Releases at EDF nuclear sites undergoing decommissioning

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EDF' French nuclear fleet under decommissioning is based on nine shutdown state reactors headquartered in six geographical sites (Figure 1). These reactors operated between 1964 and 1998 and they fall into four categories :

- « Natural uranium graphite gas » (Bugey 1, Saint-Laurent A1 et A2 et Chinon A1, A2 et A3) ;

- « Fast breeder » (Creys-Malville) ;

- « Heavy water reactor » (Brennilis) ;

- « Pressurized water reactor » (Chooz A, first PWR operating in France)

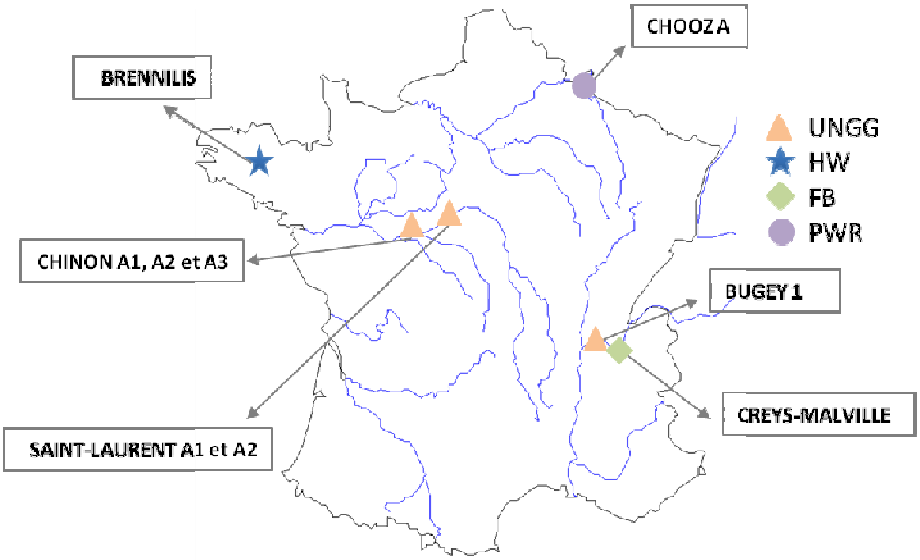

Figure 1 : French EDF shutdown reactors

To complete its dismantling nuclear program, EDF formally requests the French Administration (Department in charge of nuclear safety) and the French Nuclear Safety Authority (ASN), in accordance with Article 37 of the Enforcement Decree [1] of the French Nuclear Safety and Transparency Act [2].

Each application for dismantling authorisation contains an environmental impact assessment of the scenario used which includes the procedures for waste and environmental monitoring (Article L. 122-1 of the Environmental Code). The environmental risks are analyzed on the basis of the discharge limits permits requested by the operator to accomplish its project.

The Figure 2 below draws the methodological approach used for sizing discharge authorisations.

Input data necessary for sizing discharges authorisations and monitoring are described below :

- The scenario of dismantling and the provisional schedule;

- The physical, chemical and radiological inventories ;

- The containment means and the discharges treatment capacities.

Activity mobilised at the nuclear premises during dismantling is estimated by applying suspension coefficients adapted to each case (dismantling in ambient air, dismantling under water, dismantling with mechanical cuts or laser cuts or water cooling, decontamination, remediation…).

Radioactivity or chemical pollutants likely to be released into the environment are estimated by considering the containment means and the discharges treatment carried out.

A reduction factor dependent on treatment processes and present radionuclides is applied to pollutants mobilised in the nuclear facility. For example high efficiency filters are inefficient for the gases (3H, 14C, radio-iodine isotopes…).

The estimated releases are analysed in order to determine the groups of radionuclide for which a permit discharge will be requested. In France six categories of radionuclides are identified :

- Tritium ;

- Carbon 14 ;

- Noble gases ;

- Radio-iodine isotopes ;

- Other beta or gamma emitters fission and activation products;

- Alpha emitters.

The discharges limits requested by the operator to accomplish its dismantling project are determined taking into account their degree of measurability.

