

LICENSING THE PALLAS-REACTOR USING THE CONCEPTUAL SAFETY DOCUMENT

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1. Abstract

PALLAS aims to realize a multi-purpose reactor to replace the existing High Flux Reactor or “HFR” in Petten, the Netherlands, which has been in operation for over fifty years and is now approaching the end of its economic life. It is the goal of PALLAS to deliver a fully privately financed, owned, and operated reactor, with a safe, state-of-the-art and multi-purpose design, enabling a world leading position in the radio-isotopes market and facilitating R&D in the field of nuclear technology.

This paper provides an overview of the nuclear licensing process in the Netherlands in the context of an evolving regulatory framework. Compliance to the regulatory framework needs to be demonstrated in order to obtain the Nuclear energy act licence.

The licensing process of the PALLAS-reactor will be the first for a new nuclear facility in the Netherlands for a long time. This paper presents the way PALLAS will involve the Dutch Nuclear regulatory body from the early start of the project. PALLAS is introducing a new and additional informal step in the licensing process, being the Conceptual Safety Document. This document will be submitted to the regulator in the early phases of the project, well before the submission of the first nuclear licence application for construction. The main objective is to inform the regulator on methodologies and processes to be used for the design and the safety concept of the design in order to get regulatory involvement in an early stage of the project.

Introduction

The organisation for realizing the PALLAS-reactor was established in 2012. Since then the organisation and its management system are developed. In 2015 two supporting organisations, the Owners Engineer and the Licensing Engineer and Off Plot Scope¹ designer were contracted.

At the time of writing PALLAS has published the Invitation To Tender for the contractor which will design and manage the procurement and construction of the nuclear island. After awarding this contract, the main work on designing the reactor and preparation of the nuclear licence application for construction will start.

The nuclear licensing process of the PALLAS-reactor faces a number of challenges, mainly related to the PALLAS-reactor being the first new build nuclear reactor in the Netherlands in decades. Both PALLAS and its regulator can therefore not rely on experience from a similar licensing process.

This paper will describe what PALLAS and its regulator developed to accommodate a smooth and efficient licensing process. First the Dutch regulatory framework and its recent developments are being discussed. Afterwards it is explained which activities PALLAS will employ in the period up to the submittal of the first nuclear licence application, to ensure an early involvement of the regulator in PALLAS activities.

2. Nuclear regulatory framework in the Netherlands

The Dutch regulatory framework is based on the Dutch Nuclear energy act and its decrees and regulations which regulate activities that involve ionising radiation to ensure the safety of

¹ Off Plot Scope is also known as the Balance Of Plants

people (both workers and public) and the environment. Furthermore, the Dutch Safety Requirements as detailed below specify and detail to a large degree the specifications set forth in the Dutch Nuclear energy act. The Regulatory Body for the Nuclear energy act in the Netherlands is the Authority for Nuclear Safety and Radiation Protection or “ANVS”.

Before starting the licensing process for the PALLAS-reactor the ANVS performs a review and an assessment of the (Preliminary) Safety Analysis Report or “(P)SAR”. The basic objective is to determine whether the PALLAS-reactor complies with the safety objectives and design requirements stipulated in the Dutch nuclear regulations and thus to provide confidence for a future safe operation of the nuclear reactor. The outcome of this technical assessment is presented in the Safety Evaluation Report and forms the ground for the regulatory decision-making (licence).

For the PALLAS-reactor, two nuclear licences are required:

1. Nuclear energy act licence for Construction, including cold commissioning;
2. Nuclear energy act licence for Operation, including hot/nuclear commissioning.

The ANVS was on the one hand facing initiatives for nuclear new builds for the first time in decades and was on the other hand confronted with international developments with respect to nuclear safety. Due to this the ANVS has drafted the following documents in order to provide detailed guidance for the licensing process and major application documents to be submitted to the ANVS.

1. Dutch Safety Requirements
2. Organisation of the (SAR) Review Process
3. Technical Review Plan

These documents are based on the latest international standards, best practices and experience. A more elaborated description of these documents and how they will be used is provided hereafter.

2.1. Dutch Safety Requirements

The Dutch Safety Requirements or “DSR” which are issued in 2015 present the ANVS view on the latest technology and safety objectives for nuclear reactors. It will be used to assess the safety of the design and the outcome of this assessment will be the basis of the ANVS decision for granting a nuclear licence for the PALLAS-reactor. The requirements are based on the latest safety requirements from the IAEA, Western European Nuclear Regulators Association or “WENRA” and German regulatory requirements.

