



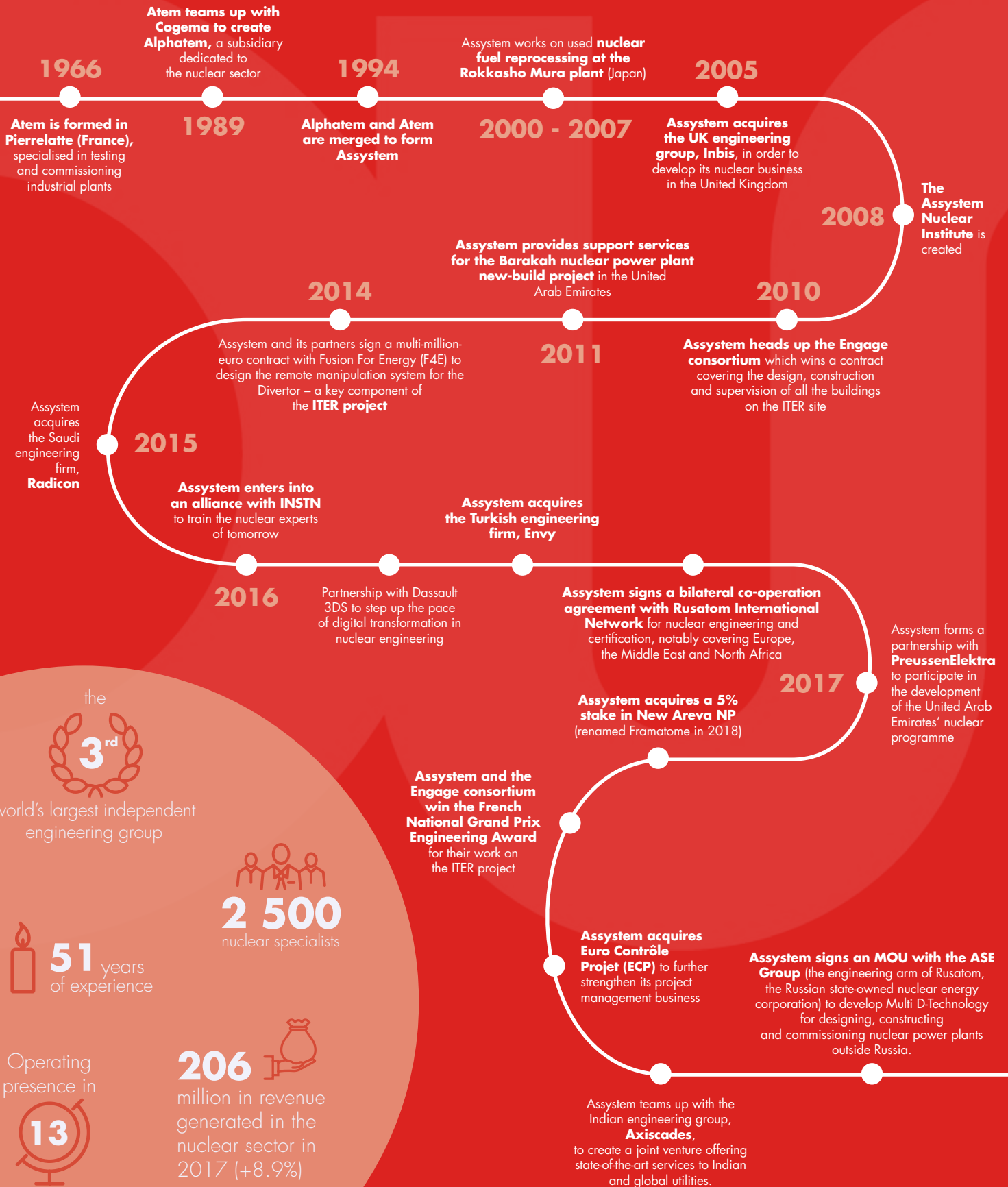
# **ASSYSTEM,**

Partner of the nuclear sector  
for more than 50 years

June 2018

**an**  
assystem

# ASSYSTEM IN THE NUCLEAR SECTOR



the  
  
**3<sup>rd</sup>**  
 world's largest independent engineering group

  
**2 500**  
 nuclear specialists

  
**51** years of experience

Operating presence in  
  
**13**  
 countries

  
**206**  
 million in revenue generated in the nuclear sector in 2017 (+8.9%)

# NUCLEAR ENERGY – THE BEST ALLY IN THE FIGHT AGAINST GLOBAL WARMING

**Driven by a firm belief that the nuclear sector has a critical role to play in the fight against global warming, for more than 50 years Assystem has invested its skills in developing nuclear energy worldwide.**

