www.laka.org | info@laka.org | Ketelhuisplein 43, 1054 RD Amsterdam | 020-6168294

PALLAS

Summary Strategic Environmental Assessment PALLAS

This page has been left blank intentionally

Summary Strategic Environmental Assessment PALLAS

October 2017

This SEA was established on behalf of:

PALLAS

Foundation Preparation PALLAS-reactor
www.pallasreactor.com

In cooperation with:

ARCADIS Design & Consultancy for natural and built assets

NRG

This page has been left blank intentionally

Table of content

1 Introduction

The High Flux Reactor (HFR) in the dunes at Petten commenced operations in 1960. Since that time, 'Petten' has expanded into the world's largest supplier of medical isotopes. These medical isotopes are used in hospitals: for obtaining diagnoses (cancer, cardiovascular diseases) and for treatments. More than 24,000 patients a day worldwide undergo research or treatment using medical isotopes produced in the HFR at Petten. The continual availability of these isotopes, and the guarantee that they can be supplied at any given moment, is crucial for many people, sometimes even a matter of life and death.

The HFR is fast approaching the end of its economic lifespan. If nothing is done, expectations are that it will gradually require more and more time and money for maintenance and repairs. Yet the production of medical isotopes must not be put at risk, as this would affect the security of supply of the isotopes. It has therefore been decided to construct a new reactor at the Research Location Petten: the PALLAS-reactor. The aerial photo (Figure 1) shows the current layout of the Research Location Petten. The HFR complex is highlighted in red. The black dotted line indicates the envisaged site for the new PALLAS-reactor.

Preparatory steps

At the end of 2013, the 'Foundation Preparation PALLAS-reactor' was founded, abbreviated: 'PALLAS'. PALLAS aims to start construction of the new reactor and related facilities in 2020. A great deal of work has been initiated in recent years. Figure 2 shows the key steps over the coming period before construction may commence.

One of the tasks of PALLAS is to ensure that a specific design is finalized: step by step and more and more details, see the arrow in Figure 2. Figure 2 also shows that there are various points over the coming period in which the authorized government bodies need to take decisions. Each step is important, but there are two clear milestones:

- revision of the current zoning plan;
- the decision regarding the Nuclear Energy Act permit (NEA permit).

For both milestones, the statutory environmental impact assessment procedure ensures that sufficient environmental information is available in advance of the decision-making process, so that the authorized government bodies are able to comprehensively assess the environmental interests. The environmental information is presented in a strategic environmental assessment, the SEA. PALLAS has commissioned two SEAs for this project:

- a **SEA** for revising the zoning plan;
- an **EIA** (much more detailed) for the NEA permit that PALLAS is expected to request in 2019/2020.

In addition to studies into the environmental impact, a great deal of further research is necessary. PALLAS must submit

