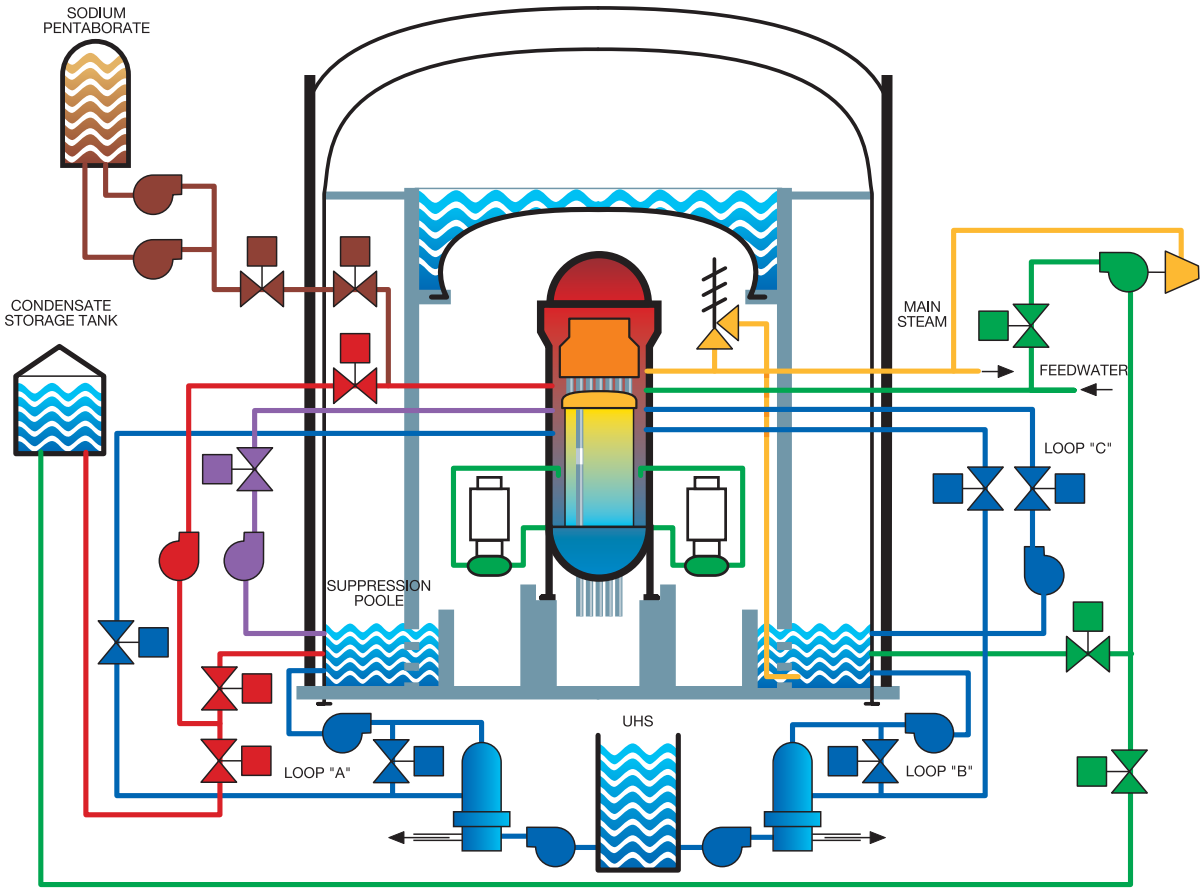
Technical features

Cofrentes NPP

IBERDROLA

Emergency systems

In order to cover an eventual failure of the normal operation reactor heat removal system, i.e., of the power generation, emergency systems are available with sufficient capacity and redundancy to maintain core cooling until the reactor is driven to safe shutdown, without boundary pressure limits and fuel design temperature being exceeded and without allowing the release of fission products to the outside.