**By 2040, energy production will have increased by 40% whereas end-demand for electricity** – driven by the development of the digital economy, electric vehicles and smart cities – will have risen by 60%. Today, two thirds of this electricity is generated worldwide from the burning of fossil fuels, which causes 40% of the planet's total CO2 emissions. **If we want to reduce global warming then we urgently need to produce this electricity using carbon-free energy sources.** We have a duty towards future generations to take practical and effective action now to combat climate change. It is therefore necessary to tackle this challenge in a rational way, based on an objective analysis of the situation. In order to make informed and dispassionate choices, it is important to consider all of the possible options for our energy mix, including nuclear energy. **Nuclear energy is a vital component of this mix as it is currently the most cost-efficient, safe and decarbonised energy that can be produced in mass quantities without interruption.**

Although renewable energies such as wind, solar and hydraulic power also need to be part of the solution they are still intermittent or limited and it will take several decades before being able to store the electricity produced on a large scale. Progress is being made year-on-year and we need to be able to count on these three sources in order to achieve a consistent and responsible energy mix for the future. However, the only possible solution today is to accept an energy mix with a 50/50 split between nuclear and renewable energies. The German experience is clear testament to this: the strategy put in place by the German government over the last six years has resulted in an energy mix comprising 29% renewable energies, 13.1% nuclear, 12.4% gas and 40.3% coal, which has increased the country's CO2 emissions four-fold and made Germany Europe's leading contributor to global warming. In addition, the price of electricity in Germany is €249 per MWh – double that in France.

Assystem wants to believe that France will take another route – one that will not lead to a failed environmental policy or a waste of the country's long-standing know-how. The experience accumulated

by EDF in France over a half century of constructing and operating the 58 reactors that make up the country's nuclear fleet is equivalent to almost 3,000 years of experience. EDF is the safest operator in the world today, meeting the most stringent safety standards.

Assystem has been involved in France's nuclear adventure from the very outset. From design through to maintenance and decommissioning, **the Group has built up cutting-edge expertise underpinned by technological independence.** And thanks to the innovative digital solutions we are developing today, we offer ways of reducing construction lead times. We provide our clients with reliable and scalable solutions for managing their complex projects. Our 2,500 specialists work on nuclear projects across the globe, helping experienced industry players with exporting their expertise and countries newly entering the nuclear sector to have ever-higher performing power plants, such as EPRs. And lastly, through the training we provide, **we are preparing the new generation of engineers to master the latest technologies.**

In conclusion, Assystem is certain that nuclear power needs to play a major role in energy transition and in the efforts to reduce global warming. **The Group is ready to provide the French State with all of its skills and resources to enable the development of a new fleet of reactors so that by 2050, the country's electricity generation will be totally carbon free.**



**Dominique Louis,**  
Assystem's  
Chairman



**Stéphane Aubarbier,**  
Assystem's Chief  
Operating Officer

# ASSYSTEM, AN INDEPENDENT ENGINEERING GROUP SERVING THE NUCLEAR INDUSTRY WORLDWIDE

**Today, a total of 48 countries use nuclear energy.** 449 reactors are in operation worldwide, including 58 in France. 157 new reactors are set to come online by 2030 and 57 are currently being built. <sup>1</sup>Assystem was formed over 50 years ago in 1966 to partner nuclear projects in the French market and since then has built up solid expertise in meeting the challenges of the nuclear industry. It now ranks as the world's third-largest independent nuclear engineering group in a market that is in the full throes of expansion not just in France but also – and above all – internationally.

