PALLAS

Notification of Intent for the Environmental Impact Assessment (EIA)

The translation of the original Dutch Notification of Intent was commissioned by the ANVS. In the event of discrepencies between this translation and the original Dutch version, the latter shall prevail.

Table of content

PALLAS

Background

PALLAS's goal is to establish a multi-purpose reactor suitable for the production of medical and industrial isotopes, and for carrying out research into nuclear technology. This reactor, the PALLAS-reactor, will replace the current High Flux Reactor (HFR) in Petten, which has now been operational for more than fifty years and is approaching the end of its economic lifetime.

Since the end of 2013, the Foundation Preparation PALLAS Reactor is established (henceforth to be known as PALLAS). PALLAS's objective is the realisation of the first phase (tendering, design and licencing) plus attracting private financing for the second phase (construction and commissioning of the reactor). For the first phase, PALLAS has been provided with a EUR 80 million loan from the Ministry of Economic Affairs and the Province of Noord-Holland (EUR 40 million each).

Until December 2013, PALLAS was a separate project of the Nuclear Research and Consultancy Group (NRG), a subsidiary institute of the Energy Research Centre of the Netherlands (ECN) and licensee/operator of the HFR. On 17 November 2009, NRG issued a notification of intent for the environmental impact procedure of the PALLAS-reactor. The former Ministry of Housing, Spatial Planning and the Environment (VROM) responded to this in June 2010 by issuing guidelines for the Environmental Impact Report.

The present Notification of Intent replaces the 2009 notification of intent, because of some key changes to the project, such as the above-mentioned establishment of the independent Foundation. In addition, in 2009, there were two potential sites for the PALLAS reactor: Petten and Borssele. With the financing by the Province of Noord-Holland thePetten site was selected.

Some important changes have been made to the technical requirements for the reactor.. Since 2009 the technical requirements for the PALLAS reactor have been continuously updated to comply with latest technology. For instance, the lessons learned (at international level) from the Fukushima accident have been monitored and incorporated into the requirements. Another significant modification to the technical requirements concerns the reactor power. While the 2009 notification of intent stated that the reactor would have a maximum reactor power of 80 MW, the current aim is to enable the business intended with the reactor at the lowest reactor power possible. According to current knowledge the reactor power is expected to be maximal 55 MW, and possibly substantially lower.

The changes mentioned above have been included in this Notification of Intent.

1 General

1.1 Reasons for this Notification of Intent EIA

PALLAS wants to construct and operate a reactor for the production of medical and industrial isotopes, and for carrying out public and private research into nuclear technology. This concerns the construction of the reactor and supply of all necessary utilities. The site is situated in the municipality of Schagen, at the Petten Research Centre (OLP), which is located near the Natura 2000 area of 'Zwanenwater en Pettemerduinen'. See map below.

Figure 1 – Map of the north of Noord-Holland with an expanded view of the OLP site

The PALLAS reactor's construction site is situated in the municipality of Schagen. A number of different organisations are located at this site (see photo below). The most important of these are: NRG, ECN, Mallinckrodt Medical BV, and the JRC Institute for Energy and Transport (part of the European Union).

Photo 1 – Aerial photo of the OLP site

Several licences are required for the construction and operation of the PALLAS-reactor, including those issued under the Nuclear Energy Act, the Water Act, the Environmental Permitting (General Provisions) Act, the Nature Protection Act and the Flora and Fauna Act. In addition, the zoning plan for the PALLAS reactor's planning requirements needs to be modified.

The construction of the reactor is an activity requiring an Environmental Impact Assessment Report, based on the Environmental Impact Assessment Decree (Appendix EIA decree activity C 22.2). The Environmental Impact Assessment is submitted as part of the application for the Nuclear Energy Act licence.

The modification of the zoning plan requires an Environmental Impact Assessment Report . PALLAS will ensure that both EIA reports documents are coordinated with one another.

The zoning plan procedure and the Nuclear Energy Act procedure will not be run at the same time. Accordingly, no use will be made of Article 14.4b of the Environmental Management Act for coordinating the EIA decree and plan. PALLAS will prepare a separate Environmental Impact Assessment Report for each procedure. The public consultation of the Environmental Impact Assessmentr Reports will take place as part of the respective procedure in question

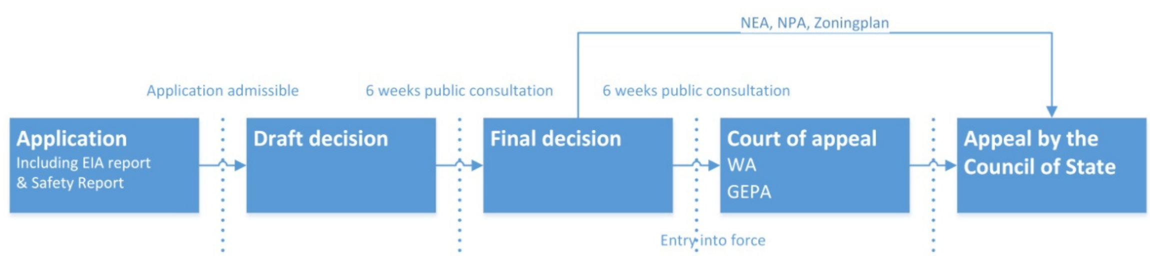


Figure 2 – The licensing procedure.

1.2 EIA procedure

The purpose of the Environmental Impact Assessment (EIA) procedure is to enable environmental aspects to play a full and proper part in the decision-making process, in addition to numerous other aspects that play an important role in the decision-making process.

PALLAS will follow the detailed EIA procedure, for which this Notification of Intent is the green light. The detailed procedure is described in Chapter 7 of the Environmental Management Act and is shown in diagrammatic form in Appendix 1. For the sake of completeness, the figure also depicts the Nuclear Energy Act procedure, as the EIA is part of the application for the Nuclear Energy Act licence.

