STRATEGIES TOWARDS THE DEVELOPMENT OF SAFETY CULTURES: AN ESKOM NUCLEAR NEW BUILD PROJECT SURVEY

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Declaration of authenticity

I declare that the research project, “Strategies Towards The Development Of Safety Cultures: An Eskom Nuclear New Build Project Survey”, is my own work and that each source of information used has been acknowledged by means of a complete reference. This dissertation has not been submitted before for any other research project, degree or examination at any university.

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(Signature of student)

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Summary

Newly recruited employees in the Eskom Nuclear Build department during 2008 had limited knowledge of nuclear safety culture or were lacking in their knowledge of safety culture. Thus, a gap was identified in the Nuclear Build department. It was felt that some of the new recruits needed training in safety culture. The problem is that the newly recruited employees do not comply with safety management systems at Eskom for hazard prevention and control. The leadership do not perform behavioural safety observations regularly. Safety culture is specific to departments in Nuclear Build. This is based from the outcome of which each department produces on safety. There are better incentives for people who comply with safety regulations in departments where safety culture is more effectively implemented. Personnel were often uninformed and ignorant on safety culture due to the fact that they were newly employed in the Nuclear Build environment. Safety related incidences and near misses were often not reported which could be due to lack of understanding and practices of the safety culture in the workplace. There was no visible health and safety structure in place at work.

Leadership commitment is crucial to safety culture because it influences employee involvement. Positive leadership sets the tone for expected behaviour of employee in the workplace. If leaders adhere to the correct safety procedure, employees are inspired to do the same. Leadership commitment impacts employee involvement and thus the enforcement of safety culture.

Other sectors, such as the South African Nuclear Energy Corporation, put safety culture at the forefront of their responsibilities. Eskom, as an organisation, has lifesaving rules which aim to prevent all work-related injuries. Some of Eskom Nuclear’s new recruits raised some reservations on the level of commitment of Eskom management on safety culture. It should be borne in mind that organisations are becoming aware of the importance of safety culture in the workplace. Nuclear energy comes with many safety concerns for employees, the public, and the environment at large. Eskom is obliged to have a safety culture that protects employees, contractors, the general public, and the environment against the hazards of nuclear radiation. This study seeks to assess the safety culture within the nuclear setting at Eskom and hence develop strategies that will help in ensuring minimal or zero occurrence of accidents. A quantitative research approach was used and was considered to be more appropriate to assess the safety culture at Eskom. The study target population was made up of Eskom senior managers, middle managers, junior managers, stakeholders, and operational staff within Regulation and Licensing, Project Management, Quality Management and Documentation, Koeberg Client Office, Johannesburg Client Office, Nuclear Engineering, Transmission and Sustainability, and Nuclear Fuel departments. The Nuclear Engineering and Transmission and Sustainability departments at Eskom have expressed similar views

on the level of compliance with safety policies during their operations and planning. However, Nuclear Engineering and Transmission and Sustainability departments do not have similar views on safety management systems in place at Eskom for hazard prevention and control. There is a potential for generalisation of the above-mentioned findings, as the views of the respondents were based on their perceptions and beliefs. This study will use a safety culture framework concept; however, not all the elements were tested. Only commitment to safety, effectiveness of safety systems, attitudes of employees towards safety, and whether or not the organisation celebrates safety success stories will be evaluated.

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List of abbreviations and acronyms

ANOVA	Analysis of Variance
BSO	Behavioural Safety Observations
HP	Human Performance
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
IRP	Integrated Resource Plan
LTI	Lost-time Injury
NB	Nuclear Build
NCO	Nuclear Client Office
NE	Nuclear Engineering
NNR	National Nuclear Regulator
OHS	Occupational Health and Safety
PAT	Plant Access Training
PWR	Pressurised Water Reactor
SHE	Safety, Health and Environment
SMS	Safety Management Systems
SPSS	Statistical Package for the Social Sciences
VIF	Variance Inflation Factor
WANO	World Association of Nuclear Operators

Chapter 1: Introduction and background

1.1 Introduction

In the past two decades, there has been a substantial increase in demand for electricity, particularly in China and India. Climate change policies that have been enforced are not helping matters, as renewable energy sources may not be adequate to meet the global energy requirements as soon as possible. Consequently, nuclear energy is still one of the viable options to fill the current energy deficit because

- nuclear power reactors are environmentally friendly, as they do not emit the gases that contribute to global warming;
- nuclear power is one of the most economical available alternative sources of electricity generation;
- nuclear plants also do not emit any nitrous oxides or sulphur dioxide, which are major contributors to smoke and acid rain; and
- nuclear stations also require only a relatively small amount of land, in contrast to the large areas required by solar or wind generating systems.

Accidents within the aforementioned establishments tend to be hazardous to the environment and also expensive in monetary terms. In the past five decades, a total of 100 nuclear accidents were recorded globally (Black, 2011). These accidents were estimated to have cost about US$20.5 billion in damages to property, emergency response, environmental remediation, and evacuations (Gould, 2008).

Out of the 100 accidents that were recorded in the past 50 years, the 1986 Chernobyl disasters in Ukraine and the 2011 Fukushima disaster in Japan are rated as the worst in the nuclear business. These two catastrophic accidents left a trail of environmental disasters due to radioactive leakages and have been classified as the worst in terms of costs and resulting deaths (Black, 2011). Although nuclear accidents are not so common, it is their catastrophic nature that merits deployment of a safety culture where employees who work in a nuclear environment need to have personal dedication and accountability for all activities that have a bearing on safety. This study thus seeks to assess the safety culture within the nuclear setting at Eskom and hence develop strategies that will help in ensuring minimal or zero occurrence of accidents.

1.2 Background

Eskom is an electricity utility in South Africa that generates, transmits, and distributes electricity to industrial, mining, commercial, agricultural, and domestic customers, and redistributors. It is mandated to provide high-quality supply of electricity to satisfy the needs of the country.

In recent years, South Africa's steady economic growth has seen a steep increase in the demand for electricity. In fact, South Africa's energy demand is expected to be twice the current levels by 2030 (Brand South Africa, 2012). Years of underinvestment in the country's power infrastructure has meant that the energy demand is rising faster than what Eskom can meet.

Eskom's power system remains tight, and there is always an increased threat of power interruptions. To augment its electricity supply, particularly during peak times, Eskom exports and imports electricity to and from neighbouring countries such as Botswana, Zimbabwe, Lesotho, Democratic Republic of Congo, Mozambique, and Namibia; however, a long-term sustainable solution for the energy deficit is through investing in more electrical energy supply.

Together with Eskom, the South African government's Department of Energy embarked on a programme to bring the electricity supply and distribution system into balance. With an infrastructural price tag of around R340 billion, Eskom is building new coal-fired power stations, which include Medupi in Limpopo, that had been scheduled to make its first contribution to the grid by the end of 2013, and Kusile, which was planned to come on stream in mid-2014.

According to Gross (2012), South Africa is still heavily dependent on coal-fired power stations (Table 1.1) and is the 14th-highest emitter of greenhouse gases. However, the country is a signatory to the Kyoto Protocol, committing it to reduce its emissions of greenhouse gases (Mqadi, 2011). As a result, the South African government is supporting sustainable green energy initiatives on a national scale through a diverse range of clean-energy options as envisaged in the Integrated Resource Plan (IRP) of 2010 (DoE, 2011). In terms of this plan, about 42% of electricity generated must come from renewable resources.

The country has a Nuclear Energy Policy that aims to increase the role of nuclear energy as part of the process of diversifying South Africa's primary energy sources to ensure energy security. The policy also seeks to reduce South Africa's over-reliance on coal. The IRP of 2010, which outlines government's strategy for meeting the increasing energy needs, indicates the government's commitment to the construction of 9 600 MW of nuclear power by 2030 (Gibb, 2011). This demonstrates that nuclear energy is slowly moving towards being the second-largest source of electricity in South Africa after coal. According to the National Development Plan- 2030, climate change is already having an impact on South Africa, with marked temperature and rainfall variations and rising sea levels. This document proposes the implementation of the 2010 IRP (procuring at least 20 000 MW of electricity from renewables) to reduce carbon emissions from the electricity industry from 0.9kg per kilowatt-hour to 0.6kg per kilowatt-hour.

Table 1.1: Current Eskom electricity generation mix (2012)

Type	Number of stations	Number of units	Net Max capacity (MW)	% Energy Produced
Coal-fired	13	79	34 772	83
Coal-fired (return to service)		8	949	2
Hydroelectric	2	6	600	1
Pumped storage	2	6	1 400	3
Nuclear	1	2	1 800	4
Wind	1	3	3	0
Open Cycle Gas Turbine	4	20	2 409	6
Total	**23**	**124**	**41 933**	**100**

Source: Gross (2012)

South Africa produces just over 4% of nuclear energy, with some two units available. The coal electricity energy is 83% of the entire electricity generation mix. Other sources, such as wind and hydroelectric electricity generation, are at a minimum, according to Table 1.1. The open cycle gas turbine uses a gas turbine to generate electricity, plays a role in supplying electrical demand during peak time, and consists of 6% of the generation mix, as shown in Table 1.1. Nuclear energy comes in with a great deal of safety security concerns for employees, inhabitants, and the environment at large. The National Nuclear Regulator (NNR) of South Africa is the authority responsible for exercising regulatory control related to safety over the design, construction, operation, decontamination, and decommissioning of nuclear installations in South Africa. The NNR ensures that Eskom complies with the legal requirements, as defined by the quality and safety management requirements, by using the RD-0034 standard. Eskom is obliged to have a safety culture that protects employees, contractors, the general public, and the environment against the hazards of nuclear radiation.

The purpose of the RD-0034 standard is to document the detailed requirements of the NNR for quality and safety management systems for licensees, applicants of a nuclear licence, as well as for designers and suppliers involved in the design, manufacturing, construction, commissioning, operation, modification, and potential decommissioning for a nuclear installation in South Africa under the National Nuclear Regulator Act 47 of 1999. The document defines the relevant quality and safety management requirements, to ensure that safety is appropriately taken into account in all the activities and decisions by the licensees and suppliers involved in the life cycle of a nuclear installation (NNR, 2008). The principles for implementing a safety culture in the respective organisations are also defined in the RD-0034 document.

The International Atomic Energy Agency (IAEA) defines safety culture as the assembly of characteristics and attitudes in organisations and individuals which establishes that as an overriding priority and nuclear plant safety issues receive the attention warranted by their significance (IAEA, 2002). Safety culture is therefore a reflection of the values and attitudes that are shared throughout all levels of the organisation, which are based on the belief that safety is important, and it is everyone's responsibility. Although the initiatives to bring safety culture awareness at Eskom are underway, it is essential to align these initiatives with worldwide standards, such as the Institute of Nuclear Power Operators (INPO 12-012), IAEA (TEC-DOC 1329), as well as the local NNR requirements.

According to Kritzinger (2015), there is a fundamental difference between conventional and nuclear safety. He emphasised that conventional safety practices that are applicable to manufacturing and construction are aimed at protecting the individual against the technology. Nuclear safety is aimed at protecting the technology, and specifically the nuclear core against human failures in order to ultimately prevent harm to employees, the public, and the environment. Nuclear safety culture has to be entrenched at every level of the supplier company, including all workers and top leaders, and takes priority over other competing goals such as profit and deadlines (Kritzinger, 2015).

1.3 Importance of the study

Although nuclear accidents are not very common, the occurrence of a single nuclear accident is usually catastrophic and, more often than not, leaves a trail of environmental disaster due to radioactive leakages. Nuclear accidents are also one of the worst in terms of costs and resulting deaths. Therefore, in order to generate electricity using nuclear power with minimal risk of accidents, a well-planned and effective nuclear safety culture needs to be deployed in the workplace. Nuclear safety culture has the goal of protecting human lives and the environment by ensuring that nuclear power plants operate at acceptable risk levels. Nuclear safety culture

- helps in preventing injury in the workplace;

- helps foster trust between management and employees at the lower ranks of the organisation;
- helps to implement a dedicated approach to safety, which has a long-term, reducing effect on organisational costs (cost-saving initiative);
- helps to develop the continuous improvement process of the organisation, which can guarantee growth within the establishment; and
- contributes to the safe and secure use of radioactive materials.

1.4 Problem statement

Eskom's Nuclear Build (NB) and Nuclear Engineering (NE) departments recently recruited new employees. Most of these new recruits came from diverse non-nuclear industries, such as in transportation, construction and engineering sectors. A number of these new recruits have raised some doubts about the commitment of Eskom management on nuclear safety culture. This doubt is based on the apparent failure of Eskom to emphasise nuclear safety culture in the workplace during the six months orientation period of the new recruits. As a consequence, approximately half of the newly recruited employees had a limited understanding and practice of nuclear safety culture in the workplace. Due to the fact that newly selected recruits did not have a nuclear safety culture experience, it is important that nuclear safety culture had to be a common denominator. The problem is that the newly recruited employees do not comply with safety management systems at Eskom for hazard prevention and control. The leadership do not perform behavioural safety observations regularly. Safety culture is specific to departments in Nuclear Build. This is based from the outcome of which each department produces on safety. There are better incentives for people who comply with safety regulations in departments where safety culture is more effectively implemented. Personnel were often uninformed and ignorant on safety culture due to the fact that they were newly employed in the Nuclear Build environment. Safety related incidences and near misses were often not reported which could be due to lack of understanding and practices of the safety culture in the workplace. There was no visible health and safety structure in place at work.

Leadership commitment is crucial to safety culture because it influences employee involvement. Positive leadership sets the tone for expected behaviour of employee in the workplace. If leaders adhere to the correct safety procedure, employees are inspired to do the same. Leadership commitment impacts employee involvement and thus the enforcement of safety culture.

1.5 Research question

The main research questions of the study are as follows:

- What is the level of compliance by employees within Eskom's nuclear establishment in order to prevent injuries and have a safe work environment?
- Is leadership committed to a safety culture?
- How safe is the work environment at Eskom within the Nuclear Build?

1.6 Research objectives

The main research aim is to assess leadership's commitment to safety.

The research objectives are as follows:

- To establish employee involvement on safety in the workplace
- To assess safety environment within the work environment
- To determine the influence of leadership's commitment and employee involvement in safety in the workplace
- To identify weak areas and hence develop strategies that will improve safety in the workplace

This study seeks to assess the nuclear safety culture at Eskom and hence develop strategies that will help in ensuring minimal or zero occurrence of accidents. Figure 1.1 is a high-level Eskom Nuclear Division organisation structure where both Nuclear Build and Nuclear Build Engineering are incorporated. The roles and responsibilities of the departments shown in Figure 1.1 are as follows:

- The Nuclear Build Engineering (NE) Business Area is responsible for all engineering aspects of the nuclear new build.
    - The Design Basis department analyses whether the nuclear power plant facilities are designed and built to withstand the most severe accidents such as earthquakes, explosions, fires, and floods. They also do strategic management of Nuclear Installation assets, and provision of an Integrated Life of Plant Plan with regard to plant upgrades and decommissioning. Furthermore, this department develops and maintains plant design and long-term strategies to fulfil design and safety objectives.

- The Safety Analysis department looks at nuclear power plant safety analysis, where probabilistic safety assessment of the nuclear plant is analysed. This includes radiation safety calculations, such as shielding and criticality of the radiation.
- The Design Control department establishes procedures, processes, and practices as part of the overall management system to achieve the design objectives. It also identifies performances and assesses parameters for the plant designs.

- The Nuclear New Build Business Area is responsible for identification, qualification, and securing of suitable sites for Eskom nuclear future installations. This business area is also responsible for building and commissioning of nuclear power stations and provides the required support to the departments mentioned below.
    - The Nuclear Sites department proactively identifies, selects, qualifies, acquires, licences, and rezones and manages sites for nuclear power generation. It also ensures that acquired sites are viable and incorporated into applicable nuclear requirements of the relevant local governmental planning documents (Jacobs, 2014).
    - The Programme Support department facilitates the development, implementation, and maintenance of business processes and systems required for the nuclear build programme.
    - The Project Management department directs, governs, and oversees the safe, cost-effective, and sustainable construction of nuclear power plants.
    - The Regulation and Localisation department facilitates localisation of content in the development of a nuclear industry in South Africa and obtains nuclear licences, environmental authorisations, and other regulatory requirements (Perry, 2013).
    - The Client Office department carries out the client function for the nuclear build programme. It ensures development and management of employer requirements specifications and the operational readiness at the various stages of the build programme. It also ensures operational readiness for various phases of the project.

All the departments within the Nuclear Build and Nuclear Engineering Business Areas adopted safety culture. The safety culture was developed within the business areas to ensure that all staff members understand that nuclear safety is the overriding consideration in all actions and activities during all phases of the life cycle of a nuclear installation.

- The Koeberg Power Station focuses on safe operation and maintenance, including outage execution of the power station, in a sustainable manner to achieve world-class safety and technical performance.
    - The Outage Management develops stable, reliable plans for outage (planned linking and updating) and online work control, including resource planning utilising a single planning tool. It utilises relevant technology aimed at outage reduction, for efficient, effective and safe use on the plant. The outage department also plans and executes agreed outages consistently within the shortest possible time by executing the agreed scope within reliability, quality, safety, and financial interest of Eskom.
    - The Services department's primary focus is to manage and control services from Human Resources, Finance, Stakeholder Management, Communication, Project Management, Commercial, Nuclear Engineering, and Fuel.
    - The Training department's role is to train and develop staff on technical competencies and develop human performance, leadership, management and supervision skills.
    - The Plant Engineering department provides plant engineering to maintain compliance with nuclear safety and production plan requirements within the scope of the design base.

- Transmission and Sustainability department role is to manage and maintain transmission infrastructure and transmit power from the high voltage yard to the customer. They are responsible for transmitting electricity via a transmission network, which supplies electricity at high voltages to a number of key customers and distributors. Transmission also manages the network on the grid. It also fulfils environmental and safety functions for Eskom in general. They are involved in construction of the high voltage yard and transmission lines as well as obtaining the required environmental and regulatory approval for proposed Nuclear Power Plant.

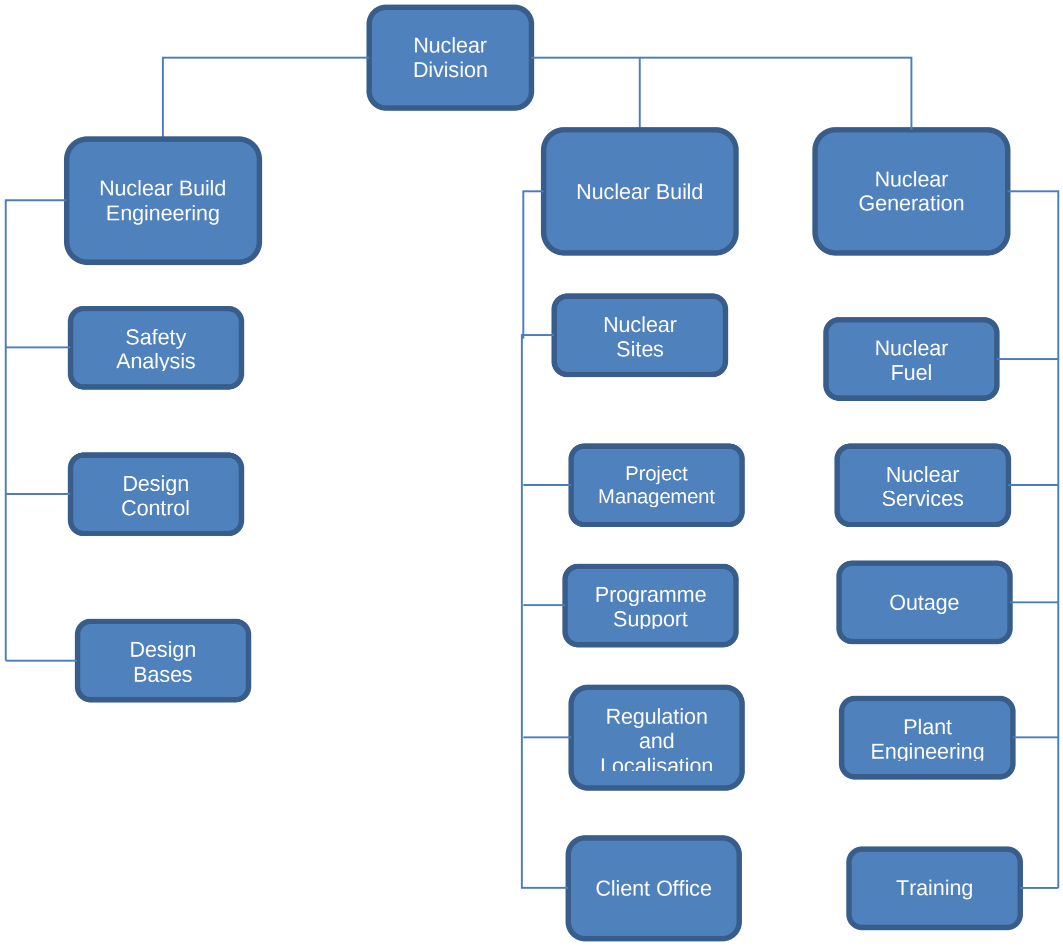

Figure 1.1: Eskom Nuclear Division structure

1.7 Ontology

According to the dictionary.com, ontology is an organizational system designed to categorize and help explain the relationships between various concepts of science in the same area of knowledge and research. It can also be described as a system of beliefs that reflect interpretation on individuals about facts. The ontology in the safety culture context from the researcher's view is illustrated in figure 1.2.