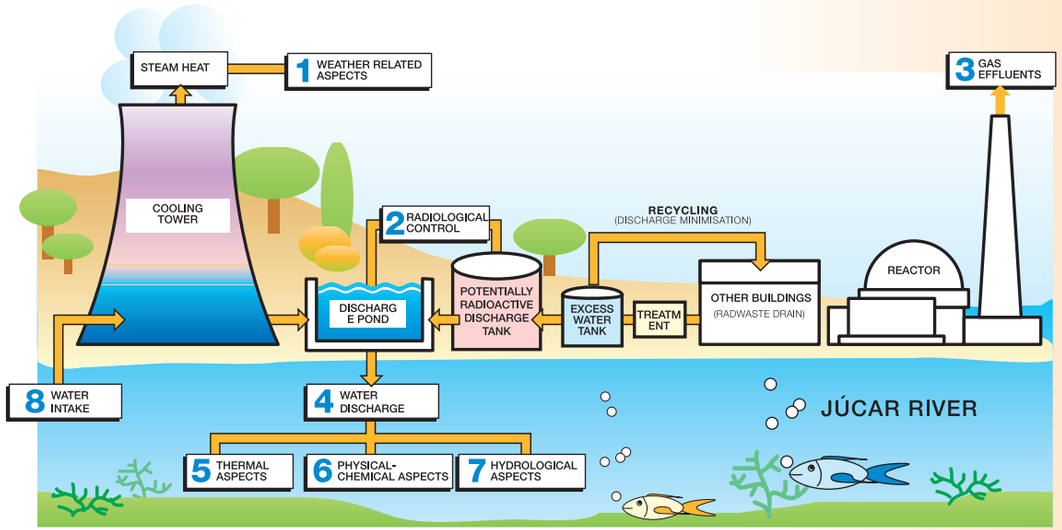


HPCS	High Pressure Core Spray	(Rociado del núcleo a alta presión).
LPCS	Low Pressure Core Spray	(Rociado del núcleo a baja presión).
RHR	Residual Heat Removal	(Extracción del calor residual).
RCIC	Reactor Core Isolation Cooling	(Refrigeración del núcleo aislado).
ADS	Automatic Depressurization System	(Sistema se seguridad y alivio de presión sistema nuclear).
SBLC	Stand-By Liquid Control	(Sistema de control del líquido de reserva).

Environment

For a continuous environmental surveillance, the necessary criteria and regulations have been implemented at Cofrentes NPP in order to match technological development to environmental and ecological demands, thus ensuring that the utility does not impact the environment.

COFRENTES NPP ENVIRONMENTAL IMPACT DIAGRAM



1.- Maximum evaporation: 0.75 m^3/s. Relative humidity increase: 1%. Air heating below 0.1 oC.

2.- Radiological potability determination analysis.

3.- Continuous gas discharge monitoring to ensure that authorised limits are not exceeded.

4.- New radiochemical control with certification of potability prior to discharging into the river.

5.- Unnoticeable thermal impact on the river by using cooling towers: 0.04 oC.

6.- Chemical analyses upstream and downstream the NPP, to verify that increase in salts is below 10% with respect to upstream values.

7.- Two samplings on each weather station (8) for sediments and water. Comparison value with other rivers is average.

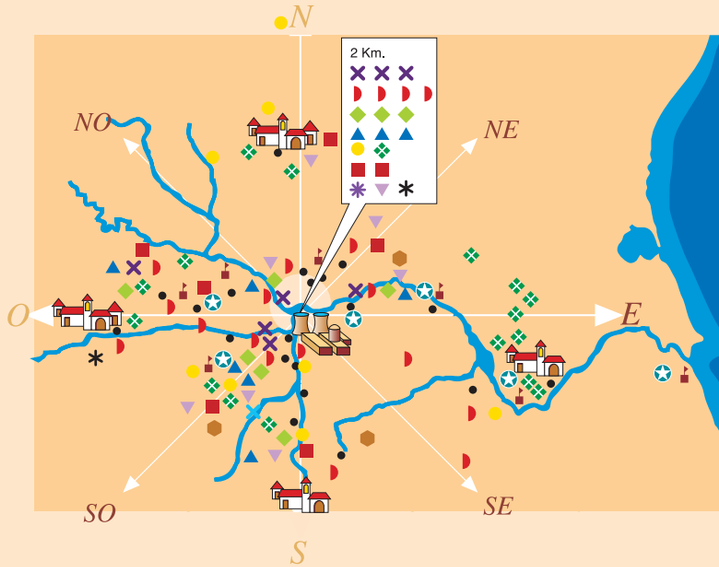
8.- 20 hm^3/year authorised by the Water Authority (Confederación Hidrográfica del Júcar). Yearly average consumption is 10 hm^3/year.

ENVIRONMENTAL RADIOLOGICAL SURVEILLANCE PROGRAMME (PVRA[1])

The map shows the sampling locations, as well as the types of samples to be taken, as established in Cofrentes NPP's Environmental Radiological Surveillance Programme (PVRA), approved by the *Consejo de Seguridad Nuclear*[2].

An NPP standard environmental radiological surveillance programme usually requires taking about 1,500 samples and making about 2,000 analyses every year.

- **9** locations with air samplers for particles and radioiodines
- **19** environmental radiation measurement locations, with thermoluminescent dosimeters
- **9** ground sampling locations
- **9** rain water sampling locations
- **9** milk sampling locations (2 cow milk, 3 goat milk)
- **18** crop sampling locations
- **8** meat, fowl and egg sampling locations
- **2** fish sampling locations
- **8** drinking water sampling locations
- **2** underground water sampling locations
- **7** surface water sampling locations
- **9** indicator and sediment sampling locations
- **3** honey sampling locations



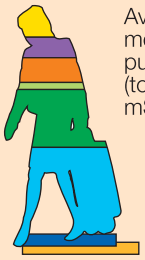
PVRA CONTRASTING

In order to monitor the results of the *Environmental Radiological Surveillance Plans* performed by those responsible at the NPPs (besides the Quality Control performed by the Licensees themselves), the *Consejo de Seguridad Nuclear* takes reference samples and has them measured at a specialised (and independent) laboratory. In those Autonomous Communities that hold a Commission Agreement with the CSN, it is the Communities who perform the *PVRA* contrast sampling.

