Cofrentes Nuclear Power Plant

IBERDROLA

Providing the community electricity

IBERDROLA SPAIN

Cofrentes Nuclear Power Plan is wholly owned by IBERDROLA GENERACIÓN NUCLEAR, S.A.U. It is currently the most important electricity-producing facility in the province of Valencia and the most powerful nuclear power plant in Spain.

Its authorized thermal power is 3,237 MW and its electrical power is 1,092 MW.

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Cofrentes Nuclear Power Plant

1 The Power Plant

Cofrentes Nuclear Power Plant is a boiling water technology reactor (BWR/6) facility and is owned by IBERDROLA GENERACIÓN NUCLEAR S.A.U. The fuel is enriched uranium, which is uranium with higher concentrations of fissionable U-235 isotopes than that of uranium found in its pure state in nature.

Many Spanish nuclear-specialized companies participated (82%) in the construction of the power plant.

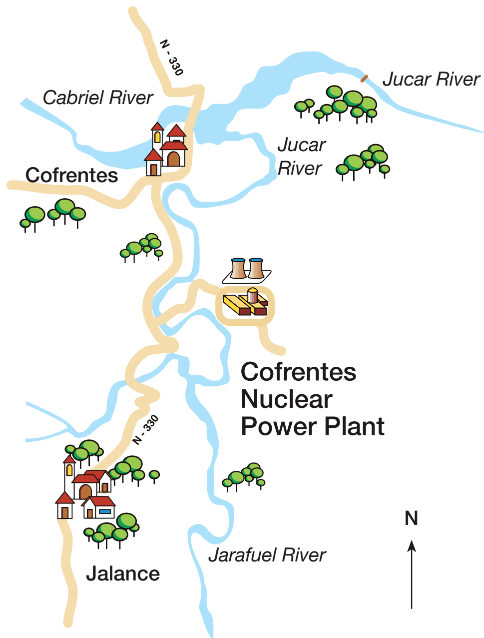
Cofrentes Nuclear Power Plant is at the forefront of nuclear power plants, both from a technological and management standpoint. The plant is not only recognized by prestigious technical publications, but also companies, and national and international organisations.

2 Location

Cofrentes Nuclear Power Plant is located 2 km from the village of Cofrentes, in the province of Valencia. It stands on the right bank of the Júcar River and is 47 m above the river (372 m above sea level).

The site occupies 300 HA.

The nearest towns are Cofrentes to the north and Jalance to the South. Both towns are located by the 330 national highway, which is 1 km from the Reactor Building. The same road is connected to the A-3 Madrid-Valencia in the town of Requena and the Madrid-Alicante highway in the town of Almansa. The city of Valencia is approximately 110 km away.



3 Technical Characteristics

Type of reactor	BWR/6 (Boiling Water Reactor)
Main Supplier	General Electric
Containment	MARK III Type
Fuel	Enriched Uranium dioxide (UO_2)
No. of fuel rods	624
Nominal steam pressure	74,5 kg/cm^2
Nominal steam flow	5.760 ton/h
Thermal Power	3.237 MWt
Electrical output	1.092,02 MWe
Length of operational cycles	24 months
Cooling system	Closed circuit through natural draught cooling towers
Generator terminal voltage	20 kV
Transformer elevation	400 kV
First coupling to grid	October 14,1984
Commercial start	March 11, 1985
Operating Permit Expiration Date	March 20, 2021

Site before construction began

Cofrentes Nuclear Power Plant during construction

4 Construction

Construction began in 1975 and ended in 1984. It took nine (9) years to finalize the facility

The Cofrentes project began when the Board of Directors of Hidroeléctrica Española (currently known as IBERDROLA) adopted the decision. General Electric Co. were contracted to supply the main equipment: the reactor and turbo generator.

The site of the power plant was chosen based on a series of criteria. It was concluded that the town of Cofrentes met all the necessary conditions as per established by Spanish Law.

The project was supervised from start to end (including construction and operation) by competent regulatory bodies to ensure established laws, norms and conditions were respected.

The Hydrographic Confederation of the Júcar also put in place the necessary mechanisms to monitor water intake and discharge in the Júcar river and water and sewage concession permit adherence.

Permits and Authorizations

1972 Initial Authorization: Ministry of Industry Resolution of the Directorate General for Energy, dated November 13. The period of public information began January 30, 1972 when a notice was published in the BOE (Official State Gazette), number 25, January 29, 1972.

1975 Building Permit: Municipality of Cofrentes Municipal Permit, March 18. **Activity License**: Municipality of Cofrentes Municipal Permit, March 18. **Construction Permit:** Ministry of Industry Resolution of the Directorate General for Energy, dated September 9.

1976 Júcar River Water Concession: Ministry of Public Works Resolution of the Directorate General for Hydraulic Works, dated December 9.

1980 Permit granted to transport the first core: Ministry of Industry and Energy Resolution of the Directorate General for Energy, dated February 21. **Permit granted of temporary storage of nuclear substances**: Ministry of Industry and Energy Resolution of the Directorate General for Energy, dated February 21.

1982 Renewal of the construction permit: Ministry of Industry and Energy Resolution of the Directorate General for Energy, dated August 4. **Adoption of pre-nuclear testing program**: Ministry of Industry and Energy Resolution of the Directorate General for Energy, dated December.

1984 Provisional Operating Permit: Ministry of Industry and Energy Ministerial Order, dated July 23.

1986 - First renewal of provisional operating permit.

1988 - Second renewal of provisional operating permit.

1990 - Third renewal of provisional operating permit.

1992 - Fourth renewal of provisional operating permit.

1994 - Fifth renewal of provisional operating permit.

1996 - Sixth renewal of provisional operating permit.

2001 - Seventh renewal of operating license (10 years)

2011 - Eighth renewal of operating license (10 years)

Vessel transport, lifting and positioning

Construction

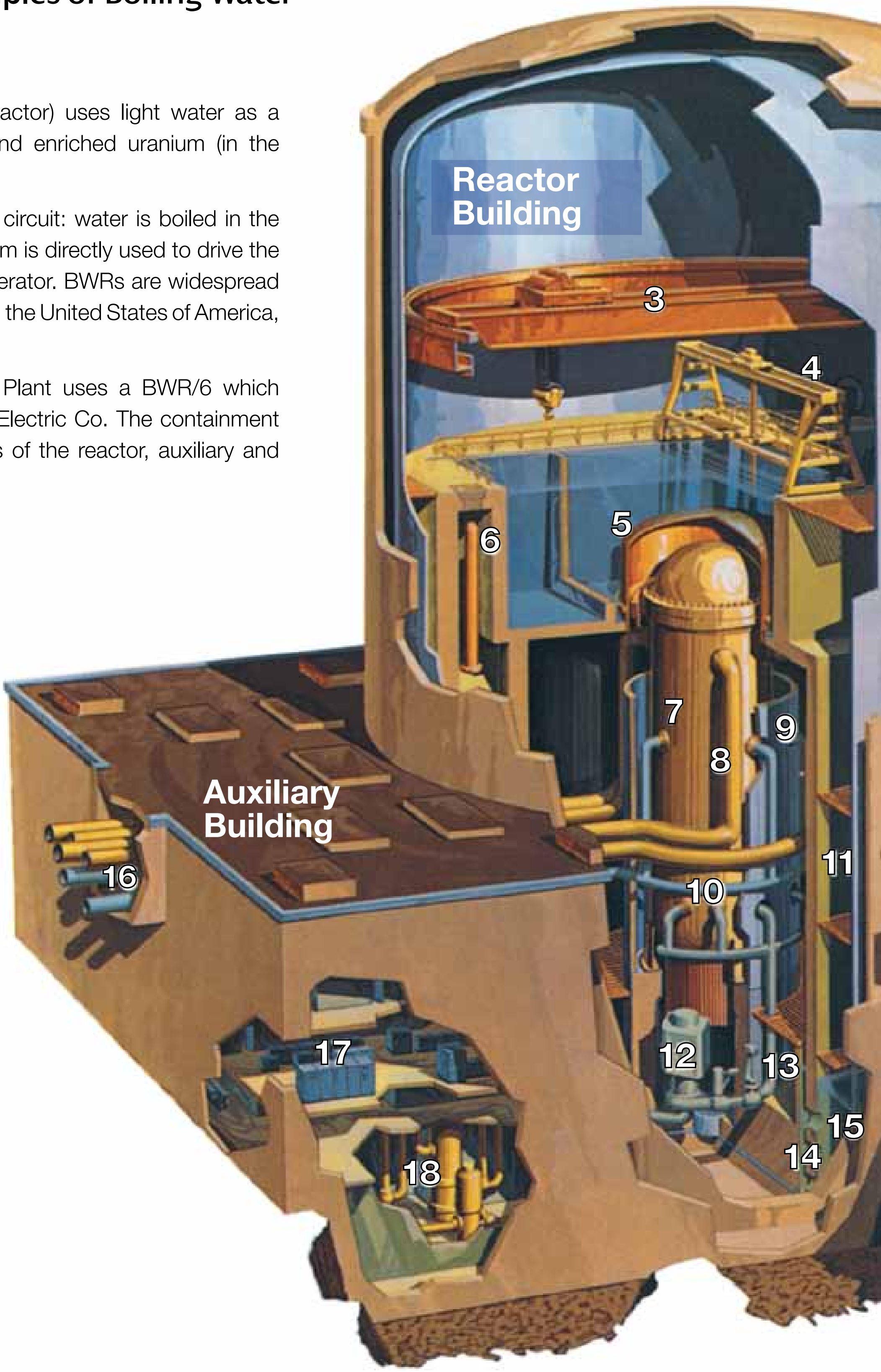
5 Mark III Containment

The Main Principles of Boiling Water Reactors

A BWR (Boiling Water Reactor) uses light water as a coolant and moderator, and enriched uranium (in the form of oxide) as fuel.

It is composed of a single circuit: water is boiled in the reactor vessel and the steam is directly used to drive the turbine coupled to the generator. BWRs are widespread and are mainly developed in the United States of America, Germany and Sweden.

Cofrentes Nuclear Power Plant uses a BWR/6 which was designed by General Electric Co. The containment is a MARK-III and consists of the reactor, auxiliary and fuel buildings.



Containment Mark III - section

Reactor Building

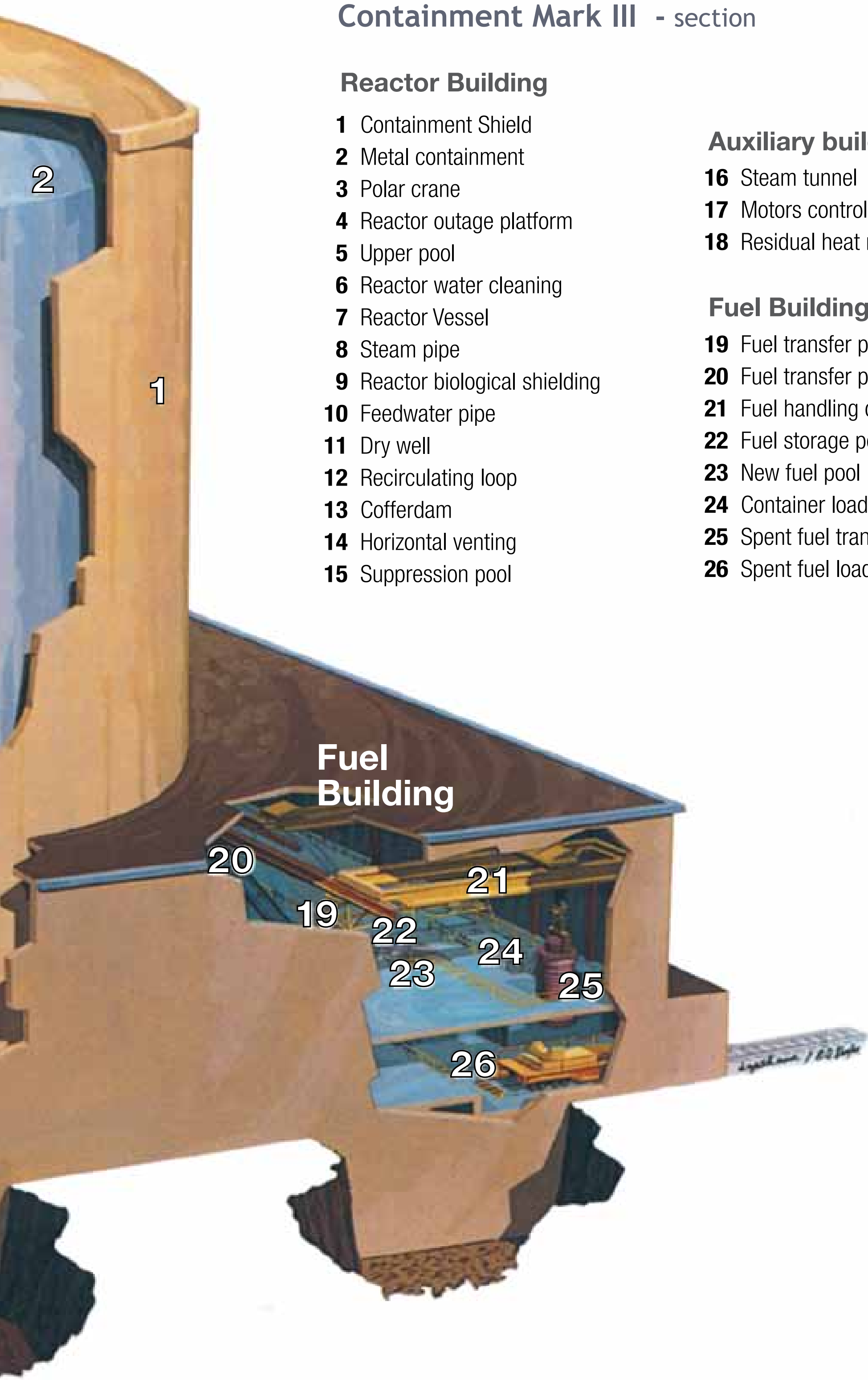
1 Containment Shield
2 Metal containment
3 Polar crane
4 Reactor outage platform
5 Upper pool
6 Reactor water cleaning
7 Reactor Vessel
8 Steam pipe
9 Reactor biological shielding
10 Feedwater pipe
11 Dry well
12 Recirculating loop
13 Cofferdam
14 Horizontal venting
15 Suppression pool

