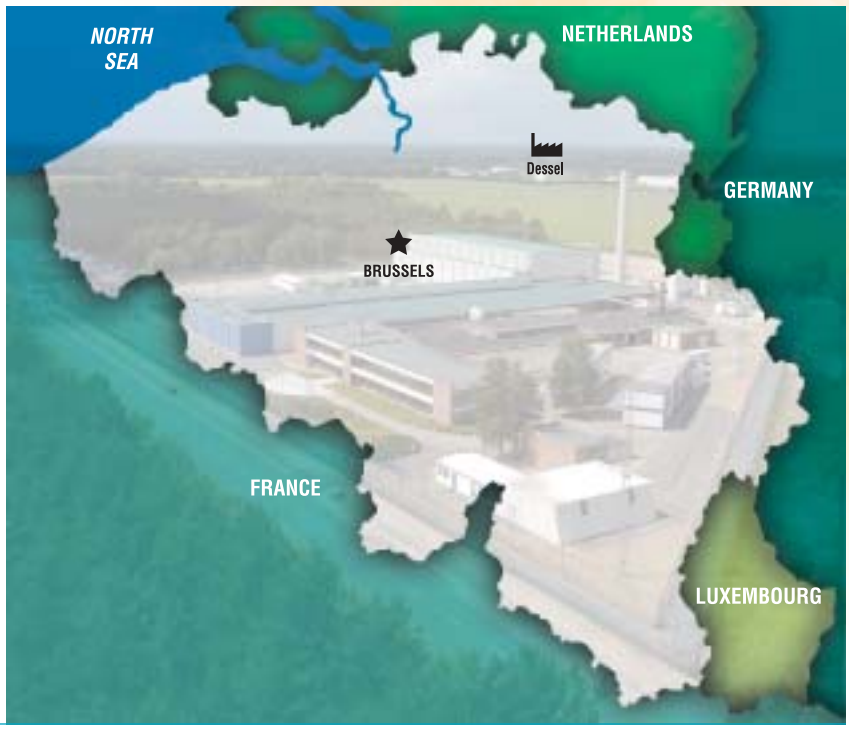


BELGONUCLEAIRE

Avenue Ariane 4, 1200 Brussels, Belgium
Tel.: (+32) 2-774 05 11 • Fax: (+32) 2-774 05 47

Europalaan 20, 2480 Dessel, Belgium
Tel.: (+32) 14-33 02 11 • Fax: (+32) 14-31 70 46

E-mail: all@belgonucleaire.be
www.belgonucleaire.be

ENVIRONMENT Report

BELGONUCLEAIRE

MOX powder

BELGONUCLEAIRE – A Profile

Established in 1957 to develop civilian uses of nuclear energy and particularly plutonium-based fuels, BELGONUCLEAIRE is jointly owned by Tractebel and by the Belgian State through SCK•CEN.
Its head office is in Brussels and its MOX plant is at Dessel, in the Province of Antwerp.

Since 1973 BELGONUCLEAIRE has been a leading producer of MOX fuel (a mixture of uranium and plutonium oxides) based on a process developed in-house (the so-called MIMAS process).
The expertise and experience gained through designing and building its own MOX fuel plant has led BELGONUCLEAIRE to provide assistance for the construction of similar facilities elsewhere in the world.

In addition to MOX fuel production, BELGONUCLEAIRE is active in programmes to neutralise plutonium resulting from the dismantling of nuclear weapons, as well as in the design and supply of systems for the treatment, conditioning and storage of nuclear waste.
BELGONUCLEAIRE's experience with fuel behaviour in nuclear reactors is also made available to clients through international irradiation and research programmes.

BELGONUCLEAIRE employs 350 people, 250 in its MOX plant and 100 in its headquarters and engineering division.