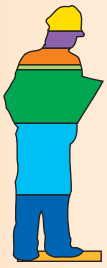
[1] *Programa de Vigilancia Radiológica Ambiental.*

[2] Nuclear Safety Council, the Spanish regulatory body.

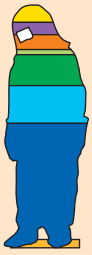
Radiation dose



Average dose of a member of the public in Spain (total 3.5 mSv/year)



Average dose of a radioactive facility employee in Spain (total 4.47 mSv/year)

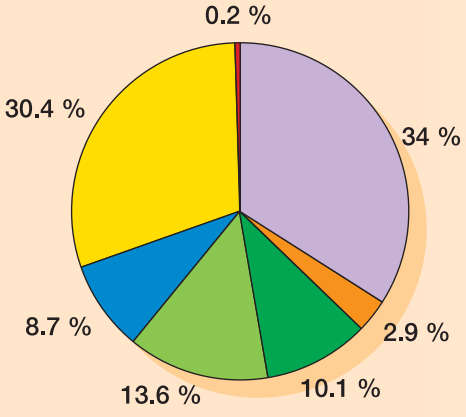


Average dose of an NPP employee in Spain (total 7.02 mSv/year)

Average dose of a member of the public in Spain when living in a high Radon level area (total 3.5 mSv/year)

WORK
DISCHARGES, DOWNFALL,
OTHERS
MEDICAL APPLICATIONS
FOOD & BEVERAGES

GAMMA RAYS
COSMIC RAYS
THORON
RADON



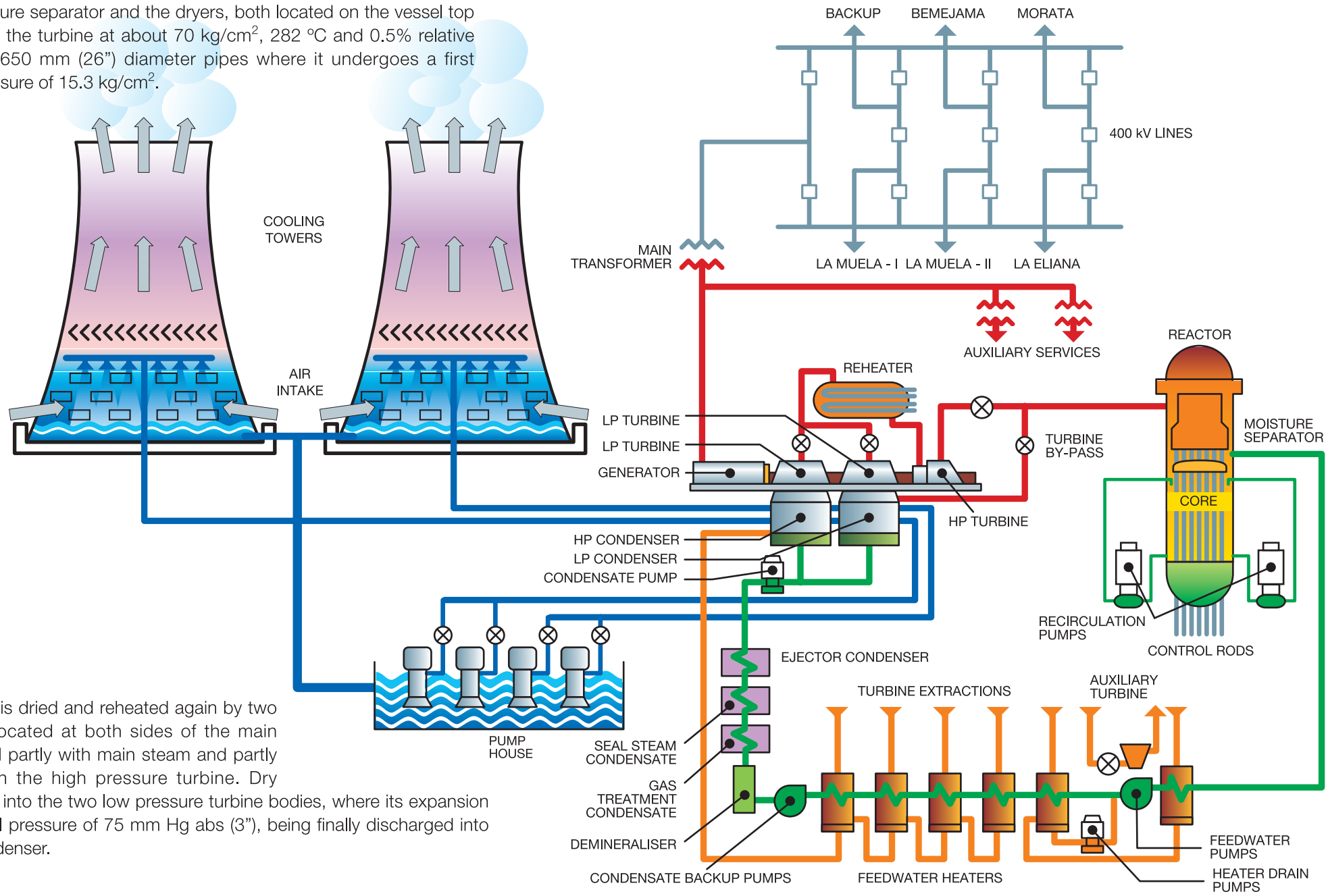
Average dose received in one year by any member of the public in Spain