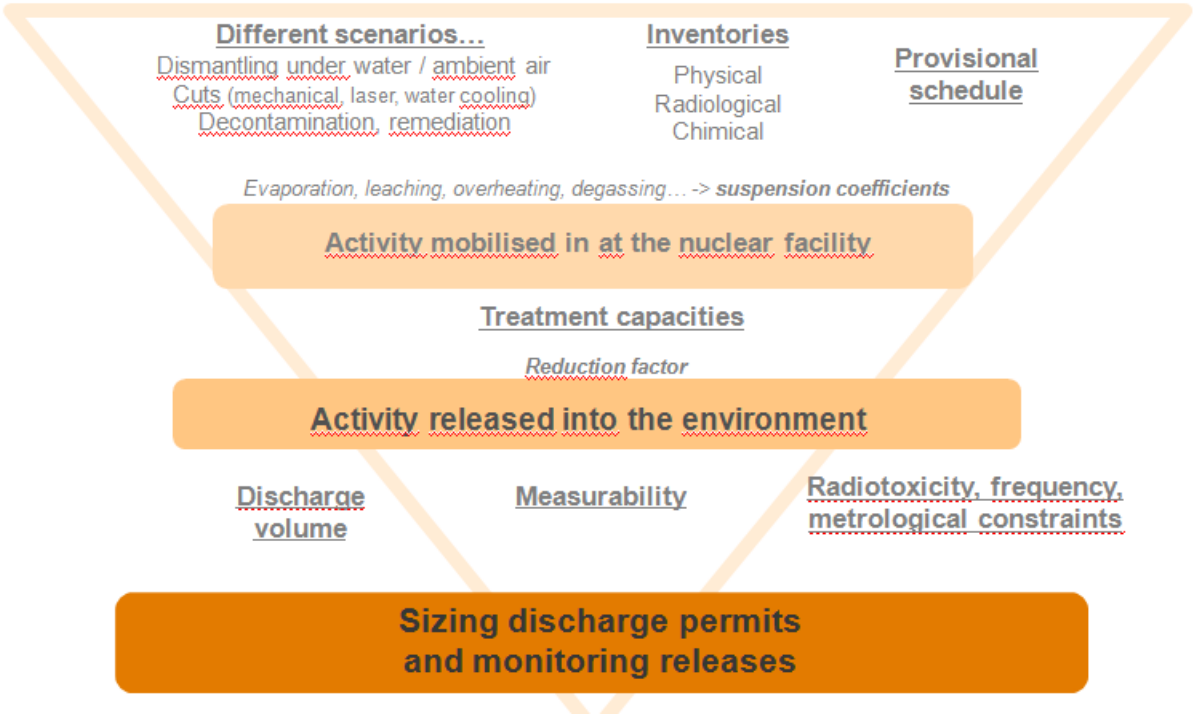

Figure 2 : Methodological approach used for sizing discharge authorizations

For the dismantling of its shutdown reactors, EDF has liquid and gaseous permits discharges for the tritium, carbon 14 and the other beta or gamma emitters fission and activation products. In addition to these three categories of radionuclides, two nuclear power plants are permitted to release gaseous alpha emitters (Saint-Laurent A and Bugey 1).

It should be noted that the radionuclide category « other beta or gamma emitters fission and activation products » is mostly composed by beta emitters ^{63}Ni, ^{55}Fe and the ^{90}Sr and to a second degree by the ^{241}Pu and the ^{151}Sm. Due to the presence of chlorine impurity in graphite of natural uranium graphite gas reactors, this category also includes ^{36}Cl.

Since discharges depend on how far dismantling has advanced and how much of the term-source has been removed, authorisations are requested by period or steps to take the progress into account.

It is important to note that discharge authorizations and studies in this field are relatively recent since the oldest and most recent discharge authorization dates respectively from 2007 for Creys Malville and 2015 for Saint Laurent A.

EDF has capitalised on the acquired knowledge on discharges in particular during day-to-day exploitation of shutdown NPP as well as during dismantling operations. Discharges need to be taken into account at a level that is proportionate to the environmental issues at stake.

References

[1] Décret n°2007-1557 du 02 novembre 2007 relatif aux installations nucléaires de base et au contrôle, en matière de sûreté nucléaire, du transport de substances radioactives.

[2] Loi n°2006-686 du 13 juin 2006 relative à la transparence et à la sécurité en matière nucléaire.