MOX plant at Dessel

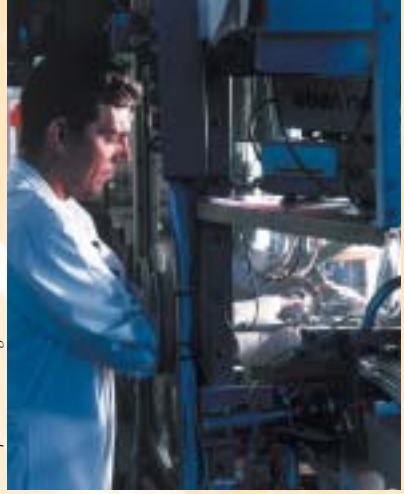
Environmental Statement

BELGONUCLEAIRE considers that the environment is a world and national heritage that cannot be placed in jeopardy for future generations and should not be freely used as a resource. It is dedicated to working in an environmentally sustainable, economically appropriate and socially responsible manner.

BELGONUCLEAIRE adheres to the following principles:

- Observe strictly environmental laws and regulations
- Establish and maintain an environmental care system that meets ISO 14001 standards
- Improve continuously environmental performance
- Apply environmental care principles to suppliers
- Promote awareness and training programmes to heighten environmental awareness among the personnel
- Use energy in a rational way
- Limit and compact the waste produced
- Limit the amount of waste waters discharged and improve their quality
- Reduce stack emissions
- Support external environmental projects

In particular, BELGONUCLEAIRE's personnel will strive to achieve better environmental performance of its MOX plant in Dessel and, by doing so, will contribute to improving the environment in general.



MOX production in gloveboxes

MOX, AN INDUSTRIAL REALITY

MOX production at BELGONUCLEAIRE

BELGONUCLEAIRE's plant at Dessel produces yearly 35 to 38 tons of MOX fuel. In 2001 this comprised 20 tons for Pressurised Water Reactors (PWRs) and 16 tons for Boiling Water Reactors (BWRs).

Continuous investments by BELGONUCLEAIRE ensure that the plant and its equipment meet modern standards. This in turn ensures a high product quality and progress towards the most modern safety practice through appropriate automation and adequate shielding.

Why MOX ?

MOX fuel is obtained by mixing two powders – depleted uranium oxide (a by-product from the enrichment of uranium) and separated plutonium oxide (derived from the treatment of used fuel). MOX fuel is, in fact, an industrial reality that fits within the general recycling principle of renewable resources. Thus, in the same way that paper, steel and plastic are recycled, it is best to recycle the nuclear resources uranium (95% of the weight of the nuclear fuel elements) and plutonium (1%). Moreover, the 4% present as fission products in the spent fuel elements cannot be recycled and are therefore selectively separated, vitrified and stored.

