Fuel Assemblies from Lingen

Our Contribution towards a Power Generation with less $\text{CO}_2$

Advanced Nuclear Fuels GmbH
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AREVA: Solutions for a Power Generation with less CO₂

According to the International Energy Agency (IEA), the worldwide primary energy consumption will at least have doubled by 2015. At the same time, CO₂ emissions need to be limited to protect our climate. In order to reach this goal, politics and industries around the world will still have to take much more effort.

AREVA has accepted this challenge. As market leader in the field of nuclear, we offer products and services of the complete nuclear fuel cycle: from uranium mining to reprocessing of spent fuel as well as planning and construction of reactors and related services for plant operation.

Furthermore, we are investing in renewable energies. Together with our partners we are developing high-tech solutions.

Fuel Assembly Production in Lingen

Advanced Nuclear Fuels GmbH (ANF) is located in Lingen in the German state of Lower Saxony. Fuel assemblies for nuclear power plants in Germany and Europe have been produced here for 40 years.

ANF consists of the fuel assembly production in Lingen with 330 employees and a component manufacturing in Karstein with 150 employees.

ANF is part of the AREVA group which offers customized solutions for power generation with less CO₂ for its customers around the globe.
In principle, a nuclear power plant works just like a fossil fuel thermal power plant. The difference is that heat is not generated by burning coal, oil or gas, but through nuclear fission inside the reactor. The heat released from a controlled chain reaction in the reactor core is transferred to the coolant agent (water).

In a pressurized water reactor, the water is put under so much pressure that it does not evaporate. It is pumped into a steam generator where the heat is transferred to a separate water-steam-cycle. Then, the water flows back to the reactor where it is reheated again. The steam generated by the steam generators drives the turbine.

A generator driven by the turbine then generates the power. In boiling water reactors, on the other hand, the water evaporates in the reactor pressure vessel; the generated steam is led directly into the turbine.

Our Point of View

The more efficient use of resources as well as climate and environmental protection are the determining factors of energy policy in all states. Outside of Germany, also affordability and security of supply are considered with the highest priority. To that end, it is essential to also make use of nuclear energy. It produces power with less CO₂ around the clock while saving fossil resources.

Basically, nuclear energy has unlimited fuel supplies. Today’s reactors almost exclusively use uranium-235 which currently known availability lasts for more than 100 years. Modern reactors also use uranium-238 and thorium-232 which are available in abundance. Long-lived radioactive waste and depleted uranium will become fuel.

This will last longer than the supposed lifetime of the sun. Nuclear energy is a renewable energy source.
Enriched uranium hexafluoride is the starting material which is delivered in a solid state from an enrichment facility inside steel cylinders (picture). These are packed in specially tested and approved containers. As a prerequisite for further steps, the uranium hexafluoride is converted to uranium dioxide powder. At the fuel assembly manufacturing in Lingen, a dry conversion process is used, designed and patented by AREVA. It does not produce any uranium-containing process waste or emissions and is, therefore, very environmentally compatible.

By heating the cylinder, the uranium hexafluoride is transformed to a gaseous state. Then, in a container with water vapor and hydrogen, it reacts to uranium dioxide powder. Gaseous hydrogen fluoride is produced which is discharged and cooled down together with the excess water vapor. Hydrogen and water vapor condense and form hydrofluoric acid of 40 percent. ANF sells the hydrofluoric acid as reusable material to the industry.

In pellet production, the uranium dioxide powder is processed to uranium pellets. In three process steps, the powder is prepared by milling, compacting and granulating to archive good flow ability. Lubricant agents ensure that the pellets can be pressed and pore former is necessary to archive the correct pellet density. This pretreated uranium dioxide powder is pressed to pellets – the so-called “green” pellets – in a rotary press.

The “green” pellets are then sintered in a sinter furnace at a temperature of 1,780 degrees Celsius. Afterwards, the pellets undergo a high precision grinding process to their target diameter. A fully automated laser-optical measurement system finally checks all pellets for their dimension.

In Lingen, the UO₂ powder is fabricated by means of a chemical process and treated mechanically. The granules become compressible with the help of different additives and can then be processed to pellets.

A uranium pellet weighing 7.5 grams and enriched to 4.3 percent contains as much energy as 1,000 kilograms of hard coal. This equals the annual power consumption of 3,000 kilowatt hours – as much as an average German household requires.
For the production of fuel rods and fuel assemblies, the Lingen plant needs cladding tubes and components such as upper and lower tie plates as well as spacers. These metallic components are manufactured in Germany as well as in the international manufacturing network of AREVA, for example in Romans (France) and Richland (USA).

The Lingen plant also delivers powder and pellets to its sister companies. This enables us to react flexibly to customer requests and strengthen our competitiveness.

