



# EUROCHEMIC

EEN PROJECT VAN BELGOPROCESS // A BELGOPROCESS PROJECT





# EUROCHEMIC

1957 // 2008

***EUROCHEMIC: A PLANT WITH TWO UNIQUE LIVES** // The experimental reprocessing plant Eurochemic in Dessel made - and still makes - in many respects industrial history. It was undoubtedly unique to have scientists from thirteen European countries sharing their knowledge in a large and ambitious project in the strongly screened field of nuclear science. This international cooperation resulted in an innovative reprocessing installation which guaranteed a decisive progress in the process of recovering spent fuel. It's striking that after the definite close down of Eurochemic the installation got 'a second life' as a pilot project for the development of nuclear decommissioning techniques. With Eurochemic for the first time a civil nuclear reprocessing plant was decommissioned. Eurochemic is a factory with two unique lives...*

**FINAL CHAPTER OF A NUCLEAR PERPETUUM MOBILE** // *The nineteen fifties were years of optimism, of reconstruction and a new confidence in the future. The economic and industrial growth, embodied in the Marshall Plan, would no doubt generate a huge growth in the demand for energy in this post-war period. The Belgian business sector had shown a great interest in the development of an industrial nuclear energy cycle. The reprocessing plant Eurochemic was to be the final chapter of this 'nuclear energy cycle'. The reprocessing of spent nuclear fuel would be the final step towards a society where the supply of energy would be limitless.*

**LEADING NUCLEAR INDUSTRY** // *In the nineteen fifties, Belgium held a prominent position worldwide in the nuclear sector. The country had gained this prominence thanks to the uranium mines in its former African colony of Congo. Belgium was one of the main suppliers of uranium ore to the United States, which was the leading nuclear superpower. In exchange for these supplies, Belgium acquired privileged access to the 'sensitive' nuclear knowledge for civilian purposes. This was demonstrated for the first time in 1952 with the establishment of the nuclear research centre SCK, Study Centre for Nuclear Energy, in Mol. The SCK was to provide the Belgian academic and industrial institutions access to the worldwide development of nuclear energy. In order to maintain this leading position in nuclear technology, the Belgian government successfully applied for the construction of the pilot reprocessing plant Eurochemic. The plant was to be built in the shadow of the SCK on the bleak moors of Dessel owned by the Belgian Royal Family.*

**TWOFOLD MISSION** // *The Eurochemic pilot plant was founded in December 1957 by an international consortium of twelve OESO countries (Organisation for Economic Cooperation and Development), in partnership with the private sector. The twelve partners were: Germany, France, Belgium, Italy, Sweden, the Netherlands, Switzerland, Denmark, Austria, Norway, Turkey and Portugal. In 1959, Spain also joined this group of countries. Eurochemic's mission was twofold: the construction and operation of an experimental reprocessing plant for the recycling of spent nuclear fuel and conducting scientific research into new reprocessing methods. Eurochemic offered the participating countries an opportunity to take their first steps in the complex area of recycling nuclear fuel. In the laboratories of Eurochemic, the future European nuclear scientists received their training. The early Eurochemic employees would later fill key positions in international nuclear organisations and companies.*



**GREAT EXPECTATIONS** // On Thursday 7 July 1960, almost 50 years ago today, Prince Albert, the present King, laid the first stone of the Eurochemic reprocessing plant in Dessel. Part of the royal retinue at the time was the then Minister of Health and Family Paul Meyers. In his speech, the Minister accurately expressed the feelings of the people at a time when the nation had high hopes for nuclear energy. "Thanks to the extremely fast evolution of the price of the kilowatt-hours generated through nuclear energy, we are right to have high hopes. This price will go down by 20%", Meyers predicted. The laying of the foundation stone was front-page news in the Belgian press.

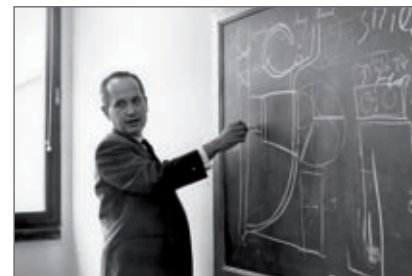
**A SIMPLE PUSH OF THE BUTTON** // Six years to the day after his brother had laid the first stone, on 7 July 1966, King Baudoin travelled to Dessel for the official opening of Eurochemic. "A simple push of the button started the reprocessing operations of uranium or plutonium enabling the reuse of the fuel in nuclear reactors", a newspaper wrote at the time. This 'simple push of the button' had been preceded by six years of intensive and innovative scientific and technological work. About a hundred young and highly qualified nuclear specialists from 13 European countries joined forces to make Eurochemic a unique industrial pilot project. This cooperation took place in an exceptional context of scientific and technological optimism. The Eurochemists were highly ambitious in their desire to have the future generations benefit from the huge advantages of nuclear energy. For the scientists, the Eurochemic plant was the pick of the bunch.



