CHAPTER I
INTRODUCTION

This chapter consists of the background, problem identification, research objective, research scopes, and the outline of the research.

1.1 Background

Nuclear energy is an energy source produced from reactions between particles in the atomic nucleus. In today's technological era, nuclear energy has become a fairly promising energy producer because it can produce much greater energy in a longer period compared to other energy generators, and is safe for the environment and human life with lower waste and operating costs (Irfan et al., 2020). This is why the demand for nuclear energy is high which has led to increasing nuclear energy production (Ritchie et al., 2020). The increase in nuclear energy production from 1965 until 2023 can be seen in **Figure 1.1**.

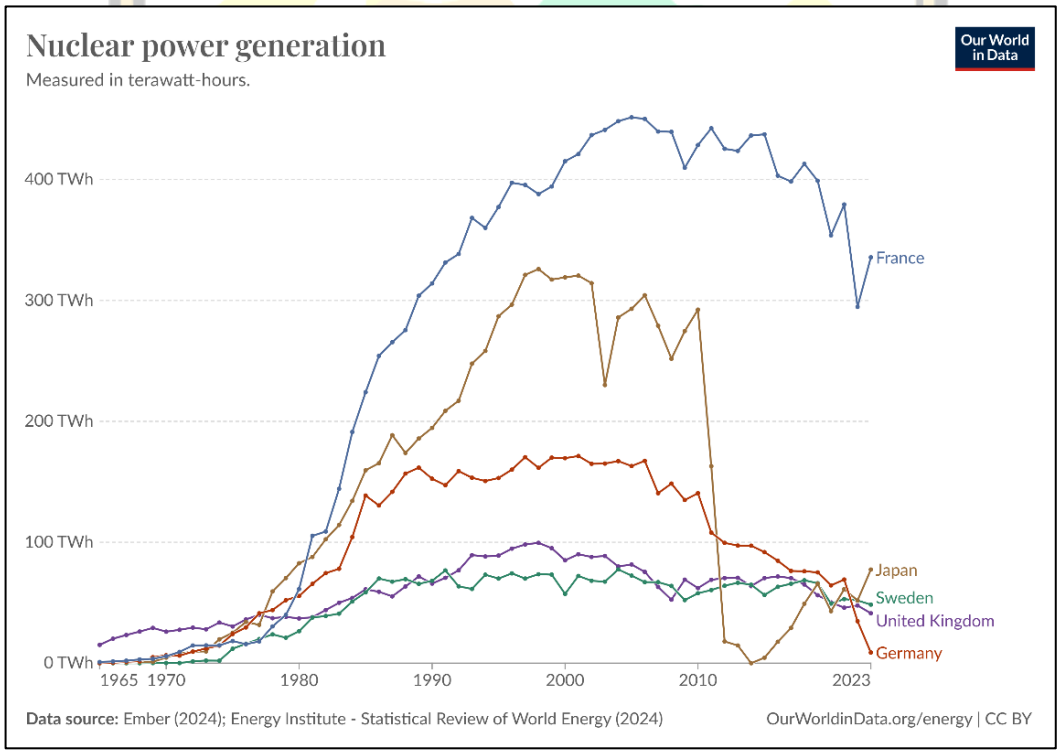

Figure 1.1 Nuclear Power Generation from 1965 until 2023

The increasing nuclear energy production makes the supervision of nuclear energy use vital in maintaining nuclear energy's safety, security, and sustainability globally. The potential of nuclear energy as an alternative energy source to meet the world's energy demands is immense. However, if nuclear technology is not properly managed, it can be the source of significant risks. An example of a nuclear reactor accident that has occurred is the accident in Fukushima Dai'ichi, Japan on March 11th, 2011 (BAPETEN, 2011). This accident causes an estimate of 1600 people to die due to evacuation conditions, environmental damage, and reactor damages.

