

# Benchmarking of a Management System

A Case Study from the Swedish Nuclear Industry

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Benchmarking of a Management System  
A Case Study from the Swedish Nuclear Industry

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## **Abstract**

This dissertation is a case study from the Swedish nuclear industry, an industry, which is very hard regulated. All proprietors of nuclear facilities in Sweden have to comply with the injunctions of SKI. In injunction SKIFS 2004:1 states SKI (Swedish Nuclear Power Inspectorate) that all nuclear facilities shall be managed and developed with the support of a quality assurance system, they recommend that IAEA's norms and standards for quality assurance could be used as guidance. In 2006 IAEA released a new set of requirements called IAEA GS-R-3, which focuses on management systems. The Swedish nuclear power plant Ringhals AB wanted to analyse how their management system RVS stood against this standard, this came to be the purpose of this dissertation. Ringhals AB is Sweden's largest power plant in the Nordic countries and has about 1300 employees. One of the keys within IAEA GS-R-3 is that it integrates all aspects of managing nuclear installations and activities including safety, health, environment, security, quality and economic requirements. It also has strong influences from other management systems standards such as ISO 9001 and ISO 14001. The author has searched through documents within RVS to locate and evaluate if the requirements from the standard are fulfilled. The result from the study was that a few gaps were identified where RVS did not fulfil the requirements in the standards. The requirements that were not fulfilled was further analysed and a suggestions on what RAB can do to fulfil the requirement was given. Apart from direct deviations were also general differences in the approach on management system between IAEA and RAB discussed. The conclusion summons that RVS is a well worked through management system that with some adjustments could fulfil of the requirements in IAEA GS-R-3.

## **List of abbreviations**

AFS - Arbetsmiljöverkets Föreskrifter (Swedish Work Environment Authority Regulations)

EFQM - European Foundation for Quality Management

EMAS - Eco-Management and Audit Scheme

IAEA - International Atomic Energy Agency

IMS - Integrated Management System

ISO - International Organization for Standardization

KTL - Kärntekniklagen (Act on nuclear activities)

OHSAS - Occupational Health and Safety Management Systems

OSART - Operational Safety Review Team

PDCA - Plan-Check-Do-Act

RAB - Ringhals AB

RVS - Ringhals Verksamhetssystem (Ringhals Management system)

SKI - Statens Kärnkraftsinspektion (Swedish Nuclear Power Inspectorate)

SSI - Statens strålskyddsinstitut (Swedish Radiation Protection Institute)

TQM - Total Quality Management

UN - United Nations

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# 1 Introduction

*This chapter provides the reader with some background to why this dissertation is conducted, what will be studied delimitation of the study and the sole purpose of the study. It also includes a description of the company Ringhals AB, which initiated and supported the study.*

## 1.1 Background

In the yearly report on Human Development released by UN (2007) it is stated that nuclear power accounts for 36.2 % of Sweden's total energy supply. This number is the second highest among the high human development countries, only France has a higher percentage of nuclear power supply. The nuclear industry in Sweden has been highly debated and in a referendum in 1980 it was decided that all nuclear power plant would be shut down in the year of 2010. Although this decision came it as recent as the 11<sup>th</sup> of January 2008 a proposition from the leader of the Liberal party, Jan Björklund to further extend and build four new reactors in Sweden. (The Local, 2008)

United Kingdom gave green light the 10<sup>th</sup> of January to the building of four new reactors to secure their energy supply, and in an article in the Guardian states the business secretary John Hutton that the first new wave of nuclear plant will be built "well before 2020". (Guardian, 2008)

Since the disaster of Chernobyl and the melt down in Harrisburg has the industry been in a decline. The regulatory environment tightened and the public got scared of the industry. Millions were spent on bailing out nuclear power companies, which had lost a lot of money. The whole industry became a byword for mendacity, secrecy and profligacy with taxpayer's money. (The Economist, 2007) An article in The Economist (2007) states that the wind has changed for the nuclear industry as the insight of the climate change is growing. Nuclear powers offer large quantities of energy cleaner than coal, more secure than gas and more reliable than wind. Only during 2007 did the NRC (Nuclear Regulatory Commission) in USA receive 12 applications for building nuclear power plants. With a growing amount of power plants it is of the up-most importance that users and regulators in the industry can ensure a high level of safety in the use of nuclear materials and radiation sources. Internationally, IAEA is the organisation responsible for safety standards used to achieve this goal.

