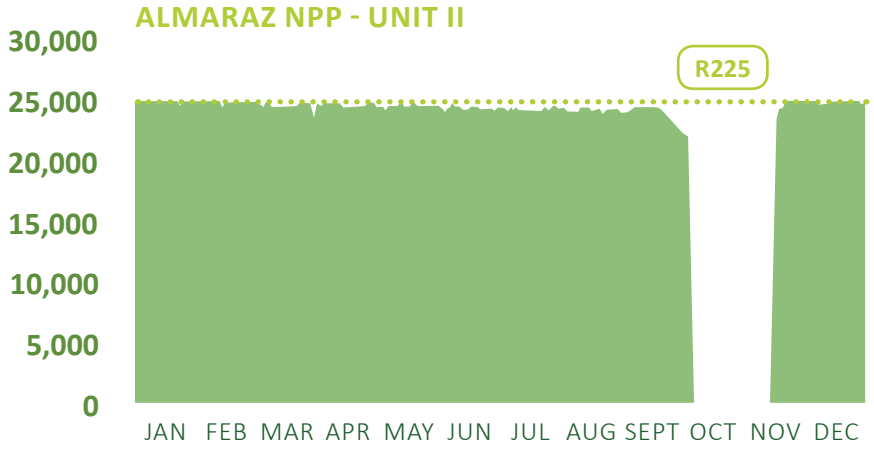
18 months both units

10%
of the national electricity production corresponds to the Almaraz and Trillo plants

The following graphs show the daily gross production of both units during 2019.

GROSS PRODUCTION DAILY 2019





TRILLO NUCLEAR POWER PLANT

Trillo Nuclear Power Plant is located in the Alcarria region, by the side of the Tajo river, in a place called “Cerrillo Alto”, in the municipality of Trillo (Guadalajara). Trillo Nuclear Power Plant is the most modern in the Spanish nuclear sector, with an installed capacity of 1,066MWe.

The Plant has a pressurised water reactor with a thermal power of 3,010 MWt and three cooling circuits employing German Siemens-KWU technology and uses enriched uranium as fuel.

Unlike the Almaraz plant, cooling is by means of two natural draft cooling towers, a water collection channel and corresponding discharge pumps to cool the condenser and raise the water to the towers. The flow of water evaporated by the towers is restored from the water intake in a catchment located in the Tagus River.

Gross production of Trillo Nuclear Power Plant from 1 January to 31 December 2018 totalled: 8,456.36 GWh, with 7,905.28 GWh net production during that period.

The main technical characteristics of the Plant are listed in the following table:

OWNERS:

Iberdrola Generación Nuclear, S.A.U. (48%)

Naturgy Generación S.L.U. 34.5%

Iberenergía, SAU (15.5%)

Nuclenor (2%).

LOCATION:

Trillo (Guadalajara)

TECHNICAL SPECIFICATION:

Reactor Type: Pressurized Water Reactor (PWR)

Supplier: KWU

Thermal Power: 3,010 MWt

Fuel: Enriched Uranium Dioxide (UO2)

No. of fuel elements 177

Gross Electrical Output: 1,066 MWe

Net Electrical Output 1,003 MWe

Cooling: Natural Draft Towers (River Tajo)

COMMENCEMENT OF COMMERCIAL OPERATIONS:

6 August 1988

CURRENT OPERATIONAL AUTHORISATION:

17/11/2014 for a period of 10 years

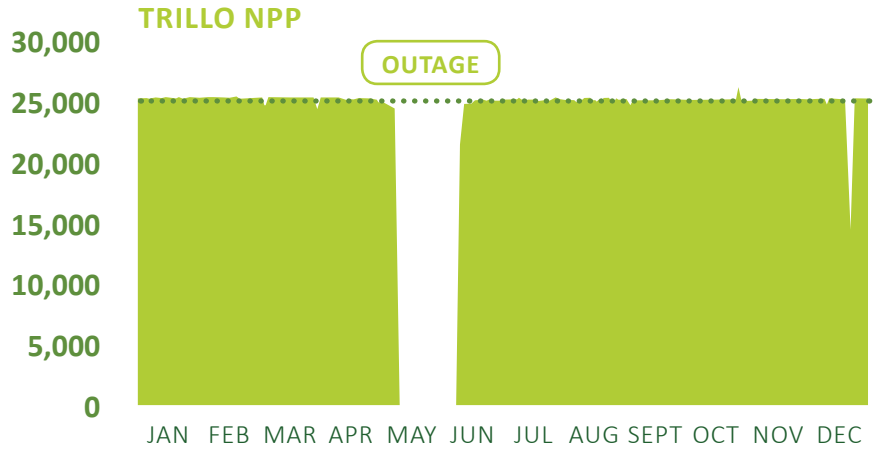
CYCLE DURATION:

12 months

44%
has generated CNAT of the total production nuclear power plant in Spain

The following graph shows the daily gross production during 2019.

GROSS PRODUCTION DAILY 2019



MISSION, VISION, KEY STRATEGIES

The Mission of the Almaraz-Trillo Nuclear Power Plants is to produce electricity in a manner which is safe, economic, respectful to the environment and ensuring long-term production by optimum operation of the Almaraz and Trillo plants.

Our Vision is to position the Almaraz and Trillo Plants amongst the best Plants benchmarked for safety, quality and costs, by employing a management model in which the development and participation of people enable higher levels of safety, productivity and efficiency to be achieved.

To achieve this mission and progress towards the goals established in the Vision, Almaraz-Trillo Nuclear Power Plants develop strategy around the following key elements:

SECURITY

OPERATING EFFICIENCY

RELIABILITY AND LONG TERM OPERATION

ORGANIZATIONAL EXCELLENCE

NUCLEAR PROFESSIONAL

ENVIRONMENTAL QUALITY MANAGEMENT

To fulfil the mission within a socially responsible framework, Almaraz-Trillo Nuclear Power Plants have established different corporate policies that establish work patterns throughout the whole organisation.

The Environmental Policy drives application of the Environmental Management System and its continuous improvement, reflecting the Board's commitment and constituting the starting principles on which the annual objectives programme is based, and in more general terms, the activities of the company in relation to the Environment.

Every organisational department has adopted the environmental policy of Almaraz - Trillo AIE, by incorporating the commitment to respect the environment into their processes.

The Policy established within the organisation is detailed below:

ENVIRONMENTAL POLICY

CNAT's environmental policy has been defined based on the purpose and context of the organisation, including the nature, magnitude and environmental impacts of its activities, products and services, and provides the reference framework for the Environmental Management System and upon which environmental objectives are established and reviewed.

It ensures the following commitments:

- To fully integrate the environmental dimension in the organisation's strategy, to ensure protection of the environment, the natural environment and pollution prevention.
- To continually improve all processes which could have environmental repercussions.
- To be aware of and evaluate opportunities and environmental risks in relation to activities performed, to ensure achievement of expected results.
- To comply with the environmental legislation in force and other voluntarily accepted requirements, whilst maintaining an attitude of ongoing adherence.
- To incorporate environmental management in all activities and levels of the organisation, including design, supply, operations and maintenance; identifying, preventing, controlling and minimising resulting environmental impacts as far as possible:

EMPLOYING raw materials and energy rationally and minimise the generation of conventional and nuclear waste and effluents.

AVOIDING inadequate waste storage and disposal of effluents, and the use of unauthorised sites.

TAKING INTO ACCOUNT the development of new technologies to improve the efficiency of the nuclear generation of electrical power, and to research environmental issues and the development of energy savings.

- To motivate and train staff to respect the environment, stimulating development of an environmental culture and communicating the Environmental Policy within and outside the Organisation.

- To report environmental actions and results in a transparent manner, maintaining appropriate channels to encourage communication with interest groups.

- To introduce and maintain updated a standard Environmental Management System.

Aligned with this Policy, The Environmental Management System at Centrales Nucleares Almaraz – Trillo A.I.E has been certified by AENOR INTERNACIONAL SAU since 2005, in accordance with international standard UNE-EN-ISO 14001 (certification no. GA-2005/0519).

This triennial certificate was last renewed in 2017, with adaptation to the updated standard UNE-EN-ISO 14.001:2015 and remains effective until 2020.

In this way, Almaraz - Trillo NPPs through the Environmental Management System identify annually the environmental risks and opportunities for the organisation that need to be addressed, considering environmental aspects, legal requirements and other voluntarily subscribed requirements, issues internal and external to the organisation, and the needs and expectations of stakeholders, and manage them by means of specific prevention and mitigation instruments for risks, and action plans for opportunities.

In addition, the environmental management policy of Almaraz - Trillo NPPs includes identifying and evaluating environmental aspects based on the life-cycle perspective, which enables those that have greater relevance on work at the plants to be identified and assessed.

ACTION PLANS

Almaraz-Trillo Nuclear Plants have continued to take extensive actions in relation to environmental issues during 2019, which are incorporated in the Environmental Management Programme, the most significant of which are detailed below:

- Reduction in the production of radioactive waste: design optimisation to minimise leakage of chemical products with impact on the generation of radioactive waste, and material declassification methodologies. There are also ongoing actions to reduce high activity radioactive waste, through a new approach to cycle management at Trillo NPP and a reduction in the volume of special waste (heads) placed in the spent fuel pool at Almaraz NPP for subsequent management as low and intermediate activity waste.

- Modifications to chillers with a view to completely eliminating the use of fluorinated gases impacting the ozone layer.

- Control of environmental impacts in the aquatic environment: implementation of a digital measurement system in the Essentials reservoir.

- Improvements to supervision of discharge conditions: installation of digital temperature recorders, adaptation of discharge parameter equipment alarms, etc.

- Improvements in the acquisition of data from the main meteorological tower and connection to the Almaraz NPP SAMO.

- Minimisation of the generation of hazardous waste linked to the reduction of the risk of spillages of chemical products: minimisation of leaks and system improvements, work on discharge lines, improvements to FP system Diesel storage tanks, etc.

- Awareness campaigns to reduce resources, generate waste and emissions, and promote good environmental practices.

ENVIRONMENTAL MANAGEMENT RESULTS

Almaraz and Trillo Nuclear Power Plants produce electricity from the fission of low enriched uranium atoms. The heat energy resulting from uranium fission is used to produce water vapour that drives the turbine that in turn moves the electrical generator.

The basis for developing an adequate and effective environmental management system is correct identification of all “elements of our activities, products and services that can interact with the environment”, that is, the environmental aspects.

Subsequent evaluation of the impact of these aspects, and the establishment of control measures for their management, is carried out by Almaraz - Trillo AIE to ensure the environment is protected.

The main aspects are grouped into the categories described below:

MATERIAL RESOURCE CONSUMPTION

This Environmental Issue category refers to the use of abiotic resources, whether by the main power generation production process or by auxiliary services.