The EIA procedure begins with an announcement by the Competent Authority of the receipt and deposition for inspection of this Notification of Intent. Anyone who so wishes can then make a contribution to the scope and level of detail of the variants to be considered in the context of the EIA. Based on the Notification of Intent and on input from the general public, the Competent Authority publishes a recommendation concerning the scope and level of detail for the EIA to be drawn up. During this procedure, the Competent Authority is advised by the Environmental Impact Assessment Committee and other legal advisors.

PALLAS uses the Notification of Intent and the recommendation concerning the scope and level of detail as a basis for the EIA that is to be drawn up. EIAs are deposited for inspection for the application for the Nuclear Energy Act licence and for the draft zoning plan. These are, respectively, an EIA decree and an EIA plan. For a period of six weeks, anyone is entitled to submit written or verbal comments (objections) to the Ministry of Infrastructure and the Environment (I&E).

1.3 Stakeholders

Initiator
The initiator is responsible for drawing up the notification of intent and the EIA. The initiator of this Notification of Intent and the subsequent EIA procedure is:

Foundation Preparation PALLAS Reactor
P.O. Box 1092
1810 KB Alkmaar

Competent Authority
The Competent Authority for the Nuclear Energy Act is the Minister of Infrastructure and the Environment (I&E).

Authority for Nuclear Safety and Radiation Protection (ANVS)
P.O. Box 16001
2500 BA THE HAGUE

Environmental Impact Assessment Committee
The Environmental Impact Assessment Committee is an independent body. For the purposes of each EIA procedure, the Environmental Impact Assessment Committee appoints a working group from among its members. This working group advises the Competent Authority in its decision making. This work initially involves guidelines for the content of the EIA, but it later focuses on the EIA's completeness, accuracy and quality.

2 Objective and recitals

2.1 Introduction

PALLAS's goal is to establish a multi-purpose reactor suitable for the production of medical and industrial isotopes, and for carrying out research into nuclear technology. This reactor, the PALLAS reactor, will replace the current High Flux Reactor (HFR) in Petten, which has now been operational for more than fifty years and is approaching the end of its economic lifetime.

The next section deals with the importance of the activities in and around the reactor.

2.2 Recitals

2.2.1 Medical isotopes – security of supply

In recent decades, Petten has become Europe's largest supplier of medical isotopes and the second largest supplier in the world (after the NRU in Canada). It meets over 30% of the global demand for medical isotopes. These isotopes are produced by irradiating raw materials (such as uranium, lutetium or iridium), after which they undergo further processing before being delivered to hospitals. There, they are used in diagnostic (scans) and therapeutic (cancer therapy and pain management) treatments.

Every day, 24,000 patients throughout the world are treated with isotopes from Petten (1,300 of these patients are treated in Dutch hospitals).

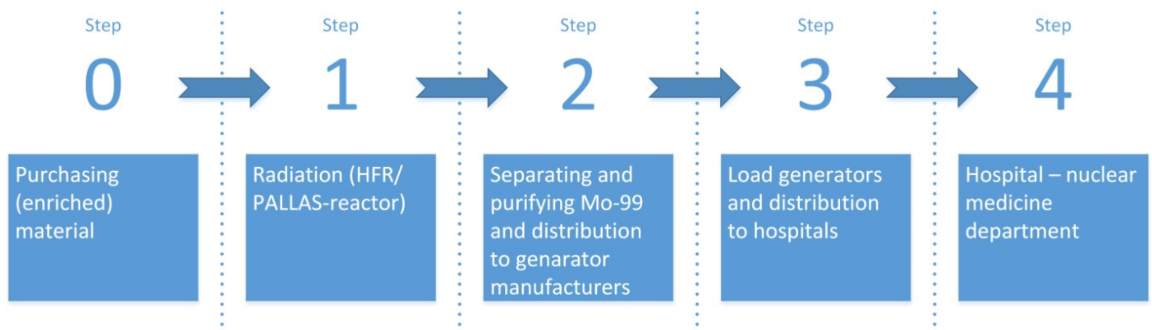


Figure 3 – The production and supply of molybdenum-99

Strong growth is forecast for the market for medical isotopes, as a result of the rapid demographic ageing and increased life expectancy of the European population. Other important factors are the increasing prosperity and life expectancy of populations in developing countries.

In addition to the Netherlands' HFR, France, Canada, Belgium, Poland, Australia and South Africa have facilities for the production of medical isotopes. At the present time, there are very few alternatives to the five existing research reactors. This is not the first time that this situation has had a major impact on the availability of medical isotopes. Between 2007 and 2014, repairs to the research reactors regularly resulted in global shortages of these products. The PALLAS reactor is expressly intended to help ensure a continuous supply of medical isotopes. Security of supply is a key concept.

2.2.2 Medical isotopes – social relevance

This continuous availability of isotopes for a wide range of medical treatments will generate health gains for people in the Netherlands, Europe and the rest of the world.

In this context, the social effects of research into (and the development of) new medical isotopes (treatments) have also been taken into account. One example is the production of the isotope lutetium-177 (Lu-177), which is being made available to various clinics throughout the world for research into new treatments. The Erasmus MC medical centre in Rotterdam is the world leader in research into the treatment of neuroendocrine tumours with Lu-177.

2.2.3 Medical isotopes – alternatives?

In the area of medical isotope production, references are often made to another type of technology – cyclotrons. This technology actually pre-dates nuclear reactors. The principle was developed in 1929, at the University of California. Currently there are in Canada several studies on the use of cyclotrons for the production of technetium-99m.

The isotope technetium-99m can be produced by bombarding molybdenum-100 with accelerated protons. However, this also creates other isotopes of technetium that cannot be used for diagnostic purposes, and which contaminate the usable fraction of Tc-99m. Nothing is yet known about the impact of such contamination on the final quality of imaging in hospitals. This needs to be investigated before certification as a medication can take place.

Technically feasible
Technetium-99m has a half-life of six hours, compared to 66 hours for molybdenum-99 that has been produced in a reactor. That makes the logistical process of such direct production much more vulnerable. This material needs to be be injected into the patient within a few hours of production.