**AN INTERNATIONAL BUILDING SITE** // Besides this combination of scientific expertise, Eurochemic was also one of the first successes of international cooperation. The project was financed with resources from the 13 participating countries and their private partners, mainly electricity producers. Originally, 21.4 million dollars had been set aside for the construction of the plant. This sum was later increased to 35.75 million dollars. Belgium contributed 14.3% of this sum and with France and Germany it was one of the main financiers of the project. These three countries jointly possessed more than half of the Eurochemic shares. The construction of the plant, which was to take more than six years, was also an international effort. The construction of the various parts of the plant was contracted out to several contractors from the participating countries. It allowed the partners to acquire expertise in the construction of a high-tech nuclear plant. The result was an ultramodern factory, built using the latest building techniques and materials from all corners of Europe. The 'heart' of the Eurochemic plant consisted of forty separate cell blocks with concrete walls, varying in thickness from 50 to 150 centimetres depending on the activity that took place there.

## INNOVATIVE RESEARCH //

To this day, Eurochemic is the only company where a group of international partners worked together on the research into industrial applications for the reprocessing of nuclear fuel. Reprocessing is a term used in the nuclear industry for the recovery of usable fissile materials from spent nuclear fuel. During this chemical recycling process, the usable uranium and plutonium are separated from the spent fission products. Thanks to this reprocessing, today 97% of the plutonium and uranium can be recovered to make new nuclear fuel. In the late nineteen-fifties, reprocessing in Europe only took place at two modest plants: at the then Windscale power plant – the current Sellafield plant – in the United Kingdom and in Marcoule in France. Eurochemic worked on a highly innovative research programme, which led to pioneering progress in nuclear reprocessing. A separate research department constantly tested new test arrangements to find the best possible ways to separate fissile material and waste. Fuel elements from the nuclear reactors of the participating countries were reprocessed in Eurochemic on an industrial scale. From 1966 to 1974, a total of 181.5 tonnes of natural and low-enriched uranium was reprocessed. Of this material, 95.5 tonnes originated from commercial nuclear reactors. A total of 677 kg of plutonium was separated. In addition, 1363 kilograms of high-enriched uranium was recycled from 30.6 tonnes of fuel elements from European pilot reactors. When Eurochemic was commissioned in 1966, it employed 378 people of thirteen different nationalities.



## ACHILLES HEEL //

The industrial and scientific cooperation between thirteen countries at Eurochemic was the first example of a joint European project. But it was precisely this international approach that proved its Achilles heel. Quite soon after the plant had been commissioned, the main partners France and Germany quit the partnership intent on taking industrial reprocessing of nuclear fuel into their own hands. With a maximum capacity of 60 tonnes uranium a year, it was impossible for Eurochemic to compete on an industrial scale with these large national reprocessing projects. In 1975, it was decided for the first time to shut down the plant temporarily. For ten years, the plant faced an uncertain future. All those years, over 190 employees kept maintaining the installations with a view to a possible restart. Obviously, for safety reasons, the plant also had to be kept under permanent surveillance. In late 1978, the Belgian government concluded an agreement in principle about the takeover of the factory with the intention for it to supply domestic needs only. In 1984, the Belgian government transferred Eurochemic to Belgoprocess (which at the time stood for Belgium reprocessing). The aim of Belgoprocess was to meet the obligations of Eurochemic (the reprocessing of irradiated fuel) including the dismantling of the installations after operations had ceased. However, the plant was never restarted because in 1985 it was decided to shut down Eurochemic for good. In this case, the State had committed itself to selling Belgoprocess to the NIRAS. The dream of this unique reprocessing plant to become 'the heart of the European reprocessing industry' had ended prematurely.

**A SECOND LIFE** // However, the decommissioned plant did enjoy a 'second life': Eurochemic was to become the first reprocessing plant in the world that would be decommissioned. It received the status of 'pilot project for the development of nuclear decommissioning techniques'. The international cooperation was also continued with an extensive programme for the management of radioactive waste, which had been produced by Eurochemic. The thirteen countries compiled a budget that allowed the Belgian government to finance the decommissioning of the plant. It was an example of the determination of the participating countries to take their responsibility for the safe management of the nuclear site.

**FIRST TEST CASE** // The department for Nuclear Support Tasks, branch 'Dismantling', of Belgoprocess started with the decommissioning of Eurochemic in 1989 with the demolition of two Eurochemic buildings for the storage of finished products of reprocessing of nuclear fuel. The demolition was a pilot project to familiarise the operators with dismantling techniques. It took over two years to decontaminate and dismantle these buildings. Still, this test case was crucial in more than one respect for the further dismantling of the reprocessing plant. Belgoprocess showed competent authorities and inspection organisations, such as the the FANC and Bel-V (former AVN), that it possessed the knowledge and skills: the company was able to fully decontaminate and demolish a nuclear structure within the stringent safety procedures and rules. The test also enabled an estimate to be made of the cost and time needed for full decommissioning. But the main thing was that Belgoprocess was able to develop a specific decommissioning strategy. From the very beginning, the company sought maximum decontamination of the materials, mainly metals and concrete, found in the reprocessing plant. In this way, Belgoprocess intended to systematically reduce the remaining radioactive waste fraction and thus minimise the cost of its removal.