THORON
RADON
COSMIC RAYS
GAMMA RAYS
FOOD & BEVERAGES
MEDICAL APPLICATIONS
VARIOUS SOURCES, DISCHARGES AND DOWNFALL

Source: CSN

Main Cycle

Saturated steam produced in the reactor is sent to the high pressure turbine after going through the moisture separator and the dryers, both located on the vessel top section; steam reaches the turbine at about 70 kg/cm^2, 282 °C and 0.5% relative humidity through four 650 mm (26") diameter pipes where it undergoes a first expansion to a final pressure of 15.3 kg/cm^2.

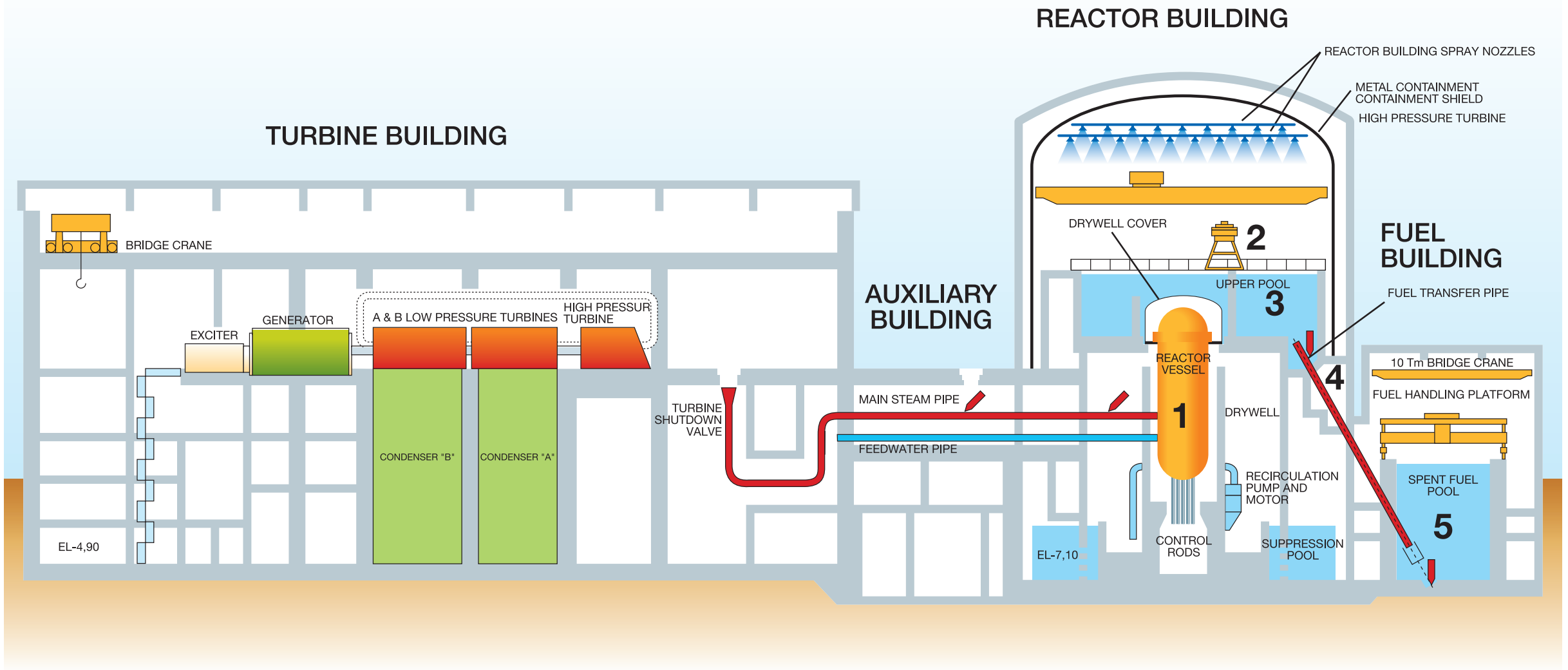


The expanded steam is dried and reheated again by two heaters and dryers located at both sides of the main turbine, which are fed partly with main steam and partly from an extraction in the high pressure turbine. Dry reheated steam is fed into the two low pressure turbine bodies, where its expansion is completed to a final pressure of 75 mm Hg abs (3"), being finally discharged into the dual pressure condenser.

