Chapter 3: Water management in power generation within the South African water management framework

As shown in the previous chapter, water in South Africa is scarce and is becoming even scarcer due to the increasing water demand in all sectors. The power generation sector consumes a huge amount of this water and since Eskom is planning to double the power capacity by 2030, the impact must be minimised by applying an effective water management framework. The water management framework for power generation in South Africa will now be explored.

For the purposes of this study water management is evaluated by means of a top-down approach as illustrated in Figure 3.1.

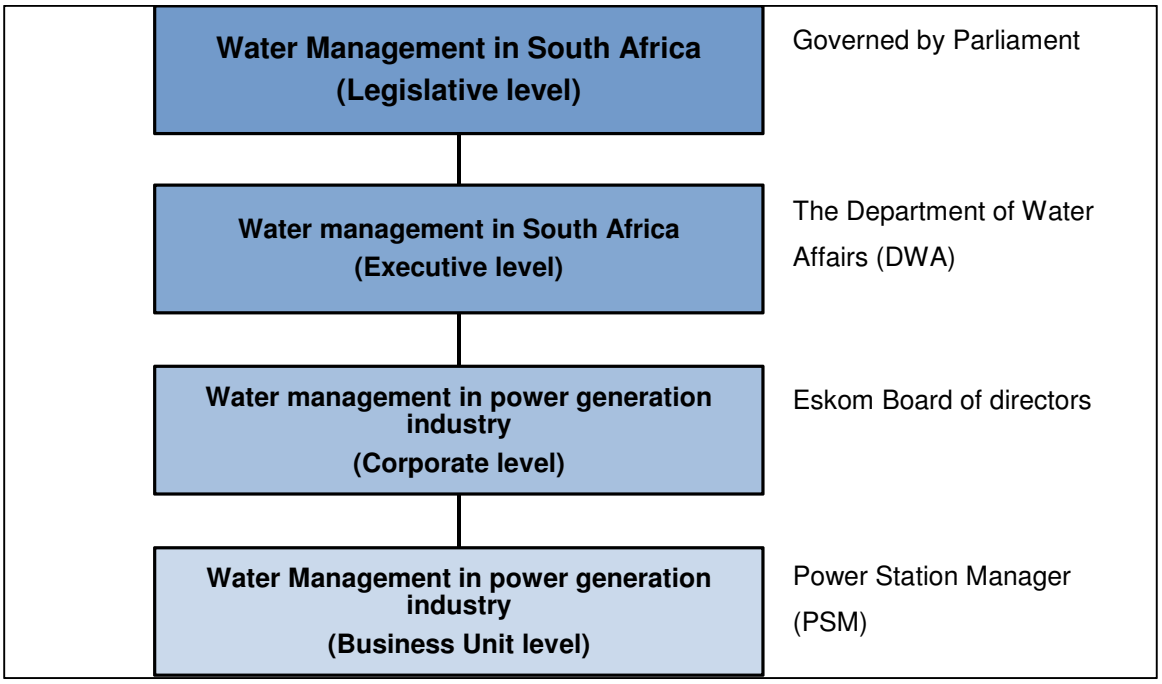

Figure 3.1: Water management approach.

The main requirements of a water management framework is given in paragraph 3.1 followed by an overview of water management in the power generation sector in paragraph 3.2. Thereafter, an integrated approach for an effective water management strategy for the power generation sector of South Africa is explored in paragraph 3.3. Finally, water management on Business Unit level is evaluated by means of a case study presented in Chapter 4.

3.1 Requirements of a water management framework

3.1.1 Documentation

Appropriate documentation of water management practices will enable continuous observation, evaluation and improvement of water management strategies utilised within the organisation. Documentation should include the organisation's water management plan, policy and procedures to be implemented. The recommended Eskom water management documentation structure is given in Table 3.1.

Table 3.1: Recommended Eskom water management documentation structure.

Water Management on Corporate Board Level	Water Management on Corporate Executive Level	Water Management implementation at PSM Level
•Intended direction •Purpose •Objectives •Roles & responsibilities •Water management governance •Procedures	•Scope •Strategy •Processes •Resources •Liabilities •Order of activities •Plan for improved practices	•Detail on roles & responsibility •Detail description of process steps •Method of reporting •Water management activities

3.1.1.1 Water management strategy

The water management strategy of an organisation should be in line with the National Water Resource Strategy (NWRS). This strategy summarises how the water resources of South Africa must be protected, used, developed, conserved, managed and controlled in accordance with the requirements of the National Water Policy of 1997 and the National Water Act No. 36 of 1998 (Muller, 2004).

In correlation with Table 3.1, the water management strategy of an organisation should typically document factors like (Goyder, 2012):

- Intended direction of the strategy
- Identify legislative and other regulations that relates to water management
- Objectives of managing water usage
- Reasoning behind managing the consumption of water
- Organisation specific strategies set out to achieve objectives
- The high level approach to water consumption within the organisation
- Identification of impacts on other users and the ecosystem

- Determination of water supply, recycling and disposal needs by means of water balances
- Identification of recycle opportunities and using different qualities of water
- Plans for treatment of wastewater
- Plans for improved practices within the organisation
- Monitoring and measurement systems
- Contingency plans

The NWRS (DWA, 2004) states that positive development in the mining and power generation sectors are vital for the economic growth of South Africa, and therefore requires high assurance of constant water supply. The power generation sector (including water used for the mining of coal for power generation purposes, disposal of by-products and pollution control) accounts for about 4.84 % of the national water supply, which amounts to 640 Gℓ/year (Wassung, 2010). This amount of water consumption has an immense impact on South Africa's water resources, and even though the power generation sector is assured of water supply, they are required to use water more efficiently without negatively impacting on economic activities. All water that is utilised for power generation purposes and is taken from a water resource or is stored on power station sites for any reason must be authorised by the Minister (DWA, 2004).

