**Who we are**

Ansaldo Nucleare is the premier Italian company in the civil nuclear sector, with over fifty years international experience in delivering technological and innovation excellence. The company provides EPC services, as well as, component design and supply for the following business lines:

- Nuclear New Build;
- Plant Operation Assistance;
- Decommissioning and Waste Management.

In May 2014, Ansaldo Nucleare completed the acquisition of NES (Nuclear Engineering Services) Ltd., bringing the workforce to a total of more than 650 employees, almost half of which are in the Engineering and Design departments. The new Ansaldo NES provides an in-house, fully integrated capability which includes design, engineering, manufacturing, assembly, testing, commissioning, site installation and integrated logistics through-life support of bespoke solutions for the nuclear decommissioning, nuclear new build markets and defence. Ansaldo Nucleare, together with recently acquired Ansaldo NES in UK, represent the nuclear arm of Ansaldo Energia Group (more than 3700 employees, 1,2 billion Euros revenues in 2014), a leading player in the power generation sector with an installed capacity of more than 190 GW completed in 90 countries worldwide.

**Where we operate**

Ansaldo Nucleare operates in the domestic and international nuclear markets, managing the entire business from its headquarters and operations office in Genova (Italy), directly and through the branches located in Romania, Slovakia, Argentina, France and the representative office in Russia. In the UK, Ansaldo Nucleare operations rely on the fully owned company Ansaldo NES. In Romania and in France, Ansaldo Nucleare provides service support through participated companies, "Polaris-Anserv" for Cernavoda NPP and "NNS" devoted to Creys-Malville NPP.

In the other countries, Ansaldo Nucleare relies on numerous Representative Offices of its parent company, Ansaldo Energia, located in over twenty countries in the world.
Ansaldo Nucleare performs its activities in accordance with a Quality and Environment Management System in compliance with the International standards UNI EN ISO 9001:2008, ASME NQA-1 2012, IAEA GS-R-3, UNI EN ISO 14001:2004. From order entry through design, manufacturing and servicing, activities are controlled in accordance with the commitments of the Quality Management System. Ansaldo Nucleare is both ASME and ISO 9001 certified. Our goal is to continually improve the quality, safety and efficiency of our services and products, fostering the Nuclear Safety Culture among our employees and supply chain. Ansaldo Nucleare is committed to a system of continual improvement to create a competitive advantage for our customers and ourselves, striving to constantly exceed the needs and expectations of our customers.

**Certification**
The Quality Management System of Ansaldo Nucleare is certified according to the following international standards:

- UNI EN ISO 9001:2008 for Quality Management System
- ASME Section III, Division 1 - Certificate of Authorization N-2961
- The National Board of Boiler & Pressure Vessel Inspectors - NB Certificate of Authorization


**Patents**
During its multi-decennial activity as prime nuclear player in Italy, Ansaldo Nucleare has been involved in the design and supply of various types of Nuclear Power Plants and Research Facilities. Through the development of these activities Ansaldo Nucleare has registered or applied for several patents for application to different nuclear plant technologies including:

- Passive Containment Cooling Condenser for SBWR
- Isolation Condenser for SBWR
- Method and Device for Neutrons’ Production in a Sub-critical Nuclear Reactor (Accelerator Driven System ADS)
- Nuclear reactor, in particular liquid-metal-cooled nuclear reactor (Metal-cooled Fast Reactor technology)
- Load compensating device for a nuclear fuel element handling machine (Fuel Handling Equipment - PWR, VVER, BWR)
- Auxiliary system for assisting a movement system of a nuclear reactor fuel elements (Fuel Handling Equipment - PWR, VVER, BWR)
- Nuclear fuel elements gripping tool provided with an emergency opening device (Fuel Handling Equipment - PWR, VVER, BWR)
- Device and method for detecting neutrons and gamma rays (Radioactive Waste Management)
- Detector Mesh for Nuclear Repositories (Radioactive Waste Management)
- Device and Method for passive adjustment of decay heat removal systems performance (Application to BWR, PWR, LFR, SFR, MSR).
Ansaldo Nucleare supplies systems, components and services for the NSSS (Nuclear Steam Supply System) as well as BOP (Balance of Plant), for various Nuclear Power Plants including PWR, BWR, CANDU and VVER in accordance with vendor requirements.