In principle, a minimum of six cyclotrons – distributed throughout the Netherlands – would be sufficient to meet the technetium-99m needs of the country’s 70 hospital-based nuclear medicine departments.

Logistical constraints
One cyclotron produces about 250 doses per day. To meet current demand, these six cyclotrons would have to complete two production runs per day, five days a week, 52 weeks per year. Even then, however, there would be no spare capacity. Thus, any malfunctions would have an immediate impact on the health service.

Given its short, six-hour half-life, the option of transporting Tc-99m from other cyclotrons is subject to major constraints. Even in a country like the Netherlands, which has a high population density, good infrastructure and an excellent health service.

No substitute
It should be noted that cyclotrons cannot produce the other medical isotopes needed for therapy, diagnosis and pain relief, unlike the HFR and – later – the PALLAS reactor (many therapeutic isotopes can be produced only in reactors).

Lifetime
The technical lifetime of cyclotrons should also be taken into account. Their use in everyday practice shows that, after ten to fifteen years, cyclotrons can be expected to show signs of ageing. This has an impact on their performance. When cyclotron are dismantled, radioactive waste is produced, as the material from which they are constructed has been activated.

No position acquired
The above-mentioned figure of six cyclotrons only relates to those needed to meet production requirements for the Netherlands. If the HFR's entire production of molybdenum-99 were to be switched to cyclotrons, the OECD-NEA has estimated that between 300 and 500 of these machines would be needed.

That number is determined not only by the required production capacity, but also by the short shelf life of cyclotron-generated technetium-99m. After all, with its half-life of six hours, this cannot be transported very far and it has to be used the same day. As a result, countries that are less densely populated than the Netherlands would require relatively more cyclotrons.

This logistical aspect is just one of the reasons why, despite their longer history, cyclotrons have still not acquired a prominent position in the highly competitive market for nuclear medicines. Not even after the 2009 crisis in security of supply, which was caused by a number of reactors simultaneously becoming unavailable.

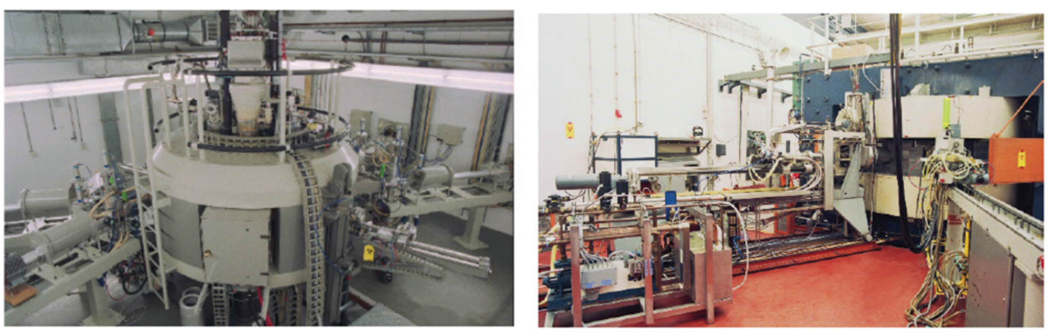


Figure 4 – Two cyclotrons in Petten

2.2.4 Energy – knowledge infrastructure

In addition to its role as Europe's largest producer of medical isotopes, NRG implements high-quality nuclear research programmes into the development and use of nuclear knowledge for socially relevant purposes. This work is commissioned both by government bodies and private organisations. In this connection, the NRG broadly identifies four distinct 'markets':

1. Innovative systems
2. Demonstrative Projects
3. Commercial new construction
4. Existing nuclear facilities

The new reactor will enable PALLAS to sustain this role over the long term, and to expand it still further. After all, in the light of rising global energy demands and CO_2 targets, it is important that all energy options be exploited as 'smart' a way as possible, to meet these requirements responsibly. The nuclear field is no exception.

Involvement of the business community
There is a strong focus on opportunities for involving the Dutch business community in the construction of the new reactor. In this context, the requisite contacts have been made. The local SMEs (such as contractors, construction companies, suppliers) will also notice the associated effects.

In addition, the construction of the PALLAS reactor will generate spin-off business activity (for the catering and hotel industries, for example), while the presence of companies and workers involved in the construction will provide an additional boost for businesses in Noord-Holland.

2.2.5 Employment

The presence of the HFR (which has been operational since 1961) has traditionally served as a motor for business activity (including the nuclear industry) in and around Petten/the Netherlands. This is clearly reflected in the history of Petten, beginning with the establishment of the *Reactor Centrum Nederland* (RCN; known today as the Energy Research Centre of the Netherlands), where the foundations were laid for organisations such as the multinational URENCO (ultracentrifuge technology for uranium enrichment) and, later, the ECN.

In 1976, the RCN was renamed the Energy Research Centre of the Netherlands (ECN), a move that was intended to expand its scope to other energy sources. In 1998, this led to a separation of activities, in which the NRG emerged as a full 'nuclear' subsidiary of ECN (and initially KEMA; with 430 and 400 employees respectively). In 1999, the NRG took over the irradiation activities for medical isotopes from JRC (Petten), a European research institute.

The HFR too attracted other business activity (and, with it, employment) to Petten. In this way, an entirely new branch of industry – medical isotopes – sprouted among the dunes of Petten. This involved both the processing of irradiated isotopes and the development of new isotopes for the medical industry. This has involved a succession of companies over the years: Philips-Duphar, Mallinckrodt Medical, Covidien and (to date) Mallinckrodt Pharmaceuticals (300 employees). When the decision was taken to construct the HFR, the development of this rapidly growing branch of industry was not foreseen.

The HFR also facilitated the creation of JRC-IET, the European energy institute (300 employees), a development that not only brought workers to Petten, but which, for example, also triggered the establishment of the European School at Bergen (in the province of Noord-Holland).

The work of operating the new reactor is unlikely to lead to a jump in direct employment. The main reason for this is new technology. However, the PALLAS reactor, just like the HFR before it, will play a pivotal part in attracting activities to Petten, and clustering them there.