Auxiliary building

16 Steam tunnel
17 Motors control centre
18 Residual heat removal system (RHR)

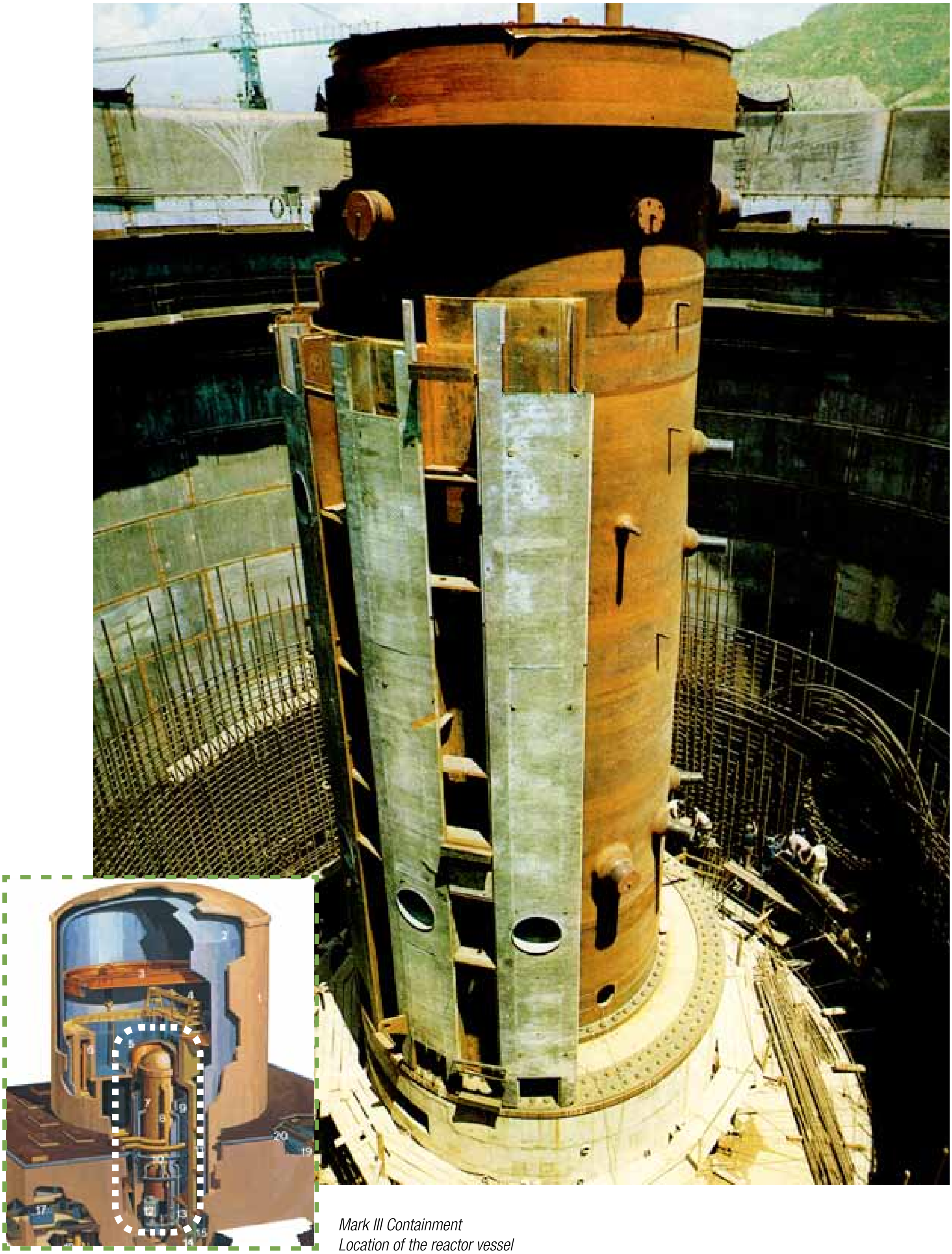
Fuel Building

19 Fuel transfer pool
20 Fuel transfer pipe
21 Fuel handling crane
22 Fuel storage pool
23 New fuel pool
24 Container loading pool
25 Spent fuel transport container
26 Spent fuel loading dock



Containment	
Type	Mark III
Design pressure	1,05 Kg/cm^2
Height	55,51 m.
Interior diameter	34,76 m.

Reactor vessel during construction

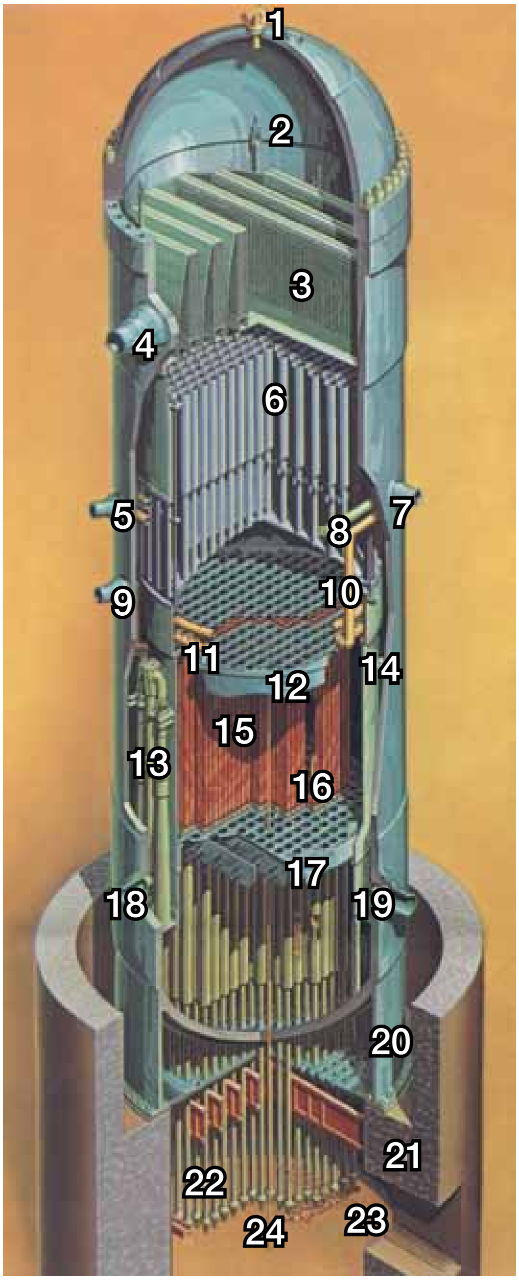


Mark III Containment
Location of the reactor vessel

The Reactor Vessel

The reactor vessel is 21.8 m high and its effective interior diameter is 5.5 m. It is made of highly-resistant, low alloy carbon steel and was designed, made and tested in compliance with the ASME Code, Section III, and Division 1.

The minimum thickness of the wall is 15.2 cm and has a 5 mm-thick stainless steel liner. It weighs 560 Tm. (including the head), which makes the component heavier.



BWR/6 reactor vessel

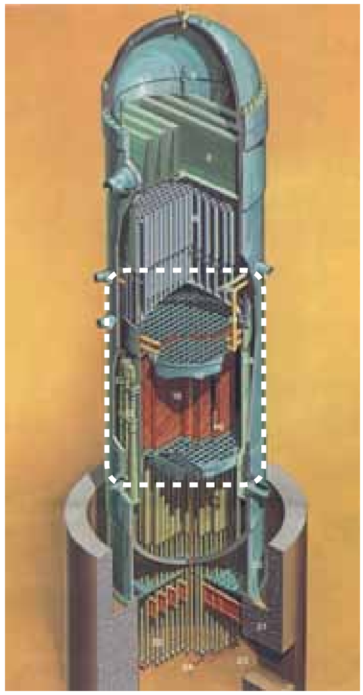
1 Head vent and spray
2 Steam dryer hoisting beam
3 Steam dryer assembly
4 Steam outlet
5 Core sprinkler inlet
6 Steam separator assembly
7 Feedwater inlet
8 Feedwater manifold
9 Low pressure cooling injection intake
10 Core sprinkler pipes
11 Core sprinkler manifold
12 Upper guide
13 Jet pumps
14 Core shroud
15 Fuel elements
16 Control rod
17 Core support plate
18 Water recirculating inlet
19 Water recirculating inlet
20 Vessel support plate
21 Reactor shielding
22 Control rod actuator
23 Control rod hydraulic actuator piping
24 Internal neutron detectors

Vessel	
Internal height	21,8 m.
Internal diameter	5,53 m.
Minimum metal base thickness	13,6 cm.
Material	Acero SA-533 GrB (inner stainless steel cladding)
Design pressure	87,5 Kg/cm^2

Control systems	
Number of control rods	145
Control rod geometry	Cruciform
Neutron-absorbing material	B4C
Drive system	Hydraulic
Other control systems	Sodium pentaborate

The Core

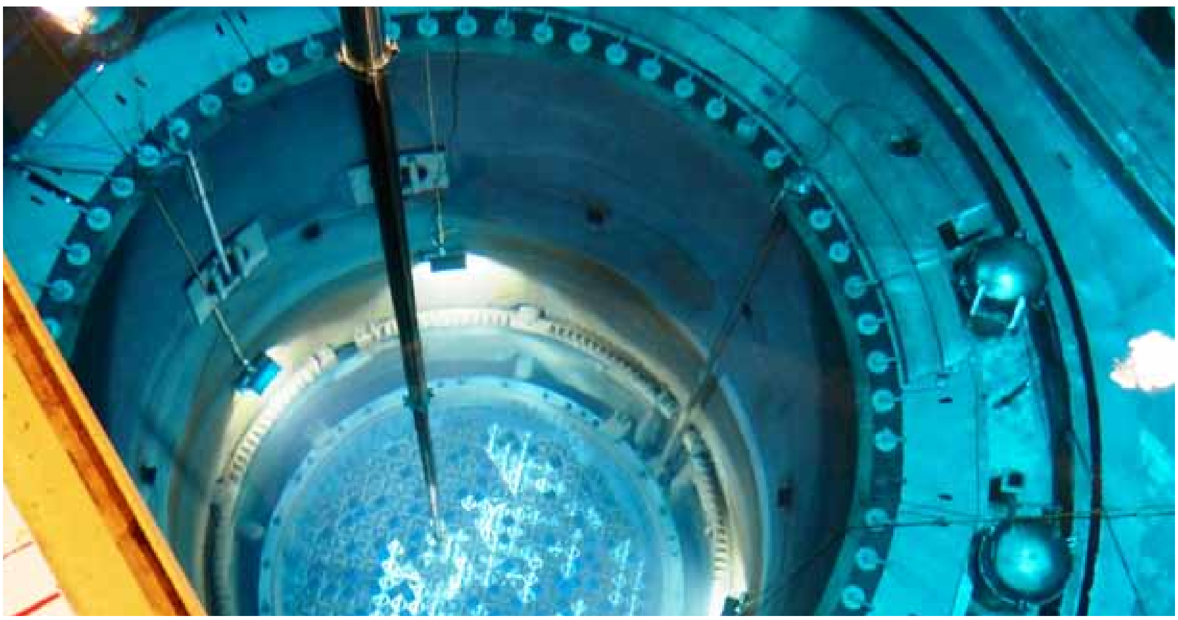
The reactor core is made up of 624 fuel elements. These fuel elements contain 113 Tm of uranium with an average 4.02% degree of enrichment in the U-235 isotope. Each fuel element is composed of rods that measure approximately 1 cm in diameter and 3.80 m long. They are vertically placed and two structures or support plates, located at each end, hold it up. There are also 7 intermediate spacers. Each element is sheathed into a square-section, ziracaloy-4 sleeve or channel.



The reactor core is housed inside the pressurized vessel. It is accurately positioned thanks to a lower support plate and upper guide or plate. Forced convection cools the core via two (2) motor-driven recirculation pumps (2 x 6,400HP) located outside the vessel. The core is also cooled by a skirt of 20 jet pumps located on the periphery of the core within the reactor vessel.

Reactor core characteristics

Active height	3,81 m.
Active diameter	4,30 m.
Number of fuel elements	624
Average linear power	472/433 W/cm
Average power density	53,4 kW/litre



Fuel Fabrication and Treatment

Uranium, in its natural oxide, is a by-product of mining and production. It is sold in concentrated forms known as yellow cake, a yellow powder which is a variety of uranium salts with a high content of metal. It is then converted to uranium hexafluoride (UF_6), which is an easily sublimable solid.

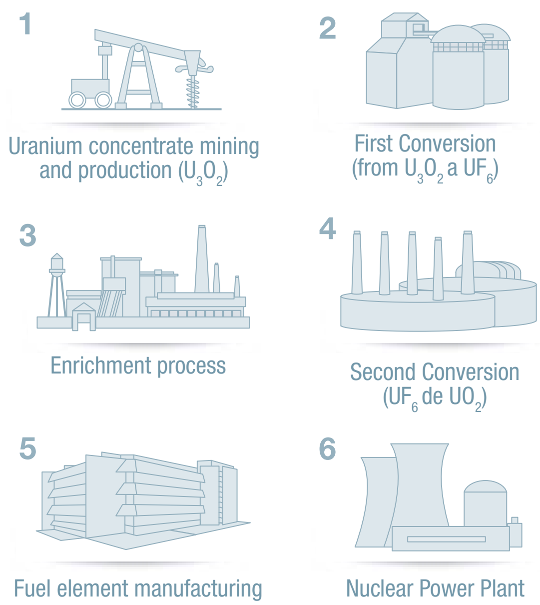
Uranium hexafluoride is enriched in the isotope U-235 through the gaseous diffusion and gas centrifuge enrichment method. After it is enriched, it sent to nuclear fuel manufacturing facilities where it is converted into uranium dioxide (UO_2), a black power. It is then pressurized into pellets and then sintered. The pellets are loaded into rods made out of Zirconium alloy and then sealed at both ends. These are now sealed fuel rods and they are subsequently grouped to form fuel elements.