The Swedish nuclear industry is regulated by Kärntekniklagen (Act on nuclear activities), which sets a requirement that states that all nuclear facilities shall be managed and developed with the support of a quality assurance system. (SKI, 2004).

Within this injunction (SKI, 2004) it is stated that IAEA (International Atomic Energy Agency) norms and guidelines for quality assurance in nuclear facilities could be used as guidance when developing a quality assurance system for nuclear facilities. Ringhals AB (RAB) have developed its management system, Ringhals Verksamhetsstysystem (RVS) that integrates traditional management functions with quality management and environmental management. The integrated management system is developed out of a TQM perspective with the award Svensk kvalit  and its European counterpart EFQM, quality- and environmental management according to ISO 9001 and ISO 14001, EMAS as well as AFS 2001:1 and OHSAS 18001 with in mind.

## **1.2 Problem**

In 2005 was a masters dissertation conducted which benchmarked RAB's Management system, RVS with IAEA's guidelines (Safety Guides 50-C/SG-Q). IAEA has since then performed a substantial update and developed a new set of guidelines and requirements wherefore a new benchmark is needed.

## **1.3 Purpose**

The purpose of this study is to benchmark RVS with the new Safety Standard from IAEA and its appurtenant Safety Requirements (GS-R-3), Safety Guide (GS-G-3.1) and the draft Safety Guide (DS349) to identify and evaluate contingent differences and propose corrective actions. The result will reflect the differences in overall approach on management systems and a concrete list of corrective actions as well as proposals of where in the management systems the corrective actions shall be made.

## **1.4 Delimitations**

This dissertation is limited to what is written in the management systems, it will never try to confirm that what is written really is conducted. Furthermore will it due to time and space constrains not go in to depth on each requirement that is covered.

## **1.5 Company description**

Ringhals is the largest Nordic power plant and it is also the only nuclear power plant in Sweden using both Pressure Water Reactor (PWR) and Boling Water Reactor (BWR). The first reactor (reactor 2) was in operation 1975 and last (reactor 4) was taken into operation in 1983. The plant is located 60 kilometres south of Gothenburg in the municipality of Varberg. The nuclear power plant has over 1300 employees and about 500 consultants and framework contractors working there per year. 2006 Ringhals had a turnover at SEK 4,7 billion and produced 27 billions Kilo Watt Hours of electricity, enough to cover the electric demand of Sweden's second largest city six times. Totally it accounts for 18 % of Sweden's electricity consumption. The ownership of Ringhals AB is divided into Vattenfall AB a government Company (70,4%) and EON Kärnkraft AB (29,6%). (Ringhals, 2006)

Its mission statement rule; "Ringhals AB shall be the leading nuclear power plant of Europe".

Its business idea is to, produce the requested quantity of energy in a safe and environmental way. The production shall be both competitive and sustainable. (Ringhals, 2007)

## 2 Theoretical frame of reference

*This chapter will present the theory behind this dissertation; including a description of the organisation that published the standard, what is included in the safety standard, other standard requirement that affect nuclear power plant in Sweden and finally what an integrated management system is. This to provide reader with the theory and the knowledge to understand where IAEA safety standard is sprung from and the many requirements that a nuclear power plant has to consider in Sweden.*

### 2.1 IAEA

The UN founded IAEA in 1957 as an autonomous organisation with the effort to make a reality of US President Eisenhower's speech "Atoms for Peace" held at the UN general assembly in 1953. IAEA consists of 130 member states and base its work on the need of these member states. (IAEA, 2007). Its statue is

*"The Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose."*

IAEA's headquarter is situated in Vienna, Austria, in addition to that they have operational liaison and regional offices located in Geneva, Switzerland; New York, USA; Toronto, Canada; and Tokyo, Japan. The IAEA Secretariat consists of a team of 2200 multi-disciplinary professional and support staff in more than 90 countries. (IAEA, 2007) As of 1997 is the agency led by Director General Mohamed ElBaradei, who took over after Hans Blix, former foreign minister of Sweden. (IAEA, 1997)

IAEA is guided by the needs and interests of the member states but also by their strategic plans and the vision or statue, which is quoted above. The work is conducted on three main pillars; Safety and Security; Science and Technology; and Safeguards and Verification.