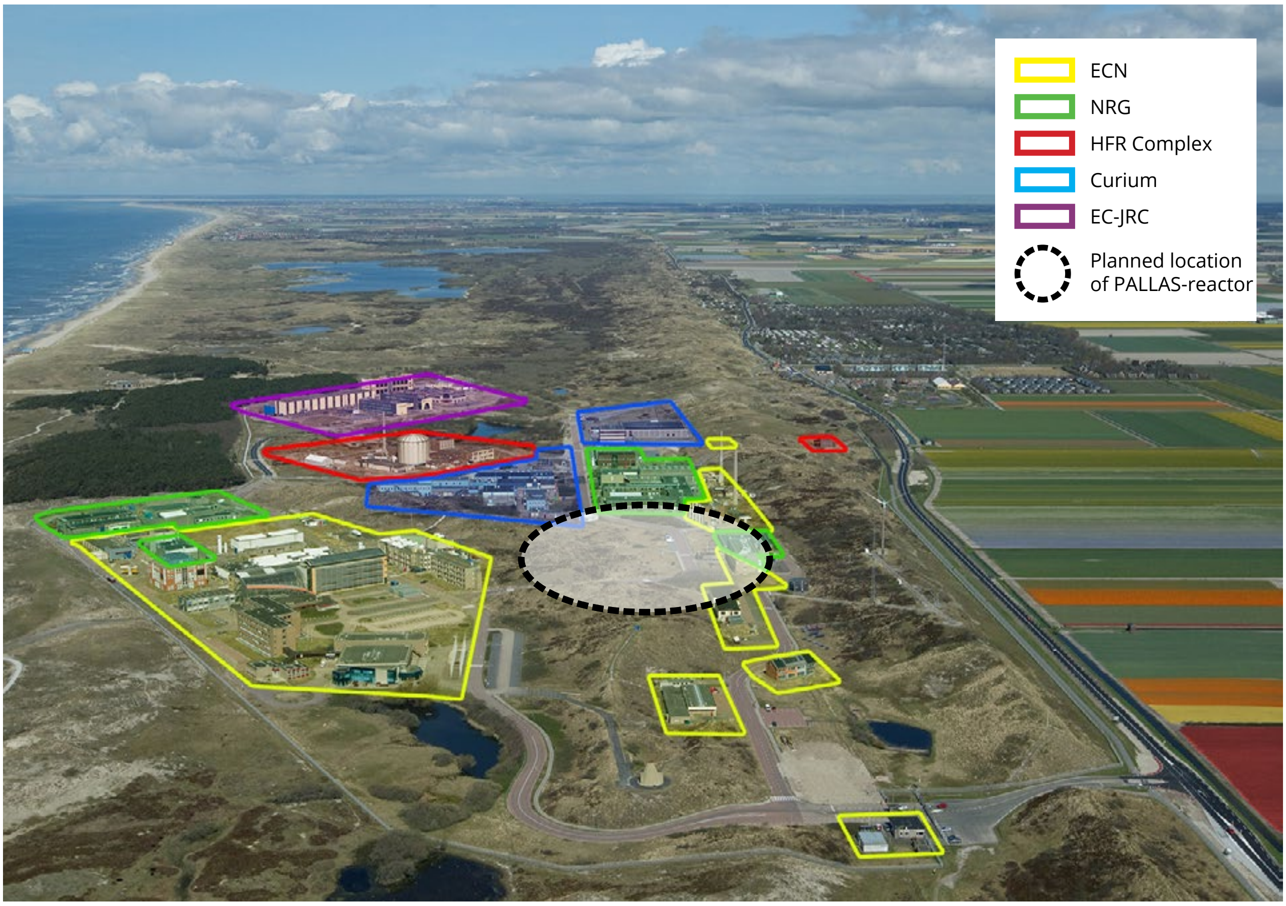


Figure 1 Aerial photo of the Research Location Petten

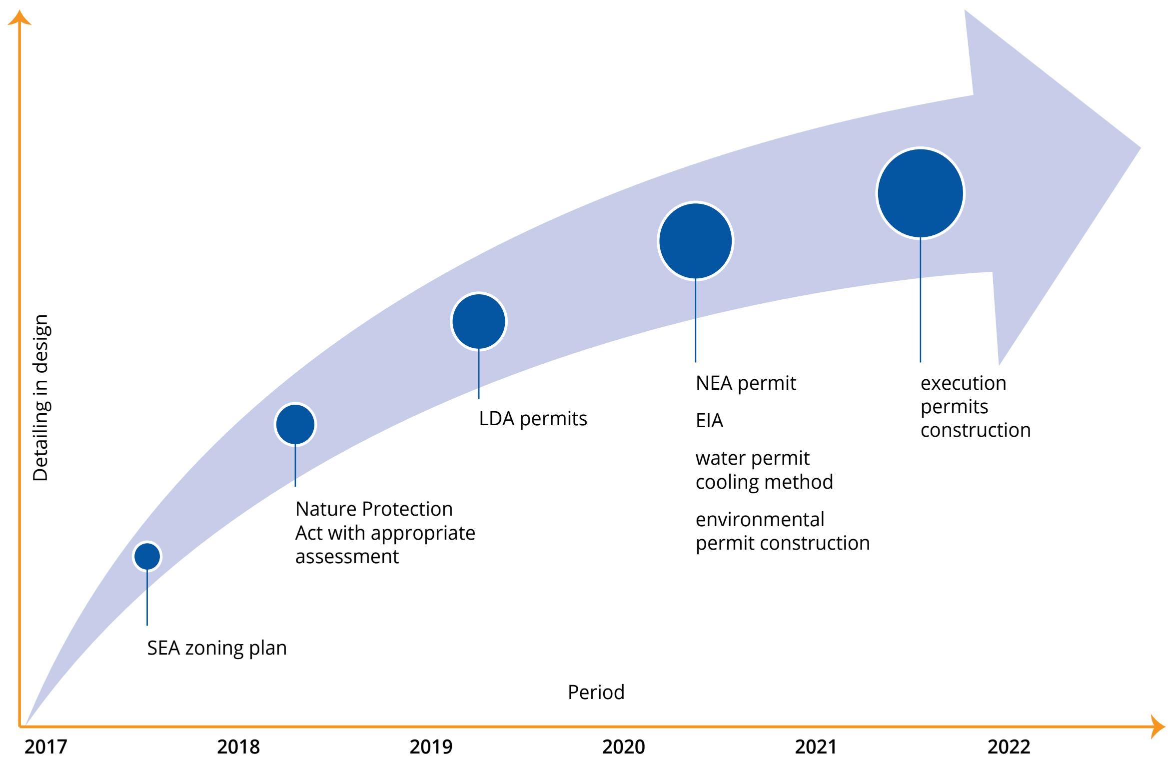


Figure 2 Preparatory steps

a Safety Report at the same time as the application for the NEA permit. That report must demonstrate conclusively that the PALLAS-reactor can be constructed to the full safety standards. For this report, the natural conditions and human activities have been studied that could have an impact. Geological conditions and weather influences are examined closely. The probability of an impact from earthquakes, fault lines and floods is carefully identified. The study further investigated whether activities by the Ministry of Defense at the Petten firing range could have certain implications for reactor operations. The study reports will become public documents and will be assessed by independent experts. Only then may the decision-making process be concluded.

Current situation: the draft revised zoning plan and SEA are ready and included for perusal

At this point in time, the first milestone is in sight: the municipal council of Schagen is due to take the decision on the revised zoning plan shortly. Why is the revision necessary?

A zoning plan simply indicates which type of buildings and user functions are permitted in the various sections of a designated area. Furthermore, a zoning plan contains a number of guidelines ('rules'), for example regarding the maximum height of the buildings. The Research Location Petten comes under the 'Zoning plan for rural Zijpe region'. In this current zoning plan, certain areas within the Research Location Petten are designated as 'focal area for nuclear activities'. A nuclear reactor, such as the PALLAS-reactor, may only be constructed on a site that has been given such a designation in the zoning plan. The PALLAS-reactor requires a contiguous site of around 1.7 hectares. A suitable site is available, see Figure 1. Part of this location already possesses the required designation in the current zoning plan. However, extra space is needed: the 'focal area for nuclear activities' zone needs to be enlarged at the site of the location for the proposed reactor. This requires revision of the current zoning plan.

The draft for the revised zoning plan is ready. The environmental impact assessment procedure is also finished. The draft version of the revised zoning plan and the SEA are attached for perusal. Over the course of six weeks, anyone may react to these documents by submitting their own views. The independent NCEA (Netherlands Commission for Environmental Assessment) then assesses whether the information in the SEA is complete and correct. After that, the municipal council of Schagen is charged with taking a decision on the revised zoning plan.

However, a positive decision on the revised zoning plan does not automatically mean the PALLAS-reactor will be built. Construction may only commence definitely once the draft has been specified in detail and it is time to apply for the NEA permit, including the second SEA (the EIA) and the above-mentioned Safety Report. However, revision of the zoning plan is a necessary condition for proceeding with the design process and completing the following procedural steps.

About the SEA and this summary

The SEA is primarily an aid to taking a decision on the zoning plan. Because a SEA has already been made for the zoning plan, it was identified early on in the process what the key environmental points for attention and research are for the follow-up phase. Further specification of the design and the extensive studies to follow, can thus build upon the insights listed in the SEA.

The SEA is a sizable and rather technical document. For that reason, this summary has been added for those who wish to quickly gain an idea of the key points of the report. The summary is structured as follows:

- Paragraph 2 briefly lists the purpose and necessity of the PALLAS-reactor.
- Paragraph 3 describes the key points of the plan and the variants studied in the environmental impact assessment procedure in terms of two sections of the report: the nuclear island and the cooling system.
- Paragraph 4 offers an overview of the environmental impact. It emphasizes any negative impact and possible measures to ameliorate the impact. Furthermore, special attention is given to the differences between the considered variants. The overview in paragraph 4 is divided into three parts: impact in the construction phase, impact in the transition phase, impact in the operational phase.
- Paragraph 5 looks forwards to the following steps in the procedure.

2 Purpose & necessity of the PALLAS-reactor

What is the purpose of the new PALLAS-reactor? The most important aim is the production of medical isotopes. These are generated in the reactor and processed further elsewhere. This is usually done at one of the other companies or institutions at the Research Location Petten. The isotopes are then supplied to hospitals, where specialists use them to examine patients (diagnoses) and treat them (therapies). The use of therapeutic isotopes is an area of application that is currently becoming increasingly important. Further to that, the reactor will also generate industrial isotopes, for instance isotopes used to check joints in pipework. But the reactor plays a role in research in the field of nuclear energy too.

The medical isotopes define the purpose and necessity of the PALLAS-reactor. This paragraph is therefore geared to these medical isotopes: which isotopes does it concern, how are they used in practice, what is the supply/demand ratio, and what is the PALLAS-reactor's contribution to this? Also a separate annex has been added to the SEA: "Medical isotopes - Global importance and opportunities for the Netherlands". This annex provides a great deal of supplementary information about the production and use of medical isotopes.

Diagnosis using isotopes: how does it work?
Medical isotopes are radioactive. Medical specialists use them to discover whether organs are functioning properly or to detect cancerous tumors at an early stage. This is done by injecting a very small amount of the radioactive material into the patient. Using a special camera, the specialists can then follow how the material is transported around the body, providing important information for assessing whether there are any active cancerous tumors anywhere.

Radioactive medical isotopes have the property of 'decaying', thus changing into other isotopes. This process runs faster for some isotopes than for others: each isotope has its own 'half-life'. For some isotopes, the value halves in just a few hours, but others take several days. But whichever it may be: medical isotopes have only a limited shelf life. Moreover, the limited shelf life means that the time between the moment at which the isotopes are generated and the moment at which the specialists use them in the hospital must be kept to an absolute minimum. The product must be quickly supplied to the customer or it will lose its value.

The most commonly used isotope for medical diagnoses is technetium-99m. But technetium-99m is based on another isotope: molybdenum-99. Molybdenum-99 is produced in reactors like the HFR, and ultimately the PALLAS-reactor. Molybdenum-99 has a half-life of 66 hours and in that time the decay produces the isotope required for research: technetium-99m. Molybdenum-99 is therefore the mother isotope of technetium-99m.

Supply and demand of molybdenum-99
The relatively long half-life of molybdenum-99 is one of the properties that makes this isotope so well suited to medical applications. As there is a time span of 66 hours between production and actual use, hospitals do not need to place a fresh order daily. Due to the relatively long half-life, it is also possible to serve customers at large distances from Petten: throughout the Netherlands, elsewhere in Europe and even on other continents. So the production of molybdenum-99 allows Petten to cover a very wide market. And that is exactly what we see in practice.