Uranium ore

Rods

Yellow Cake

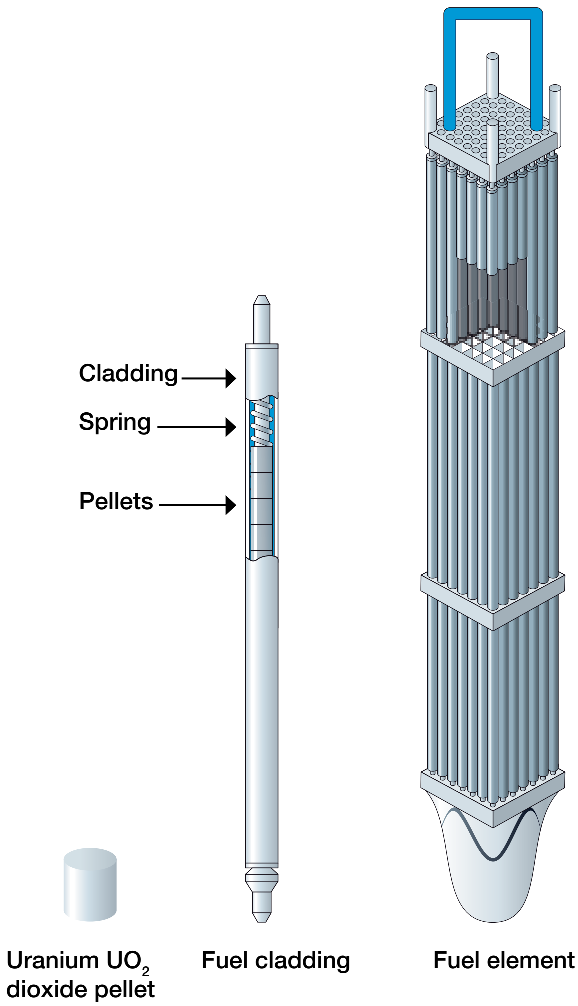
Uranium dioxide



Cycle

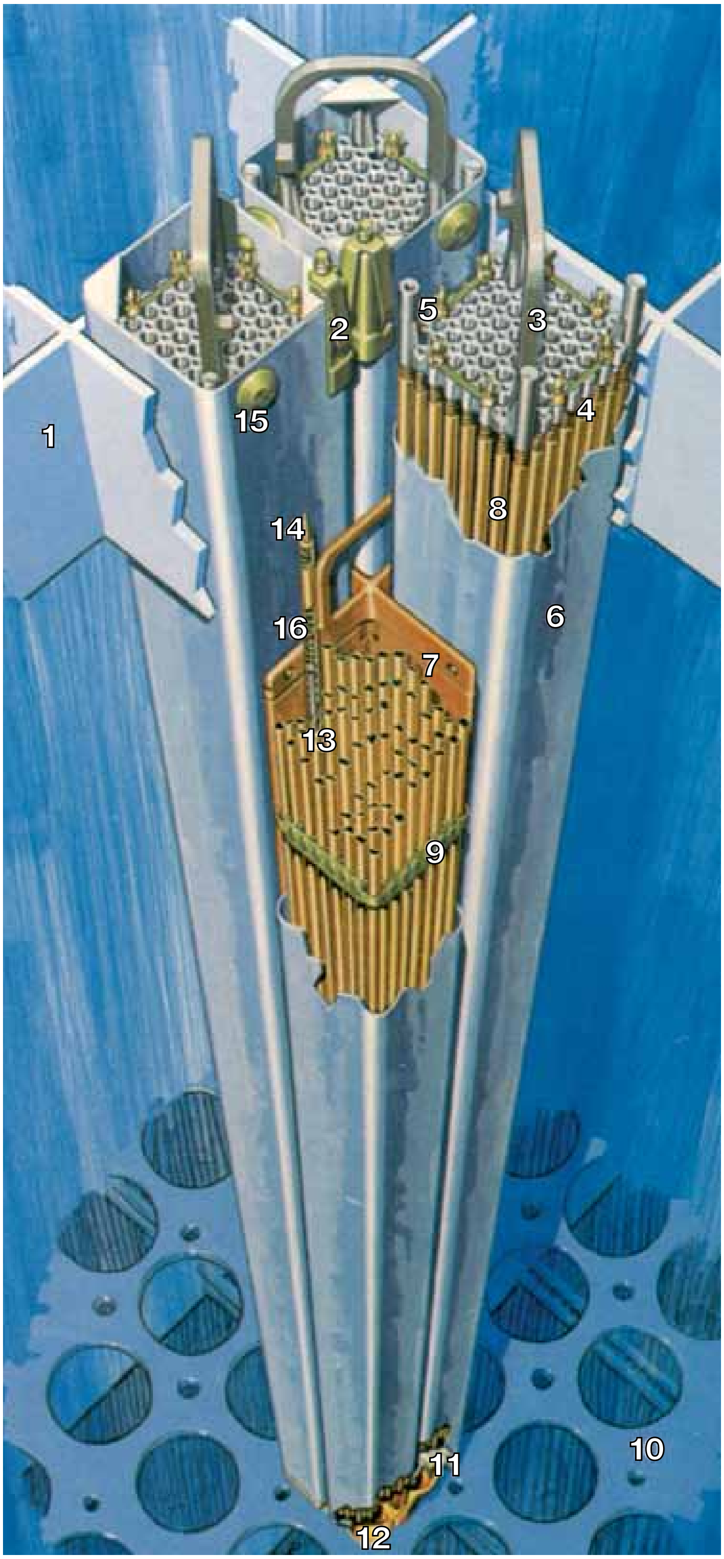
Enriched uranium has higher levels of fissionable U-235 isotopes than the uranium found in nature.

Uranium is obtained from minerals that contain only 0.71% of U-235 and the remainder is a slightly heavier U-238 isotope. This mixture of isotopes is natural Uranium. Most of the energy currently produced in nuclear reactors is the product of the fission of U-235 cores.



Composition of a fuel element

Fuel Element and Control Rod Cruciform



The core not only houses fuel elements and measurement instruments but also 145 stainless control rods in a cross-shaped structure filled with boron carbide, and enriched with the neutron-absorbing B-10 isotope. The control rods are inserted into the core from beneath.

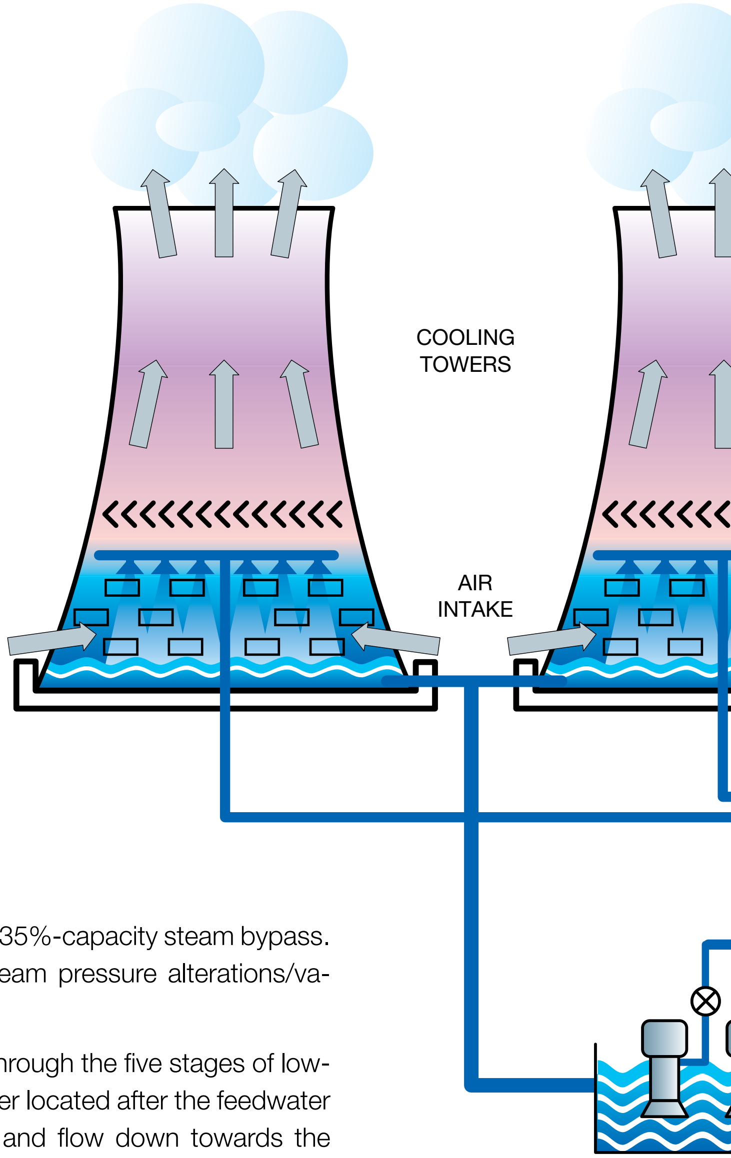
Control Rods

1 Upper fuel guide
2 Channel fixer
3 Upper handling bail plate fitting
4 Expansion springs
5 Shut-off spring
6 Channel
7 Control rod
8 Fuel rod
9 Separation rack
10 Core support plate
11 Lower plate fitting
12 Fuel support fitting
13 Fuel pellets
14 End plug
15 Channel separators
16 Cavity spring

Main Cycle

The reactor produces saturated steam that after traveling through the moisture separator and steam dryer, located in the upper area of the reactor vessel, to the high-pressure turbine, where it is subject to conditions of approximately 72 kg/cm^2, 282ºC and 0.5% humidity through four (4) 650 mm (26”) diameter pipes. It undergoes a first expansion to reach a final pressure of 15.3 kg/cm^2.

This expanded steam is dried and reheated in the two heaters and humidity dryers housed on either side of the main turbine and partly powered by a high-pressure turbine extraction. The dry and reheated steam then enters the two (2) low-pressure turbine bodies to complete expansion to a final pressure of 75 mm (3”) absolute mercury column. It is discharged into the double-pressure condenser.

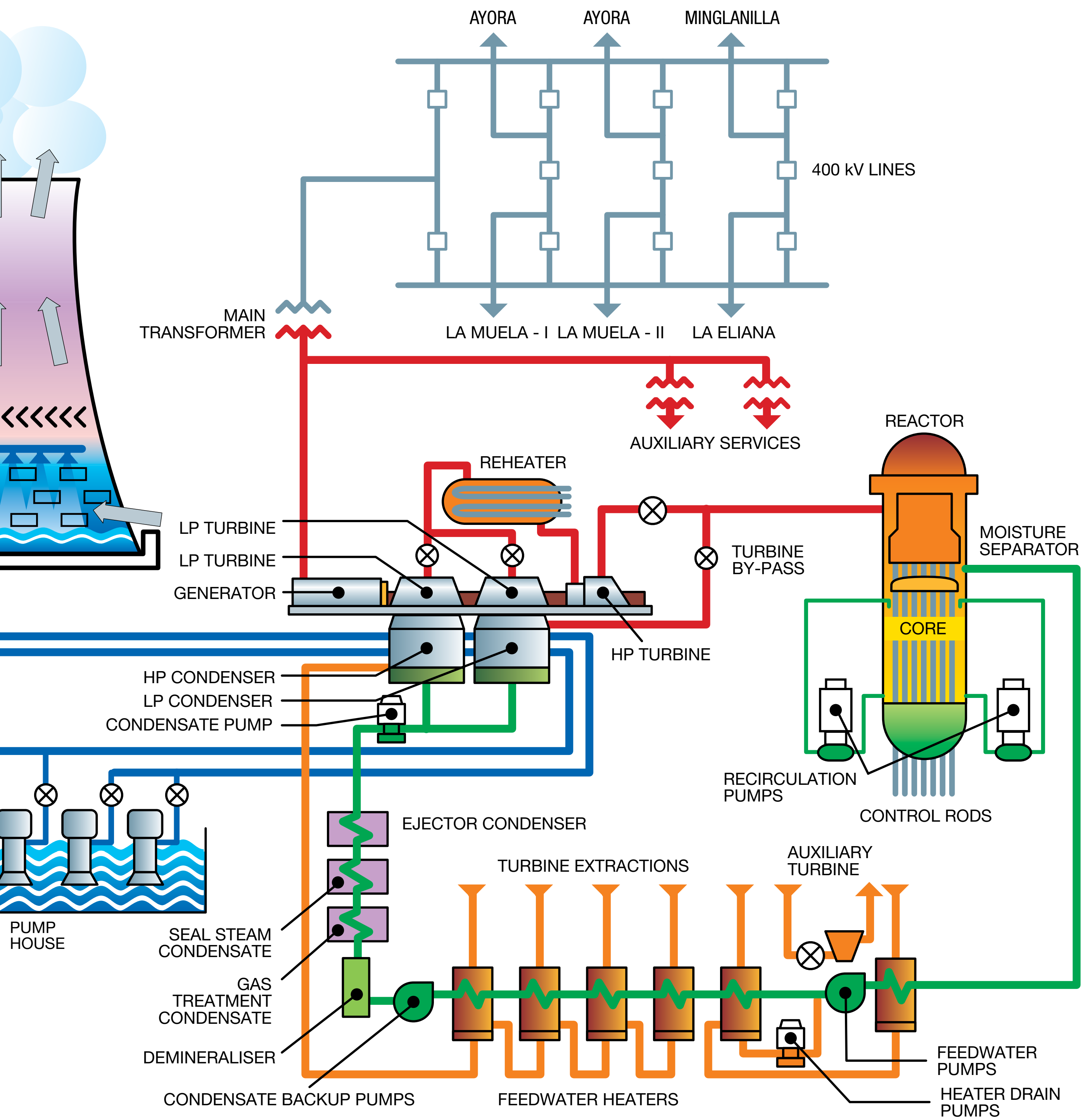


Operation

The turbine rotates at 1,500 rpm and is equipped with a 35%-capacity steam bypass. This enables start-ups and compensates minimum steam pressure alterations/variations.

The regenerative cycle is completed when it has gone through the five stages of low-pressure condenser heating and the high-pressure heater located after the feedwater turbopumps. The low-pressure heater drains 1 to 4 and flow down towards the condenser. The remaining condensers and steam separators/reheaters drains are directly injected back into the cycle. This reduces the flow of the low-pressure pumps and the size of the condenser pumps.

The condenser is cooled in a closed circuit by the natural draft cooling towers. These towers are able to cool 32.8 m^3/s of water when at full load.



HP: High pressure
LP: Low pressure

Cooling Systems

Emergency systems are in place in the event of any failure related to the normal reactor heat extraction. These systems are equipped with sufficient capacity and redundancies to ensure the core remains cooled until the reactor is safely shut down; ensuring that liner pressure limits and fuel design temperatures are not exceeded, which guarantees fission products are not released into the atmosphere.

The following lists the emergency systems and their role:

1- Nuclear system pressure relief system

2- Reactor Core Isolation Cooling (RCIC)

3- Emergency Core Cooling System (ECCS)

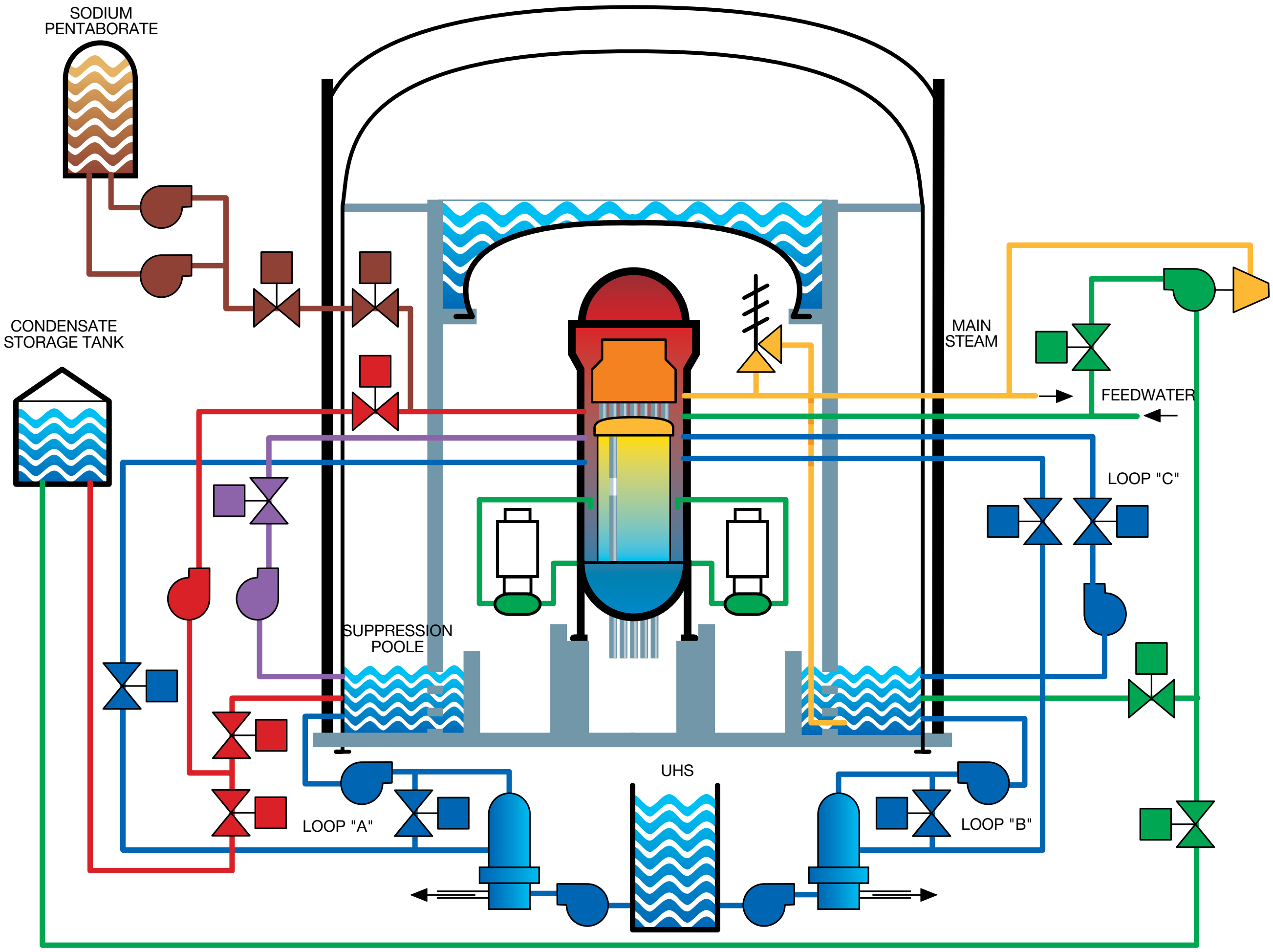
Safety during Extreme situations

The objective of the defence-in-depth principle applied during the design, construction and operation of nuclear power plants is to ensure people and goods are not harmed in any way.