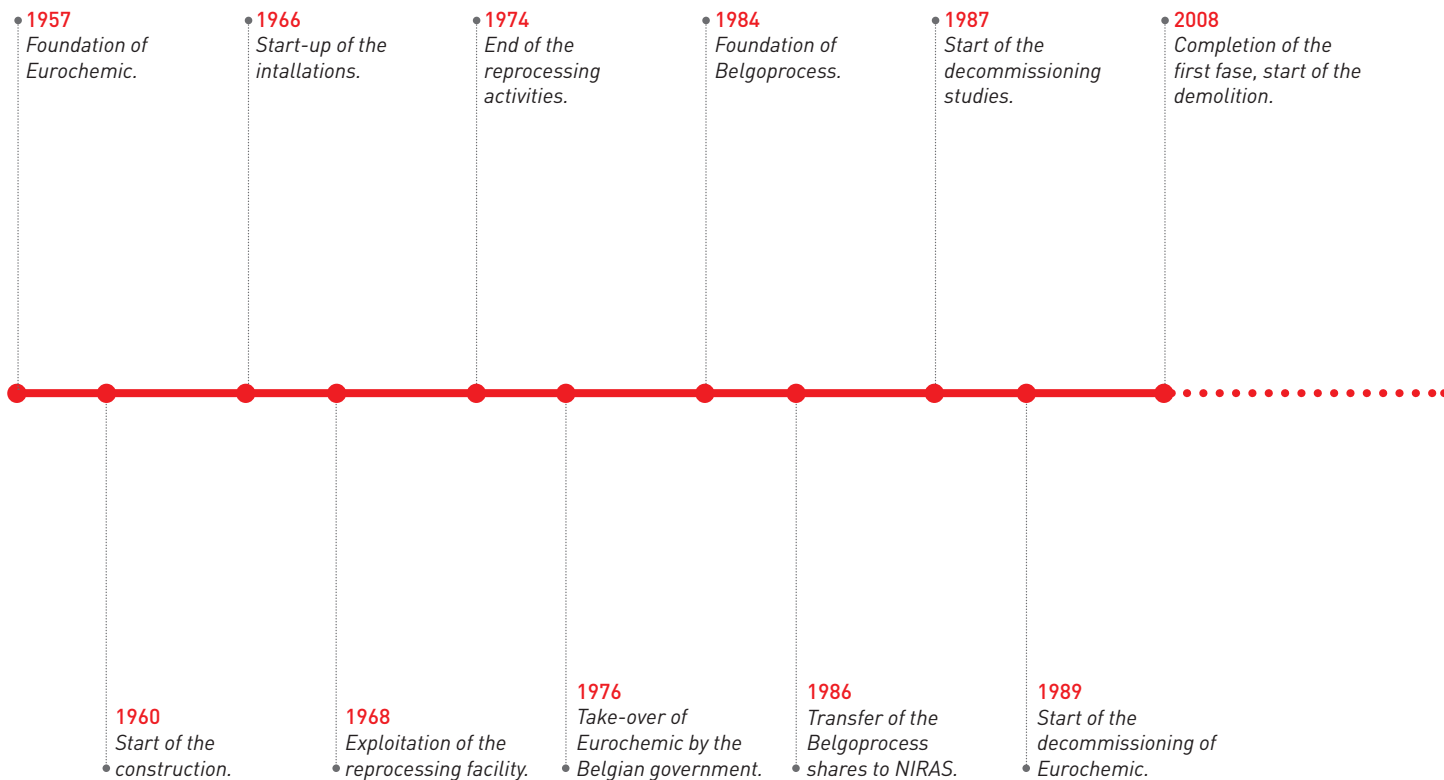
**MAXIMUM DE CONTAMINATION** // In order to achieve maximum decontamination, Belgoprocess made substantial investments in research into new technologies for the optimum decontamination of concrete structures and metals. This research led to decontamination installations that attracted worldwide attention. Among the installations developed by Belgoprocess were abrasive grit blasters for the dry removal of radioactive surface contamination from concrete and metals using the impact of metal grit. Other important developments included shaving techniques, used for the decontamination of concrete walls. These installations and tools contributed to the impressive results that Belgoprocess has achieved in the recycling of contaminated materials. To this day, 56.4% of the treated concrete could be recycled, 92.3% of the barite concrete, 68.6% of the metal and 40.2% of the other materials. It is estimated that 63.6% of the contaminated materials could be released for reuse in conventional industry.



## **DISMANTLING PROCEDURE** // *The dismantling of Eurochemic is a phased operation.*

*Since 2004, the plant has been divided into an eastern, a western and a central part. The dismantling started in 1990 and is scheduled to be fully completed in 2012. So far, the eastern part has been fully dismantled, decontaminated and is now ready for demolition. The dismantling of the forty cells, or 106 cell structures, always follows more or less the same procedure. First, the 'spots' - places with high radioactivity - in each cell are removed, thus reducing the radiation in the room and lowering the risk of operators becoming contaminated. Eurochemic operators receive an average radiation dose of 1.5 mSv a year. The legally permitted maximum dose is 20 mSv a year. During a second phase, all metal components are removed using plasma torches. During a third phase, the concrete walls are decontaminated with the aid of shavers. What remains, is an empty room, every inch of which is inspected for any remaining radioactive contamination. If these inspections no longer detect any contamination, the cell can be hermetically sealed. After three months, the measuring procedure is repeated. If still no contamination is measured, the cell can be released for demolition. Dismantling is a highly labour-intensive job. The operators wear special protective clothing and breathing apparatus. The extreme physical efforts allow no more than two hours of work a day. In all, 56 persons are working on the dismantling of the Eurochemic plant.*