Because of the possibility of conflicting strategies in terms of water consumption and power generation, the strategy for the sector defines a framework of action that has the following outputs (NWRS, 2004):

- Continuous water audits and water balances to be done
- Benchmarks set for the water use of the different processes and industries
- Reports comparing the performance of the sector with the benchmarks that were set

To achieve these outcomes, power stations and mines are required to obtain a licence to draw water from national water resources. A Water Management Plan must also be submitted in accordance with the guidelines set by DWA (NWRS, 2004).

3.1.1.2 Water management policy

The governmental policy in terms of water management in South Africa is stipulated in the National Water Resource Strategy (NWRS). Currently the second draft of this strategy is being evaluated for implementation from 2013 (Molewa, 2012). The water management

policies of the power generating organisation should be in line with National water management policies.

The water management policy of the organisation should clearly state their objectives and commitment towards water management (Goyder, 2012):

- The accountable and responsible persons with regard to water management policy implementation
- Commitment to regular review and verification of the water management policies and continuous improvement thereof
- Integration of the organisation's objectives with the South African water management policies
- The rational of the organisation towards managing water consumption
- Methods and processes that are implemented to manage water consumption
- The method that are used to measure and report performance

3.1.1.3 Water management procedures

A water management procedure entails detail information on the approach used for water management. Such a procedure may include the following, as illustrated in Table 3.1(Alberta, 2011):

- Detail on responsibilities, accountabilities and resources
- Detail description of process steps
- Integration with existing water management initiatives
- Method of reporting
- Water management activities
- Water balances
- Methods to improve water performance by means of benchmarking

The water management policy, strategy and procedures may also be integrated into one document if all the necessary information is covered by the document.

3.1.2 Governance

The success of a water management framework depends on effective control thereof as well as having well defined roles and responsibilities. The employees of the organisation must at all times be aware of their responsibility towards reducing water usage and what role they play in the bigger picture. To be able to save water effectively, it is important to have all employees aware of why water usage must be minimised and how to make this part of their day to day activities. This indicates that water management is not only about having an

effective process in place, but it is also about enabling employees of the organisation to make the behavioural changes necessary to make water saving a natural practice.

3.1.2.1 Commitment and accountability

Water management, like any other big organisational initiative, needs a suitable amount of funds and support to be successfully implemented and sustained. It therefore needs commitment from every power station's management team, including the Power Station Manager (PSM), to do the following (Eskom, 2012):

- Specify and authorise the relevant water management policy
- Communicate the advantages of the water management strategy to all parties
- Define the water management key performance indicators (KPI's)
- Make sure the water management strategies of the power station is in line with the overall water management approach of the organisation
- Ensure compliance to laws and regulations; and
- Make sure effective structures are in place to support the water management framework.

It is important that every power station is held accountable for managing their water usage in an adequate and effective manner. This can be done by means of implementing and sustaining a water management framework.

3.1.2.2 Main factors of water management control

There are several factors that must be considered when developing the water management framework (Alberta, 2011):

- The power generation water management structure as it is currently
- The level of understanding about the water management practices by persons involved
- The level of commitment to water management practices by persons involved
- The readiness of the organisation to implement the water management framework
- Challenges the water management framework possibly may have to face

3.1.3 Information systems

In order to develop a successful water management framework, the correct tools and technology must be identified to help capture and analyse water usage related information. This information must then be distributed to the responsible persons that must make decisions regarding problematic areas.

Such information systems may include the following:

- Water measurement devices
- Water loss calculations
- Power station water balances

The following requirements must be met for water usage information to be utilised effectively within the framework (Eskom, 2012):

- It must be known what data needs to be captured
- The method of data capturing must be established
- The purpose of end-users must be clearly defined

The information requirements of the framework mainly involves the capturing, monitoring, analysing and reporting of water usage data for the different power stations that forms part of the power generation sector in South Africa.

3.1.4 Checklist for water management framework development

The checklist given in Table 3.2 provides a list of the different questions that must be asked and answered satisfactorily for the water management framework to be effective. The questions may also be used as a guide to determine the progress of the framework while it is being developed.

Table 3.2: Checklist for water management requirements.