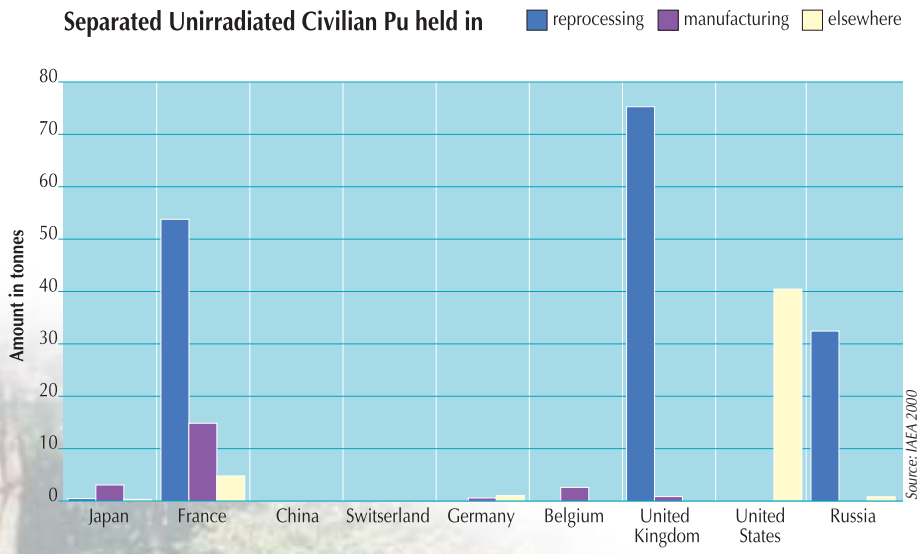
MOX, an industrial reality

MOX is as an industrial reality, part of the general management of reusable nuclear materials. The satisfaction of our clients in Belgium, France, Germany, Switzerland and Japan proves that MOX is a fuel that meets the highest quality criteria.
BELGONUCLEAIRE has the obligation to guarantee this permanently to its clients and their safety authorities during each fabrication campaign for European or Japanese electricity producers.

Existing stocks of separated plutonium

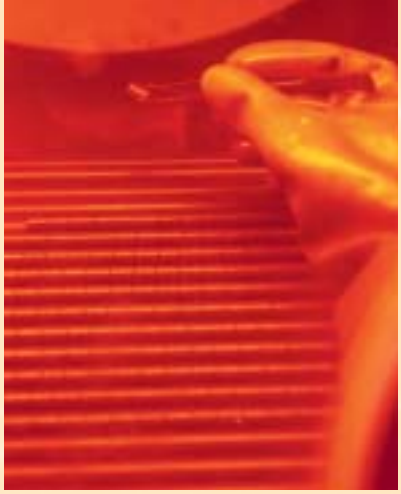
Separated plutonium has two origins: reprocessing of irradiated fuel and dismantling of nuclear weapons. During reprocessing, the spent nuclear elements are first mechanically fragmented and dissolved in nitric acid. The uranium and plutonium are then separated from this solution by chemical extraction. The plutonium resulting from this procedure is used for MOX. Through dismantling of nuclear warheads, military plutonium becomes available and it can be transformed in oxide form, processed into MOX and valorised for electricity production. It yields an irreversible form of the plutonium making impossible its weapon use.

Total worldwide quantities of separated plutonium are estimated to be 230 tonnes for civilian material and 250 tonnes for military material. This last quantity corresponds roughly to 40000 nuclear warheads.



Bar Diagram

Shows amount of civil separated plutonium (reprocessed and not yet loaded in reactors) available around the world by the end of 2000



MOX tablets

MOX decreases stocks

When standard nuclear fuel is used in the nuclear reactors within the power plants, plutonium is always produced. A standard fuel element consists initially of 450 kg of enriched uranium. After burning it in the reactor it contains 5 kg of plutonium. 200 kg of plutonium are produced by every 1000 MWe nuclear power plant operating for one year. A standard MOX fuel element contains 35 kg of plutonium and only 26 kg remain on removal from the reactor. This means that instead of producing 5 kg plutonium, MOX uses or "burns up" 9 kg of plutonium. When only MOX bundles are used in a nuclear power station the plutonium is reduced because there is no standard nuclear fuel present to produce plutonium. Recycling of plutonium in MOX fuel definitely reduces the amount of plutonium that is produced in power plants. Using 30% of MOX assemblies in existing power plants leads to a zero net production of plutonium.

MOX helps to valorise plutonium

Approximately 450 nuclear power plants around the world today provide 16% of the world's electricity. MOX uses plutonium as a potent renewable energy resource. It is better to use it for energy than for weapons. The energy content of 1 kg of plutonium corresponds to 1000 tonnes of oil. Therefore, BELGONUCLEAIRE's MOX plant's yearly throughput of 2500 kg corresponds to 25 supertankers of 100,000 tonnes.

