



HAL
open science

Prospective life cycle assessment (LCA) of the decommissioning of the Fessenheim nuclear power plant

Mehdi Iguider, Marc Allemann, Haldan Koffi, Maria Boltoeava, Michal Kozderka, Gaetana Quaranta

► To cite this version:

Mehdi Iguider, Marc Allemann, Haldan Koffi, Maria Boltoeava, Michal Kozderka, et al.. Prospective life cycle assessment (LCA) of the decommissioning of the Fessenheim nuclear power plant. International Symposium of LabEx DRIIHM 2022, Jun 2022, Nantes, France. , 2022, 10.34972/driihm-387350 . hal-03716543

HAL Id: hal-03716543

<https://hal.science/hal-03716543>

Submitted on 7 Jul 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Prospective life cycle assessment (LCA) of the decommissioning of the Fessenheim nuclear power plant (NPP)

Mehdi Iguidier, Marc Allemann, Haldan Koffi, Maria Boltoeava, Michal Kozderka, Gaetana Quaranta

Université de Strasbourg, CNRS, IPHC UMR 7178, F-67037 Strasbourg, France



Context and objectives

In February and June 2020, the Fessenheim NPP respectively went through the shutdown of its first and second reactors.

The question that now arises is whether the dismantling of the CNPE will be significant in terms of environmental impacts.

This study consists in evaluating the environmental impacts during the decommissioning phase of Fessenheim NPP.

2 System definition

The system studied breaks down into three phases: dismantling, decontamination and demolition (see Fig.2)

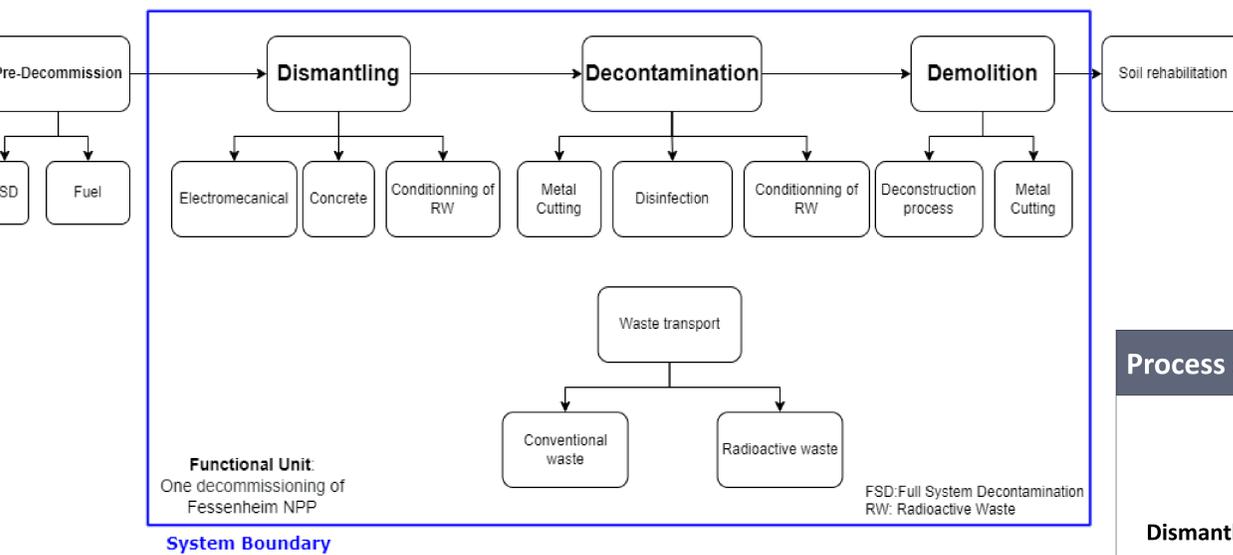
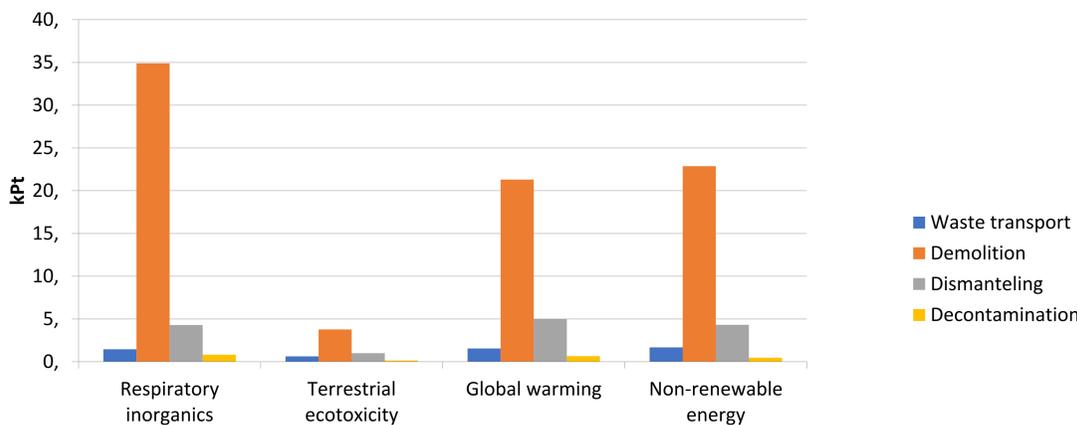