#	Requirement	Essential (E) / Advanced (A)	In place (Yes / No)
1.	Has the organisation expressed their support towards the development and implementation of a water management framework	E	
2.	Has someone been identified as the responsible person to implement the water management framework	E	
3.	Does the water manager have access to staff across the organisation?	E	
4.	Are water management policies well defined within the organisation?	E	
5.	Are water management strategies and objectives well-established and documented within the organisation?	A	
6.	Is there awareness of the consequence of poor water management within the organisation?	E	
7.	Does the framework take into account effectiveness of water management strategies?	E	

8.	Is there a template for the capturing of water management information?	E	
9.	Are there practices in place to identify, analyse and monitor water management issues?	A	
10.	Is there a method for staff to record new water management issues?	E	

3.2 Overview of water management in power generation sector

Effective management of water usage in the power generation sector on corporate level is vital to ensure that power generating companies can deliver on their commitment to the South African community. This commitment involves water resources to be *"protected, used, developed, conserved, managed and controlled in accordance with the requirements of the policy and law"* (DWA, 2004).

There are several factors that have contributed to increased focus on effective water management in the power generation sector of South Africa (Eskom[2], 2012):

- Drought and water shortages
- Strict water use targets enforced by Water Affairs, which may result in higher maintenance costs and penalties for not meeting targets
- Planning between Department of Energy and the department of Water Affairs is not always in line (Conflicting policies)
- Limited water resources available at Eskom new build power stations
- Overall water quality deterioration results in higher raw water usage and more water treatment costs
- Possible future climate change may result in severe water deficiencies

A water management framework is meant to assist the power generation sector in the managing of its water usage through the application of a water management process.

3.2.1 Water management framework defined

A water management framework is defined by the Australian Government National Water Commission (AGNWC) as *"a set of fundamentals to be addressed by water managers to enable water reporting that is transparent, accessible and accountable"* (AGNWC, 2012).

Such a framework must take into consideration (AGNWC, 2012):

- The policies, objectives, governance and commitment towards water management which forms part of the organisation's operational policies.
- The organisational structure in terms of planning, implementation, monitoring and reporting, evaluation and improvement which forms part of the organisation's practices.

The purpose of establishing an organisational water management framework is to ensure that problem areas are effectively identified and responded to in the necessary manner. This includes things like the extent of the problem, the organisation's ability to accept and manage water usage challenges and the culture within the organisation related to water saving practices. Finally, water usage need to be managed in such a way that the organisation maximises its ability to meet its strategic objectives as well as water usage targets and goals (Alberta, 2011).

3.2.2 Key considerations

The following questions should be asked in the process of developing the water management framework (Alberta, 2011):

- What are the organisation's key goals and policies?
- How is the organisation measuring, managing and monitoring the implementation of these goals and policies?
- Are the water management practices working effectively?
- If not, why not?

3.2.2.1 Main elements of water management

For a water management framework to be effective, the correct balance between its structure and human elements like staff culture must be achieved. This is because for example an organisation that has a flawless water management structure in place, with no staff supporting and enforcing it, will prove the framework to be useless. Water management therefore includes the interrelationship between organisational culture and operational structures.

The strategic elements of water management include the following (AGNWC, 2012):

- Participation of parties involved (throughout)
- Clarity of rights and responsibilities of involved parties and the government (throughout)

- A well-established context
- Identification of problem areas
- Analysis of problem areas
- Evaluation of problem areas
- Improvement strategies for problem areas
- Monitoring and review of improvements

The relationship between these strategic elements is illustrated in Figure 3.2.