Nuclear power plants and MOX produce no CO_2

Nuclear power plays an important role in energy production in our country and throughout Europe. In Belgium, nuclear energy represents 58% of the electricity production. Since the beginning of the 20th century, the emission of greenhouse gases - primarily carbon dioxide or CO_2 - has risen sharply due to the increased use of fossil fuels (coal, fuel oil and natural gas) in various sectors, including industry, energy and transportation. This phenomenon is continuing and even accelerating. For the coming decade, the International Energy Agency (IEA) predicts an increase in total CO_2 emissions of 30 to 40%. Therefore several western countries that produce most of world's CO_2, are trying to find a way to decrease these emissions. The 1992 Framework Convention on Climate Change (FCCC) was the first formal international statement of concern and agreement to take action. This was followed by the 1997 Kyoto Protocol that specifies high commitments by individual countries and involves several decisions. One of them is that by 2012, developed countries have to reduce their collective emissions by 5.2% from the 1990 levels, with each country being committed to a specific figure. Given this situation, nuclear power is an environmentally safe form of energy. In fact, it generates practically no CO_2.

Plutonium and radioactivity

Radioactivity is a natural phenomenon and is thus present in the nature. Plutonium is created by the use of uranium in nuclear reactors. Plutonium is radioactive and the radiotoxicity of plutonium is mostly due to the fact that it emits alpha radiation. Alpha radiation is the spontaneous emission of particles that are relatively large and highly energetic. These particles can cause severe damage when penetrating living tissues.
A piece of paper is sufficient to stop alpha radiation.
Once MOX fuel is produced, plutonium is present in the form of an oxide. In this form, it is inert and its chemical toxicity is negligible. However, specific precautions are required when handling it because of its high radiotoxicity.

MOX production in gloveboxes

BELGONUCLEAIRE carries out environmental management

Located in Flanders, BELGONUCLEAIRE has appointed an environmental co-ordinator in accordance with the Flemish Environment Law of 1996 (Vlarem I, II). This co-ordinator gives advice on the development, introduction, application and evaluation of environmentally friendly production, including process, wastes and REU (Rational Energy Use).

The co-ordinator also regularly performs checks through internal audits to ensure that all environmental laws and regulations are being respected. He reports to the competent Authorities concerning wastes and discharges in accordance with legal prescriptions.

ISO 14001 CERTIFICATION

BELGONUCLEAIRE's facility at Dessel was awarded the ISO 14001 certificate in May 2000. The ISO 14001 certificate means that BELGONUCLEAIRE has the organisation, procedures and methods that lead to professional environmental management, and that these procedures and measures are effective.

ISO 14001 is an international standard for environmental care systems. It provides a framework for the establishment, maintenance and improvement of an organisation's environmental care system. The certification authority visits the plant regularly to ensure that all requirements are fulfilled and that the organisation still complies with the regulations.

The ISO 14001 certificate comes as a complement to other certificates awarded earlier to BELGONUCLEAIRE – for quality (ISO 9002) and for safety (VCA).

FANC

Since 2001, the FANC (Federal Agency for Nuclear Control) is the competent safety and security authority for nuclear activities in Belgium. This agency is mainly responsible for:

- Protection of personnel and the public against ionising radiation
- Regulation and inspection of nuclear facilities
- Accompanying EURATOM and IAEA inspections concerning safeguards and non proliferation, as well as physical protection of the nuclear materials

Protecting people against ionising radiation

Since 1980 a principle known as ALARA (As Low As Reasonably Achievable) has been in force in the nuclear industry to protect personnel from exposure to radiation. During manipulation in the gloveboxes, for example, radioactive contamination must be prevented. For this reason workers carry out full and systematic checks during work following each use of the gloves. When the workers leave the controlled zone additional checks are performed.

Since the plant was established in 1973 these protective measures have prevented any incident exceeding the legal limit.

The legal limit for exposure is 20 mSv per year. By comparison, the averaged annual dose received in Belgium from naturally occurring radioactivity (radiation from the ground, atmospheric radiation, radon and radiation from the body) is 3 mSv.

At the same time, the collective dose (the dose received by all the personnel together) has been significantly reduced. In 2001 the collective dose remained below 35 mSv per ton of MOX produced.