Assystem's growth has been driven by two main vectors: **partnering long-standing nuclear players in their new projects and helping countries who are new to the industry launch their national programmes.**

We partner numerous major nuclear players in their domestic and international markets. Working alongside EDF, Framatome, Orano and the CEA, we have developed unrivalled expertise in site identification and environmental studies as well as design, construction, commissioning, maintenance and decommissioning of nuclear power

plants, and waste management. Today, we are a key participant in the world's largest nuclear projects, including in Cadarache for the ITER project, Flamanville, Hinkley Point, Taishan, and Olkiluoto for the third-generation EPR, and working with Rosatom's Russian teams in Turkey and KEPCO's Korean teams in the United Arab Emirates. The number of examples is growing each year, with the signing of new partnerships such as the bilateral co-operation agreement entered into in 2016 between Assystem and the Rosatom International Network to provide nuclear engineering services to countries in the Middle East and North Africa.

**In terms of helping new-entrant countries develop their nuclear programmes,** our independence gives our clients a guarantee of impartiality. **We support these countries' governments in defining, designing and rolling out their nuclear programmes in a safe and cost-efficient way.**



## WORKING ALONGSIDE NEW ENTRANTS IN THE NUCLEAR MARKET

**In May 2010, Turkey entered the nuclear market with the stated aim of deploying its first nuclear power plant,** which is intended to supply 28% of the country's future electricity demand. In association with the Russian supplier, Rosatom, Assystem is providing engineering services for the construction of four VVER 1,200 MWe reactors at Akkuyu on Turkey's Mediterranean coast. Assystem's contribution to this project covers work on the initial studies and design phase as well as on site supervision and configuration.

The Barakah plant, located to the west of Abu Dhabi in the UAE – a \$20 billion project – is being built by a consortium led by Korea Electric Power Corp (KEPCO). When fully operational it will generate 5,600 MWe. **Assystem has been entrusted by the future Emirati operator to provide on-site technical assistance and ensure that the relevant technical and regulatory requirements are met during the construction phase.**

<sup>1</sup> <http://www.world-nuclear.org/information-library/facts-and-figures/world-nuclear-power-reactors-and-uranium-requireme.aspx> - April 2018

# DIGITISING AN INCREASINGLY COMPETITIVE INDUSTRY

**Having been a nuclear industry player for over 50 years, Assystem firmly believes that the industry's future depends on its ability to fully embrace digital solutions in order to optimise costs and guarantee lead times.** The complexity of today's projects makes digital solutions essential for keeping deadlines while respecting all of the safety and regulatory requirements.

**By using digital engineering tools throughout the life cycle of projects and infrastructure (Digital Asset Management or "DAM"), we can be assured of data continuity, both vertically (between the various teams involved) and horizontally (over the course of time), throughout the project's different stages.** Digital solutions in the nuclear industry ensure data integrity from the design phase of nuclear power plants right through to their decommissioning. The data obtained can be used to identify and resolve technical difficulties before the build starts, optimise the way in which plants are operated and maintained and ensure traceability in terms of regulatory compliance. In addition, using digital tools makes it much easier to leverage the experience built up during previous projects and re-use it in the future. Utilised right from the design phase, DAM offers a clearer long-term view of a project and enables us to control both building and operating costs and therefore more accurately determine the final price of a kWh of power, which is increasingly being agreed on a contractual basis with the operator at the outset of a project. The use of these types of digital technologies in the aeronautic and automotive industries has generated productivity gains of between 20% and 50% as it encourages the sharing of precise and consistent data and significantly reduces the amount of repetitive work in the research phase (which in turn reduces needless additional work).

DAM can involve one or more digital engineering tools which can be used in parallel with one another, such as Product Life Cycle Management (PLM) or Building Information Modelling (BIM), which are both used by Assystem for nuclear sector projects.

PLM digitises all of the engineering processes and related data for complex projects, which means they can be more effectively managed. The underlying concept of PLM is collecting and archiving data throughout the project's life cycle about the design, construction and operational aspects of the respective infrastructure. Consequently, PLM guarantees data continuity for all of the project's stakeholders a crucial factor for the nuclear sector where projects are extremely long. For example, PLM has reduced costs by around 15% for the

research engagements carried out by Assystem on the ITER project, for which PLM was used right from the outset.