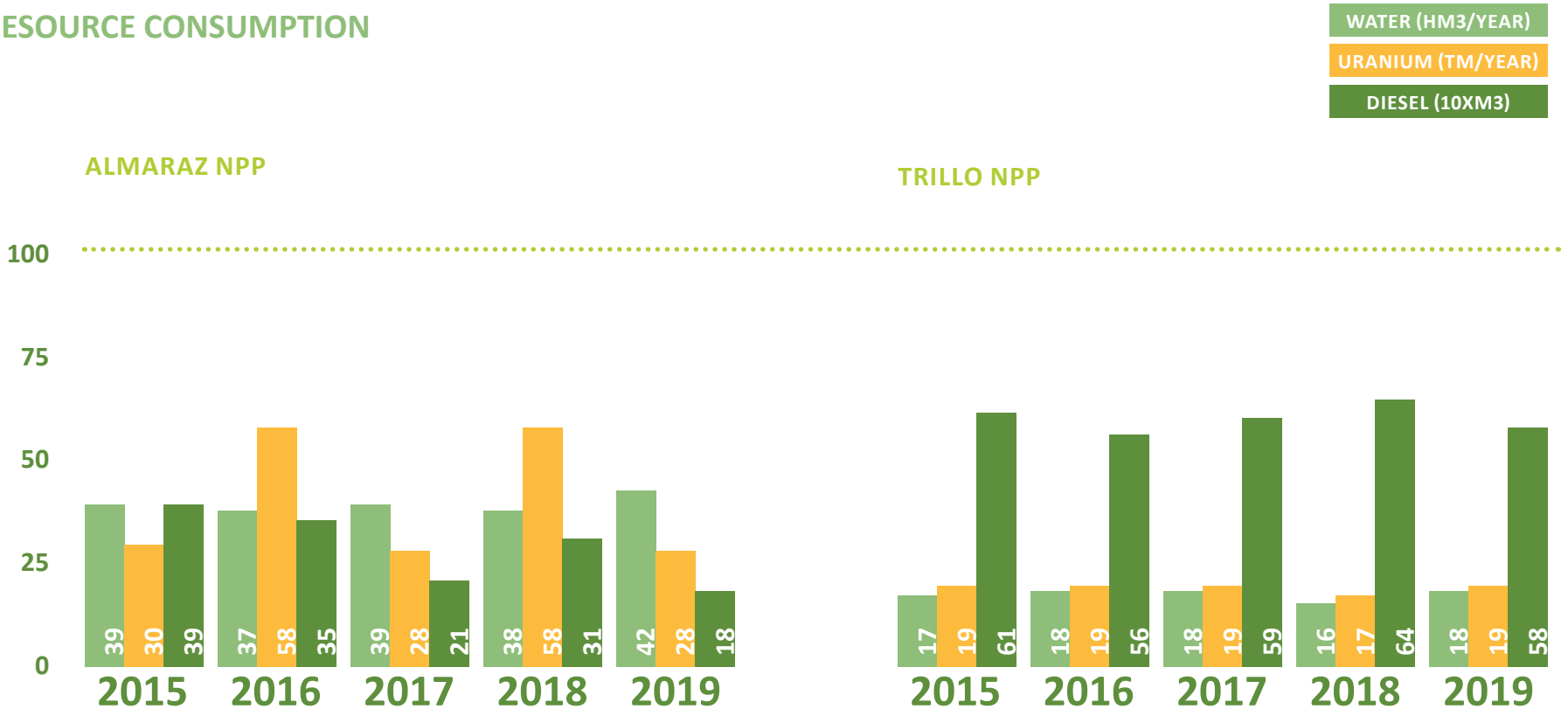
WATER

ENRICHED URANIUM

DIESEL OIL

CHEMICALS

RESOURCE CONSUMPTION



Water consumption

Nuclear power plants need a source of water as a coolant in the primary circuit to produce the steam condensation that when expanding in the turbine, moves the generator and produces electrical energy, with a small proportion being consumed in the process by evaporation, and the rest returned to the natural receiving environment.

Water consumption is directly related to the number of operational hours of the Power Plant and therefore to the production of electrical energy. Also, water consumption depends not only on the cooling needs and the operating regime of the Plants, but also on the weather conditions, (mainly temperature and humidity) as, during the summer months, the increase in temperatures and the increase in associated evaporation result in the consumption of a greater volume of water.

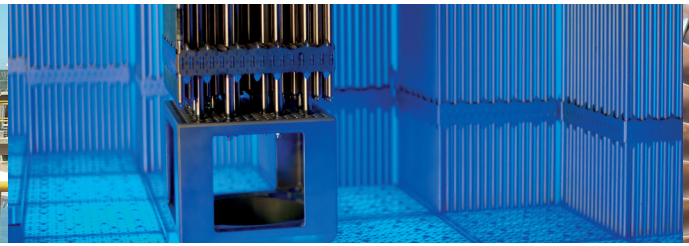
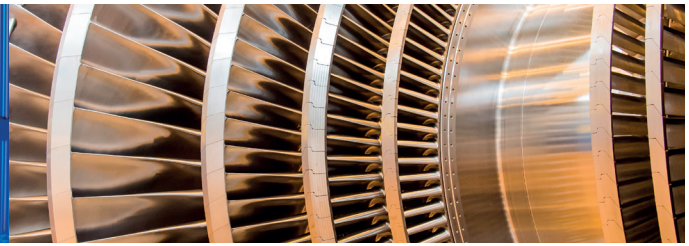
Both plants are supplied with water for cooling from the Tagus River. For this purpose, they hold water catchment concessions granted by the Tagus Hydrographic Confederation that restricts the volume of water collected. These limits have been strictly adhered to in 2019.

Also, there is an additional consumption of water for consumptive uses, and the volume captured is also limited by concession, and as in the case of cooling, the requirements have been met in 2019. Consumptive uses are irrigation, FP, sanitary uses and replenishing circuits. In the case of Almaraz NPP the latter includes the contribution to compensate evaporation in the turbine cooling system towers.

Both plants have a discharge point to the Tagus River, through which water used but not consumed is returned to its environment.

Effluents from plants are treated prior to discharge to the receiving environment, and the physico-chemical parameters are exhaustively monitored.

The totals consumed in the year for the two plants and uses detailed above (cooling and consumptive purposes) are shown below.

WATER CATCHMENTS		QUANTITY 2019 (m^3)
		TRILLO NPP
COOLING NEEDS	(EVAPORATED: Tajo river catchment - Discharge)	17,736,308
CONSUMPTIVE USE	(Catchment river Cifuentes)	73,840
		ALMARAZ NPP
COOLING NEEDS	(EVAPORATED Calculated Arrocampo + TEVA)	42,130,893
CONSUMPTIVE USE	(Tajo river raw water catchment)	997,039[1]

Uranium consumption

The fuel used in power plants to produce electricity is enriched uranium introduced into the reactor. The consumption of uranium is directly related to the number of hours of operation of the Power Plant.

The uranium is conditioned to form fuel elements that are inserted into the nuclear reactor vessel. The main objective for the design of the core (determining the positions of the elements within the reactor) is safety and reliability, and compliance with licensing parameters and criteria. Fully respecting this basic premise, we seek to optimise the consumption of uranium, extracting as much energy as possible with the chosen design.

Diesel consumption

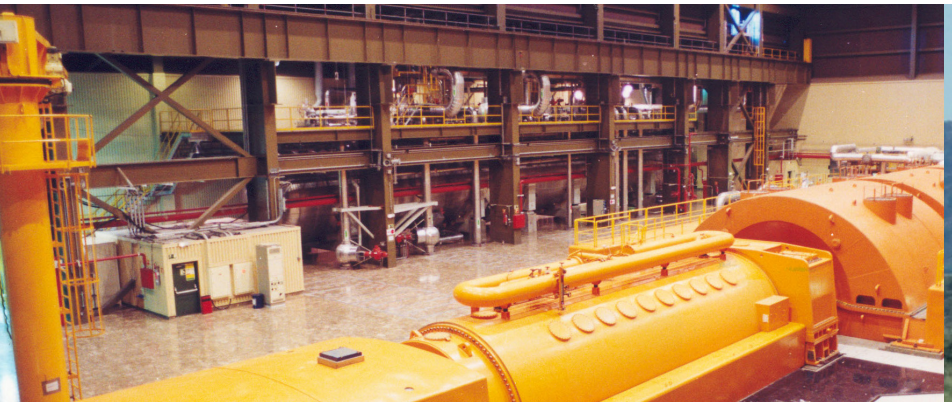
Diesel B is used at both plants, mainly by the Emergency Electricity Generation System (Diesel motors which come into operation in case of the total loss of the off-site AC supply), auxiliary steam on shut-down (boilers only in the Trillo Nuclear Power Plant).

Diesel A is also used, mainly by company vehicles and for fire-fighting field practices.

The specific consumptions of Diesel in 2019 are shown below:

DIESEL CONSUMPTION	QUANTITY 2019 (m^3)	
	ALMARAZ NPP	TRILLO NPP
DIESEL B	144.8	528.0
DIESEL A	39.2	51.5

1 The evaporated category that appears in the table for the Trillo Plant originates in the cooling towers circuit, and in the case of Almaraz, in the Arrocampo reservoir and TEVA towers also used to cool it



Chemical consumption

Almaraz and Trillo Plants have various storage facilities in their facilities for **chemicals**, which are used to ensure the quality and purity of the cooling circuit and of the cycle top-up water, with those consumed the most being: sulphuric acid, sodium hydroxide, sodium hypochlorite, and ammonia.

Consumption of these products is directly related to the amount of water consumed and captured, which in turn requires greater control of chemical parameters for its conditioning.

Almaraz -Trillo NPPs work to ensure efficient use of materials, minimising the generation of waste and environmental pollution. This is evident in the implementation of environmental objectives as detailed and also in the section on waste and consists of the reduction of leaks of chemicals through the introduction of improvements at different points of the plant.

Consumption of the main chemicals used in the plant, expressed as quantity of pure product, is detailed below.

CHEMICAL CONSUMPTION	QUANTITY 2019 (T pure product)	
	ALMARAZ NPP	TRILLO NPP
SULPHURIC ACID	133.98	4,596.00
SODIUM HYDROXIDE	36.81	37.27
SODIUM HYPOCHLORITE	21.80	183.33
AMMONIA	119.43	0.19
OILS	23.96	19.87

From the previous table, it should be noted that there is significant consumption of sulphuric acid at Trillo NPP, destined to the cooling towers circuit, to maintain the chemical conditions it requires (to prevent calcium carbonate incrustations). There is also significant consumption of sodium hypochlorite used as a biocide by the same system.

With regard to ammonia, the consumption detailed for Almaraz Nuclear Power Plant is due to its use as an alkalinizer in the secondary circuit (water - steam). The characteristics of this circuit at the Trillo Plant make a similar dosage unnecessary.

ENERGY CONSUMPTION

Direct energy consumed within the operating limits of the plants comes from primary sources: mainly uranium, and Diesel.

Another intermediate form of energy is generated from uranium: electrical energy.

Part of this electrical energy produced by both plants is used for own energy consumption (as almost all the power plant equipment and activities need to consume electricity for their daily operation), and the rest of production is sold to the Energy Market.

Direct energy consumption is detailed below:.

ENERGY CONSUMPTION[2]	QUANTITY 2019 (GJ)	
	ALMARAZ NPP	TRILLO NPP
FUEL: URANIUM:	185,084,836	92,251,156
FUEL: DIESEL B	5,325.0	19,410.9
FUEL: DIESEL A	1,439.4	1,894.1
AUXILIARY ELECTRIC POWER (SELF-CONSUMPTION)	2,305,768	1,983,863

CONVENTIONAL ATMOSPHERIC EMISSIONS

Emissions derived from combustion activities

In the process of generating nuclear originated electricity, no greenhouse gases or any other combustion products are produced that contribute to increasing the greenhouse effect.

2 The actual annual consumption of uranium is expressed as the thermal energy harnessed from the total produced in the reactor and transformed into electrical energy, considering an average yield of 33%.
Auxiliary electric energy for self-consumption is determined as the difference between the gross energy and the net energy produced by the power plants. GJ Conversion: 1 kWh = 0.0036 GJ.
Lower calorific value source of Diesel fuel: MITECO, "Emission factors: Carbon footprint registration, compensation and carbon dioxide absorption projects" April 2020 (Version 13).

However, due to the use of Diesel B as fuel, mainly to operate auxiliary boilers and emergency Diesel groups, atmospheric pollutants are generated, including a small volume of greenhouse gases that are released into the atmosphere. Emissions from transport associated with the use of vehicles and those associated with fire-fighting training are also taken into account.

It should be noted that the operating regime of these combustion sites is not continuous as during normal operation, Diesel generators are started-up only to perform periodic tests or maintenance work.