Without the HFR and without the PALLAS reactor, the NRG and Mallinckrodt Pharmaceuticals would soon leave the dunes of Petten, as would support services, such as the fire brigade and the security companies. A development of this kind would impose a severe strain on the activities of ECN and JRC-IET, and would involve far-reaching and costly effects on all the organisations involved. In other words, this would mean the end of a cluster of energy and healthcare activities that is found nowhere else in the world.

With an approximately 1,600-strong workforce, Petten is one of the largest employers in the northern region of Noord-Holland, which offers employment to approximately 30,000 people. More than half of the local population works outside the area. Apart from the town of Den Helder (which is home to the Royal Netherlands Navy, and which also has a naval base and an airport), the main economic drivers are agriculture and horticulture, fishing, recreation and tourism *and* ECN/NRG/Mallinckrodt Pharmaceuticals/JRC-IET.

3 Description of the proposed activity

3.1 Introduction

All in all, the process of designing, licensing, constructing and commissioning the PALLAS reactor will take about ten years. The new reactor will have a lifetime of at least forty years. The plan is that, once it is in operation, the PALLAS reactor will seamlessly take over the HFR's production activities.

To arrive at a suitable design, PALLAS is currently preparing a document listing all of the reactor's functional, security and safety requirements. This document is known as the User Requirements Specification (URS). It includes recent national and international safety requirements (applicable to the PALLAS reactor), including those of the International Atomic Energy Agency (IAEA).

The chosen reactor design is one that is commonly used for research reactors. This chapter provides a more detailed explanation of this type of reactor and of the capabilities of the PALLAS reactor. In particular, it addresses the following aspects: the nuclear fission process in the reactor by which neutrons are released, the reactor cooling system, the irradiation positions and the reactor's safety systems. Finally, it covers the need for a temporary transitional situation, during which both the HFR and the PALLAS reactor are in operation.

3.2 The PALLAS reactor, a 'tank in pool' type

PALLAS, like the HFR, will be a 'tank in pool' type (see Figure 5 – Diagram of a 'tank in pool' reactor). In this design, the reactor vessel containing the reactor core is located in a large pool of water. The reactor vessel houses fuel elements (that produce neutrons) and control rods (that capture neutrons, and thus regulate nuclear fission).

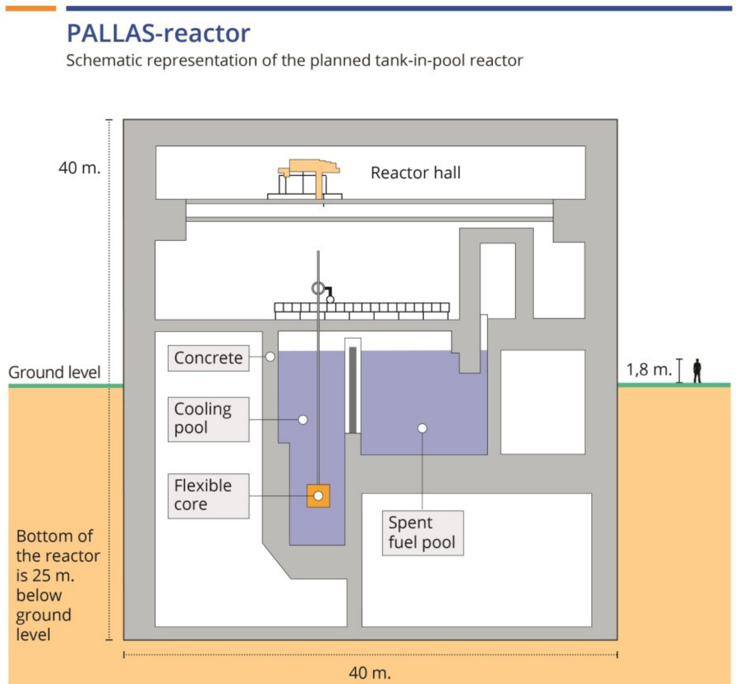


Figure 5 – Diagram of a 'tank in pool' reactor

The big advantage of a 'tank in pool' reactor is that the pool of water provides sufficient shielding for experiments and isotopes for irradiation to be safely inserted into/removed from the reactor during normal operation.

3.2.1 Nuclear fission

Fuel elements consist of a number of thin plates through which cooling water flows. Each of these plates consists of a slice of uranium compound confined in aluminium. The atomic nuclei of uranium (fissionable material) undergo fission. Naturally occurring uranium consists of the isotopes uranium-234, uranium-235 and uranium-238. Only the nucleus of uranium-235 can be fissioned by a slow (thermal) neutron. In addition to two fission products (atomic nuclei of elements with about the half of the mass of a uranium nucleus) and radiation (gamma radiation), this fission produces several high-energy (fast) neutrons. If these fast neutrons are sufficiently slowed by the moderator (in PALLAS, the cooling water in the reactor serves as the moderator) and are not captured in the meantime, then another slow neutron can again be captured by a uranium-235 nucleus, resulting in fission, which means that the process has repeated itself (chain reaction). To ensure that the chain reaction in the reactor core can be sustained, the percentage of uranium-235 in the total amount of uranium in the reactor core is artificially increased (enriched) from 0.7% (the level of uranium-235 in natural uranium) to just under 20%. Uranium with an enrichment of less than 20% is described as low-enriched uranium. The United Nations' International Atomic Energy Agency (IAEA) is working to achieve a situation in which only low-enriched uranium is used in reactors. PALLAS will use only low-enriched fuel elements. Targets containing high-enriched uranium are still being used in the HFR for the production of molybdenum. PALLAS is being designed to make it possible to switch, in the future, from high-enriched to low-enriched uranium targets for the production of molybdenum.

3.2.2 Cooling

The fission of uranium's atomic nuclei releases heat, which is carried away by the reactor-core cooling system. This heat is transferred to cooling water that flows through the reactor vessel. The cooling water is circulated in the primary loop. A heat exchanger transfers the heat collected by the cooling water from the primary loop to a secondary system. This secondary system takes in fresh cooling water from a nearby body of surface water and, after it has been warmed-up, returns it to the same body of surface water or transfers it to another one. The primary and secondary loops are physically separated. The reactor core and the spent fissionable material also lose heat to the water in the pool. The pool water is cooled in a similar way to the cooling water.