Continuing efforts to increase safety

Plutonium is used in the form of an oxide for the production of MOX fuel. If this radioactive plutonium enters the body, it may have dangerous consequences because of its high radiotoxicity. The handling of plutonium therefore demands stringent precautions for the personnel involved to avoid any uptake like ingestion or inhalation. Therefore all operations must be carried out within gloveboxes. Gloveboxes are gas-tight boxes, with glove portholes to enable the handling of radioactive materials.

MOX tablets

Measures against radioactive contamination

The gloveboxes are kept at a lower pressure than the production hall, which in turn is held at a lower pressure than the rest of the plant. By maintaining these different pressure levels, possible contamination from manipulated MOX material through the gloveboxes to the production hall and to the outside world is made practically impossible. These measures and the continuous high efficiency filtration of air in both the gloveboxes and the production halls, together with the use of an extensive network for detection of radioactivity prevent any contamination outside the plant.

Atmospheric discharge: far below the limits

The production process at Dessel produces no gaseous effluents. Ventilation networks from both the building and the production gloveboxes discharge the air to the atmosphere after filtration through several high-efficiency filters in series. These filters each retain more than 99.95% of the airborne particles they receive. The ventilation flow is continuously monitored before being discharged through the stack. During the precautions, the plant remains consistently at a very low level of radioactive discharge, i.e. less than a factor 1000 below the authorized discharge level.

Emergency planning

In accordance with Belgian regulations for nuclear emergency planning, the government's national crisis centre is located in Brussels and co-ordinates actions at federal level. At the level of the province of Antwerp, a co-ordination cell organises civil protection. The company takes constant care to ensure that its emergency plans are kept up-to-date. The emergency plans are practised regularly taking into account the following possible causes: fire (in or outside the controlled area), criticality, on-site contamination, stack discharge (with off-site contamination), accident with external cause. During emergency plan conditions, a co-ordination staff room is set up at the plant: it consists of senior management staff who co-ordinate the operations on-site. The operations room is involved with health physics, site protection, internal and external contacts, technical support and public relations. The operations team consists of the intervention agents, safeguards inspectors and employees. External support services are provided by SCK•CEN to perform environmental monitoring. Nuclear inspectors (FANC or its delegates from AVN) and neighbouring nuclear facilities are also involved. External relations with the media are co-ordinated by the company's head office. The government's crisis centre co-ordinates the actions with external services (such as the fire brigade, ambulance, police, civil protection...)

Criticality prevention

In a MOX plant, criticality is an uncontrolled start of a chain reaction in the processing of pure fissile material. It can lead to severe, or even deadly, exposure of personnel to ionising radiation. Therefore, precautions must be taken to prevent criticality accidents.

Criticality prevention is based on two pillars: the definition of clear technical specifications of the material to be processed and good reliable operational practices. At BELGONUCLEAIRE both aspects are integrated in a quality system to ensure maximal efficiency.

The technical specifications are derived from calculations, which are performed with validated computer codes. Well-defined margins are applied to all uncertainties. For each modification of the process, a documented criticality analysis is made, to demonstrate the acceptability of the specifications versus the calculation results. The criticality computations and the analysis are audited by an accredited Belgian Control Institution.

Transfer of nuclear material inside the MOX plant is subject to a strict control procedure and to a near real time accountancy system of the fissile material.

Criticality barriers between different units in the production line are used. Accredited personnel operate these barriers. The movements of these barriers are registered, and are under continuous remote surveillance. Moreover, it is worth noting that the whole fabrication process is operated in dry conditions, which helps in reducing criticality hazards.

To guarantee the awareness of the operational personnel, regular schooling as well as controls are organised on:

- Training in criticality safety principles
- Technical specifications

Control of rods

Fire protection

As in any industrial facility, fire is a major hazard. Fire protection relies on an extensive fire detection system, high-performance fire extinguishers, and last but not least a sound prevention practice.