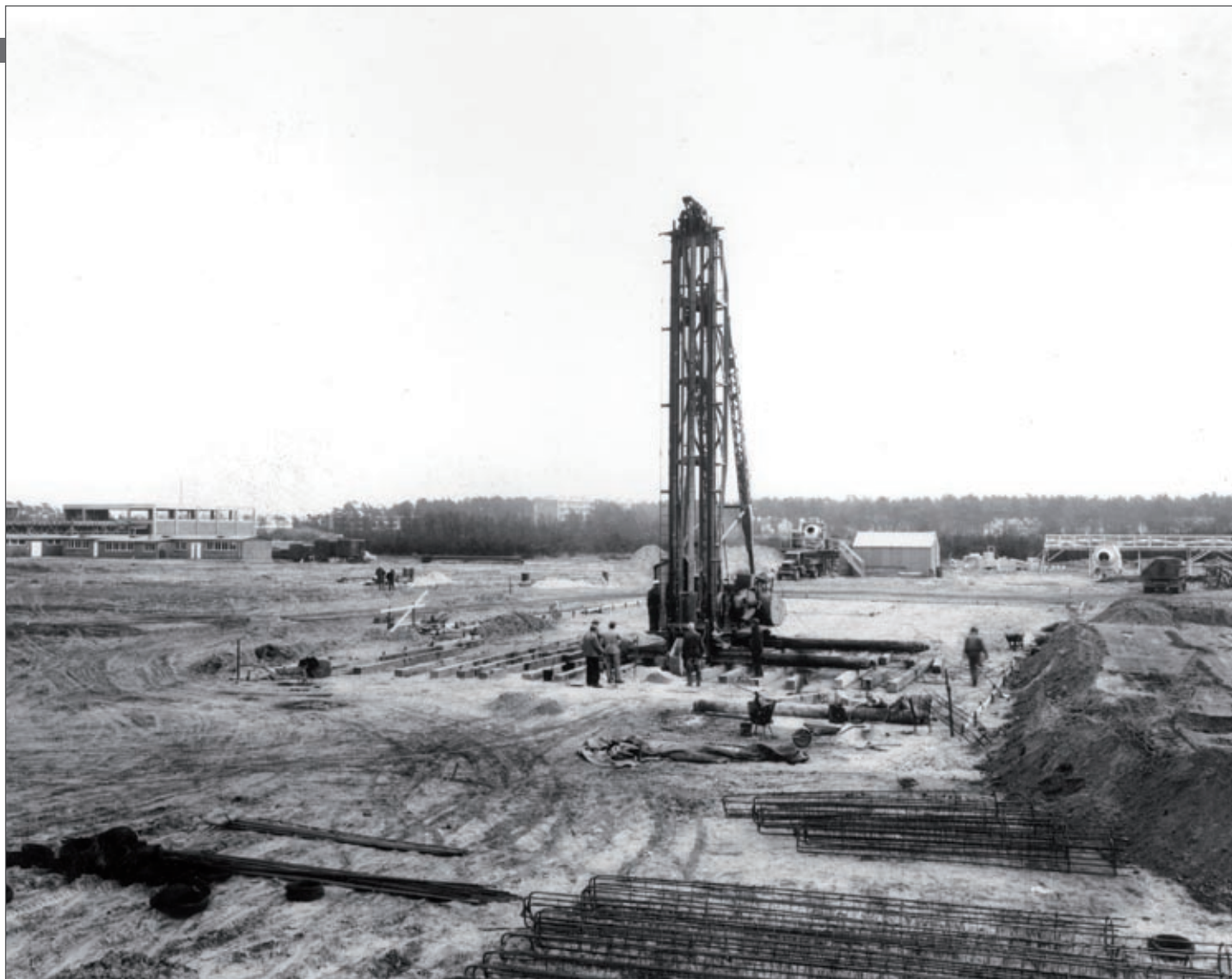






**EUROCHEMIC**

**IMAGES**



*Sinking the foundation piles. To prevent water from seeping in the installations during flooding, the ground level was raised.*

01

*Laying of the foundation Stone by Prince Albert.*

02

*Foundations work of the storage pond for spent fuel. In the background, research building 10, the first building to be commissioned.*

03

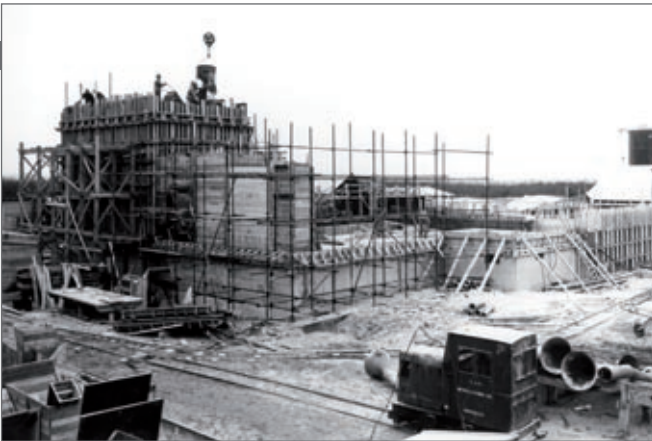


02



03

01



- 01 *The reprocessing plant is constructed entirely from concrete. The construction of the formwork and the casting of the concrete were done by hand.*

- 02 *The large hall of the storage pond was the first part of the construction to be completed.*