Extreme situations can occur as a result of possible accidents that are beyond the control of nuclear power plants. These cases of force majeure include earthquakes, flooding, and hurricanes, among others or in situations as a result of a failure in the power plant.

In order to be ready and minimize the consequences of such, a series of probable events were analysed by reviewing historical data, and gaining in-depth knowledge of the local and regional geological, seismic, hydrological and meteorological characteristics of the area, as well as what other activities are being carried out in the area. Systems are designed and build in accordance with the results of these studies to ensure the power plant can be safely shut down and not harm people or the environment.

In the event an incident originated in the nuclear power plant, there are safety systems in place to impede radiological consequences. These systems are independent and redundant so that in the event one of these systems fails, the other ones will automatically actuate.



Cooling Systems

	HPCS	High Pressure Core Spray
	LPCS	Low Pressure Core Spray
	LPCI	Low Pressure Core Inyection
	RCIC	Reactor Core Isolation Cooling
	ADS	Automatic Depressurization System
	SBLC	Stand-By Liquid Control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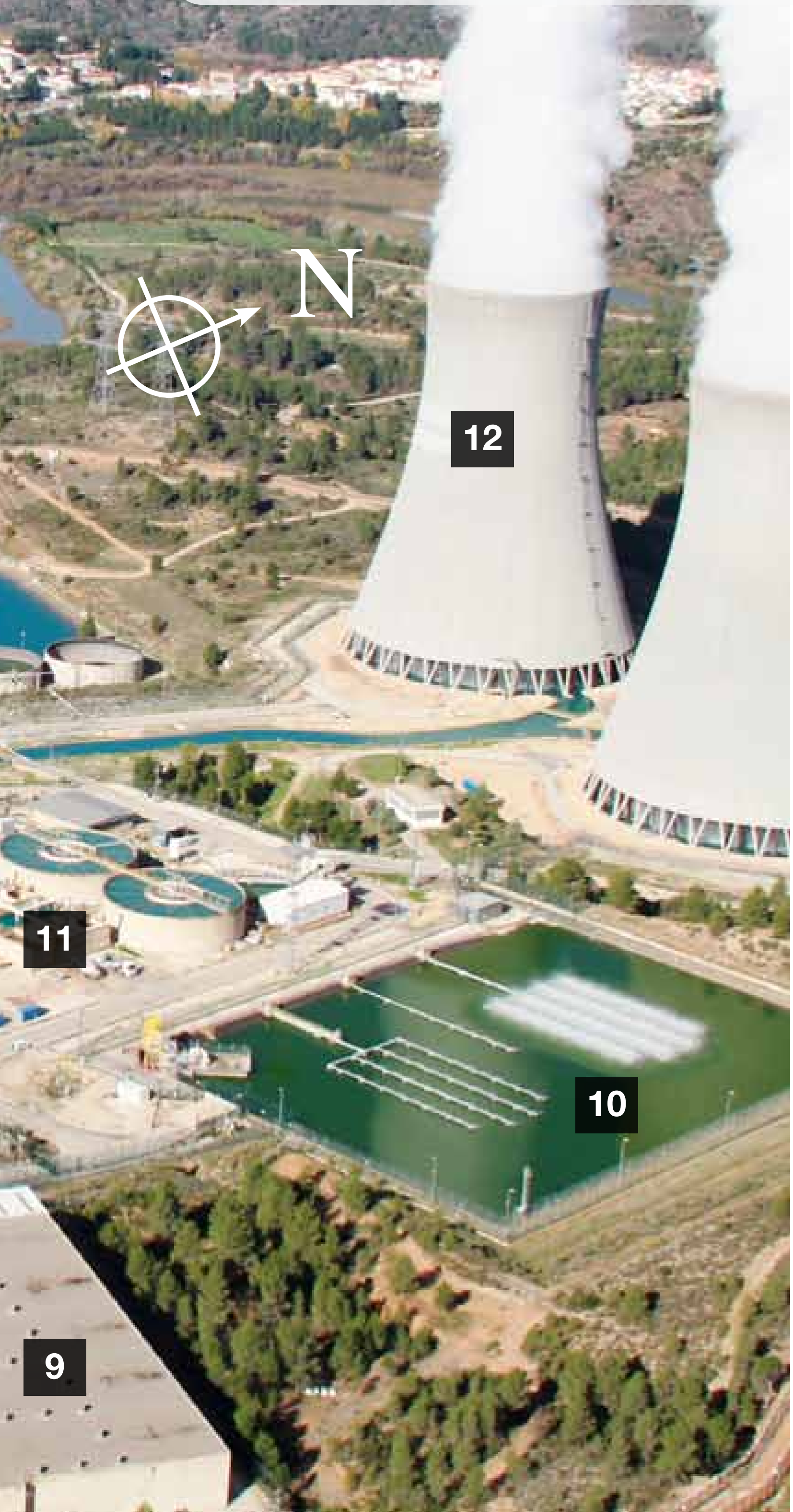
6 Site Map

The buildings are almost all located inside the exclusion area and within a 750 m radius from the reactor axis



1 Reactor Building
2 Service Building
3 Fuel Building
4 Auxiliary Building
5 Diesel Generator Building
6 Gas Exhaust Stack
7 Low-level Waste Treatment Facility
8 Turbine Hall
9 Low- and Mid-level Waste Storage Facility
10 Essential Service Water Tank
11 Water Treatment Facility
12 Cooling Towers
13 Discharge Tanks
14 Switchyard

Facility buildings can be grouped into three (3) main areas:

- Main buildings area
- Cooling services and liquid management area
- Outdoor station

The following buildings run from north to south: turbine hall, auxiliary building, reactor building and the fuel building. The auxiliary boilers, heaters, radwaste treatment building and diesel building are located to the east. The services building and electrical building are located to the west. Workshops and storage buildings, office buildings and canteen are located to the south west. The personal access point, office building and the medical services building are located further south west from the later.

Main Buildings

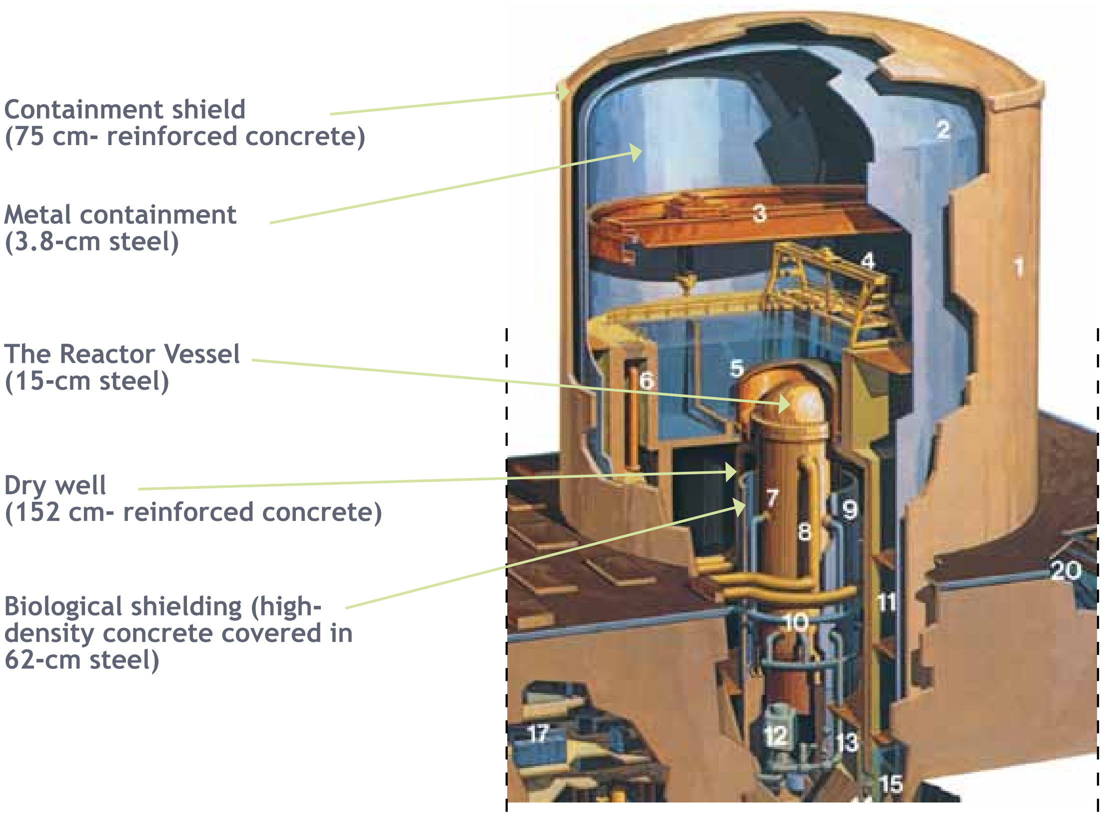
Reactor Building

The reactor building is a seismic-type 1 building and it is designed to house the reactor, the main reactor circuits and auxiliary components. It forms a 42-m circle and reaches a maximum internal height of 52 m. It is also equipped with a pressure suppression system that absorbs released energy and prevents fission products from being released into the atmosphere in the event of design basis accident (Loss of Coolant Accident)

The reactor vessel is located in the middle of the building and is supported by a pedestal. A shield covers its entirety and is comprised of the following layers:

- A dry well wall (absolute design pressure of 3.1Kg/cm^2) together with the top metal vessel head create a water-proof area. The only exit route is through the suppression pool,
- The ring-shaped pressure suppression pool is filled up with water to level 5.7 m and holds 3,200 m^3,
- The steel, cylinder-shaped containment is 58.5 m high (51.4 m at surface level) and 40 m in diameter. It forms an ellipsoidal dome that can bear an absolute internal pressure of 2.05 Kg/cm^2,
- The shielded building, made out of reinforced concrete and located in the centre of the metal containment area. There is 1.5-m space between each cylinder and which will remain at the same permanent depression as the atmosphere. The purpose of this is to ensure that if outside air makes it inside, it will prevent leaks to the atmosphere.

The upper fuel pools are located above the dry well and operation floor to load and offload the reactor. The 100 Tm polar crane is also located on this level.



Turbine and Generator Hall

The largest area of the facility measures 100 x 39.5 m and houses the following main components: the turbine and the generators. They are aligned and face north-south. It also houses the main condenser, where the turbine low-pressure bodies discharge, as well two steam dryers/heaters. It also houses the above mentioned components' auxiliary equipment.

Turbine characteristics

Type	Tandem Compound, 4 flows
Maximum power	1092,02 MWe
Speed	1.500 rev./min
Steam pressure upon intake	67,55 kg/cm^2
Steam temperature upon intake	282 °C

Fuel Building

The Fuel Building has the necessary equipment and installations to house new fuel until it is loaded into the reactor. It is equipped with two large stainless-steel covered pools that store used and irradiated fuel under water. These two pools are separated by a third, much smaller pool called the transfer pool. The transfer channel is connected to this pool as it connects this building to the pools located inside the containment building, above the reactor vessel. The channel is used to move new fuel elements to the reactor and move out spent fuel out.

Spent fuel storage

Auxiliary Building

The Auxiliary building is located between the reactor and turbine buildings and the steam channel passes through it. The tunnel is rectangular and made out of reinforced concrete. It penetrates the building to reach the dry well. It holds the main steam piping, feedwater piping and other process lines that connect the reactor to the turbine area.

Main Steam Piping

Other buildings

The main block of buildings is adjoined by other smaller buildings to the north-east.

Access Control Building

The access control building is equipped with surveillance equipment and scanners to check all personnel entering the protected area and ensure that nobody poses a physical risk to the facility.

Auxiliary Boiler Building

This building houses two small gas-oil boilers that produce 227 Kg/min of saturated steam at 8 Kg/cm^2. The steam is used in the sealed turbine glands as long as there is no nuclear steam in the well heating, hot condenser and during specific loading rates such as during turbo pump and heating tests.

Heater Building

This building houses high and low pressure heaters (except for those associated to the condenser heaters and drain chillers located in the turbine hall) and feedwater turbopumps (2 out of 80% unit capacity 12,000 HP.)

5B Heater

Radwaste Treatment Building

Liquid and solid radwaste are collected and treated in this area so as to not affect power plant availability and maintain the number of external discharges to a minimum.

Solid waste (dirty filters, depleted resins, contaminated materials and tools, among others) and concentrated active liquids are drummed with cement to eliminate the liquid state of the materials. Drums are stored in the temporary storage area within the controlled area and then shipped to a temporary solid radwaste storage facility.

Radwaste Treatment Building

Accessing the Controlled Area

A new access building opened in 2007. It is equipped with all the necessary dressing room services in order to facilitate personnel entry/exit and in accordance with radiological protection regulations.

New controlled area access point

Diesel Generator Building

This building houses three diesel generators in three independent rooms. Each generator is equipped with an alternator (6.3 kV generated voltage) that is actuated by the aligned motors working in tandem.

Service Building

The power plant's control room is located west from the auxiliary building. It houses all the auxiliary components and services, process computer room, the cable distribution areas, battery room and ventilation equipment.