Ansaldo Nucleare is at the forefront of the technological development of new NNPs, taking advantage of its experience of different types of reactors over the last fifty years.

Ansaldo Nucleare has provided a significant contribution to Generation III+, cooperating with Westinghouse since the early 1980s in the development of Passive Plant Technology and contributing to the Design Certification of AP600 and AP1000 NPPs.

In addition, Ansaldo Nucleare is actively involved in Generation IV international programmes (the Sustainable Nuclear Energy Technology Platform (SNETP) and the European Sustainable Industrial Initiative on Nuclear Energy, ESNII). In this context, Ansaldo Nucleare is acting as leader for the Lead-Cooled Fast Reactors development programmes, for the successful completion of the “Advanced Lead-cooled Fast Reactor European Demonstrator” (ALFRED).

Moreover, in the frame of Front End Engineering Design (FEED) projects, Ansaldo Nucleare is participating in the design of systems and components for the Multi-Purpose Hybrid Research Reactor for High-tech Applications (MYRRHA).

The company is also present in the nuclear fusion sector through the realization of the fusion reactor ITER (International Thermonuclear Experimental Reactor) for which it contributes to the supply of fundamental components of the plant.

**EPC Services and Nuclear New Build**

- **Cernavoda Unit 2 Completion Contracts** (Societatea Nationala Nucleareletrica, SNN, Romania) - in 2003 Ansaldo Nucleare and AECL, as Main Contractors, were awarded the completion of the Second Unit. Power operation initiated, according the initial schedule, at the end of 2007.

- **AP1000 Sanmen Unit 1** (Westinghouse, China) - Detailed Design Activities and procurement activities.

- **Eurex Saluggia** (Sogin, Italy) - Intermediate Level Liquid Waste Storage Facility (NPS plant)- Design, procurement, erection and commissioning of the storage facility.

- **ITER** (Fusion for Energy (F4E), France) - Supply of 7 out of 9 sectors of the ITER Vacuum Vessel.
**Nuclear and Radiation Analysis**
Definition of radiological protection requirements, development of nuclear calculations for the design of storage facilities; calculation of radiation fields, shielding sizing and verification. Design and supply of radiation monitoring systems, implementation of ALARA requirements and dose evaluation of professionally exposed personnel and the population.

- **AP1000 Radiation Analyses** (Westinghouse - USA): In-containment radiation zoning during normal and accidental operations and post accident Skyshine Analyses.

**Fluid System Design and Integration**
Definition of operational and safety performances of plant systems, conceptual and detailed designs of fluid systems aimed at optimizing solutions within performance requirements, safety design guides, Clients' needs, industry standards and good engineering practice.

- **European Passive Plant Program (EU Utilities):** Detailed design of the AP1000 Defense-in-Depth Systems (e.g., Residual Heat Removal System, Component cooling System).
- **Trino NPP** (Sogin - Italy): Integrated System for the Extraction, pre-treatment and Treatment by Wet Oxidation of Radioactive Sludge.

**Fluid and Thermal-Hydraulic Analysis**
Advanced two-phase flow and inhouse developed computer codes to perform fluid and thermal hydraulic analysis on a wide range of different fluids (including molten metals) of engineering interest. Advanced CFD (Computational Fluid Dynamics) analysis tools routinely used to complement the transient thermal hydraulic analysis.

- **Cernavoda NPP** (SNN - Romania) – Design and analysis of the Recirculating Water System Loop including the Valve Slam Absorber Optimization
- **AP1000 ThermalHydraulic Transients** (Westinghouse - USA) - Design transients analyses to support AP1000 Reactor Vessel internals.