02





03



04

*A Sikorsky helicopter of the Belgian air force lowers a prefabricated pulsed column, the heart of the installation, into its place in the building.*

03

*Besides the reprocessing plant, a workshop, a research building and other facilities buildings were also built.*

04



01

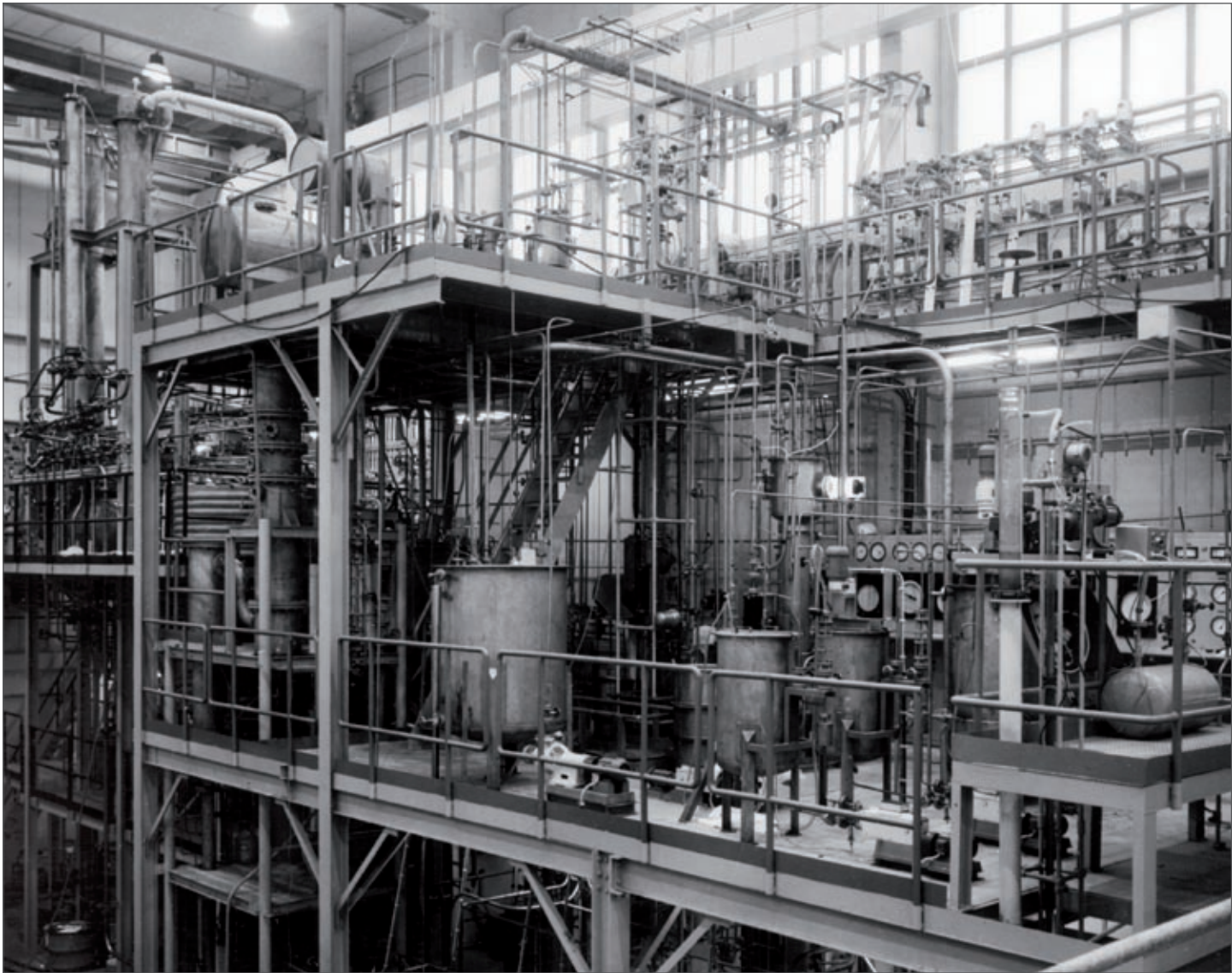


02



01 The construction of Eurochemic was an international effort. Materials were supplied from companies from all thirteen participating countries. The technicians and researchers were also from the participating countries, which did not always help the communication on the site. But the atmosphere between the, mostly young, employees was always excellent.

03 The purpose of test arrangement of a pulsed column in the research building was to carry out tests and to train staff.







*In 1966, the plant was completed. The next two years staff was trained and the installation finalised. In 1968, operations started.*

01

*The water treatment plant pumped up groundwater, which was filtered into industrial water. Demineralised water was also produced.*

02

*Quality inspections were carried out in the shielded boxes of the process control laboratory both during and after the process.*