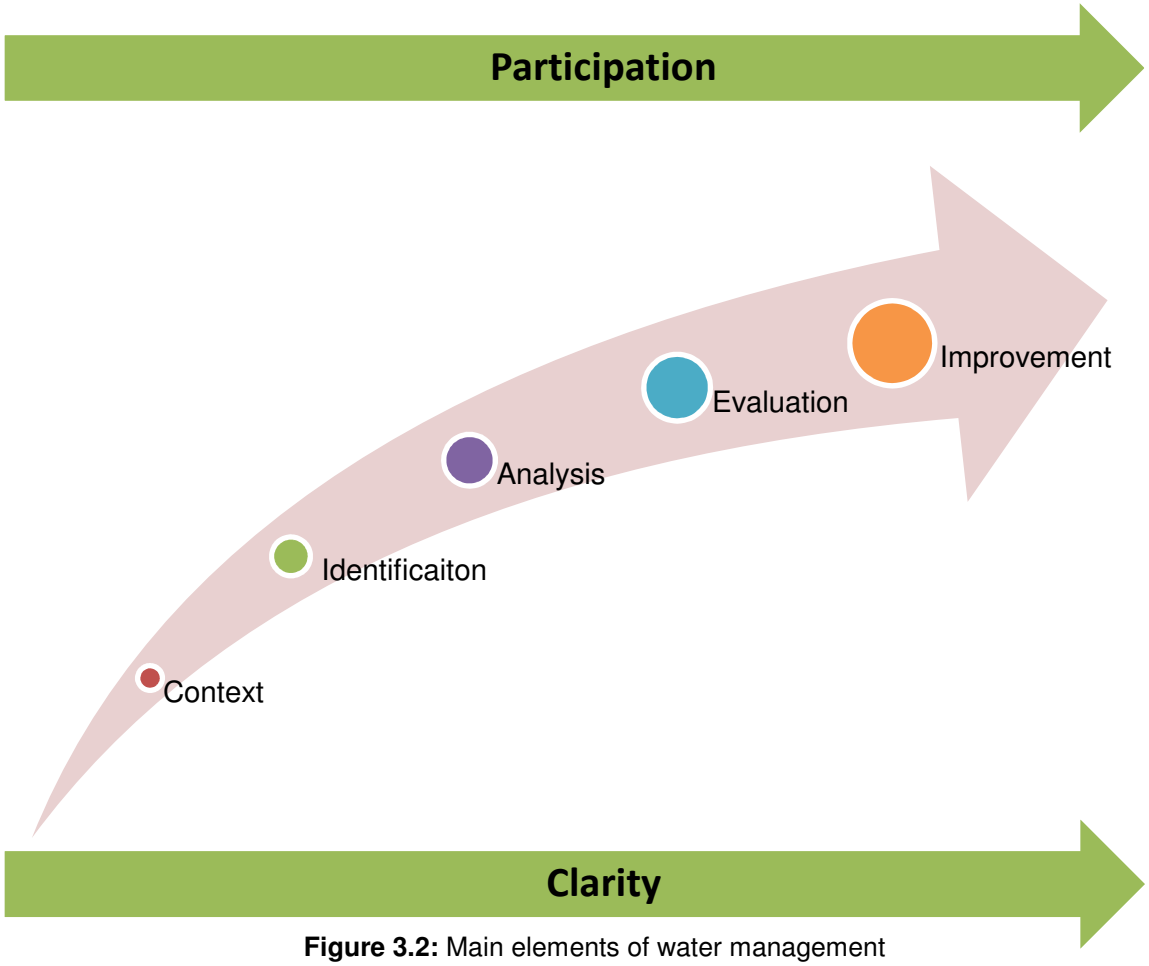

Figure 3.2: Main elements of water management

3.2.2.2 Integrating water management with operational strategies

To maximise the advantages of water management, it is vital to integrate water management strategies with the current operational strategies of the organisation. The implementation of such a water management framework in line with the cross-functional decisions of the organisation will assist in achieving its water management goals.

3.2.2.3 Qualities of an efficient framework

The qualities of an efficient framework include the following (Booth, 2011):

1. ***Simplicity*** – The overall design of the framework must be simple. The details to the framework may not be as simple, but the basic process and how it all fit together must be easy to understand.
2. ***Clarity*** – It must be clear from the layout of the framework how it fits into the bigger picture without the user having all of the details.
3. ***Boundaries*** – The boundaries of the framework must be well-defined. This relates to the meeting of requirements that form part of the responsibilities as set out by the framework.
4. ***Adaptable*** – The framework should be developed in such a way that it is capable of expansion and addition of functions as required by the user. If the framework is not expandable, it restricts the user and may not serve as a framework that is applicable in the user's specific environment.

3.2.3 Technical solutions to be integrated into framework

Potential methods of reducing water usage in the power generation industry include the following (NETL, 2009):

1. **Advanced cooling technologies** – New technologies are designed to reduce the cost and improve the performance of power stations, while also reducing the amount of water consumed in wet cooling, direct and indirect dry cooling power generation.
2. **Water reuse and recovery** – Water reuse methods like indirect dry cooling, desalination and condensing heat exchangers.
3. **Utilising water from non-traditional sources** – Water from coal-mines can be treated which serves as a cost-effective method to reduce the usage of freshwater with the added environmental benefit of reducing polluted mine water runoff.
4. **Modern and efficient water treatment technologies –** Advanced methods are being developed to remove pollutants and improve water treatment systems.

3.3 Water management framework for power generation

The water management framework requirements and overview given in the preceding paragraphs can now be utilised to reach an integrated approach for an effective water management strategy. This water management framework serves as the underlying basis on which water management in the power generation sector of South Africa can be built.

The water management framework given in Figure 3.3 serves as a strategic building block framework which takes into consideration the policies and strategies required by the South African government. This framework covers accountability aspects of power generation companies like Eskom in terms of governmental policies while also building on existing water management processes.

It is important to clearly distinguish legal requirements from company goals, standards and requirements. Legal requirements, as set out by the Department of Water Affairs (DWA), form the basis of all water management in South Africa. From the legal requirements, company policies are defined on corporate level, and the policies of the company will determine what standards, specifications and strategies are required for divisional and business unit level. These standards, specifications and strategies are the tools that make everything work.

Therefore, the order of water management in the power generation sector can be defined in different levels:

- ***Level 1*** – Legislative level: Governed by Parliament
- ***Level 2*** – Executive level: Governed by the Department of Water Affairs (DWA)
- ***Level 3*** – Corporate level: Governed by Eskom Board of Directors
- ***Level 4*** – Business Unit level: Governed by individual Power Station Managers

These levels are illustrated by means of a pyramid in Figure 3.3 where each level is more stringent and more detailed than the level above. Each subsequent level of the framework derives its mandate and authority from the level above. For the framework to be implemented successfully, it must make provision for each level to be monitored and "governed" by the level above it.