- *Promoting Safeguards & Verification*

IAEA claims that they are the world's nuclear inspectorate, and have worked with verification in more than four decades. It is the inspector's work to see to that the safeguarded nuclear material and activities are not used for military purpose. It is also IAEA that is responsible for the nuclear file in Iraq. (IAEA, 2007)

- *Promoting Safety & Security*

IAEA helps countries to upgrade their nuclear safety and to prepare for and respond to emergencies. They do this mainly through international conventions, standards and guidance. Two sets of activities are prioritized, safety and security. In the safety area is the core element setting up and promoting the application of international safety standards for the management and regulation of activities involving nuclear and radioactive materials. In the security area is the focus on helping states prevent, detect and respond to terrorists or other malicious acts such as illegal handling of nuclear materials and to protect nuclear installations and transports against sabotage. (IAEA, 2007)

- *Promoting Science & Technology*

IAEA states that the work to mobilise peaceful application of nuclear science and technology for critical needs in developing countries. Furthermore it is written on their webpage that their work contributes to the fighting of poverty, sickness and pollution of the earth's environment and other of the UN's Millennium Development goals for a safer and better future. (IAEA, 2007)

## 2.2 IAEA Safety Standard

As safety is a national responsibility are the international standards and approaches from IAEA a tool to promote consistency in the safety work. They are also a way providing help in assuring that nuclear and radiation related technologies are used safely, and facilitate international technical cooperation, commerce and trade. (IAEA, 2007)

The IAEA safety standards reflect according to IAEA the international consensus on what constitutes a high level of safety for protecting people and the environment. The IAEA safety standard is divided into three categories, which are:

### Safety fundamentals

In this document are the objectives, concepts and principles for protection and safety presented they also provide a basis for the safety requirements.

### Safety requirements

The safety requirements establish according to IAEA (2007) the requirements that must be met to ensure the protection of the people and environment. All requirements are expressed as shall statements and derive from the objectives, concepts and principles of the Safety fundamentals. IAEA states that if they are not met must measures be taken to reach and restore the required level of safety.

### Safety guides

The safety guides consists of recommendations on how to comply with the Safety requirements. All recommendations are expressed as should statements but IAEA still recommends nuclear facilities to take measures or equivalent alternative measures. The safety guides are presented as good practice and should reflect best practises to in order to help the users in the strive to achieve a high level of safety. (IAEA, 2007)

This standard supersedes the document Safety Series No. 50-Sg-Q1-Q7 published in 1996. (IAEA, 2007) Safety Series No. 50-Sg-Q1-Q7, which consisted of basic requirements that nuclear power plants could adopt for establishing and implement a quality assurance programme. (IAEA, 1996)

One of the authors of the safety standard published an article in the Indonesian magazine Atom Indonesia (Dahlgren, 2007). There she states that the code on Quality Assurance in Safety Series No. 50-Sg-Q1-Q7 as well as developments in within the International Organisation for Standardization ISO 9001:2000 and ISO 14001:1996 were considered when the integrated management system requirements was developed. The experiences of Member states within IAEA from developing, implementing and improving management systems were also considered.

According to Kerstin Dahlgren (2007) is the aim of the safety standard to provide requirements and guidance when implementing an effective management system, which:

- Integrates all aspects of managing nuclear installations and activities including safety, health, environmental, security, quality and economic in a coherent manner.
- Promotes continual improvement
- Describes the planned and systematic actions necessary to provide adequate confidence that all these requirements can be satisfied, and
- That it supports the enhancement and improvement of organisational and safety culture.

In a report published by the an independent group of specialists with the support of the Swedish nuclear power industry called Analysis Group (Analysgruppen, 2007) found the author signs that pointed that the recent published safety standards by IAEA would become supporting tools in the evaluation process of nuclear power plants.

## **2.3 SKI/SSI**

### **SKI**

Kärntekniklagen primarily regulates the nuclear activities in Sweden. (the act on Nuclear activities). This act is also the basis for the work of Statens Kärnkraftinspektion, SKI, (Swedish Nuclear Power Inspectorate). The act declares that the holder of a license for nuclear activities has full responsibility for the safe operation of the facility. The mission of SKI is to ensure that the proprietor of nuclear facilities follows the act.