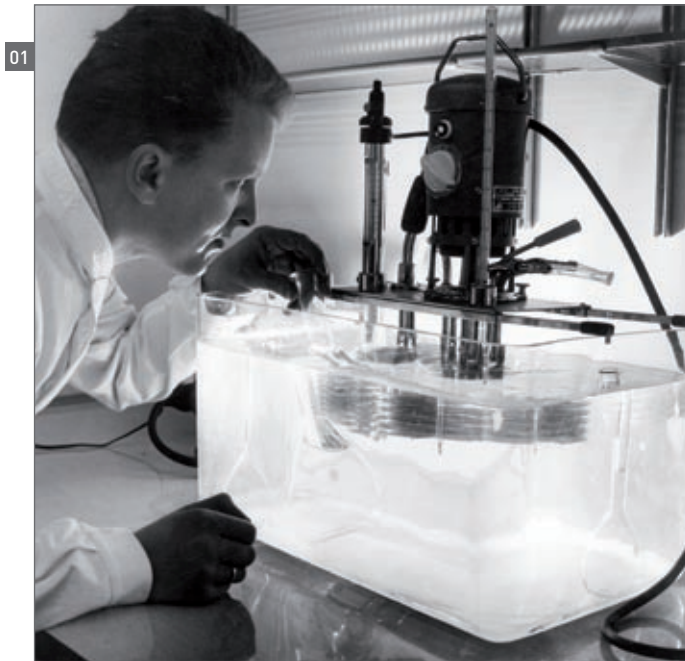
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02



03



01 *Eurochemic was also a research institute. In the labs, researchers continually developed techniques to optimise the process.*

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02 *The purity and the isotopic composition of uranium were determined with the aid of a mass spectrometer.*

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03 *Analysis of low-level samples in the process control lab.*







03 *Arrival of spent fuel from nuclear plants from the participating countries. The reprocessing of the fuel elements was complicated because each reactor used different types with different lengths and alloys.*

04 *Storage of spent fuel in the storage pond, sorted according to type. The plant was not started up until there was sufficient fuel.*



03



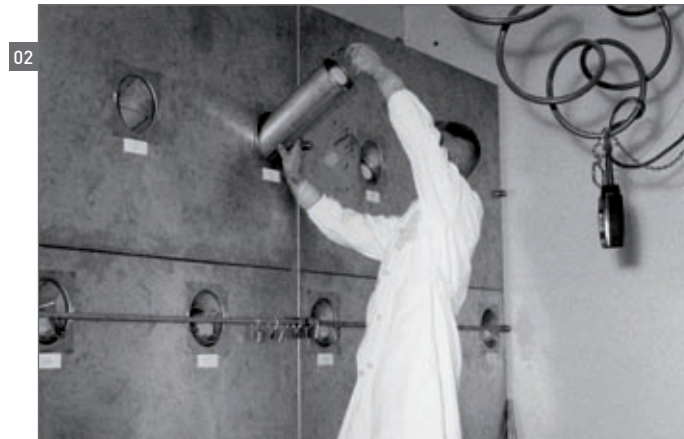
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*The spent fuel was loaded under water with the aid of a loading machine and transferred to the dissolver where it was dissolved.*

01

*A cargo of reprocessed uranium in a liquid solution being transported in safety containers specially designed for the transport of hazardous materials.*