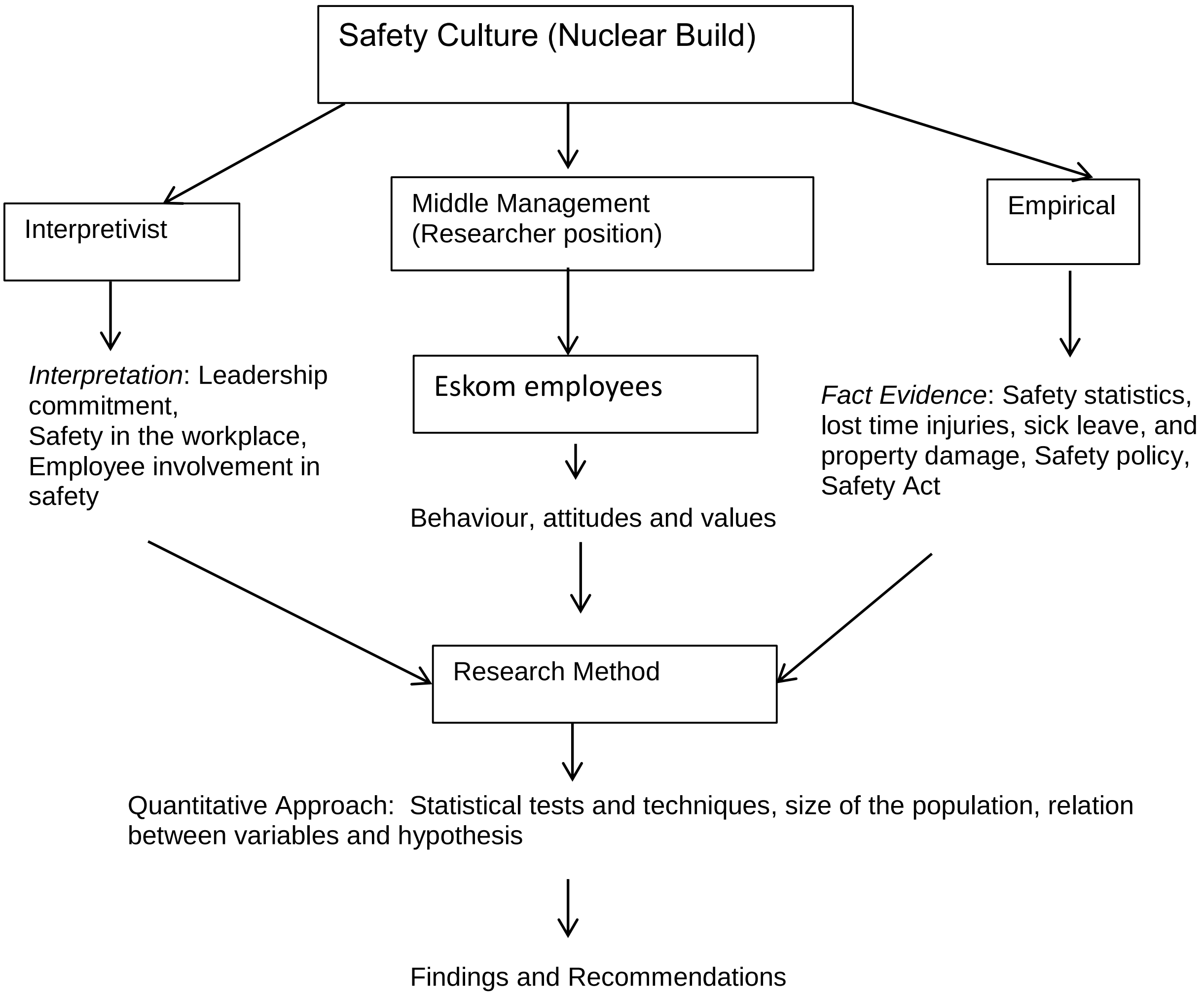

Figure 1.2: Illustration of ontology in the safety culture context

1.8 Hypothesis testing

The following hypotheses are to be tested:

Hypothesis statement 1

H_0: Employees from Nuclear Engineering and Transmission and Sustainability departments have similar views on the safety management systems in place at Eskom for hazard prevention and control.

H_1: Employees from Nuclear Engineering and Transmission and Sustainability departments do not have similar views on the safety management systems in place at Eskom for hazard prevention and control.

Note: Transmission and Sustainability is one department

Hypothesis statement 2

H_0: Employees from Project Management and Nuclear Engineering departments have similar views on the level of compliance with safety policies during their operations.

H_2: Employees from Project Management and Nuclear Engineering departments do not have similar views on the level of compliance with safety policies during their operations.

Hypothesis statement 3

H_0: Leadership's commitment and employee involvement does not significantly affect safety in the workplace

H_3: Leadership's commitment and employee involvement significantly affect safety in the workplace

1.9 Limitations of the study

This study largely attempts to assess the safety culture within a nuclear setting at Eskom and hence develops strategies that will help in ensuring minimal or zero occurrence of accidents. The study will use the safety culture framework designed by Ekenedo (2013). However, not all the elements in this framework will be tested. Only commitment to safety, effectiveness of safety systems, attitudes of employees towards safety, and whether or not the organisation celebrates safety success stories will be evaluated. Information for the study was solicited from Eskom employees in various departments including Nuclear in South Africa.

2.0 Outline of the study

The study is structured as follows:

Chapter 1: Introduction

This chapter outlines the broad objectives and purpose of the study. The statements of the problem and research questions are provided together with limitations of the study.

Chapter 2: Theoretical framework

This chapter reviews the related conceptual framework on the critical factors for an organisation with an effective safety culture.

Chapter 3: Literature review

This chapter provides a critical analysis of the literature review and will focus mostly on the safety culture definition and the theory on development of the safety culture.

Chapter 4: Research methodology

This chapter provides information on the research methodology that the researcher used. Issues that are covered here include the research design, population and sampling, data collection techniques, data analysis method, and ethical considerations.

Chapter 5: Research results

This chapter presents the results of the research.

Chapter 6: Discussion, recommendations, and conclusion

The outcome of the study is discussed, with cross-references to other relevant studies as covered in the literature review and the underlying conceptual framework in this chapter. The chapter also includes recommendations flowing from the study and is concluded by explaining whether the objectives of the study are met.

Chapter 2: Theoretical framework

2.1 Introduction

A good safety culture in the workplace has many benefits. Some of these benefits include a reduction in lost employee hours, reduction in sick leave, reduced operational costs, reduced pollution costs, reduction in property damage, and reduced insurance premiums. Developing a good safety culture in the workplace ensures that lives are preserved, assets are secured, and the business grows.

Organisations that are committed to the safety of their workers, assets, and products put in place effective Safety Management Systems (SMS) and comply with the South African Occupational Health and Safety Act 85 of 1993. However, these systems alone may not be enough to achieve the desired level of safety in the workplace (Golda, 2013). It has been proven that what really matters is the value that is placed on safety by both the employer and the employees (Ekenedo, 2010). SMS and their associated policies and procedures depend on the actions of the individuals for their successful implementation.

A good safety culture can be the most cost-effective and good accident prevention process (Honeywell, 2013). It is the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to and the proficiency of an organisation’s health and safety programmes (Humphries, 2012).

The previous chapter provided an introduction and background to the study. This chapter attempts to develop a safety culture framework that can be used as a guide or baseline which seeks to assess the safety culture within a nuclear setting at Eskom and hence develop strategies that will help in ensuring minimal or zero occurrence of accidents.

2.2 Framework for developing and sustaining sound safety culture in the workplace

A number of theories have been put forward which can provide basic principles for building a safety culture. However, a conceptual model that will be used to assess the safety culture at Eskom’s nuclear setting is based on the framework of sustained safety culture in the workplace of Ekenedo (2013) (Figure 2.1). This ideal model underscores the role of human factor in accident causation and effective functioning of the SMS. This human factor, which includes the attitudes, values, norms and beliefs, considers that employers and employees have shared responsibilities when it comes to risk and safety (which constitute safety culture). The model of Ekenedo (2013) in Figure 2.1 was chosen because it has a systematic flow and is comprehensive in its coverage, as it touches all the necessary facets across an organisation that has an influence on safety culture. This conceptual model will specifically enable addressing of the following:

- To assess the commitment of the organisation to reinforce safety values in the workplace
- To establish whether there is an effective system of workplace analysis and hazard prevention and control
- To determine whether the organisation celebrates safety success stories
- To assess the attitudes of employees towards safety
- To identify weak areas and hence develop strategies that will improve safety in the workplace

The identification of the conceptual model and theoretical proposition for the study enables the selection of an appropriate research design and methodology for the investigation, which is presented in Chapter 4.

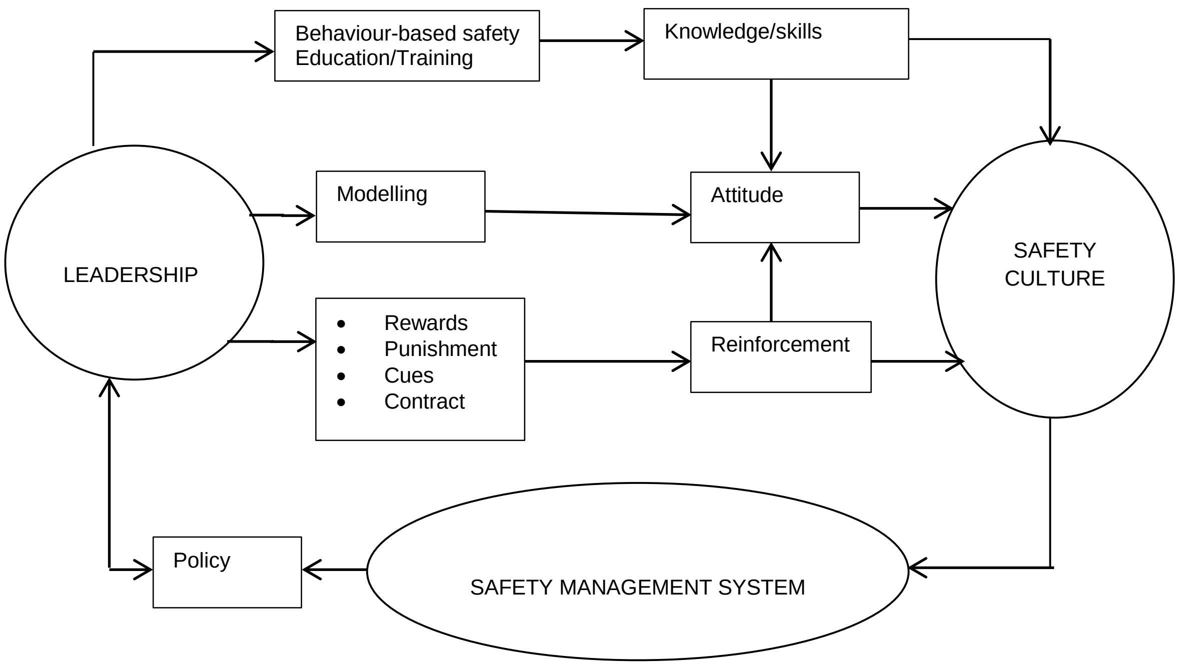

Figure 2.1: A framework of sustained safety culture in the workplace

Source: Ekenedo (2013)

2.3 Elements of safety culture

2.3.1 Leadership and employee commitment to safety

According to Ekenedo (2013), the leadership of an organisation is the main driver of safety culture by enabling, modelling, inspiring, and reinforcing good safety practices in the workplace. These need to meet with the policies that are derived from the safety management system. The roles of the leadership in an organisation include providing education and training that improve knowledge and skills necessary for safety practices. Adequate knowledge and skills are basic requirements for behavioural and attitudinal change. Leadership also models good safety practices and ensures that work safety is practised by providing the needed rewards and punishment that reinforce positive safety practices.

An organisation’s commitment to safety can be reflected by safety values, safety fundamentals, and doing more than just compliance (Humphries, 2012). Good safety attitude should transcend from top management right through to the lowest and newest member of staff. Supervisors and safety trainers should be committed to reinforcing the safety values developed by top management of the organisation.

2.3.2 Workplace analysis and hazard prevention and control

Management systems, safety systems, and individual attitudes and perceptions on safety must be measured and analysed in order to get to understand the current status of the organisation. This should be able to reveal weaknesses that prevent people from performing at their best. This is often referred to as climate survey. Climate surveys should be conducted periodically in organisations that strive for a good safety culture to measure successes.

2.3.3 The organisation celebrates success

According to Ekenedo (2013), recognition, rewards, incentives, reinforcement, and feedback to employees are important elements in safety. A good safety culture makes it worthwhile for everyone to maintain a state of mindfulness by celebrating success. The initiative also includes improving the safety leadership skills of staff, simplifying the company’s requirements, and rewarding successful performance.

2.3.4 Attitudes of employees towards safety

One of the ways to reduce workplace injury and accidents is to train workers in safety in order to acquire the basic knowledge and skills that will enable them to recognise and avoid dangers in the workplace. However, at times employees do not always behave accordingly. Attitudes on safety have a major impact, and those attitudes not only vary individually but are also affected by the workplace safety climate. According to Golda (2013), it has been proven that attitudes cultivated by management influence individual behaviour.

To be successful in having a safe working environment, leaders need to understand factors that influence human behaviour. Like any other skill, safety techniques are most effective when workers receive feedback about their performance. Fostering an attitude of individual responsibility promotes alertness and sensitises workers to safety. Moreover, feedback can help sustain changes by providing reminders and monitoring new behaviours.

2.3.5 Training and safety information

All employees of an organisation need to be thoroughly trained on safety aspects. Training should be behaviour-based. Behaviour-based safety education and training enable efficient organisational learning and adoption of best practices (Honeywell, 2013). According to Ekenedo (2013), employees who are trained are more likely to be mindful of safety issues in the workplace and are more aware of the hazards associated with their work environment. To ensure that employees think "safety" every time in the workplace, safety awareness campaigns, workshops, and meetings can be helpful. To guarantee good safety practices in the workplace, discussions and information distribution on safety should be embedded into the work processes.

2.3.6 The environment in which people work is blame-free

Trust is an essential part of a good safety culture and often the most difficult hurdle to overcome in establishing a safety culture. Everyone in the organisation is encouraged to realise that incidents are worth reporting, and they are comfortable in correcting unsafe practices across, down, and up the hierarchy. In an ideal blame-free environment, employees would be able to report errors or near misses without fear of reprimand or punishment. When this is achieved, management is accurately informed of the correct status; hence, management can come up with proper strategies that are effective and corrective.

2.4 Conclusion

Organisations need to adopt effective models that will guarantee a good safety culture in the workplace. To facilitate this, systematic, well-planned and comprehensive safety culture models are desirable (Ekenedo, 2013). The generic framework of sustained safety culture in the workplace is one such model that can be adopted as a guide to the study. The next chapter will be a review of literature relevant to this study.

Chapter 3: Literature review

3.1 Introduction

The preceding chapter dealt with the theoretical framework which formed the basis for developing and sustaining a sound safety culture in the workplace. Chapter 2 also looked at various theories on general safety culture in the workplace. This chapter provides a critical analysis of the literature review and will focus mostly on the safety culture definition. Theory on development of the safety culture (Hudson 2001) International Atomic Energy Agency [IAEA], 2002) and the procedures and practices for the development of safety culture which are used in the workplace will be discussed in detail. Furthermore, safety culture indicators and symptoms that cause safety culture to be weaker will be explored. The quality management system, as well as the interrelation of both quality management and safety systems, will also be covered.

It is crucial for organisations to develop and operationalize a safety culture in the workplace. This can assist in minimising accidents and can improve the working environment and the performance of the organisation at large. Additionally, a well-implemented safety culture can score positives in general communication effectiveness, employee motivation, and role clarity.

3.2 Safety culture defined

Safety culture has been defined previously by various authors. According to Chib and Kanetkar (2014), safety culture is a reflection of attitudes, beliefs, and perceptions that employees share in relation to safety. In support of the definition of Chib and Kanetkar (2014), Tilwick and Steynberg (2012) defined safety culture as the commitment shown by organisations and individuals through attitudes, behaviours, and competencies towards safety within an effective safety management system. The above definitions on safety were well supported by Ek, Runefors and Borell (2013), who defined safety culture as reflecting individual, group and organisational attitudes, values, and behaviours concerning safety. However, Watts (2012) defined safety culture as a shared system that prioritises safety in all decisions and actions and seeks to minimise the potential for harm to individuals, the public, and the environment. The definition of Oedewald (2012) of safety culture was more comprehensive in comparison to most definitions from other authors. His definition is characterised by the organisation’s willingness and ability to understand the nature of safety and the risk related to its core task as well as its willingness and ability to manage activities so that safety is constantly taken into account. On a different perspective offered by Brooks (2012) with regard to safety specific to the nuclear environment, he defined nuclear safety culture as the collective understanding of the uniqueness of nuclear power by leaders and individuals, and their values, beliefs, and behaviours that demonstrate daily their commitment to emphasise safety first in all things in order to ensure the protection of people and the environment.

Based on the definition of safety culture from the aforementioned authors, it can be observed that Tilwick and Steynberg (2012) and Ek et al. (2013) raised almost similar key issues, which are organisation, individuals, attitudes, and behaviours. In addition to these key issues, the definition of Brooks (2012) covered beliefs and environmental aspects. However, Watts (2012) raised issues on the system and the environment in the definition but was silent on attitudes, beliefs, and values in her definition of the safety culture.

Another definition covered many aspects that safety should be involved with (ECAST, 2011). In this case, safety culture was defined as the set of enduring values and attitudes regarding safety issues shared by every member of every level of an organisation. Thus, safety culture is defined as the extent to which every individual and every group of the organisation is aware of the risks and unknown hazards induced by its activities and continuously behaving so as to preserve and enhance safety as well as being willing and able to adapt itself when facing safety issues and being willing to communicate safety issues and consistently evaluating safety-related behaviour (ECAST, 2011).

3.3 Development of safety culture

Safety culture can be described through five levels. These levels start from a culture where safety hardly is prioritised to a culture where safety is given high priority (Bergerson, 2003). According to Hudson and Van der Graaf (2002), the development of the safety culture level is illustrated as follows:

- Pathological – “Who cares as long as we are not caught?”
- Reactive – “Safety is important; we do a lot every time we have an accident.”
- Calculative – “We have systems in place to manage safety, but just to satisfy rules, regulations and authority.”
- Proactive – “We work on the problems we still find.”
- Generative – “Safety is always in focus when doing business. Continuous safety improvement is of high importance.”

The development of the safety culture goes through three stages until the ultimate is reached (IAEA, 2002). The three stages are as follows:

- Stage 1: Safety based only on rules and regulations
- Stage 2: Good safety performance becomes an organisational goal

- Stage 3: Safety performance can always be improved

The IAEA development method of safety culture was chosen in this study, as it integrates all the levels which are mentioned in detail by the Hudson and Van der Graaf model.

3.3.1 Stage 1: Safety based only on rules and regulations

The organisation at this stage handles safety-related challenges when they arise. The organisation views safety issues as an external requirement due to the inefficiency with its structures to address safety matters effectively within the designated timelines (IAEA, 2002). The typical examples which the organisation finds itself in include addressing similar safety-related injuries or illness in the workplace and similar unsafe working conditions being raised by workers. Some characteristics of an organisation in stage 1 are as follows (IAEA, 2002):

- Problems are not anticipated, and the organisation reacts to each one as it occurs.
- Communications between departments and functions is poor.
- Collaborations and shared decision-making are limited.
- People who make mistakes are blamed for their failure to comply with the rules.
- The role of management is seen as enforcing the rules.
- There is not much listening or learning inside or outside the organisation which generally adopts a defensive position when criticised.
- People are viewed as components of the system.
- There is an adversarial relationship between managers and other employees.
- People are rewarded for obedience and results regardless of long-term consequences.
- The organisation manages issues as they arise and put out fires.

3.3.2 Stage 2: Good safety performance becomes organisational goal regulations

This stage focuses on the organisation’s capability to manage safety compliance and all legal regulations. The organisation addresses mainly the safety conditions in the workplace as well as the training of its staff on safety matters. It ensures that medical surveillance safety procedures and practices are made to comply with the regulations' standards. The organisation at this stage employs safety personnel with the knowledge of address safety and health compliance (IAEA, 2002).

In stage 2, the organisation is aware of behavioural issues. Safety targets are set by the organisation at this stage to meet its goals and accountability for achieving the goals are specified. Some characteristics of an organisation in stage 2 are as follows (IAEA, 2002):

- There is growing awareness of the impact of cultural issues in the workplace although it is not understood why added controls and training have not yielded the expected safety improvements.
- Management encourages interdepartmental and interfunctional communications.
- Management response to mistakes is to introduce more controls and procedures and to provide retraining.
- The role of management is to make sure that goals are achieved and that work objectives are clear to employees.
- The organisation is willing to learn from external groups, especially new techniques and best practices
- The relationship between employees and management is adversarial although there may be more opportunities to discuss common goals.
- People are rewarded for exceeding goals regardless of long-term consequences.
- The interaction of people and technology is considered, but more from the viewpoint of increasing the efficiency of the technology.
- There is more teamwork.
- The organisation remains reactive in relation to problems although there may be more anticipation of potential problems in planning.

3.3.3 Stage 3: Safety performance can always be improved

The organisation that has reached this stage has safety management systems in place where risks and hazards are addressed properly (IAEA, 2002). The organisation in this stage understands the safety culture and how it affects its people and the challenges associated with it. The organisation that performs at this stage addresses all the risk and hazards before they affect staff. Some of the characteristics of an organisation that is in stage 3 are as follows (IAEA, 2002):

- Problems are anticipated and dealt with before they occur.
- Collaborations between departments and functions are good.
- There is no goal conflict between safety and production.
- Almost all mistakes are viewed in terms of process variability with emphasis placed on understanding what has happened rather than finding someone to blame.
- Management's role is seen as coaching people to improve performance.
- Learning from others, both inside and outside the organisation is valued.
- People are respected and valued for their contribution.
- The relationship between management and employees is mutually supportive.
- People are aware of the impact of cultural issues, and these are considered in decision-making.
- People are rewarded for improving processes, as well as results.
- People are considered to be an important part of organisational systems, with attention given to satisfying their needs and not just to achieve technical efficiency.

The progress of an organisation to move from these stages is dependent entirely on the commitment of its employees and management. Change in an organisation's safety culture is not easy and it takes time and effort (IAEA, 2002).

3.4 Safety culture practices

Safety culture practices help organisations to develop their safety culture in the workplace. Safe working procedures, practices for management, employee involvement to improving safety performance, and stakeholder involvement are amongst the safety culture practices which are required in ensuring a high standard of safety in the workplace. The introduction of safety culture practices into an organisation provides a tangible intention to improve safety (IAEA, 2002).

3.4.1 Safe working procedures

Safe working procedures are done to indicate the step required to execute the task safely in order to avoid injuries or harm to the environment. Wachter and Yorio (2014) indicate that safe working procedures provide important and consistent information to workers on what is expected of them from a safety perspective. Routine and complicated activities in the workplace can be performed effortlessly by following safe working procedures.

3.4.2 Practices for management

Management involvement is crucial in ensuring that high standards of safety are followed (IAEA, 2002). Management is judged by its subordinates in an organisation based on its behaviour and actions. Those in management must support the development of safety culture by doing the following (IAEA, 2002):

- Placing emphasis on safety issues just as they place it on core management issues such as production, sales, and quality control
- Encouraging a questioning attitude on safety
- Encouraging all employees to identify safety hazards and correct them
- Regularly reviewing safety to ensure its adequacy for the current and future circumstances
- Ensuring that the employees have full and open access to all of the tools and equipment they need to perform their work safely
- Being supportive and providing time and resources to develop a safety culture
- Gaining an understanding of the safety culture concept
- Committing and realising that safety is a long-term effort and safety excellence is never an ending journey

3.4.3 Employee involvement in improving safety performance

Employees need to contribute more and be involved in improving safety in the workplace. Companies must promote a sense of shared responsibility for safety in order to improve safety performance. French and Scott Geller (2008) bring out that when people feel as though they have the influence or are important, they are more likely to put the discretionary effort needed for success. According to French and Scott Geller (2008), employees contribute to a culture of safety excellence by being actively engaged in a safety improvement process. This can only work if the culture allows them to feel positive about themselves, their co-workers, and their organisation. Employees need to be encouraged to be actively involved in safety and should be allowed to participate in safety improvement teams. Employees' participation can be used to help identify and solve safety issues in the workplace.