SKI supervises all nuclear activities in Sweden such as, nuclear fabrication, and nuclear power plant operation, operation of other technical facilities transport and waste management. They do this on the behalf of Swedish government, parliament and the Swedish people and report the results to the Swedish Ministry of Environment. Their main areas of work are:

- Activity-based supervisory work, which focuses on the licensee's ability to conduct and develop safety and safeguards and maintain high quality in all parts of the activities.
- Inspections are important tools in SKI's supervisory activities. SKI's inspectors visit the facilities regularly and check the facilities' compliance with regulations, licence conditions and safety requirements.
- SKI reviews all major technical and organisational modifications and changes, which are introduced within nuclear facilities.

(SKI, 2007)

### **SSI**

SSI is an abbreviation of Statens strålskyddsinstitut, which is the Swedish Radiation Protection Authority. They are a central probation authority working for radiation protection of humans and the environment, both in present time and in the future. SSI sets requirements on the doses of radiation for those working with radiation can be exposed to. They also issue regulations and see to that they are fulfilled. SSI has round the clock staff standby to respond to radiation accidents. Other roles include information, training advisory, recommendations and support and evaluation of research on radiation. (SSI, 2007)

### **Merger of SKI and SSI**

The 7<sup>th</sup> of May the Swedish Ministry for Environment published a memorandum proposing a merger between SKI and SSI to a new authority. The purpose is that the new authority will gain significantly with coordination. According to the ministry do both of the authorities share a common ground and a merger would lead to firmer supervision of both nuclear technical and non-nuclear technical activity. The merger shall be conducted before the 1<sup>st</sup> of April 2008. (Miljödepartementet, 2007)

## **2.4 Management Systems**

The author has had problems locating an official definition of the term management system; this was also lifted as an issue during a conversation between the author and Peter Hartzell (2007) at the Swedish Institute of Standards. The author turned to Oxford English dictionary for guidance. A search for management system gave no hits, although the word management was referred to as: organisation, supervision, or direction.

Combined with the reference for system, which reads, a set or assemblage of things connected, associated, or interdependent, so as to form a complex unity. This presents a decent explanation of what the term mean, supervision or direction of how to connect associated or interdependent things to form a unity. This is perhaps not to far from away ISO's own explanation of the term management system, as they say that management system refers to what the organisation does to manage its processes, or activities, so that its products or services meet the objectives it has set itself, such as. (ISO, 2007)

- Satisfying the customer's quality requirements,
- Complying with regulations, or
- Meeting environmental objectives.

Furthermore provides ISO 9001:2000 another explanation of management system, it calls it a system for establishing policy and objectives and a way to achieve these objectives. (ISO, 2000)

RAB use EFQM definition of management system to describe, RVS, which is that a management system is a framework of processes and procedures used to ensure that the organisation can fulfil all tasks required to achieve its objectives. (EFQM, 2007)

### Evolution of management systems

Kerstin Dahlgren (2007) presents a model for the over the last century regarding the approaches applied by organisations in order to achieve better performance.

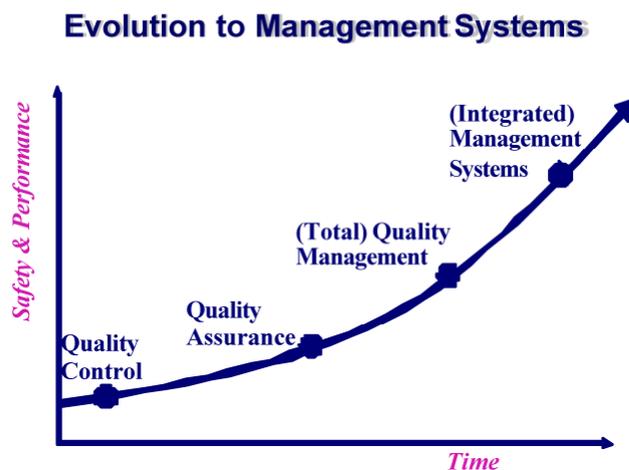


Figure 1 (Dahlgren, 2007)

This model is not as detailed and complex as the reality but it gives directions of how management systems have evolved.

**Quality Control:** Sorting non-conforming products from conforming products.

**Quality Assurance:** Measures taken to systematically prevent non-conformances from occurring.

**Quality management:** Introduced the consideration of everyone involved within the process and the concept of internal customer and supplier.