Diesel sets

Control Room

Other facilities

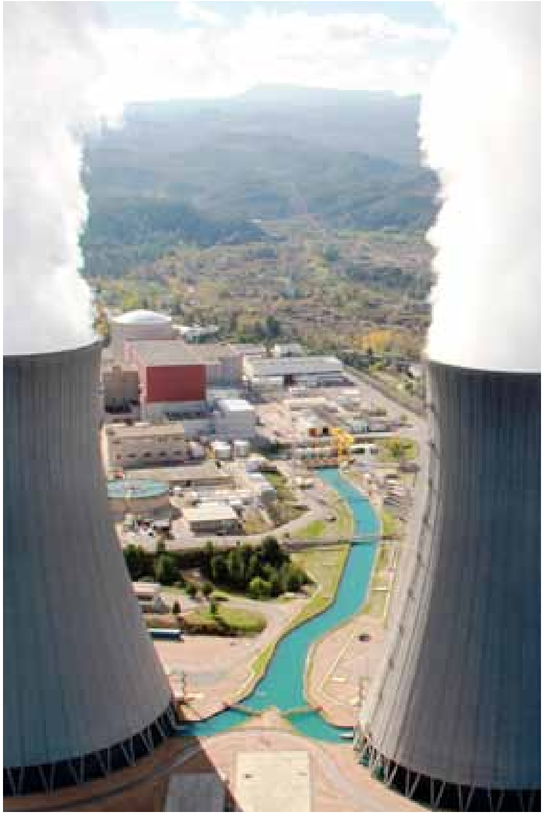
The remaining cooling, water treatment and discharge monitoring facilities are all located to the north of the above mentioned buildings. The following are also located in this area: cooling towers, circulation pump house and channels, water treatment building, the ultimate heat sink, several deposits, discharge control ponds, etc.

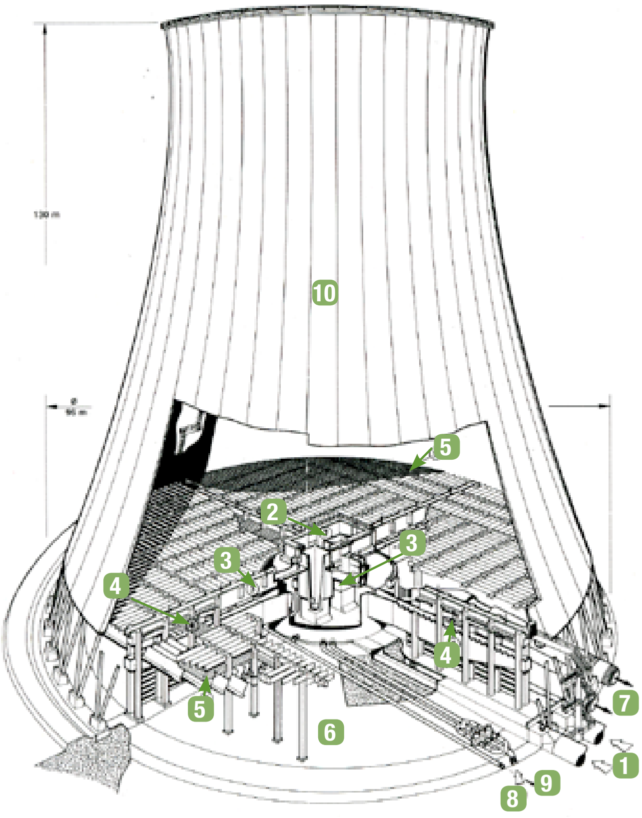
Cooling towers

Cofrentes Nuclear Power Plant is cooled via a closed circuit and natural draft cooling towers. These towers measure 130 m high and 90 m in diameter at the base. The water coming from the main turbine condenser cooling is sent to the towers via a closed piping system. It is cooled when it is pulverized against a counterflow of rising air. Water exits the bottom of the cooling towers via a uncovered channel to the outdoor circulation pump house, where four (4) helical pumps, with a vertical shaft and a unit capacity of 2,800 HP propel a cooling flow of 34 m^3/s to the condensers to close off the circuit.

Atmospheric cooling via natural draft towers

1. *Cooling water mains*
2. *Hot water outlet*
3. *Cooling water distribution system*
4. *Cooling water distribution piping*
5. *Droplet separator panels*
6. *Cooled water collector pond*
7. *Cooled water outlet mains*
8. *Make up water mains*
9. *Drainage pipes*
10. *Rising air draft conduct*





Water Treatment Building

The water treatment area is located between the cooling towers and turbine hall. It is a separate and independent area. It houses all the equipment required to control the quality and purity of the cooling circuit water. It also houses the necessary equipment to treat the makeup required for different plant uses.

The Interior of the Water Treatment Building

Essential Service Water Tank

ast of the treatment area. The purpose of this tank is to supply water to plant essential services for 30 days during shut-downs, without external provisions. It is a large seismic type-1 tank and it holds an active volume of 82,500 m^3 of water (free surface; 13,579 m^2; depth: 8.25 m). It is equipped with sprinklers to cool the closed circuit and has its own pump house.

Essential Service Water Tank

Discharge ponds

There are two (2) ponds to the south-west of the cooling towers and they hold 130,000 m^3. There are three (3) regulating reservoirs that hold up to 5,500 m^3 and collect plant liquid discharges before they are analysed and discharged in a controlled manner into the river.

Discharge Ponds

Temporary Drum Storage Building

The Temporary Drum Storage Building is located east of the buildings and it is used to store low and medium, solid radwaste. It has a capacity to store for a lifespan of 20 years.

Temporary Drum Storage Building

Off Gas Tower

All gaseous effluents are released through this tower once all the required radioactivity controls are conducted. The stack is 75 m high and the purpose of this stack is to ensure a complete surveillance and control of the emissions as well as better atmospheric dispersion.

Outdoor switchyard

The 400 kV switchyard is located in the western area of the site. It is located at level 347 m which is 25 m lower than the other facility buildings. It is a one and a half-breaker type and has six (6) outgoing lines: Minglanilla, Ayora, La Eliana, La Muela, La Muela II and the hydroelectric installation CORTES - LA MUELA to transport electricity produced by the power plant.

There is also a smaller 138 kV switchyard located at level 372 to the west of the Electrical Building. Two lines are connected to this switchyard from two nearby hydroelectric installations (Cofrentes, Cortes and Millares) which provide the power plant energy during start-ups and shutdowns.

The facilities that provide make up water are located outside the above mentioned facilities. There is an intake structure and a pump house located downstream from the Júcar and el Cabriel junction near the Embarcaderos dam.

Off Gas Tower

Outdoor switchyard

7 Waste Management

Final radwaste management and storage in Spain is allocated to ENRESA

Nuclear power plants and all other waste-producing industrial facilities treat waste so as to not impact the community or the environment.

Waste Classification

Radioactive waste is classified into two categories:

- a) Low- and intermediate-level radwaste: *these two types of waste are treated the same way and they are cemented in steel drums. Intermediate-level radwaste is mainly made up of ion exchange resins and evaporator concentrates. Low-level radwaste includes protective clothing (coveralls, gloves, etc.) and small tools used while conducting maintenance operations.*
- b) High-level radwaste: *this includes spent fuel elements extracted from the reactor during outages and temporarily stored in the spent fuel pools located inside nuclear power plants.*

The management of these types of waste is allocated to the company ENRESA in Spain. ENRESA is a public company regulated by the Government through Royal Decree. Its finances and action programs are approved by members of a democratically-elected Parliament. ENRESA has implemented six (6) waste management plans since it was first created. It has revised the technical stages and actions that make up the overall radwaste management process. It has also studied trends and changes made by other countries.

El Cabril Waste Storage Facility

Low and intermediate level waste is temporarily stored in nuclear power plants until it is permanently transported to El Cabril Waste Storage Center in the municipal district of *Hornachuelos* in the province of Cordoba. This facility is designed and built to meet all current requirements regarding the storage of these types of waste including the waste originating from power plant decommissioning.

Low and Intermediate Level Radwaste Treatment

Gases, liquids and radioactive sludge are also treated to separate and concentrate the different radioactive elements. Contaminated tools, clothing and pieces of equipment (all low level) are also stored in hermetically-sealed steel drums.

Cement, tar or resin is used to solidify radwaste in steel drums. Afterwards, the drums are hermetically-sealed. These drums are also temporarily stored in buildings, located at the plant and especially designed for this purpose; until the level of radioactivity drops (stored in the same manner as spent fuel).

Drum handling

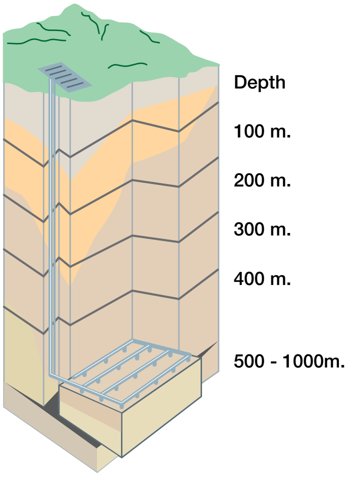
High-level radwaste Treatment

When fuel elements can no longer produce energy profitably, they are extracted from the reactor and temporarily stored (from 6 months to years) in pools of water. These pools are built out of concrete and stainless steel walls, and located in an area of the power plant that has been specifically designed for this purpose.

Three barriers (water, concrete and steel) ensure that spent fuel radioactivity levels gradually lower and prevents a release.

After spent fuel has been temporarily stored, it is transported to reprocessing plants where the fuel is recycled. Radioisotopes are also recovered and used for medical, agricultural and industrial purposes.

Maximum safety precautions are followed when transporting high-level radwaste. The containers used during transportation are accredited and subject to the most rigorous controls and tests.



Drawing of the Permanent Waste Storage in stable geological formations

Containers are subject to the following tests:

- free-falling from a height of nine (9) meters onto a flat and hard surface,
- exposed to 800ºC fires for 30 minutes, without the use of any type of cooling system,
- submerged in 1-m deep water for at least eight (8) hours.

Stored in stable geological formations (e.g. saline or crystalline). It has been proven that these formations remain unchanged after millions of years and lack any water currents that could hypothetically carry the waste to the trophic chain.

A high-level radwaste management facility is currently under construction in the municipality of Villar de Cañas in the province of Cuenca. The facility will temporarily store all of the spent nuclear fuel generated in Spain at a single location.

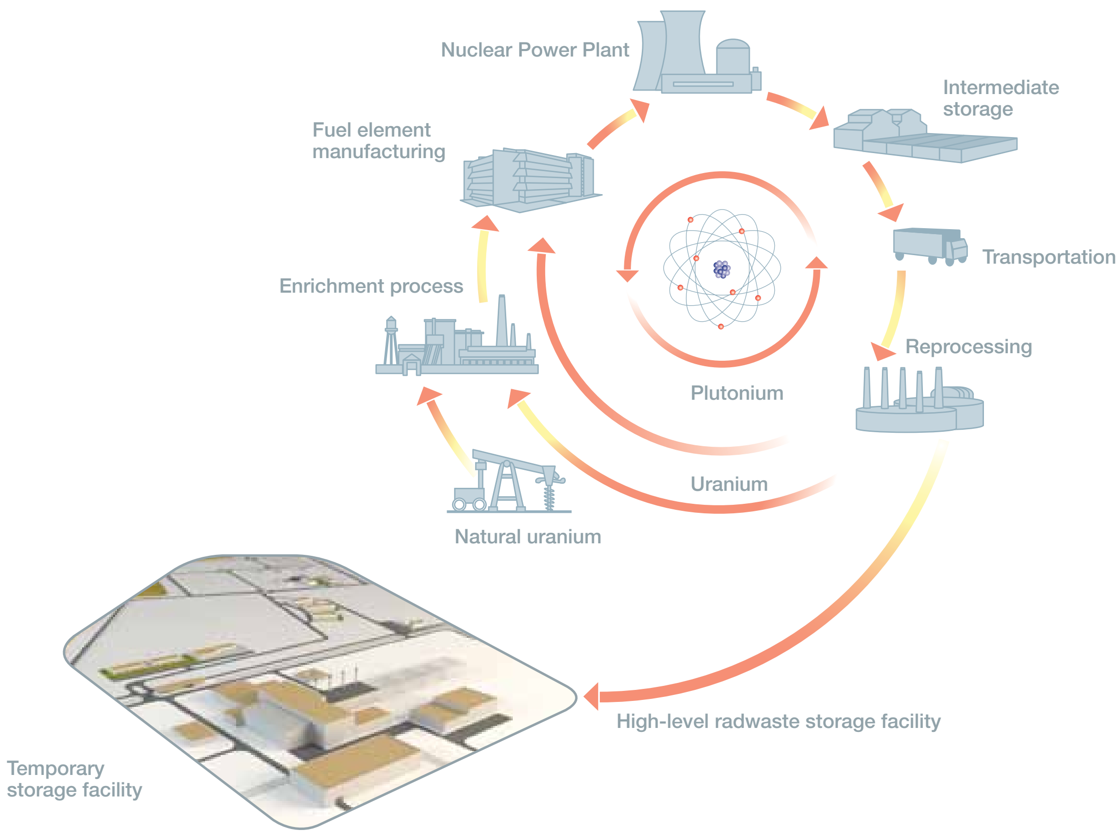


Diagram of a fuel closed circuit

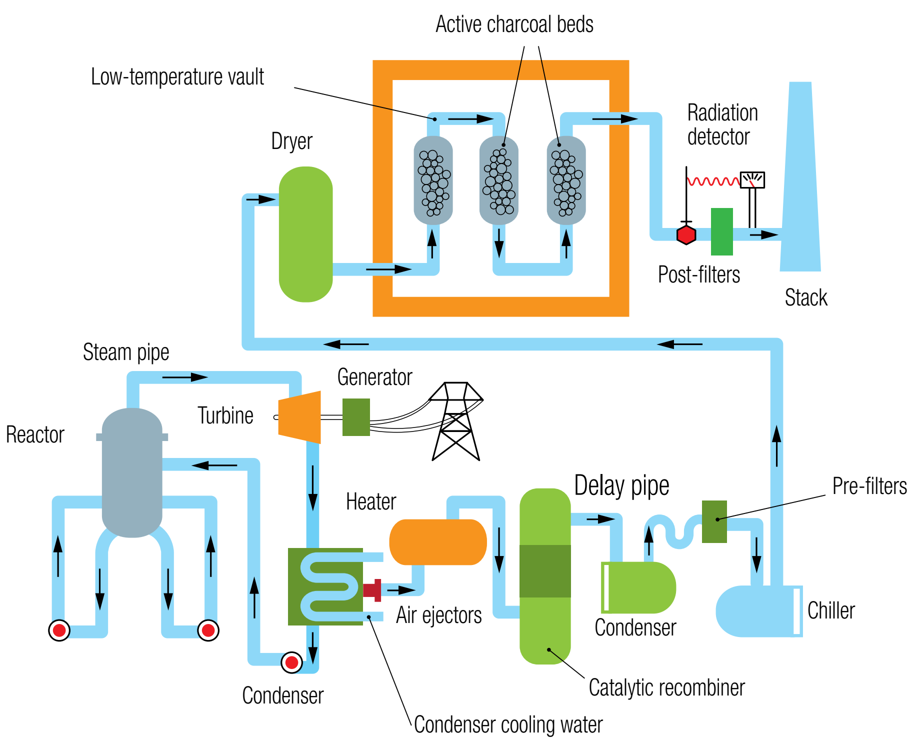
8 Radiological Protection

Radiation detectors are located throughout the facility

The primary circuit of the power plant is always active to ensure:

- The coolant atoms are activated when going through the reactor core.
- The corroded products are activated, under the same circumstances, and carried down by the coolant.
- Fission of the Uranium outside the fuel rods (small residual impurities resulting from the fuel element manufacturing process)
- Fuel rod fission by-products are released in the event of zircaloy cladding flaw.