Refuelling

During refuelling operations, one third of the assemblies located inside the reactor vessel (1) are removed by a mechanical arm from the platform (2) and taken through the pools (3) to the transfer pipe (4), to be sent to the spent fuel storage pools (5).

New fuel loading operations follow the same path in the opposite direction.



Containment Mark III

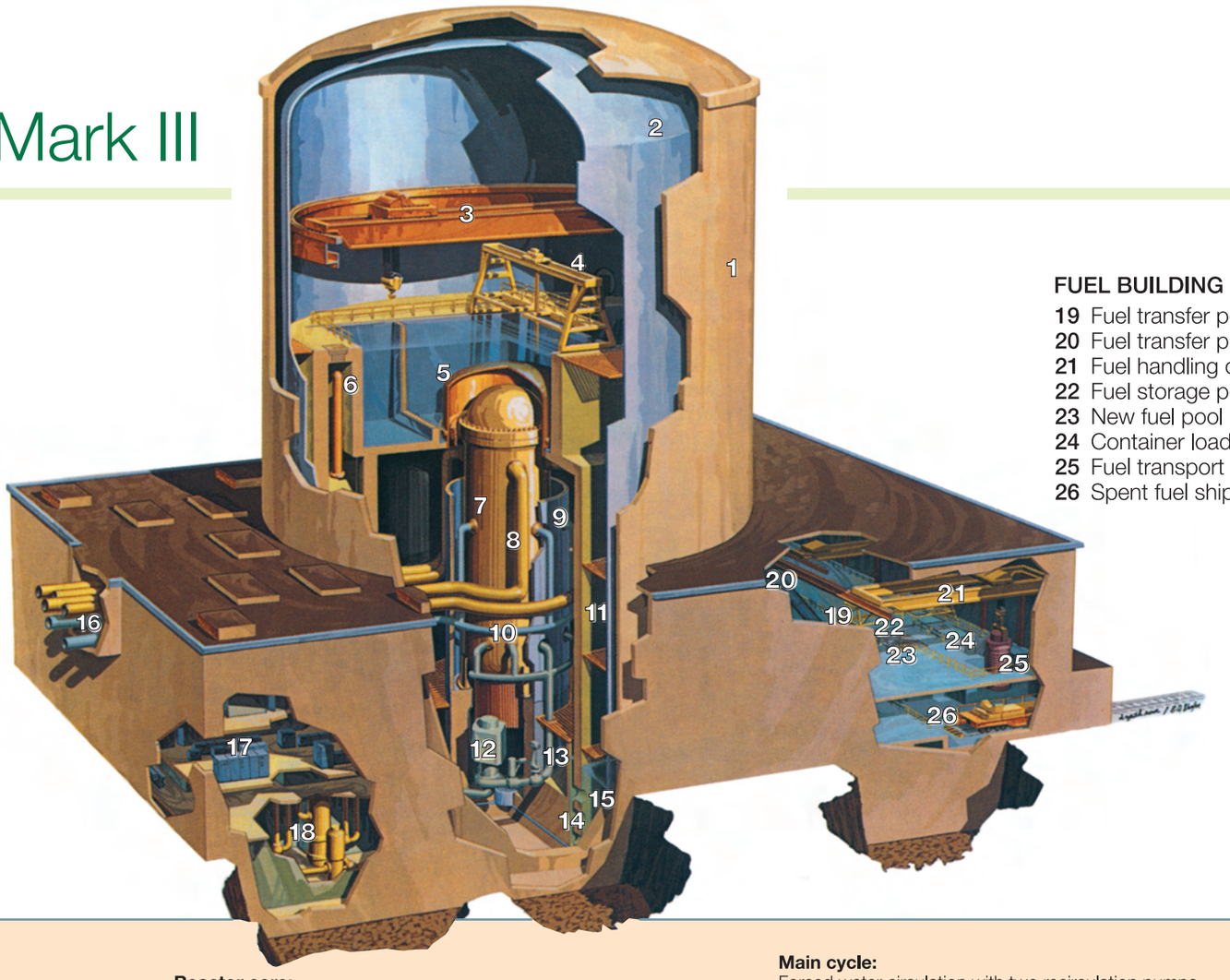
Sectional view

REACTOR BUILDING

1 Containment shield
2 Metal containment
3 Polar crane
4 Reactor refuelling platform
5 Upper pool
6 Reactor water cleaning
7 Reactor vessel
8 Main steam pipe
9 Biological reactor shield
10 Feedwater pump
11 Drywell
12 Recirculation loop
13 Cofferdam
14 Horizontal vent
15 Suppression pool

AUXILIARY BUILDING

16 Steam tunnel
17 Motor 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 Fuel transport container
26 Spent fuel shipping area

Technical features

Licensee: Iberdrola Generación, S.A.
Main supplier: General Electric Co.
Engineering contractor: Empresarios Agrupados/Gibbs & Hill
Location: Cofrentes (Valencia), Spain
Type: Boiling Water Reactor (BWR/6)
Construction:
- *Starting date:* September 1975
- *First connection to the grid:* October 1984
- *100% power:* January 1985
- *Commercial operation:* March 1985

Potencia:
Electrical: 1.092,02 MWe.
Thermal: 3.237 MWt.

