Glossary

ADS: Accelerator Driven Systems is an innovative machine formed by coupling a substantially subcritical reactor core with a high-energy proton accelerator for the production of Energy and the transmutation of nuclear waste. They are intrinsically safe, when compared to nuclear reactors, because when the accelerator is switched off, the nuclear cascade generating energy disappears in less than a millisecond. The accelerator current also modulates power production with precision. ADSs can be used to eliminate the plutonium and Minor Actinides stockpile produced by present-day reactors and efficiently use thorium as fertile element.

Breeder reactor: A nuclear reactor that produces more fissionable material than it consumes to generate energy. This special type of reactor is designed to extend the nuclear fuel supply for electric power generation. Conventional reactors, in contrast, can extract less than one percent of its energy.

Carbon neutrality: Carbon neutrality refers to achieving net-zero carbon dioxide emissions. This can be done by balancing emissions of carbon dioxide with its removal (often through carbon offsetting) or by eliminating emissions from society.

CERN: The European Organization for Nuclear Research, based in Geneva, Switzerland. A research centre that studies the fundamental structure of particles that make up everything around us, using the world's largest and most complex scientific instruments including a unique range of particle accelerator facilities.

Chain reaction: A sequence of reactions where a reactive product or by-product causes additional reactions to take place in a self-amplifying chain of events.

Core: Is the portion of a nuclear reactor containing the nuclear fuel components where the nuclear reactions take place, and the heat is generated. Typically, the fuel will be low-enriched uranium contained in thousands of individual fuel pins.

CRS4: The Center for Advanced Studies, Research and Development in Sardinia is an interdisciplinary research center.

ENEA: Italian National Agency for New Technologies, Energy and Sustainable Economic Development.

Energy Amplifier: is an alternative definition of an ADS, which underlines the fact that an energetic particle beam is used to stimulate a nuclear cascade into a sub-critical core, which in turn releases enough energy to power the system and leave an energy profit for power generation. According to the design of the core, the Energy Amplifier can generally “amplify” the energy of the particle beam 80 to 120 times.

Euratom: is an international organization established by the Euratom Treaty on 25 March 1957 with the original purpose of creating a specialist market for nuclear power in Europe.

Fast Reactor: is a category of nuclear reactors in which the fission chain reaction is sustained by a fast neutron, as opposed to thermal neutrons used in thermal reactors (most of today’s commercial reactors).

Fast neutron flux: A flux of neutrons carrying on average energies above 0.5 MeV (Mega Electron Volt, a measure of energy) or greater

Generation IV International Forum: The Generation IV International Forum (GIF) is a co-operative international endeavor which was set up to carry out the research and development needed to establish the feasibility and performance capabilities of the next generation nuclear energy systems.

Geological repository: a way of storing radioactive waste within a stable geologic environment (typically 200–1000 m deep).

IAEA: International Atomic Energy Agency, an international organization that seeks to promote the peaceful use of nuclear energy.

LFR: Lead Fast Reactor. This technology, with its closed fuel cycle, have the potential to multiply the energy output from a given amount of natural uranium by a factor 100; improve high level radioactive waste management through the transmutation of minor actinides; avoid the loss of coolant possible with water-cooled reactors because lead is kept at atmospheric pressure and contained in a double-wall vessel; validate lead technologies as a necessary step for the development of ADS

LFR-TL-X: Is a Lead-cooled Fast Reactor, designed by *new*cleo where TL stands for Transportable Long-lived core and X its power, ranging from 5 to 20 MWe or more, depending on the application.

Long-Lived Waste: Are radioactive materials with a long half-life (more than 20,000 years). Because of their persistent radiotoxicity it is necessary to isolate them from man and biosphere and to confine them in nuclear waste repositories for geological period of times.

Micro-reactor: Are Small Modular Reactors (SMRs) that have a power less than approximately 50 MW.

Minor Actinides: The actinide elements in used nuclear fuel other than uranium and plutonium. Actinides are the 15 metallic chemical elements with atomic number from 89 (Actinium) to 103 (Lawrencium).

Nuclear cascades: A series of nuclear interactions originated by a single event that come to an end. They are originated, for example in sub-critical reactors. The corresponding term for traditional critical reactors is chain reaction, a sequence of reactions where a reactive product or by-product causes additional reactions to take place in a self-amplifying chain of events.

Nuclear waste transmutation: The transmutation of nuclear waste is the process to convert transuranic nuclear waste (Plutonium and Minor Actinides) into fission products

Nuclear Proliferation: The spread of nuclear weapons, nuclear weapons technology, or fissile material to countries that do not already possess them.

Particle accelerator: A particle accelerator is a machine that uses electromagnetic fields to propel charged particles to very high speeds and energies and contain them in well-defined beams. They are used to study the fundamental laws of physics, but in many other applications such as to cure cancer, to produce nuclear medicine drugs and as ion implanters for the manufacture of semiconductors.

Passive Safety: Are safety features that take advantages of natural forces or phenomena such as gravity, pressure differences or natural heat convection to accomplish safety functions without requiring an active power source or human intervention.

Sub-critical reactor: Is a nuclear system that cannot sustain a chain reaction, and any beginning of a chain reaction dies out over time.

Small Modular Reactor (SMR): SMRs are nuclear fission reactors that are a fraction of the size of conventional reactors. They can be manufactured at a plant and transported to a site to be installed. Modular reactors reduce on-site construction, increase containment efficiency, and enhance safety. The greater safety comes via the use of passive safety features that operate without human intervention. SMRs also reduce staffing versus conventional nuclear reactors.

Thorium: Thorium is a metallic element at least three times more abundant in Earth's crust than uranium and doesn't need isotope enrichment to be used as nuclear fuel. LFR reactors with a thorium blanket can generate power from the plutonium left by uranium thermal reactors. The use of thorium as fertile element eliminates the production of minor actinides. A reliable and economic ADS paves the way to the adoption of a fuel cycle based on the use of thorium as proposed by Carlo Rubbia at CERN.

Transmutation: A nuclear transmutation occurs in any process where the number of protons or neutrons in the nucleus is changed.

Transuranic elements: the chemical elements with atomic numbers greater than 92, which is the atomic number of uranium.