3.4.4 Other stakeholders' involvement

Organisations should ensure that the public and surrounding communities are informed and updated about safety regulations. The organisation should also create a platform where day-to-day community concerns around safety projects are raised and addressed. It should also ensure that the community and other stakeholders understand various legal obligations imposed on the project.

Contractors and the general public are the most crucial part in an organisation and should be involved in the safety performance of the organisation. They play a major role in improving safety in the organisation. The contractor has to comply with all legal and safety regulations (IAEA, 2002). The contractors need to have the necessary competency to carry out their role safely. The contractor could have a different safety culture than the organisation that employs them. The organisation should always involve other role players and create a platform to communicate safety issues with them. Some organisations use newsletters to communicate with stakeholders on issues pertaining to safety (IAEA, 2002).

3.4.5 Communication of safety issues to the public

It is important to maintain public confidence in safety during the construction of projects. Various legal regulations are used to communicate potential risk, health and safety in the workplace. Public safety forums are established to disseminate relevant information during construction (IAEA, 2002). Information on safety performance of external groups can assist in developing mutual respect between members of an organisation or external groups (IAEA, 2002). However, the information must be communicated in a way that minimises the possibility of misinterpretation. The organisation's safety, health and environmental (SHE) plan can be used by a contractor for compliance with the SHE specification during the construction of a project.

3.4.6 Safety assessment processes

Self-assessment entails self-evaluation and self-inspection. This assessment is conducted in organisations that are committed to achieving high safety standards by maintaining and developing safety management (IAEA, 2002). It is important for employees of an organisation to do a self-safety assessment. Also, external audits are performed by an independent external consultant or a staff member from a different department within the organisation to assess their colleagues. The purpose of the self-assessment is to promote improved safety performance through the direct involvement of people in the critical examination and improvement of safety in the workplace (IAEA, 2002).

3.4.7 *Training in promoting safety culture*

Good safety training can reduce the number of injuries, deaths, and property damages in the workplace. Proper safety procedures should be developed by employees by following safety training interventions to enhance a safety culture. New employees must be trained so that they can embrace the importance of the safety culture in the workplace. Training may not necessarily alter attitudes, values, or behaviour of employees in the workplace but may increase knowledge and skills (IAEA, 2002). Training equips employees with knowledge and skills necessary to make sound decisions. For instance, the employees have to be trained to identify hazards and report them. Supervisors also require training so that they know how to conduct accident investigations properly and also to use the root cause analysis.

3.5 Safety culture indicators

Safety indicators are used to measure the performance of an organisation on safety-related aspects. The safety indicators can also be used by employees and stakeholders to motivate them to work on safety and increase the organisational safety potential (IAEA, 2002). Furthermore, safety performance indicators are executed by the organisation to gain information on its current safety level and on the efficacy of its safety improvement efforts (Reiman & Pietikäinen, 2010). Indicators can also be seen as a way of communicating safety issues to the public.

The organisation's Occupational Health and Safety (OHS) performance is traditionally measured by expressing accidents and illness or disease statistics. It should also be noted that a low accident or ill health rate does not guarantee that risks are controlled and will not result in accidents (Reiman & Pietikäinen, 2010). Safety performance indicators are a tool that could be used as input values in the safety management system. The indicators are used for the following reasons (Jovašević Stojanović & Stojanović, 2009):

- To supply information on safety problems in order to enable policymakers to value their seriousness
- To support policy development and priority setting by identifying key factors that cause risk
- To develop action plans and means for implementation
- To monitor the effects of policy responses

According to Reiman and Pietikäinen (2010), current safety performance indicators are usually lagging. To be able to monitor the effects of proactive safety work, as well as anticipate the vulnerabilities, organisations should define leading indicators. Safety performance indicators are used to motivate a certain kind of behaviour from employees and management. Some of the potential advantages and disadvantages of using the indicators to measure safety culture are described as follows (IAEA, 2002:

Advantages

- The use of indicators allows trends to be detected.
- Managers pay greater attention to what is being measured. The use of safety culture indicators will increase their interest in the concept.
- Safety culture is an important aspect of organisational life; hence, it should be treated like other important aspects and measured.

Disadvantages

- Safety culture is complex and obviously satisfactory measures exist.
- Some elements of safety culture such as basic assumptions may be unconsciously held and present great difficulties for measurement.
- Managers may feel that they have little influence over trends in safety culture indicators when they have limited understanding of the concept of safety culture and the period of time needed to effect a change in safety culture.

The use of safety indicators should not just be a paper exercise but should also be utilised to monitor the safety behaviour of employees in the workplace. These behaviours must be studied and continuously monitored to address the behavioural safety of employees in the workplace. Proper channels of engagement with employees must be set out to address the behaviour between employees and management in the organisation.

3.5.1 Types of performance indicators

There are two types of performance indicators which are used (IAEA, 2002). One relates to the results, while the other is associated with activities and compliance with processes and procedures. These indicators can be used to assist the organisation in decision-making. These indicators are discussed next.

Type 1: Results-orientated indicators identify measurable results, including individual and organisational contributions. The key performance indicators are often expressed in terms of percentages, rates, or absolute values. Typical examples could be as follows:

- Injuries and work-related health in terms of lost-time injuries (LTIs)

- Production days lost through sickness absence
- Incidents or near misses (including those with the potential to cause injury, ill health, or loss)
- Number of working days since the last accident

Type 2: Implementation-orientated indicators measure the fidelity of actions and compliance in the application of methods, resources, and approaches to tasks. Typical examples could include the following:

- The percentage of workers with SHE training
- Number of behavioural safety observations performed
- Number of management visits to the shop floor
- Number of SHE audits performed

3.5.2 Measurability

The safety performance measurements form part of the Occupational Health and Safety (OHSAS:18001) Management System. The OHSAS 18001 is an internationally recognised standard for occupational health and safety management system. It helps the organisation to improve legal compliance and have a sound OHS system that will enable organisations to control OHS risks and create awareness in the organisation. To achieve an effective health and safety management system, it is important to have a proper risk profile which will provide a solid foundation for a health and safety management system. The primary purpose of the safety performance measurement is to provide information on the progress and current status of the strategies, processes, and activities used by an organisation to control risks to the OHS management system (Arezes & Miguel, 2003). Safety Performance Management should seek to answer questions such as what is the position relative to OHS's aims and objectives? How is the company in comparison with others? Is the management of the OHS efficient? Is the company culture supportive of OHS, particularly pressed by competing demands? (Arezes & Miguel, 2003).

The primary focus of performing safety performance management is to demonstrate to the organisation and stakeholders such as regulators, insurance companies, shareholders, and contractors that instruments to control risks are in place and used effectively. Arezes and Miguel (2003) indicate that OHSAS 18002:2002 proposed various safety performance monitoring measures that use methods such as

- results from risk identification, assessment, and control;

- systematic inspection using checklist and workplaces;
- previous analysis of new installations, equipment, and materials;
- inspection in order to verify if all machines and safety systems are operational;
- assessment of occupational exposure to physical, chemical and biological agents and comparison with established threshold or recommended values;
- evaluation of workers' behaviours in order to identify unsafe work practices which could be corrected;
- document and record analysis;
- benchmarking of OHS practices; and
- identification of workers' attitudes towards implementation of the OHS management system.

A typical performance measurement system within the OHS system that summarises typical safety performance workflow is illustrated in Figure 3.1. According to the Towlson model in Figure 3.1, policy development constitutes the general objectives and intentions of the organisation. This is demonstrated by a written statement of intent. To successfully implement the policy, motivation, commitment, and involvement of people are required. Planning involves setting objectives, identifying hazards, assessing risks, implementing standards of performance, and developing a positive safety culture. Implementing is concerned with actions required to deal with specific types of hazards. Measuring performance provides information on whether targets have been achieved or compliance with the law. Auditing focuses on the total health and safety management system and analysing its efficiency, effectiveness, and reliability.

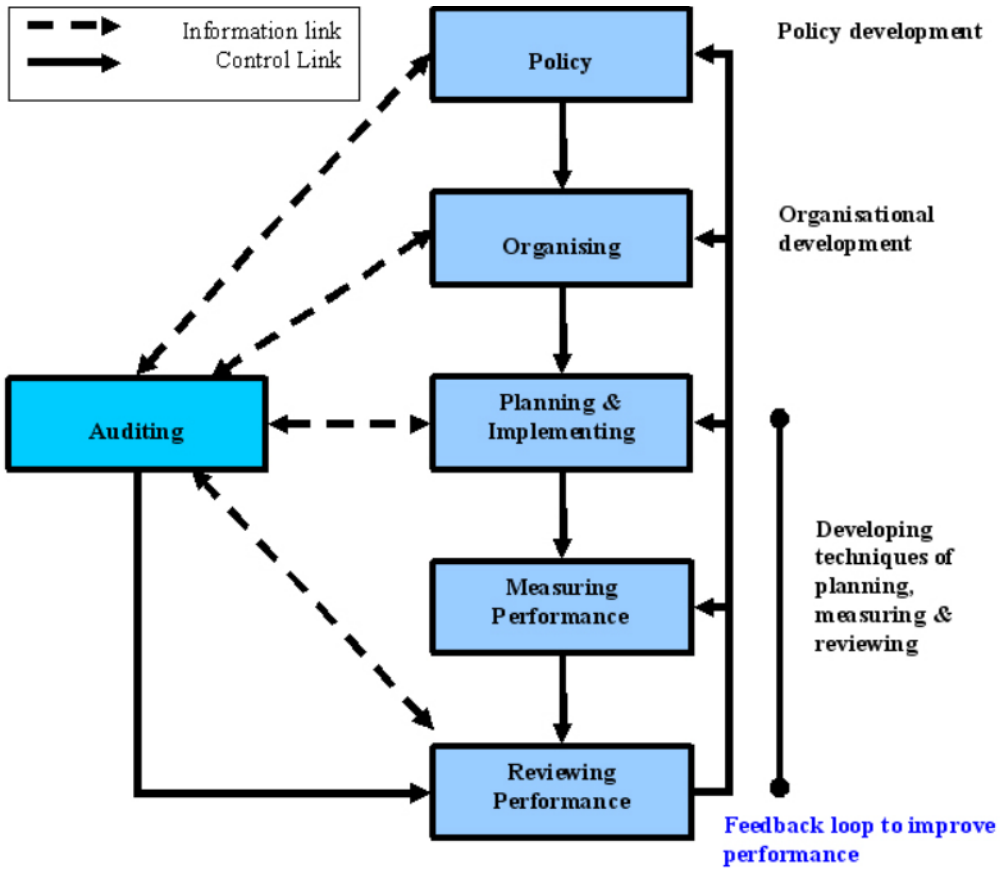

Figure 3.1: Typical performance measurements within the OHS management system

Source: Towlson (2016)

3.5.3 Consequence of measuring

It is not easy to measure commitment to safety and relationship with the regulator; as a result, organisations often use the number of accidents or number of safety-related training courses done (IAEA, 2002). The consequences of not being able to measure commitment to safety or relationship with the regulator mean that measures of number of accidents or number of training courses have to be used. These measures become important indicators in the organisation for measuring safety (IAEA, 2002).

A low injury rate, even over a long period of time, does not guarantee that risks are being controlled, more specifically in organisations where there is a low probability of accidents but where major hazards are present (Health and Safety Executive [HSE], 2001). Organisations need to recognise that there is no single reliable measure of health and safety performance. What is required is a basket of measures or balance scores providing information on a range of health and safety activities. Some of the problems associated with measuring health and safety in the workplace are as follows (HSE, 2001):

- People can stay off work for reasons which do not relate to the severity of the event.
- Under-reporting – putting emphasis on injury and ill heath rates as a measure – particularly when related to a reward system, can lead to such events not being reported.
- Injury rates often do not reflect the severity of an event, but merely the consequence.
- A low injury rate can lead to complacency in the workplace.
- There is evidence to show there is not necessarily a relationship between occupational injury statistics (e.g. slips, trips, and falls) and control of major hazards such as loss of containment of flammable or toxic material.
- Injury statistics reflect outcomes, not cause.

The introduction of safety culture indicators will help because it forces managers to reflect on safety culture far more than they normally would (IAEA, 2002). Another important consequence of introducing measures is not only to bring under greater control what exists by influencing managers' and employees' behaviour but also to expand their awareness of the area being measured. The effectiveness of the safety management system will be undermined if the safety measurements are not correctly carried out in the workplace. Management will not rely on information obtained from such measurements of how well safety and health are controlled in the organisation (IAEA, 2002).

3.6 Symptoms of the weakening safety culture

The weakness in an organisation's safety culture can create an unstable safety state which can make an organisation vulnerable to safety incidents. By being alert to early warning signs, corrective action can be taken in time, to avoid adverse safety consequences (IAEA, 2002).

A model with five stages of decline to safety culture was developed (IAEA, 2002). The stages of this model are separated by the degree of severity and consequence. The stages of this model can be summarised in Table 3.1.

Table 3.1: Five stages of decline to organisational safety culture

Stage	Name of stage	Characteristics of stage
1	Overconfidence	Good past performance leading to self-satisfaction.
2	Complacency	Occurrence of minor events that are subjected to minimum self-assessment and delay in improvement programmes.
3	Denial	Number of minor events increases, with possibly a more significant event. These are treated as isolated events. Findings from audits are considered invalid. Root cause analysis not used.
4	Danger	Several serious potential events occur, but management and employees reject criticism from audits or regulator, by considering their views as biased. The oversight function is afraid to confront management.
5	Collapse	Regulator intervenes to implement special evaluations. Management is overwhelmed and may need to be replaced. Major and very costly improvements need to be implemented.

Source: IAEA (2002)

The organisation should conduct critical self-assessment to measure the decline in safety. The organisation should also establish action plans to address the root cause of the challenges that it faces.

Symptoms which the organisation can check to determine whether the safety culture is weakening are as follows (IAEA, 2002):

- *Lack of systematic approach:* Lack of reliable information and weakness of risk assessment process in the organisation. The organisation lacks clear goals and accountability, and there is lack of improvement safety culture plans and allocation of resources.
- *Procedures not properly serviced:* Procedures not regularly reviewed and updated.

- *Incidents not analysed in depth and lessons not learned:* A system in-depth analysis of incidents is required if lessons are to be learned and the root causes identified.
- *Resource mismatch:* This may be shown by an organisation's excessive project slippage; excessive overtime worked by employees; lack of suitable, qualified and experienced people; and increased use of contractors in key organisational roles for long periods of time.
- *Number of violations increasing:* All violations should be thoroughly investigated to establish the root cause.
- *Increase backlog of corrective actions:* The extent of the backlog is a good indicator of managerial effectiveness in planning, resource allocation, prioritising, and monitoring of work. Attention should be given to the number of corrective actions that have exceeded their target date for implementation and the magnitude of the delay.
- *Verification of readiness for operation or maintenance:* The existence of a systematic process for preparing the work is an indication that attention is being paid to this important aspect.
- *Employee safety concerns not dealt with properly:* A system is required where employees are encouraged to raise safety concerns and corrective actions implemented. Employees will become demotivated if they perceive that their safety concerns are ignored.
- *Disproportionate focus on technical issues:* Human factors should be an integral part of risk assessment.
- *Near-miss reporting:* Near-miss reporting system is important, and the organisation should recognise the valuable information that can be obtained from this type of event.
- *Lack of assessment process:* The lack of self-assessment process indicates an organisation's potential weakness in safety culture, as continuous improvement opportunity will be lost.
- *Housekeeping:* Poor standards in housekeeping indicate management disinterest and employees who have little pride in their environment.

3.7 Quality management and safety

An organisation's leadership is important in ensuring that both safety and quality management flourish in the organisation (IAEA, 2002). Safety and quality complement each other. A safety management system consists of those arrangements made by an organisation for the management of safety to promote a strong safety culture and achieve good safety performance. Both safety management and the safety culture are influenced by leadership throughout the organisation (IAEA, 2002).

The Quality Management department in the organisation or in a project environment is primarily responsible for most quality aspects. During construction, Eskom quality management will ensure that quality standards are followed. The management system in a nuclear plant should ensure that safety issues receive, from the start, adequate priority at the project management level (IAEA, 2012). Safety is related to quality. A quality assurance planning documentation should integrate all stages of the management system.

Management should also ensure that professionalism, safety, and quality culture govern every action (IAEA, 2012). Quality assurance requires verification, which entails surveillance, checks, and audits by independent quality assurance professionals.

There are certain features to be considered when doing quality control of the project during construction. Factors that affect quality management include labour involvement, simultaneous activities, long time span, areas, and site conditions (IAEA, 2012). Quality management requires a systematic approach and a good strategic formulation to obtain effective site inspection, as demonstrated in Figure 3.2.

The quality control factors which an organisation should take into consideration during the construction of the proposed nuclear power plant are the long time span that it takes to construct the nuclear power plant. Quality control effort needs to be extended throughout the life span of the project (IAEA, 2012). The construction activities occur over large areas on-site; as such, quality control and assurance are required in every area. It should also be considered that during construction, some of the activities are done simultaneously, and quality matters and control measures could be different for various activities. The construction conditions on-site are normally more difficult to check than the conditions in the laboratory due to inclement weather conditions.

Figure 3.2: Areas that may affect quality control on a construction site

Source: IAEA (2012)

Safety and quality should be prioritised over cost and time in a project or operational environment. A safety and quality culture is required prior to the start of construction amongst all key stakeholders in a project.

3.8 Relationship between leader commitment, employee involvement, and safety

There has been extensive research into the link between employee engagement and safety outcomes. A meta-analysis undertaken by (Harter, Schmidt, Killham &Agrawal, 2009) found that the top 25% of business units (in terms of engagement) have 49% less safety incidents than the bottom 25%. Similarly, the same study found that in health settings, the most engaged organisations have 41% less patient safety incidents (i.e. falls, medical errors, infection rates, and risk-adjusted mortality rates).

Research has also shown that engaged employees are motivated to work safely, and non-engaged employees are more susceptible to "burnout" (Nahrgang, Morgeson & Hofmann, 2011). This decreases employees' focus and motivation to do the right thing. It has been shown that employees who say they almost always enjoy their tasks were two and a half times less likely to report a back injury than those who said they hardly ever enjoyed their tasks.

It is recognised that leadership is important in the creation of a culture that supports and promotes strong health and the safety performance of an organisation. The manager and the team leader are vital in inspiring employees to a higher level of safety and productivity, which means that they must apply good leadership attributes on a daily basis. In a related submission, Fukuda, Imanaka, Hirose and Hayashida (2009) found that management involvement in a number of safety activities was positively associated with good safety performance. This suggests that workers' perceived control and risk may be highly related to workers' involvement or responsibility for safety. Moreover, workers appear to perceive safety as a joint responsibility between workers and management.

3.9 Conclusion

This chapter provided safety culture definitions by various authors. The different stages of safety culture development were highlighted. The safety culture practices in an organisation were explored. The safety culture experts highlighted in this chapter that leaders and individuals in the organisation must demonstrate daily their values, beliefs, and behaviours in the safety culture at the workplace. The leadership and employees must show their commitment to emphasise safety first in all things in order to ensure the protection of people and the environment. The areas of the literature which this research will build on are employee involvement to improving safety performance, assessing safety in the work environment and leadership commitment to safety and practices for management. Furthermore this research will build on the work by (Nahrgang, Morgeson & Hofmann, 2011) on the relationship between leader commitment, employee involvement and safety in the workplace. The research by Nahrgang, Morgeson & Hofmann forms a pillar of this research.

Most of the safety culture assessment done by the researchers listed in chapter 3 of this dissertation focuses on the qualitative approach way of assessing safety culture with an exception of (Harter, Schmidt, Killham &Agrawal, 2009) who uses meta-analysis which is a quantitative approach. This dissertation also uses quantitative approach and is backed by the statistical analysis. The strength of this research is more quantitative.

These areas are amongst the safety culture attributes which are required in ensuring a high standard of safety in the workplace. The participation of employees is expected to help identify and solve issues in the workplace. The next chapter will focus primarily on research methodology concepts used in this study.

Chapter 4: Research methodology

4.1 Introduction

The foregoing chapter was a review of literature pertinent to this study. This chapter presents the research methodology that was applied to ensure that safety culture within Eskom's nuclear establishment is practised and thus prevents injury and to have a safe and secure work environment. Issues that are discussed in the chapter include the research design, population and sampling, data collection techniques, data analysis method, and ethical considerations.

The flow diagram indicating various steps and process which this research used is for survey construction is summarised as shown in figure 4.1.These steps are briefly discussed in this chapter.

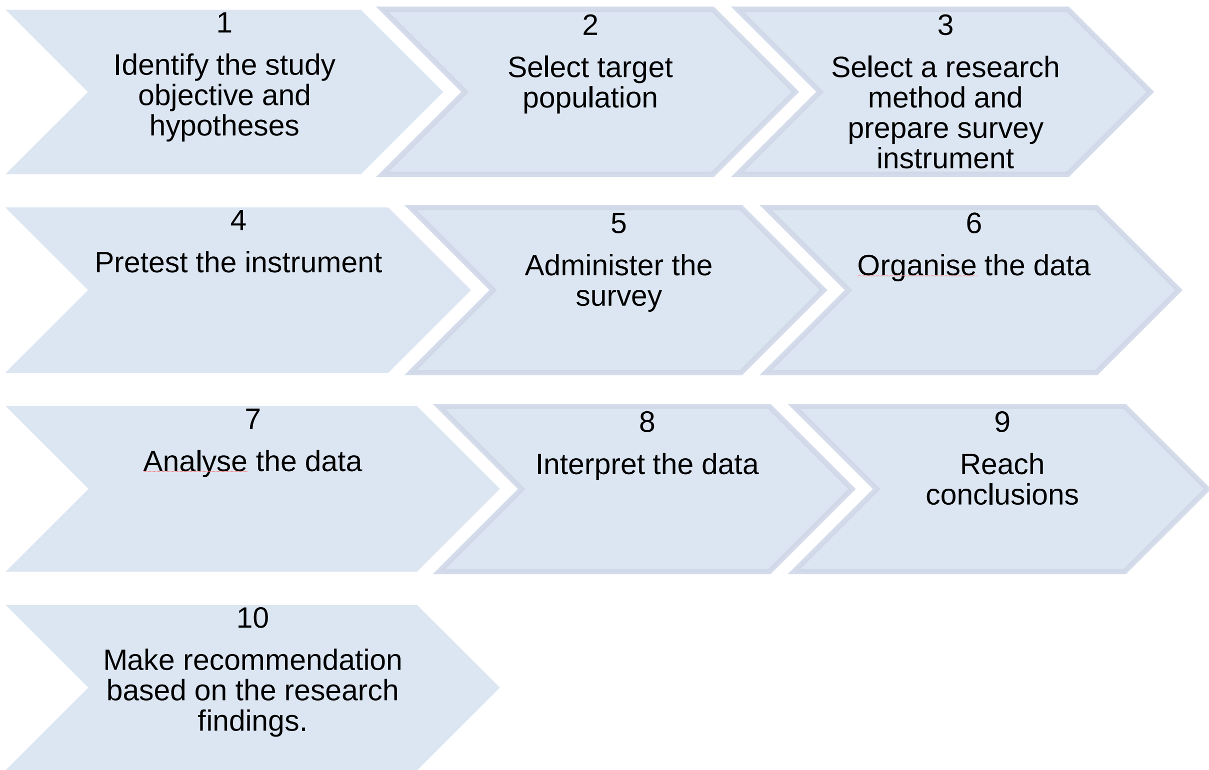

Figure 4.1: Process Flow Diagram for Constructing a Survey

4.2 Research approach

There are two approaches that can be applied in research. These are qualitative and quantitative research approaches. Quantitative research approach utilises a series of statistical tests and techniques, and often yields data that is projectable to a larger population (Creswell, 2003). This research approach is deeply rooted in statistics. However, quantitative research approach requires large population sizes, which are naturally hard to come by and expensive. Quantitative research approach is not flexible and is vulnerable to statistical error if not used appropriately (Davis & Cosenza, 2005).