**As well as PLM, the other main solutions that are revolutionising infrastructure design and construction are BIM and digital twin modelling.** Thanks to these solutions, errors and problems can be identified at the project's embryo stage so that the necessary adjustments can be made and monitored throughout the entire design phase before construction begins. All project participants have access to the data and can see in real time what impact a change would have on the project as a whole. Consequently, this technology facilitates teamwork and transparency by reducing the risk of losing information. For large-scale projects, **BIM and digital twin modelling are essential allies for optimising lead times and therefore costs.**

## STEMA – USING BIM FOR WASTE MANAGEMENT

**The STEMA project undertaken by France's Atomic Energy and Alternative Energies Commission (CEA) at the Marcoule nuclear site consists of embedding radioactive effluent using a mineral cement matrix.** Two new buildings had to be constructed for the project: a waste unloading station to collect both on-site and off-site effluent and a cementation building to condition the effluent in cement matrices inside waste drums.

Assystem and another engineering firm, EGIS, were chosen as a consortium to provide Engineering Procurement and Construction management (EPCm) services for the entire project, from preliminary studies to commissioning.

In order to guarantee the success of this state-of-the-art project, the Group used BIM to develop a digital twin of the project which provides the manager and operator with all of the information needed throughout the buildings' life cycle (operations, maintenance, modifications and decommissioning), enabling more responsible and secure management of radioactive waste in nuclear facility clean-up and decommissioning operations.

# INNOVATION DRIVING PERFORMANCE IN THE NUCLEAR INDUSTRY

Assystem contributes to nuclear R&D activities to help meet the challenges of the future, while increasing the performance, cost efficiency and safety of existing and new nuclear infrastructure, for both nuclear power plants and the infrastructure used in the fuel cycle. For example, Imagine – our in-house innovation programme – is aimed at accelerating the development of digital solutions designed to improve the effectiveness of existing processes and methods. This programme has led to multiple cutting-edge solutions for the industry.

## **SMALL MODULAR REACTORS (SMR) PROJECT**

Assystem believes that as well as highly powerful new-generation nuclear power plants (EPRs) – which can be used by countries with electricity grids capable of accommodating such high power levels – the future also lies in Small Modular Reactors (SMRs).

Because of their small size and flexibility, SMRs offer an innovative solution for supplying carbon-free electricity in remote locations, for residents and industrial sites. SMRs also meet market demand for solutions, requiring less hefty initial investment and can be implemented more rapidly. Assystem's teams are focusing on the architecture of the conventional nuclear island to help create modular and flexible concepts based on two main ideas:

- Prefabricating similar modules in a factory, which are then assembled on site to make the SMR, enabling mass production and therefore optimising costs and lead times.
- Adapting the reactor to the power required, by assembling several modules and therefore providing a solution tailored to specific usages.

Assystem is also developing solutions for remotely operating SMRs to reduce the number of on-site staff required. Other areas of research include innovations allowing maintenance to be performed without interrupting production.

This research is being carried out in accordance with systems engineering processes using tools such as BIM and PLM to create digital twins from the outset with a view to optimising the design – and subsequently the operation – of SMRs

## **HOT LAB PROJECT**

The latest nuclear power plant projects involve heightened, regulatory constraints and the need to build facilities that can evolve throughout their lifespan, Assystem has decided to take a closer look at the architecture of hot cells. Hot cells are laboratories that enable radioactive equipment and/or components to be manipulated for the purpose of inspection, maintenance and decommissioning activities. At Assystem we have set up a cutting-edge project to devise new solutions in terms of flexibility and scalability, using Industry 4.0's latest digital innovations, including smart robotics, big data and immersive tools, such as augmented reality, for remote control activities. We are rethinking traditional practices by offering a mobile and flexible solution based on modular components, which allows commissioning, configuration and maintenance to be carried out separately from operating activities and therefore radically optimises a facility's operational availability. This project to create latest-generation hot cells is designed to reduce costs, whilst meeting the strictest safety standards for maintenance and decommissioning phases. By proposing operating methods using remote manipulators we can guarantee safety and anticipate future regulations concerning the protection of workers by keeping them away from radioactive sources during the essential phases of a facility's operation.