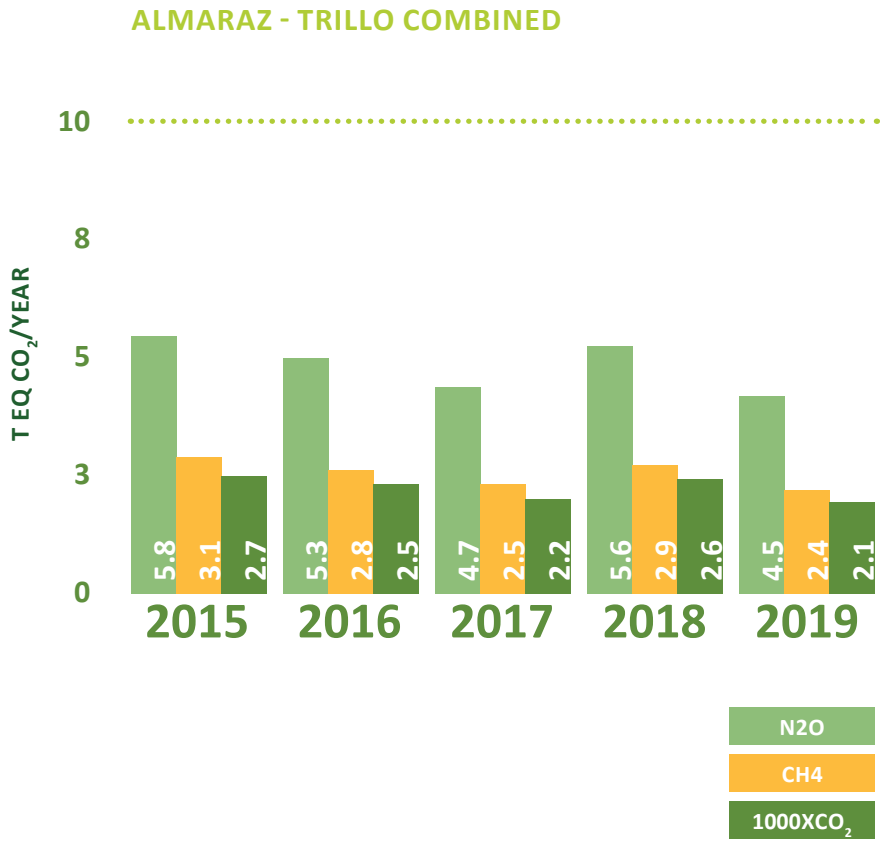
Also, the auxiliary boilers (Trillo NPP only) are only normally operated during refuelling to supply auxiliary steam.

Emissions information is reported below following the recommendations of the GRI (Global Reporting Initiative) for the preparation of sustainability reports.

The following graph shows an estimate of greenhouse gases emissions derived from the combustion of Diesel (CO_2, CH_4, N_2O), expressed in CO_2 equivalent tons, (teq CO_2), using the described methodology, and the emission factors described in the 2006 Guidelines of the Intergovernmental Panel on Climate Change (IPCC) for national inventories of **greenhouse gases**[3].

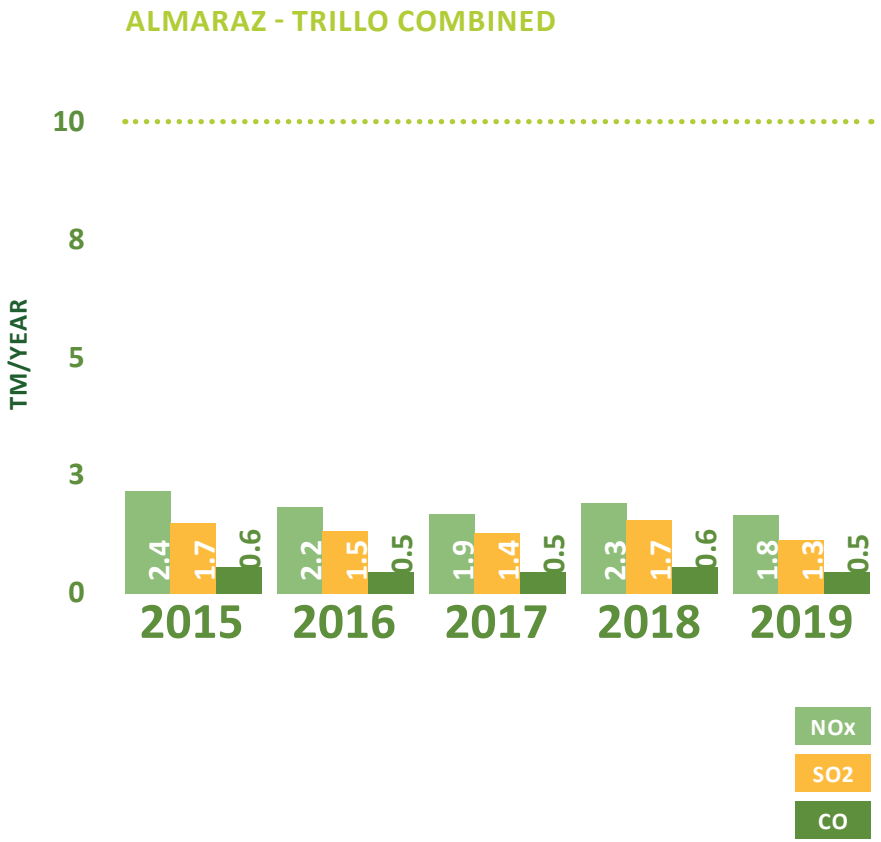
As basic indicators of total air emissions, the annual amounts of sulphur dioxide (SO_2), nitrogen oxides (NOx) and CO emitted into the atmosphere have been determined, derived from the consumption of Diesel A and B expressed in tons.

EMISSIONS OF GREENHOUSE EFFECT GASES
(AUXILIARY AND EMERGENCY EQUIPMENT, VEHICLES AND FP)



3 The conversion factors used to express the emissions of these greenhouse gases in CO_2 equivalent tons are those published by the IPCC in the Fifth Assessment Report on Climate Change (2013) and correspond to the potential global warming values of CH_4 and N_2O with respect to CO_2 for a 100-year horizon.

EMISSIONS TO THE ATMOSPHERE
(AUXILIARY AND EMERGENCY EQUIPMENT, VEHICLES AND FP)



Emissions of fluorinated gases

Substances that reduce the ozone layer have a marginal presence at Almaraz - Trillo NPPs and are located in some of the cooling systems that still contain HCFCs. These items of equipment and systems are maintained in accordance with the provisions of current regulations.

In compliance with Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, for several years the aim of Almaraz - Trillo NPPs has been to replace items of equipment at both plants that contain HCFCs with others which use HFCs type gases.

Greenhouse gases are present in the HFCs in cooling, air conditioning, FP equipment, and SF_6 is present in high voltage switches. The only emissions to the atmosphere originated by these products are those derived from possible losses. For this, both Almaraz and Trillo NPPs carry out preventive and corrective control and maintenance to avoid leaks in accordance with current regulations.

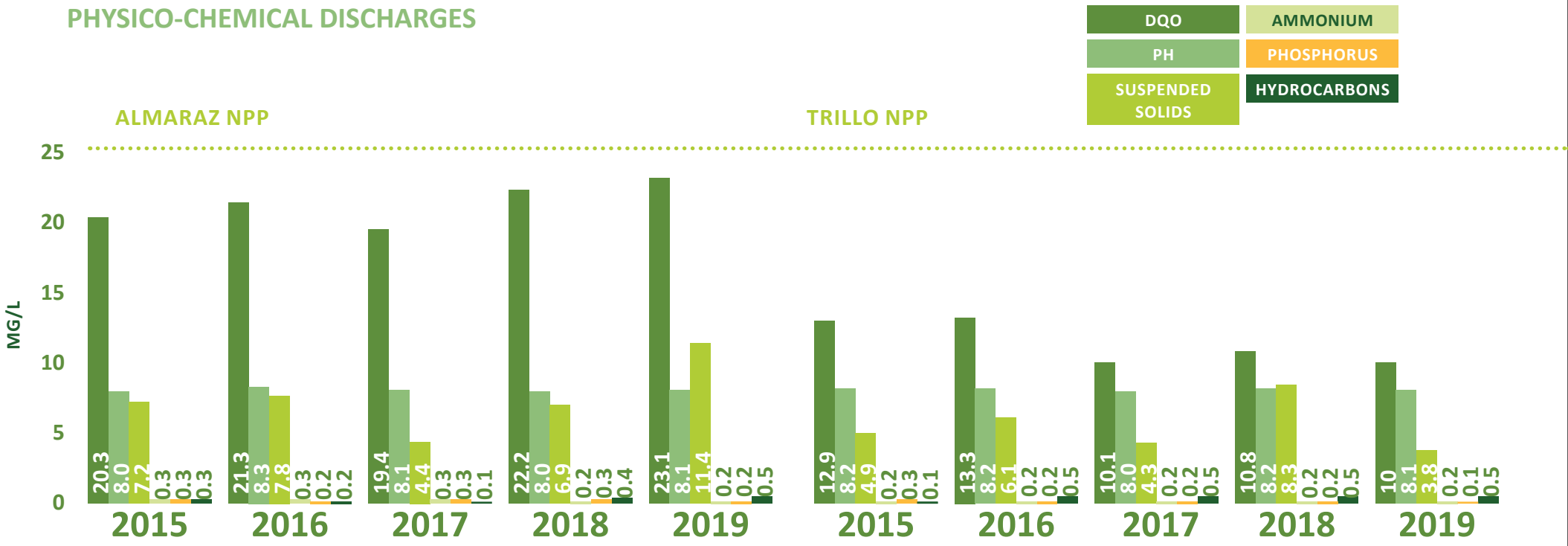
CONVENTIONAL LIQUID EFFLUENTS - CHEMICAL PHYSICAL DISCHARGES

To ensure the correct physical-chemical quality of the water before it is discharged into the receiving environment, both plants employ waste water treatment plants and a collection network for all liquid effluents, with exhaustive monitoring of the physical and chemical parameters.

This discharge is also regulated by the Tagus Hydrographic Confederation through the corresponding authorisation process. Monthly samples are taken by a Control Authority, for analysis and verification of the quality of the water discharged, so ensuring that there is no significant variation between the capture and discharge values, in compliance with the requirements of the Authorisation.

The following graphs show the evolution of the main parameters limited by discharge authorisations, which are sent monthly to the Tagus Hydrographic Confederation.

PHYSICO-CHEMICAL DISCHARGES



RADIOLOGICAL EMISSIONS OF LIQUID AND GASEOUS EFFLUENTS

External radiological emissions, both atmospheric and liquid, are restricted by the Operating Authorisation and are controlled in accordance with the regulations established by the Nuclear Safety Council.

External doses resulting from effluents from both plants, either as liquids or gas emissions to the atmosphere, remain at very low levels, demonstrably less than the limits established by the Nuclear Safety Council, and they reflect the values in the corresponding External Doses Calculation Manuals - EDCMs. These doses are insignificant compared to those originated by natural background radiation, and the associated graphs show the year-on-year changes.

Natural background radiation is of the order of 700 to 1200 µSv/year in areas surrounding the sites, while radiation from doses resulting from operation of the Plants lies in the range 50 – 100 times lower, in the most unfavourable situation. The true calculation of doses, taking into consideration human geography and the actual activities taking place close by, results in values even less than those referred to, which means the contribution to environmental radiation from operation of the Power Plants is insignificant.