Qualitative research approach deals with smaller but more focused samples. This research approach is a highly subjective research discipline, designed to look beyond the percentages in order to gain an understanding of a participant's feelings, impressions, and viewpoints (Leedy & Ormrod, 2010). Interview designs are qualitative in nature and take several hours, allowing the moderator to elicit extremely candid, highly complex responses so that the result is rich information unobtainable from quantitative research approach.

A quantitative research approach study was considered to be more appropriate to assess the safety culture at Eskom. The benefits of using this approach are that it allows the researcher to measure and analyse data. The relationship between an independent and dependent variable can be studied in detail with the quantitative research approach. This is advantageous because the researcher is more objective about the findings of the research. Quantitative research can be applied to test hypotheses in experiments because of its ability to measure data using statistics (Leedy & Ormrod, 2010).

According to Salkind (2012), a case study is a method used to study an individual or an institution in a unique setting or situation in as intense and as detailed a manner as possible. Case studies take longer to complete but can yield a great deal of detail and insight. Case studies are complex because they generally involve multiple sources of data, may include multiple cases within a study, and produce large amounts of data for analysis. According to Spring (1997), researchers from many disciplines use the case study method to build upon theory, to produce new theory, to dispute or challenge theory, to explain a situation, to provide a basis to apply solutions to situations, to explore, or to describe an object or phenomenon. The advantages of the case study method are its applicability to real-life, contemporary, human situations and its public accessibility through written reports. This is the reason why the author has chosen a case study approach as a solution to this research.

4.3 Research design

Survey questionnaire design was used to assess the safety culture at Eskom. The questionnaire targeted Eskom employees in senior management, junior management, middle management, and operational staff. The focus was on nine departments, namely, Regulation and Licensing, Project Management, Quality Management and Documentation, Johannesburg Client Office, Nuclear Engineering, Transmission, and Sustainability, Koeberg Client Office and Nuclear Fuel, where there are usually safety concerns. The roles and responsibilities of departments are explained briefly below and in Chapter 1. Furthermore, an overview of the Eskom Nuclear Division structure is demonstrated in Chapter 1.

The Eskom Quality and Documentation Management department is responsible mainly for ensuring that the work carried out by Eskom is in line with the legal requirements as defined by quality and safety management requirements by using the RD-0034 standard, which is the National Nuclear Regulator (NNR) document for quality and safety management requirements for nuclear installations. The Documentation section is responsible for storing; archiving of documents, files, and records; and managing the document management system. The Nuclear Build Business Area was responsible for all the departments listed above with the exception of Transmission, and Sustainability, Nuclear Engineering, and Koeberg Client Office. Koeberg Client Office is located in Cape Town. The Nuclear Build employees at Koeberg are most acquainted with the Nuclear Power Station setup, as they were involved in the development of site safety reports for the Nuclear-1 project.

Nuclear Engineering department is responsible for other activities such as design of the proposed nuclear project. Some of the design activities that it was responsible for include site offices, ground water monitoring, accommodation, terracing, plant installation, sewerage treatment plant, desalination plant, intake and outtake tunnels, water requirements, marine works, major associated infrastructure, and nuclear engineering. This department reported to the Eskom Nuclear Division manager.

Koeberg Power Station is the only nuclear power station in Africa and has a pressurised water reactor (PWR) design. It boasts the largest turbine generators in the southern hemisphere. Koeberg ranks amongst the safest of the world's top ranking PWR's of its vintage and is the most reliable Eskom power station.

A questionnaire was developed for this study. During the development stage of the questionnaire, the researcher ensured that it was structured in such a way that it covered all the relevant issues on safety culture. An effort was also made to ensure that the questionnaire was kept simple and clear. After its design, the questionnaire was piloted to five Eskom employees using convenience non-probability sampling. The pilot study was meant to get a second opinion on the appropriateness of the questionnaire. After incorporating inputs from the pilot study, the questionnaire was distributed to the targeted Eskom employees working in nine different departments where there are usually safety issues.

4.4 Population, sample, and sampling methods

According to Leedy and Ormrod (2010), a population refers to the collection of all elements of interest in a particular research study. It (population) represents a group that the researcher wishes to generalise the research to and is normally defined in terms of demography, geography, occupation, and time. Population objects may include individuals, groups, organisations, human products, and events.

In this study, the population is made up of Eskom senior managers, middle managers, junior managers, and operational staff within Regulation and Licensing, Project Management, Quality Management and Documentation, Koeberg-Client Office, Johannesburg Client, Nuclear Engineering, Transmission and Sustainability and Nuclear Fuel departments. The study population size is estimated at 200.

The size of the population usually makes it impractical and uneconomical to involve all the members of the population in a research project. Therefore, a sample is used to minimise costs associated with data collection and to be able to get results within a reasonable time frame. Using a 95% confidence interval with a margin of error of $\pm$ 5%, a sample with at least 134 Eskom employees is sufficient to represent the study population. The total number of employees the researcher was trying to reach with this survey was 200 (target population size). The desired confidence level of 95% was chosen, which is normally within the common standard of 95% and 99% used by researchers. The 95% confidence level was deemed to be appropriate for this survey. It should be borne in mind that a higher confidence level requires a larger sample size.

A simplified formula developed by Yamane (1967) to calculate the required sample size was used. The 95 % confidence level and margin of error of 0.05 was assumed. The formula is as follows:

$$n = \frac{N}{1+N(e^2)} \qquad \text{……………………equation 1}$$

Where n is the sample size,

N is the population size and e is the level of precision.

When the formula is applied to the above sample,

$$n = \frac{200}{1 + 200(0.05^2)}$$

$$n = 134$$

Stratified random sampling method was used in this study to guarantee that the selected sample fairly represented the target audience (i.e. senior managers, middle managers, junior managers, and operational staff within Regulation and Licensing, Project Management, Quality Management and Documentation, Koeberg-Client Office, Johannesburg Client, Nuclear Engineering, Transmission and Sustainability and Nuclear Fuel departments. Stratified random sampling is an approach that is used to sample from a population that consists of subpopulations that vary considerably (Lewis, 2005). The sampling used for the study ensured that the employees were selected from various targeted populations within the Nuclear Build environment at Eskom. A stratification process group member of a population into relatively homogeneous subgroups (strata) before sampling. Then random or systematic sampling is applied within each stratum. This often improves the representativeness of the sample.

According to Baruch and Brooks (2008), the average response rate for studies that utilized data collected from individuals was 52.7% with a standard deviation of 20.4. The response rate of 67.5% (135/200) for this research is above the average response rate of 52.7%.

4.5 Data collection

Good research designs should cover data collection techniques that are to be applied. Data sources can either be primary or secondary. Primary data is collected by the researcher for the purpose of his or her own study and has the advantage of being appropriate for that particular study (Welman, Kruger& Mitchell, 2005). Secondary data, on the other hand, is information collected by individuals or agencies and institutions other than the researcher him or herself and is ready for use. Secondary data should be used with care because it might sometimes be old, outdated, and irrelevant.

In this study, a survey design in the form of a questionnaire was used to collect primary data on the safety culture at Eskom. The research questionnaires used are attached as Appendix A. Questionnaires were chosen for the following reasons:

- The responses are gathered in a standardised way, so questionnaires are more objective.
- Generally it is relatively quick to collect information using a questionnaire. However, in some situations they can take a long time not only to design but also to apply and analyse.
- Potential information can be collected from a large portion of a group. This potential is not often realised, as returns from questionnaires are usually low. However, return rates can be dramatically improved if the questionnaire is delivered and responded to in time.

During the development phase of the questionnaire, efforts were made to ensure that it adequately covered the objectives of the study. After its design, (and before distributing it to the larger population) the questionnaire was first piloted to five experienced and knowledgeable Eskom employees on safety to check for its relevance, adequacy, and if there are any errors. The questionnaire was distributed to the target audience by means of emails, while some were conveniently hand delivered.

4.6 Data analysis

According to Leedy and Ormrod (2010), data analysis is a process of transforming raw data into usable information that can be used in decision-making. There are a variety of ways in which data analysis can be approached. Thus, it is important to think critically about objectives and conclusions that will be drawn.

Data was inspected for omitted or misplaced values. Credibility of the values was established by checking the minimum and maximum, as well as means and standard deviations. Skewness coefficients of > 2 and kurtosis of > 4 were used as guidelines to exclude unsatisfactory items from further analyses.

Investigation of the internal consistency and reliability of the instrument was undertaken. This was accomplished through the use of Cronbach's Alpha. Mean scores and standard deviations were computed to get an understanding of the opinions of respondents on the safety culture at Eskom.

Hypothesis testing was applied in order to compare the views of participants across grades at Eskom on the effectiveness of the safety values that were cultivated within the organisation. Correlation analysis was performed to understand relationships between attitudes towards safety in the workplace and the occurrence of accidents. The Statistical Package for the Social Sciences (SPSS) software was used to analyse the results.

4.7 Reliability and validity

Reliability refers to the extent to which measurement instruments produce consistent, stable, and uniform results when observations are done repeatedly under the same conditions (Creswell, 2003). Yin (2009) states that to improve reliability, the researcher should use the same template as far as is possible. Testing reliability of the questionnaire in this study was a challenge; however, an effort was made to structure the questionnaire in such a way that it covered relevant issues about the study and its objectives. Efforts were made to carefully word the questionnaire using simple language with no ambiguities.

Validity, according to Lewis (2005), is whether the measure or observation actually represents what one thinks it represents. Validity can either be internal or external. Internal validity of a conclusion refers to the degree to which it correctly attributes changes in the dependent variable to the independent variable (Welman et al., 2005). If things other than those measured affect the results, by introducing systematic bias, the results are less valid. A measurement device can be said to have predictive validity when the behaviour predicted from the attitude measure correlates highly with the actual observed behaviour. When investigating the effect of an independent variable on the dependent variable, there is usually a host of other factors apart from the independent variables under study, which may bring about changes in the dependent variables and which therefore may adversely affect internal validity (Welman et al., 2005). If these factors are not checked, observed changes to the independent variable cannot be interpreted, and this will render the internal validity of conclusions reached questionable. According to Davis and Cosenza (2005), external validity can be defined as the degree to which the study results can be generalised across populations, settings, and other similar conditions. Internal and external validity are often compromised by managers due to considerations of practicality and resource constraints.

Since the study is quantitative in nature, validity and generalisability of the results are not a challenge. The researcher made an effort to ensure that the questionnaire was constructed using simple language to the benefit of respondents. The questions and surveys were kept as short as possible to keep respondents interested and motivated to complete the survey. Efforts were also made to ensure that the questions were clear and provided answers to the objectives of the study. Similar questions were grouped to keep the survey logical and focused.

4.8 Ethical considerations

General ethical standards for the research that were taken into account were commitment to honesty, avoidance of plagiarism, and respect for the dignity and privacy of the respondents. Ethics in research refers to the social code that conveys moral integrity and adherence to widely acceptable values in the research fraternity. Ethical considerations for this study included individual and professional codes of conduct during the development and carrying out of the research. Steps to ensure adherence to research ethical standards included the following:

Permission: Before the questionnaire was emailed or faxed for completion, permission was sought from potential respondents through appropriate formal structures.

Confidentiality and anonymity: Participants were assured of the anonymity and confidentiality of their participation in this study. Caution was taken not to subject the participants to any risk of unusual stress, embarrassment, or loss of self-esteem. The sensitivity of different attitudes, norms, and cultural expectations was also respected and appreciated by the researcher.

Recruitment procedures or voluntarily participation: Efforts were made in advance to communicate and inform potential respondents that taking part in this exercise is voluntary and that there are no potential consequences for those who chose not to participate. All emails related to the survey carried a clear narrative description of the purpose of the study, as well as a guarantee that the information provided would only be used for scholastic purposes.

4.9 Conclusion

The chapter provided the research design concepts applied in the study. The chapter gave a highlight on research methods, population and sample, data collection, data analysis, ethics, as well as reliability and validity. The next chapter presents the results and discussion of the study.

Chapter 5: Research results

5.1 Introduction

The previous chapter laid out a detailed framework for the methods that are applicable in this study and can help to achieve the study objectives. These methods were identified as to assess leadership's commitment to safety within the work environment; establish employee involvement on safety in the workplace; assess the safety environment within the work environment and thus develop strategies that will help in ensuring minimal or zero occurrence of accidents.

This chapter provides results on the assessment of the safety culture within the nuclear setting at Eskom, emphasising on the nuclear new build setting, and hence develop strategies that will help in ensuring minimal or zero accident occurrences. The analysis data is based on a questionnaire survey that targeted senior management, middle management, junior management, and operational staff within Eskom Nuclear. To make analyses easier for interpretation, data is summarised using graphs and tables. The results in this part of the study form a basis for the next chapter that deals with a discussion, conclusion, and recommendations of the study.

5.2 Assess leadership's commitment to safety within the work environment

A number of statements were made to the respondents to assess leadership's commitment to safety within the work environment. The respondents were requested to tick their preferred answer by using the following rating when responding to the statement:

- strongly disagree
- disagree
- neither agree nor disagree
- agree
- strongly agree

The statements that were made to the respondents to assess leadership's commitment to safety within the work environment were as follows:

- There is visible leadership showing involvement of management in safety-related activities at Eskom.
- Eskom's management is clearly committed to safety in the workplace.

- Eskom's management supports the active involvement of staff in improving safety in the workplace.
- Eskom has a clear policy on safety in the workplace.
- Eskom's safety policy is reviewed from time to time to accommodate changes within the nuclear industry.
- Eskom's management often communicates safety policies to every employee.
- Leadership at Eskom is committed to providing education and training to employees in order to improve knowledge and skills necessary for safety practices.
- Eskom leadership is committed to ensuring that the organisation complies with safety regulations.
- Eskom leadership provides rewards to employees to reinforce positive safety practices.
- Management at Eskom inflicts punishment on underperforming employees on safety-related issues in order to strengthen positive practices in the workplace.

5.2.1 Results of the respondents on leadership's commitment to safety within the work environment

Perceptions of respondents on the safety culture within the work environment are rated using a five-point scale (where 1 indicate very poor, 2 is poor, 3 is average, 4 is good, and 5 is excellent performance on the safety attribute under assessment). The results of the respondents on leadership's commitment to safety within the work environment are presented in Table 5.1. These results can be interpreted as follows:

- *Mean scores:* This refers to all the scores provided by the 135 respondents to a specific attribute and expressed as an average of mean. The score ranges from 1 to 5.
- *Good:* The percentage of the respondents' perception or view on an attribute.

Table 5.1: Perceptions on leadership's commitment to safety

Attribute	Mean scores	Good	Poor	Comment
Leadership involvement in safety	4.0	83.7%	4.4%	Excellent
Management commitment to safety	4.0	85.9%	12.6%	Excellent
Management supports involvement of staff	3.8	80.7%	17.0%	Good
Clarity of policy on health and safety	4.4	93.3%	5.2%	Excellent
Constant review of safety policy	3.7	83.7%	8.1%	Good
Communication of safety policies	4.1	83.7%	8.1%	Excellent
Safety education and training	3.7	70.4%	17.8%	Good
Safety resources	3.7	68.9%	15.6%	Good
Compliance with safety regulations	4.0	84.4%	5.9%	Excellent
Rewards to reinforce safety practices	3.1	40.0%	30.4%	Average
Punishment on safety underperformance	3.4	50.4%	17.0%	Average

According to Table 5.1 above, about 83.7% of the respondents were of the view that there is an excellent visibility and involvement of management in safety-related activities at Eskom. Only 4.4% of the respondents rated involvement of Eskom management in safety-related activities as poor and 11.9% rated as average. Eskom leadership involvement in safety, management commitment to safety, clarity of policy on health and safety, communication of safety policies and compliance with safety regulations recorded good performances with mean scores that were above a 4.0 point mark, against a maximum score of 5 which is an excellent achievement. However, provision of rewards to employees to reinforce positive safety practices and inflicting punishment on underperforming employees on safety-related issues in order to strengthen positive safety practices in the workplace recorded average mean scores. Table 5.1 shows that rewards and punishment system on safety-related activities and punishment on safety underperformance were the only elements that were perceived to be average. Analysis is therefore carried out to determine departments that were not performing as expected on safety rewards and punishments and punishment on safety underperformance.

Table 5.2 is a presentation of the perceptions of the respondents on safety rewards to reinforce positive safety practices across departments. This is one of the attributes which was measured to assess the perception of the respondents on leadership's commitment to safety in the workplace. The results are further illustrated graphically in Figure 5.1.

Table 5.2: Perceptions of the respondents on safety rewards to reinforce positive safety practices across

Department	Very Poor	Poor	Average	Good	Excellent	Number of Respondents
Regulation and Licensing	10%	0%	10%	70%	10%	10
Project Management	6%	12%	35%	24%	24%	17
Quality Management and Documentation	0%	57%	14%	29%	0%	7
JHB-Client Office	0%	0%	11%	78%	11%	9
Nuclear Engineering	31%	25%	19%	16%	9%	32
Transmission and Sustainability	4%	4%	42%	29%	21%	24
Nuclear Fuel	0%	83%	0%	17%	0%	6
Koeberg - Client Office	20%	4%	56%	0%	20%	25
Other	0%	40%	20%	20%	20%	5

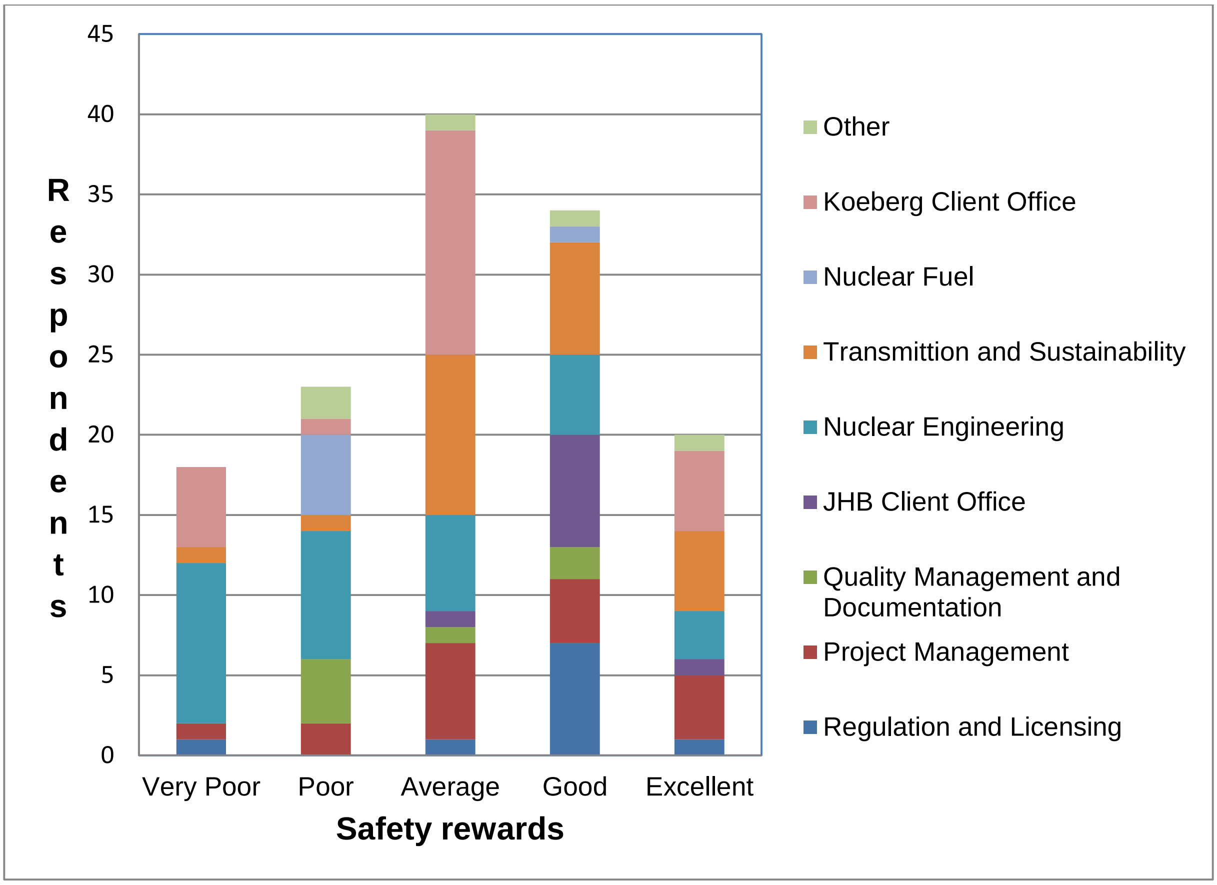

Figure 5.1: Perceptions of respondents on safety rewards to reinforce positive safety practices across departments

Figure 5.1 indicates the perception of the respondents on rewards system to reinforce positive safety practices across departments within the organisation. About 57% of the respondents within the Quality Management and Documentation department were of the view that the rewards system to reinforce positive safety practices was poor. About 83% of the respondents in the Nuclear Fuel department were of the opinion that the rewards system to reinforce positive safety practices was very poor. The respondent's perceptions of a safety rewards system to reinforce positive safety practices in the workplace were found to be mostly average, as shown in Table 5.2.

Figure 5.2 shows the perception of the respondents on whether punishments are meted to underperforming employees on safety-related issues in order to strengthen positive safety practices in the workplace across departments. About 78% of the respondents in JHB Client Office, 70% in Regulation and Licensing departments were of the view that there is good visibility of punishments to underperforming employees on safety-related issues in order to strengthen positive safety practices in the workplace. About 56% of the respondents in Koeberg Client Office, 42% in

Transmission and Sustainability and 35% in Project Management viewed that there punishments to underperforming employees on safety was average.