Reactor core:

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

Fuel:

Material	UO_2
Average fuel enrichment	3,6%
Active rods per assembly	74 / 96
Assembly geometry (number of rods)	
GE11/SVEA-96/GE12	10x10,11x11
Rod diameter	12,27 mm.
Rod material	Zircaloy-2
Rod thickness	0,8 mm.
Average fuel depletion	28.400 MWd/t

Control systems:

Number of control rods	145
Control rod geometry	Cross-shaped
Neutron absorbing material	B_4C
Drive mechanism	Hydraulic
Other control systems	Sodium pentaborate

Main cycle:
Forced water circulation with two recirculation pumps.

Working pressure	72,4 kg/cm²
Feedwater inlet temperature	217 ºC
Steam outlet temperature	282 ºC
Feedwater flow	5.771 ton/h.

Vessel:

Internal height	21,3 m.
Internal diameter	5,53 m.
Minimum base metal thickness	13,6 cm.
Material	SA-533 GrB steel, with internal stainless steel lining
Design pressure	87,5 Kg/cm²

Containment:

Type	Mark III
Design pressure	1,05 Kg/cm²
Height	Altura 55,51 m.
Internal diameter	34,76 m.

Turbine:

Type	Tandem Compound, 4-flow
Maximum power	1092,02 MWe.
Speed	1.500 rev./min.
Steam inlet pressure	67,55 kg/cm²
Steam inlet temperature	282 ° C

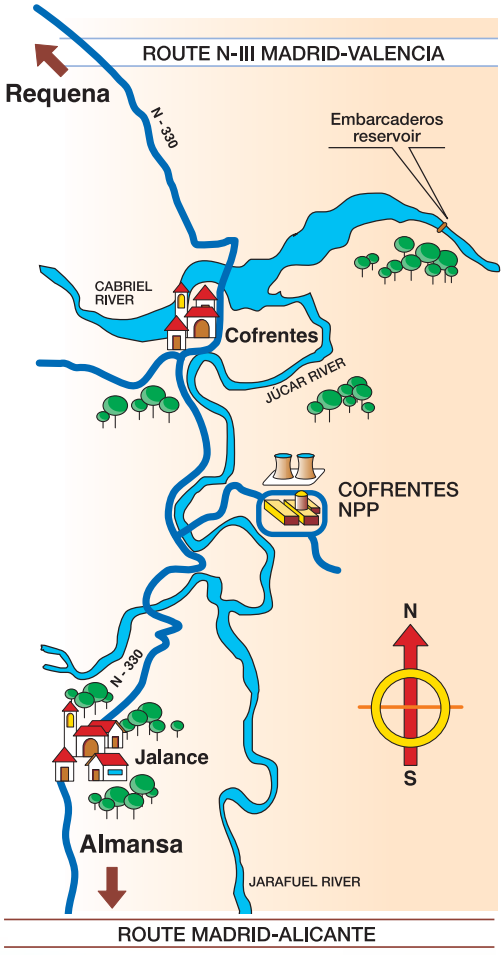
Location

Cofrentes NPP is located 2 km away from the township of Cofrentes, in the province of Valencia, at the tail of the old Embarcaderos reservoir, on the right bank of the Júcar River, quite close to where it meets the Cabriel River.