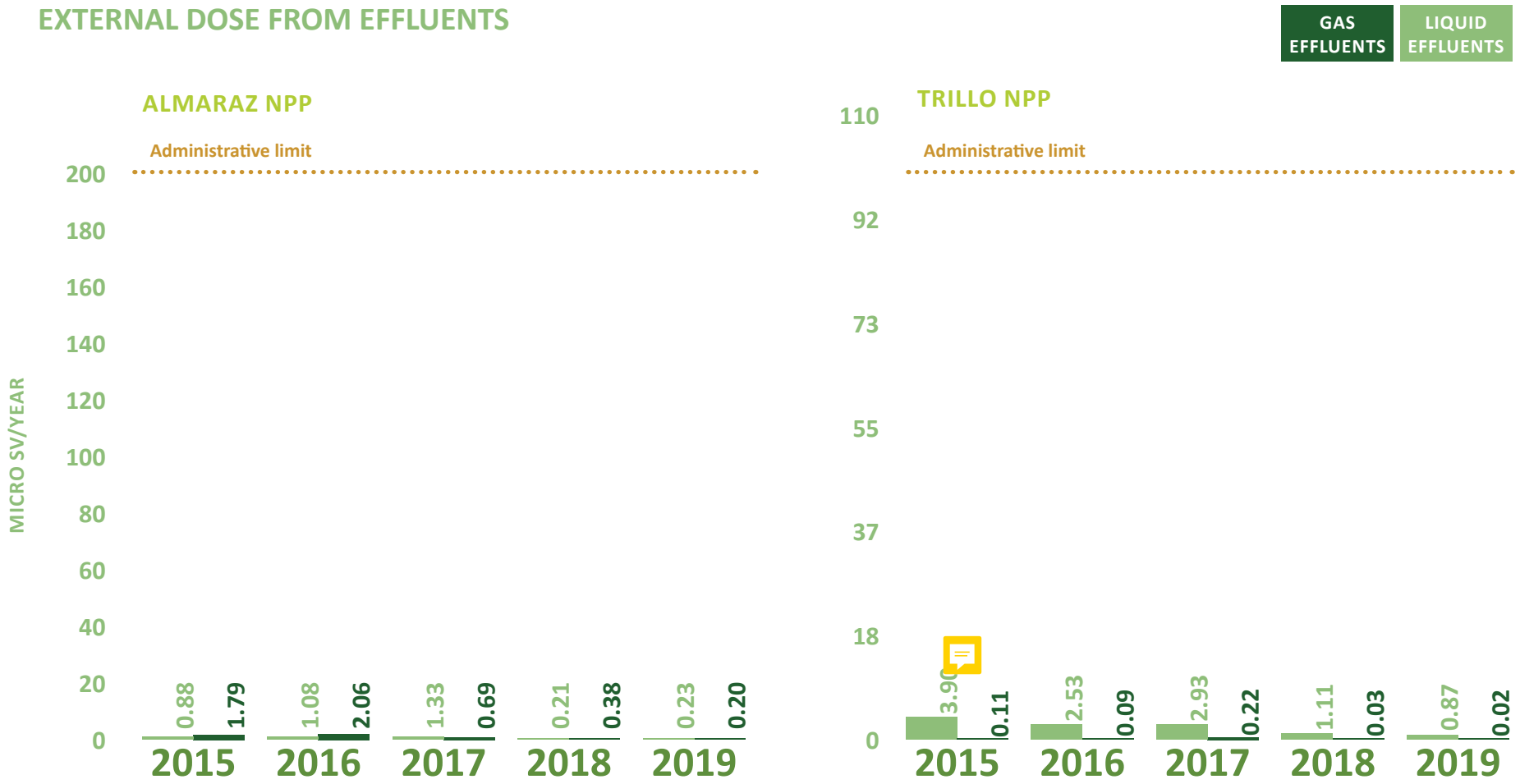
The plants run Environmental Radiological Surveillance Programmes to detect possible radiological impacts on the environment.

Doses measured during environmental radiological surveillance

Dose value trends, measured in the environment of both plants by the corresponding environmental radiological surveillance programmes are recorded, and the comparison of the measurements taken in 2019

at Almaraz and Trillo NPPs with values from the Nuclear Safety Council REVIRA programme, indicate that the levels for our sites are even less those found in the natural surroundings in several places.

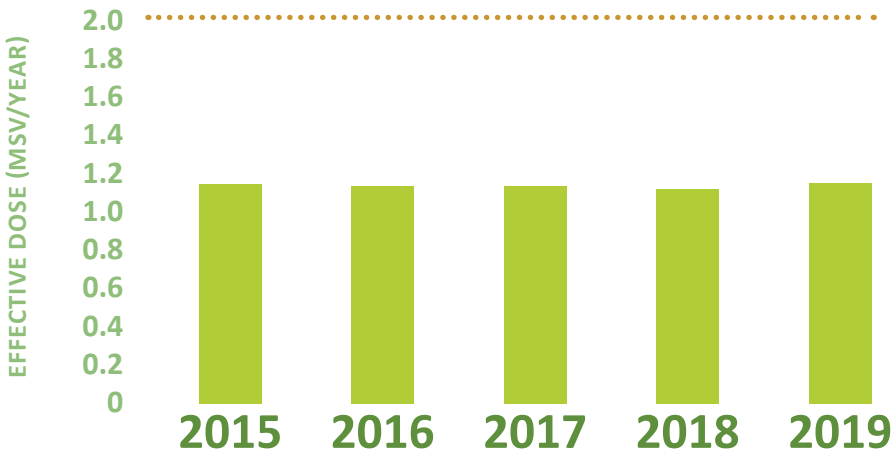
EXTERNAL DOSE FROM EFFLUENTS



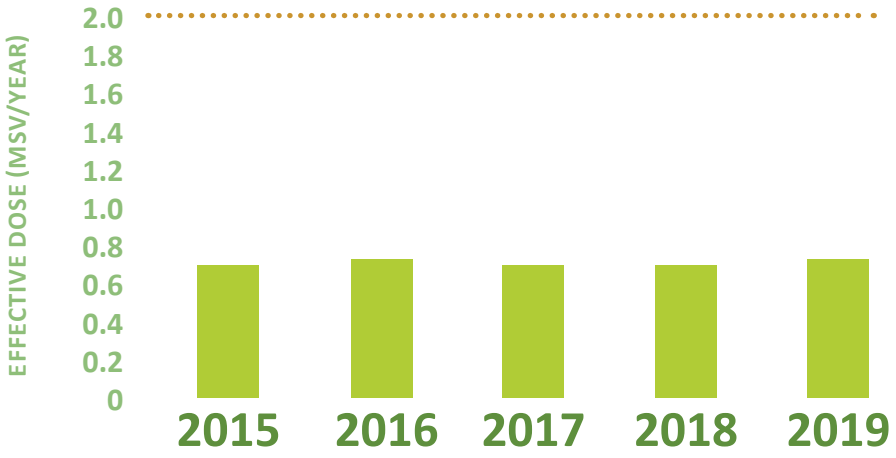
ENVIRONMENTAL RADIOLOGICAL MONITORING

ENVIRONMENTAL DOSE

ALMARAZ NPP

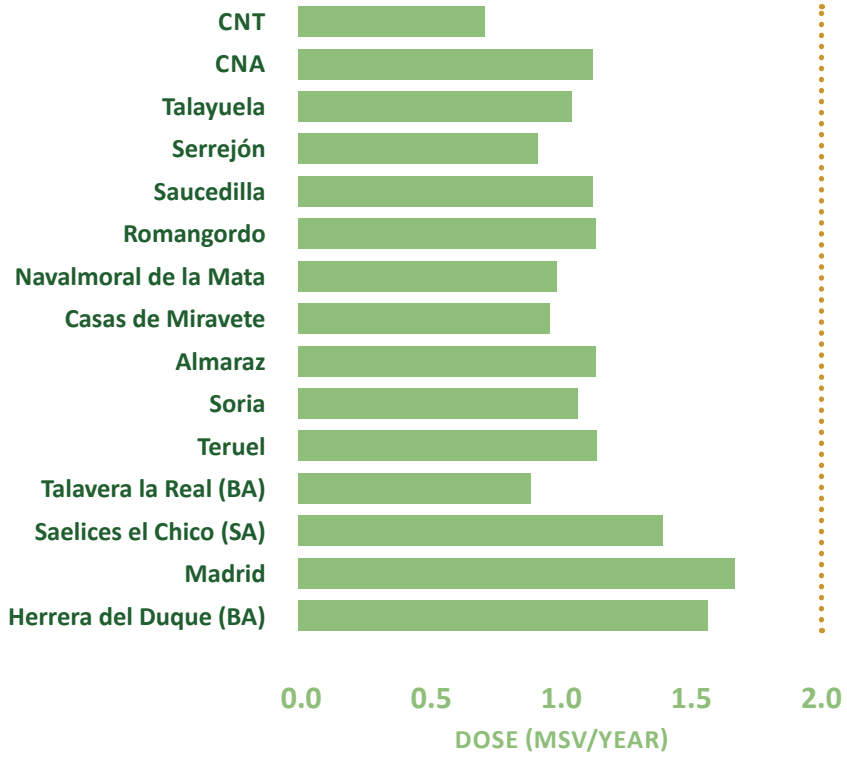


TRILLO NPP



ENVIRONMENTAL DOSIMETRY: ALMARAZ - TRILLO

COMPARISON WITH REVIRA-CSN & RAREx-J.EXTREMADURA STATIONS



GENERATION OF WASTE MATERIAL

Almaraz and Trillo Nuclear Power Plants, as a consequence of their activity, generate the following types of waste: hazardous, non-hazardous and radioactive of low and intermediate activity (LILW), and very low activity (VLLW), which are identified, stored and managed in accordance with the current legislation and the provisions of the specific procedures of the Environmental Management System.

In addition to the waste described, high activity radioactive waste is generated during plant refuelling periods. After being replaced by new fuel, approximately one third of the elements housed in the reactor vessel are removed for transfer to spent fuel storage pools.

High Activity Waste

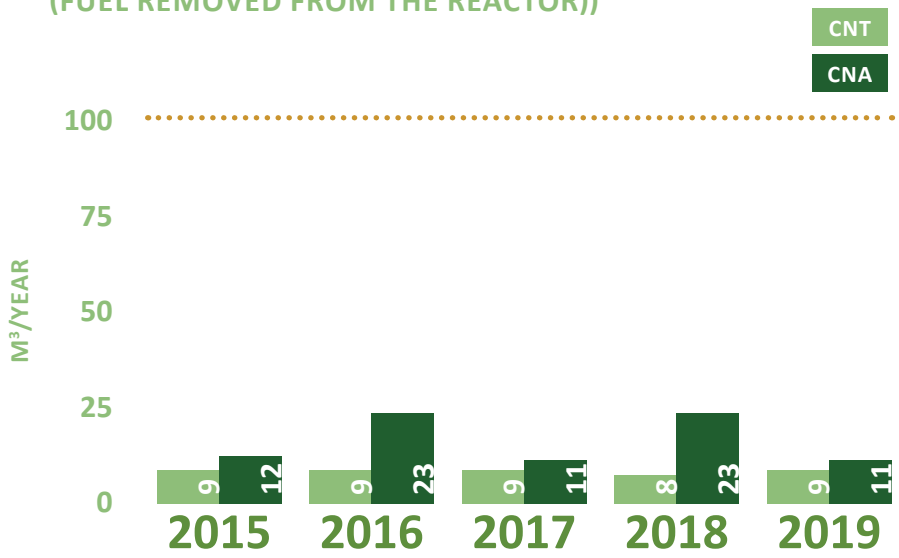
In 2019 a total of 100 spent fuel elements were removed from the reactors: 40 fuel elements from Trillo NPP, and 60 elements from Unit II at Almaraz NPP which were then replaced with new elements. The volume occupied by the recovered elements from both plants was approximately 20 m^3.