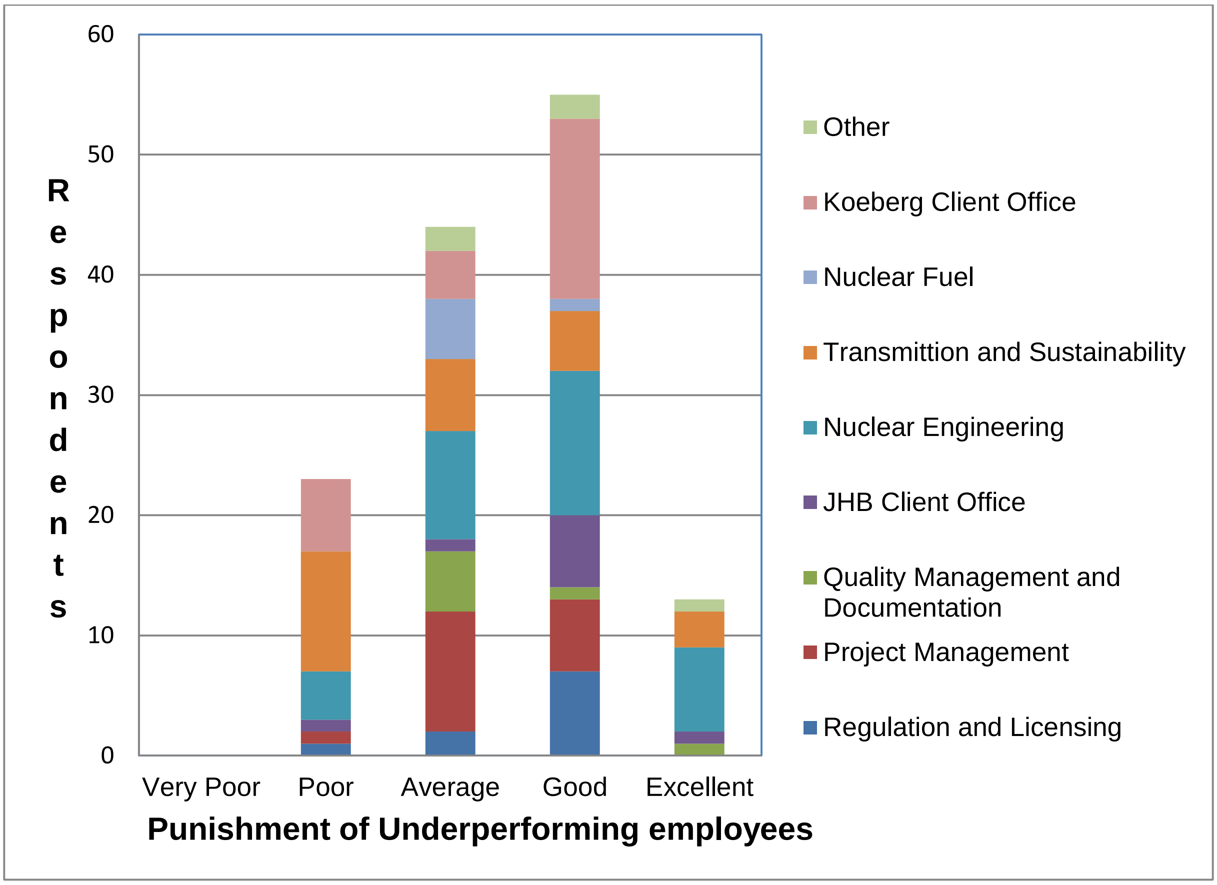

Figure 5.2: Perceptions on the application of punishments to underperforming employees on safety-related issues

5.3 Assessment of employee involvement on safety

Some statements were made to the respondents to assess the employee involvement on safety within the work environment. The respondents were requested to tick their preferred answer by choosing one of the options below.

- strongly disagree
- disagree
- neither agree nor disagree
- agree

- strongly agree

The statements that were made to the respondents to assess the employee involvement on safety within work environment were as follows:

- Eskom employees are satisfied with information about company policy on safety.
- Ownership of safety is evident in all employees at Eskom.
- Eskom employees have the necessary knowledge and understanding of safety-related issues in the workplace.
- There is a high level of compliance with safety policies by employees at Eskom.
- Eskom employees often demonstrate safety-conscious behaviour in the workplace.
- Most Eskom employees perceive safety as an important element in positively affecting employees' performance levels.
- Employees at Eskom believe that safety is equally as important as economic aspects.
- Eskom employees view positively their responsibilities of safety in the workplace.
- Eskom employees show a willingness to get involved in improving their safety working conditions.
- All employees at Eskom are thoroughly trained on safety aspects in the workplace.
- Eskom employees are mostly satisfied with the content of training in safety in the workplace.
- Eskom employees are happy with cooperation from management in ensuring that safe working conditions prevail.
- Eskom employees show a prudent approach to safety-related issues in the workplace.
- Eskom employees often share amongst themselves information on safety in the workplace.

5.3.1 Results of the respondents on the assessment of employee involvement in safety

Perceptions of the respondents on the employee involvement on safety-related activities at Eskom are illustrated in Table 5.3. The rating scale that was used to measure the perceptions of the respondents on the employee involvement on safety at Eskom is as follows:

- 1 means very poor
- 2 is poor
- 3 is average
- 4 is good
- 5 is for an excellent

Table 5.3: Perceptions on employee involvement on safety

Attribute	Mean scores	Good	Poor	Comment
Information about company policy on safety	3.5	60.7%	15.6%	Good
Employee ownership of safety	3.3	56.3%	26.7%	Average
Employee safety knowledge	3.6	71.1%	16.3%	Good
Compliance with safety policies	3.5	59.3%	16.3%	Good
Demonstration of safety behaviour	3.6	63.0%	15.6%	Good
Importance of safety to performance	3.7	72.6%	10.4%	Good
Safety is equally as economic	3.5	48.9%	13.3%	Good
Employees are positive on their safety roles	3.7	65.9%	8.9%	Good
Employees involved in improving safety at work	3.7	65.2%	11.9%	Good
Employee training on safety	3.4	54.8%	19.3%	Average
Content of training in safety	3.3	46.7%	17.8%	Average
Cooperation from management on safety	3.4	49.6%	17.0%	Average
Employees show prudence on safety issues	3.6	57.0%	14.1%	Good
Information sharing on safety	3.8	80.7%	14.1%	Good

All the attributes on employee involvement on safety were perceived to be good (with average scores of at least 3.5) except for employees ownership of safety, employee training on safety, content of training material in safety and cooperation from management on safety, as highlighted in Table 5.3. These attributes were perceived by the respondents to be average visibility within the organisation with mean scores of less than of 3.5. Content of training material on safety and perhaps cooperation from management on safety were of particular concern, with only 46.7% and 49.6% of the respondents who rated it as good.

An analysis across departments on elements that were perceived to be of average or poor performance, which included company policy on safety, influence of safety on employee performance, general importance of safety, employee training on safety, content of training in safety, and showing a prudent approach on safety-related issues by employees, was performed.

Table 5.4 indicates perceptions of the respondents across departments on whether ownership of safety by employees at Eskom is evident. Ninety per cent of the respondents in the Regulation and Licensing department are of the view that ownership of safety is evident in all employees at Eskom. However, only 24% of the respondents in the Koeberg Client Office maintain that ownership of safety is evident in all employees at Eskom. 78% of the respondents in the JHB Client Office are of the view that ownership of safety is evident in all employees at Eskom. This view is in contrast with the respondents from a similar department in Koeberg.

Table 5.4: Perceptions on ownership of safety by employees across departments

Department	Very Poor	Poor	Average	Good	Excellent	Number of Respondents
Regulation and Licensing	0%	0%	10%	80%	10%	10
Project Management	6%	12%	12%	65%	6%	17
Quality Management and Documentation	0%	14%	0%	71%	14%	7
JHB Client Office	11%	0%	11%	78%	0%	9
Nuclear Engineering	22%	22%	16%	38%	3%	32
Transmission and Sustainability	0%	13%	13%	71%	4%	24
Nuclear Fuel	0%	17%	0%	83%	0%	6
Koeberg Client Office	0%	32%	44%	4%	20%	25
Other	0%	100%	0%	0%	0%	5

A graphical depiction of the respondents' perception of the ownership of safety by employees at Eskom across department is provided in Figure 5.3.

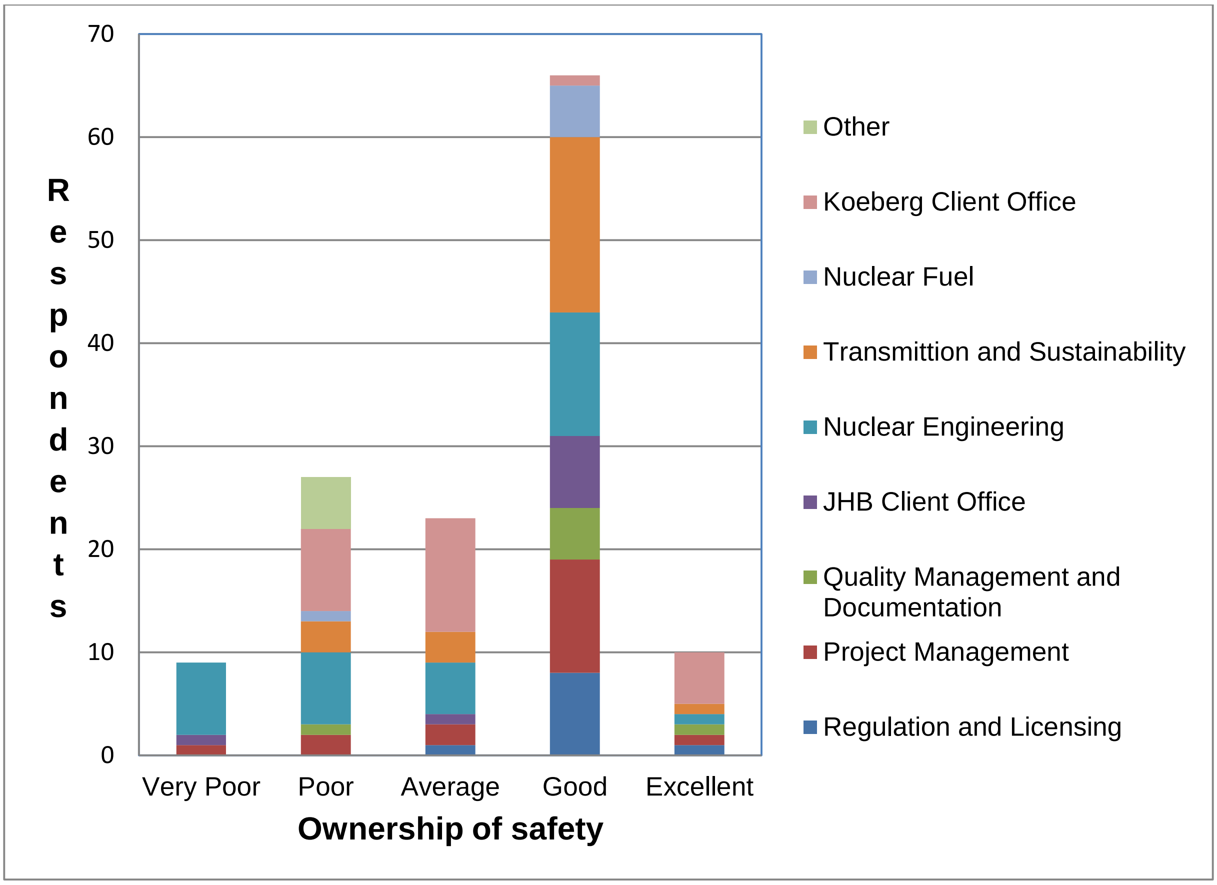

Figure 5.3: Perceptions on ownership of safety by employees across departments

The perceptions of the respondents across departments on whether Eskom employees are thoroughly trained on safety aspects in the workplace are revealed in Table 5.5 and Figure 5.4. A significant 19% of the respondents were not satisfied with the training of safety aspects at work. However, 100% of the respondents in the Regulation and Licensing department were happy with the training of safety aspects in the workplace. Similarly, about 78% of the respondents in the JHB Client Office are happy with the training aspects in the workplace. However, 83% of the respondents in the Nuclear Fuel department are not happy with the training aspects in the workplace. They were of the view that the quality of the training that they received on safety was generally average.

Table 5.5: Perceptions on training on safety aspects at the workplace by employees across departments

Department	Very Poor	Poor	Average	Good	Excellent	Number of Respondents
Regulation and Licensing	0%	0%	0%	40%	60%	10
Project Management	6%	6%	18%	59%	12%	17
Quality Management and Documentation	0%	14%	86%	0%	0%	7
JHB Client Office	0%	11%	11%	78%	0%	9
Nuclear Engineering	22%	22%	22%	28%	6%	32
Transmission and Sustainability	0%	4%	25%	54%	17%	24
Nuclear Fuel	0%	0%	83%	17%	0%	6
Koeberg Client Office	0%	20%	28%	32%	20%	25
Other	0%	0%	0%	80%	20%	5

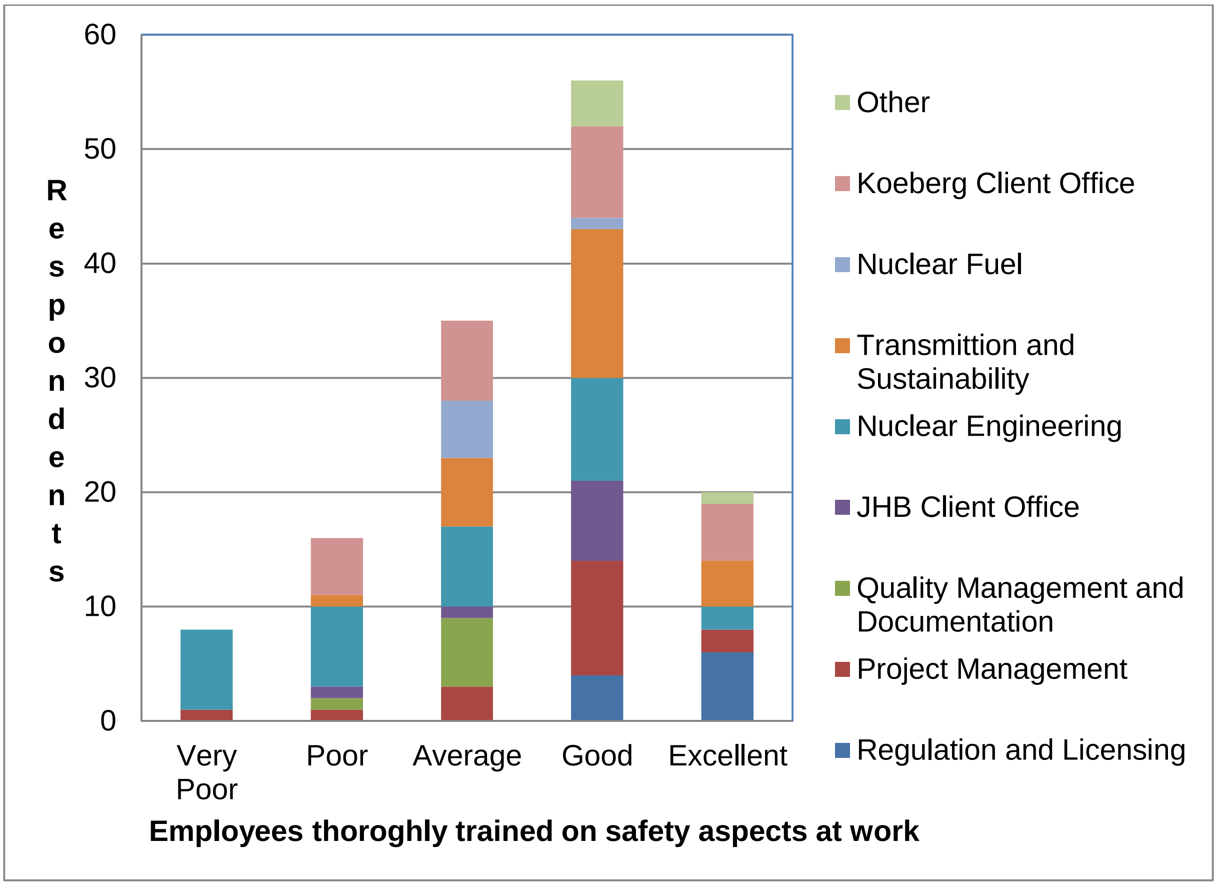

Figure 5.4: Perceptions on whether Eskom employees are thoroughly trained on safety aspects in the workplace

Table 5.6 and Figure 5.5 indicate perceptions of the respondents across departments on whether employees were satisfied with the content of training in safety in the workplace. A significant 18% of the respondents were not satisfied with the content of training in safety that was offered by the organisation. About 12% of the respondents from the Project Management department, 67% from the JHB Nuclear Client Office department, 31% from Nuclear Engineering, and 20% from Koeberg Nuclear Client Office were of the view that the content of training in safety in the workplace was poor to very poor.

Table 5.6: Perceptions on the suitability of training content on safety across departments

Department	Very Poor	Poor	Average	Good	Excellent	Number of Respondents
Regulation and Licensing	0%	0%	70%	20%	10%	10
Project Management	0%	12%	41%	41%	6%	17
Quality Management and Documentation	0%	0%	86%	14%	0%	7
JHB Client Office	0%	67%	11%	22%	0%	9
Nuclear Engineering	22%	9%	38%	31%	0%	32
Transmission and Sustainability	0%	4%	13%	63%	21%	24
Nuclear Fuel	0%	0%	83%	17%	0%	6
Koeberg-Client Office	0%	20%	28%	32%	20%	25
Other	0%	0%	0%	80%	20%	5

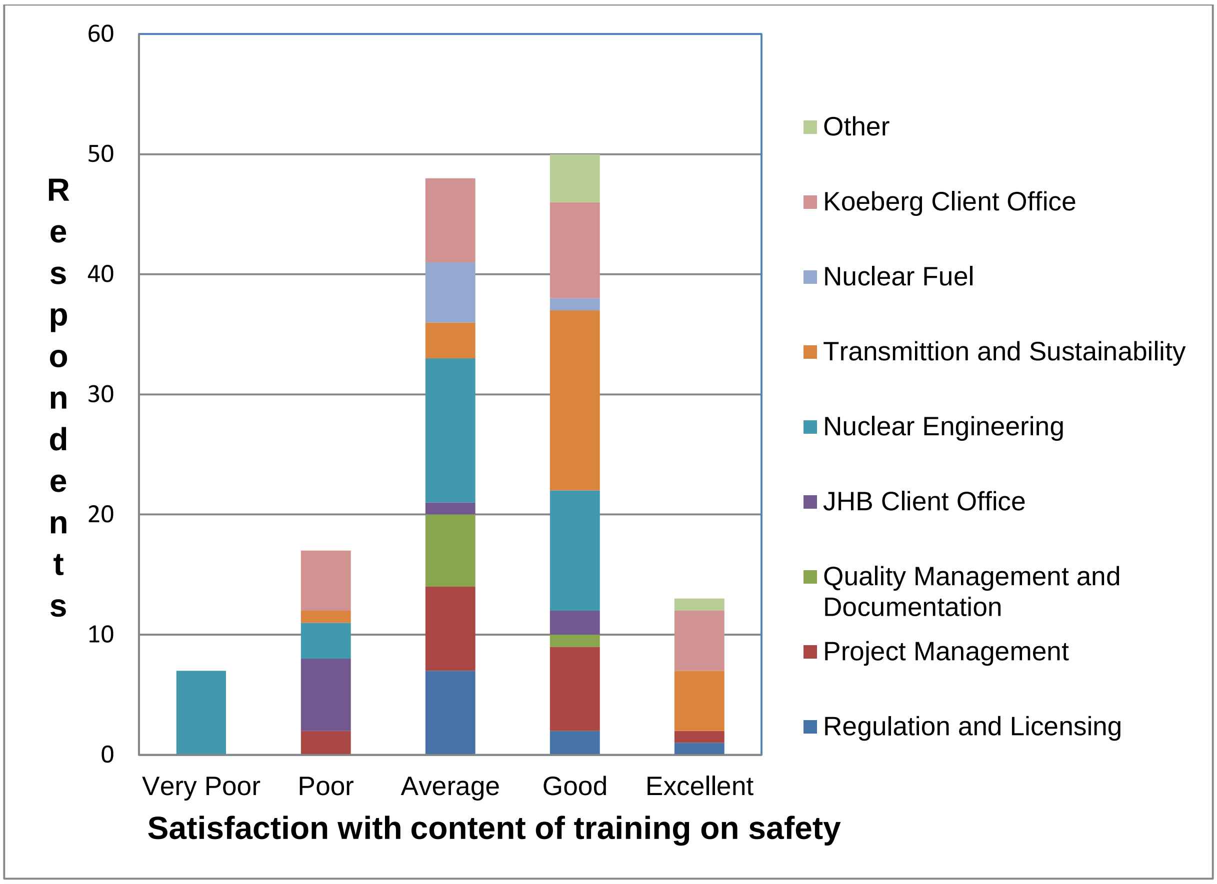

Figure 5.5: Perceptions on the suitability of training content on safety across departments

In Table 5.7 and Figure 5.6, the perceptions of the respondents across departments on whether Eskom employees are happy with cooperation from management in ensuring that safe working conditions prevail are brought out. A considerable 17% of the respondents from all the departments were not happy with the cooperation from management in ensuring that safe working conditions prevail. About 6% of the respondents from the Project Management department, 11% from the JHB Client Office, 28% from the Nuclear Engineering department, 29% from the Transmission and Sustainability department and 20% from the Koeberg Client Office were not delighted with the cooperation from management on safety.