The market for the production and supply of molybdenum-99 is a worldwide market with a limited number of players. A French reactor that produced molybdenum-99 has recently been decommissioned. A Canadian reactor has been switched down to standby mode and only produces in emergency cases. Currently there are only six reactors worldwide that produce molybdenum-99 for medical use, including in Belgium and South Africa. But at this point in time, the HFR in Petten is the world's largest producer: the HFR supplies roughly 70% of European demand for molybdenum-99, and some 30% of worldwide demand. Estimates by the Nuclear Energy Agency of the Organization for Economic Co-operation and Development (OECD-NEA) and a report by the Institute for Public Health and Environment (RIVM) indicate that future demand for molybdenum-99 in Western countries (Europe, North America, Australia) is set to increase slightly. But stronger growth is expected on other continents of 4 to 5% per year.

In medical terms, it is necessary that security of supply of medical isotopes is guaranteed into the future too, such as molybdenum-99. Illustrative of what happens when supply is temporarily interrupted, are the problems in the period 2007-2010. The HFR was deactivated for a time as an emergency measure. This coincided with production problems in Belgium and Canada (at the above-mentioned reactor that is now only on standby). During that time, major shortages arose among hospitals, and examinations and treatments suffered severe delays, with some having to resort to less targeted and less effective or less patient-friendly methods. This was reason enough for the Dutch cabinet to decide in 2012 to

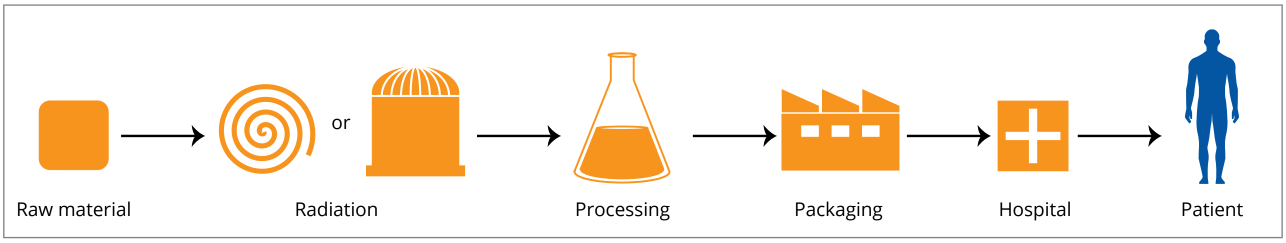


Figure 3 Production, delivery and use of medical isotopes

replace the HFR, designating the municipality of Schagen as the location for the new reactor.

Therapeutic isotopes: use in treatments
In addition to diagnoses, medical isotopes are commonly used in treatments (therapies), for example to treat very specific types of tumor, or for pain relief. Therapeutic applications are rapidly increasing in importance and the nuclear medicine is discovering more and more innovative possibilities and treatments. The specific isotopes required for treatments are part of a range of products that will be supplied by the PALLAS-reactor. These isotopes can only be made using a reactor.

Alternatives
In future, we may well see more producers of molybdenum-99, but aged facilities will also be decommissioned. New initiatives are uncertain or are currently in an experimental phase, such as the Canadian Non-reactor based Isotopes Supply Contribution Program (NISP) or the ASML/ Lighthouse project.

Some people claim that so-called cyclotrons ('accelerators') could take over production of isotopes. But not every medical isotope produced using a reactor can be made using such accelerators. Therapeutic isotopes for instance, can thus far only be produced using a reactor. Furthermore, the commercial production of the diagnostic isotope technetium-99m using cyclotrons is not possible at the moment. There are experiments, such as in Canada, but the question remains whether production can be scaled up to large-scale production within a realistic timescale. It is in any case clear that reactors and cyclotrons will not be replacing each other but complement each other. Illustrative of this is that there are two cyclotrons producing isotopes at the Research Location Petten in addition to the reactor (see also Figure 4).

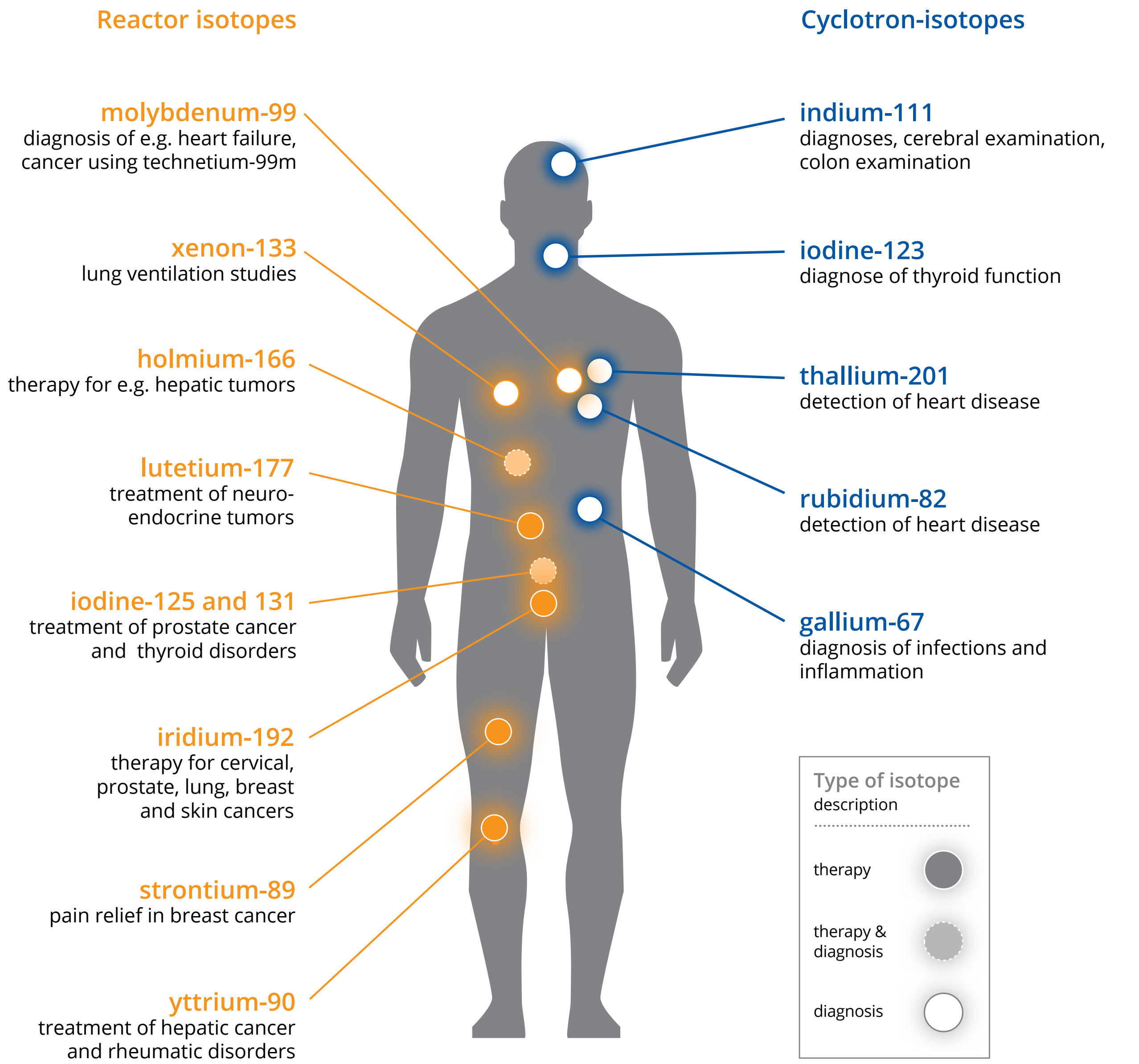


Figure 4 Overview of medical isotopes for diagnoses and therapies

Figure 5 An example of using SPECT camera. Multiple two-dimensional images are processed by a computer to give a three-dimensional image. SPECT scans nearly always use technetium-99m.