The gas treatment system processes and captures those that are free-moving in the condenser until activity levels decrease.



Gas treatment system

The Condensate Treatment System (100% capacity) captures a large majority of the active ions in its resin bed. Even though all these systems are in place, small leaks are inevitable during normal plant operation. The fact that there is a significant number of process equipment and piping that contain active liquids obligates the plant to have a network of detectors set up throughout the plant to detect any potential leaks. This allows personnel to know the levels of radiation and potential contamination risks in work areas at any given moment. In addition to these permanent pieces of equipment, RP personnel have access to a wide range of portable equipment to identify and contain contaminated areas. Direct-read and thermoluminescent dosimeters are used to determine the average dose each individual receives. The thermoluminescent dosimeters are more precise.

Permanent feet/hand and whole body detection gates are used to prevent potentially-contaminated people or equipment from leaving the controlled area. Internal contamination is measured in people with Whole Body Counters (WBCs). The WBCs are located in a room especially equipped for this purpose.

During plant operation, potential primary circuit leaks are controlled and discharges are practically unnoticed.

However, during normal plant operation, radioactive substance discharges and releases are very small and the dose received by individuals living in proximity, is practically insignificant, if compared to the doses received from natural radioactive sources and medical practices (e.g. X-rays, cobalt-therapy, application of isotopes in nuclear medicine, etc.) used in the developed world.

Readers

Gamma detection gates

9 Water Treatment System and Plant Liquid Management

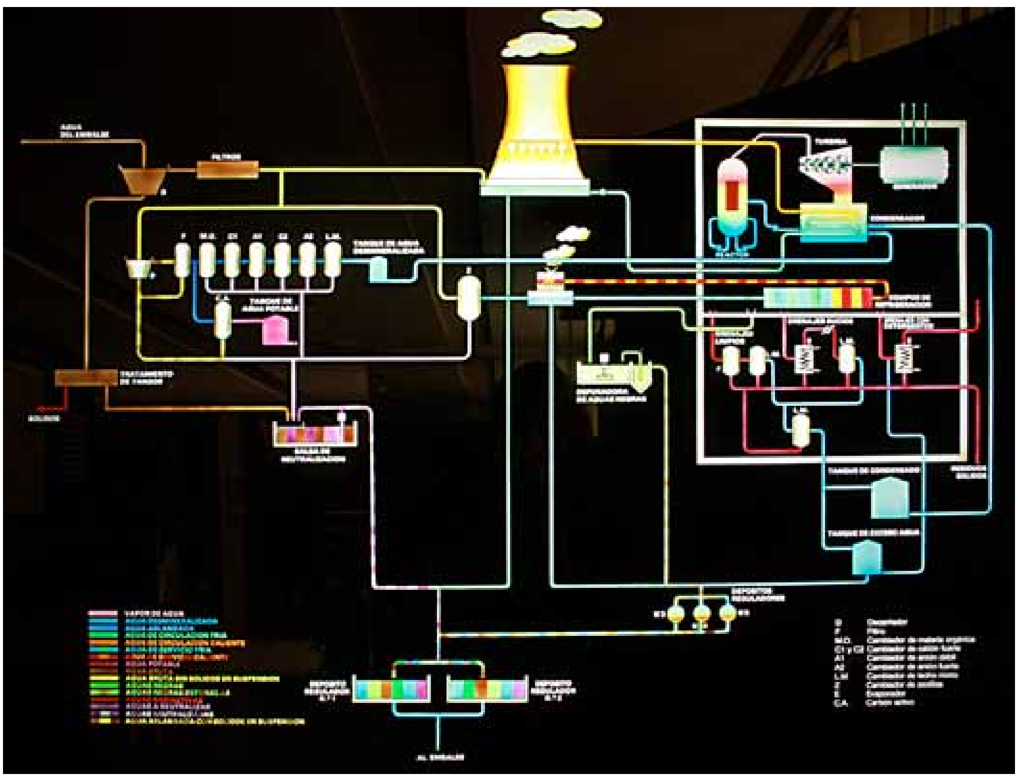
The plant needs a series of water systems to operate. Each of these systems has specific characteristics and roles

Intake systems and treatment

All the water needed for plant operation is obtained via the pump house located 5 km north west from the main buildings. The pump house is equipped with three pumps that provide 1,100 L/s to the first water treatment plant where it is decantated and filtered. Any suspended river matter is eliminated.

Primary Circuit Water Treatment System

Some of the filtered water is filtered via three 100% pressurized sand filters. It is then demineralized in two ion exchange chain resins. The obtained water can now be used as make up water in the primary circuit. Each one produces 30 m^3/hour.



Main cycle

Facility Service Water System

This system is used to cool most of the non-safety related plant equipment. It is equipped with three mechanical draft towers that recover losses with filtered water and control purges to maintain two to three cycles of concentration. The softened water from the first step is processed through an additional softening in the zeolite exchangers. It has a production capacity of 1,520 m^3/day.

Essential Service Water System

This is the first back-up system that is always available. It is to be used to cool safety systems during accidents or when the regular reactor coolant system fails. It is also equipped with a 79,800 m^3 backup reservoir that is connected to the sprinklers located on the hot water return mains. Water lost as a result of natural evaporation is restocked with filtered water. This water is continuously supplied to prevent salt concentrations from collecting.

The reservoir is also subject to a chlorination treatment to remove any organic matter.

Neutralization System

All water treatment system effluents are sent to a neutralization tank where pH levels are stabilized between 5.5 and 9 before being discharged into discharge tanks.

Mechanical Draft Towers

Discharge System

All plant discharges are conducted in a controlled manner. Discharges are sent to a collection system where the content is analysed before being discharged in order to ensure the process is respected.

There are two types of effluents classified as:

- Non-radioactive.
- Potentially radioactive.

The first category represents the highest volume and is mostly the result of natural draft cooling tower purging. Non-radioactive effluents are stored in two separate 130,000 m^3 tanks for three to four days and then analysed before being discharged.

Potentially radioactive effluents are stored in three 5,500 m^3 tanks. The effluents are analysed before being discharged into the non-radioactive discharge tanks.

The final discharge is conducted once the regulatory bodies, the Hydrographic Confederation of Júcar and the Nuclear Safety Council of Spain have authorized the discharge into river, after verifying that all the established discharge requirements have been respected.

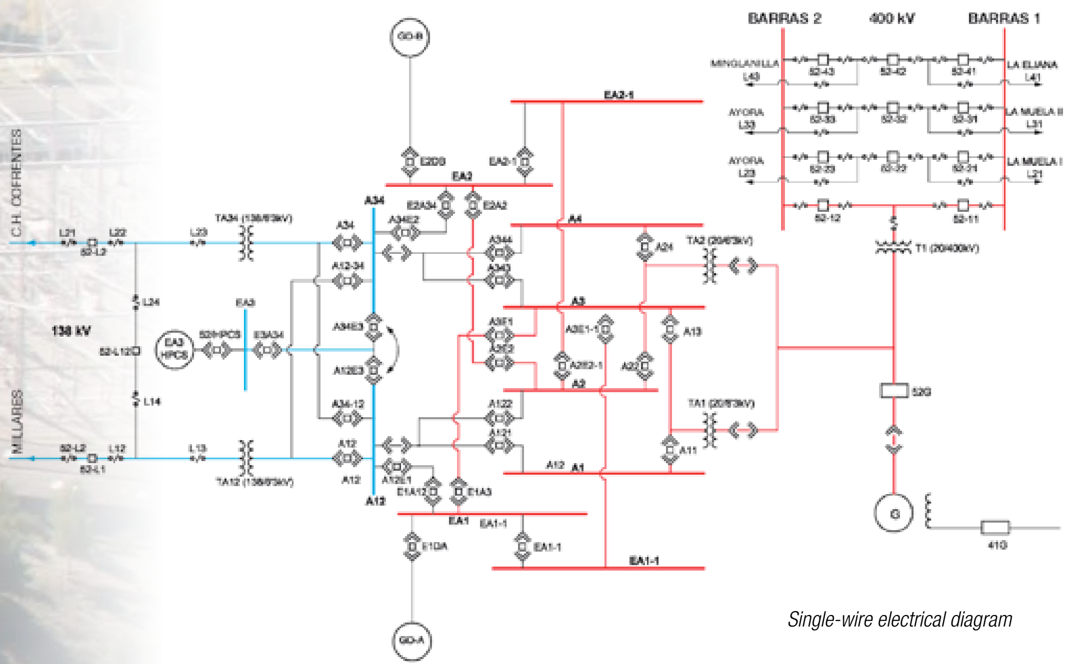
Depósitos reguladores

Electrical System

The plant's electrical system is divided into five areas:

- Production
- Distribution and transport
- Auxiliary services
- External power
- Generation breaker

In the event the plant lost its capacity to power itself by the 6.3 buses or its emergency power supply provided by 138 KV switchyard, the plant can be powered by the external 400 KV grid. A generation breaker was installed in 1997 between the generator and the main transformer to isolate the 20 KV output of the main transformer's main generator (T1) and auxiliary equipment (TA-1 and TA-2) in the event of a turbo generator trip. This allows the plant to be powered with power from the national electrical grid. This provides the plant with an additional source of power from a stable and reliable network that ensures plant system availability and operation at all times.



Single-wire electrical diagram

10 Instrumentation and Control

The following describes the main control functions performed by a Boiling Water Reactor:

- Control the power of the unit.
- Control plant safety.
- Monitor process fluid and emissions to the exterior.
- Monitor plant operation and performance.

The above mentioned functions are automatically performed based on the pre-established instructions and guidelines determined by control room operators.

There are other secondary control functions that impact auxiliary systems and equipment. These are available to operators from the control room, or operators are equipped with the necessary information to give localized orders.

Nuclear Safety Monitoring

There are several nuclear safety systems in place at the plant that are activated during abnormal plant conditions. These include high pressure in the dry well, low water levels in the vessel, high pressure in the reactor, high neutron flux levels, high levels in the Scram chamber, rapid closing of the turbine valves, main steam line isolation, high radiation levels in the steam tunnel, excessive leaks or low pressure in the turbine inlet.

The three main functions are:

1) *Automatic reactor shut-down*

2) *Nuclear system isolation*

3) *Emergency System Actuation*

Control Room

Computerized Plant Operation and Performance Surveillance System

Operation and Plant Nuclear Engineering personnel have access to three computerized systems, in addition to the already-available control systems. SIEC - Integrated Computerized Process System, nuclear calculations and, conduct and supervision during emergency situations.

Process computer

The purpose of this computer is to conduct reactor core calculations and provide data regarding reactor technical limits, power, core distribution, power density, isotopic composition of the core, monitor range sensitivities and several other correction factors.

Information System and Operation Support during Emergencies

A powerful information system was installed to comply with licensing requirements following the 1979 TMI accident in Harrisburg, U.S.A. The system processes approximately 1,900 signals and its functional results are:

- Emergency Information function groups (SPDS: Safety Parameter Display System)
- Support function groups for Operation personnel.

Nuclear Calculation Computer (NCO)

The NCO is designed to monitor the reactor core and provide information to assess past, current and future nuclear fuel behaviours through the use of a software called 3D-MONICORE.

11 Safety

Minimize the possibility of an accident from taking place and minimize its impact in the event of an accident

Safety, currently understood and applied to nuclear reactors, known as the safety concept of defence-in-depth has two clear objectives:

1- Minimize the chance of an accident from taking place.

2- Minimize the impact of an accident, should one take place.

This dual purpose is reflected in the following three modes of operation that condition the design, construction and operation of modern nuclear power plants:

- inherent safety integration in the planning and design,
- rigorous quality control compliance,
- integration of plant protection and safety systems.

It is important to stress that radioactive product discharges originating in the core and released offsite are prevented as a result of the successive barriers that are in place. These barriers include the cladding that wraps the fuel pellets, the vessel, the dry well; the metal containment and the containment building.

Cofrentes is also equipped with state-of-the-art fire extinguishing systems as well as access control and safety measures.

Stress tests were conducted on all Spanish nuclear power plants following the Fukushima accident in March 2011. The results of these stress tests resulted in establishing new and more robust power plant protocols and improvements:

- Plant flood risk
- Plant vulnerability
- Total loss of AC power
- Connections to other power grids
- Portable on-site power generating equipment
- Pool cooling
- Hydrogen and containment building pressure control

The Environment and Cofrentes Nuclear Power Plant

1 The Plant and Surrounding Areas

Cofrentes Nuclear Power Plant is located in the valley of Ayora-Cofrentes. It is located in the south-eastern part of the province of Valencia

The valley of Ayora-Cofrentes is formed by a depression in the limestone massifs of the area: the mountain ranges of Boquerón, Sierrecilla and Palomera; to the west, the mountain ranges of La Muela de Cortes de Pallás; and to the east, the mountain range de Caroch.

The area around the power plant is quite rugged so farming is difficult. The only areas that can be used for agricultural purposes are along the Júcar, Cabriel and Jarafuel rivers. The dryness of the land and the Mediterranean climate is ideal for olive and almond groves. Pine trees begin to populate the area as one moves further east and higher up. These pine trees are mostly Aleppo and Maritime Pines.

Most of the livestock found in the region is made up of sheep and goat. There are also mostly stabled pigs and cattle. There are also native wild animals such as the wild boar and mountain goat. They are typically found in the more mountainous region of the valley, especially in the National Park of *La Muela de Cortes*.

There are about 10,000 people living in various towns within a 20-km radius. The population density per kilometre is very low compared to that of the province of Valencia or the rest of Spain. The demographic previsions indicate the population will stabilize and will not have any significant impacts around the plant during the life of the plant.

2014 Population Census

Municipality	Inhabitants	Km²
Ayora	5.359	441,42
Cofrentes	1.097	102,00
Jalance	927	93,30
Jarafuel	805	107,50
Teresa C.	620	113,90
Zarra	484	49,20
Total	9.292	907,32

Valley of Ayora-Cofrentes

- Total Surface Area .... 90.469 Ha.
- Productive Surface Area .... 84.252 Ha.
  - Arable 24%
  - Forests and pastures 76%
- Unproductive Surface Area .... 6.217 Ha.

Highway N-330 connects the towns of Requena and Almansa. Most of the towns in the area are located off this highway. The plant site was selected by following a selection process based on other energy-producing facility criteria. The criteria included a cooling medium, ground suitability, areas of consumption, and specific criteria required by nuclear regulatory bodies.

Studying these requirements allowed to perform a technical assessment of the selected site and include the appropriate measures to ensure plant operation has the least possible impact on the surroundings. The following were all studied and the results of the study were presented to a competent body to demonstrate the integration of the plant with the area around the power plant as regards to the conservation and maintenance of the ecosystem of the area of influence of the plant: agriculture, livestock, habits of the population, seismology of winds, rain, demography, animal species, air and river water temperatures throughout the year, communication routes, and ambient humidity, among others.