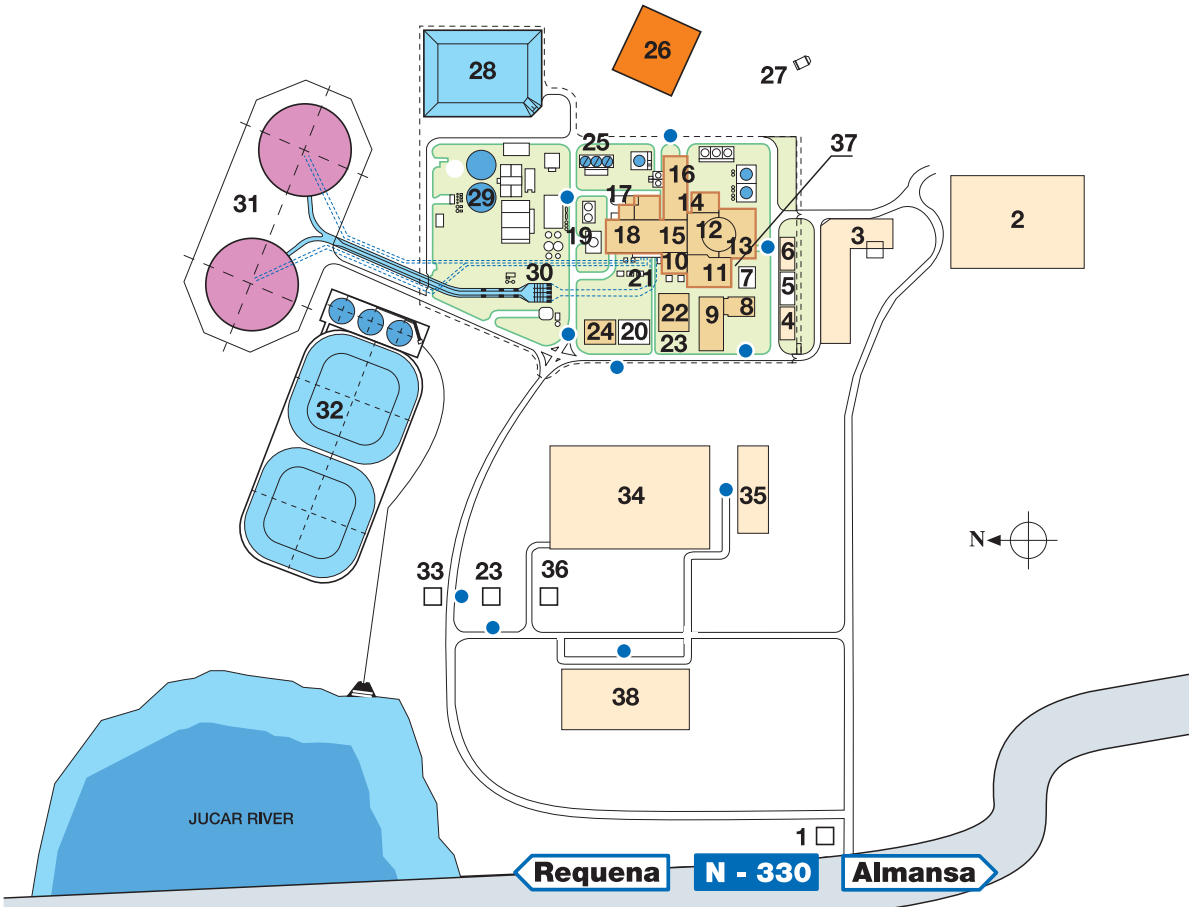
The plant site is on a plain by the Júcar River, 47 m above average river level (372 m above sea level). The site covers a total area of 300 ha, including the so called “exclusion area”.

The closest towns are Cofrentes, to the North, and Jalance, to the South, both on the N-330, which runs past 1 km away from the reactor building; this road joins the Madrid-Valencia route N-III at Requena, and the Madrid-Alicante route at Almansa, on the South. Road distance to Valencia is 100 km, direct distance is 65 km.

The plant is based on a Boiling Water Reactor, type BWR-6, with a gross electrical power of 1,092 MWe.



General Layout



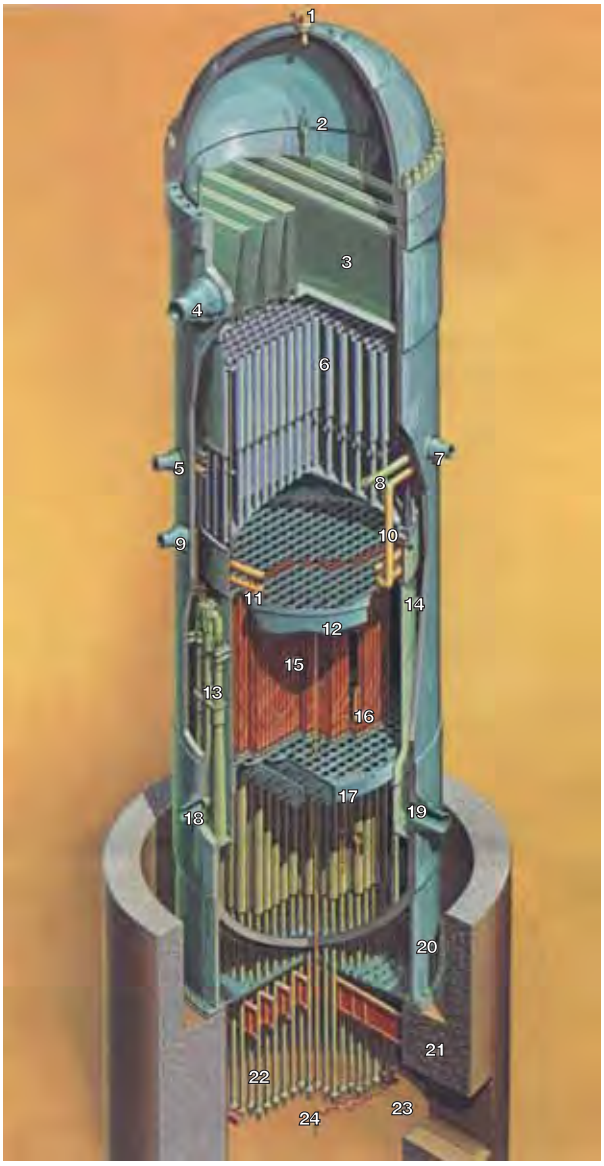
1 Main gate
2 Contractors car park
3 Iberdrola personnel car park
4 Access control building - 1 (E.C.A.-1*)
5 Medical Services (ground floor) and Administration (top floor)
6 Start up offices (R.P. - Whole Body Counter)
7 Iberdrola canteen
8 Production building (offices)
9 Warehouse and shops
10 Electrical building
11 Services building
12 Reactor building
13 Fuel building
14 Diesel generators building
15 Auxiliary building
16 Radwaste treatment building
17 Heater building
18 Turbine building
19 Controlled area access building
20 Contractors changing rooms
21 Main transformers
22 138 kV switchyard
23 Engineering offices
24 Jobsite offices and Registry
25 Service water cooling towers
26 Radwaste storage building
27 L05: Off-gas tower
28 Essential services water pond
29 Water treatment plant
30 Circulation water pumping station
31 Cooling towers
32 Discharge ponds
33 Training centre
34 400 kV switchyard
35 Inactive archive and warehouses
36 Refuelling outage office (O.T.R.**)
37 Controlled area access - Service building, elevation 0.200
38 Controlled area access - Turbine building, North
39 Service providers area
● Bus stop