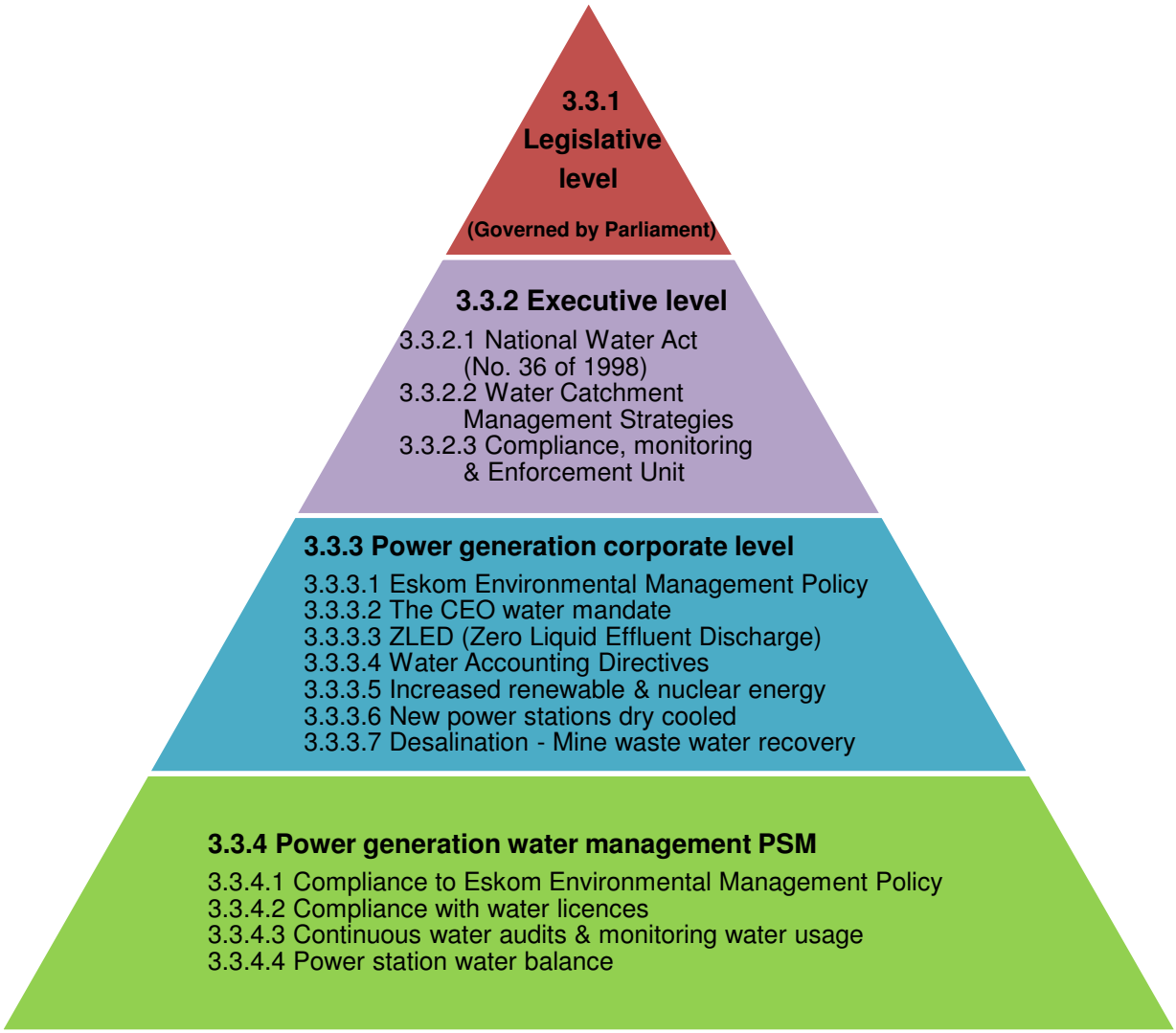

Figure 3.3: Water management authority for power generation in South Africa.

The four levels of authority illustrated in Figure 3.3 form the foundation of water management legislation and enforcement in the power generation sector.

3.3.1 Water management on legislative level

Water management in South Africa is governed by parliament on legislative level. The minister of Water and Environmental Affairs, Mrs. Edna Molewa, released a new National Water Resource Strategy (NWRS-2) to be implemented which *"sets out the strategic direction for water resources management with a particular focus on priorities and objectives for the period 2013 – 2017. It provides the framework for the protection, use, development, conservation, management and control of water resources".* This strategy may be utilised to provide the baseline of water management in all sectors due to the pressure on South Africa's water resources, and the need to manage these resources wisely (DWA, 2004).

3.3.2 Water management on executive level

Water management on executive level is governed by the Department of Water Affairs (DWA). It involves all National water management standards, specifications & strategies.

3.3.2.1 National Water Act (No. 36 of 1998)

The National Water Act (No. 36 of 1998) is the main legal instrument by which water resources in South Africa must be managed. Governance over water management practices is required in terms of the Act, (No. 36 of 1998) for the *"protection, use, development, conservation, management and control of South Africa's water resources."* Governance on government level is necessary to ensure the water management strategies of the power generation sector are in line with the overall water management approach of South Africa.

3.3.2.2 Water Catchment Management Strategies

The DWA has presented various programmes for the improvement of power station water management performance. The general concept of how the community is to be involved with water management as depicted by the National Water Act (No 36 of 1998) is described in the Integrated Water Resources Management (IWRM) plan. Eskom actively participates in the development of Catchment Management Agencies (CMAs).