**Fire Fighting Systems**
Definition of fire hazards and plant zoning; evaluation of potentially explosive zones (ATEX); identification of the suitable means for firefighting, taking into account potential radiological releases; design of fire detection systems.

- **VVER/RBMK – R2.08/96** (EU - Tacis Program) - Fire Risk Assessment for all Type of Reactors;
- **Kozloduy NPP Units 1 to 4** (EBRD - Nuclear Safety Account) - Fire Protection Equipment (Project B.9).
**Instrumentation & Control (I&C)**

Design and supply of I&C systems for power plants, fuel handling equipment and test facilities including: design, supply and commissioning of new, digitally-based automation systems for the whole Balance of Plant (Distributed Control System); control systems for Fuel Handling Machines (FHM-CS) for different types of reactors; control systems for waste management facilities and for on-site power supply systems.

- **Cernavoda Unit 2 (SNN - Romania):** Balance of Plant Distributed Control System (DCS)
- **Tianwan NPP Units 3 & 4 (JSC Atomstroyexport - China):** Supply of the Control systems for the Fuel Handling Machines (FHM).

**Integrated Plant Layout and Engineering**

Space management of standard and bespoke design, operational decommissioning requirements. Building 3D models to control engineering detailed design and the integration of various engineering disciplines into a single plant-engineering tool.

**Electrical Systems**

Design and supply of electrical distribution systems to feed operational and safety equipment: Medium and Low Voltage power systems and Emergency Diesel Generator Stations (EDGS); Un-interruptible Power Supply systems; protection systems based on selection studies and short circuit currents; grounding networks. Conceptual and detail design of cabling and cables routing and installation.

- **Embalse NPP (NA-SA, Argentina):** Diesel Generator (DG) sets and associated auxiliaries (e.g., cooling system, lubrication oil, DG station control boards)
- **Cernavoda Units 1 & 2 (SNN - Romania):** Medium Voltage and Low Voltage plant distribution systems.
- **AP1000 Sanmen Unit 1 (Westinghouse, China):** In-Containment Plant Layout and Space Management including piping routing, supports location, mechanical & steel frame modules design and electrical divisional trains. 
Design of Civil Structures
Design of standard reinforced concrete structures and special construction techniques for accommodating nuclear systems and components; complex steel frame architectures for sustaining large components. Design against external and internal events such as aircraft collision, sloshing phenomena, seismic spectra from time history, pressure spikes, thermal loads and structure-to-structure interaction.

- **Nuovo Parco Serbatoi Saluggia (Sogin, Italy)** - Intermediate Liquid Waste Storage facility. Bunkered building designed to withstand Air Craft Crash (ACC).
- **AP1000 Standard Plant and AP1000 Sanmen Unit 1 (Westinghouse, USA / China)** - Design of a Modularized Shield Building Roof capable to withstand ACC events.

Mechanical Modules Design and Prefabrication
Design of complex integrated structures for the integrated assembly of equipment, piping, conduits and instrumentation, all organized and mounted on a sustaining steel frame. Structures are transportable by land or sea and provided with inspection and maintenance platforms with suitable connections for a simplified hook-up to related systems and anchoring to civil works.

- **AP1000 Standard Plant / AP1000 Sanmen Unit 1 (Westinghouse, USA / China)** – Mechanical Modules Design (KQ10, KQ11, DVI A/B, RNS).

Piping Design
Mechanical stress analysis and the design of piping systems, including piping supports. Fatigue analysis for piping systems. Leak Before Break (LBB) and High Energy Line Break analyses for piping systems. Guillotine-break analysis, pipe-whip restraints and jet impingement shielding.