**Integrated management system:** Organisation gives attention to issues such as safety, health, quality, environment, finance security, human resources, cultural aspects etc. in a coherent and integrated manner.

This model also concludes that integrated management system is not the final solution for managing organisations. (Dahlgren, 2007)

## **2.5 Management Systems Standards**

*Here follows descriptions of management system standards and audit schemes that are included in RAB's management system, RVS. It also includes descriptions of system standards that have influenced IAEA Safety Standard.*

### **ISO 9001:2000**

The International Standard Organisation (2000) states that the adoption of a quality management system should be a strategic decision of an organisation. Meaning that it should not try to implement a system just for the sake of it. The design and implementation is supposed to be influenced by the varying needs, particular objectives, the products provided, the processes within the organisation and the size and structure of the organisation.

ISO 9001 promotes the use of process approach when developing, implementing and improving the efficiency of the quality management system. A process is according to ISO (2000) an activity that uses resources, and managed in order to transform input to output. By identifying and management by all the linking process will the organisation function more effective and have a better ongoing control of its processes. The use of processes together with identification is called "process approach". (SIS, 2002)

ISO 9001 was first released in 1987 than revised in 1994 both these issues had the focus on enabling organisations to produce the same quality of products every time by specifying procedures, the policy and instructions in a quality handbook. The 2000 revision moved the focus towards customer satisfaction and continuous improvement. (Jørgensen et al., 2006)

### **ISO 14001:2004**

Jørgensen et al, (2006) writes that an environmental system is: "part of an organisations management system used to develop and implement its environmental policy and to manage its environmental aspects". ISO 14001 was first released in 1996 and later revised in 2004. ISO (2004) states in the introduction of their standard that more and more organisation are increasingly concerned with its impact on the environment and in demonstrating a sound environmental performance. They continue by writing that many organisations are conducting environmental reviews and audit to assess their environmental performance but for these to be effective they need to be conducted within a structured management system that is integrated within the organisation.

ISO 14001:2004 includes requirements for an environmental management system, which drives the organisation to develop and implement a policy and objectives that account legal requirements and information about significant environmental aspects. According to ISO depends the success of the environmental management system on the commitment from all levels and functions of the organisation, but in particular the senior management. ISO also declares that the overall goal with the standard is to support environmental protection and prevention of pollution in balance with socio-economic needs. (SIS, 2004)

### **EMAS**

The EU Eco-Management and Audit Scheme (EMAS) is a management tool complied both for companies and for other organisations that are willing to evaluate, report and improve their

environmental performance. The European Commission (2007) declares that organisations can progress from ISO 14001 to EMAS without duplicating the work.

Ans Kolk (2004) writes that EMAS takes the environmental management one step further with its requirement on an independent verified public environmental statement. On top of this come also requirements on:

- Government approval for legal compliance, meaning that an EMAS-registered organisation has to demonstrate full compliance to environmental legislation;
- Continual improvement of environmental performance;
- Employee's participation and openness to the public, i.e. an EMAS registered organisation has to demonstrate an open dialogue with employees and interested parties, such as stakeholders, local authorities and suppliers.

(European Commission, 2007)

### **OHSAS 18001**

OHSAS 18001 was formulated on the basis of the British standard BS 8800 and published in 1999. It is used for certification of occupational health and safety management system. (Jørgensen et al., 2006). It is focused on hazards identification and risk assessment, which separate it from other international safety standards. In recent time have organisations of all types more actively addressed the question of health and safety in the workplace, partly because of legal requirements but also in response to the fear of lawsuits and the pressure from raising insurance premiums. (Whitelaw, 2004)

Bad publicity from unsafe practise and the realisation that accidents do have a negative impact on the organisations financial situation, in form of through stoppage, investigations and loss of productivity, all these issues have become drivers for the work with safety. (Whitelaw, 2004)

WhiteLaw (2004) concludes that true assurance on safety can only be achieved with a proactive management system that manages safety rather than reacting when an event occurs. OHSAS was according to (Jørgensen et al., 2006) developed to be compatible with ISO 9001:1994 and ISO 14001:1996, to facilitate integration of the management systems, if organisations wish to do so.