Conclusion
The demand for molybdenum-99 for medical research is a given. But demand for other medical isotopes for treatments is set to increase further. In terms of alternative methods for producing molybdenum-99, it will remain uncertain for at least the next ten years whether they could genuinely produce sufficient volumes. And for the production of therapeutic isotopes, reactors will in any event remain necessary.

It is therefore justified to designate the PALLAS-reactor as 'necessary'. No risks must be taken with the supply of medical isotopes. The new PALLAS-reactor ensures that a wide range of medical isotopes will be continually available. This means that patients in the Netherlands, Europe and elsewhere on earth can continue to rely on the required research and treatments.

Significance for employment

The companies and institutions located at the Research Location Petten provide many jobs in the top part of North Holland (Dutch: Noord-Holland). Moreover, these companies and institutions attract and retain highly-educated graduates to the region. At this moment, 'Petten' accounts for around 1,600 jobs. The construction and operation of the PALLAS-reactor provides a fresh boost to employment and economic activities in the top part of the province.

3 Outline plan, proposed variants

3.1 Location

At the Research Location Petten, a site of around 1.7 hectares is needed to provide sufficient room for the new nuclear island, with the reactor, a few smaller buildings, such as offices and possibly a pumping station (for cooling water), and facilities for employees and visitors, including a car park.

Figure 6 indicates which area within the boundaries of the Research Location Petten is available for the nuclear island and the related amenities. It also provides an impression of the possible layout. The exact layout will be determined at a later date.

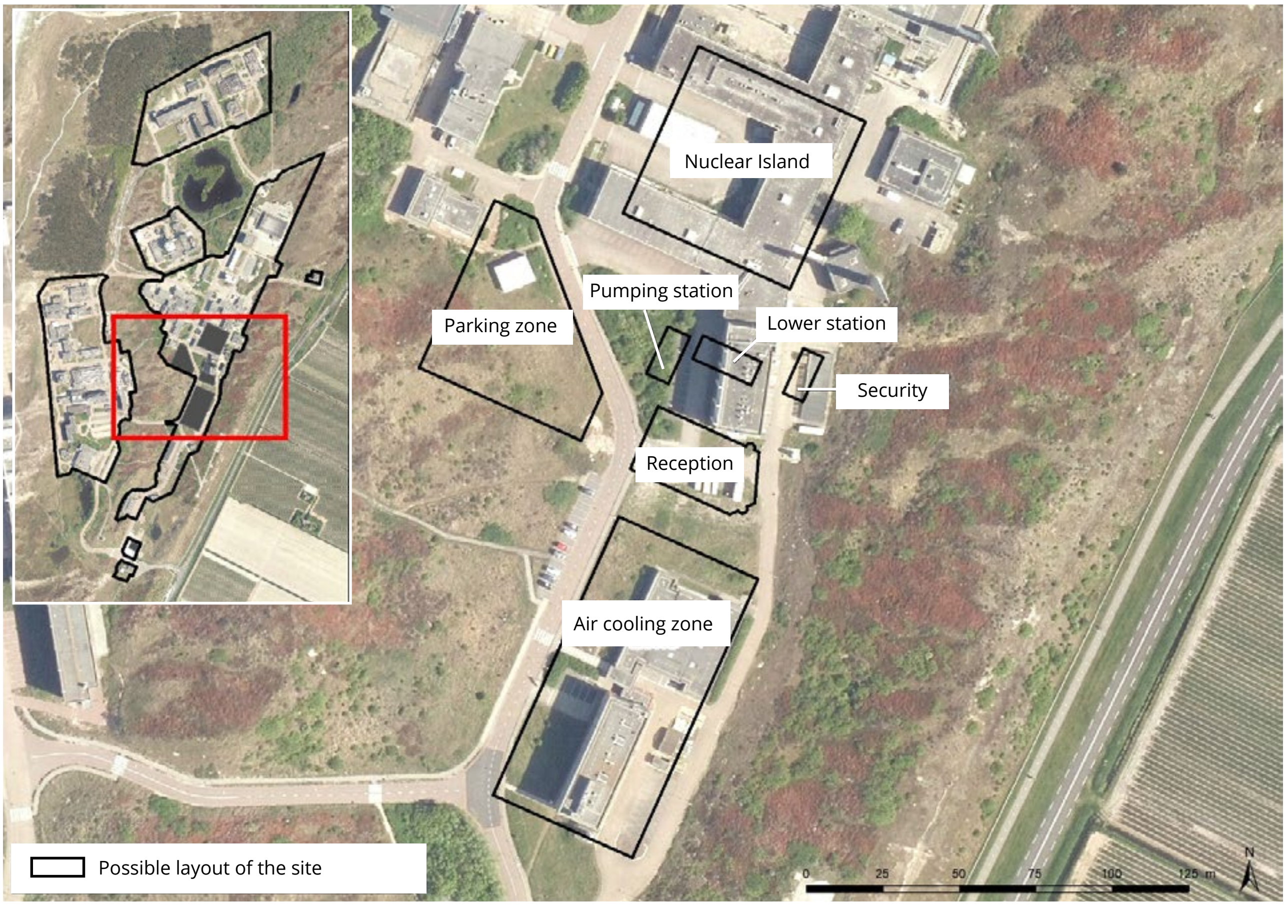


Figure 6 Possible layout of the PALLAS site at the Research Location Petten

3.2 A pool-type reactor

The most important new building is the nuclear island in which the reactor is housed. PALLAS has opted for a so-called pool-type reactor, just like the existing HFR. Figure 7 is a schematic illustration of that. In a pool-type reactor, the reactor core is located in a large water basin (the pool). The reactor core comprises fissile elements and control rods. The fissile elements are thin aluminum plates containing uranium. Fission of the atomic nuclei of this uranium releases neutrons that can in turn trigger the fission of even more atomic nuclei. The control rods are able to absorb the released neutrons. Inserting the control rods between the fissile elements from the top or from the bottom allows the fission process to be controlled.

The reactor is used for experiments (nuclear technological research) and specifically for the production of isotopes. For these applications, there is an important role for so-called targets: pieces of material, often made of aluminum, containing uranium. These targets must be inserted into or adjacent to the reactor core by robots. The neutrons generated in the fission process in the reactor irradiate the targets. Once the targets have been charged sufficiently, they are then removed. Some of the irradiated targets go to laboratories, mostly somewhere else at the Research Location Petten. A larger part undergoes further processing to make the irradiated targets suitable for applications in hospitals. This also takes place elsewhere at the Research Location Petten. So the new reactor is a key vendor for customers located at the Research Location Petten, exactly like the existing HFR is currently.