- **Mochovce 3 & 4 (ENEL/Slovenske Elektrarne, Slovak Republic)**: Piping stress analysis validation.
- **AP1000 (Westinghouse, USA)**: Design, stress analysis and LBB evaluation for the AP1000 Class I & II piping.
Ansaldo Nucleare has consolidated experience in the design & supply of pressure-retaining nuclear components and special mechanical equipment for nuclear applications (Fission & Fusion Technologies. Components are usually manufactured by selected sub-suppliers based on Ansaldo Nucleare drawings and under our responsibility. Through Ansaldo NES, we also have the opportunity to manufacture machines & tools directly in house.

**Pressure Components**

- Concept design (performance and mechanical), for metal containment, pressure vessel, heat exchanger, etc.

- Detail design in accordance with design specification and applicable codes. Stress calculations (thermal, thermo-mechanical, dynamic - seismic/flow-induced vibration/impact, fracture mechanics) and code verification, final design report comprehensive of manufacturing non-conformances evaluation/disposition.

- Manufacturing design, including the supply of material specifications, fabrication specifications, the review of supplier-generated documentation, follow-up of shop activities, inspections and testing.

- Follow-up of erection/installation activities.

**Sanmen Unit 1 - AP1000 Passive Residual Heat Removal System** (Westinghouse, China) - Design according to ASME-III and supply of a first of a kind passive heat exchanger for the AP1000 plant.

**Sanmen Unit 1 - AP1000 Steel Containment Vessel** (Westinghouse, China) - The containment vessel, 40 m diameter, 65 m height, has been designed according to ASME-III Class MC, Division 1.
Machines & Tools

- Design of in-reactor fuel handling machines
- Design and supply of cranes and related tools for remote operation in inaccessible buildings/areas.
- Design and Manufacturing of bespoken special tools for fuel and waste retrieval.

- **Covra-Habog - Bunker And Transfer Cranes And Canister Crane** (SGN, Holland) - Design and supply of two nuclear cranes, including all the related gripping devices, for the COVRA HABOG facility.

- **Ignalina NPP - Fuel Inspection Hot Cell Handler** (NUVIA UK, Lithuania) - Design and supply the crane and the associated tools to provide the required handling functions within the Fuel Inspection Hot Cell area.

- **Silo Emptying Plant** (SEP) - Special tools for waste retrieval (Sellafield, UK).
Ansaldo Nucleare provides a large range of service activities aimed at safe operation, system optimization and performance enhancement of Nuclear Power Plants.

**Plant Life Extension (PLEX) and Power Uprating**

Engineering activities addressing walk down inspections and engineering assessment to assure and validate PLEX to Customer requirements. Realization of the plant refurbishing and modifications to restore the plant operation conditions and to obtain a higher efficiency and better performance.

- **Embalse Nuclear Power Plant** (NA-SA, Argentina): BOP Condition Assessment & Residual Life Evaluation, of the thermal cycle, supply of systems and components, Supervision of Installation and commissioning activities.

**BOP Optimisation**

Optimisation through Thermal Cycle analysis and performance testing. Safety and reliability enhancement by means of elimination of common failure causes and identification of system upgrading.

- **Cernavoda Units 1 & 2** (SNN - Romania) - Plant uprate, optimization of the thermal cycle, increase of plant availability, replacement of pre-heaters, pumps and valves, supervision of installation and commissioning activities.
- **Embalse Nuclear Power Plant** (NA-SA, Argentina): Power uprate through optimization of the thermal cycle and turbine replacement in parallel to the PLEX program.

**Fatigue and Leak Before Break (LBB) Analysis**

Justification of the LBB analysis applicability to Primary Coolant Loop (and Surge lines) of Eastern (and Western) Light Water Reactor, verifying that all the mandatory requirements are met; identification of material characteristics, possible degradation mechanisms, calculation of applied loads and stresses to exclude the possibility of a piping failure.

Execution of the fracture mechanics calculations - elastic or elastic-plastic regime - for assumed through wall cracks, both for crack stability and for leakage flow rates, using certified computer programs, according to the required methodology.