The spent fuel is stored inside the installations, in the corresponding pools located in the controlled area. At 31 December, they were 1,512 spent fuel elements stored corresponding to Unit I at Almaraz NPP, 1,564 to Unit II, and 556 from Trillo NPP. In addition, both Plant have an Independent Spent Fuel Storage Installation (ISFSI), which is used for dry storage inside dual usage storage-transportation containers.

At the end of 2019, a total of 736 elements were stored in 34 containers at Trillo and 64 spent fuel elements in 2 ENUN-32P containers in Almaraz NPP.

The graph shows the generation of spent fuel over time at both Plants. The highest values for Almaraz NPP correspond to when the period of refuelling of the two units coincides in the same year.

GENERATION OF HIGH ACTIVITY RADIOACTIVE WASTE
(FUEL REMOVED FROM THE REACTOR))



Very Low Activity and Intermediate and Low Activity Waste

This type of waste originates as a result of plant operations and maintenance, through activities carried out in the controlled zone. This also applies with regard to the spent filtration elements and purification outputs from cooling and other systems, materials resulting from installation maintenance work, overalls and protective clothing.

Radioactive waste, based on the specific activity (concentration) of its radionuclides, is classified as LILW or VLLW. All this waste has been optimised since operations began at the plant. Work procedures and facilities for treating and conditioning this waste using the latest technology have been implemented, and an environmental culture has been established amongst all workers at the plant for the reduction, segregation and recycling (when possible) of all residual materials. As a result of the segregation measures implemented in recent years, the content of radioactive isotopes in waste is being reduced and its concentration is decreasing, changing its rating.

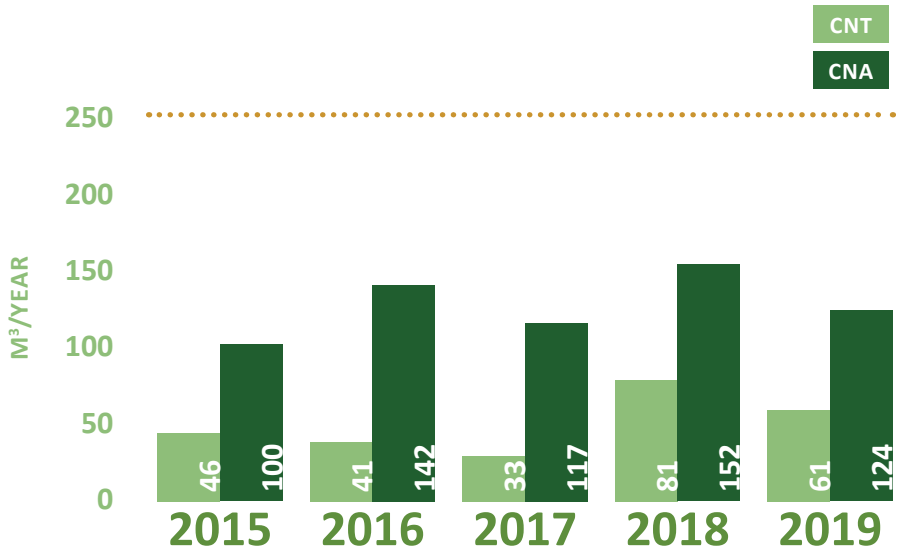
Intermediate and Low Activity Waste is processed within the Plants themselves, with the objective of preparing it for final storage. There is a specific treatment process for each type of waste material, depending on its origin:

- **Heterogeneous solids**
- **Drainage, from evaporator concentrate**
- **Pressed solids**
- **Spent ionic exchange resins**
- **Used filters**
- **Evaporator concentratesr**

During 2019, the Almaraz Plant generated a total of 48.40 m^3 of Low and Intermediate Level Waste (LILW), and 76.04 m3 of Very Low Level Waste (VLLW). In the case of the Trillo Plant, it was 48.62 m3 and 12.54 m^3 respectively. The graph shows the joint production trends for these waste materials.

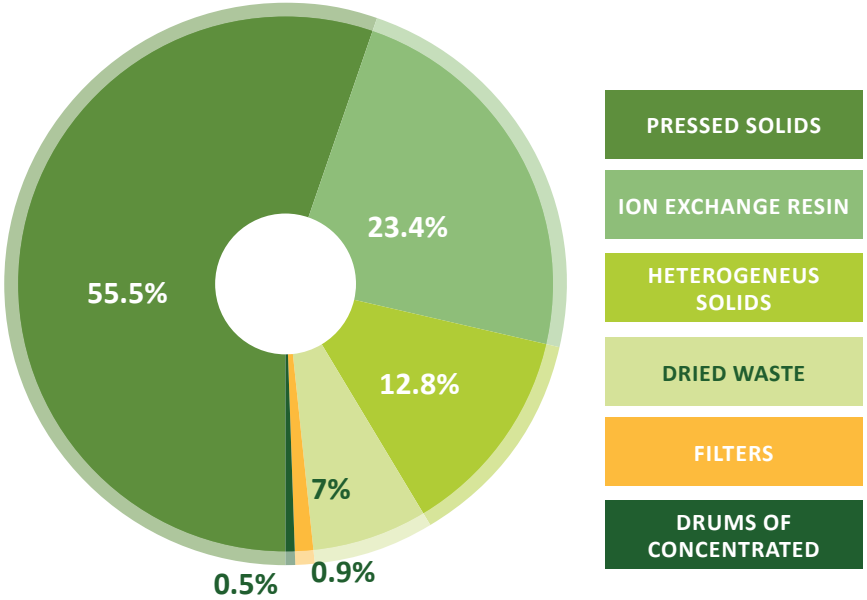
The diagram shows the proportional distribution of the different categories.

GENERATION OF LOW AND INTERMEDIATE RADIOACTIVE WASTE, AND VERY LOW ACTIVITY



DISTRIBUTION OF INTERMEDIATE AND LOW RADIOACTIVE WASTE, AND VERY LOW ACTIVITY GENERATED IN 2019

(ALMARAZ - TRILLO COMBINED)



Low and Intermediate Level Waste material, after it has been conditioned for the purpose of preparing it for final storage, is stored temporarily inside the Plants, and is routinely removed by the National Radioactive Waste Company (Empresa Nacional de Residuos Radiactivos - ENRESA) to sites within installations provided for storage in El Cabril (Córdoba).

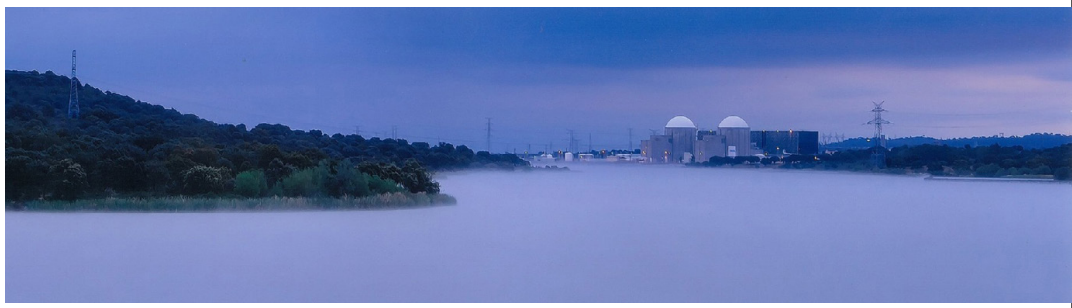
During 2019, several dispatches were made to these installations, totalling 101.20 m^3 from Almaraz and 91.96 m3 from Trillo.

Production of Hazardous and Non-Hazardous Waste Materials

Nuclear power plants also routinely generate, industrial-type waste, non-radioactive, due largely as a result of preventive maintenance of machines and conventional equipment: replacement of oils, equipment sludge cleaning, filters, containers, etc. All these activities result in the generation of different categories of Hazardous and Non-Hazardous wastes.

Exceptionally, waste may also be generated as the result of work and design modifications, and unusual corrective maintenance activities, which cause fluctuations in the time series.

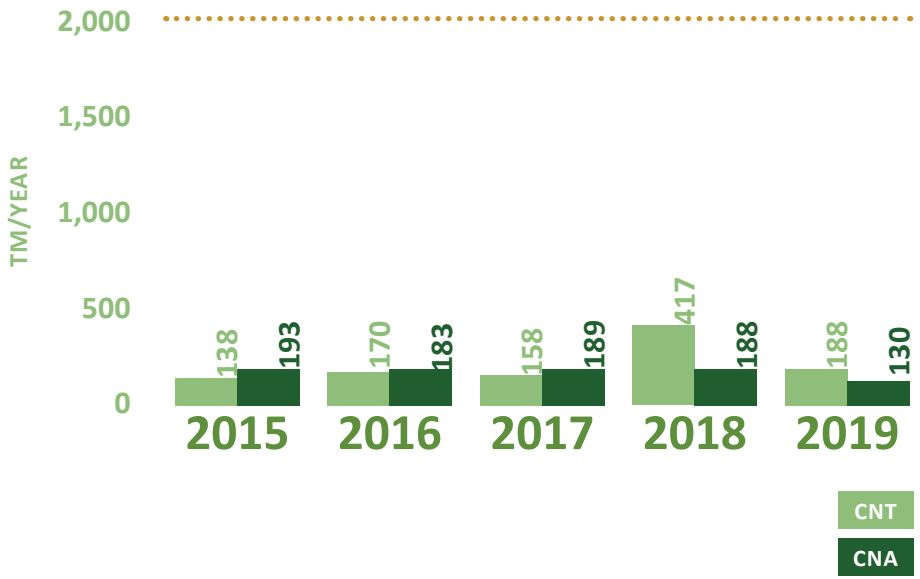
Consistent with the commitment to minimise the waste generated, it is selectively collected to separate out recyclable materials, so that waste that cannot be reused and/or recycled is directed for disposal (landfill). Plant personnel receive training and information on the segregation at source of the waste generated for this purpose.



Hazardous waste is managed following guidelines established in the corresponding Hazardous Waste Minimisation Studies at each of the Plants.

The **Hazardous Waste** trend is shown below:

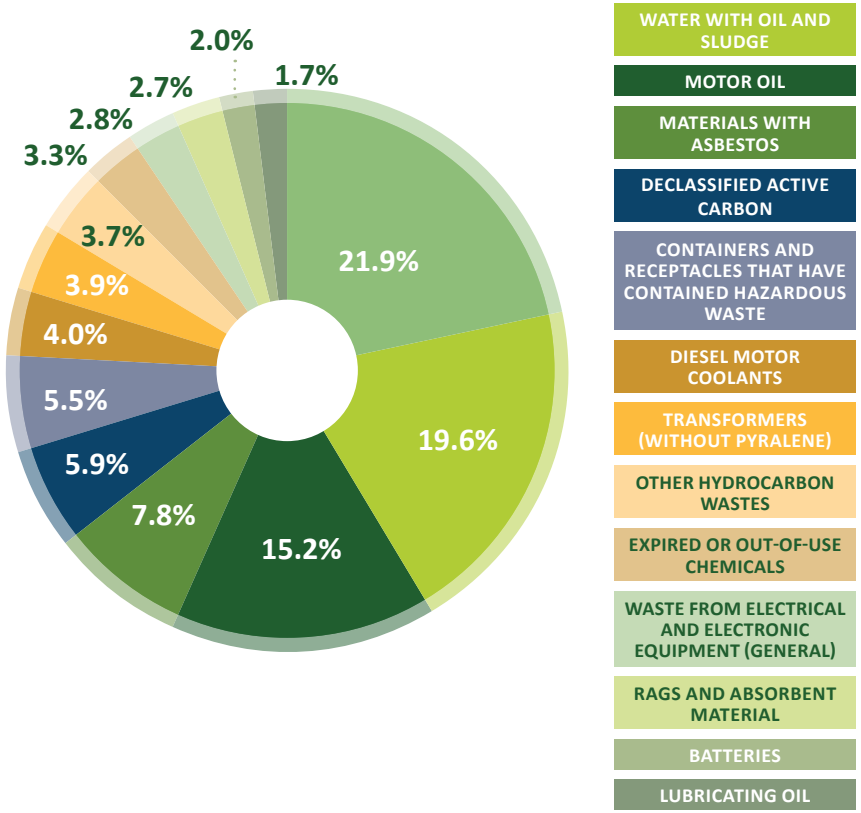
GENERATION OF HAZARDOUS WASTE



The following graph shows the relative proportions of different types of hazardous waste in 2019.

