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Evaluation of the impact of experimental fusion-aimed installations on their area of influence: the price of sustainable energy

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Abstract

Nuclear energy is receiving renewed attention since the EU considered it Green Energy, but fission still has problems that must be solved, which makes research on nuclear fusion a must. Its control is full of technical difficulties related to the extreme temperatures and pressures needed and also to the neutronic radiation. The International Fusion Materials Irradiation Facility – Demo Oriented NEutron Source (IFMIF-DONES) is an experimental facility to test materials to build the future fusion reactors. IFMIF-DONES impact on the people living near its future location (Escúzar, Province of Granada, Spain) has been evaluated through a survey among its inhabitants.

Keywords: Sustainable Development; Nuclear Facilities; Psychosocial Risks; Socioeconomic Impact.

Introduction

High attention is paid to energy sources that can contribute to Sustainable Development from all the perspectives of Brundtland Report [1]. Recently the United Nations (UN) identified and developed in more depth 17 concrete objectives whose achievement could be the key for a fair and sustainable growth. They are called the Sustainable Development Goals (SDG) [2]. Among these SDG shown in Figure 1, the number 7, "clean energy", pursuits to "ensure access to affordable, reliable, sustainable and modern energy for all".

In the framework of this SDG 7, but also in many others like Nr. 1, 8, 11 and 13, the urgency to produce energy allowing a sustainable development avoiding geopolitical threats and uncertainties as well as dangers coming from waste management has become a must.

In this scenario, the energy released by nuclear fission is efficient and less contaminant than these coming from coal and fuel burning, but the risks are still real and the management of the radioactive fuel after its timelife is complex and, mainly, very controversial. Thus, the efforts to control nuclear fusion, whose fuel are just hydrogen isotopes deuterium and tritium are becoming more and more intensive.

The main of these difficulties is to avoid structural damages due to the neutron radiation that cannot be stopped with magnetic fields. This problem has worried the fusion community since the 80s and the need of some facility to make irradiation experiments with fusion-like neutrons has been identified for a long time.

The International Fusion Materials Irradiation Facility – Demo Oriented NEutron Source (IFMIF-DONES) [3] is an experimental facility currently under construction in Escúzar (Province of Granada, South of Spain) that will produce fusion-like neutrons (14 MeV) through the following process:

1) Acceleration of deuterons at 40 MeV.
2) Collision of deuterons with a loop of liquid lithium.
3) Production of neutrons from the former nuclear reaction.

These neutrons will be used to irradiate different materials. The analysis of the damages will help designers to define the materials for the construction of the future reactors.

The initial budget around 700 M€ is expected to have a deep impact in the area, which has strong dependence of the agriculture and low formation of their inhabitants. So IFMIF-DONES can contribute to the growth of the territory from a sustainable perspective in agreement with the Sustainable Development Goals [4 - 6].

Besides the expected benefits, it is a matter of concern the way Escúzar inhabitants will perceive the installation (Fig. 1), because its goals cannot be achieved without the implication of a healthy community knowing the importance of the project for the achievement of clean and almost unlimited energy.

People's perception of IFMIF-DONES

This study reports a study on the perception of Escúzar inhabitants of IFMIF-DONES. The results and conclusions are presented and discussed.

A survey with 37 items about economical, social and hazard-related impacts of IFMIF-DONES was delivered among 311 inhabitants of Escúzar, the village where this facility is going to be built [7, 8].

The survey and all the expenses related to it (salary of survey takers, analysis tools etc.) have been funded by the Project DONES Preparatory Phase (Ref. 870186), granted by the European Commission in 2019 [4].

All the questions had three possible answers: Yes, No and I don't know. They had been designed by physicists working on the project, mathematicians, and local authorities. After the initial design, they were validated by specialists in methodology.

Concerning the structure of the survey, have been organized in six main blocks:

1. Personal data: gender, age, children, training and professional activity (5 items).

2. General knowledge about IFMIF-DONES project (4 items).

3. Specific knowledge about energy and nuclear facilities (6 items).

4. Socio-economic aspects of the project (12 items).

5. Perceived Safety (6 items).

6. Information about the interest and general opinion of the project (4 items).

The analysis of the collected data yielded interesting results. Some of them were not statistically significant whereas other showed a clear significance (Table I).

The perceived safety is interesting because it had not been studied in the literature concerning scientific installations. An ANCOVA model has been used.

Table I. – Statistical parameters of the data analysis

Factors	Squares sum	F	p
Gender	12.93	5.889	0.016
Impact	85.14	38.788	<.001
Economy	37.81	17.227	<.001
Residuals	1097.53		

In Table I, it is demonstrated that only variables "Impact" and "Economy" are statistically significant to explain the perceived safety: higher values in "Impact" or "Economy" lead to higher values in perceived safety. With respect to the gender, women has higher values than men for perceived safety.

Fig. 1. Simulated view of IFMIF-DONES in its final site in Escúzar (Province of Granada, Spain) [3].

Conclusions

Large projects can not exclusively focus on the physical success of the experiments, but also on their social, economical, psychological and all kinds of impacts on the people interacting with them. Otherwise, the overall sustainability of the project would be threatened.

One useful tool to evaluate the abovementioned impacts is the direct survey to the inhabitants of the zone where the facility is going to be settled.

In this work, a survey among 311 inhabitants of Escúzar (Spain), the village where IFMIF-DONES is going to be built, was carried out with the target of evaluating the impact of this fusion-oriented facility on their lives. The survey deals with social, economic and well-being-related topics that can affect people acceptance of this project and can show the way to the Authorities for future projects.

The results obtained show that the big efforts made up to date to explain people what IFMIF-DONES is, have been fruitful and the perception of the installation is quite good.

It is important to highlight the following findings:

1) Women seem to have less fear to eventual safety problems than men.

2) The higher the level of studies, the lower the concern on safety issues.

3) The higher the trust on the economic foster of IFMIF-DONES for the area, the lower the concern about risks.

Future research will be carried out in parallel to the construction of the installation to evaluate the perception of the people and maximize the synergy between research on sustainable energy and Global Sustainability itself.

The results presented can be worthy for the Administrations in charge of developing large fusion-related experimental installations. Thus, the time saved and the way to focus the information and define target population, may take these results as model in order to be more effective from all the possible perspectives.

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