See chapter 4 for details of the various options for the intake of fresh cooling water and the discharge of heated cooling water.

The options for using residual heat in the heated cooling water will be studied. See also section 5.10.

3.2.3 Irradiation positions

The neutrons produced by the PALLAS reactor will be used for research and development work on components and materials, for performing experiments, and for the production of radioisotopes. To this end, the PALLAS reactor will have various irradiation positions within the reactor pool. These positions vary per user or per customer.

3.2.4 Safety systems

Radioactive materials (such as fission products and activation products) in the reactor core constitute the greatest potential danger in nuclear reactors. These substances can harm any humans, animals and plants that are exposed to them. This harm is caused by the ionizing radiation that these substances emit as they decay. The PALLAS reactor will have various protective barriers to prevent the release of radioactive materials and any exposure to ionizing radiation. In sequence, these barriers are:

- The fuel matrix[1] and the fuel cladding
- The primary cooling water system and the pool of water
- The reactor building

If one of these barriers is threatened or fails, multiple, automatic, and differently designed passive and/or active safety systems come into operation. These systems ensure that:

- The reactor is shut down
- The reactor is cooled
- The dispersal of radioactive materials is prevented

The EIA will explore the PALLAS reactor's safety systems in greater detail.

[1] The fuel matrix is the material into which the fissionable material (uranium) has been incorporated.

3.2.5 Temporary transitional situation involving the HFR

All of the PALLAS reactor's systems will be tested before it is actually commissioned. The first tests will take place without a core load. Subsequent tests will be performed with a core load, whereby the reactor's power output will be slowly and gradually increased. This test period is necessary in order to demonstrate that the reactor meets its original design specifications and the set criteria. However, it also ensures that there will be a temporary transitional situation in which both the PALLAS reactor and the HFR are operational. This transitional period will be addressed in the EIA.

4 The proposed activity and variants

The proposed activity involves constructing and operating a new nuclear reactor, to be known as the PALLAS reactor, at the Petten Research Centre, in the municipality of Schagen. Several variations on this theme have been developed. The EIA will examine the environmental impacts of the proposed activity and possible variants.

4.1 Proposed activity

The proposed activity involves replacing the HFR by constructing and operating a new, modern nuclear reactor, to be known as the PALLAS reactor (see Chapter 3). An important prerequisite of any nuclear reactor is that it should have adequate cooling. This is necessary to carry away the heat generated. To this end, the PALLAS reactor has a primary and a secondary cooling water system. The secondary system will be fed with water drawn from the Noordhollandsch Kanaal.

4.2 Variant with regard to cooling

Seawater (the North Sea) is available just a few hundred meters from the Petten site. The EIA will examine the environmental impact of using seawater to cool the reactor. In this variant, the heat generated is also delivered to a secondary cooling water system.

4.4 Variants with regard to integration in the vicinity

The EIA will address the integration of the PALLAS reactor into the vicinity. The reactor will share the OLP with other business premises and facilities. The applicable zoning plan already contains preconditions with regard to such integration (for example, the maximum construction height). Variants will, therefore, be considered in terms of construction height and the related issue of visibility from the local road (the N502) and from the low-lying land to the east of the site. It will not be possible to provide an exact description of the variants to be considered until the design has been worked out in sufficient detail. The required level of detail will certainly be achieved before the completion of the EIA.

4.5 Zero alternative / Autonomous development

The current HFR has a licence for an indefinite period. This does not mean, however, that the HFR has an unlimited lifetime. The time will come when the HFR will no longer be able to comply with the latest legislation, or when – for commercial reasons – it is no longer profitable.

Autonomous development reflects a situation in which construction of the new reactor does not take place. The HFR will continue to operate for as long as possible, provided that this is feasible in terms of safety, and in terms of the technological and economic aspects involved. Autonomous development will serve as a reference framework for the environmental impact of the proposed activity.

5 Environmental impacts

5.1 Introduction

The PALLAS reactor's life cycle will consist of several stages: reactor construction, operation, shutdown and decommissioning. The environmental impact of the construction and operation of PALLAS will be examined and described in the EIA.

In due course, a separate EIA will be drawn up for the shutdown and decommissioning of the reactor. The EIA on construction and operation that is soon to be drawn up will examine the main environmental impacts of shutdown and decommissioning.

This chapter presents an overall indication of the environmental impact of the construction and operation of the PALLAS reactor.

5.2 Radiological emissions during normal operation

Limits on exposure to ionizing radiation are set out in the Radiation Protection Decree. In addition, PALLAS will comply with the ALARA principle. ALARA is the acronym for 'As Low As Reasonably Achievable'. This means that exposure to ionizing radiation should always be kept as low as reasonably achievable. ALARA is, therefore, the basis for drawing up design requirements, but it is also the basis for the future use of the reactor.

5.2.1 Direct external radiation from buildings

During normal operation of the PALLAS reactor, local residents/passers-by could, theoretically, be exposed to ionizing radiation from sources located inside the buildings. The further away you are from the buildings, the lower the intensity of this radiation. Moreover, the buildings themselves provide some shielding from the radiation. Such exposure is low, compared to the natural background radiation in the Netherlands. The EIA explores the radiation doses received by local residents/passers-by and staff working on-site in greater detail. It will be shown that these are lower than the statutory limits.

5.2.2 Emissions to the atmosphere

During the PALLAS reactor's commissioning and operation phase, small amounts of radioactive materials will be emitted to the outside air through the ventilation duct, in a controlled manner. These amounts are kept to a minimum, through the use of an effectively operating filter system. The annual radiation doses received by individuals outside the PALLAS reactor site as a result of these emissions will be low and will fall within the statutory limits.