The fire detection system consists of several hundreds fire detectors installed over the whole plant, from production shops or electrical cabinets up to office rooms. All these detectors are connected to a central alarm monitoring and management station in order to take in due time all necessary actions.

Actions can be automatic or manual initiation of an extinguisher, contact with the fire brigade or technical intervention.

The fire extinction system is adapted in function of the location of the fire. Due to criticality hazard, water or powder may not be used for the most sensitive nuclear zones: the latter are protected by a CO_2 extinguishing system - ensuring extinction in compliance with the nuclear safety criteria of the plant.

In other zones several types of fire extinguishers are available based on water, CO_2, powder or FM-200 gas (the CFC-free equivalent of halon).

Redundant hydrant networks ensure appropriate water supply under all circumstances, either from the municipal water distribution or from a water well. In case of fire, the company's fire brigade acts during the first minutes untill the nearest district fire brigade takes over.

Regular meetings and joint exercises ensure that both fire brigades can act in the most effective way. In order to prevent fire initiation, most gloveboxes are placed under inert gas cover.

Specific operations with risk of fire (like e.g. cutting, welding, inflammable products) are subject to a case by case analysis and authorization process.

In order to prevent fire propagation, walls, doors, roof and roofstructure, ventilation ducts and cable paths are protected against standardized fire conditions.

The plant complies fully with the norms of the Belgian National Agency for Fire Protection (ANPI/NVBB).

Reducing waste production

As with all industrial processes, the fabrication of MOX leads to waste production. In the nuclear industry, waste is made up of nuclear waste and industrial waste. The nuclear waste is conditioned and stored in accordance with the regulations issued by NIRAS (the National Institute for Radioactive Waste and Enriched Nuclear Material). It is then transferred to BELGOPROCESS, a subsidiary of NIRAS, where it is temporarily stored before processing and final storage. OVAM (Public Flemish Waste Company) is the regional company controlling industrial waste management in Flanders.

Waste consists of liquid and solid waste.

Liquid wastes

Liquid wastes comprise non-active effluents, active wastes and plutonium-contaminated wastes. Active wastes originate mainly from the water and cooling circuits in the production area and from the water used for cleaning the production rooms. Active waste undergoes a purification treatment prior to discharge into a buffer tank. Depending on the measured activity, it is either disposed of by NIRAS or is treated as industrial wastewater. Non active effluents do not contain any radioactive materials and originate mainly from the non-nuclear buildings (i.e., from sanitary facilities) and are therefore processed according to OVAM regulations.

Plutonium-contaminated effluents are mainly produced by the plant's analytical laboratories. These effluents can include variable amounts of plutonium – from less than 1 milligram up to several grams per litre. If the plutonium content is high, the liquid waste undergoes a plutonium recovery treatment. Otherwise it is classified as radioactive waste and treated by NIRAS.