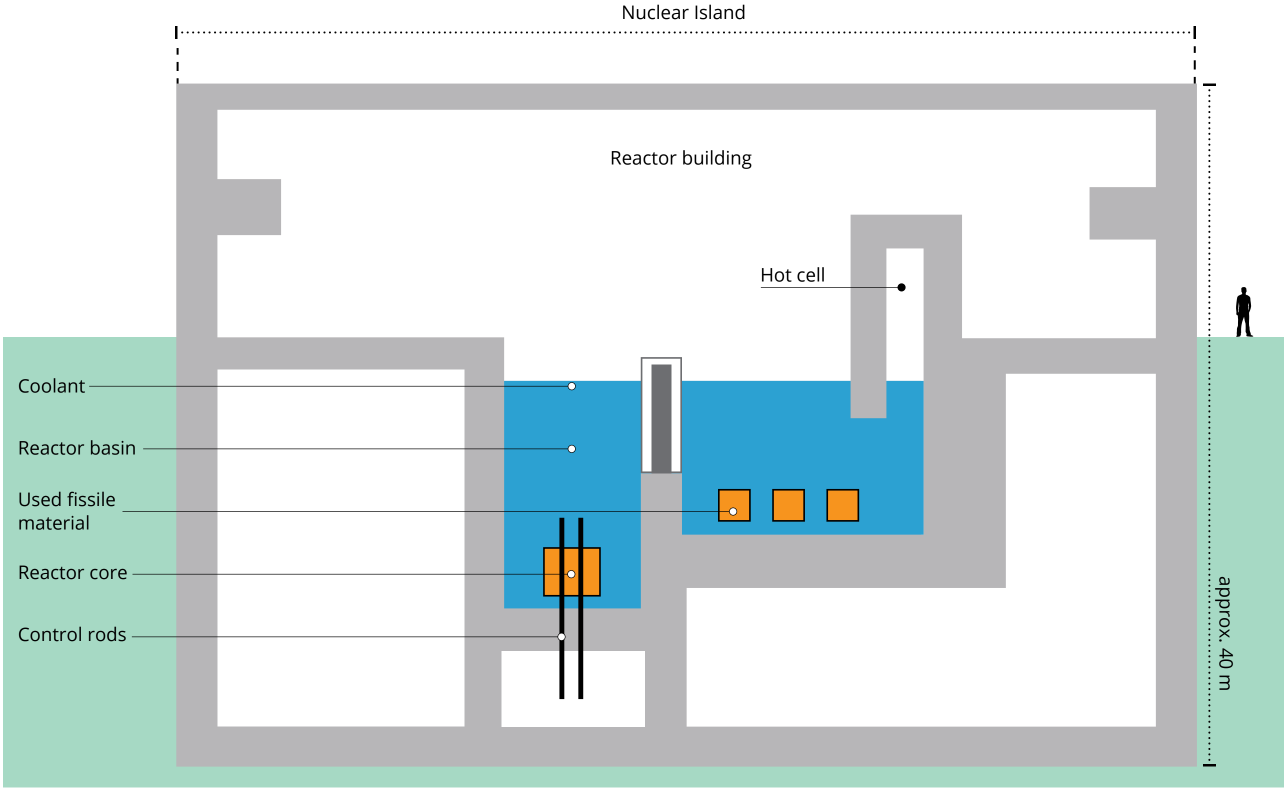


Figure 7 Schematic illustration of pool-type reactor

3.3 Three variants for the reactor construction height

The design of the reactor will be specified in greater detail over the coming period. That also applies to the exact layout, the dimensions and the outward appearance of the nuclear island. One key point of attention at this stage is the height of the new nuclear island: how far may it rise above ground level? This question is relevant as the current zoning plan indicates a maximum construction height of 24 meters above ground level.
The starting point in the environmental impact assessment procedure is that the nuclear island needs to be 40 x 60 x 40 m in size. Because the height is an important factor, three variants are proposed (see Figure 8):

- **Sunken variant (B1):** 17.5 m above ground level and 29.5 m below ground level. In this variant, the deeper foundation of the nuclear island results in a total height of 47 m instead of 40 m. A large part of the nuclear island is underground.
- **Half-sunken variant (B2):** 24 m above ground level and 16 m below ground level. This variant takes the maximum permitted building height in the zoning plan as the starting point.
- **Ground-level variant (B3):** 40 m above ground level. This variant would require an increase in the current maximum permitted building height in the zoning plan.

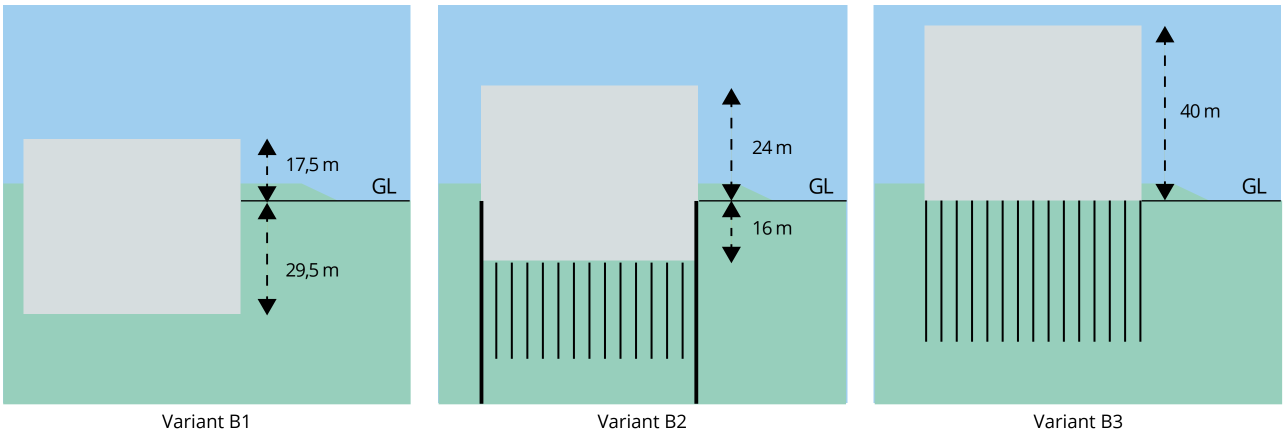


Figure 8 Three variants for the nuclear island construction height

3.4 Three variants for cooling the reactor

The fission process in the reactor core releases heat. Moreover, used fissile elements are stored temporarily in the water basin and these elements also produce heat. One condition for operating the reactor safely is that there is sufficient cooling at all times. The water in the basin is the first stage of cooling. In turn the heated basin water is cooled – via a so-called heat exchanger – in a second cooling system ('secondary cooling'). Three variants are proposed in the environmental impact assessment procedure for this second cooling system (Figure 9):

- **Fresh-salt variant (K1):** Cooling water is extracted from the Noordhollandsch Kanaal and discharged to the North Sea. This system is already used for the existing HFR. In case of the PALLAS-reactor, there will be a period in which the new reactor is already operational but the HFR is still also functioning. This means that the PALLAS-reactor needs its own cooling system and that extra intake volumes will be required from the Noordhollandsch Kanaal, as well as extra pipework and an extra discharge point in the North Sea.
- **Salt-salt variant (K2):** Cooling water is extracted from the North Sea and discharged to the North Sea. This system requires the construction of an intake station with pumps on a platform at sea, a pipe to the reactor and a pipe that transports the used cooling water to its own discharge point at sea.
- **Air-cooled variant (K3).** In this variant, the cooling water is fed through a number of cooling units after absorbing heat from the water basin. This would be constructed close to the nuclear island and would be a maximum of 11 m high. Water is also needed for the cooling units, but much less than in variants K1 and K2. Mains water may be used for the air-cooled variant.