DISTRIBUTION OF THE MAIN HAZARDOUS WASTE GENERATED IN 2019

(ALMARAZ - TRILLO COMBINED)

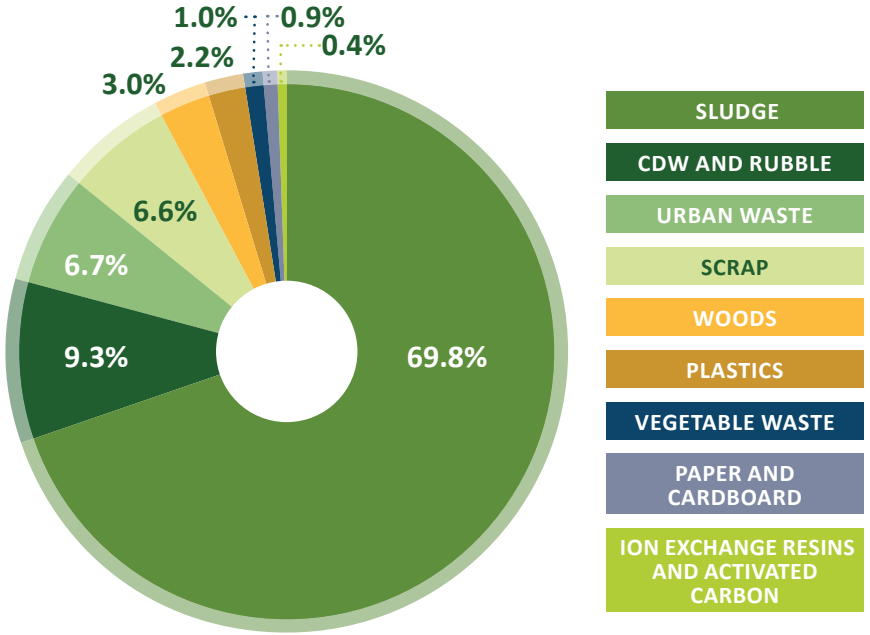


With regard to **Non-Hazardous Waste**, it should be noted that the most sensitive category in relation to extraordinary activities carried out at the Plant, is the generation of debris and construction and demolition waste (CDW), as a result of the design modification work which occurred during the year.

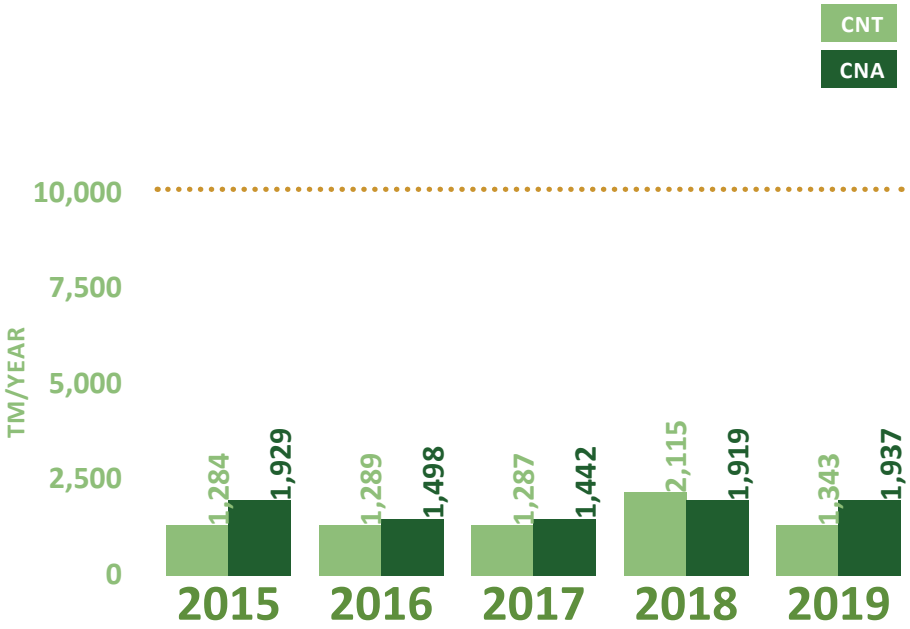
Another important contribution is the generation of sludge from water pretreatment at both plants, which has become a routine source of non-hazardous waste generation, following the commissioning of new pretreatment plants at Almaraz and Trillo NPPs in 2012, as the following graph shows proportionally compared to other categories.

DISTRIBUTION OF NON-HAZARDOUS WASTE GENERATED IN 2019

(ALMARAZ - TRILLO COMBINED)



GENERATION OF NON-HAZARDOUS WASTE



BIODIVERSITY

Almaraz Nuclear Power Plant is located in the Extremadura community, in the region of Campo Arañuelo (Caceres) on a site bordered by the Tajo and Tiétar rivers.

Almaraz Nuclear Power Plant occupies an area of 428 hectares, excluding that flooded by the Arrocampo reservoir. The area used for Plant operations is approximately 1,123,000 m^2, which incorporates the different industrial areas of the plant. The rest of the land is mostly mountainous terrain.

The climate in the area is continental, with low and erratic rainfall, making the environment an area with more pastures than crops, and pasture lands and irrigation are the two most common forms of land use. The proximity to large numbers of environmental protection areas is notable, including the Monfragüe National Park LIC (Site of Community Importance) and its ZEPA (Special Protection Area) and Environment Pastures alongside the Arrocampo.

Trillo Nuclear Power Plant is located in Castilla La Mancha, in the Alcarria region (Guadalajara), alongside the course of the Tagus River.

The Plant has a surface area of approximately 554 ha. The surface area used for Plant activity is approximately 870,000 m^2, which correspond to different industrial areas of the plant, and the rest is mostly mountain terrain.

The Alcarria has a continental Mediterranean climate, typical of inland areas of the Iberian Peninsula, with strong thermal oscillations, very hot summers and very cold winters and little rain or frost presence. The plant site is located in the vicinity of the LIC and ZEPA in the Alto Tajo Natural Park.

Flora and fauna

In accordance with the precautionary principle, Almaraz - Trillo NPPs are committed to understanding the environment, and participate in different studies to better understand the behaviour of species in the habitats in which it operates through an Agreement with the Ecology Area of the UEX Faculty of Sciences, to carry out scientific-technical work on monitoring spatio-temporal structures and successions of plant populations in the environment of Almaraz NPP, and the bird populations that use the Arrocampo reservoir.

They are also collaborating with the University of Extremadura for ornithological study of the Arrocampo ZEPA of the environment to carry out various improvement and local development projects.

In addition, since the Arrocampo reservoir was filled in 1978, a Monitoring and Control Plan was developed that includes limnological and ichthyological studies. These studies have been carried out without interruption to date throughout the Arrocampo and Torrejón reservoirs, in accordance with their corresponding authorisations.

More information about these studies is provided in the section of Environmental Monitoring Programmes.

LEGISLATION

The installations that make up Almaraz – Trillo A.I.E. are subject to compliance with a broad regulatory framework, and in addition administrative authorisations are required to exercise the activity, waste water discharge, emissions into the atmosphere, generation of waste, etc.

Centrales Nucleares AIE guarantees legal compliance of its installation, through application of a system that ensures identification and compliance with applicable environmental legislative requirements.

The Environmental Management System employs a computerised tool and legislative database, updated monthly, which includes all the legal or voluntary provisions of a conventional type typified in the scope of applicability in Almaraz-Trillo NPPs, with the corresponding detail requirements extracted.

The legislative compliance verification process is performed every six months, and this is discussed by the A.I.E. Board in the Environmental Committees, and during the Annual Review of the Environmental Management System by the Board.

The emergence of the following legislation had particular relevance for our activities in 2019:

- **Regulation 2019/521 of 27 March 2019** amending, for the purposes of its adaptation to technical and scientific progress, Regulation (EC) no. 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures.

- **Law 10/2019, 11 April,** on environmental protection for the Autonomous Community of Extremadura.

- **Regulation (EU) 2019/1021, of 20 June 2019** on persistent organic pollutants.

- **Amendments to Annexes A and B of the European agreement on International Transport of dangerous goods by road (ADR 2019).**

- **Order (Extremadura) 20 May 2019** establishing the High Danger Period for forest fires for the INFOEX Plan and regulating the use of fire and activities that could cause fires during that period in 2019.

- **Resolution of 08/05/2019** of the Directorate General for the Environment of the Extremadura Council by which the Plan for the Prevention of Reduced Forest Fires for Almaraz NPP is renewed.

- **Decree 134/2019,** of 3 September, which regulates the implementation of certain forestry actions within the ambit of the Autonomous Community of Extremadura

and the Registries of Cooperatives, Companies and Forest Industries and Protecteed Forests of Extremadura.

- **Order of 15 October 2019** which establishes the period of danger under forest fires for the INFOEX Plan, regulates the uses and activities that may give rise to fire risk and develops the general prevention and self-protection measures defined in the PREIFEX Plan.

- **Impact Report on the Arrocampo SPA of the Junta de Extremadura**, authorising navigation for ecological studies and maintenance and conservation work in the Arrocampo reservoir.

- **Order 8/2019 (Castilla-La Mancha), 25 January**, of the Ministry of Agriculture, Environment and Rural Development, Fishing Restrictions 2019.

- **Law 8/2019, 5 April**, for a more responsive Administration in the Autonomous Community of Extremadura.

- **Implementing Regulation (EU) 2019/1262 of the Commission, 25 July 2019**, amending Implementing Regulation (EU) 2016/1141 in order to update the list of invasive alien species of concern to the Union.

- **Order of 3 September 2019** general fishing closures in the Autonomous Community of Extremadura.

ENVIRONMENTAL AUDITS

The Environmental Management System at Centrales Nucleares Almaraz – Trillo A.I.E has been certified by AENOR since 2005, in accordance with the UNE-EN-ISO-1400 international standard.

Between 23 and 27 September 2019, an Environmental Management System Monitoring Audit was performed by AENOR INTERNACIONAL SAU. The auditors reviewed the Almaraz and Trillo plants and the activities carried out at the Plant's Offices, declaring the final outcome, "compliant".

The Environmental Management Certificate, after thirteen years of validity, was most recently renewed in 2017, the year in which it was adapted to the updated version of UNE-EN-ISO-14001: 2015, the standard in force until 28/11/2020, recognising the involvement of Management and the collective effort of the entire Organisation over these years. Each milestone of this nature must be understood, however, as a new starting point towards an improved environmental performance by the company.

Previously, in April, there was an internal audit of the System, an obligatory part of the verification process and no non-compliances were discovered.

There were several inspections by the Nuclear Safety Council on subjects related to the environment at both plants.

AENOR

Certificado del Sistema de Gestión Ambiental

GA-2005/0519

CENTRALES NUCLEARES ALMARAZ-TRILLO, A.I.E.

ENVIRONMENTAL MONITORING PROGRAMMES

Almaraz and Trillo Plants have historically run several environmental monitoring programmes, with the aim of verifying the absence of significant environmental impacts as a consequence of their activities, whether of a radiological or conventional type.