Globally, many countries employ nuclear technology for energy production, medical purposes, industrial applications, and research activities. Therefore, the presence of nuclear regulatory agencies is essential to ensure that the utilization of this technology complies with the established safety and security standards. In Indonesia, a Nuclear Energy Regulatory Body is responsible for ensuring the country's safe, secure, and controlled use of nuclear energy and radiations. This role includes strict oversight of nuclear reactor operations and guaranteeing the welfare, security, and peace of society from nuclear or radiation dangers (BAPETEN, 2024). In 2023, there are 7 reports on nuclear accidents/emergencies recorded by the company which can be seen in **Figure 1.2** (BAPETEN, 2023).

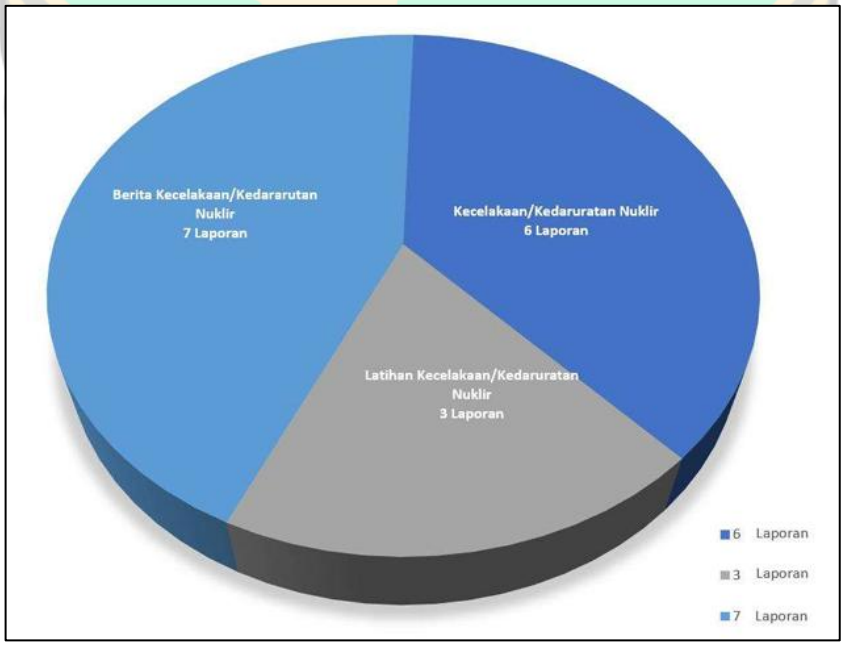

Figure 1.2 Nuclear Accidents/Emergency Report

The company faces numerous challenges in performing its functions. One of the major challenges is the need to analyze data rapidly and accurately, especially at times of emergencies. Public and environmental safety ultimately depends on the accuracy of this data, the analysis's quality, and the decision-making process's effectiveness. Currently, the company uses a website called B@LIS – SMILE as the tool to help in inspections and reports. However, this tool is not able to help the company in making fast and accurate decision, and manage the inspection data effectively. Thus, there is a pressing need for a solution that enables the company to efficiently manage data, simplify complex information, and facilitate quick and accurate decision-making.

One of the most efficient solutions to address this problem is a Decision Support System (DSS). Decision Support System (DSS) is a flexible, interactive, and adaptable information system that's developed to provide information, data modeling, and manipulation to produce various alternatives of decisions and answers (Hutahaean et al., 2023). DSS assists decision-makers in formulating policies or taking appropriate actions. A fast exchange of data and information is needed when nuclear emergencies occur to know the correct and effective action to be done in the situation (Khusyairi, 2014).

DSS is crucial for nuclear regulatory agencies because it can handle various critical data. Data sources such as radiation monitoring results, field inspection reports of nuclear facilities, and safety audit findings can be filtered, analyzed, and presented for more insightful interpretations. This processed data can be utilized to monitor the performance of nuclear facilities, identify potential risks, and simulate the consequences of specific events. In essence, DSS enhances the efficiency, accuracy, and speed of decision-making based on reliable data.

The implementation of DSS in the nuclear industry is not a new concept. Many developed countries have already employed DSS to enhance supervisory systems in nuclear facilities. For instance, DSS has been used to monitor early warning systems for radiation leak detection or to conduct risk assessments in

reactor operations. Recently, there has been a growing trend in incorporating Artificial Intelligence (AI) and Machine Learning into DSS to improve risk prediction capabilities and enable real-time data processing. This advancement makes DSS increasingly relevant and vital for nuclear regulatory agencies as they navigate complex operational challenges.