- **AP1000 LBB Piping Analyses** (Westinghouse, USA): Performance of the LBB analyses.
- **VVER 1000 Model 320 NPP / METSAMOR NPP UNIT 2** (EU Commission / Armenia)
  LBB Applicability Review and Basic Implementation Engineering, definition of new Leak Detection System (LDS) configuration.
**Fuel Handling Equipment and Tools**
Customized development of Fuel Handling Machines (FHM) and Control Systems, including the design of controlling architecture (safety monitoring and operating functions) of the driving and actuation system.

- **EUREX Saluggia** (Sogin, Italy): Emergency Defueling of the Saluggia Fuel Pool (Design and supply of special components and tools for the safe removal of radioactive material).

- **Tianwan NPP - Units 1 & 2** (Atommashelexport “OJSC”, China) - Refurbishment and optimization of the Control System Sets of the FHMs.

**Instrumentation & Control (I&C), Automation and Monitoring Systems**
Design and supply of automation systems for BOP. Design, supply and installation of monitoring systems for Diesel Generating Stations. Integrated Monitoring systems dealing with radiation, nuclear safety, structural and seismic real time monitoring.

- **Integrated Automatic Monitoring System (IAMS)** (Chernobyl, Ukraine) - Integrated structural, seismic, radiation and criticality monitoring control system for the sarcophagus.

- **Treatment Of Backlog Of Radioactive Waste Water** (Khmelnytsky NPP, Ukraine) - Design, supply, installation, testing and commissioning of electrical, instrumentation & control equipment and radiation monitoring.

**Post Fukushima Beyond Design Basis Events equipment**
Assessments to evaluate NPPs capabilities to withstand scenarios which are out of design requirements, covering - as initiating events - seismic excitation, tsunami, severe meteorological conditions. Mobile Emergency cooling system.

- **Embalse NPP** (NA-SA, Argentina) - Diesel Generator (DG) sets and associated auxiliaries (e.g., cooling system, lubrication oil, DG station control boards)
Our activities include feasibility studies, safety analysis, basic and detailed design, procurement of equipment and tools for the dismantling, packaging and transfer of waste materials produced in the frame of the decommissioning and management of the on-site dismantling activities.

**Feasibility Studies and Decommissioning Plans**
Decommissioning studies for NPPs and experimental reactors in Italy and abroad to analyse alternative solutions and define the best decommissioning strategies based on technical, economical and ALARA requirements.

- **ISPRA European JRC (EU, Italy)** - Engineering support services for the ISPRA JRC decommissioning and waste management program.

**Integrated Detailed Design**
Ansaldo Nucleare follows a systematic approach starting from ‘reverse engineering’ to obtain a reliable picture of the plant up to the detailed design of the dismantling process. Multidisciplinary engineering work for the overall dismantling of buildings and plants on nuclear sites, including 3D CAD models, choice of applicable cutting techniques, definition of dismantling and handling sequences, safety analysis, assessment of personnel radiation exposure, evaluation of costs and timeline scheduling.

- **CISAM Research Reactor Decommissioning.**

**Management Tools**
Development of specific software packages and computer tools to manage materials derived from decommissioning and dismantling operations.

- **IDMT (Integrated Decommissioning Management Tool)**: This tool is conceived and designed to manage the entire lifecycle of the Decommissioning of a Nuclear Plant or Facility:
  - organization of dismantling activities
  - treatments / decontamination
  - management of primary and secondary wastes.

**Dismantling Equipment and Tools**
Concept and detailed design, procurement of equipment (innovative and/or prototype) for dismantling of primary plant structures and components, and packing of waste resulting from decommissioning in storage containers.

- **Gioconda, Cart, Colibri Rigs (ISPRA JRC, Italy)** - Retrieving, dismantling and packing of irradiated rigs and Irradiated Nuclear Material (INM) items stored in ADECO and relevant supplies.
**On-site Decommissioning Work**  
Management of in-field activities, coordination and supervision of decommissioning activities (dismantling, physical and radiological characterization, waste disposal).