Table 5.7: Perceptions on the cooperation from management in ensuring that safe working conditions prevail

Department	Very Poor	Poor	Average	Good	Excellent	Number of Respondents
Regulation and Licensing	0%	0%	70%	20%	10%	10
Project Management	0%	6%	29%	53%	12%	17
Quality Management and Documentation	0%	0%	0%	100%	0%	7
JHB Client Office	0%	11%	11%	78%	0%	9
Nuclear Engineering	22%	6%	47%	25%	0%	32
Transmission and Sustainability	0%	29%	13%	42%	17%	24
Nuclear Fuel	0%	0%	0%	100%	0%	6
Koeberg Client Office	0%	20%	56%	4%	20%	25
Other	0%	0%	20%	60%	20%	5

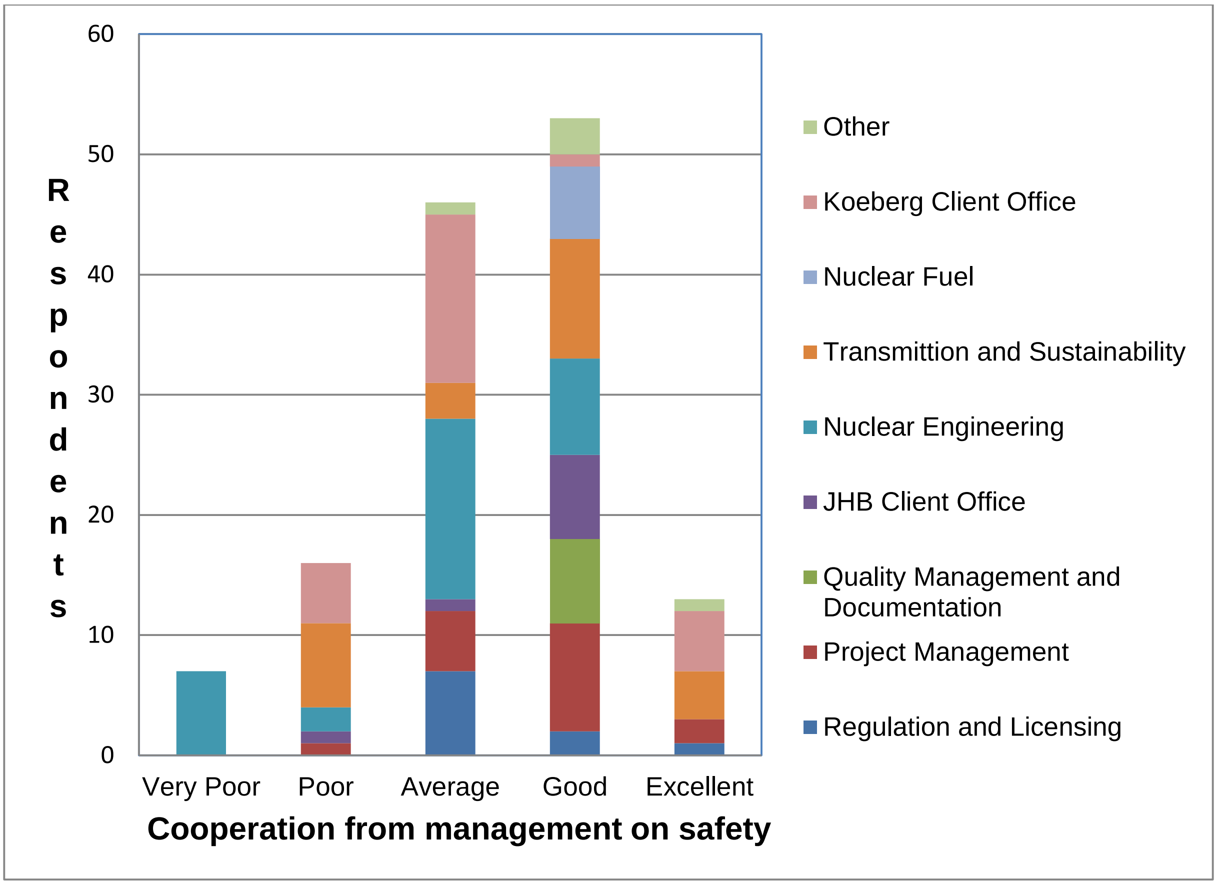

Figure 5.6: Perceptions on the cooperation from management in ensuring that safe working conditions prevail.

5.4 Assessment of safety environment in the workplace

A number of statements were made to the respondents to assess the safety environment in the workplace. The respondents were requested to tick their preferred answer by choosing one of the options below.

- strongly disagree
- disagree
- neither agree nor disagree
- agree
- strongly agree

The statements that were made to the respondents to assess the safety environment in the workplace were as follows:

- Eskom has good safety management systems in place for hazard prevention and control.
- Workplace safety at Eskom undergoes constant examination.
- Eskom is often proactive with regard to hazard prevention in the workplace.
- Every Eskom employee feels duty-bound to accurately report on issues related to safety in the workplace.
- Every Eskom employee is encouraged to correct unsafe practices across the organisation.
- Eskom employees are more aware of the hazards associated with their work environment.
- There are often workshops, meetings, and safety awareness campaigns at Eskom to guarantee good safety practices in the workplace.
- Safety-related issues are embedded into the work process at Eskom.

5.4.1 Results of the respondents on the safety environment in the workplace

Perceptions of the respondents on the safety environment in the workplace are shown in Table 5.8.

Table 5.8: Perceptions on the safety environment in the workplace

Attribute	Mean scores	Good	Poor	Comment
Safety management systems	4.0	83.7%	6.7%	Excellent
Safety reviews	3.9	73.3%	15.6%	Good
Hazard prevention	4.0	74.1%	14.8%	Excellent
Reporting on safety	3.3	45.9%	23.0%	Average
Safety practices	3.9	75.6%	11.1%	Good
Awareness of hazards at work	3.8	74.1%	5.2%	Good
Safety workshops	4.2	91.1%	7.4%	Excellent
Safety ingrained in work processes	3.8	77.0%	8.1%	Good

According to Table 5.8, the respondents expressed delight on safety management systems in place for hazard prevention and control, constant safety reviews that are often undertaken, hazard application of safety practices, awareness on hazards prevention at work, frequent safety workshops, and embedment of safety-related issues into the work processes. All the aforementioned elements recorded mean scores of at least 3.8 with more than 70% of the respondents expressing delight on their visibility and application in the workplace. However, reporting accurately on safety related issues by employees was perceived to be performing averagely with a mean score of 3.3 compared to a maximum possible score of 5. An analysis across departments on elements that were perceived to be average applied (which included reporting on safety) is carried out.

The perceptions of the respondents on how safety is reported in the workplace across departments are shown in Table 5.9 and Figure 5.7. A substantial 23% (poor and very poor) of the respondents were not happy with how the organisation reports on safety in the workplace. It appears that not much is done to frequently and appropriately report on safety at work. About 50% of the respondents from the Regulation and Licensing department, 12% from the Project Management department, 78% from JHB Client Office, 25% from the Nuclear Engineering, 8% from the Transmission and Sustainability department, 20% from Koeberg Client Office and 40% from other departments were not happy with safety reporting at Eskom. This unhappiness could be due to insufficiency in terms of frequency and content on reporting safety at work.

Table 5.9: Perceptions on reporting on safety in the workplace

Department	Very Poor	Poor	Average	Good	Excellent	Number of Respondents
Regulation and Licensing	50%	0%	30%	10%	10%	10
Project Management	0%	12%	29%	29%	29%	17
Quality Management and Documentation	0%	0%	29%	71%	0%	7
JHB Client Office	11%	67%	0%	22%	0%	9
Nuclear Engineering	3%	22%	41%	25%	9%	32
Transmission and Sustainability	0%	8%	17%	58%	17%	24
Nuclear Fuel	0%	0%	0%	100%	0%	6
Koeberg Client Office	20%	0%	56%	4%	20%	25
Other	40%	0%	20%	40%	0%	5

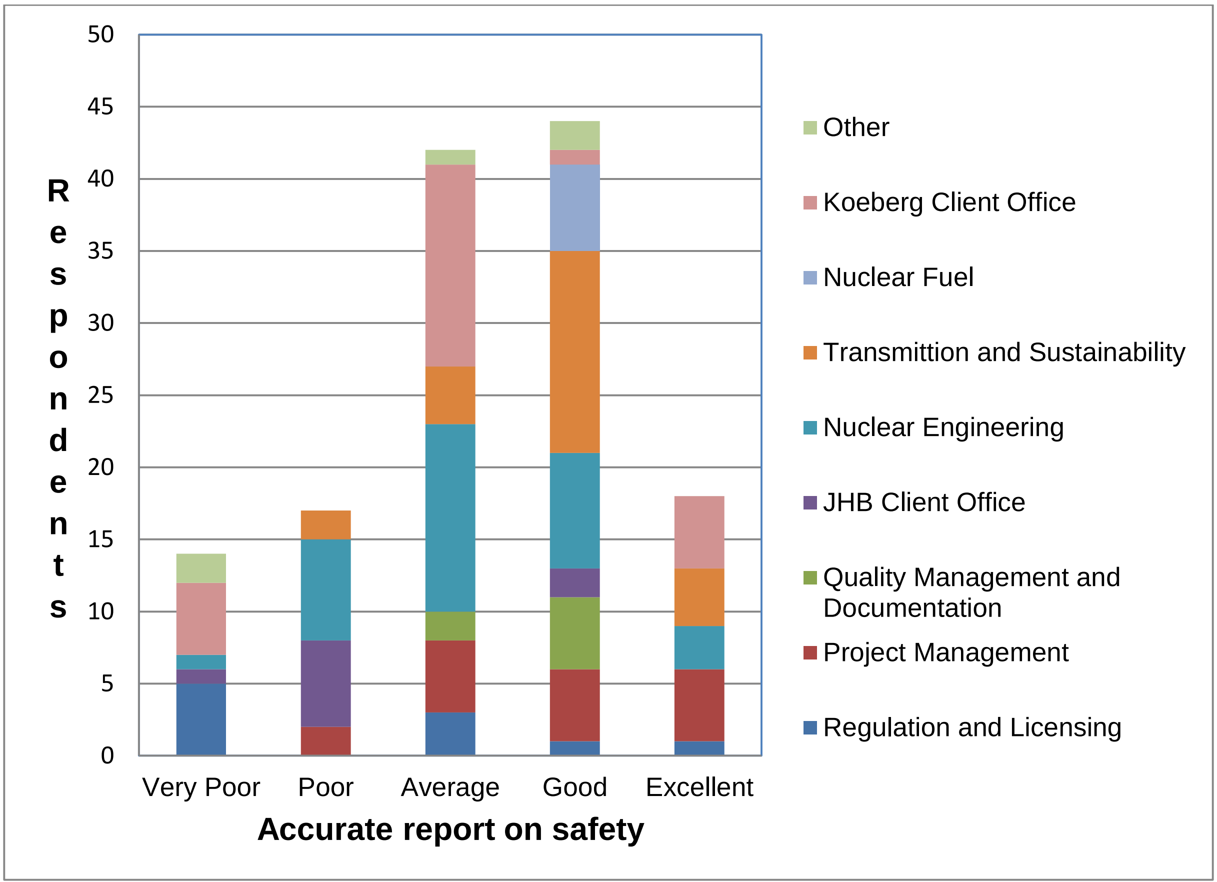

Figure 5.7: Perceptions of the respondents on how safety is reported in the workplace across departments

5.5 The influence of leadership’s commitment to safety and employee involvement in safety

The influence of leadership’s commitment and employee involvement on safety is discussed with reference to Pearson correlation (Table 5.10) and ANOVA (Table 5.11) and Coefficients (Table 5.12)

5.5.1 Determination of the influence of leadership’s commitment to safety and employee involvement in safety using multiple linear regression

The influence of leadership’s commitment and employee involvement on safety is discussed with reference to multiple linear regressions (Table 5.12). Generally, the regression model is useful in predicting the relationship between two or more variables. The model generates the following equation to describe a statistical relationship between one or more independent variables (predictor) and a dependent variable (response):

$$Y = a + bX_1 + bX_2 \quad \text{.......... Equation 2}$$

Where

Y is the predicted value of the dependent variable

X_1 is the value of the first predictor

X_2 is the value of the second predictor variable

The influence of predictor variables on dependent variables is predicted based on the significance of the coefficient of the predictor variables. The significance of that coefficient is based on the probability (p-value) using a standard of 0.05 threshold. A p-value which is less than 0.05 indicates that it is possible to reject the null hypothesis.

According to Rumsey (2016), all hypothesis tests ultimately use a p-value to weigh the strength of the evidence (what the data is revealing about the population). Rumsey (2016) further indicated that the p-value is a number between 0 and 1 and interpreted in the following way:

- A small p-value (typically ≤ 0.05) indicates strong evidence against the null hypothesis, so the null hypothesis is rejected. In other words, a predictor coefficient that has a low value is likely to be a meaningful addition to the model.
- A large p-value (> 0.05) indicates weak evidence against the null hypothesis, thus the null hypothesis is not rejected. A large p-value suggests that changes in the predictor are not associated with changes in the response. In other words, the predictor variable of concern with a p-value that is more than 5% is insignificant, and there is no meaningful addition.
- The p-values very close to the cut-off (0.05) are considered to be marginal (could go either way).

The regression analysis produces some statistics such as a standard coefficient or beta coefficient. These are estimates resulting from regression analysis that have been standardised so that the variances of dependent and independent variables are one. Standardising coefficients makes comparison easier, as this does not take into account the independent variable scale of units. Similarly, a regression model that is carried out using an unstandardised variable produces unstandardised coefficients that are not easy to compare.

The SPSS software was used to analyse the results. Leadership commitment and employee involvement in safety were treated as independent variables, while safety in the workplace is the dependent variable. Inter correlation between the variables are represented in Table 5.10. The two independent variable showed a correlation of 0.791, which is of some concern in terms of possible multicollinearity. For this reason, multicollinearity diagnostics was done. The tolerance value was 0.375 and the variance inflation factor (VIF) was 2.669. For this value to be acceptable, the tolerance level should be greater 0.2 (Menard, 1995) and VIF less than 10 (Myers, 1990).

The values thus meet the criteria for multicollieairity and the analyses were taken further.

Table 5.10 Correlations

		Safety Environment in the Workplace	Leadership Commitment to safety	Employee Involvement in safety
Safety Environment in the Workplace	Pearson Correlation	1.000	.711	.851
	Sig. (1-tailed)	.	.000	.000
	N	135	135	135
Leadership Commitment to Safety	Pearson Correlation	.711	1.000	.791
	Sig. (1-tailed)	.000	.	.000
	N	135	135	135
Employee Involvement in Safety	Pearson Correlation	.851	.791	1.000
	Sig. (1-tailed)	.000	.000	.
	N	135	135	135

Furthermore, the regression model on the influence of leadership commitment to safety and employee involvement in safety had a high coefficient of determination (r^2) of 0.725. This means that the combination of employee involvement in safety and leadership commitment to safety explains a total of 72.9% of the variance in safety environment. According to Ellis and Steyn (2003), an R^2 value of 0.25 and higher can be seen as practically important.

Table 5.11: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854[a]	.729	.725	.35851

a. Predictors: (Constant), Employee Involvement in Safety, Leadership Commitment to Safety
b. Dependent Variable: Safety Environment in the Workplace

Table 5.12 below, shows a test the adequacy of the regression model that has been developed using ANOVA. Based on the results in Table 5.12, it can be observed that the p-value is less than 0.05. This therefore implies that the model is significant.

Table 5.12: ANOVA[a]

Attribute	**Sum of Squares**	**df (degrees of freedom) (n-1)**	**Mean Square (Sum of Squares/df)**	**F**	**Sig. (Similar as p-value)**
Regression	45.577	2	22.789	177.300	0.00[b]
Residual	16.966	132	0.129	-	-
Total	62.543	134	-		

a. Dependent variable: Safety Environment in the Workplace
b. Predictors: (Constant), Employee Involvement in Safety, Leadership Commitment to safety

The table of coefficient is presented in Table 5.13 below

Table 5:13: Coefficients[a]

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t (test statistic)**	**Sig. (also denotes as α)**
	B	Std. Error	Beta		
(Constant)	0.560	0.187	-	2.991	0.003
Leadership Commitment to safety	0.107	0.078	0.102	1.372	0.172
Employee Involvement in safety	0.800	0.077	0.771	10.411	0.000

a. *Dependent variable: Safety environment in the workplace*

Table 5.13 indicated that the employee involvement in safety coefficient was significant ($p<0.05$). This means that the general safety in the workplace within Eskom is influenced by the involvement of employees in safety aspects. However, leadership commitment to safety coefficient was not significant at 0.05 level, generating a p-value of 0.172. This implies that the general safety in the workplace within Eskom is not significantly influenced by leadership's commitment.

5.6 Results of hypothesis testing

This part of the analysis tests whether there are any differences in views for participants that are in different departments using independent samples T-test. A T-test is a statistical procedure that is applied in order to test whether means of two sets of data are significantly different from each other. A 5% level of significance is applied in this case. If a calculated p statistic is less than the 0.05 threshold, then there are significant differences in views for participants that are from a different department. The converse is also true.

Before applying T-test statistic, Levene test of equality of variance was performed. Levene test is an inferential statistic that is used to assess equality of variance for a variable calculated for two or more groups (Levene, 1960). Levene tests the assumption that the variances of populations from which different samples are drawn are equal. If the p-value of Levene test is less than 0.05, then the sample variances are unlikely to be coming from a population with equal variances. In such an instance, the null hypothesis is rejected, and the T-test for unequal variances is used. The inverse also holds.

Hypothesis statement 1

H_0: Respondents from Nuclear Engineering and Transmission and Sustainability departments have similar views on the safety management systems in place at Eskom for hazard prevention and control.

H_1: Respondents from Nuclear Engineering and Transmission and Sustainability departments do not have similar views on the safety management systems in place at Eskom for hazard prevention and control.

Table 5:14 Group Statistics

	Department	N	Mean	Std. Deviation	Std. Error Mean
LEADERSHIP COMMITMENT TO SAFETY	Nuclear Engineering	32	3.4318	.64737	.11444
	Transmission and Sustainability	24	4.0606	.44266	.09036
EMPLOYEE INVOLVEMENT IN SAFETY	Nuclear Engineering	32	3.1617	.63780	.11275
	Transmission and Sustainability	24	3.8780	.54824	.11191
SAFETY ENVIRONMENT IN THE WORKPLACE	Nuclear Engineering	32	3.5352	.70727	.12503
	Transmission and Sustainability	24	4.1042	.59054	.12054

Table 5.14 and Figure 5.8 represents the mean scores for the 2 groups namely Nuclear Engineering and Transmission and Sustainability departments on the Leadership commitment to safety, Employee involvement in safety and Safety environment. It is evident that in each case, Transmission and Sustainability department has a higher score than Nuclear Engineering department. The independent samples t-test in Table 5.15 was done to test whether the differences between Nuclear Engineering and Transmission and Sustainability departments were statistically significant.

Table 5.15: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
LEADERSHIP COMMITMENT TO SAFETY	Equal variances assumed	4.171	.046	-4.091	54	.000
	Equal variances not assumed			-4.312	53.615	.000
EMPLOYEE INVOLVEMENT IN SAFETY	Equal variances assumed	2.210	.143	-4.411	54	.000
	Equal variances not assumed			-4.509	52.929	.000
SAFETY ENVIRONMENT IN THE WORKPLACE	Equal variances assumed	.945	.335	-3.192	54	.002
	Equal variances not assumed			-3.276	53.321	.002

In the case of Leadership commitment to safety, Levene's test for the equality of variances showed that there was a significant difference in variance between the two groups ($p<0.05$). The t-test for unequal variances was thus used. The t-test was significant $t\ (53.615) = -4.312$, $p = 0.000$. It can thus be inferred that the Transmission and Sustainability department (M=4.06 SD=0.44) had a significantly higher score on Leadership commitment to safety than Nuclear engineering (M=3.43 SD=0.64). This can be inferred that Transmission and Sustainability department feel that leadership is more committed to safety and noticeable and visible than their counterparts in Nuclear Engineering.

In the case of Employee involvement and Safety environment, variances were not significantly different ($p>0.05$) and thus the T test for equal variances assumed was used. For both Employee involvement $t\ (54) = -4.411$, $p<0.05$ and Safety Environment in the workplace $t\ (54) = -3.192$, $p<0.05$ the mean scores of the groups were significantly different. It can thus be inferred that, with regard to Employee involvement, Transmission and Sustainability department (M=3.88 SD=0.55) had a significantly higher score than Nuclear Engineering (M=3.16 SD=0.64). In similar way, Transmission and Sustainability department (M=4.10 SD=0.59) had a significantly higher score than Nuclear Engineering department (M=3.53 SD=0.71) on Safety environment.

The null hypothesis is therefore rejected with regard to all three scales.

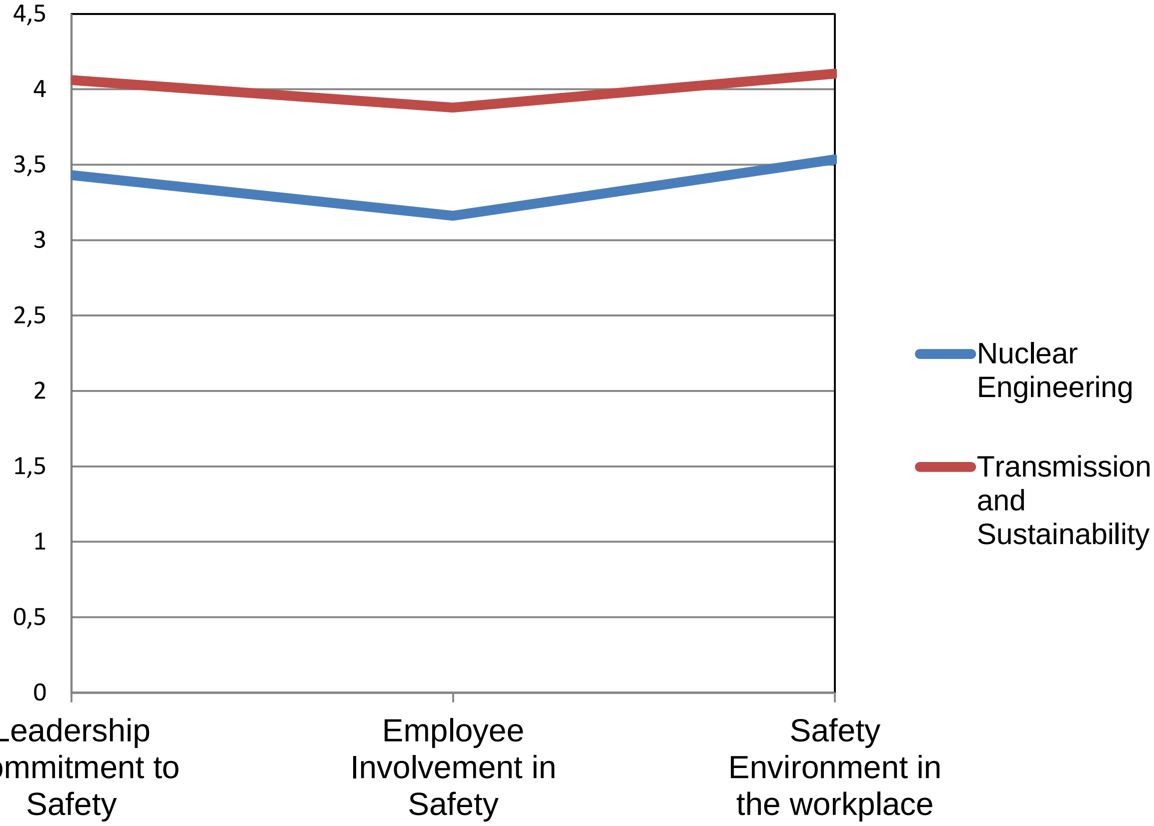

Figure 5.8: Mean scores for Transmission and Sustainability and NE department

Hypothesis statement 2

H_0: Employees from Project Management and Nuclear Engineering departments have similar views on the level of compliance with safety policies during their operations.

H_2: Employees from Project Management and Nuclear Engineering departments do not have similar views on the level of compliance with safety policies during their operations.

Table 5.16:Group Statistics

	Department	N	Mean	Std. Deviation	Std. Error Mean
LEADERSHIP COMMITMENT TO SAFETY	Project Management	17	3.9091	.78269	.18983
	Nuclear Engineering	32	3.4318	.64737	.11444
EMPLOYEE INVOLVEMENT IN SAFETY	Project Management	17	3.6303	.71081	.17240
	Nuclear Engineering	32	3.1617	.63780	.11275
SAFETY ENVIRONMENT IN THE WORKPLACE	Project Management	17	3.9632	.91937	.22298
	Nuclear Engineering	32	3.5352	.70727	.12503

Table 5.16 and Figure 5.9 represent the mean scores for the 2 groups namely Project Management and Nuclear Engineering departments on the Leadership commitment to safety, Employee involvement in safety and Safety environment. It is evident that in each case, Project Management department has a higher score than Nuclear Engineering department. The independent samples t-test in Table 5.17 was done to perform statistical significance tests between Project Management and Nuclear Engineering departments.