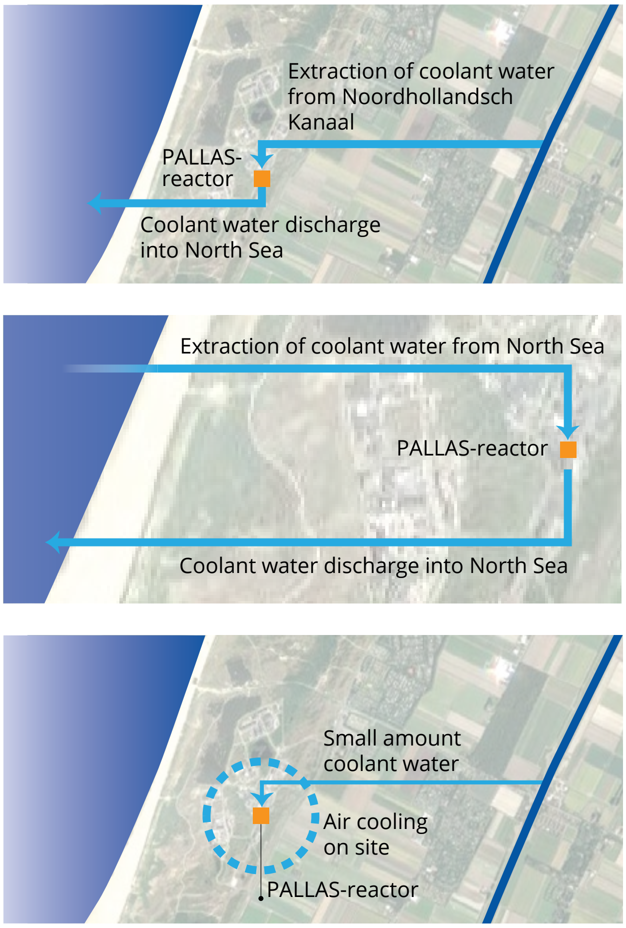


Figure 9 Three variants for cooling: K1 (top), K2 (middle), K3 (bottom)

3.5 Construction phase, transition phase, operational phase

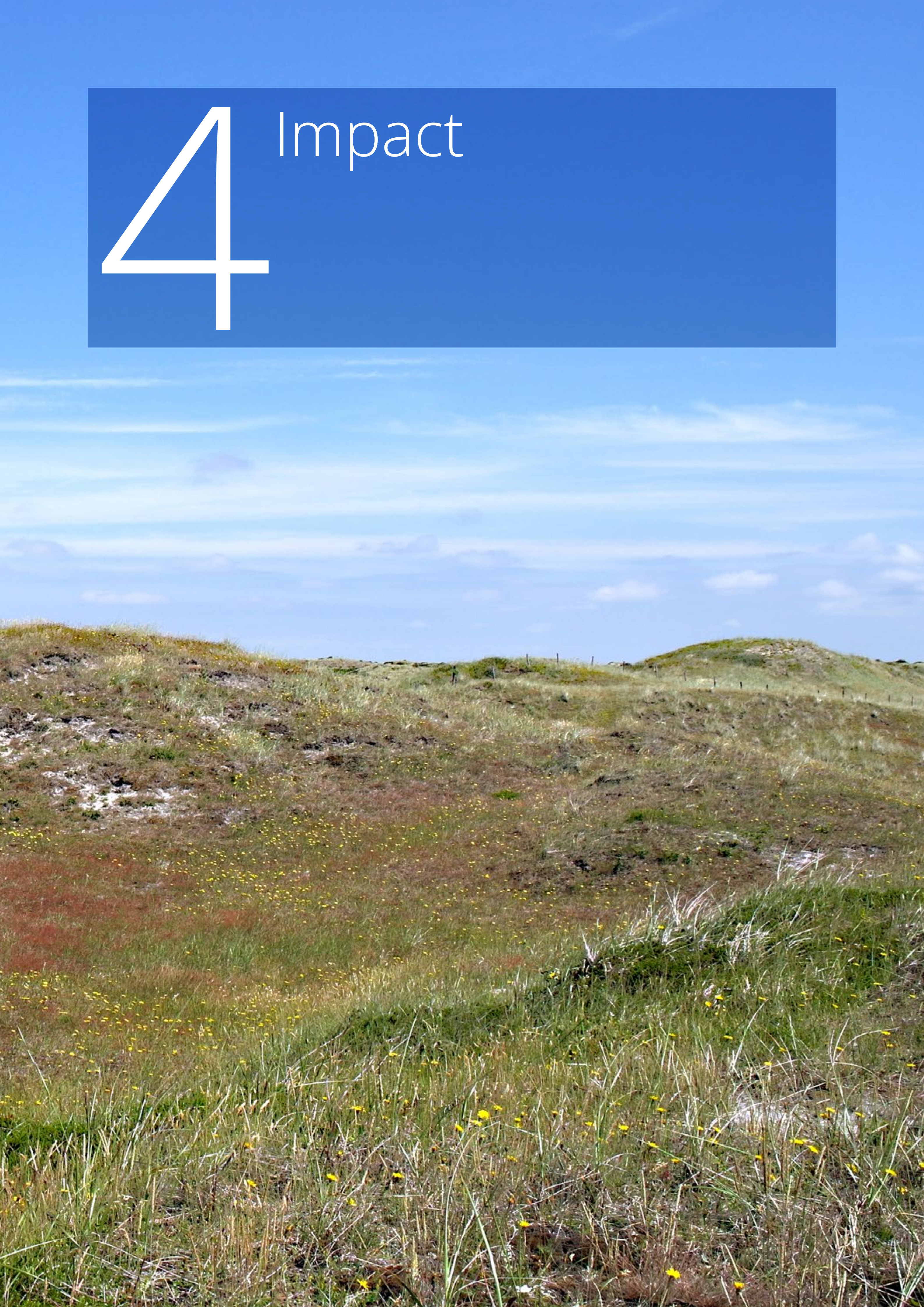
Construction phase
Construction of the PALLAS-reactor and all related facilities will take about four years. A detailed plan of action for the necessary work has not yet been drawn up of course, but the SEA lists the key activities:

- If the half-sunken variant is chosen, then construction of the nuclear island will require digging a deep pit. In the construction of this pit and the placing of pit walls, techniques are used that prevent vibrations and settling in adjacent buildings in which radioactive material is processed.
- During construction, a Lay Down Area (LDA) is set up for the storage of building materials, machines and vehicles and facilities for construction personnel. A temporary concrete plant will probably be erected on the LDA. The study assumed that the LDA would be no larger than 5 hectares.
- An overview has been made of construction work that could create a nuisance for local residents and cause disruption to the surrounding nature. A maximum estimate of traffic movements during construction has also been drawn up, including for trucks supplying and removing construction material.

Transition phase
During the transition phase, the PALLAS-reactor will be gradually put into operation. Once the PALLAS-reactor is fully operational, decommissioning work can commence on the HFR. How this transition process should be managed is still not clear at this point. The environmental impact assessment procedure assumes that there will be a period in which both reactors will be operational at the same time. Subsequently the environmental impact resulting from this transition period has been examined.

Operational phase
In its operational phase, the PALLAS-reactor is operational and the HFR is dormant.

4 Impact



4.1 Approach

Assessment framework

The study lists what the impact is of the PALLAS project in the construction phase, the transition phase and the operational phase. The basic assumption in the survey and assessment of the impact is that the different parts of the plan are given a 'maximum weight'. One example of this is the capacity of the reactor: a maximum capacity of 55 megawatts is assumed. The cooling system is coordinated to this maximum capacity. The maximum reactor capacity and the cooling capacity is then used as the basis for forecasting the impact. That is a safe approach that gives us a maximum upper level for the environmental impact. As the specifications are further detailed, a lower capacity and more limited cooling capacity may suffice. Certain environmental impacts may then be lower. The same applies to other parts of the plan: by assuming a maximum weight, the maximum environmental impact is demonstrated.

The guiding principle for the survey and assessment of the impact is a so-called assessment framework. That comprises eleven aspects:

- radiation protection and nuclear safety;
- soil and water;
- water safety (flood protection);
- air quality;
- noise;
- light;
- nature;
- spatial quality, landscape and cultural history;
- recreation and tourism;
- archeology;
- traffic.