The content of these programmes is detailed below:

STUDIES OF ALMARAZ NUCLEAR POWER PLANT SURROUNDINGS

Two environmental studies of the areas surrounding the Almaraz plant were carried out incorporating the Arrocampo and Torrejón reservoirs:

- **Ecological Study of the aquatic ecosystem.**
- **Thermal study of the reservoirs.**

These surveillance studies are far-reaching because the Arrocampo must also be considered as another Plant system, as it was built exclusively for industrial use cooling Almaraz NPP and is used for final heat dissipation, and therefore it is necessary to have as accurate as possible knowledge of its characteristics in terms of its ability to perform its cooling function, in both the short and long/term. This requires intensive monitoring and surveillance of both physical and chemical parameters, especially temperature, as well as biological factors.

The main characteristics of the Arrocampo reservoir are as follows:

- **Capacity 35.5 hm^3.**
- **Very elongated form, with a length greater than 10 Km and a surface area of 7.73 Km^2, with a predominance of shallow water.**

Divided into two parts with a thermal separation screen which requires the cooling water to execute a path approximately 25 km along the reservoir facilitating cooling prior to returning to the cooling intake.

The natural hydric supply to the Arrocampo reservoir is much reduced and is fed mainly by water from the river Tajo, through pumping.

The water added to the Arrocampo reservoir from the Torrejón reservoir has a high nutrient level, particularly phosphorous and nitrogen.

The contribution of these nutrients, combined with the effect of the water temperature causes the development of a significant biomass of planktonic organisms in Arrocampo, whose metabolic processes influence the quality of the water, and which must therefore be controlled and monitored.

Ecological Study of the Arrocampo and Torrejón reservoirs

Two studies carried out in an independent and coordinated manner are used to monitor the aquatic ecosystems of both reservoirs:

- **Limnological study**
- **Ichthyological study.**

The limnological study sampling and analysis programme consists of sampling and measurement points and is carried out with the frequency detailed in the following table:

RESERVOIR	NUMBER OF SAMPLING POINTS	
	LIMNOLOGICAL STUDY	ICHTHYOLOGICAL STUDY
ARROCAMPO	7	9
TORREJÓN	8	10
VALDECAÑAS	1	-
ESENCIALES	1	-
MEASUREMENT/ SAMPLING FREQUENCY	MONTHLY/ SEASONAL	QUARTERLY

These studies are used to determine the state of the ichthyofauna, and the diversity and abundance of species, paying attention to their evolution over time. From a limnological viewpoint, the plankton state is monitored in detail, as well as the wide variety of physico-chemical variables.

The results obtained from both studies, which are sent to the Administration, indicate the existence of a dynamic equilibrium in the ecosystem consisting of the Arrocampo reservoir, which is observed to be affected fundamentally by the plant's power level, the physico-chemical characteristics and the volume of water provided from Torrejón, and the meteorological conditions in the area. This state of equilibrium has not experienced any significant modification during recent years. The Torrejón reservoir shows conditional zoning, in the initial stretch as a result of the channelled flow from the deep water of the Valdecañas reservoir, in the middle stretch a result of the recirculated flow from the Arrocampo reservoir, and in the final stretch as a consequence of the pumped flow from Tiétar.

Thermal Study of the Arrocampo and Torrejón reservoirs

Exhaustive monitoring of the temperature trends in the water in the Arrocampo and Torrejón reservoirs has been carried out, and an evaluation of the values measured with the objective of understanding the thermal impact which plant operations have on the water mass.

Continual measurement and recording systems are also provided to measure temperature, the pH value, dissolved oxygen and water flow in the Arrocampo overflow, with the objective of verifying the basic characteristics of the discharge from Arrocampo.

In order to comply with the conditions of the water exploitation concession, the most relevant information about the thermal state of the reservoirs is sent monthly to the Tajo Hydrographic Confederation as the responsible management body, so that it is kept constantly updated about this condition.

STUDY OF THE TRILLO NUCLEAR POWER PLANT SURROUNDING AREAS

The environmental study which is carried out in the vicinity of the Trillo plant consists currently of monitoring the river Tajo, where water from the Plant is discharged, and the Entrepeñas reservoir, located downstream in the proximity of the Plant.

This study covers evaluation of the water quality from the physico-chemical viewpoint, and its content of metals and other undesirable substances, as well as the characteristics of other elements of the aquatic ecosystem such as sediments, benthic algae, phyto and zoo plankton and ichthyofauna.

The intake from the river Tajo is taken from the water held by the Ermita dam, constructed to guarantee a constant level to enable the functioning of the pumps supplying the Plant, which is subsequently discharged to the river again after fulfilling its cooling function, immediately into the water downstream of the dam through a diffuser system which facilitates complete mixing with the flow in the river.

The Plant is situated at the end of the zone of upper Tajo, where the river experiences significant flow variations due to the non-existence of water regulation from the higher reaches causing flooding, although minor, with a particular frequency, coinciding with episodes of intense rainfall, which have a bearing on water quality as a result of the debris picked up at such times.

Generally, the waters of the Tajo in the area of the Plant are of good quality and can be characterized as oligotrophic.

The Entrepeñas reservoir is located downstream close to the Plant and its principal characteristic is the low level experienced in recent years, and the significant variations in levels experienced throughout the year. The basic use made of the water stored in the Entrepeñas reservoir is for hydroelectric production and irrigation, as, together with the Buendía reservoir, they constitute the reserve for the Tajo-Segura transfer.

The sampling and analysis programme consists of 4 sampling points situated upstream and downstream of the Ermita weir, including a point located in the Entrepeñas reservoir, capturing samples of water with a monthly frequency, and sediments, benthic algae, phyto and zoo plankton and ichthyofauna, with a quarterly frequency.

ENVIRONMENTAL RADIOLOGICAL MONITORING

Almaraz and Trillo Plants exercise continuous strict control and monitoring of their own radioactive effluent emissions. Nonetheless, with the objective of verifying experimentally the impact radioactive elements might have on the environment, the plants have implemented an Environmental Radiological Monitoring Programme (ERMP) through direct measurement of radiation levels in the surroundings near to the installations, and of the content of radioactive substances from a series of types of environmental samples which are collected from a set of sampling points.

Comprehensive monitoring is carried out on all abiotic elements and living organisms represented in the ecosystems associated with all the natural resources of the surroundings of the plants (air, land and water).

The usefulness of the analytical results is assured through parallel implementation of a quality control programme by another, independent laboratory, and by the implementation of a programme of independent monitoring (PVRAIN) directly by the Nuclear Safety Council.

Also, in the case of the Almaraz Plant, a collaboration agreement is maintained with CEDEX to enable this official body, reporting to the Ministry of Public Works, to carry out independent surveillance of the

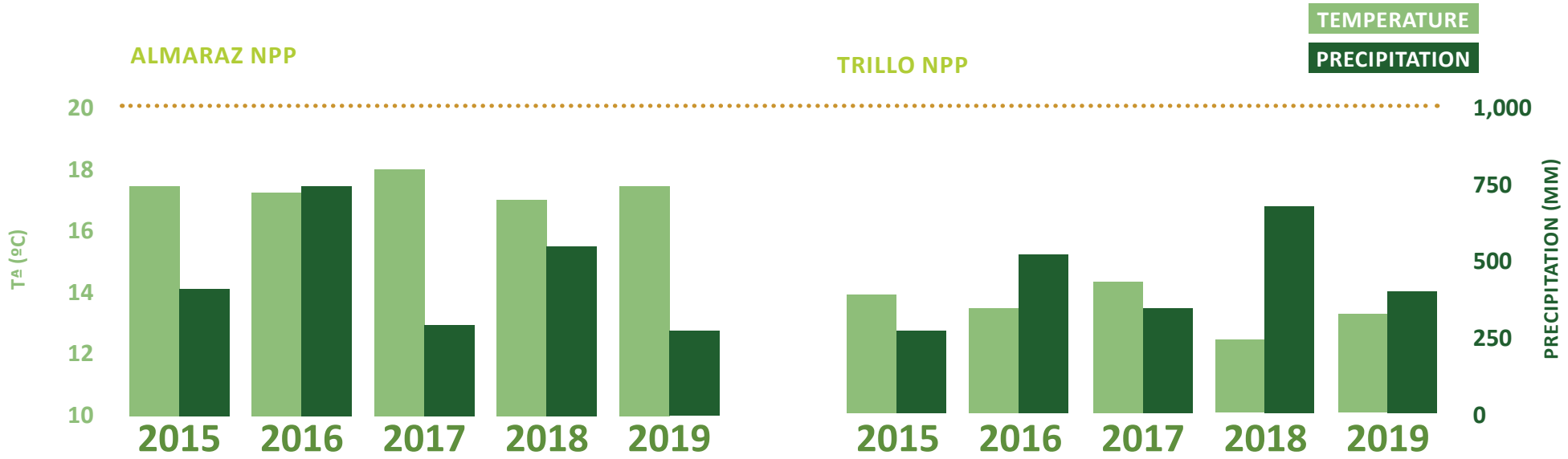
aquatic resources in the proximity of the Plant. Extremadura Council also carries out independent radiological monitoring, with the help of the University of Extremadura.

Results obtained during 2019 at both plants indicate that the radiological state of the ecosystems of their surroundings have experienced no significant variations during the year, with natural background values remaining unchanged, confirming the absence of environmental effects due to the leakage of radioactive elements, rendering radiologically insignificant any leakages from both plants.

METEOROLOGICAL STUDIES

Almaraz and Trillo plants employ meteorological stations which are used continuously to measure and record the most significant parameters such as temperature, precipitation, wind direction and speed, humidity and solar radiation. The meteorological information is of particular relevance for various applications related to the environment, providing an excellent description of the climate at the site, after thirty years of monitoring.

METEOROLOGY AT THE SITE AVERAGE TEMPERATURE AND TOTAL PRECIPITATION

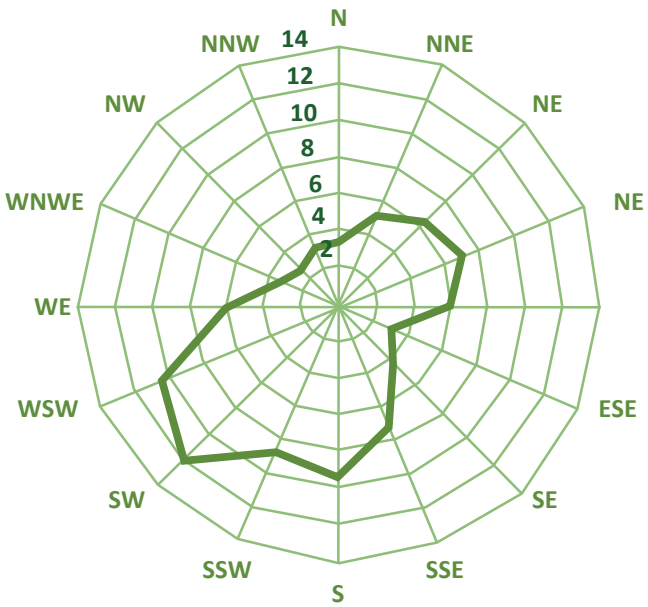


The stations provide the required redundancy to ensure continuous availability of meteorological information.

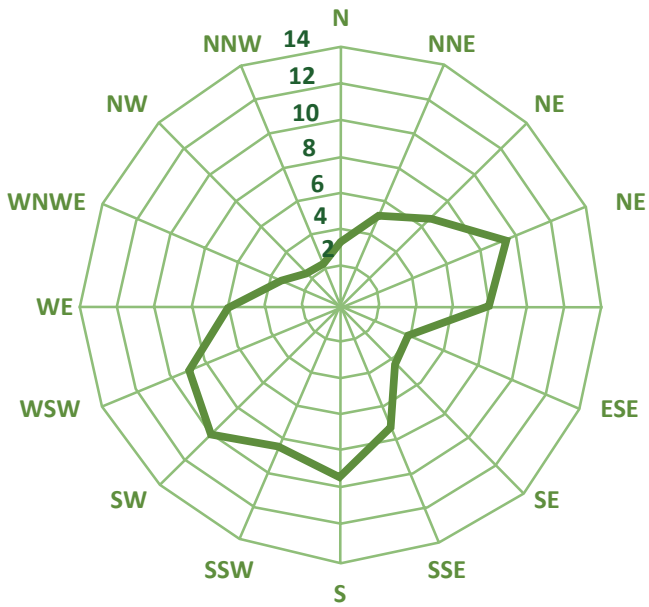
The average temperature readings and total precipitation registered during recent years at each plant are shown below, as well as the corresponding wind frequency rose diagrams for each direction.