The DSR and are initially written for Nuclear Power Plants. A methodology is provided for the application of a graded approach for Research Reactors. This methodology is to ensure that the application of requirements is in balance with the hazard potential of the reactor. Although the DSR requirements are in general goal-oriented the DSR contains several solution-driven requirements and which are specifically written for a Nuclear Power Plant. Especially for these requirements the application of a graded approach is relevant.

The provided methodology for the application of a graded approach consists of the following three steps:

1. Categorization of the research reactor according to the specific hazard potential;
2. Analysis of specific factors which are not properly covered by the categorization in step 1
3. Decision and justification of an appropriate application or waiving of requirements in case of the PALLAS-reactor.

PALLAS will provide, in case of grading or waiving of a particular requirement, justification in a documented manner to the regulatory body. PALLAS will demonstrate compliance to the DSR in the (P)SAR in order to obtain the Nuclear energy act licences.

2.2. Organisation of the (SAR) Review Process and Technical Review Plan

Due to the significance of the review and assessment process of the (P)SAR, the ANVS has prepared two documents, the Organisation of the (SAR) Review Process or “ORP” and the Technical Review Plan or “TRP”, as guidance for the technical experts that are taking part in the ANVS review. A key success factor mentioned in the ORP is that at the start of the process the ANVS and PALLAS agree on the way the review process of the (P)SAR is structured.

The ORP gives the general review plan of the ANVS. The document describes the activities recommended to take place before the ANVS reviews the (P)SAR. Furthermore it gives the ANVS expectations with respect to the organisation of the (P)SAR review, the applicant's organisation, the communication and escalation protocols, the documents used, the document flows, revision management and acceptance review.

The TRP ensures that the review of the (P)SAR will be performed in a highly safety-oriented manner, such that review activities are performed according to the safety significance of the issue considered. By guiding the reviewers through a wide range of review topics and especially point to areas with high safety importance, the TRP facilitates a thorough, uniform, transparent and efficient review of the (P)SAR in which all topics significant for safety will be addressed appropriately. It contributes to a process in which all experts involved share a common review approach.

The ORP and TRP are openly communicated with PALLAS, giving a clear understanding of ANVS's expectations concerning the scope, structure and level of detail of a (P)SAR. Also the documents are living documents and, when this is considered to be beneficial, they can be tailored to the specific aspects of PALLAS. PALLAS intends to use the TRP when drawing up the P(SAR), since it will be valuable in developing a sufficiently detailed and well-structured (P)SAR that meets the expectations of the ANVS.

3. Early involvement of the regulator during the pre-licensing phase

PALLAS recognizes the complexity of the licensing process and strives for an early involvement of and a close interaction with the ANVS. In this respect, PALLAS has engaged with the ANVS by organising regular meetings in the pre-licensing phase, being the period prior to the submittal of the first application for the Nuclear energy act.

During the pre-licensing phase PALLAS is formally not yet under regulatory control. As such the ANVS cannot make any formal statements with respect to the future nuclear licences. All discussions of PALLAS with the ANVS and reviews performed by the ANVS are however very valuable for achieving a smooth and efficient licensing process. First because it allows the regulator to gradually learn about the organisation PALLAS, its processes, activities and the design of the PALLAS-reactor. And second because it allows PALLAS to reflect its choices, methodologies and possible design solutions with the ANVS and obtain confidence in an early phase that this will result in a safe and licensable reactor.

The regular meetings with the ANVS serve amongst others to present, discuss and achieve a common understanding of:

1. The licences needed, interfaces between the licences, regulatory bodies involved, their respective processes, the required application documents and the format and content of the application documents;
2. The overall safety goals and the DSR requirements in particular, and the discussion of possible technical solutions;
3. The use of the ORP and TRP and, if relevant customise them for PALLAS;
4. The organisation of PALLAS, the integrated management system, roles of contractors and the project status;

5. PALLAS positions, approaches and technical solutions and receive the response of the ANVS and improve these by using the input given by the ANVS.

3.1. Conceptual Safety Document

One of the main steps PALLAS has taken to ensure early regulatory involvement in the design and safety concepts and methodologies of PALLAS is to add an informal step to the Dutch licensing process being the Conceptual Safety Document or “CSD”.

The main objective of the CSD is to inform and give the regulator an early insight into the processes and methodologies of PALLAS and its contractors towards safety and design to ensure the development of a safe and licensable reactor. The CSD will provide information on the conceptual design of the reactor and on those (design) topics which are fundamental for PALLAS safety and licensing approach such as the design process and control activities or the safety concepts and principles. It will provide the Regulator a profound insight into key design features, processes and methodologies used in the design and the safety demonstration of the PALLAS-reactor.

Documents similar to the CSD are used in France, where the document is named: Dossier d’Options de Sûreté (DOS) and in Belgium, where the document is named “Design Options and Provision File (DOPF)”. In France and Belgium these documents are also informal steps in the licensing process. The content of these documents is not prescribed.