South Africa has been divided into 19 CMAs which allows for the identification and analysis of individual problems in each area. This is appropriate since not all areas are facing the same problems; some problems may by more quantity related, whereas other areas may have bigger problems in terms of the quality of their natural water resources. These problem areas should then be improved on, and progress should be monitored and reviewed in order to measure performance and report back. All the different stakeholders of each CMA are required to manage water according to regulations set out by the IWRM (AWARD, 2008).

3.3.2.3 Compliance, Monitoring and Enforcement (CME) Unit

Regulation of the National Water Policy is one of the Department of Water Affairs' (DWA) key functions and risks in terms of its implementation have been identified. Therefore, the DWA established a new Compliance Monitoring and Enforcement (CME) Unit in the water sector to limit water transgressions and safeguard all water resources of South Africa. The CME Unit is responsible for monitoring compliance to legal water matters as well as enforcement in cases where there is non-compliance (Nepfumbada, 2010).

3.3.2.3.1 Compliance

In terms of water legislation like the National Water Act and the Water Services Act, all water users, including power stations, are liable for the following (Nepfumbada, 2010) :

- Water policy implementation
- Acquiring the necessary authorisation
- To be licenced in terms of their water usage

The employees of any organisation must at all times be aware of their responsibility towards reducing water usage and what role they play in the bigger picture. Management must be committed to compliance and motivate personnel to do the same. Funds are required to sustain implementation and ensure compliance. That is why organisational motivation to be committed is often driven by financial penalties if they do not comply with regulations (Nepfumbada, 2010). Unfortunately, these penalties do not always have a big enough impact in terms of financial detriment to override other business objectives and priorities. Therefore other methods to ensure commitment and accountability are also required.

3.3.2.3.2 Monitoring & Review

It is necessary to coordinate and monitor compliance to standards, licence conditions and regulations of all water catchment areas (Nepfumbada, 2010). This will be done by the CME Unit to increase the effectiveness of strategies and to ensure internal and public accountability (DPIWE, 2004).

3.3.2.3.3 Enforcement

The enforcing of water management policies are the responsibility of both the DWA and the water user, in this case, Eskom. Integration of the organisation's objectives with the South African water management policies is non-negotiable. Enforcement may be required in cases where non-compliance is found. It can be utilised as a method of restraining entities that do not comply with regulations by means of the appropriate legal action against illegal water use.

If the commitments and agreements taken by an organisation in terms of water usage are violated, the DWA moves to the next step which is the issuing of a "Notice of intention to issue a Directive". If no response or corrective action is given after a directive was issued, the DWA can move to Criminal Prosecution (Nepfumbada, 2010).

3.3.3 Power generation water management on corporate level

Water management on corporate level determines what policies and strategies the organisation needs to be in line with the national water management framework. The water management policy of an organisation should clearly state their objectives and commitment towards water management. Since Eskom is a strategic water user, the Department of Water Affairs (DWA) guarantees them 99.5 % water availability (Ringwood, 2006). This means that Eskom is accountable to use water responsibly and take a stewardship approach towards continuously improving water management strategies.

Various power generation policies and strategies are implemented to control the amount of water consumed. These include the following:

- Eskom Environmental Management Policy
- The CEO water mandate
- ZLED – Zero liquid Effluent Discharge
- Water Accounting Directive
- Increased renewable and nuclear power
- New power stations dry cooled
- Desalination - Mine waste water recovery

3.3.3.1 Eskom Environmental Management Policy

The Eskom Environmental Management Policy includes water management principles and continuous water usage improvement practices based on ISO 14001.

Every year strict targets are set for each power station in terms of water use for different processes to ensure water is re-used and managed according to the policy. The performance of the sector can then be measured against these targets to determine if water management practices are achieving desired outcomes. Since the DWA recognises Eskom as the only strategic water user in South Africa it is crucial that the Eskom Environmental Management Policy is strictly adhered to.

3.3.3.2 The CEO water mandate

As part of Eskom's commitment to the UN Global compact, annual reports on the progress and compliance with water conservation principles will be submitted. Water has been identified as a primary resource on which power generation is dependant and therefore securing control thereof is essential (Eskom[2], 2011).

As per the CEO mandate, Eskom has pledged to do the following (Eskom[2], 2011):

- Do comprehensive assessments of water consumption to explain how the company utilises water for the production of electricity and other reasons.
- Water conservation targets and waste-water treatment strategies.
- Investing in new water conserving technologies to achieve water management goals.
- Increased awareness of the importance of water conservation within the corporate culture of the company.
- Water sustainability must be taken into consideration in all business decision-making.

3.3.3.3 ZLED

Eskom adopted the ZLED (Zero Liquid Effluent Discharge) policy in 1987 to be implemented at power stations where the design allows it. This policy allows for the re-use of water through cascading, and thereby preventing polluted water to return to natural water sources (Pather, 2004). The budget for the technical implementation of ZLED at all power stations over the next five years as well as funds required to adhere to licence requirement have been approved (Eskom[2], 2011).

Cascading is the re-use of water for different applications based on its quality. Water is cascaded from higher quality to lower quality, measured by its conductivity. Water of higher quality will have a lower conductivity and is then used for applications that require high quality water such as cooling water. Water that is of low quality will have a high conductivity and is re-used for applications such as ash conditioning. Where possible, all waste water from the power generation process is captured and sent back to the water treatment plant waste water sump, where it is treated as required and re-used continuously. Finally, all pollutants should be captured by the cascading process and sent to ash dams, or ash heaps where water evaporates and leave pollutants behind. In wet cooling power stations, water is only allowed to be lost by means of evaporation, in the process dissolved and suspended solids are retained and no pollutants are deliberately discharged into our natural water resources (Pather, 2004). Unfortunately, water is also lost to ground water by means of dust suppression where some pollutants might be present in the water.