3. Fuel Rod Production

In this production step, the pellets are inserted into the cladding tubes. For this purpose, the pellets are compiled in fuel columns which are inserted into zircaloy cladding tubes, welded on one side, using vibration technology or force-monitored slide-in unit. Then, the cladding tube is assembled with a compression spring, evacuated in a welding chamber, flooded with helium and welded under pressure. The fuel rod welded on both sides makes sure that no radioactivity leaks out during the later irradiation in the reactor. The completed fuel rod is subject to several tests, among others the enrichment analysis of the contained pellets, a helium-leakage-test as well as a visual check.

The so-called fuel rods consist of uranium pellets that are filled in zircaloy cladding tubes of around four meters in length.

4. Fuel Assembly Production

The production of the fuel assembly for pressurized water reactors starts with the assembly of the support structure. The spacers and the guide tubes are welded to a mechanically stable supporting structure (cage). The fuel rods are fully inserted therein according to a predetermined loading plan. Afterwards, the upper and lower tie plates are installed.

Finally, the fuel assembly is cleaned, subject to a comprehensive final test and stored hanging in subsurface fuel assembly storage until dispatch. For the production of fuel assemblies for boiling water reactors, ready-mounted cages are used.

At our Lingen site, we are able to produce around 1,500 fuel assemblies per year for pressurized- and boiling water reactors all around the world.
Environmental Protection

All AREVA facilities have committed themselves to protect the environment and use natural resources economically. Possible effects on the environment are already taken into account during planning and construction of production facilities. AREVA attaches great importance to ensuring that environmental impacts are limited as much as possible and stay well below the legal limits.

The approved emission levels are continuously monitored by us and also by the respective supervisory authorities in charge. In order to fulfill our commitments and continuously improve environmental protection, an integrated management system was introduced. The ANF plants have been certified according to DIN ISO 14001 since 1997.

Radiation Protection

In connection with state of the art ventilation and filtering systems, shielding, continuous monitoring as well as individual radiation protection measures, our manufacturing technologies ensure the highest possible safety of our employees.

In our facility, the dose is at a low level. It is lower than the sum of the average natural and medical radiation exposure in Germany. Therefore, we are far below the legal limits of the Radiological Protection Ordinance.

The dose of the employees and the emission of radioactive material are monitored on a regular basis by us and by the supervisory authorities independently of one another.

Safety at Work

The use of modern technologies, the good occupational and further training of our employees as well as the preventive maintenance of the production facilities guarantee a high safety at all workplaces.

All installations regularly undergo technical checks by experts and independent specialists. In 2004, we introduced a joint management system for safety, health and the environment which has been certified according to OHSAS 18001 since 2005.

Together with the quality management, it was transferred to an integrated management system, certified accordingly in 2010 and checked regularly.

Did You Know?

Radiation Exposure

- due to natural causes, for example uranium in the ground, comes up to an average of 2.1 millisievert per year in Germany.

In addition, there is the average medical radiation exposure of 1.9 millisievert per year, for example due to x-rays or cancer therapies.

- is limited to 20 millisievert per year by law for people who are exposed to ionizing radiation during their work, for example the staff of hospitals or nuclear power plants.

- comes up to about 0.1 millisievert for passengers and crew of a transatlantic flight.
Advanced Nuclear Fuels GmbH
Fuel Assembly Production in Lingen –
A Strong Partner in the Region and Worldwide

To this day, ANF has delivered more than 33,000 fuel assemblies to nuclear power plants in Germany and Europe. The fuel assemblies are characterized by their good performance and high reliability at competitive costs. Intensive and continuous research and development in Erlangen guarantee that our fuel assemblies consist of robust components and highly reliable materials. Our priority is the safe and efficient use of the fuel to the benefit of our customers.

As one of the largest employers in the region, ANF in Lingen is an important economic factor. We are committed to education and culture. Therefore, we support local institutions and clubs. Our employees take part in many local sports events and represent their company this way.

We are in close contact with schools in the region and especially support vocational schools. As part of the AREVA training and apprenticeship system, we have been qualifying our young talents in technical and administrative professions for many years now. Our trainees are often among the best in their year. In cooperation with universities, we offer dual degree programs and support bachelor- and master-theses. Public acceptance of our work has been secured by safe operations for forty years, modern workplaces with high standards as well as high transparency of our work.
AREVA is a world leader in nuclear power. The group’s offer to utilities covers every stage of the nuclear fuel cycle, reactor design and construction, and operating services. Its expertise and uncompromising dedication to safety make it a leading industry player.

AREVA also invests in renewable energies to develop, via partnerships, high technology solutions.

Through the complementary nature of nuclear and renewables, AREVA’s 45,000 employees contribute to building tomorrow’s energy model: supplying the greatest number of people with energy that is safer and with less CO₂.

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