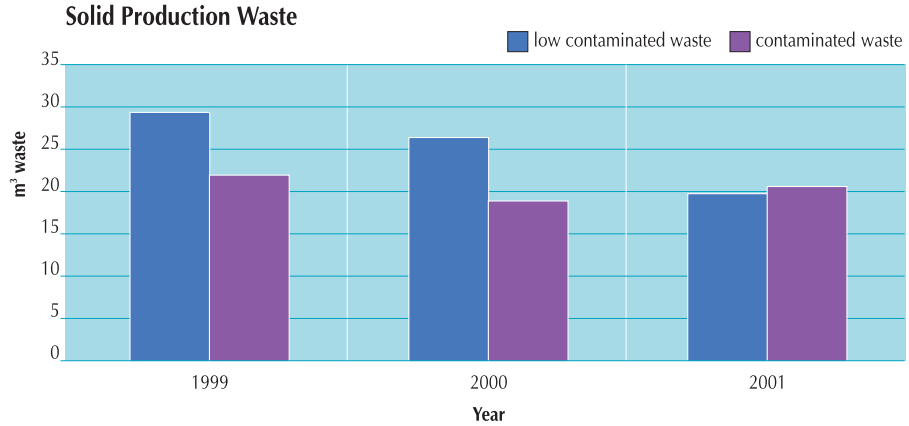
Welding of waste barrel

Solid waste

Solid waste production consists of three main categories of nuclear waste (contaminated with plutonium, low and very-low contaminated). All material leaving the controlled area is considered as nuclear waste until the absence of contamination is established by measurements. Nuclear waste products are sorted not only according to their level of activity, but also according to treatment requirements - incineration, compacting or embedding in cement.

In 2001 some 20m^3 of contaminated and 20m^3 of low contaminated waste material were produced.
All material leaving the gloveboxes is considered to be contaminated waste. This waste varies from tissues, through tools to gloves. All these waste products are sorted and packaged according to NIRAS specifications and sent to this organisation for processing and storage.

Solid Production Waste



All costs related to the treatment and storage of waste by NIRAS are charged to BELGONUCLEAIRE.

Non-nuclear waste products are sorted in an industrial waste area. They are then collected by an authorised company, which processes them further. Each year BELGONUCLEAIRE notifies to OVAM the quantity and type of industrial waste produced.

Efficient technologies and increasing awareness and attention of individuals help to decrease the amount of waste produced.

PROMOTING NON-PROLIFERATION AND NUCLEAR DISARMAMENT

Regulations

Application of safeguards is under the strict supervision of the Belgian Federal Agency for Nuclear Control as well as of the competent international authorities: Euratom Safeguards Office (ESO) in Luxembourg and the International Atomic Energy Agency (IAEA) in Vienna.

Promoting non-proliferation

Today, all fissile and fertile nuclear materials are considered as potentially usable to some extent to manufacture crude nuclear explosives. The peaceful nuclear industry processes or uses such materials and must, therefore, contribute to the national and international efforts to avoid diversion of these materials from their peaceful uses, in order to effectively prevent the proliferation of nuclear weapons.
According to the Non-Proliferation Treaty (NPT), countries with nuclear activities must establish and maintain a State System for Accounting and Control of all nuclear material subject to safeguards; this system shall be applied in such a manner as to enable IAEA to verify that there has been no diversion of nuclear material from peaceful uses to nuclear weapons or other nuclear explosive devices.

The control is based on the detailed follow-up of all nuclear materials present in the plant. This involves:

- A measurement system for the determination of the quantities of nuclear material, together with the evaluation of their precision
- Procedures for managing shipper/receiver differences, making a physical inventory and evaluating its precision
- A system of records and reports and provisions ensuring that the system is operated correctly

Belgium being a Non Nuclear Weapon State (NNWS), the Belgian nuclear facilities are subject not only to Euratom inspections (since 1972), but also to full scope IAEA inspections (since 1978).
Some 10 years ago, the BELGONUCLEAIRE MOX plant was among the first facilities to come into consideration for application of the New Partnership Approach (NPA), an agreement signed between the European Commission and the IAEA in April 1992.

Control of rods

Besides enhancing the effectiveness and the efficiency of safeguards implementation in the NNWS of the EU, one goal of NPA was to optimise the yearly inspection manpower effort of IAEA and to install unattended equipment in order to strengthen the safeguards.

Nuclear disarmament

Nuclear fuel can be produced from several types of plutonium including military plutonium. Both the USA and Russia have decided to undertake partial disarmament. They intend to neutralise their military plutonium derived from the dismantling of nuclear weapons by reprocessing it into MOX valorising it for electricity production and making this material impossible for futher weapen use.

