

Internship Report

Universitat Politècnica de Catalunya

Master's Degree in Nuclear Engineering



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1. Introduction

This internship comes from an agreement between the “Secció d’Enginyeria Nuclear” (Departament de Física i Enginyeria Nuclear) de la Universitat Politècnica de Catalunya (UPC) and the Associació Nuclear Ascó Vandellós II (ANAV), which is currently managing the operation of the nuclear power plants of Ascó and Vandellós II. The internship was carried out during the last quarter of the Master’s Degree in Nuclear Engineering as a compulsory subject. Concretely, it started the 16th of September of 2013 and lasted until the 13th of March of 2014. By means of this internship period, the student developed his Final Master Thesis.

The main aim of this internship consists in facing a particular problem related to the nuclear industry. In order to solve this problem, the student has had to apply the acquired knowledge along the Master’s first year, and has learned some new concepts from a practical point of view about the nuclear field. Concretely, this internship has been focused into an analysis and optimization of the operation of the Ascó NPP Circulating Water System.

2. Work Environment

The project was developed in the “Dirección de Servicios Técnicos”, which is one of the departments of ANAV and is placed in Vandellós NPP (Tarragona). Concretely, the internship has consisted in a collaboration with the “Ingeniería de Sistemas (Balance of the Plant)” group. During these period, a problem was given to the student, who had to solve it. In order to solve this problem, the student was provided with all the necessary information about the project, the related Systems, and their historical (performance) data.

During the intership, some responsibilities were assigned to the incoming student: First, the student has had to study and to estimate the viability of a set of modification and improvement proposals of Ascó’s NPP Cooling Towers, with the aim to recommend the best choice. Although this work was done independently by the student, at all times it has been supervised by the director of the thesis and members of the working group. Furthermore, the results obtained at the end of each stage of this analysis have been shared with the team members, so there was a continuous feedback between both sides. Last but not least, the developed work will be considered in the future decisions that can be taken by the group and the company.

3. Technical aspects of the internship

The project assigned to the student during his internship consisted in an “Analysis of a set of modification proposals of Ascó’s Nuclear Power Plant Cooling Towers”. This project intends to solve the following problem:

Owing to the old age of Ascó’s Nuclear Power Plant Cooling Towers, which are a part of the Circulating Water System, the electrical production of the facility has decreased and the number of events, which trips the turbine, have augmented. For this reason, a set of reparation and improvement proposals were presented.

In order to solve this problem, the student analysed the different proposals and estimated their improvement. In the end of this work, the student suggests the best choice according to the obtained results. The followed work-flow for solving this problem has been:

- **Survey of the current performance of the towers:** In order to know the current status and operation of the cooling towers, their historical data was analysed. The results of this study were implemented in the modelling process.
- **Modelling:** The main point of this project was to know the improvement in the annual electrical production of each proposal. For this reason, a thermodynamic model of the Circulating Water System and Cooling Towers was developed from the existing and provided data. In addition, because of the efficiency of these systems depends on the Ebro’s river and local atmospheric conditions, an annual statistics of these parameters was done through the historical data. Finally, these quantities were introduced in the developed model, so an annual estimation of the energetic uprate was obtained.
- **Analysis of the results:** From the obtained results, the economical feasibility of the different proposals was analysed. First, a set of assumptions were done and then, the Payback, the Net Present Value, and the Internal Rate of Return were computed.
- **Environmental Impact:** The implementation of the project might suppose an impact to the environment. In order to quantify it, the main factors were studied taking in mind the conditions issued according to the technical specifications and the current regulation.
- **Conclusions:** Finally the best solution was suggested.

Other problems (non-related directly with the project) that raised and were solved during the internship were:

- **Analysis of the impact caused by the unavailability of the towers:** The supplier of the 'new' towers shall be able to develop and implement their proposals within the programmed schedule. In addition, the installed towers must satisfy the specified improvement. The non-fulfilment of any of this requirements would suppose a reduction of the performance of the plant. In that case, the supplier must remunerate the economic losses to the plant. By means of the developed model of the Circulating Water System, the student has estimated the impact caused by the non-fulfilment of any of this requirements.
- **Study of the regulations about the towers filling:** The materials of the towers must satisfy the current regulations. The fulfilment of these criteria guarantee the quality of the filling and the operation of the Cooling Towers within the safety limits. Since the implementation of any of the proposals of the Cooling Towers will modify the material of the filling, the student has searched and studied the standards that these materials must follow.
- **Study of the causes of the current performance of the towers:** During the development of the Master's Final Thesis the current performance of the tower was studied. After doing this first study, it was not really clear what were and are the causes that explain their behaviour of the last years. In order to solve this problem, a deeper study of the historical data of these devices was done. Although some points were answered, there are some unexplained phenomena due to the lack of data.
- **Multiple presentations to the working team:** The used methodology and results obtained from the different problems have been periodically presented to all the members of the working group. The challenge of these talks has consisted in doing a short presentation but including all the fundamental content with the aim to explain the developed work in a simple and clearly way.

4. Experience and Training acquired

Along the internship, the student has faced and resolved a particular problem related to the nuclear industry. In order to solve it, the student had to apply the acquired knowledge during the first year of the Master's degree. The main subjects which were directly related with the developed work are: "Project I", "Project II", "Systems, Components and Materials", and "Engineering Projects" ¹. They provided to the student the ability to identify the different tasks of the technical and financial management of a nuclear facility and assess the problems associated with analysing and proposing possible solutions.

In addition, thanks to the assignments and deliveries from the subjects "Reactor Physics and Thermal-hydraulics" and "Regulations and Safety" the student was able to perform the analysis of the historical data and the modelling process without any problem.

On the other hand, the student not only had to apply the acquired knowledge, but he has also acquired some new ones. The development of this internship and its associated tasks have led to the student:

- Deeper understanding of the tertiary side of a Nuclear Power Plant and its role into the efficiency of the plant.
- Deeper understanding of the influences of the environmental conditions (and heat sink) into the performance of the plant.
- Improvement of the capacity for analysing and processing big amounts of data.
- Improvement of the capacity for developing models from empirical and theoretical equations and by means of historical data.
- Improvement of the presentations skills, allowing to exhibit the developed work and the obtained results in a precise and synthesised way.
- Higher competence for working and solve actual problems independently.
- Increase his sense of responsibility

¹Complements de Formació

5. Conclusions

Though this internship the student has faced a real problem related to the nuclear industry. The development of this project has had two kind of contributions:

On the one hand, the internship student has developed skills in the application of theory to practical work situations, and has developed techniques directly applicable to his careers.

On the other hand, the acquired knowledge during the first year of the master has allowed the student to develop and solve the assigned problem and its associated tasks successfully. In addition, the results from this study were well received and criticized by the group members of “Sistemas ”.

For these reasons, the student considers that the internship has been a positive experience.