** E.C.A.-1 Edificio de Control de Acceso - ** O.T.R. Oficina de Trámites de Recarga*

Reactor BWR/6

BWR/6 REACTOR VESSEL SECTIONAL VIEW

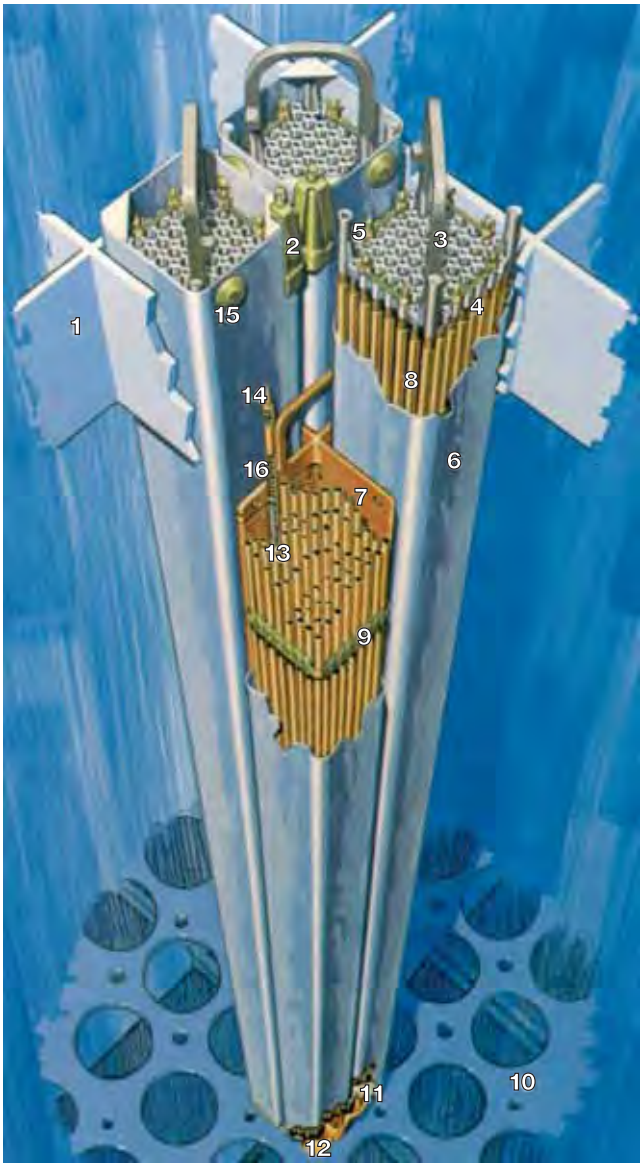
1 Cover vent and spray nozzle
2 Steam dryer hoisting bar
3 Steam dryer assembly
4 Main steam outlet nozzle
5 Core spray inlet nozzle
6 Steam separator assembly
7 Feedwater inlet nozzle
8 Feedwater sparger
9 Coolant injection inlet nozzle
10 Core spray pipe
11 Core spray sparger
12 Top grid
13 Jet pumps
14 Core shroud
15 Fuel assemblies
16 Control rod
17 Core plate
18 Recirculation water inlet nozzle
19 Recirculation water outlet nozzle
20 Vessel support skirt
21 Reactor shield
22 Control rod drive mechanisms
23 Control rod drive hydraulic lines
24 Incore neutron detectors



REACTOR CORE BASIC MODULE

Fuel assemblies & cross-shaped control rod

1 Top fuel guide
2 Channel fastener
3 Upper tie plate with handle
4 Expansion spring
5 Locking tab
6 Channel
7 Control rod
8 Fuel rod
9 Spacer grid
10 Core plate assembly
11 Lower tie plate
12 Fuel support piece
13 Fuel pellets
14 End plug
15 Channel spacer
16 Plenum spring



IBERDROLA

COFRENTES NPP
46625 COFRENTES Valencia
Telephone: 961 894 300
Information Centre Telephone: 961 894 137
Fax: 962 196 477
Email: cncofrentes@iberdrola.es