3.3.3.4 Water Accounting Directive

Water consumption can be effectively measured by means of accurate water accounting. Water accounting for a power station involves accurate balances of all water that goes in and out of a power generating unit. It takes into account leakage losses as well as UAW (Unaccounted-for water) and focuses on the reduction thereof (Mwendra *et al*., 2003).

The Water Accounting Directive policy has recently been approved and is to be implemented at all Eskom coal fired power stations to ensure effective and detailed accounting and management of water resources (Eskom[2], 2011). In collaboration with DWA (2009) Eskom has committed to cradle to grave life cycle costing of power stations as well as the reduction of water cost drivers. Accounting for the true cost of water is currently a difficult task, but the cost benefit of accurate water accounting may prove to be extremely important in the near future when water resources are predicted to be scarce due to over utilisation and climate changes.

3.3.3.5 Increased renewable and nuclear power

An increased focus on renewable power technologies as well as nuclear power is required. Eskom has committed in collaboration with DWA (2009) to increase wind, solar and hydro power to at least 1600 MW by 2025. Renewable power consumes considerably less water per kWh sent out than normal coal fired power as can be seen in Table 3.3. It therefore makes sense from a water conservation point of view for Eskom to invest in these technologies.

Table 3.3: Water consumption for different power generating technologies (Azevedo *et al.,* 2011).

Production method	Water consumption (ℓ/kWh)
Solar (PV)	0
Solar (Concentrated)	3.3
Wind	0
Coal	2.2
Nuclear (CW included)	3.3
Natural gas	0.8

Eskom has recently awarded partly sponsored contracts to independent renewable power companies to add renewable power to the grid.

Nuclear power offers the opportunity of utilising seawater for cooling purposes, thereby effectively consuming less water per kWh of power produced. This is one of the strategic drivers behind Eskom's plan to implement 9.6 GW of nuclear power to the National Grid.

3.3.3.6 New power stations dry cooled

One of Eskom's short term strategies for water conservation is the implementation of dry-cooling technologies at all new fossil fuel power stations. Dry-cooling technologies are more expensive in terms of capital as well as operating costs and there is efficiency loss in the power generation process, but Eskom has committed to this water conservation strategy

nevertheless. This is critical in water scarce areas like Limpopo province where new fossil fuel power stations are being built. Making use of dry-cooling technologies reduces the water consumption of a power station by 90 %, and with this strategy in place Eskom is already saving 70 million m^3 of water per year. This strategy is valid for all power stations accept those close to the coastline for which sea water can be utilised for cooling purposes (Eskom[1], 2012). The strategy also includes the decommissioning of wet-cooled power stations at their end of life.

3.3.3.7 Desalination - Mine waste water recovery

Eskom is investigating the possibility of utilising coal mine waste water as a supplementary water resource, thereby reducing the impact on water resources from coal mining for power generation purposes. Desalination, the removal of the maximum amount of salts by using the minimum amount of water while not compromising on efficiency, has been implemented at Lethabo and Tutuka power stations and forms part of the ZLED policy (Eskom[1], 2011). In this way the coal mine and the power station work together in a joint initiative to reduce pollution of South African water resources and improve waste water management (DWA, 2009).

3.3.4 Power generation water management on business unit level

Eskom is implementing several standards, specifications and strategies for better water management on power station level. The key strategic water management strategies at business unit level include the following:

- Compliance to Eskom Environmental Management Policy
- Compliance with water licences
- Continuous water audits & monitoring of water usage
- Power station water balances

3.3.4.1 Power station Environmental Management Policy

In order to comply with the Eskom Environmental Management Policy, every power generation facility must have an Environmental System based on ISO 14001. This includes water management and continuously improving water usage practices (Eskom[1], 2011).

Every year strict targets are set for each power station in terms of water use for different processes to ensure water is re-used and managed according to the policy. One such target is to use an average of less than 1.82 ℓ water per kWh of water consumed at Lethabo power station which is a wet cooled power station (Eskom[2], 2012).

3.3.4.2 Compliance with water licences

Every power station is required to obtain a water licence and to comply with the requirements set therein. The licensee, or power station, is responsible for compliance to the terms of the licence as well as the payment of any water use charges or levies imposed by a responsible authority. Audits on the implementation of water use licences are to be carried out as required by the conditions stipulated for the licence.

3.3.4.3 Continuous water audits & monitoring of water usage

Commitment to regular review and verification of water management policies and continuous improvement thereof is necessary. Performance in terms of water usage must be measured and reported periodically. This reported information must then be utilised as a means of finding solutions to recurring problems. Eskom has committed to continuously doing water audits and balances at all power stations and also to be transparent on all water issues experienced (Eskom[2], 2011).