NPP ALMARAZ

COMPASS ROSE OF THE YEAR 2019

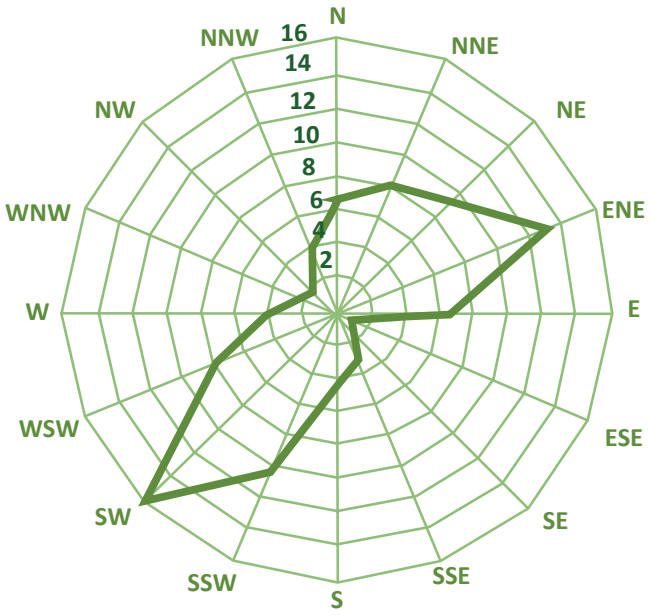


COMPASS ROSE. PERIOD 1987-2019



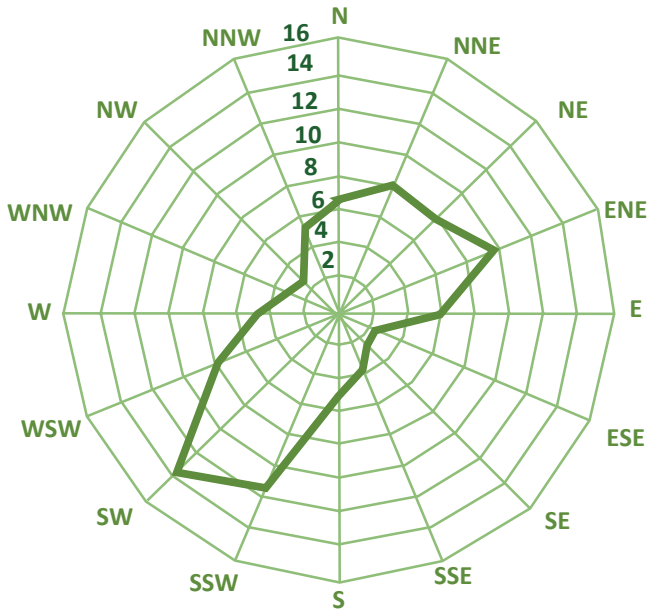
NPP TRILLO

COMPASS ROSE OF THE YEAR 2019



CALMS 1.12%

COMPASS ROSE. PERIOD 1976-2019



CALMS 0.85%

RELATIONSHIP WITH STAKEHOLDERS

One of the cornerstones of the Environmental Management System is communications. The actions in this area, focused on the dissemination of our activities and actions to promote environmental awareness, are directed both at employees and other audiences external to the organisation but linked to its activity: official bodies, neighbours, associations, media and public in general: all these agents are the so-called stakeholders.

LOCAL AUTHORITIES

CNAT continues to maintain fluid and dynamic relationships with institutions with responsibilities in the field of power plant performance, and four biannual meetings were held on this matter in 2019, two at each plant, with the leaders of the municipalities in the areas of influence, and details of the operating results and future plans and projects were provided.

In 2019 180 personalised meetings were also held with leaders of surrounding councils to study on a bilateral basis the relationships of the Plants with each municipality and potential collaboration channels. Local Information Committees organised by the Ecological Transition Ministry (MITECO) are held annually.

MEDIA

A strong relationship with the media is maintained based on truth, transparency and our constant availability to meet their information demands. During 2019, 15 news updates were distributed, providing information about the most significant events at the installations related to various operational and maintenance issues at the plants (refuellings, drills etc., environmental issues and other information of general interest).

Additionally, and specifically, the managers responsible for both plants have held biannual meetings with the media in their surrounding area, and they have provided them with relevant information about the installations regarding operating results and future plans and projects.

PUBLIC

Over the years, the Information Centres at the Almaraz and Trillo NPPs have emerged as effective channels of communication with the public.

Thanks to the diversity of audiovisual and exhibition resources that they are equipped with, the general public are much better informed about nuclear energy, and in particular the characteristics of the nuclear installations and their relevant environmental aspects.

CNAT continues to develop periodic and specialised publications. During 2019 several general interest publications have been made available, most of which can be found on the CNAT website (www.cnat.es).

In addition, the organisation has a corporate blog www.energiaymas.es to improve public awareness of the activity that takes place in our installations and in the municipalities in their areas.

IMMEDIATE VICINITY

Almaraz and Trillo NPPs represent an important socio-economic reference, as they are an unquestionable source of employment and wealth in their areas of influence. The commitment of the Almaraz-Trillo Plants to their neighbouring communities materialises in the form of support for initiatives that improve the quality of life and economic and social development of their regions. In 2019, there were several initiatives, of which the most significant undertaken in the environmental field were:

- **Collaboration Agreement Framework with the University of Extremadura, to implement technical and scientific projects. In addition, the company also collaborates with the Department of Chemical and Energetics Engineering at UEX, for work relating to scientific and technical analysis of the retention of radioactive isotopes by activated carbons prepared from native residues, and the reuse of activated carbons present in Almaraz NPP filters for processing cooling circuit water.**

- **Agreement with the Department of Ecology, Faculty of Sciences at UEX, to carry out scientific and technical work relating to monitoring spatio-temporal structures and sequences of plant populations in the surrounding areas of Almaraz NPP, and the bird populations that use the Arrocampo reservoir.**

- **Collaboration with the University of Extremadura for ornithological study of the Arrocampo ZEPA of the environment to carry out various improvement and local development projects.**

- **Collaboration agreement between the Energy Chair at the University of Extremadura to encourage the introduction of college students to the professional world, and their integration, after completion of studies by means of scholarships that facilitate contact with the business world.**

- **Collaboration Agreement with the City of Toril to encourage visits to the Biosphere Reserve Interpretation Centre: Portico de Monfragüe.**

- **Collaboration with the town councils in the areas surrounding Almaraz NPP for the implementation of projects of improvement and local development.**

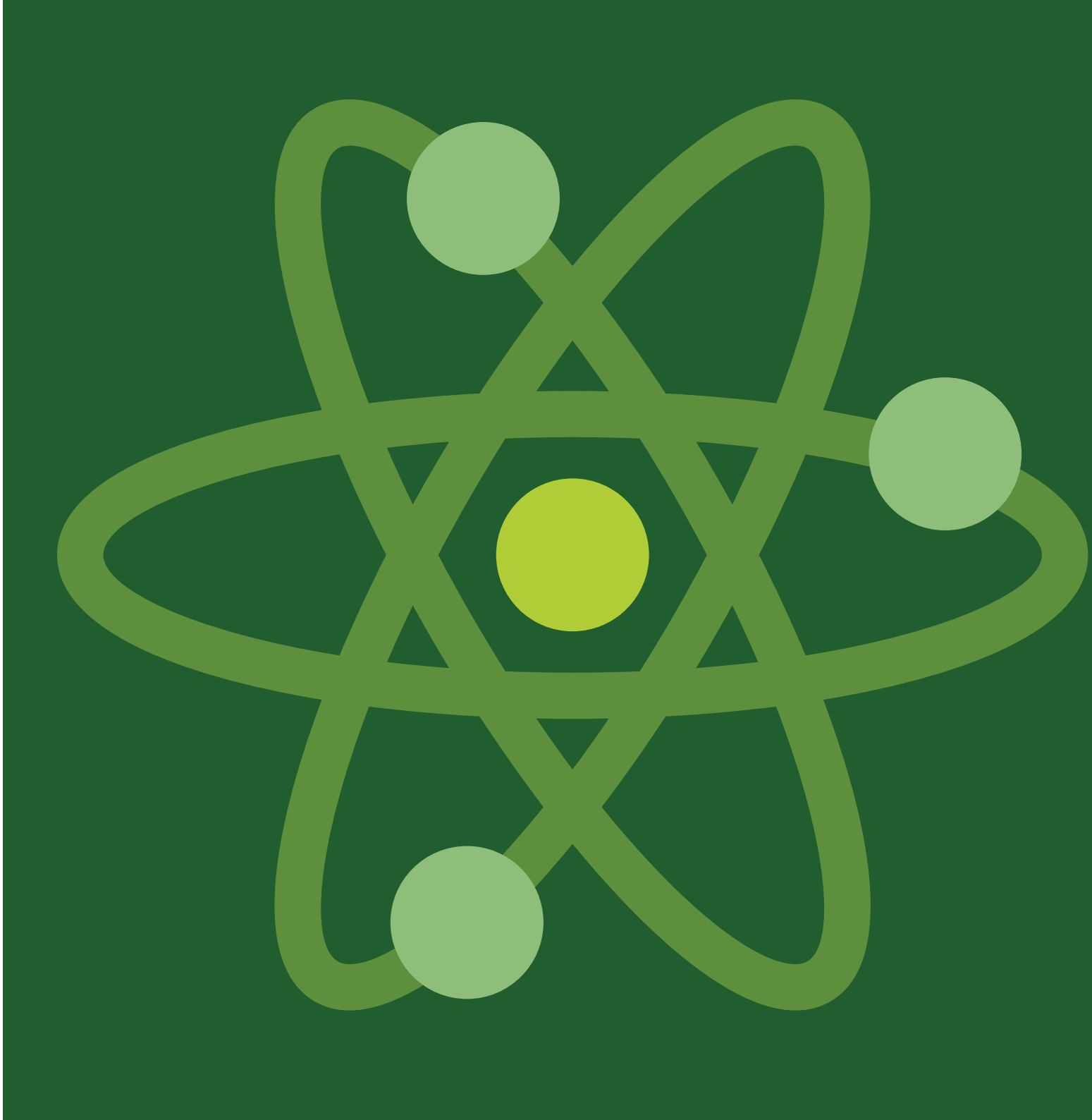
- **Collaboration with the Irrigation Community on the Valdecañas Irrigation Plan.**

- **Various collaborations with schools and associations in the area surrounding Trillo NPP in activities related to the environment (apicultural observatories, workshops, and tours through natural environments).**

- **Agreement with the Riberas del Tajo Association, to carry out programmes and actions in areas of economic, social, cultural and environmental development.**

- **Agreement with Mantiel City Council to publicise its Beekeeping Observatory.**

ALMARAZ NPP
Apdo. Correos, 74
10300 Navalmoral de la Mata (Cáceres)
(+34) 927 54 50 90
ci.almaraz@cnat.es

TRILLO NPP
Apdo. Correos, 2
19450 Trillo (Guadalajara)
(+34) 949 81 79 00
ci.trillo@cnat.es

ALMARAZ-TRILLO NPP AIE
Avda. de Manoteras, 46-BIS
Edificio Delta Nova 6. 5ª Planta
28050 Madrid
(+34) 91 555 91 11
comunicacion@cnat.es