Each of these eleven aspects is further sub-divided in criteria and sub-criteria. For instance, the aspect 'soil and water' includes the criteria 'groundwater', 'water quality', 'cooling water extraction and discharge' and 'soil quality'. Further, a criterion like 'groundwater' is also subdivided into a number of sub-criteria, including the impact that changes in the water table level have on agriculture in the direct locality.

Focus

The key question is whether the PALLAS-reactor has such an environmental impact in the construction phase, the transition phase or the operational phase that it represents an obstacle to the zoning plan. This would apply if it ultimately turns out that the following is the case:

- The PALLAS-reactor leads at certain points to severe nuisance and/or breaching of statutory environmental standards.
- The major nuisance and/or breaching of environmental standards is/are genuinely unavoidable: it is not possible in the follow-up process – for example in terms of the NEA permit – to implement executable measures that sufficiently counterbalance or soften the negative impact.

For the decision on the zoning plan, it is important to understand whether the PALLAS-reactor involves such an unavoidable and unacceptable environmental impact. If it turns out that this is not the case, then the PALLAS-reactor may be realized at the proposed location. In that case, there is no restriction on revising the zoning plan from an environmental perspective. For this decision, it is important to ascertain whether there are any actual differences between the examined variants for the height of the reactor building and the cooling system. One possible outcome is that, although the plan may be executable, there may already be good reasons at this stage to drop one or more of the variants. These would then not reappear in the further specification of the follow-up process.

The following paragraphs show what the main results of the study are for each phase. The emphasis here is on the negative impact, on the differences between variants, and whether it is possible or even necessary that measures in the follow-up process are specified further. In almost all cases, the definitive permits are the designated place for securing such measures.

4.2 The construction phase

The construction of the PALLAS-reactor

The primary negative impact of the construction of the reactor – and the main starting points for additional measures – relates to the following aspects:

- **Nuclear safety.** At the Research Location Petten, in the direct locality of the PALLAS site, nuclear activities take place. For this reason, methods are used, including in the construction of the reactor building, that reduce as far as possible irritating vibrations or settlings problems in adjacent buildings, for example by laying foundations using drilling instead of piling. Guidelines to safeguard nuclear safety during construction are established in the permit process.
- **Noise.** The activities lead to noise nuisance, but there are different practically executable measures to limit nuisance or at least maintain it below statutory thresholds. The main potential source of noise is the temporary concrete plant that may be erected at the LDA. However, the search area for the LDA is large enough to position it centrally at a distance from dwellings. Erecting noise barriers is also an option. Noise nuisance from plant traffic can be limited by temporarily reducing the maximum permitted speed on access roads. The municipality of Schagen may arrange this in advance using a traffic resolution.

Construction of the cooling facilities

The construction of an air-cooled system (variant K3) does not have any specific negative impact in the construction phase. The two water-cooled variants (K1 and K2) do require extra measures. It is necessary with these variants to lay new pipework and that always leads to local and temporary nuisance:

- **Groundwater.** The trenches for the pipework must be temporarily pumped dry. This could be negative at a local scale for the natural vegetation or agriculture.
- **Noise**. For the fresh-salt water variant (K1), a new pumping station is required at the Noordhollandsch Kanaal. Construction of this could lead to noise nuisance for adjacent

- dwellings. Lighting of the construction strip for new pipework could also cause a nuisance for the nearby recreation park.
- **Nature**. Both water-cooled variants (K1 and K2) have a negative impact on the surrounding nature: temporary surface loss, desiccation and disturbance.

Although the effects for this are temporary and local, they all require special attention in the follow-up process. What are the possibilities? For the pipework from the Noordhollandsch Kanaal (variant K1), it is important at this stage that only a search area is indicated. The exact route is not yet known and plotting this in only outline terms should prevent any problems, for instance by placing it as far as possible from dwellings. Also the timing of the work offers opportunities, such as: not working in the nesting season close to areas important to bird life, and not working close to beaches during the summer months. Further, various technical measures are available to limit noise nuisance, light nuisance and disruption of nature, or to minimize pumping for instance, so the impact on groundwater is kept to a minimum.

4.3 The transition phase

The unique feature of the transition phase is that at the Research Location Petten, two reactors will be operational at the same time: the new PALLAS-reactor and the existing HFR, which will still not be dormant at that point. Specifically for this transition phase, the following effects are important:

- **Radiation protection and nuclear safety.** Two reactors produce more radiation than one. However, both reactors comfortably meet the statutory norms, each separately and also in combination. This is secured in the NEA permits: the permit applicable to the HFR and the yet to be granted permit for the PALLAS-reactor.
- **Cooling water extraction.** This point applies exclusively to the water-cooled variant K1. If this variant is eventually chosen, then the consequence of this is that, during the transition phase, cooling-water extraction from the Noordhollandsch Kanaal is temporarily doubled. However, in case of severe drought, both the PALLAS-reactor and the HFR can be switched off. In just a few seconds, the intake of cooling water can be reduced to just 10% of the normal volume, and reduced even further if necessary. This makes the probability of too little cooling water being available at any given moment, negligible.

4.4 The operational phase

The operational PALLAS-reactor
Once the PALLAS-reactor is in operation, then in terms of the environmental impact, there are few differences with the current situation, or with the envisaged future situation in which the HFR remains in operation. Also the mutual differences in building height between the three variants of the nuclear island are limited, with the exception that the aspect that is addressed as last below:

- **Nuclear safety.** The PALLAS-reactor is positively assessed for nuclear safety: the most modern and the best available techniques are applied in the reactor, while it has to meet more stringent requirements than the HFR does.
- **Groundwater**. The variants with a sunken or half-sunken nuclear island (B1 and B2) have some impact on groundwater, but the effects of this are very limited and can be mitigated by constructing a drainage system.
- **Water safety.** The higher construction variants (B2 and B3) are positive for water safety as very little sand is moved or removed from the damming system of the seawall for these variants. Although the sunken variant (B1) scores slightly less well on this point, it still guarantees the required level of water safety.
- **Experiential value, identity.** The higher the new reactor building is, the more it stamps its presence on the experiential value and identity of the dune landscape. The sunken variant (B1) is more favorable in this regard. The scenic impact of the higher variants can be influenced to a certain degree with the building's design and color. However, particularly for the variant highest above ground level (B3), the reactor building is very much present in the landscape and is visible at a large distance.

Cooling of the PALLAS-reactor
The three cooling variants each have their own pros and cons:

- **Cooling water extraction in relation to the fresh water supply.** The fresh water supply is a point of attention even now, and the predicted climate change also increases the pressure. In those terms, it would be positive to terminate cooling water extraction from the Noordhollandsch Kanaal and to switch to intake from the North Sea (the fresh/salt water cooling variant K2) or to air cooling (variant K3).
- **Noise**. Both water-cooled variants (K1 and K2) produce very little noise in the operational phase. Air cooling (K3) on the contrary is a significant source of noise: measures are then necessary to limit noise nuisance.
- **Nature**. In terms of nature, the impact on the North Sea is a point of attention for both water-cooled variants. For both K1 and K2, heated cooling water is discharged to sea, causing ‘thermal contamination’. Furthermore, cooling variant K2 has the disadvantage that when extracting cooling water from the sea, it is not always possible to avoid sucking in fish.
- **Experiential value.** Cooling variant K2 has a negative impact on the experiential value: the necessary platform for the intake of sea water will be visible from the beach. Air-cooling variant K3 generates condensation clouds that are clearly visible in the winter, even from a large distance.