While DSS is a powerful tool to support decision-making, its effectiveness is heavily influenced by the system's user interface (UI). A well-designed UI ensures the processed information is effectively communicated to users, including decision-makers, supervisors, technicians, and managers. A good UI allows users to grasp the overall situation and make more informed decisions quickly by presenting information in an intuitive and easily understandable format.

Additionally, the system must cater to users with varying levels of expertise, ranging from field technicians and data analysts to high-level decision-making managers. In this context, the UI must incorporate features such as clear data visualization tools, user-friendly navigation menus, and responsive design elements to ensure that all users can interact with the system efficiently. This encourages the use of User-Centered Design method in designing the UI for the Decision Support System, as this method focuses on the user needs in the system (Priyatna, 2019). Based on previous research conducted on the development of DSS for railway maintenance in Bulgaria shows that the design of UI with User-Centered Design helps in improving their efficiency in making decisions to contribute in managing the railway to be safer (Marinov, 2017).

To conclude, the design of a DSS UI plays a pivotal role in enhancing the efficiency and accuracy of nuclear surveillance systems. By addressing challenges such as big data visualization, user accessibility, and system reliability, a well-designed UI ensures that DSS can effectively support nuclear regulatory agencies in fulfilling their mission to enhance nuclear safety and operational safety risk management.

This research contributes to the global effort of maintaining nuclear safety and security by improving the efficiency and accuracy of decision-making which leads to helping mitigate risks. The DSS is also a solution to increase operational efficiency by identifying operational risks while saving costs and increasing productivity. The effectiveness of the decision-making process provided by the DSS is also directly linked to the security and peace of society. A user-friendly and effective UI helps ensure that the decision-makers can respond rapidly and accurately during emergencies, therefore protecting the public from nuclear and radiation danger.

1.2 Problem Identification

The problem identified based on the background of this research are as follows.

1. How to create a user interface prototype for the company's Decision Support System that meets the need of the users?
2. How far does the prototype meet the usability metrics (usability score ≥ 80, Maze Usability Score ≥ 75, and System Usability Scale ≥ B-) to ensure the design meets the user needs?

1.3 Research Objective

The objectives of this research are as follows.

1. To implement User-Centered Design method to create a user interface prototype for the company's Decision Support System.
2. To evaluate the usability of the user interface prototype using quantitative usability metrics (usability score ≥ 80, Maze Usability Score ≥ 75, and System Usability Scale ≥ B-) to ensure the design meets the user needs.

1.4 Research Scopes and Assumptions

This research is conducted with the scopes and boundaries set by the researcher as follows.

1. The research focuses solely on the design and evaluation of the UI/UX prototype, not on developing the Decision Support System or its decision-making module.
2. The decision logic (Analytical Hierarchy Process) is assumed to already exist in the parent system and the data on the prototype is a realistic dummy for testing purposes.
3. The evaluation metrics focus on effectiveness, efficiency, and user satisfaction and not the accuracy of the decision made by the system.
4. The design is limited to a desktop-based interface only.
5. The data used is limited to what's provided by the company.

1.5 Outline of Report

The outlines of this final project report are as follows.

CHAPTER I INTRODUCTION

This chapter consists of the background, problem identification, research objective, research scopes, and the outline of the report.

CHAPTER II LITERATURE REVIEW

This chapter consists of theories and concepts related to the topic of the research.

CHAPTER III RESEARCH METHODOLOGY

This chapter consists of the methodology of research conducted for the research.

CHAPTER IV **DATA COLLECTION AND DESIGN PROCESS**

This chapter consists of the design process and user interface testing for the decision support system.

CHAPTER V **ANALYSIS**

This chapter consists of the decision support system user interface design and testing analysis.

CHAPTER VI **CONCLUSION**

This chapter consists of the conclusion of the research and suggestions for future researches and the company.