

SUBJECT 2

HOW THE PLANT WORKS

(see figure on next page)

In a nuclear power plant, like in any thermal power plant, the energy released by fuel in the form of heat is converted into mechanical energy and then into electrical energy.

In a classical thermal power plant such heat comes from the burning of coal or oil; in a nuclear power plant, it comes from the fission³ of the atomic nuclei which make up the nuclear fuel.

The production unit Flamanville 3 which will be erected on the Flamanville site is equipped with a pressurized water reactor like those of the French nuclear fleet's plants. The functioning of such a nuclear production unit is based on a primary system, a secondary system and a cooling system:

- **The primary system** is a closed system installed in a leaktight concrete enclosure which constitutes the reactor building.

It comprises a reactor, namely a steel vessel containing the nuclear fuel (reactor core) and four cooling systems (loops) each with a reactor coolant pump and a steam generator. The EPR vessel benefits from a number of improvements in comparison to the existing plants which allow it to reflect even better neutrons, to improve its flexibility and to extend its lifetime.

The heat produced by the nuclear reaction inside the reactor vessel is extracted with pressurised water in the primary system. The heated water passes through steam generators where heat is transferred, without entering into direct contact with the primary fluid through the steam generator's tubes.

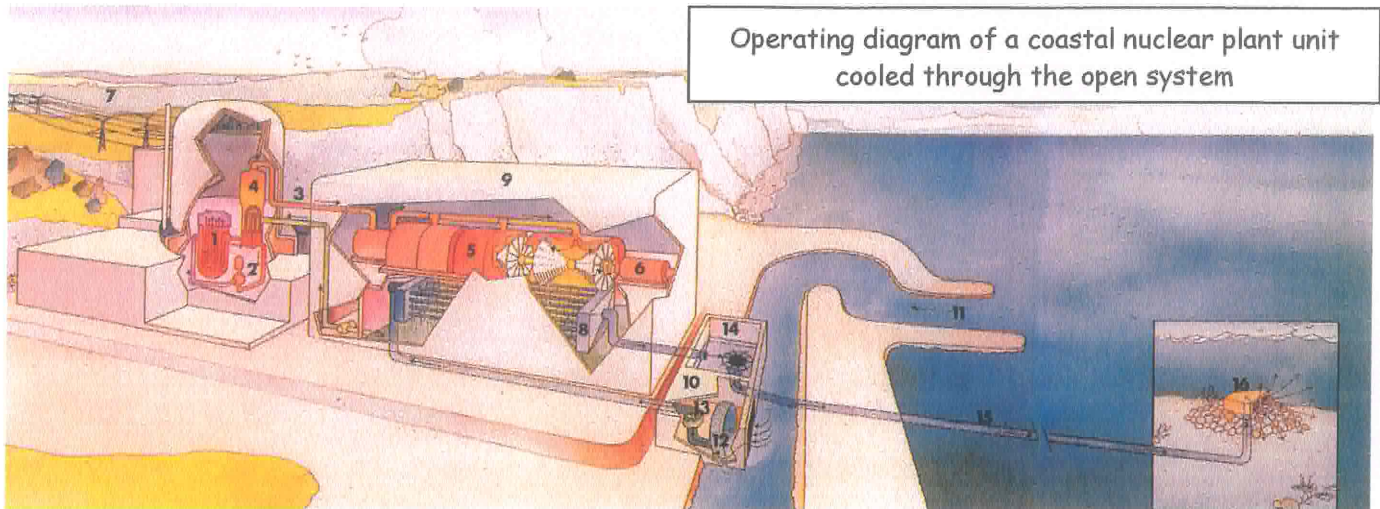
- **The secondary system** is a closed system which is independent of the primary system. It supplies steam to the turbine generator set located in the turbine hall.

Water in this system evaporates in the steam generators in contact with the primary system and feeds the turbine coupled to the generator which produces electrical energy. When leaving the turbine, the steam is cooled and returned to its liquid state in the condenser and then sent back to the steam generator. The planned efficiency of the Flamanville 3 turbine generator set is greater in comparison with that of existing plants.

- **The cooling system** is independent of the primary and secondary systems. It cools the condenser by circulating river or sea water.

This system can be either open or closed depending on the production unit's construction. An open system refers to circulating water which is directly drawn from and discharged into the sea or a river. This is the case for the Flamanville 3 plant whose cooling water is taken from the Channel. The same applies for the other two existing units on the Flamanville site.

³ The bursting of nuclei accompanied by an emission of neutrons, radiation and a significant release of heat.



1: Reactor core	9: Turbine Hall
2: Primary system	10: Pumphouse
3: Secondary system	11: Water intake
4: Steam generator	12: Filtering
5: Turbine	13: Pumping
6: Generator	14: Intermediate Discharge Pond
7: Power lines	15: Submarine tunnel
8: Condenser	16: Diffuser

The Flamanville 3 production unit is operated from a computerised control room by a team of qualified engineers and technicians on the basis of operating rules, which ensure the plant runs safely as planned at the design stage. The operating team will be trained prior to the plant's start-up in a simulator, which is a reliable copy of the reactor control room built on the Flamanville site.

Furthermore, the plant benefits from a range of monitoring, protection and safeguard systems, which warn of any unusual operating development and which return the reactor to a safe state. Their purpose consists in:

- ensuring the nuclear reaction is kept under control regardless of the situation,
- keeping the fuel cooled in all circumstances,
- limiting the pressure and the temperature in the reactor building in the case of an accident.

These systems are quadrupled on the Flamanville 3 EPR plant and installed in separate buildings. This further bolsters their operating reliability and it means that an incident affecting one system can be tackled without the other three being affected and it also means that maintenance operations can be undertaken while the reactor is operating.

☞ **TO FIND OUT MORE**, please see:

- **Documents 5 et 6** *Piece B - Chapter II: Functioning and operating main principles*