Reviews on the water management at all Eskom power stations must be done every two years. Audits on water use licences are also to be carried out as required by the conditions stipulated for the licence. Blue and green drop assessments of water supply and infrastructure must be carried out at all power stations in compliance with the Water Service Act (DWA, 2009). Eskom has set individual annual targets for power stations by monitoring performance on a monthly bases and then reporting it annually. The annual average water consumption of Eskom must not exceed the target of 1.35 ℓ/kWh (Eskom[2], 2011) to prevent the over utilisation of resources.

Monitoring of water also involves the prevention of water degradation in terms of water discharged to natural water resources or groundwater (Mwendra, 2003). The actual water consumption of each power station is one of its Key Performance Indicators (KPI's), meaning that it has financial implications in terms of bonuses if targets are not achieved.

3.3.4.4 Power station water balances

Water that enters every power station is measured by the DWA at the power station's property borders. The water that enters the power station equals the water that goes out of the power station plus the water accumulated inside the power station as illustrated in Figure 3.4.

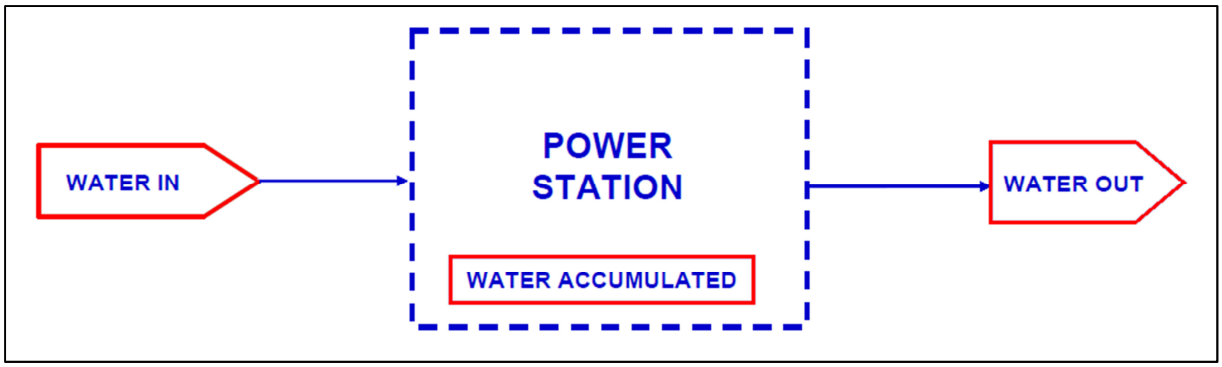

Figure 3.4: Basic power station water balance.

The metering procedure implemented at Eskom power stations is currently operating at an accuracy of 0.5 %, which is very good, but continuous verification and upgrades of these metering systems are still required to take place. From these measurements water and salt balances are carried out monthly in order to ensure performance is up to standard and all possible problems are identified (Eskom[2], 2011).

3.3.5 Implementation

The adoption of standard policies and procedures across the different business units are of great importance if accurate accounting and improved practices want to be achieved. Confirmation is required to demonstrate how water management processes have been implemented and how successful they are by means of critical reviews on an annual basis.

Poor implementation of good policies and strategies are often the result of conflicting policies and lack of management objectives. It is therefore very important that strong leadership and internal motivation is applied to successfully implement water management strategies. Internal motivation may include group sessions where the importance of water conservation is encouraged, signage that demonstrate the proper method of conserving water as well as incentives for individuals who have shown exceptional commitment and dedication to water conservation. Strong leadership will require management to work in line with the relevant water management institutions to ensure water management forms part of their strategic and business plans (DWA, 2004) and that everything possible is done to minimise water consumption.

Lastly, the implementation of effective water management at power stations will only be successful where there is a realistic and clear plan in place for implementation and where there are efficient funds dedicated to water management (DWA, 2004). The plan must be developed by key personnel involved with water management at power stations and set out

applicable and realistic targets and strategies. Water management targets must be part of the power station's KPI. Achievement must be acknowledged and awarded, and non-achievement must carry a penalty within the performance appraisal system.

3.3.5.1 Limitations of the framework

The following limitations of the framework have been identified in terms of compliance, monitoring and enforcement of water management policies and strategies:

- It is not clear if Eskom has the aptitude to take all the different water concerns into account and come up with strategies to solve all the water related problems for every power station.
- There is a backlog for the issuing of water licences by the DWA, and no real solution as to how the backlog will be addressed. This results in a long time delay when entities apply for a licence and therefore they are allowed to operate illegally while they are waiting for their water licences (Nepfumbada, 2010).
- Legal processes are often time consuming and complicated which may lead to all laws not being enforced as they should.
- In terms of the National Environmental Act (NEMA) Eskom cannot be prosecuted because they are a part of state, and therefore criminal investigations against them may prove to be ineffective.

3.3.5.2 Advantages of the framework

The advantages of the water management framework described as part of this dissertation include the following:

- It serves as an illustration of how national, departmental, corporate and business unit level regulations, policies and strategies fit together.
- It builds upon existing processes.
- It clarifies accountability to all those involved in water management of the power generation sector.
- It serves as a link between different information sources on the water management topic in the power generation sector.
- It provides a basis to build on for water management of the power generation sector.

Water management in the power generation sector of South Africa as described in Chapter 3 will now be investigated on the business unit level by means of a case study on Lethabo power station in Chapter 4.