02

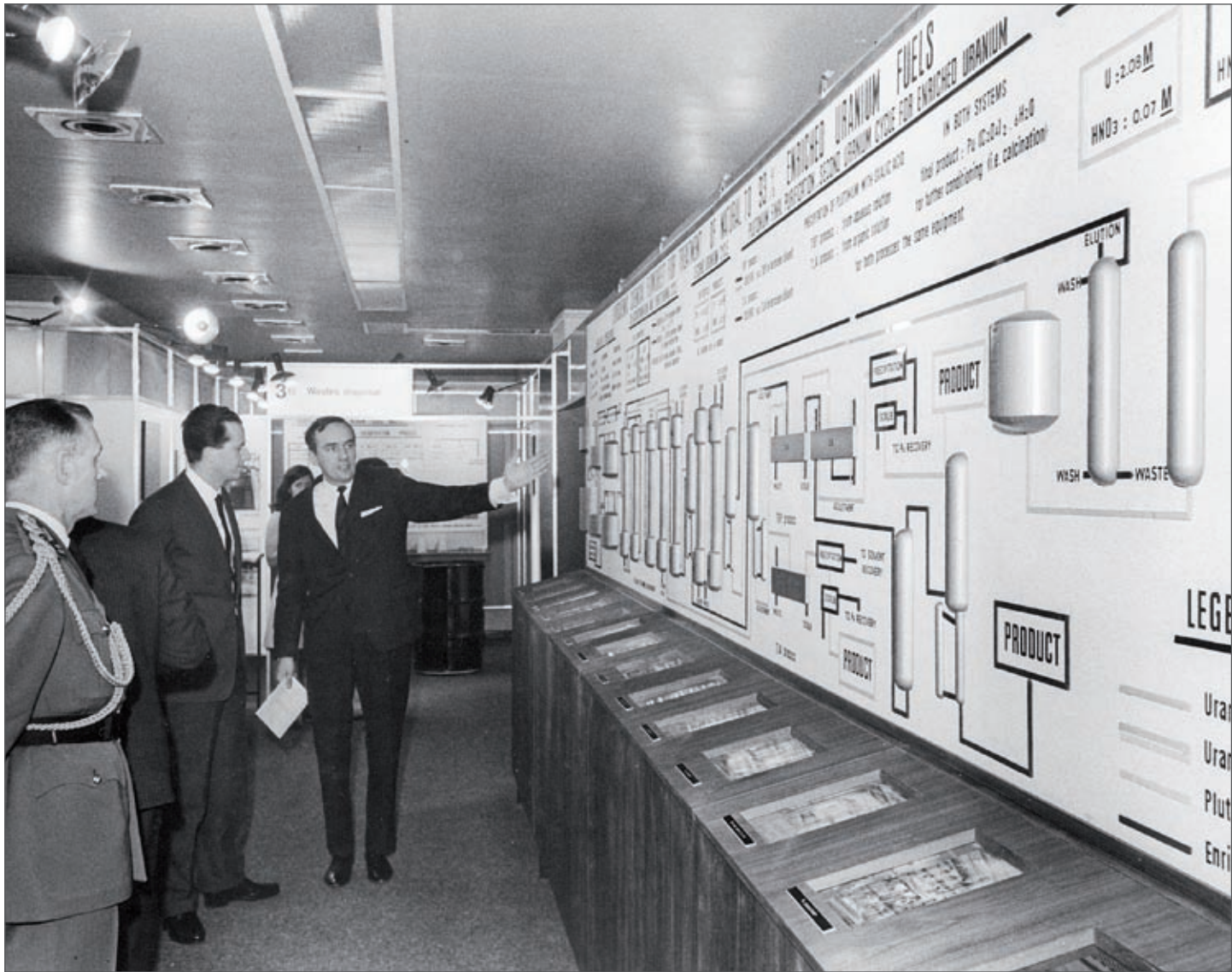


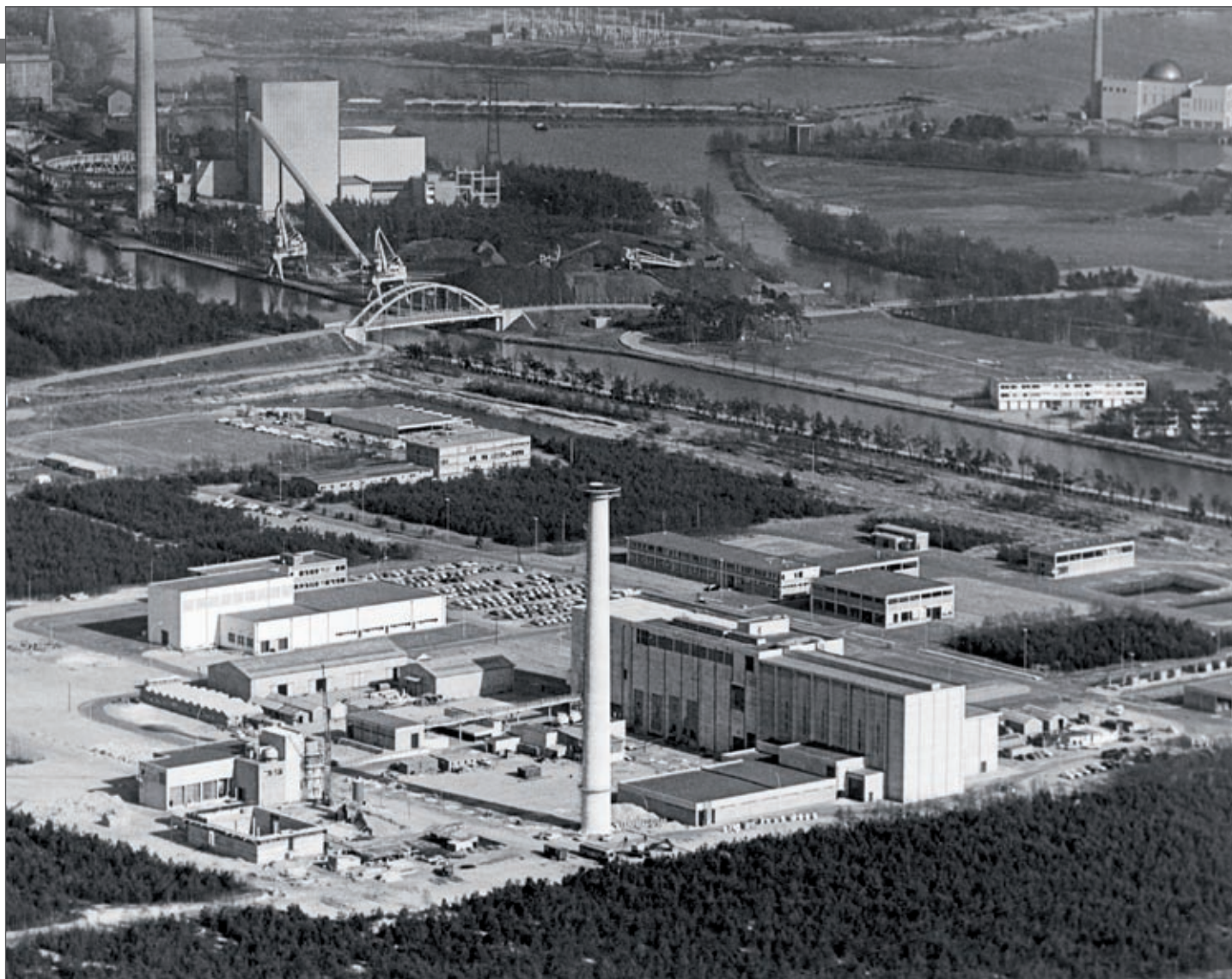
01 *Cylinders of plutonium and high-enriched uranium in oxide form (powder) being filled.*