Details of these radiation doses received by individuals in the vicinity of the PALLAS reactor will be given in the EIA. It will also contain a description of the technical provisions that will be used to restrict and monitor the discharge of radioactive materials from the ventilation duct. The anticipated concentrations of radioactive materials in the vicinity of the PALLAS reactor will be calculated, as will the dose that individuals can receive when exposed to such concentrations of these materials.

5.2.3 Emissions to surface water

Waste water will be produced during the PALLAS reactor's commissioning and operation phase. Following purification, this water (which will still contain a small concentration of activity) will be discharged into surface water in a controlled way. The annual radiation doses received by individuals outside the PALLAS reactor site as a result of exposure to such radioactive materials that have been discharged into surface water will be low and will fall within the statutory limits. Details of these radiation doses received by individuals in the vicinity of the PALLAS reactor will be given in the EIA.

5.2.4 Radiation during transport

The transport of spent fissionable material and irradiated material will take place at regular intervals. Such transport will comply with international and national legislation. This legislation imposes requirements on the integrity of the packaging. Limits are also imposed on the dose rate at a given distance from the transport vehicle, and on the packaging used. The EIA will focus on the exposure incurred by local residents and other road users as these transports pass by.

5.3 Radiological emissions in the event of accidents

The PALLAS reactor has been designed – and will be constructed and operated – in such a way that safety will be fully guaranteed. The safety systems are briefly discussed in section 3.3.4 and will be explained in more detail in the EIA. As part of the design process, accident scenarios are postulated. This might involve scenarios resulting from equipment failure or human error, or even events outside the reactor. The reactor and its safety systems are designed to withstand such accident scenarios. It will be shown that, in such an event, the reactor can be safely shut down and cooled, and that radioactive materials are controlled.

The EIA will include a summary of the key design basis accidents that are deemed relevant for the PALLAS reactor and of the possible radiological consequences. The radiological consequences are analysed and tested against the limit values in the Nuclear Installations, Fissionable Materials and Ores Decree. The focus here is on the potential radiation doses received by individuals outside the site.

5.3.1 Transport safety

The spent fissionable material will be transported in specially designed and certified packaging. Such packaging is designed and tested to guarantee that the contents will not be released in the event of a serious traffic accident. The security arrangements for these transports include police escorts.

Transport is not covered by the licence application for the PALLAS reactor. This is because, in the case of nuclear transports, the transport companies involved have to apply for separate certificates and licences. For information purposes, the EIA will include a consideration of the risks and potential consequences of accident scenarios involving the proposed activity and its variants.

5.4 Waste management

Activities within the PALLAS reactor will generate radioactive waste and spent fissionable material. After being processed (where applicable), this waste will be transported to COVRA (Central Organisation for Radioactive Waste). The EIA will address the issue of the waste arising from the operation of the PALLAS reactor and of ensuring that there is timely and adequate capacity for the processing and storage of spent fissionable material and radioactive waste.

5.5 Non-proliferation

Although the non-proliferation aspect does not, strictly speaking, involve an environmental impact, the EIA will nevertheless provide an explanation, in connection with the globally recognised social importance of this issue.

5.6 Atmosphere

During the PALLAS reactor's operation phase, emissions of fine particulates, nitrogen and greenhouse gases will not differ significantly from the current situation. The biggest sources of such emissions would be the hot water boilers and the central heating system. The emissions are of the same order of magnitude as those originating from other laboratories and offices at the current site in Petten. They are not addressed in the EIA.

During the construction phase, construction traffic, machinery and other equipment will temporarily be present on-site. The dispersal calculations are based on recalculations of the relevant components of the construction traffic, machinery and other equipment. In this context, emissions of the following substances will be investigated: fine particulates (PM_{10}), NO_x, SO_2. The effects on the immediate vicinity and on the areas of natural habitat will be evaluated.

5.7 Water

The EIA distinguishes between waste water, cooling water, rainwater, sanitary water and groundwater.

5.7.1 Waste water

Before it is discharged, waste water released into the PALLAS reactor will be purified by a wastewater treatment system. The sources of this water will include activities in the controlled area[2] of the PALLAS reactor, such as cleaning operations, the use of showers, and the like. After treatment in a water treatment plant, the water still contains a small concentration of radioactivity. It is then discharged into the North Sea. The issue of the anticipated amount of waste water involved, and its impact on the quality of surface water, will be addressed in the EIA.

[2] A controlled area is an area inside a building, where there is the possibility of exposure to radiation and radioactive materials.

5.7.2 Cooling water

The PALLAS reactor will be water-cooled. To this end, the reactor has a primary and a secondary cooling water system (see section 3.3.2 'Cooling'). In all the variants considered, cooling water that has been heated (in a secondary system) in accordance with the current standards and requirements is discharged into the North Sea, as is presently the case with the HFR. The cooling water to be discharged has not been in contact with water from the reactor's primary circuit, thus it will have no added activity.

The secondary system will be fed with water drawn from the nearby Noordhollandsch Kanaal. One variant involves extracting cooling water directly from the North Sea.

The EIA will explain how using cooling water impacts the surface water from which it is extracted. It will also describe the impact of discharging heated cooling water.

5.7.3 Sanitary water

In addition to the release of waste water, there is also sanitary water from rooms in what are referred to as 'non-controlled areas'.[3] This water passes through the site's sewer and into the municipal sewer, after which it will be purified by a wastewater treatment plant. This sanitary water is comparable to sanitary water from an office setting. The EIA will not explore the issue of sanitary water any further.

5.7.4 Rainwater

Rainwater from rain falling on the roofs of the PALLAS reactor will pass through a separate drainage system and will be allowed to infiltrate into the soil in situ. This is based on the assumption that rainwater is clean. The EIA will not explore this issue any further.

5.7.5 Groundwater

Some groundwater may be extracted during the construction phase. This is a temporary measure. The EIA will identify the effects of temporary groundwater extraction.

5.8 Soil

For the purposes of the construction of the PALLAS reactor, an exploratory survey will be made of the quality of the soil beneath the planned structures. Any soil contamination found in the course of this operation will be remediated in accordance with the legal guidelines. The description in the EIA will focus on the anticipated presence or absence, nature and distribution of any soil contaminants.

