

Overview of the European and worldwide research and education landscape in nuclear energy

A team of five undergraduate third-year Engineering students from Lancaster University undertook an intensive two-week project investigating nuclear education in Europe. This project was supervised by Professor Claude Degueldre, Chair of Nuclear Engineering, Engineering Department, Lancaster University and by swissnuclear. The project is part of the module ENGR445: Industry-linked Group Projects coordinated by Chris Lambert.

Abstract

In June 2021, *swissnuclear* and Lancaster University organized a research project on nuclear education into the European nuclear industrial, governmental organisations, research centres and universities. This is an important issue since nuclear energy is at a turning point in several countries which implies a need of nuclear education resurgence.

Regulatory bodies: different countries not only provide the safety requirements to run nuclear power plants and facilities, but some also support the important nuclear education and research required for further progress and development within the nuclear power sector. Research regarding nuclear regulation was conducted by first considering the country's current energy policy and government stance regarding nuclear energy, collecting information on their competences and activities. This research gives an overview of what these government/private agencies are currently doing/plan to do to support nuclear education, research, and the future of nuclear energy within their individual countries.

Industry education and training are incorporated into both vocational and professional routes; the definitions in an industrial context are as follows. NPPs (Nuclear Power Plants) activity is split into three sectors:

- NPP new build – planning, design, construction, commissioning, and handover of the licensed plant.
- NPP operation – electricity generation and outages for inspection and maintenance.
- NPP decommissioning – removal of nuclear materials and dismantling of the plant so the site can be delicensed or reused.

Nuclear societies are also key vectors of nuclear education. They organise conferences and meetings, arrange events, and provide materials and resources to both members and the public. An important aspect of nuclear societies is the exchange of knowledge and expertise with the next generation of nuclear scientists, engineers, operators, and other professionals. This is achieved through the Young Generation branch of each society which is comprised of students and young professionals. It is interesting to note that the number of Individual members plot with the number of reactors in operation reaches an average of 100 members per reactor.

Research facilities included in the report are: radioisotope labs, hot cell laboratories, fuel manufacture facilities, fuel recycle facilities, hot fuel management facilities, relevant radioisotope production facilities, research reactors and neutrino detectors. Deep geological storage facilities for nuclear waste are not considered research facilities. For all these facilities training and seminars are required to optimise safe research. This is included in specific education programs with remote presentations when physical presence is not needed.

Numerous **universities** offer nuclear education in Europe. Since the nuclear sector is a field which requires highly skilled workers institutions are needed to offer high standard of nuclear education. A list of nuclear degrees offered in Europe was collated into a spreadsheet to analyse the locations and types of nuclear degree schemes on offer. The list shows that the majority of degrees are nuclear physics, chemistry and engineering. The list includes the courses listed on the European Nuclear Society's website and then expanded on by further research into universities offering nuclear education. In most European countries there are higher education courses containing nuclear material. In Europe there are 131 higher education courses on nuclear sciences and engineering within 23 countries in Europe. Most of the degrees offered in universities are at a master level. A lack of nuclear education at a bachelor level was identified.