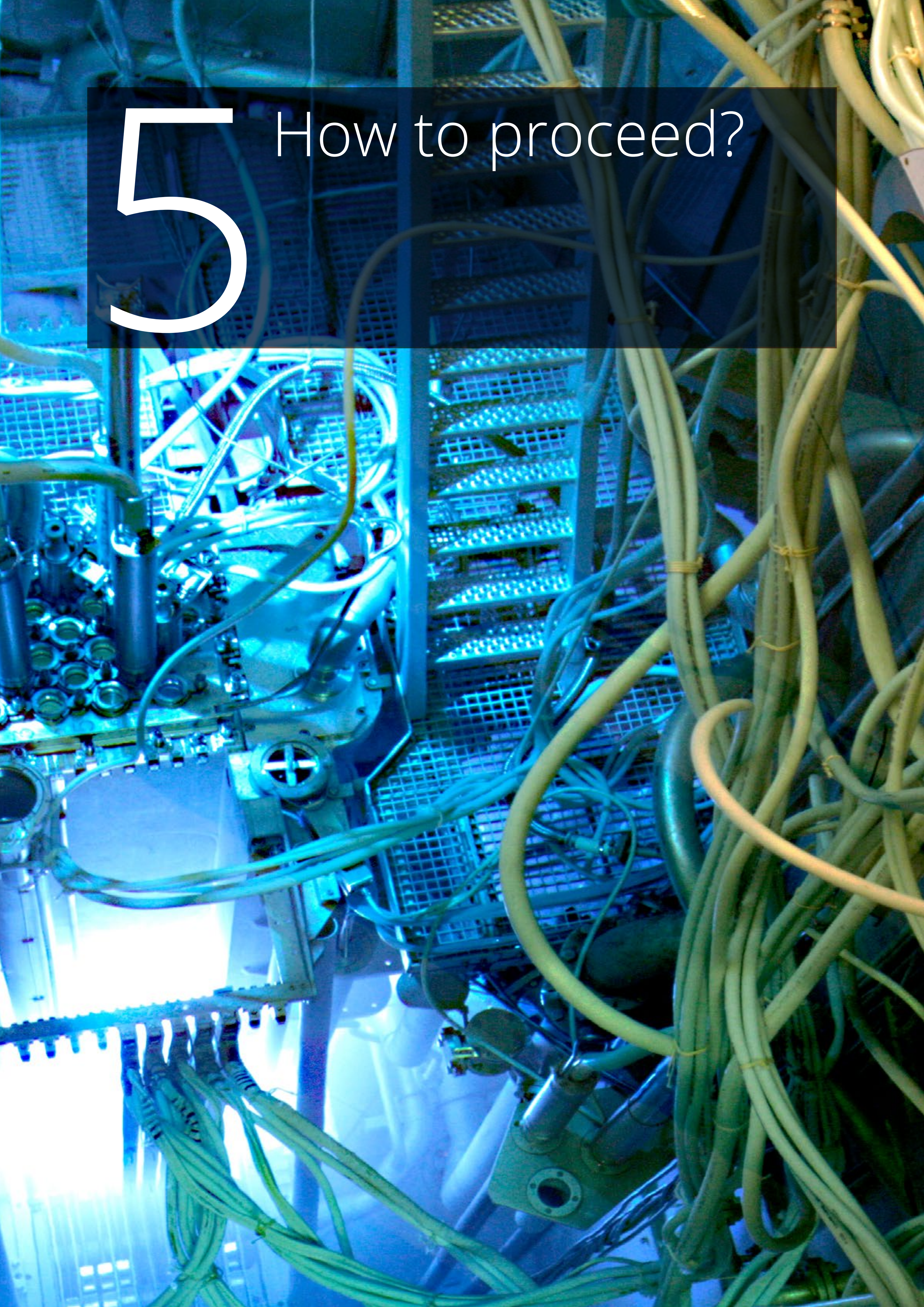
4.5 Conclusion

The study assumes maximum design specifications of the different parts of the plan. Based on that, the maximum environmental impact has been identified for the construction phase, the transition phase and the operational phase. The survey and assessment reveal that – even in the maximum situation – no unacceptably severe norm-breaching environmental impact would arise if the PALLAS rector is erected and operated on the intended spot at the Research Location Petten. The conclusion is therefore that the environmental impact does not form any barrier to revising the zoning plan.

At least as important as that is that the study has also systematically explored what the points of attention are in environmental terms for the further detailing of the follow-up process. The summary above states the different potential impacts for which supplementary measures are desirable or even necessary. A complete overview of these measures is included in the SEA. The legal securing of these measures could and probably will be done in most cases during the permit process.

Finally, also relevant to the follow-up process is the fact that there is no longer a reason in the revision of the zoning plan to consider raising the current upper limit for the building height. The study includes a nuclear island variant with a maximum height of 40 meters above ground level. There was previously a lack of clarity about the impact – especially for groundwater – of a half-sunken and fully sunken reactor building. The now completed study has shown that the sunken options would only have a limited and manageable impact on groundwater. At the same time, a nuclear island up to 40 meters above ground level would have a major impact on the landscape, and there are few options for mitigating this impact. This is also why the draft revision of the zoning plan assumes the same maximum height as the current zoning plan: no more than 24 meters above ground level.

5 How to proceed?



Draft revision of zoning plan and the SEA for inspection
The draft revision of the zoning plan and the SEA are both complete. The next step in the procedure is that both documents are submitted at the same time for inspection. Over a period of six weeks, anyone may respond to these documents. This may be done by submitting a standpoint. The standpoint may relate to the zoning plan, or to the information presented in the SEA. One important question in regard to the SEA is whether the report contains sufficient information to be able to take full account of the environmental impact during the decision-making process.

Assessment by the NCEA
All submitted standpoints are sent to the independent NCEA (Netherlands Commission for Environmental Assessment). This committee takes account of these standpoints in its assessment of the SEA, and checks whether the information in the SEA is complete and correct. It will then issue an assessment guidance to the municipal council of Schagen.

Establishing the zoning plan and any appeals
The municipal council of Schagen is responsible for establishing the zoning plan. The resulting decision is partly based on the information in the SEA, the standpoints and the guidance from the NCEA. It is then possible to appeal this decision at the Administrative Jurisdiction Division of the Council of State.

The result
The revised zoning plan and the SEA together form the framework for further detailing, which eventually results in a complete and concrete design. For the realization of this, PALLAS will request different permits, with the Nuclear Energy Act permit (NEA permit) being the most important. At the same time as submitting the NEA permit application, PALLAS must also submit other research documents. These include a detailed Safety Report, and a second environmental impact assessment procedure providing a complete overview of the full scope of environmental impact in the concrete design. As with the current SEA, the second environmental impact assessment procedure also focuses separately on the construction phase, the transition phase, and the operational phase, but then far more specifically. But this second environmental impact assessment procedure is submitted for inspection by and is assessed by the NCEA. This ensures that sufficient environmental information is available in advance of the decision regarding the NEA permit so that environmental considerations are once again fully taken into account in this decision.

Planning
The aim is to complete the preparatory phase (design, studies, permits, financing) by 2020. Construction of the reactor and all related facilities will take no more than four years. This means that the new PALLAS-reactor will be operational from 2024 onwards.

Further information
The draft revision of the zoning plan, the complete SEA and this summary can be downloaded at the site of the municipality of Schagen (www.schagen.nl) and the site of PALLAS (www.pallasreactor.com).
At www.pallasreactor.com, lots of extra information about the PALLAS project is also available.
Practical information for those considering submitting a standpoint – such as the applicable term and the address the standpoint must be sent to – is also published at www.schagen.nl and www.pallasreactor.com, as well as via adverts in local and regional media.


PALLAS

Photography	**Kees de Gooijer** (Source: Hoogheemraadschap Hollands Noorderkwartier): cover.
	Hein van den Heuvel (Source: NRG): page 6.
	NRG: page 10, 14 and 22.
Print	Proja B.V. in Alkmaar
Ref.nr.	PALLAS-51-1042
Copyrights	PALLAS


www.pallasreactor.com
Ref.nr. PALLAS-51-1042