Any activities/materials that pose a threat to the soil near the PALLAS reactor will be described in the EIA. The principle here is to achieve a negligible soil risk, in accordance with the Netherlands Soil Protection Guideline (NRB).

[3] This is an area in which no exposure to radiation or radioactive materials is to be expected.

5.9 Conventional safety

PALLAS's management system is certified to ISO 9001 and ISO 14001. PALLAS considers the health and safety of its people and those who work for PALLAS to be a top priority. This is founded on championing and maintaining an open and transparent safety culture.

5.10 Energy

When selecting a design for the PALLAS reactor, sustainability was one of the considerations. Aspects that were given special consideration included the reactor's power consumption and the potential for reusing the residual heat in cooling water. The EIA will compare the proposed activity and the variants on this aspect.

5.11 Noise, light and vibration

When in operation, PALLAS will comply with the applicable rules with respect to environmental noise exposure in the vicinity. During the operation of the PALLAS reactor, the acoustic situation will not differ substantially from the current one (the operation of the HFR). This also applies to light pollution. There is expected to be little or no vibration nuisance during the period of operation.

During the construction of the new reactor those in the vicinity may experience some noise, light and/or vibration nuisance. The EIA will focus on these issues, with a special emphasis on the Natura 2000 areas.

5.12 Flora and fauna

The natural environment is one of the topics that is carefully examined in the EIA. Although the construction site is not part of a protected area of natural habitat, it is located near a Natura 2000 area. This is shown in the image below. The nearby Natura 2000 site is shaded yellow.

Figure 6 - Petten site, with the Natura 2000 area shaded in yellow

The EIA will determine whether the PALLAS reactor poses a risk of significant adverse impacts to protected Natura 2000 areas in the vicinity. In addition, both the construction phase and the operation phase will be examined to determine whether there might be any impact on protected plants and/or animals on and around the construction site.

5.13 Landscape and visual values

At the time of writing this notification, existing structures are still occupying the construction site. It is possible that the PALLAS reactor will be visible from outside the boundaries of the OLP site. The EIA will address variations in construction height, which will affect visibility.

5.14 Archaeology

The EIA will address any – potential – archaeological values of the construction site.

5.15 Cultural history

Any cultural-historical values associated with the immediate vicinity of the planned PALLAS reactor will be identified. The anticipated impact on these values of the construction of the PALLAS reactor will be indicated.

5.16 Recreation and tourism

OLP is located in an attractive area for recreation and tourism. Thus, the EIA will address both of these aspects.

5.17 Security

The EIA will broadly address security measures for the PALLAS reactor. Given the nature of this topic, the EIA will not go into detail.

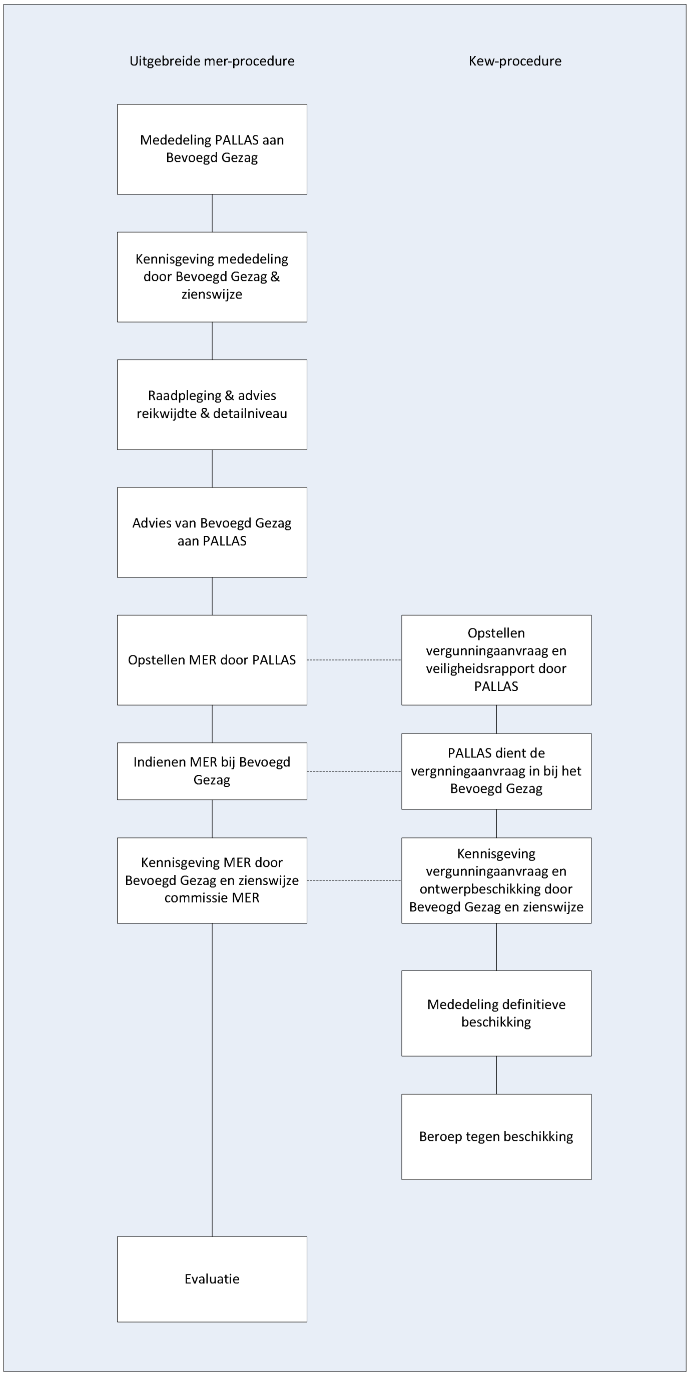
5.18 Relevant developments in the area

The Hollands Noorderkwartier District Water Board cooperates with the Province of Noord-Holland and the Department of Waterways and Public Works (part of the Ministry of Infrastructure and the Environment) to create a strong and secure North Sea coast (‘Weak Links’). As part of the ‘Reinforcing our Coast’ project, work on the Hondsbossche and Pettemer Coastal Defences has been in progress since 2014. Sand replenishment has reinforced the coast in that area with approximately 250 meters of additional beach, plus a stretch of dunes. The effects of this activity are described in an Environmental Impact Assessment (Environmental Impact Assessment of the Hondsbossche and Pettemer Coastal Defences, published on 29 January 2013; 076463363:E.1).