Figure2: System definition

4 Impact Assessment and interpretation of results



The point is the total environmental load expressed as a single score. The "point" represents the impact of a person living in Europe for one year

Decommissioning impact analysis

The greatest impact in terms of "points" is observed on the category "Inorganic respiratory effect" during the decommissioning of the Fessenheim NPP with 41.5 kPt, (420 t PM2.5 eq total). The decommissioning emits 282000 t CO₂ eq; which contributes strongly to **global warming** (28.5 kPt total). Regarding the use of **non-renewable energies**, the decommissioning process uses 4460 TJ of energy (29.3 kPt total) with a share of 22% of uranium. It is deduced that this comes from the French energy mix. Conventional waste accounts for 95% of the decommissioning waste.

However, the impact of transporting radioactive waste (RW) is 3.2 to 6.1 times greater (depending on the considered impact category) than transporting conventional waste. It is found that the conditioning imposed by ANDRA and RW transport distance from the NPP to the treatment centers (CIRES: 317km, CSA: 314km, ICEDA: 395km); (conventional waste: 42km) are the reasons for this.

Importance of the demolition step

Demolition is responsible for 75% of the **global warming**. This emission is generated by metal cutting with 198000 t CO₂ eq. Regarding the use of **non-renewable energies**, demolition contributes essentially to this impact due to the cutting of metals with 84.13% of emissions and especially the use of 1.3.10⁹ MJ from coal and 7.9.10⁸ MJ from natural gaz. Demolition contributes to 68% in the **terrestrial ecotoxicity** impact category. Demolition alone represents 654000 t of Triethylene glycol (TEG) eq. emitted in the soil (3.77 kPt).

1 Methods

To assess the potential impacts of the NPP, the LCA methodology has been applied.

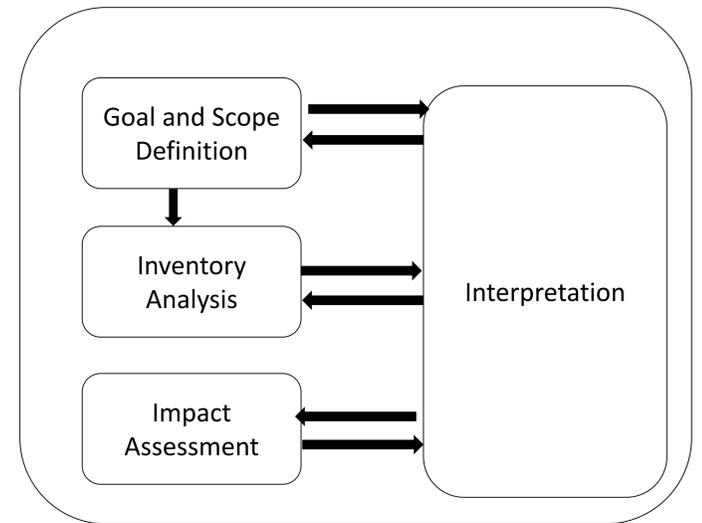


Figure1: LCA methodology, ISO 14040, 14044, 2006, 2020

3 Inventory analysis

Process step	Procedure	Energy input	Material input
Dismantling	Electromechanical		Oxygen: 34426 m ³ Acetylen: 1881185 m ³ Hydrogen: 3623.7 m ³ Argon: 3623.7 m ³
	Conditionning of RW		Ciment mortar for RW: 130068.1 t
	Concrete	Diesel: 6698.8 l	
Decontamination	Disinfection		Water: 1280 m ³ Steel Gravel: 61.4 t Phosphoric acid: 30 m ³ Oxalic acid: 13.6 t
	Metal Cutting		Oxygen: 2979.1 m ³ Acetylen: 1567.9 m ³ Hydrogen: 313.6 m ³ Argon: 313.6 m ³
	Conditionning of RW		Ciment mortar for RW: 15987 t
Demolition	Deconstruction process	Electricity: 414166 kWh Diesel: 1311811 l	
	Metal Cutting		Oxygen: 265735 m ³ Acetylen: 139861 m ³ Hydrogen: 27972 m ³ Argon: 27972 m ³
Waste transport	Conventional waste	Road: 15120000 tkm	
	Radioactive waste	Road: 61014800 tkm Electric train: 73800000 tkm Diesel Train: 5200000 tkm	

Conclusion

It was found that the demolition process contributes the most to the different studied impact categories for the NPP decommissioning.

A detailed analysis of the process shows that this is linked to the production of acetylene used during the cutting of metals. The question raised is that of a possible replacement of acetylene during the metal cutting process. The question of the French policy on the threshold of release of radioactive waste is also raised because a modification of these thresholds would allow a better valorization and/or recycling of the wastes as well as a reduction of the distances of transport, which would reduce the global warming.