02 *Storage of cylinders of plutonium and high-enriched uranium in oxide form.*

03 *Eurochemic was leading in technology and regularly attended trade fairs, for example in Geneva, Rome, Utrecht and Antwerp. In 1967, King Baudoin visits the Brussels trade fair.*









*In 1974, the reprocessing plant was shut down. It was only after ten years that the decision was taken to decommission the plant. In the meantime, the installations were maintained by over 190 employees.*

01

*Before the actual dismantling, the rooms are cleared and all uncontaminated elements removed.*

02

*Mobile utilities such as electricity and compressed air are then brought into the bare concrete structures.*

03



02



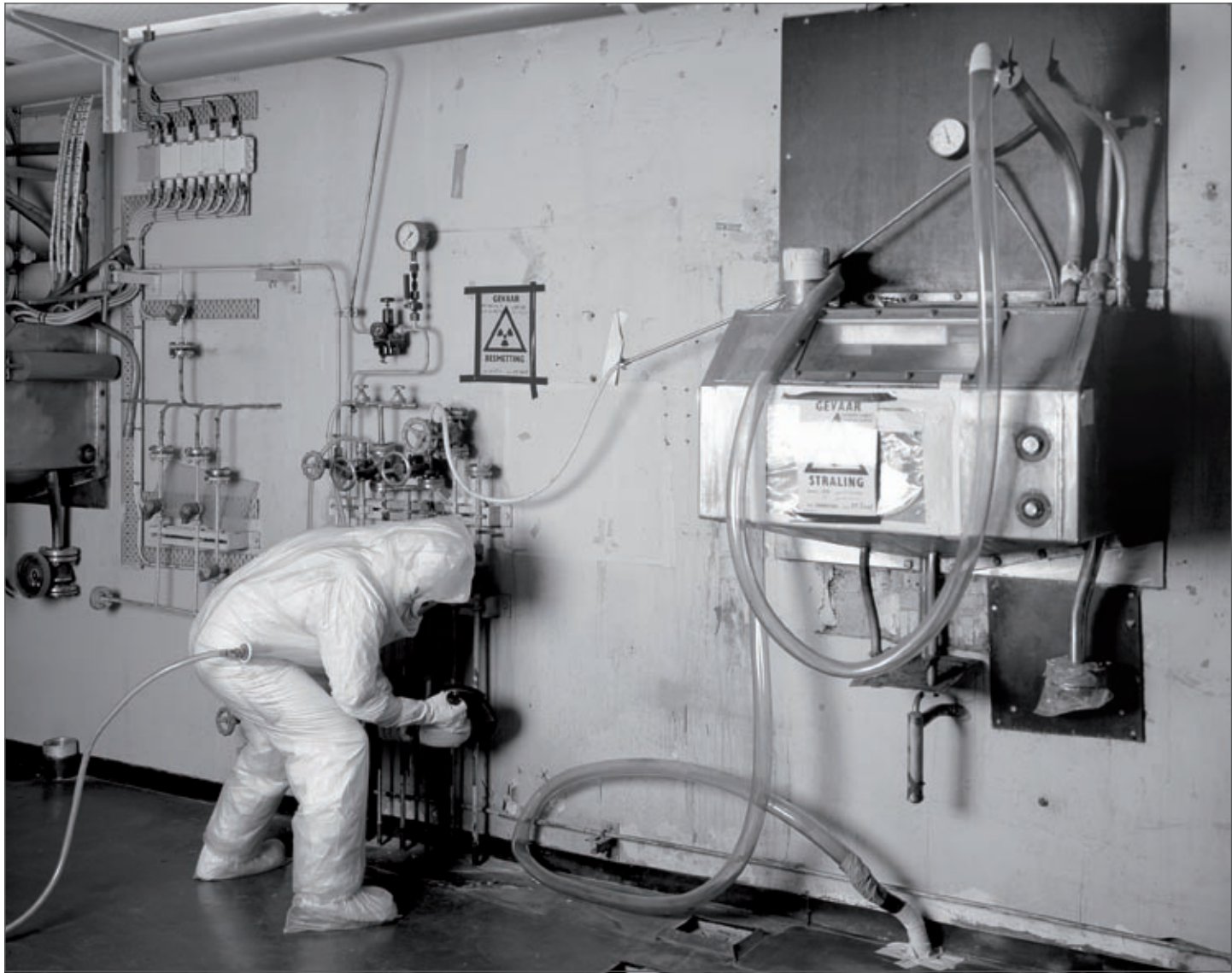
03



01 An operator is being prepared for an intervention. Belgoprocess developed special pressurised protective suits to protect against contamination.

02 The removal of the paraffin around a tank in a cell. The cells in the plant were hermetically sealed, there the degree of contamination was highest.

03 Also from the corridors nuclear contaminated elements had to be removed, such as the blisters or sampling points.



01





*Remote controlled demolition hammers are used to remove subsurface contamination in walls and floors.*

01

*Surfaces are scraped with the aid of shavers, diamond-tipped rotating discs.*

02

*Belgoprocess adapted conventional material for nuclear applications.*

*In order to remove the large transit pipes between cells, concrete crushers and demolition hammers are used.*

03



02



03





01 Waste containers are carefully inspected awaiting further treatment (decontamination or waste disposal).

02 After decontamination, 90% of the removed materials will be treated as waste or recycled.

03 The decontaminated cells will be demolished by controlled demolition.







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