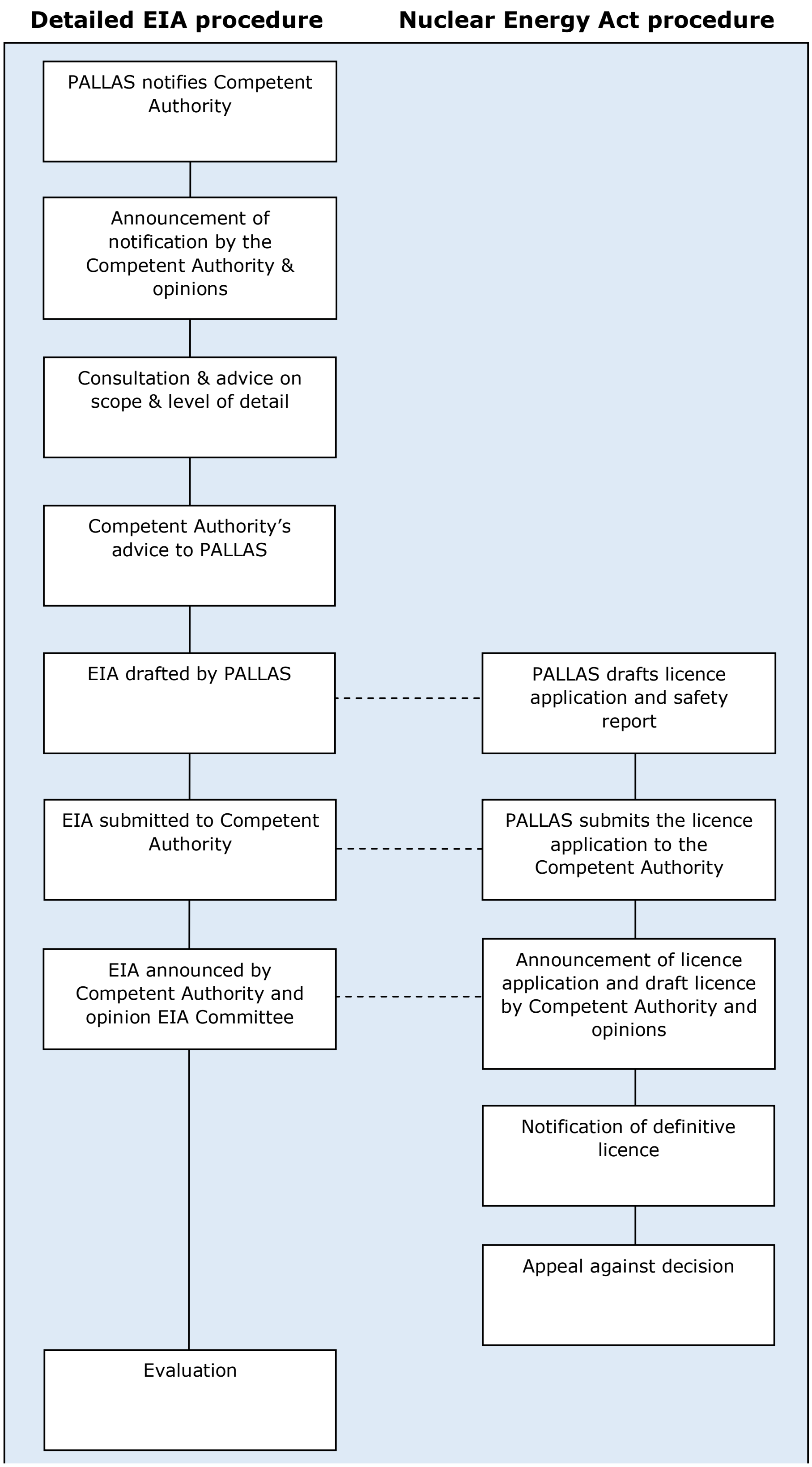
This work is taking place at a distance of approx. 1.8 kilometres from the PALLAS reactor site. It will have been completed before construction work on the PALLAS reactor commences. Accordingly, this project will have no effect on the PALLAS initiative.

Furthermore, there are no known developments in the area that might impact the PALLAS reactor, nor have any been announced.

Appendix 1



Uitgebreide mer-procedure
Kew-procedure
Mededeling PALLAS aan Bevoegd Gezag
Kennisgeving mededeling door Bevoegd Gezag & zienswijze
Raadpleging & advies reikwijdte & detailniveau
Advies van Bevoegd Gezag aan PALLAS
Opstellen MER door PALLAS
Opstellen vergunningaanvraag en veiligheidsrapport door PALLAS
Indienen MER bij Bevoegd Gezag
PALLAS dient de vergnningaanvraag in bij het Bevoegd Gezag
Kennisgeving MER door Bevoegd Gezag en zienswijze commissie MER
Kennisgeving vergunningaanvraag en ontwerpbeschikking door Beveogd Gezag en zienswijze
Mededeling definitieve beschikking
Beroep tegen beschikking
Evaluatie


Detailed EIA procedure
Nuclear Energy Act procedure
PALLAS notifies Competent Authority
Announcement of notification by the Competent Authority & opinions
Consultation & advice on scope & level of detail
Competent Authority's advice to PALLAS
EIA drafted by PALLAS
PALLAS drafts licence application and safety report
EIA submitted to Competent Authority
PALLAS submits the licence application to the Competent Authority
EIA announced by Competent Authority and opinion EIA Committee
Announcement of licence application and draft licence by Competent Authority and opinions
Notification of definitive licence
Appeal against decision
Evaluation