Table 5.17:Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
LEADERSHIP COMMITMENT TO SAFETY	Equal variances assumed	.017	.895	2.284	47	.027
	Equal variances not assumed			2.153	27.845	.040
EMPLOYEE INVOLVEMENT IN SAFETY	Equal variances assumed	1.957	.168	2.353	47	.023
	Equal variances not assumed			2.274	29.800	.030
SAFETY ENVIRONMENT IN THE WORKPLACE	Equal variances assumed	.047	.830	1.815	47	.076
	Equal variances not assumed			1.675	26.301	.106

For all scales, Levene's test for the equality of variances showed that there was no significant difference in variance between the two groups ($p<0.05$). The t-test for equal variances was thus used. For leadership commitment $t(47)=2.284$ and $p<0.05$ and Employee involvement $t(47)=2.2353$, $p<0.05$, there were significant differences between the 2 groups. For Safety environment however, the difference was not significant $t(47)=1.815$, $p>0.05$

It can thus be inferred that the Project Management department (M=3.90 SD=0.78) had a significantly higher score on Leadership involvement than Nuclear Engineering (M=3.43 SD=0.65). With regard to Employee involvement, the Project management department (M=3.63 SD=0.71) also had a significantly higher mean score than the Nuclear Engineering department (M=3.16 SD=.64). The Null hypothesis is therefore rejected for these two scales but not for the Safety environment scale.

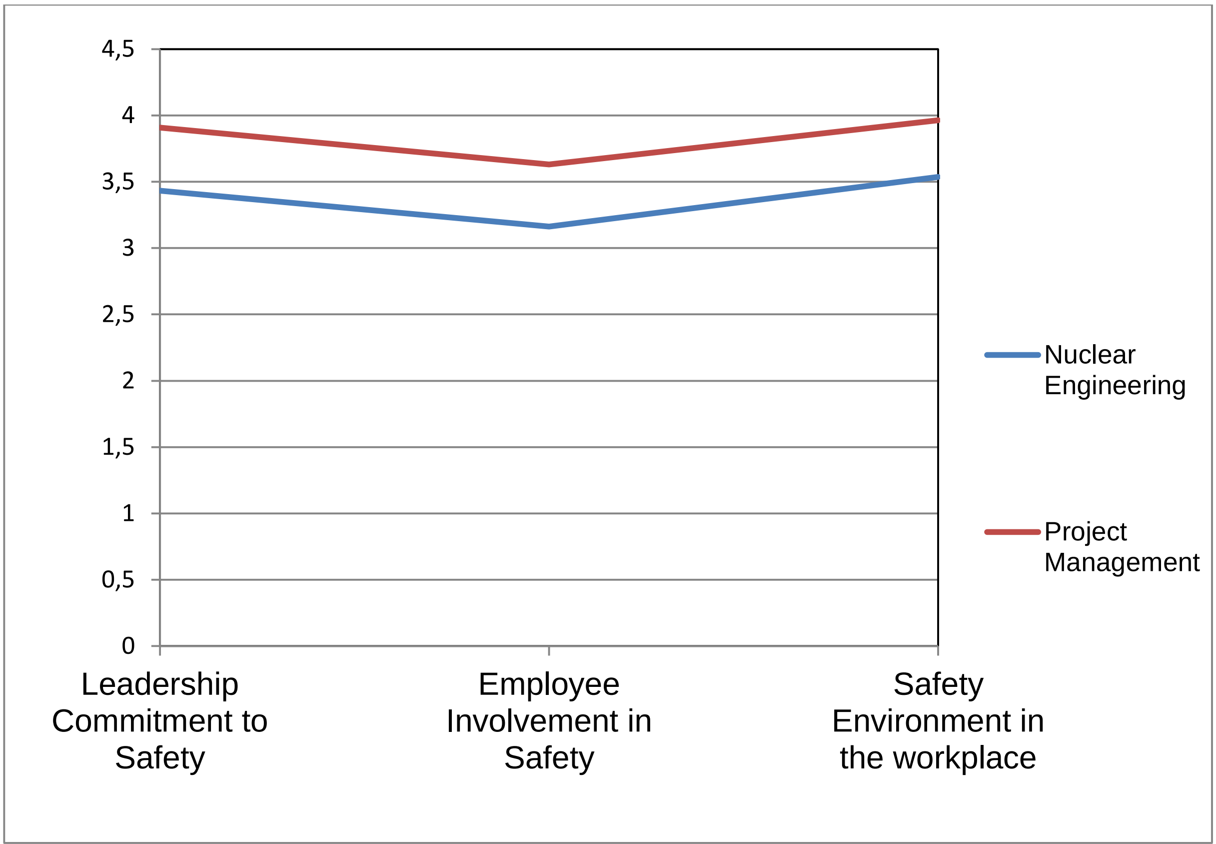

Figure 5.9: Mean scores for Project Management and Nuclear Engineering department

5.7 Reliability

According to Tavakol and Dennick (2011), Cronbach's Alpha is a measure of internal consistency of a test or scale. It is expressed as a number between 0 and 1. Internal consistency describes the extent to which all items in a test measure the same concept or construct, and hence it is connected to the interrelatedness of the items within the test. A low value of alpha could be due to a low number of questions, poor interrelatedness between items, or heterogeneous constructs (Tavakol & Dennick, 2011).

Based on the formula = rk / [1 + (k -1)r], where k is the number of items considered and r is the mean of the inter-item correlations, the size of alpha is determined by both the number of items in the scale and the mean inter-item correlations. George and Mallery (2003) provide the rules of thumb in Table 5.18.

Table 5.18: Rule of thumb for interpreting Cronbach's Alpha values

Cronbach's Alpha	Interpretation
> 0.9	Excellent
> 0.8	Good
> 0.7	Acceptable
> 0.6	Questionable
> 0.5	Poor
< 0.5	Unacceptable

Cronbach's Alpha (Table 5.19) was used to measure the reliability of the instrument in this study. The Cronbach's Alpha for each attribute that included leadership's commitment to safety, employee involvement on safety, and safety environment in the workplace were higher than the 0.7 standard threshold. Cronbach's Alpha values in Table 5.18 are all above the threshold value of 0.7. As a result, it can be deduced that the measuring instrument is able to give consistent results in repeated use.

The Cronbach's Alpha value of 0.878 was achieved on leadership's commitment to safety attributes, which consisted of 11 questions. This value falls within the acceptable threshold, as shown in Table 5.19, related to leadership's commitment to safety. This attribute has 11 questions which are linked to it. Similarly, the value of Cronbach's Alpha of 0.922 was achieved when measuring the reliability of the instrument on the employee involvement on safety attribute, which consisted of 14 items or questions.

Table 5.19: Measuring reliability of the instrument using Cronbach's Alpha

Attribute	Cronbach's Alpha
Leadership commitment to safety	0.878
Employee involvement in safety	0.922
Safety environment in the workplace	0.874

5.8 Conclusion

This chapter presented the results from the respondents with respect to the assessment of the safety culture within the nuclear setting at Eskom, emphasising on nuclear new build setting, and hence developing strategies that will help in ensuring minimal or zero accident occurrences. The data was analysed, interpreted, and summarised using graphs and tables. The results in this part of the report form the basis for the next chapter, which deals with a discussion, conclusion, and recommendations.

Chapter 6: Discussion, recommendations, and conclusion

6.1 Introduction

The aim of the study was to assess the effectiveness of safety culture practised in 2008 within Eskom's nuclear establishment in order to prevent injury and have a safe and secure work environment. The penultimate chapter presented the results of this study. This chapter intends to discuss the results obtained in this study in order to identify any departure points with currently available literature. A conclusion, recommendations, and further studies are also covered.

6.2 Discussion

This section discusses the findings of the survey which was conducted in relation to the theory that was detailed in the theoretical concept and literature.

6.2.1 Discussion on leadership's commitment to safety in the workplace

According to Humphries (2012), an organisation's commitment to safety can be reflected by safety values, safety fundamentals, and doing more than just compliance. He further stresses that leadership of an organisation should be committed to reinforcing safety values. This theory was supported by Ekenedo (2013), who emphasised that leadership of an organisation is the main driver of safety culture by enabling, modelling, inspiring, and reinforcing good safety practices which include providing the needed rewards and punishment that reinforce a positive safety culture.

The findings of this study were largely in line with the theories of Humphries (2012) and Ekenedo (2013) on leadership's commitment to safety in the workplace. However, the results of the study indicated that insignificant work has been done to reward and more specifically punish employees who perform or underperform on safety-related activities respectively. These findings are in disagreement with the theory above that expects leadership to provide rewards and punishment to employees in order to reinforce positive safety practices.

6.2.2 Discussion on employee involvement in safety-related activities

The findings of the study indicated that Eskom employees are involved in safety-related activities. In particular, information about company policy on safety, employee safety knowledge, demonstration by employees on safety behaviour, importance of safety to performance, compliance with safety policies by employees, employees are positive on their safety roles, employee involvement on improving safety in the workplace, employees demonstrate safety behaviours, information sharing on safety among employees and employees show a prudent approach on safety related issues were perceived to be very good. These findings are in total agreement with the theory of French and Scott Geller (2008) which stresses that employees contribute to a culture of safety excellence and hence need to be actively engaged in safety and safety improvement process within the organisation. This helps to reduce injuries, deaths, property damages, and facilitates in having a safe and secure work environment.

6.2.3 Discussion on safety environment in the workplace

The findings of the study demonstrated that there is a general excellent safety environment in the workplace (Eskom). In particular, excellent perceptions were expressed on safety management systems in place for hazard prevention and control, proactive approach of Eskom with regards to hazard prevention and awareness on hazards prevention at work, frequent safety workshops. The good outcomes were observed on constant safety reviews that are often undertaken, application of safety practices, and embedment of safety-related issues into work processes.

These findings are supported by Wachter and Yorio (2014), who emphasised that an organisation needs to have in place appropriate safety management systems such as safety ingrained into work processes and procedures, visible information on safety at work, standard safety practices, regular safety workshops, safety reviews, and regular reporting on safety. Wachter and Yorio (2014) stressed that these safety systems promote a good and continuously improved safety environment in the workplace and are focused on hazard prevention. However, employees accurate reporting on safety issues at the workplace was average. This should be investigated further and perhaps solutions such as anonymous reporting be explored.

6.2.4 Discussion on the relationship between employee engagement, leadership involvement, and safety

Theory suggests that there is a strong positive link between employee engagement and safety outcomes in the workplace (Harter et al., 2009). This theory is well supported by the results of the study that revealed a strong correlation between employee involvement and safety in the workplace. Fukuda et al. (2009) also found that management involvement in safety activities within an organisation was positively associated with good safety performance. The findings of the study were also in line with the findings of Fukuda et al. (2009), as they revealed that leadership involvement was positively correlated with safety.

6.3 Conclusion

Based on the information obtained from the respondents in this study, it can be concluded that there is good visibility and involvement of management in safety-related activities at Eskom. The findings of the study also indicated that there is good clarity of policy on health and safety, communication of safety policies, management commitment on safety in the workplace, and compliance with safety regulations. Also, management was perceived to provide support on staff involvement in safety-related activities. However, provision of rewards to employees in order to reinforce positive safety practices and inflicting punishment on underperforming employees on safety-related issues in order to strengthen positive safety practices in the workplace was perceived to be only average. Eskom employees should be encouraged to report safety incidence including near misses.

Information about company policy on safety, employee safety knowledge, compliance with safety policies by employees, demonstration by employees on safety behaviour, importance of safety to performance, safety is equally as important as economics, employees are positive on their safety roles, employees involved in improving safety at work, employees show prudent approach on safety related issues and information sharing on safety amongst employees were perceived to be good within Eskom. Nonetheless, employee ownership on safety, employee training on safety, content of training in safety, cooperation from management on safety, and employees' show of prudence on safety issues were rated low.

Respondents expressed delight on safety management systems in place for hazard prevention and control, hazard prevention, constant safety reviews that are often undertaken, application of safety practices, awareness on hazards prevention at work, frequent safety workshops, and embedment of safety-related issues into work processes. Nevertheless, reporting on safety-related issues in the workplace was perceived to be below par.

Using correlations model, the findings of the study established that safety in the workplace is significantly dependent on employee involvement. However, no significant influence of leadership's commitment to safety was found. Correlation analysis revealed a positive and moderate association between leadership commitment and employee involvement, and leadership commitment and safety with significant ($p < 0.01$) correlation coefficients of 0.608 and 0.566 respectively. A positive and strong or high dependable correlation (with a correlation coefficient of 0.762) that was significant at $p< 0.01$ was observed between employee involvement and safety in the workplace. The results show that increasing population data will have a positive effects on some parameters and also negative effect on other parameters.

Eskom Koeberg Nuclear Power Station is a member of the World Association of Nuclear Operators (WANO), which is an international group of nuclear operators dedicated to nuclear safety. The mission statement of WANO is to maximise the safety and reliability of nuclear power plants worldwide by working together to assess, benchmark, and improve performance through mutual support, exchange of information, and emulation of best practice.

Nuclear safety culture at Koeberg Power Station is emphasised at all levels of the organisational structure. This is achieved through continuous training which involves individuals doing refresher courses when their training expires. Nuclear safety culture at Koeberg Power Station training includes Plant Access Training (PAT) and Human Performance (HP) tools which all emphasise sharing of knowledge, performing work safely, use of right procedures, and questioning attitude. In addition to these training courses and on a monthly basis, departments are also mandated to present and discuss a nuclear safety trait of the month with their staff. On a daily basis, groups such as maintenance, chemistry, and operations, which interact with the plant more often, perform briefing sessions before the start of each work package and also present and discuss the nuclear safety trait of the day. All these measures instil awareness and consciousness of nuclear safety and general safety both at work and at home. This awareness should be emphasized for Nuclear Build employees to foster a culture of nuclear safety.

6.4 Recommendations

The report of this study into the Strategies towards the Development of Safety Cultures: An Eskom Nuclear New Build Project Survey will be made available to the following stakeholders:

- Mr Dave Nicholls (Eskom – Nuclear Divisional Executive)
- Eskom Nuclear Outage Management – Koeberg Power Station
- Human and Organisational Performance, Eskom Nuclear
- Nuclear Engineering
- Nuclear Project Management
- Nuclear Client Office
- Nuclear Support
- Eskom Transmission and Sustainability
- Eskom Information Centre

Eskom leadership, as the main driver of safety culture, has to demonstrate more commitment towards safety culture by enabling, modelling, inspiring, and reinforcing good safety practices in the workplace that comply with the policies of the organisation. This can be achieved by conducting regular planned safety management audits and assessment throughout Eskom. The frequency at which these assessments are done will provide an indication of a safety culture. The Eskom leadership in the Nuclear Division has to act upon and implement recommendations from the audits and assessments. Eskom leadership has to provide the necessary resources to conduct assessments and implement findings from the safety management assessment. The strong senior management commitment and involvement towards safety culture will promote a positive safety culture and reinforce good safety practices in the workplace, thus benefiting the organisation. Good safety leaders must be confident enough to be audited by an external auditor. It is one thing to do an internal audit, yet another thing to bring in an outsider to do an external audit.

Leadership commitment is crucial to safety culture because it influences employee involvement. Positive leadership sets the tone for expected behaviour of employee in the workplace. If leaders adhere to the correct safety procedure, employees are inspired to do the same. Leadership commitment impacts employee involvement and thus the enforcement of safety culture.

Eskom needs to provide rewards to employees who perform well on safety-related activities in order to reinforce positive safety practices. Again, the organisation needs to inflict punishment on underperforming employees on safety-related issues in order to strengthen positive safety practices and culture in the workplace. The employees must be recognised and rewarded as soon as possible for their behaviour. The recognition system must be proportional to the importance of the behaviour. Similarly, failure to adhere to positive safety practices must be addressed immediately in the organisation. The benefit of rewarding employees for doing a good job is that Eskom increases the likelihood of an employee practising a good safety culture in the workplace. This behaviour becomes a standard practice of a good safety culture.

Eskom needs to have a visible and clear company policy on safety that is well communicated to employees and all other stakeholders of interest. Communication of the importance of safety in the workplace should be done through a variety of channels, to capture various audiences. The benefit of clear company policies on safety is that Eskom employees will have a clear idea of what is expected of them, in terms of the organisation's objectives. Furthermore, the human resource development in the organisation will be supported. Clear company policies also support quality initiatives aimed at continuous improvement.

Eskom employees need to be empowered through being involved in safety planning. This gives employees a sense of ownership of safety process and a better understanding of issues that pertain to safety in the workplace. The more an employee understands and takes ownership of the safety plan or process, the more he or she will take action. The high response rate from Nuclear Engineering in this study implied that the department is more willing and open to express or raise matters of concern. This should be encouraged, as it falls under one of the healthy nuclear safety culture traits. Employees take ownership in processes that they developed.

Eskom needs to encourage its employees to contribute to a culture of safety in the workplace by bringing new ideas to management's attention. An internal safety communication system should be reinforced by both management and staff, which will increase an awareness of safety topics and transfers of knowledge to empower people to be successful. Ideas can be shared using toolbox talk in a construction environment and meetings.

Eskom should ensure that its employees are continuously educated and trained on safety. The training should emphasise on how to identify hazards, manage risks, and do the job safely in the workplace, among other things. Education and training should focus on improving knowledge and skills necessary for safety practices. Better-equipped employees and management will be able to reach the desired goals and objectives of the nuclear safety culture. This will ultimately add value to the organisation as a whole. A comprehensive nuclear safety culture training programme needs to be established to provide Eskom with measurable results. Eskom needs to educate employees on reporting safety issues in the workplace including injuries, first aids and near misses.

Efforts being done by Human Performance department in Nuclear Division, more specifically at Eskom Koeberg Power Station on the 10 traits of a healthy Nuclear Safety Culture, are commendable. The workshops on Nuclear Safety Culture to discuss issues associated with safety culture and development thereof must be encouraged to take place regularly. They will assist and accelerate the development of a safety culture, and they will help gain greater public acceptance and trust of the nuclear industry.

Another important aspect to be considered is regarding training on safety. To guarantee that training on safety is effective, Eskom can enlist workplace safety experts to review the content and context of all materials for training on safety in the workplace.

Eskom must ensure that there are periodic reports of all injuries (minor and major), including incidents of near misses. The organisation must also look out for and report hazards in the workplace. Employees need to be encouraged to report safety issues in the workplace and met with praise when they report them. Behavioural Safety Observations (BSO) is currently being done by staff and management in other departments at Eskom; however, this should be encouraged in other departments within the Nuclear Division. BSO could be linked to the key performance indicators for the employees and be integrated with the safety and objectives of the organisation. The benefits of the periodic reports are that the organisation sets the standards for accurate and detailed reporting of injuries and illness and ensures that nothing is swept under the rug.

6.5 Further study

The following are suggested for future research:

- A further study should be carried out to assess the influence of reward systems on positive safety practices at Eskom. Recognising and rewarding employees for compliance with safety practices, is one way of developing and reinforcing that working safely is valued by an organisation. The benefits of a reward systems is that safety management will provide recognition to the delivery of an effective safety performance. The need for a study is to establish whether a positive safety climate created through safety recognition and rewards system, could lead to reduced workplace safety incidents.

- A further study needs to be carried out to assess attitude and behavioural factors affecting safety culture at Eskom. A poor safety culture encourages an atmosphere where not complying with safety working practices, is acceptable. An organization's attitude and values regarding a safe working environment for its employees should be a norm. These important factors influence's the organization safety performance. The need for a study is to assess whether behavioural safety initiatives at the workplace improves employee's perception and attitude towards work related safety strategies. It is also important to develop an instrument to measure what the employee's perception and attitude hold towards Eskom safety efforts.

References

Arezes, P. & Miguel, S. (2003). *The role of safety culture in safety performance.* Measuring business excellence. http://dx.doi.org/10.1108/13683040310509287 (Accessed 16/01/2015).

Baruch,Y&Brooks,C.(2008). Survey response rate levels and trends in organizational research. http://journals.sagepub.com/doi/pdf/10.1177/0018726708094863 (Accessed 28 May 2017)

Bergerson, B.C. (2003). *Tool to be used to survey and improve safety culture in the European railway industry.* http://www.sintef.no/globalassets/upload/teknologi_og_samfunn/sikkerhet-og-palitelighet/prosjekter/safeculture/hovedoppgave_camillabergersen.pdf (Accessed 13/03/2014)

Black, R. (2011). *Fukushima: As bad as Chernobyl?* http://www.bbc.com/news/science-environment-13048916. (Accessed 20/08/2011)

Brand South Africa (2012). *South Africa energy supply.* https://www.brandsouthafrica.com/investments-immigration/business/economy/infrastructure/energy (Accessed 14/10/2014)

Brooks, J. (2012). *A culture within a culture: The impact of organizational culture on nuclear safety.* IAEA Technical Meeting on Safety Culture in Pre-operational Phases, Cape Town, South Africa, 26-30 November.

Chib, S. & Kanetkar, M. (2014). *Safety culture – The buzzword to ensure occupational safety and health.* http://creativecommons.org/licenses/by-nc-nd/3.0/ (Accessed 18/10/2014).

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (Revised edition). Orlando, CA: Academic Press.

Creswell, J.W. (2003). *Research design qualitative, quantitative, and mixed methods approaches.* 2nd ed. Thousand Oaks, CA: Sage.

Davis, D. & Cosenza, R. (2005). *Business research for decision making.* 3rd ed. Bellmont: Wadsworth Publishing Company.

DoE (2010). *Integrated Resource Plan for Electricity 2010-2030*. Revision 2. http://www.energy.gov.za/IRP/irp%20files/IRP2010_2030_Final_Report_20110325.pdf (Accessed 20/11/2013)

ECAST. (2011). *Safety management and safety culture.* http://easa.europa.eu/essi/ecast/main-page-2/sms/ (Accessed 10/01/2015).

Ek, A., Runefors, M. & Borell, J. (2013). *Relationships between safety culture aspects – A work process to enable interpretation.* http://www.elsevier.com/locate/marpol (Accessed 10/10/2014).

Ekenedo, G.O. (2010). *Comprehensive first aid and safety.* Port Harcourt: The Glory of the Later House Publishing Co.

Ekenedo, G. (2013). Framework for developing and sustaining sound safety culture in a developing economy. *European Journal of Natural and Applied Sciences,* 1(1), pp. 31-40.

Ellis, S.M. & Steyn, H.S. 2003. Practical significance (effect sizes) versus or in combination with statistical significance (p-values), *Management Dynamics,* 12(4): 51-53.