- **Caorso NPP** (Sogin, Italy): Caorso Turbine Building & Off-Gas dismantling.

**Waste Management Facilities (WMFs)**  
Detailed design and provision of WMFs, including hot workshop for segmentation and associated dedicated filtering systems, mechanical and/or chemical decontamination systems, temporary storage areas, radiological monitoring stations and materials grouting station.

- **PHADEC** (Phosphoric Acid Decontamination) Facility (Sogin, Italy) - Industrial scale plant for carbon and stainless steel decontamination.

- **SALUGGIA NPS** (Nuovo Parco Serbatoi) (Sogin, Italy) Bunkerized Storage Facility for Intermediate Level Liquid of Waste (ILLW).

**Licensing Processes**  
Support to the Client during the overall licensing process to meet Safety Authority requirements.


- **CAORSO/GARIGLIANO NPPs**: Application for overall Decommissioning.
Ansaldo Nucleare provides solutions for liquid, solid and organic radioactive waste management and disposal for Low and Intermediate Level Waste (LILW).

**Conditioning of Liquid Waste**
Definition of treatment processes based on the chemical and radiological characteristics of waste produced during prior or current operation of nuclear plants and the waste generated during decommissioning.

- **KHMELNITSKY** - Turn key delivery of a LILW treatment facility with the purpose to separate sludges by centrifugation and evaporation
- **STEL** (Stazione Trattamento Effluenti Liquidi) (JRC ISPRA, Italy) - Turn key delivery of a LILW treatment facility by co-precipitation and ultra-filtration.

**Treatment of Solid Waste**
Definition of treatment technologies and handling systems for solid waste produced during prior the operation of nuclear installations and the waste generated during decommissioning.


**Treatment of Organic Waste**
Development of an innovative wet oxidation process for waste consisting of organic material, specifically for use in the treatment of nuclear waste including ion exchange resins and waste conditioned in urea-formaldehyde.

- **Trino WOX** (Wet OXidation) Facility (Sogin, Italy) Prototypical system for treatment and conditioning of radioactive organic waste in order to reducing waste volume.

**Handling Systems**
Concept definition and design of systems and equipment for the handling and/or lifting of storage containers for radioactive waste and spent fuel.

- **Silo Emptying Plant (SEP) Mobile Caves (Sellafield, UK): Supply of three SEP Mobile Caves for the Remote retrieval of ILW sludge’s from multiple vertical silos.
- **Latina** (Sogin, Italy) - Supply of No.2 Cranes For The Movement Of Radioactive Waste At Decommissioning Area Of Latina NPP In Italy.

**Radioactive Waste Transport Storage Containers**
Design, construction and qualification of containers in compliance with the requirements of IAEA Regulations and UNI standards for the transport and storage of radioactive waste.

- **LILW Containers for the National Repository** (Sogin, Italy): Design, qualification and procurement of stainless steel containers (IAEA-IP2 packaging) for Low & Intermediate Level Waste.
- **ISPRA European JRC** (EU, Italy) - Design, qualification and procurement of carbon steel containers (IAEA-IP2 packaging) for Low & Intermediate Level Waste.
Radioactive Waste Storage Facilities
Design of Interim Storage Facilities for LILW including: civil works, handling systems, radiation monitoring, I&C, HVAC (Heating Ventilation and Air Conditioning), safety analysis.

- **Andreeva Bay** (Russia) - Main contractor for Design of Solid & Liquid Radioactive Waste Management & Temporary Storage Facilities for radwaste produced by submarines dismantling.

Technological Developments in the field of RAW Management

- Development of new methods for liquid radwaste conditioning: testing of innovative methods for the vitrification of radioactive acid solutions coming from decontamination

- Scintillating fibres for radiation monitoring: development of an innovative detector syste for gamma portals and real time monitoring of LILW deposits.