To determine the content of the CSD for PALLAS the experience with both the DOS and the DOPF are used. Also the content is customised to PALLAS, to cover those topics that PALLAS would like to inform the regulator on and which are available with the conceptual design. The CSD is expected to be around 100 pages, covering at least the topics listed hereafter:

3.2. Content of the Conceptual Safety Document

1. The organisation for PALLAS:
 - a) Structured approach of PALLAS organisation and its contractors towards the entire safety demonstration and to ensure compliance to regulatory requirements;
 - b) Key processes, methodologies and quality assurance;
 - c) Commitment to regulatory compliance.

- 2) The objectives:
 - a) Codes and Standards;
 - b) Acceptance criteria and radiological safety objectives;
 - c) Reactivity control;
 - d) Heat removal;
 - e) Confinement strategy;
 - f) Codes and model for safety analyses.

- 3) The methodology implemented to reach the objectives:
 - a) Classification of SSCs;
 - b) Material selection approach and process/specification qualification of specific materials;
 - c) Deterministic safety analysis;
 - d) Probabilistic safety analysis;
 - e) Internal and external hazards analysis;
 - f) Severe accident analysis;
 - g) ALARA demonstration and practical elimination;
 - h) Radiation protection.

- 4) The Safety Approach and Design approach:
 - a) Approach for the entire safety demonstration;
 - b) Defence in depth principle;
 - c) Multiple barriers concept;
 - d) Graded approach;
 - e) Protection against internal and external hazards;
 - f) Approach to: testing and qualification of SSCs, commissioning and start-up tests, periodic testing, inspect-ability and maintainability, issues related to human-machine interface and human factors, emergency planning and preparedness, cliff-edge effect;
 - g) Design process and control activities.
 - h) Assessment of radiological consequences on the population during normal operations
 - i) Assessment of radiological consequences on the population in accident conditions

- 5) A global high level description of the technical solution, based on the pre-conceptual design:
 - a) Plant layout description/overall architecture and plant process description;
 - b) Operational mode description;
 - c) Hazard classification (inventory of radioactive material);
 - d) Technical design methods;
 - e) Hypothesis and philosophy for: core design, I&C concept, electrical power supply, experimental devices, storage and handling of fuel, supporting and auxiliaries systems, spent fuel and radioactive waste management, design for decommissioning, complementary needs for the installation.

The CSD will be written by PALLAS and its supporting contractors and will be based on the conceptual design. An internal review process by senior professionals with suitable qualifications and experience in design and safety, and different from those who contributed to the CSD, will ensure an independent review. After formal approval by the PALLAS management, the CSD will be submitted to the ANVS for their review. PALLAS acknowledges that the CSD is not part of the formal licensing process. Nevertheless, the benefits from this additional step can be maximized if the ANVS performs a review of the CSD similar to the review of the (P)SAR as presented in the ORP and TRP.

The basic objective of the CSD review and assessment is to determine whether at this stage of the project, the proposed conceptual design and methodologies and processes for the safety demonstration comply with the safety objectives and design requirements stipulated in the Dutch regulations and thus to provide confidence at an early stage for a future safe operation of the nuclear reactor.

PALLAS expects the ANVS to prepare a review report similar to the Safety Evaluation Report including the results and conclusions of the assessment and compiling all review findings. PALLAS will provide a response to the review findings of the ANVS. Also, the remarks and findings of the ANVS on the CSD will be further taken into account for the preparation of the subsequent licensing documentation and in particular the (P)SAR for the Nuclear energy act licence for Construction.

Since one of the main objectives of the CSD is to ensure regulatory involvement from the early start of the project and to facilitate the licensing process, PALLAS expects that the ANVS review team that reviews the CSD will also participate to the review of the (P)SAR at a later stage.

4. Concluding remarks

Licensing a nuclear reactor in a country for the first time in decades can be a challenge both from the regulators and future licensee's point of view. For the licensing of the PALLAS-reactor in the Netherlands both PALLAS and the ANVS have developed instruments to facilitate the licensing process. PALLAS is confident that the development of the DSR, ORP, TRP, CSD but especially the regular meetings with the ANVS will result in achieving a common understanding on the process and content relevant for the licence applications and due to that will help facilitate the process.

PALLAS is glad that the ANVS welcomed the CSD and is willing to review and comment on the document. Although a positive review of the CSD by the ANVS is not to be considered as a formal approval, this will give PALLAS the confidence that proceeding as described in the CSD, will result in a safe and licensable reactor.

The ANVS guidance documents, the regular meetings and the CSD will aid PALLAS in mitigating licensing risks and therefore downstream risks of cost increase or schedule delays.