French, R. & Scott Geller, E. (2008). *Creating a culture where employees own safety.* http://www.safetyperformance.com/CreatingaCultureWhereEmployeesOwnSafety.pdf (Accessed 10/01/2015).

Fukuda, H., Imanaka, Y., Hirose, M. & Hayashida, K. (2009). Factors associated with system-level activities for patient safety and infection control. *Health Policy,* 89(1), pp. 26-36.

George, D. & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update.* 4th ed. Boston: Allyn & Bacon.

Gibb, A. (2011). *Eskom proposed Nuclear-1 Power Station draft environmental impact report.* Arcus Gibb (Pty) Ltd.

Gould, P. (2008). *Fire in the rain: The dramatic consequences of nuclear accidents.* Baltimore, MD: Johns Hopkins Press.

Gross, C. (2012). Electricity generation options considered by Eskom. Presentation at the Energy Planning Colloquium.

Harter, J. K., Schmidt, F. L., Killham, E. A. & Agrawal, S., T. L. (2009). Q12 Meta-Analysis: The Relationship Between Engagement at Work and Organisational Outcomes.
www.gallup.com/consulting/File/126806/MetaAnalysis_Q12_WhitePaper_2009.pdf. Accessed 14/05/ 2014

HSE. (2001). *A guide to measuring health and safety performance.* http://www.hse.gov.uk/opsunit/perfmeas.pdf (Accessed 15/01/2015).

Honeywell. (2013). *Culture of safety.* http://www.honeywellsafety.com/Culture/?LangType=1033 (Accessed 03/03/2014).

Hudson, P. T. W. (2001). *Safety management and safety culture: the long, hard and winding road*. Occupational health and safety management systems

Humphries, J. (2012). *Developing a safety culture.* http://www.amicentral.org/Loss Control/powerpoint (Accessed 16/07/2014).

IAEA. 2002. *Safety culture in nuclear installations: Guidance for use in the enhancement of safety culture.* IAEA: Austria.

IAEA. 2012. *Project management in nuclear power plant construction: Guidelines and experience.* IAEA: Austria.

Jacobs, G. (2014). Nuclear Sites Department Management Manual, NSIP01816, Eskom.

Jovašević Stojanović, M. & Stojanović, B. (2009). *Performance indicators for monitoring safety management systems in chemical industry.* http://www.doiserbia.nb.rs/img/doi/1451-9372/2009/1451-93720901005J.pdf (Accessed 16/01/ 2015).

Kritzinger, J. (2015). *Eskom corporate affairs media assessment.* http://intranet.eskom.co.za/CommunicationsContentHub/DailyMediaAssessments/MediaAss%2015%20April%202016.pdf (Accessed 15/04/2016).

Leedy, P.D. & Ormrod, J.E. (2010). *Practical research planning and design.* Upper Saddle River, N.J.: Merrill Prentice Hall.

Levene, H. (1960). *In Contributions to probability and statistics: Essays in honor of Harold Hotelling*. Stanford University Press, pp.278-292

Lewis, J. (2005). Becoming a practitioner researcher: Study guide for MBA, 736 Milton-Keys: Open University.

Mqadi, L. (2011). The Eskom News Journey, COP 17-CMP 7, Eskom.

Menard, S.W. (2002). Applied logistic regression analysis (2nd Edition). Thousand Oaks, CA: Sage.

Myers, R.H. (1990). Classical and Modem Regression with Applications, 2nd ed., Duxbury Press, Boston.

Nahrgang, J., Hofmann, D. & Morgeson, F. (2011). *Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement and safety outcomes.*

National Planning Commission. (2012). National Development Plan 2030: Our future – make it work.

NNR. (2008). Quality and safety management requirements for nuclear installations, RD-0034, National Nuclear Regulator.

Oedelwald, P. (2012). *Safety culture in the construction phase – lessons learned from Olkiluoto 3.* IAEA Technical Meeting on Safety Culture in Pre-operational Phases, Cape Town, South Africa, 26-30 November.

Perry, R. (2013). Nuclear Build Management Manual, Report No.300-1032, Eskom.

Reiman, T. & Pietikäinen, E. (2010). *Indicators of safety culture – selection and utilization of leading safety performance indicators*. Report number: 2010:07 ISSN: 2000-0456. www.stralsakerhetsmyndigheten.se (Accessed 15/01/2015).

Rumsey, D. (2016). *Statistics for dummies.* 2nd ed. John Wiley and Sons Incorporated.

Salkind, N.J.(2012). Exploring Research, Eight edition.Pearson Education, Incorporated.

Tavakol, M. & Dennick, R. (2011). *Making sense of Cronbach's alpha*. International Journal of Medical Education, 2, pp. 53-55

Tilwick, D.L. & Steynberg, B.J. (2012). Safety culture lessons learnt for application in construction, AV-QMS-PST-0003; 2012-11-27, Aveng Group.

Towlson, D. (2016). *Brief summary of some common safety management systems and related approaches.* http://www.rrc.co.uk/nlpdfs/Spring07/Articles/Viewpoint.html (Accessed 18/06/2016).

Yamane, T.(1967).Statistics, An Introductory Analysis , 2nd ed. New York: Harper and Row.

Wachter, J. & Yorio, L. (2014). A system of safety management practices and worker engagement for reducing and preventing accidents: An empirical and theoretical investigation. Accident and Analysis Prevention.

Watts, G. (2012). *New Safety Report-Sharing lessons learnt and new insights captured during development.* IAEA Technical Meeting on Safety Culture in Pre-operational Phases, Cape Town, South Africa, 26-30 November.

Welman,C., Kruger, F.& Mitchell, B. (2005). *Research Methodology.*3rd ed. Cape Town: Oxford University Press

Appendices

Appendix A: Research questionnaire

Master of Science in the Management of Technology and Innovation

This questionnaire constitutes part of the survey for a dissertation to be written as partial fulfilment of the programme of Master of Science

TOPIC OF STUDY

Strategies Towards The Development Of Safety Cultures: An Eskom Nuclear New Build Project Survey

Please indicate your preferred answer with an X in the appropriate box.

SECTION A: BACKGROUND INFORMATION

1. Highest academic level you achieved

Matriculation

Certificate

Diploma

Degree

Postgraduate

2. Indicate your position at work

Senior Manager

Middle-level Manager

Junior Manager

Operational staff

Other (specify)

3. Indicate your work experience in nuclear-related projects in years

Less than 2 years

2 to 3 years

4 to 5 years

More than 5 years

4. Your department

Regulation and Licensing

Project Management

Quality Management and Doc
Management

Johannesburg Nuclear Client Office

Nuclear Engineering

Transmission and Sustainability

Nuclear Fuel

Koeberg Nuclear Client Office

Other

SECTION B: LEADERSHIP COMMITMENT TO SAFETY

5. There is visible leadership showing involvement of management in safety-related activities at Eskom.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

6. Eskom's management is clearly committed to safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

7. Eskom's management supports the active involvement of staff in improving safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

8. Eskom has a very clear policy on health and safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

9. Eskom’s safety policy is reviewed from time to time to accommodate changes within the nuclear industry.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

10. Eskom’s management often communicates safety policies to every employee.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

11. Leadership at Eskom is committed to providing education and training to employees in order to improve knowledge and skills necessary for safety practices.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

12. Eskom leadership is committed to ensuring that the organisation is fully resourced on safety-related equipment.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

13. Leadership at Eskom is committed to ensuring that the organisation complies with safety regulations.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

14. Eskom leadership provides rewards to employees to reinforce positive safety practices.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

15. Management at Eskom inflicts punishment on underperforming employees on safety-related issues in order to strengthen positive safety practices in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

SECTION C: EMPLOYEE INVOLVEMENT ON SAFETY

16. Eskom employees are satisfied with information about company policy on safety.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

17. Ownership of safety is evident in all employees at Eskom.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

18. Eskom employees have the necessary knowledge and understanding of safety-related issues in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

19. There is a high level of compliance with safety policies by employees at Eskom.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

20. Eskom employees often demonstrate safety-conscious behaviour in the workplace.

I strongly disagree

I disagree

Neither agree nor disagree

I agree

I strongly agree

21. Most Eskom employees perceive safety as an important element in positively affecting employees' performance levels.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

22. Employees at Eskom believe that safety is equally as important as economic aspects.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

23. Eskom employees view positively their responsibilities of safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

24. Eskom employees show a willingness to get involved in improving their safety working conditions.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

25. All employees at Eskom are thoroughly trained on safety aspects in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

26. Eskom employees are mostly satisfied with the content of training in safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

27. Eskom employees are happy with cooperation from management in ensuring that safe working conditions prevail.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

28. Eskom employees show a prudent approach on safety-related issues in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

29. Eskom employees often share amongst themselves information on safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

SECTION D: SAFETY ENVIRONMENT IN THE WORKPLACE

30. Eskom has good safety management systems in place for hazard prevention and control.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

31. Workplace safety at Eskom undergoes constant examination.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

32. Eskom is often proactive with regard to hazard prevention in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

33. Every Eskom employee feels duty-bound to accurately report on issues related to safety in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

34. Every Eskom employee is encouraged to correct unsafe practices across the organisation.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

35. Eskom employees are more aware of the hazards associated with their work environment.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

36. There are often workshops, meetings, and safety awareness campaigns at Eskom to guarantee good safety practices in the workplace.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

37. Safety-related issues are embedded into the work processes at Eskom.

I strongly disagree

Disagree

Neither disagree nor agree

I agree

I strongly agree

38. Please identify three main challenges that Eskom faces with regard to safety in the workplace.

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

Thank you for your participation and time

Appendix B: Demographics

A – Demographics

To have a clear understanding of the respondents' perceptions on the safety culture within an energy utility in South Africa, basic statistics according to academic qualification, position at work, experience levels, and department were first analysed. Out of a total of 200 questionnaires that were dispatched to potential respondents within Eskom (which included senior managers, middle and junior managers, and operational staff), 135 responded. This gives a response rate of 67.5%.

A1.1 Distribution of the respondents by academic qualifications

Figure A1 illustrates the distribution of the respondents by academic qualifications. The figure shows that 67% of the respondents were in possession of a postgraduate qualification. Further, 27% and 6% of the respondents were in possession of a degree and diploma qualification respectively. None of the respondents were in possession of a matriculation certificate only. The researcher needed to establish the level of competencies, experience, and qualification of the study group to understand the level of maturity of the group. It is also important to obtain the management and employees' views on safety in the workplace. Accountability on safety falls on all levels in the organisation.

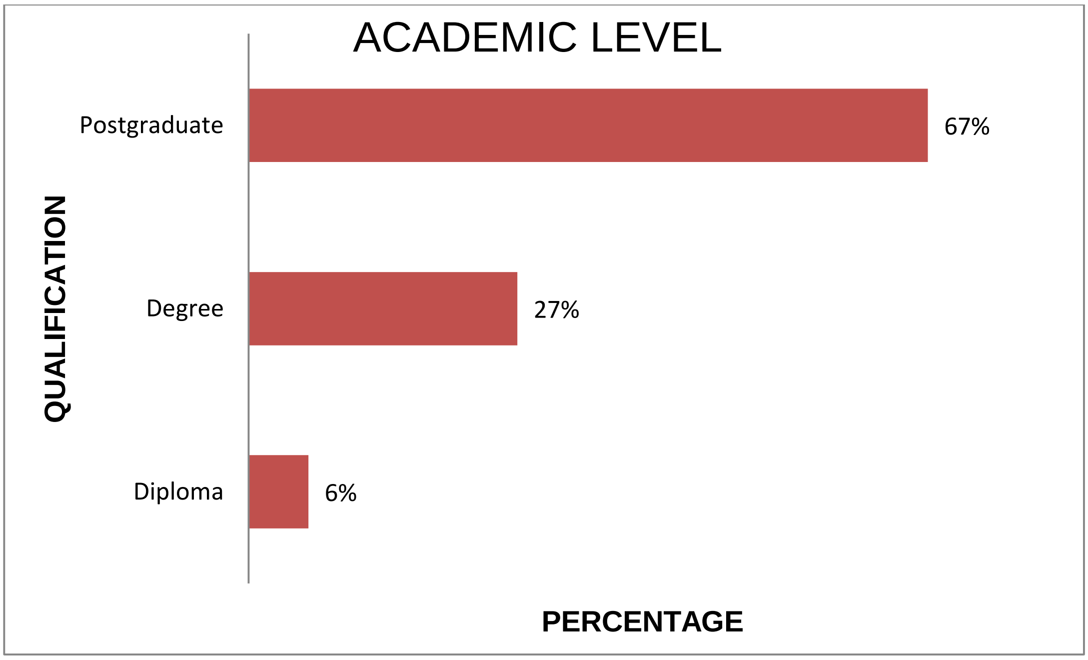

Figure A1: Distribution of the respondents by academic qualifications

A1.2 Distribution of the respondents by position at work

One of the key factors that contribute to safety culture is management commitment and employee involvement. It is indispensable in an organisation that this workforce is identified and they understand their role or position in communicating risks and supporting the correct behaviour.

The distribution of the respondents by position at work is illustrated in Figure A2. The majority (about 34%) of the respondents were middle management, while operational staff respondents accounted for 33%. Those in junior management positions accounted for 23% in total number of participants. Senior management personnel and other category contributed 5% apiece to the total.

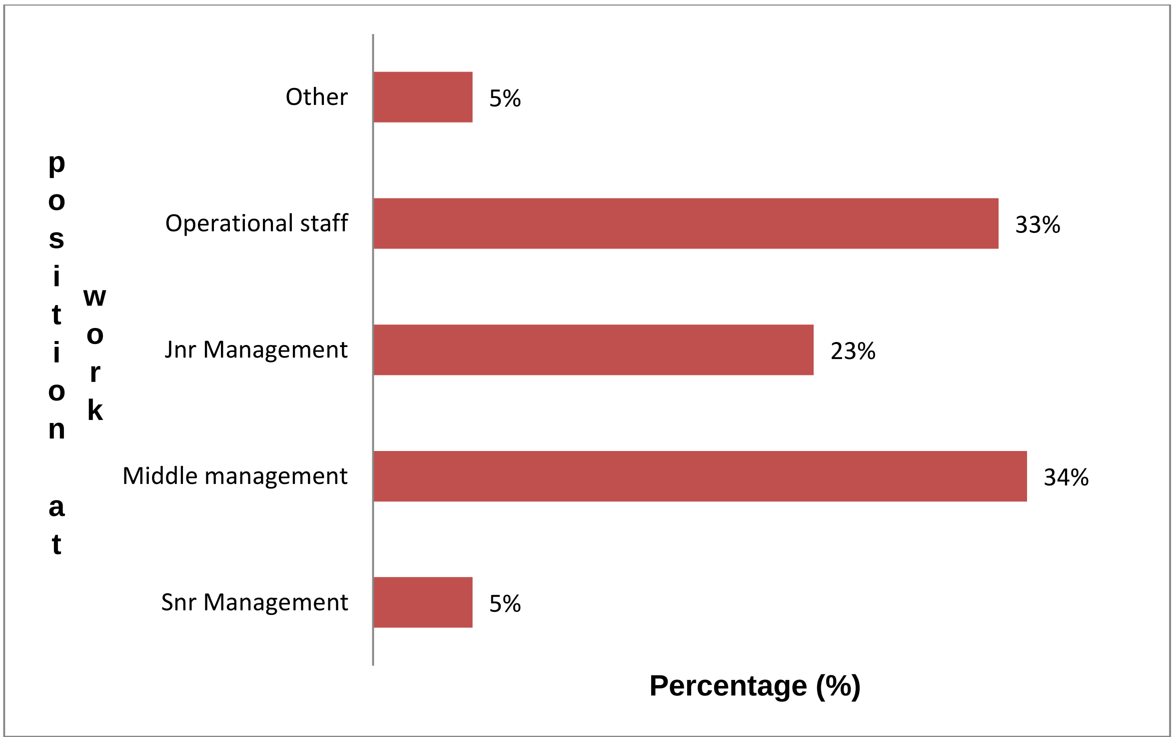

Figure A2: Distribution of the respondents by position at work

A1.3 Distribution of the respondents according to experience levels

Distribution of the respondents according to experience levels are demonstrated in Figure A3. The majority (about 65%) of the respondents have been working in energy, particularly in nuclear for at least five years. On the contrary, about 24% of the respondents have been working in energy, particularly in nuclear for a maximum of two years.

It is crucial to combine different employee groups in the survey, such as managers and non-managers, people from different functions, in order to get a different perspective on the key safety culture issues.

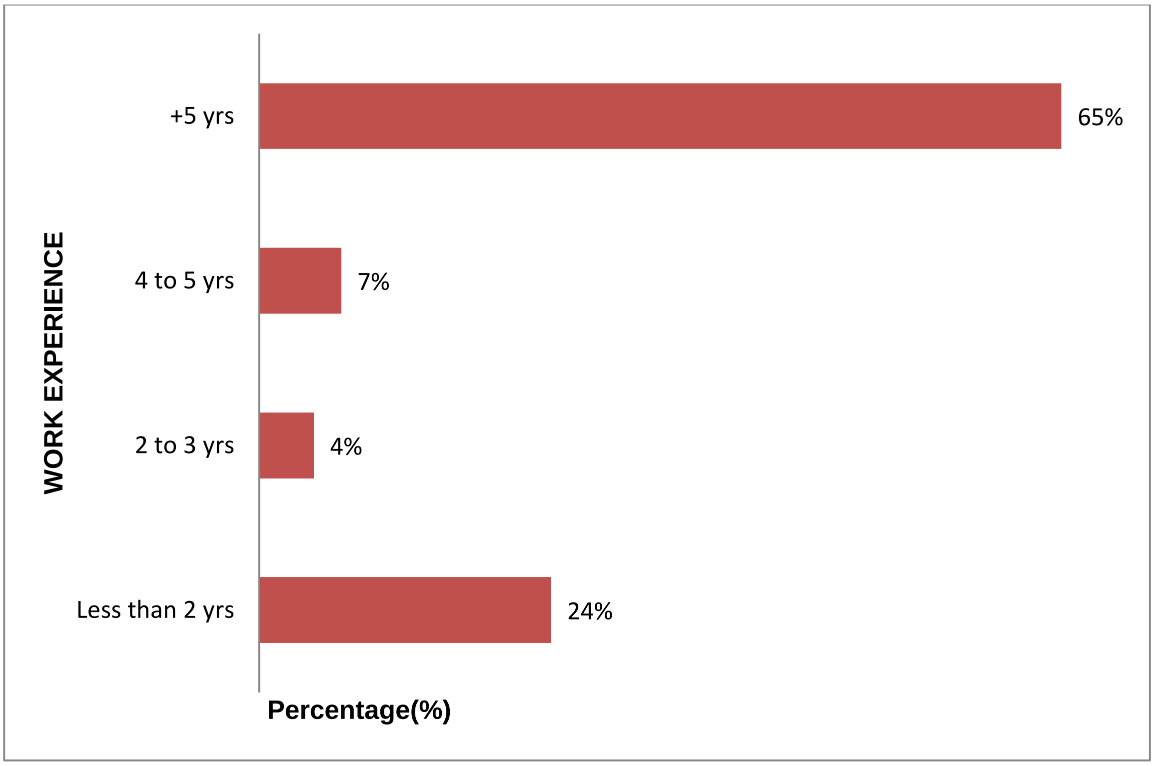

Figure A3: Distribution of the respondents according to experience levels

A1.4 Distribution of the respondents according to departments

Distribution of the respondents according to departments is illustrated in Figure A4. Respondents across nine departments took part in this exercise. Respondents from Nuclear Engineering contributed 24% to the total number of respondents. Transmission and Sustainability department contributed 18%, whereas Koeberg Nuclear Client Office contributed 19%,Regulation and Licensing and JHB Nuclear Client Office accounted for 7% apiece to the total number of respondents.

The high response rate from Nuclear Engineering, Koeberg Client Office and Transmission and Sustainability departments could imply that the departments are more willing and open to express or raise matters of concern.

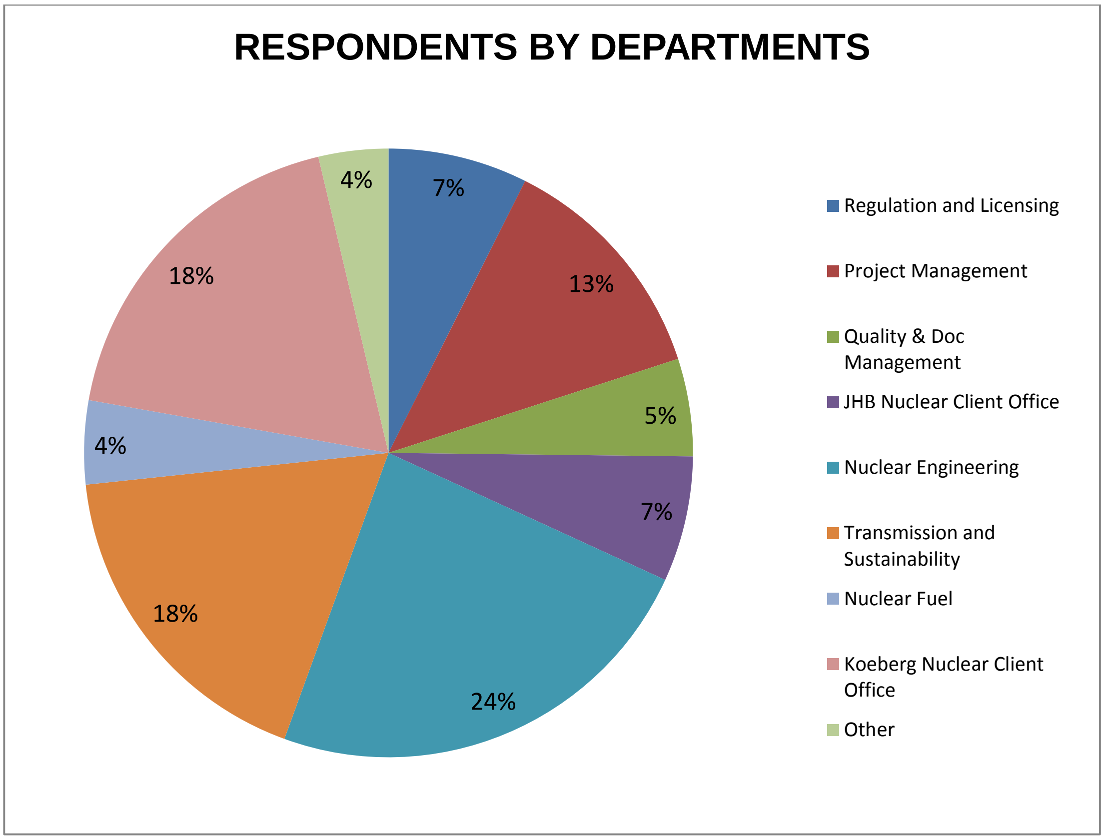

Figure A4: Distribution of the respondents according to departments

A1.5 Descriptive statistics on safety in the workplace

This subsection covers descriptive statistics on leadership's commitment, employee involvement, and general safety in the workplace.