## **MACHINE VISION PROJECT**

A third major area of innovation for Assystem is the development of a non-intrusive system for controlling the surface quality of the tubes used in nuclear facilities. These types of control systems need to be able to identify areas that have scratches that could lead to performance problems. Currently, this task is partly carried out manually, which means that the operator has to come close to equipment that may have been activated and therefore become radioactive. Assystem has designed a system called "Machine Vision", based on omnidirectional laser sensors and innovative signal processing techniques that enable faults to be detected with a resolution better than 50µm. Consequently, operators can work remotely and use a control screen to extremely precisely identify any areas requiring maintenance.

## **ITER, AN UNPRECEDENTED INTERNATIONAL PROJECT**

In 2015, Assystem joined the ITER project (International Thermonuclear Experimental Reactor) by signing a nuclear safety engineering contract with EFDA (European Fusion Development Agreement, formerly Fusion for Energy - F4E).

In 2010, Assystem signed an EPCm contract. Worth €150 million, this is the largest awarded contract in Europe and covers the design, construction and supervision of all of the site's buildings. An international consortium called Engage, led by Assystem, was set up specifically for the bid in conjunction with the following companies: Egis (France), Empresarios Agrupados (Spain) and Atkins (United Kingdom). A total of 220 people are currently involved in the project, and since 2011, Assystem's role within ITER has been extended to cover the construction of the actual reactor. ITER Tokamak is one of the most complex machines ever devised. Assystem is participating in preparing the assembly phase and is bringing its expertise to the project in terms of handling, lifting and assembling components. In 2014, Assystem and its partners signed a contract relating mainly to the remote manipulation system for ITER's Divertor machine. Assystem is responsible for making this system, which will extract the components of the Divertor before putting them back in place once maintenance tasks have been completed.

In 2016, as part of the Momentum international consortium, Assystem's role in the project extended when it won a contract for managing the assembly of over a million of the reactor's components.

The ITER project is one of the most ambitious scientific projects of our time and its aim is to demonstrate the scientific and technological feasibility of energy obtained through nuclear fusion - the process that powers the sun and the stars.

In 2017, the team from Engage won the Industry and Technology Consulting Prize for its work on the ITER project at the French National Grand Prix Engineering Awards.

# BRINGING OUT THE TALENTS OF TOMORROW'S NUCLEAR SPECIALISTS

With an operating presence in 13 countries, Assystem – which is an international engineering group – currently boasts 2,500 specialists in the nuclear sector. As a key player in the design, construction and maintenance phases of nuclear power plants in France and abroad, Assystem is pursuing its business development by leveraging its greatest asset – its human capital.

In 2018, the Group intends to recruit 1,000 new employees worldwide to develop and maintain nuclear power plants. Our new hires will have the opportunity to work on large-scale projects such as Flamanville 3, ITER, Hinkley Point C (HPC) and Grand Carénage. In May, we launched our new employer brand with a major recruitment campaign and a programme called **#INCREDIBLEENGINEERS** aimed at showcasing the engineering profession.

## **ASSYSTEM – COMMITTED TO DEVELOPING YOUNG TALENT**

Assystem places particular importance on transferring knowledge, particularly to the younger generation, and has put in place numerous measures to achieve this. For example, we regularly participate in engineering schools' forums, hold educational conferences, forge partnerships with major engineering schools to reach out to young talent and co-design training programmes in order to develop and hone the specific skills required in the nuclear sector, both in France and internationally.

Every year, we also organise an in-house innovation contest so that our engineers can work together on creating cutting-edge projects. In 2018, 100 interns participated in this event by taking part in a hackathon organised in several countries.

In addition, Assystem offers a Graduate Program aimed at helping prepare the new generation of executive managers. This 24-month program is broken down into three engagements, including one international engagement, and participants are mentored by a member of the Assystem Executive Committee. It provides an excellent way for high-profile graduates to discover all of the professions the Group has to offer.