US PROJECT

BELGONUCLEAIRE has made its technology available to ensure non-proliferation and for application within the framework of the excess weapons plutonium disposition. Since 1995 BELGONUCLEAIRE has been in contact with US Industry and Authorities to use its technologies for converting military plutonium into MOX fuel. Since 1999 it has been the subcontractor providing Belgian MOX technology to the consortium DCS (Duke, Cogema, Stone & Webster) that is working for the US Department of Energy with the aim of designing, building and operating a MOX plant in the US.
Furthermore, the MIMAS process developed by BELGONUCLEAIRE, which is now the industrial process most often used to manufacture MOX fuel, has been selected for the project.
In the framework of the qualification programme proposed to the US NRC (Nuclear Regulatory Commission), lead test assemblies could possibly be manufactured in Europe. BELGONUCLEAIRE has a wide industrial experience; the Dessel plant has processed similar material in the past so that it has been recognised as a suitable plant for performing this qualification. US has recently appoached the Belgian authorities to discuss the condition to fabricate these lead test assemblies at Belgonucleaire.

Beginning of 2002, the US Department of Energy completed an exhaustive review of the options for the secure disposal of 34 tonnes of weapons plutonium surplus to military stockpiles. Despite its earlier commitment to a dual-track strategy, the immobilisation option has now been dropped, and all 34 tonnes will be processed and used as MOX fuel.

RUSSIAN PROJECT

BELGONUCLEAIRE is participating, with the financial support of the Belgian State, in an international study for the design of a MOX plant in Russia. BELGONUCLEAIRE is also playing a role as expert for the European Commission in the framework of the Russian plutonium disposition programme.

COMMUNICATION

Communication is important at all levels within the company. Every year, BELGONUCLEAIRE prepares a detailed communication plan, which describes its values, mission, objectives and strategy. Within its framework, we define our target groups (decision-makers, pressure groups, media etc…) with which we intend to communicate.

EXTERNAL COMMUNICATION

Communication is a key element for public acceptance of our activity. We therefore try to report regularly on our activities and we listen to and respond to our neighbours, customers, shareholders, and suppliers.

BELGONUCLEAIRE regularly invites visitors from other organisations or foreign countries to visit its MOX plant. Several members of the personnel regularly attend national or international conferences and seminars. BELGONUCLEAIRE communicates with the general public by providing information directly on demand (e.g., brochures and reports can be obtained in this way).

Our website is updated regularly and is a source of information for everyone who wants to know more about BELGONUCLEAIRE in particular or the nuclear industry in general.

We also regularly communicate with local communities around the MOX plant. This allows us to exchange views and information and to obtain valuable feedback from local communities on our goals and performance: BELGONUCLEAIRE supports several local initiatives with environmental purpose. We organise talks at schools in the Mol-Dessel-Geel region and we also support specific local cultural and sportive events. BELGONUCLEAIRE annually attributes a prize to a student for the best thesis devoted to nuclear energy in general and nuclear industry in particular.

INTERNAL COMMUNICATION

Internal communication is a day-to-day activity and a "must" to keep the personnel motivated and to create a positive climate in the company.

BELGONUCLEAIRE's Intranet is a good medium to distribute the information required. BELGONUCLEAIRE also diffuses a weekly press review to its staff.

For further information please contact:

A. De Backer • Tel: 014/33.03.94; email: a.debacker@belgonucleaire.be at the plant
M. Poncelet • Tel: 02/774.06.68; email: m.poncelet@belgonucleaire.be at headquarters.

MOX bundle

CONCLUSIONS

- Manufacturing and using MOX fuel in nuclear power plants is a safe, secure and environmentally friendly way of valorising plutonium to produce energy.

- From the very beginning, BELGONUCLEAIRE has proven that highly reliable MOX can be manufactured safely and this is achieved by taking constant care of quality during the fabrication process.

- Paying constant attention to safety in and around the plant results in a safe and clean environment and good public acceptance in the region around the plant; the plant also contributes to providing stable employment in the region.

- MOX helps in reducing (civilian as well as military) plutonium stockpiles and therefore reduces proliferation risks and nuclear threats, which are prerequisites of sustainable development.