2 The Environmental Management System

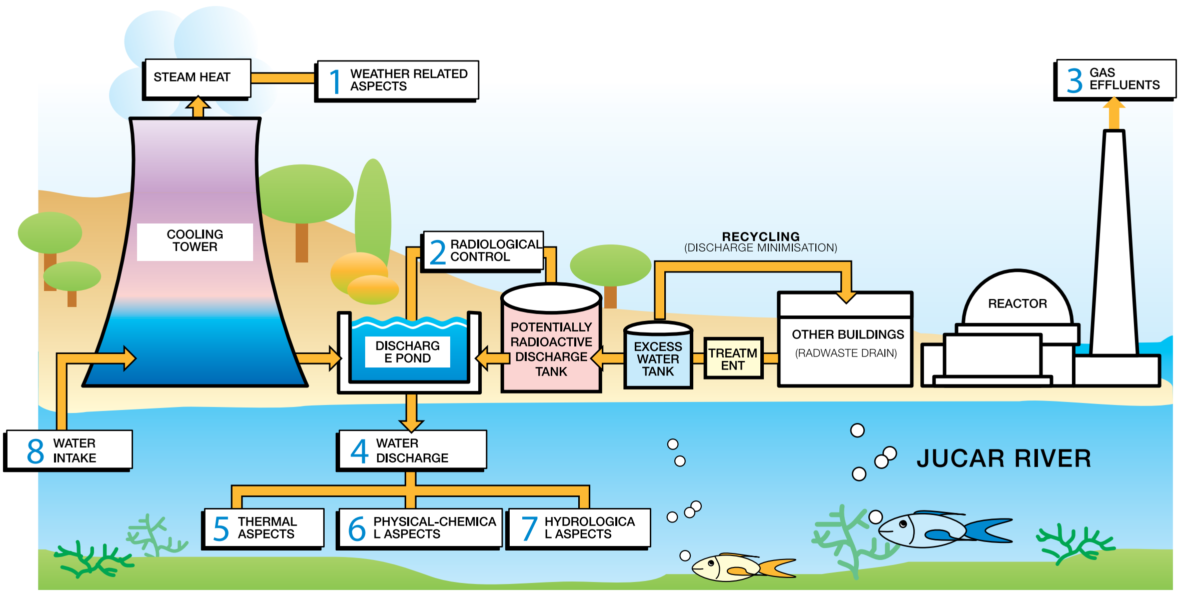
Environmental Protection

The following illustration shows the overall theoretical model of how a nuclear power plant could impact the Environment. Foreign studies and continuous power plant operation observations have permitted to gain enough experience to safely analyse the different and potential types of impact a nuclear power plant could have on the environment. It also allows studying more closely the most vulnerable areas identified in the drawing.

Based on this model, the drawing illustrates the spots specific to the Cofrentes Nuclear Power Plant.

› diagram 1

Drawing of the overall impact



1- Maximum evaporation of 0.75 m^3/s. 1% humidity increase. Global warming set at less than 0.1ºC.

2 - Radiological potability analysis.

3 - Continuously measure gaseous discharges to ensure authorized levels are not exceeded.

4 - Radiochemistry control and potability certification before being discharged into the river.

5 - Thermal impact on the rivers is barely noted because of the cooling towers: 04ºC.

6 - Upstream and downstream chemical analysis to ensure salts are less than 10% in upstream.

7 - Two sediment and water samples per weather station (8). The value is average if compared to other rivers.

8 - Authorization from the Hydrographic Confederation of Júcar at 20 Hm^3/year. Annual average consumption 19 Hm^3/ year.

Cofrentes Nuclear Power Plant implemented an Environmental Management System to ensure the environment is protected from the possible consequences of electricity production.

The Environmental Management System complies with UNE 77-801-94/EN-ISO 14001 and is certified by AENOR since December 11, 1996. This demonstrates the plant complies with all existing legislations. It also proves that all environment-related items are documented and the quality of the environment is continuously improving.

The Environmental Management System is part of the overall management system that defines environmental policies, organizational structure, responsibilities, practices, procedures, processes and resources used to enforce this policy within the general objective of TOTAL QUALITY that affects all Cofrentes NPP personnel. The plant created an environment committee and it is chaired by the Plant Manager. The other members include all the department heads whose department activities have environmental implications.

Cofrentes Nuclear Power Plant studies all plant activities to identify, prevent and minimize environmental impacts. The facility is committed to:

- Complying with applicable environmental protection legislation whenever possible; being stricter when defining acceptation criteria.
- Protecting the environment located around the Cofrentes Nuclear Power Plant.
- Minimize environmental impacts of tasks by continuously improving and updating environmental management policies throughout the plant.
- Prevent the site and surrounding areas from being contaminated by implementing appropriate technical and administrative safeguards.
- Foster environmental awareness among all plant personnel.
- Establish and maintain communication processes with stakeholders —especially with the local community—regarding environmental concerns
- Make the Annual Environmental Report available to the public and include adopted environmental objectives.
- Define and monitor the environmental program and objectives.


Certificado del
Sistema de Gestión Ambiental

AENOR
Gestión Ambiental

GA-1996/0008

IBERDROLA GENERACIÓN NUCLEAR, S.A.U.
Central Nuclear de Cofrentes

AENOR

IAF ENAC IQNet

Cofrentes Nuclear Power Plant is committed to producing electricity while respecting the environment, and using natural resources in a sound manner so as to contribute to sustainable development. Environmental management development and integration is based on the following principles:

- Respect the environment and minimize environmental impacts.
- Use raw material and energy soundly.
- Foster a protective and respectful environmental culture when conducting design, operation and maintenance activities.
- Manage waste by applying minimization-at-the-source criteria, recycling, recovering, and when possible, eliminating it all together by choosing the method that has the least environmental impact.
- Take into account environmental impact when procuring materials and hiring services.
- Ensure stakeholders uphold this commitment and responsibility by complying with the regulation UNE-EN-ISO 14001: "The Environmental Management System"
- Train and inform plant personnel by sharing internal and external environmental experiences and instilling a respectful attitude towards the environment.

3 The Plant and Water

The impact of Cofrentes Nuclear Power Plant on the aquatic environment mainly manifests itself in biological and hydrological thermal effects...

All power plants that use steam turbines, including those which use fossil fuels (natural gas, carbon, fuel oil) and nuclear power plants, require a source of water to act as a coolant and produce steam condensate. As the steam condensate expands in the turbine, it moves the generator and produces electricity *(diagram 2)*.

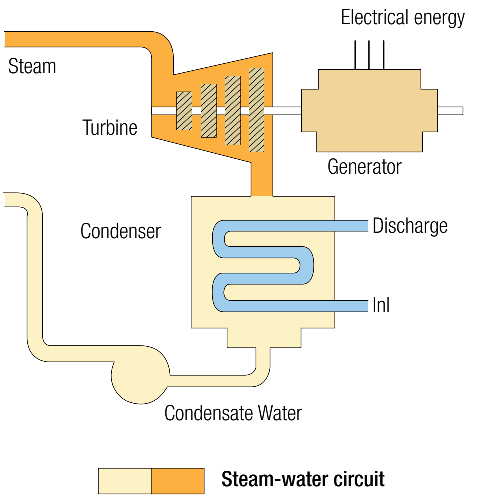
The most commonly used cooling systems are listed in Diagram 3: open-circuit circulation and closed circuit with cooling towers. In open-circuit circulation, water is completely returned to the source where it was taken and slightly warmer. However, in closed circuits, temperature increases are rare. This temperature increase is practically non-existent.

Cofrentes NPP uses a closed-circuit cooling system.

The average flow of the Júcar River where the plant is located is 45 m^3/s. The plant was designed to use 1.1 m^3/s and the maximum intake per year is 34.7 Hm^3/year. 0.75 m^3/s of the flow evaporates through the natural draft cooling towers and the remaining 0.35 m^3/s returns to the river via the only controlled discharge location and after a series of chemical and radiochemical analyses are conducted beforehand to determine radiological potability as per the requirements stipulated

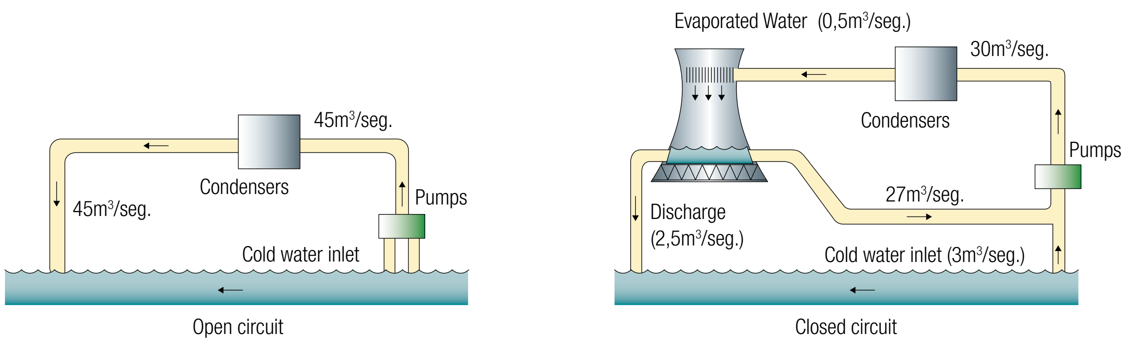
› diagram 2

Simplified drawing of how conventional electrical or nuclear plants are cooled



› diagram 3

Diagram of the open and closed cooling circuits



by the Hydrographic Confederation of Júcar and written in the “Cofrentes NPP Discharge Rule” and approved by the Regulator.

Cofrentes Nuclear Power Plant’s impact on the aquatic environment is illustrated in *diagram 1 (page 55)*. The origin and importance of the thermal biological and hydrological effects are described below. Based on the aforementioned values, salt level concentrations produced by the plant are easily assessed by comparing the amount of salts dissolved in the Júcar river (following the described cooling process), and the amount of salts subsequently returned to the river. Water evaporation hardly increases river salt concentration levels at 1.4% which is usually not perceived by normal analysis methods.

Discharge characteristics are also controlled and monitored before discharging into the river to maintain water quality levels as per the limits set by the corresponding Administrative Authorization. The process is facilitated because there are two discharge tanks and one single emission point every four (4) days of plant operation.

On the other hand, the water that is used must have the appropriate physical-chemical characteristics to ensure good plant equipment operation. As a result of river water being analysed since 1976, chemical impacts of the plant on the Júcar River can be determined and monitored. Water analysis results are compared on a monthly basis by the Hydrographic Confederation of Júcar. Upstream and downstream samples are taken and the potability discharge condition applied during the radiochemical analysis and salt level increase is less than 10%.

CHEMICAL AND RADIOCHEMICAL CONTROL OF THE JÚCAR-CABRIEL RIVERS

- Upstream and downstream analysis of the Júcar and Cabriel rivers are conducted and compared every 15 days.
  - Chemical analysis: Δ salts < 10% upstream
  - Radiochemical analysis: potability

LIQUID DISCHARGES

- Radiochemical analysis. Radiological Potability Certification.
- Chemical analysis.

The water intake structure was built by taking the necessary precautions to ensure it hardly affected the Júcar riverbed and reservoir. The fact that a hydraulic plant was already in place also influenced the choice of liquid effluent superficial discharge. This means that the construction of the plant did not affect the flow of the river. In addition, all plant buildings are waterproof which prevents leaks from taking place. Based on these considerations, the hydrological effects are minimal.

The type of cooling used by the plant isolates the plant from the environment and ensures biological and thermal effects on the river are practically nil *(diagram 4 and box 1)*.

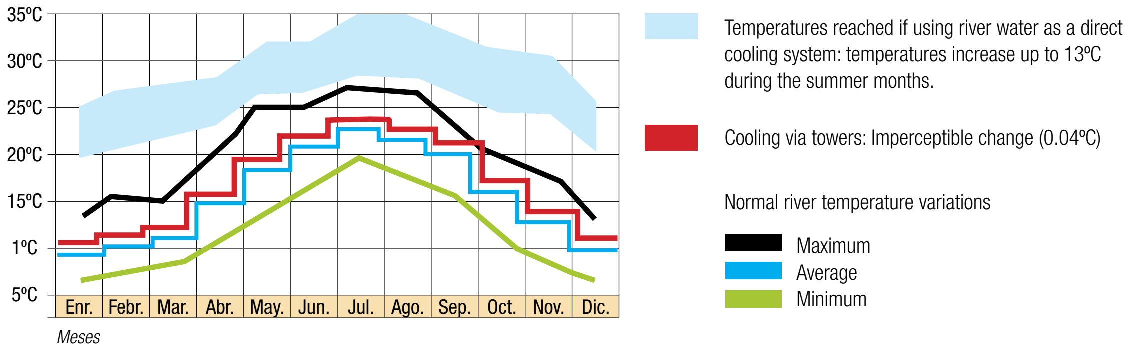
In regards to liquid discharge radioactive contamination, the analytical model that is used to calculate the potential paths of the discharged rad material in superficial waters is based on *diagram 5*. Individual dose limits are stipulated by the corresponding Administrative Authorization.

› box 1

- · Total discharge tank storage capacity .... *259.512 m^3*
- · Average flow of the Júcar River (Q) .... *45 m^3/s*
- · Plant water concession (2,44% Q) .... *1,1 m^3/s*
- · Returned flow to the river (0,78% Q) .... *0,35 m^3/s*
- · Maximum consumption flow (1,66% Q) .... *0,75 m^3/s*
- · Annual collection limit .... *34,7 Hm^3*
- · Average temperature increase of the Júcar River .... *0,04 ºC*
- · Natural extreme weather variations in the Júcar River .... *20 ºC*

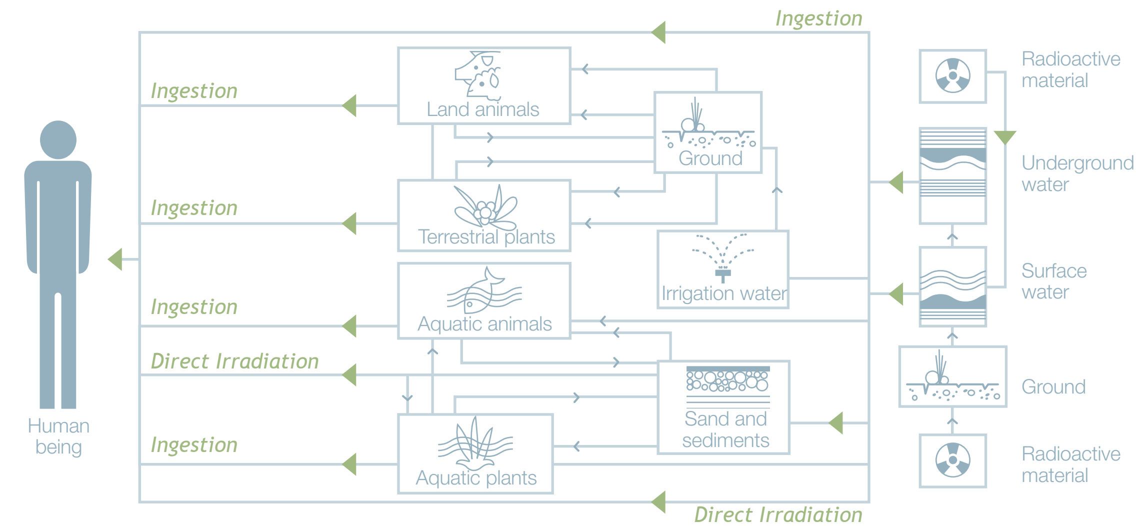
› diagram 4

River water temperature comparison with and without cooling towers

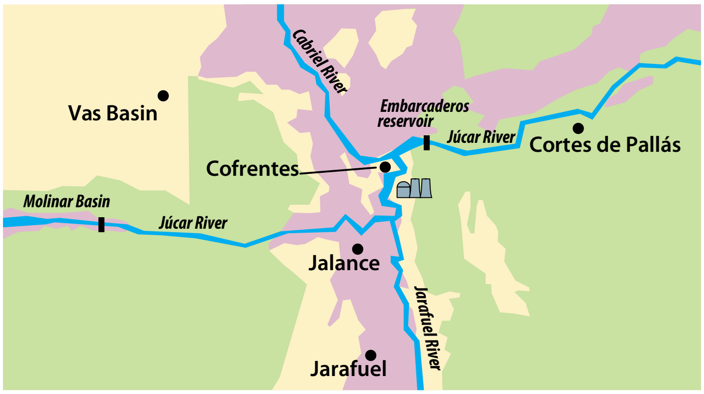


› diagram 5

Path of radioactive materials discharged in surface waters



The way the river curves through the land reflects existing correlation between the chemistry and geology of the river *(diagram 6)*.