## **ASSYSTEM – COMMITTED TO TRAINING NUCLEAR SPECIALISTS**

In order to keep up our expertise in an innovative and constantly-changing environment, in 2008 we created the Assystem Nuclear Institute (the "ANI"). This in-house training centre leverages the expertise of our internal specialists and offers training programmes to all employees. It helps engineers move between different business sectors so they can enhance their skills and gain a large degree of autonomy. In doing so, it prepares the new generation for the technological challenges that nuclear sector projects bring with them. The ANI offers a wide range of different training, including equipment operation, nuclear safety, and tests and commissioning; as well as two specific training courses on operation and maintenance, and the fuel cycle and decommissioning.

Several hundred employees follow ANI training courses every year, making Assystem a major contributor to shaping the new generation of nuclear specialists.

## **ASSYSTEM – COMMITTED TO PROMOTING GENDER EQUALITY IN ENGINEERING**

For over ten years now, Assystem has championed moves to open up engineering to more women by raising its people's awareness about the importance and advantages of gender diversity in the workplace.

In 2010, we created an internal network in France called **#INCREDIBLEWOMEN**

which is designed to connect our female employees in order to encourage gender diversity and create a proactive approach to hiring women engineers. In 2018, this network was extended to the Group's international operations, starting with the United Kingdom, with the guiding thread being women's ambition. At the same time, we have put in place numerous initiatives to encourage women to choose a career in engineering and to increase the number of women in our workforce and help them attain top managerial positions.

We also promote gender diversity via partnerships with France's major engineering schools (involving conferences and mentoring programmes etc.) and we have created a Gender Diversity Academic Chair.©

Assystem has been a member of the UN Global Compact since 2011 and in line with the Compact's aim of encouraging businesses to be good corporate citizens, in 2018 we entered into three new gender diversity partnerships. These comprised signing up to the UN's Women's Empowerment Principles (WEP), which set out seven principles that signatory companies undertake in order to promote women's rights in the workplace, as well as two partnerships with women's non-profit associations: Elles Bougent ("Girls on the Move") in France and Women in Nuclear in the United Kingdom.

## **FANNY FOUIN, MECHANICAL ENGINEER ON THE ITER PROJECT**

### **What has your career path been with Assystem?**

"I joined Assystem in 2013 as a mechanical engineering intern working in the engineering consulting team for the ITER project. After my internship, I was hired as a mechanical engineer and worked on various ITER engagements. I was then given the opportunity to continue my career with Assystem in the United Kingdom, where I worked with a team of over 20 other people on the ITER "Remote Handling" project. Recently I have joined the innovation team working on the Hot Cell project where I provide support to the technical team and act as a liaison between the French and UK teams".

### **What makes you proud to work for Assystem?**

"I'm really proud to work on the remote maintenance of the ITER project – the world's largest-ever nuclear fusion reactor that is currently being built and is so cutting edge and technologically advanced. This project represents the future of energy and is a real challenge in terms of engineering skills, constantly propelling us to give our very best. We are at the dawn of a potential energy revolution, which is obviously extremely stimulating on an intellectual level and makes me feel proud to be playing my part!".

### **How do you think that Assystem promotes gender diversity in the workplace?**

"Historically, engineering – and particularly mechanical engineering – has always been a male dominated field. I am lucky to belong to the generation that is benefitting from the first wave of progress in terms of gender diversity in business. Encouraging girls to take up scientific and technical studies is key to improvement in the future. We need to help girls overcome the feeling that engineering is just for men. It is our role as engineers to get this message across by reaching out to the younger generation in schools and colleges. Raising awareness upstream is absolutely vital, and Assystem is playing a significant role in this respect through its **#INCREDIBLEWOMEN** programme".

MORE THAN **50**  
YEARS OF EXPERIENCE

**13** OPERATING IN  
COUNTRIES

**450 M€**  
REVENUE

**5,000**  
EMPLOYEES WORLDWIDE

ENABLER OF ENERGY & DIGITAL REVOLUTIONS

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