› diagram 6

Júcar River Geology and Chemistry

Characteristics

- TRIASSIC - Gypsiferous clay limestone and loams
- CRETACEOUS - Limestone and loams
- TERTIARY - Clays, loams and limestone

Water characteristics

		El Molinar	Jarafuel	Cabriel	Embarcaderos
CONDUCTIVITY	(!-! mhos / cm)	770,00	1.120,00	1.100,00	900,00
PH		7,70	7,86	7,99	7,99
CALCIUM	(mg / l Ca++)	117,90	196,50	149,40	135,60
MAGNESIUM	(mg / l Mg++)	37,00	51,30	44,10	41,1
CHLORIDE	(mg / l Cl -)	46,60	86,10	146,70	101,90
SULPHATES	(mg / l SO_4 =)	190,00	360,00	263,00	220,00
NITRATES	(mg / NO_3 -)	8,90	7,30	5,30	8,00

4 The Plant and the Air

The possible effects the plant may produce on the atmosphere are due to steam released by the cooling towers and gaseous radioactive effluent emissions produced during plant operation

Cooling tower steam could theoretically affect the micro climate of the area where the power plant is located because of the contents and temperature of the steam released by the towers. This information has been compiled since the plant first began to operate 30 years ago.

Mathematical models are developed to study cooling tower process so as to understand the impact the plant has on local micro climate.

Cofrentes Nuclear Power Plant

Using this data, studies on emission rates have been conducted based on plant operational conditions and weather conditions. The results of the studies indicate the prediction that local climate is only slightly affected. The presence of increased clouds and fog in the area around the power plant is very low, which in turn has had a very slight impact on the amount of sunlight.

Therefore, the impact of the towers is independent form the nuclear nature of the plant. The second possible impact is the emission of gaseous radioactive effluents into the atmosphere. These include iodine isotopes and noble gases which are produced during plant operation.

Gaseous effluents are subject to the same criteria as liquid discharges. All gaseous effluents are brought to a single emission point and released into the atmosphere only after being subject to rigorous radioactivity controls, through a 75-m high stack located on site. These activities are conducted in this manner in order to 1) ensure total surveillance and control of gaseous emissions and 2) ensure adequate dispersion into the atmosphere.

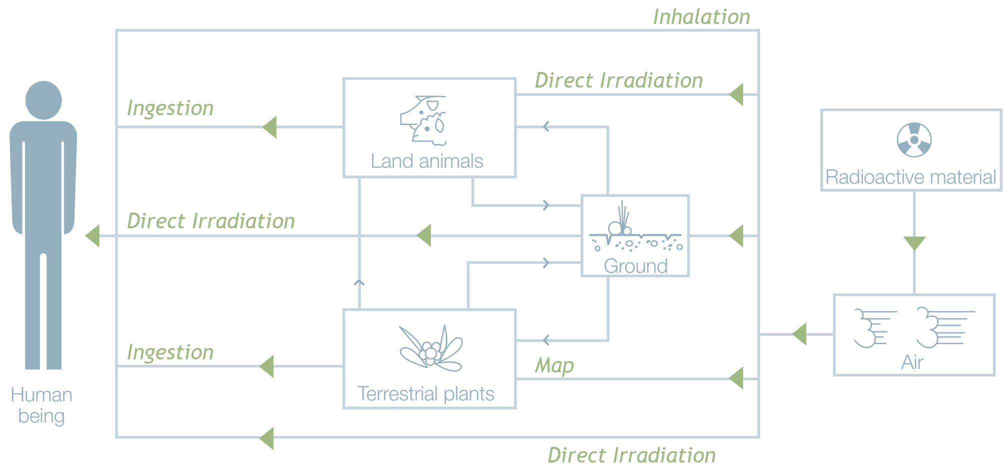
Annual gaseous radioactive effluents that exceed natural radioactive background is limited by Administrative authorization.

These dose limits make an insignificant additional contribution compared to the average annual dose from natural radiation.

Diagram 7 shows the potential paths radioactive materials could take if discharged into the atmosphere and how they could reach human beings.

› diagram 7

Path of radioactive materials discharged into the atmosphere



HYDRO-BIOLOGICAL IMPACT

- 8 annual sampling campaigns.
- 2 sediment and water samples per weather station.
- Biological quality of river water (biological index):
  - Ion concentration found in water and species such as weeds, protozoa, larvae, etc.
  - The value, in comparison to other rivers, is average.
  - Highly influenced by floods, dam openings and droughts.
  - No plant-related impact.

Maximum evaporation of cooling water	*0,75 m³*
Average increase of humidity	*1%*
Global warming	*Less than 0,1ºC*
Reduced sunlight by the plume	*Less than 15 min/day*
Increase in precipitation	*Between 10 and 13%*

5 Radiological Surveillance Measures and Methods

Radiological impact on people is measured by dose (amount of dose received) based on the type of radiation and the body part affected

Liquid and gaseous radioactive emissions are taken into account when assessing the dose produced by plant emissions and determining which paths they may take when released into the atmosphere to each residents of the area *(see diagrams 5 and 7)*.

The assessment is conducted by taking into account to very different point-of-views. In the first, the dose a person could potentially receive is assessed based on absolutely conservative criteria. This person is known as "the most exposed individual". In the second, the collective dose of all those individuals highly or not so highly affected by the plant is assessed based on realistic and statistical data of the habits and distribution of these individuals.

Population dose assessment is conducted by taking into account all the different exposure paths and it is periodically conducted during plant operation to ensure the stipulated dose values are respected and doses are as low as reasonably possible.

When conducting population dose assessments, the following components are to be considered: the type of radioactive material released by the plant into the gaseous and liquid effluents, location, number and the age group of the people living in the area that could be potentially affected (nursing mothers, children, teenagers and adults), dietary habits, transfer and weather conditions.

To do so, detailed studies on demography, farming and livestock have been conducted in the region, as well as studies on dietary habits of different age groups. Weather conditions were also studied to determine wind frequency, direction and speed, temperatures, precipitation and sunlight.

Population dietary habits

Consumption* in the Valley of Ayora-Cofrentes

Milk	137 l.
Cheese	4,6 kg.
Meat	70,3 kg.
Eggs	23,2 doc.
Vegetales	297,5 kg.

**Quantity of food per person and year*

The "most-exposed individual" is defined by the person who is affected by all the exposure channels and the most disadvantaged conditions: only drinks water from the area with the highest concentration of discharged liquid effluents, eats fish from the above mentioned area, eats vegetables and animals that are watered with that same water. This person is also believed to breathe air with the highest levels of concentration. They also eat animals and plants who breathe that same air. See Diagram 7. Even though this individual does not exist, the hypothesis of such person is used as a benchmark to ensure no one receives a high dose. The dose limits such a person could receive are stipulated by Administrative Authorization, as indicated in the sections THE PLANT AND WATER, and THE PLANT AND AIR.

6 ERSP (Environmental Radiological Surveillance Program)

In order to assess the radiological impact the plant could have on the environment, and thus on persons, Cofrentes has a regulated Environmental Radiological Surveillance Program that stipulates the methods to be used to determine the radiological effects the facility could have on people and the environment

The current law stipulates nuclear facilities must have an Environmental Radiological Surveillance Program that determines and assesses the equivalent dose of people who could be affected by radioactive effluents released into the environment, based on the channels of exposure.

Samples are taken in a systematic manner before and during plant operation in the region: air, water, dirt, ground, crops, fish, milk, meat, etc., within a 30-KM radius from the power plant. Samples are analysed to identify isotopes and their level of activity. Sampling locations, types of sampling, collection frequencies, measurements and analyses were defined before the power plant started up and once a study was provided on the following elements: flora, fauna, farming, livestock, location of towns found in the proximity of the plant.

ANNUAL ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAM

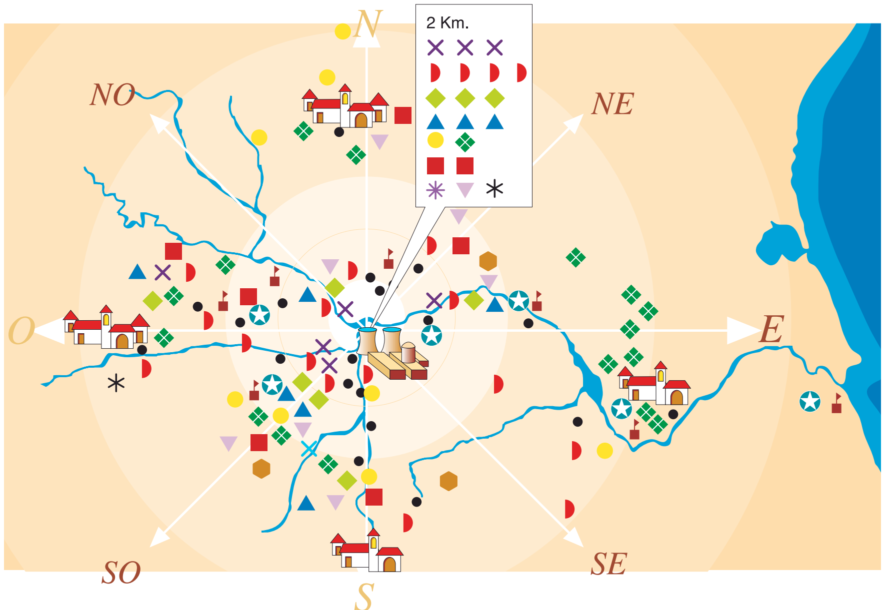
1.200 .... samples

1.700 .... analyses

Number of samples and analyses conducted per year

ERSP types and locations of samples

- 9 Particle and Radio iodine Air sampler Locations
- 19 Ambient radiation level measurement with thermoluminescent Dosimeter
- 9 Ground sampling locations
- 9 Rainwater sampling collection locations
- 9 Milk sampling locations (2 cow, 3 goat)
- 18 Crop sampling locations
- 8 Meat sampling locations, birds and eggs
- 2 Fish sampling locations
- 8 Drinkable water sampling locations
- 2 Ground water sampling locations
- 7 Surface water sampling locations
- 9 Sediment sampling locations and indicators
- 3 Honey sampling locations



Annual sampling average	No. of sampling locations*	No. of collects*	No. of performed analysis*
Air (PP/I)	12	624	72
Water (LL/LL2 or DES/SP/PO/SB/OI)	23	326	658
Ground (S/S2)	7	7	28
Sediments	7	14	28
Food (LC/C/PM/CAH/ML)	37	103	199
Direct radiation	19	76	76
Total	105	1150	1661

* Number of samples and analyses conducted/year

The results of the ERSP revealed that facility operations do not have a radiological impact on surrounding areas.

For more information on the recommendations and norms stipulated in the Environmental Radiological Surveillance Program, please refer to Guide No.4.1 (Environmental Radiological Surveillance Program Design and Implementation) prepared by the Spanish regulator.)

In addition to the above mentioned surveillance system, Cofrentes also has liquid and gas measurement equipment installed at the discharge points, in accordance with current legislation and competent agencies. Its laboratories are duly equipped to identify and quantify elements that need to be controlled. Cofrentes also counts on an additional control measure for emissions: a calculation IT tool to determine the radiological impact of the effluents. It uses the data collected by the above mentioned devices and the two weather stations to create the calculations. 100-m and 50-m towers (primary and secondary towers) were erected at the weather stations. They are equipped with an information acquisition and treatment system that allows to have all the necessary meteorological variables available at all times to ensure gas effluent discharges are continuously assessed.

Two collection and storage ponds were built at the power plant to ensure water safety via analysis before being discharged into the river.

The weather station is equipped with measurement equipment measure the following continuously:

- *Wind speed and direction at different heights.*
- *Wind direction verticality.*
- *Temperature.*
- *Temperature verticality differences.*
- *Air humidity.*
- *The number of hours of sunlight.*
- *Solar radiation intensity.*
- *Evaporation.*
- *Precipitation.*
- *Air pressure.*

Cofrentes NPP Weather Station

Information Centre

The Cofrentes Nuclear Power Plant Information Centre was opened to the public in 1978 before the plant was started up in 1984. The purpose of the centre is to provide the community information on the construction and plant operation characteristics.

It is equipped with a projector room and two model rooms so that visitors can learn about how the power plant operates.

Visitors are welcome from Monday to Friday from 9 a.m. to 3 p.m. Entrance is free and the visit can take up to two hours.

IBERDROLA GENERACIÓN NUCLEAR S. A. U.

Cofrentes NPP Information Center

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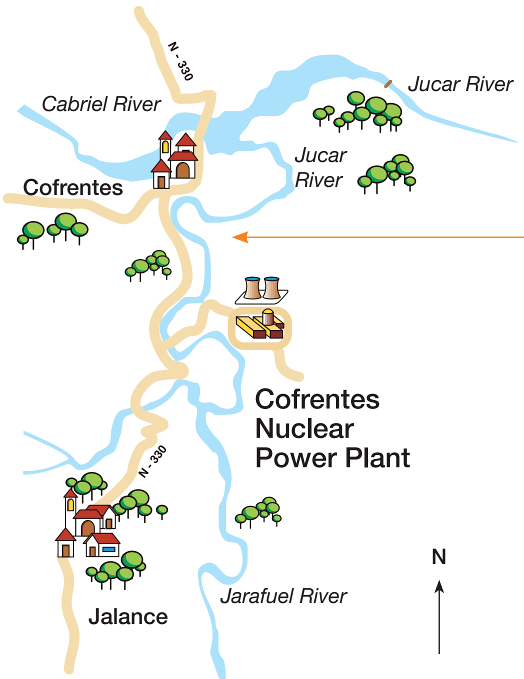
Cofrentes NPP Information Centre



The Information Centre is located offsite. It is close to the town of Cofrentes on highway N-330 and it is clearly indicated with a signpost.

The Information Centre's geo-location is QR.

edition 2016

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