### **AFS 2001:1**

The Swedish Work Environment Authority set a regulation regarding systematically occupational environment work. Systematically occupational environment work is defined by the Swedish Work Environment Authority as the employer's work to investigate, implement and evaluate the organisation in way, which prevents non-health and occurrence of workplace accidents and to achieve a satisfying occupational environment. (Arbetsmiljöverket, 2001)

The regulation covers all employers, it also includes is those who hire staff. The systematically work with occupational health shall be a part of the daily work. The employer shall give all individuals in the organisation the authority to affect occupational environment. The organisation must have a policy for the occupational health that describes the working conditions and what is done to prevent un-healthiness and work related accidents. The tasks of occupational health shall be spread within the organisation and the employer shall see to that the needed competence and knowledge is available.

A regular evaluation of the working conditions and the risk of un-healthiness and work related accidents shall be performed. It is also stated that in the case of a work related accident shall the employer evaluate the reason for occurrence and what can be done to prevent it reoccurring. (Arbetsmiljöverket, 2001)

## 2.6 PDCA-Cycle

ISO write on their web page that both ISO 9001 and ISO 14001 use the Plan – Do – Check – Act (PDCA) as an operating principle. (ISO, 2007) This model is also sometimes called the Deming cycle from W Edward Deming who made PDCA-cycle popular during the 50's. The foundation of the PDCA-cycle is the idea of analysing and measuring processes in order to identify deviations from customer requirements. (Karlöf, 2007) The model can be used in various situations such as, a model for continuous improvement, when starting a new improvement project when developing a new or improved design of a process, product or service. (Tague, 2004)

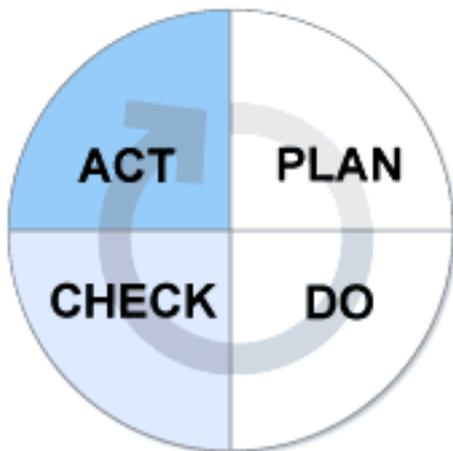


Figure 2. PDCA-cycle ISO (Bengt Karlöf, 2007)

As seen in the figure above consists the model of four steps, which should be repeated again and again for continuous improvement. Those four steps can be describes as;

*Plan* - Establish objectives for the change and decide how the change should be implemented.

*Do* - Implement the change that was decided upon in the previous step.

*Check* - Measure the results to see how far the actual achievement met the planned objectives.

*Act* – Correct and improve the plans and the method for implementation of the objectives. Continue to the plan phase once again. (Karlöf, 2007)

## 2.7 Correspondence between management system standards

The table below is supposed to visualise an example of the similarities between the different management system standards. It is these similarities and compatibilities that have made it possible for organisation to integrate its management systems. Furthermore is this also an example of how IAEA has been influenced and how they incorporated other management standards when they developed their standard GS-R-3.

<i>IAEA GS-R-3</i>	<i>ISO 9001</i>	<i>ISO 140001</i>	<i>OHSAS 18001</i>
6.7. Management Review A management system review shall be conducted at planned	5.6.1 Management Review Top management shall review the organisation's quality	4.6 Management Review Top management shall review the organisation's	4.6 Management Review The organisations top management shall, at intervals that it

<p>intervals to ensure the continuing suitability and effectiveness of the management system and its ability to enable the objectives set for the organisation to be accomplished.</p>	<p>management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. This review shall include assessing opportunities for improvement and the need for changes to the Quality management system, including the quality policy and quality objectives. Records from management reviews shall be maintained (ISO 9001, 2000)</p>	<p>environmental management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. Reviews shall include assessing opportunities for improvement and the need for changes to the environmental management system, including the environmental policy and environmental objectives and targets. Records of the management reviews shall be retained. (ISO 140001, 2000)</p>	<p>determines, review the OH&amp;S management system to ensure its continuing suitability, adequacy and effectiveness. The review shall ensure that the necessary information is collected to allow management to carry out this evaluation. This review shall be documented. The management review shall address the possible to need to adjust policy, objectives, and other elements of the OH&amp;S MS in light of audit results, changing circumstances, and the commitment to continual improvement. (OHSAS 18001:1999)</p>
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Table 1. Correspondence between management system standards

## 2.8 Integrated Management Systems

Beckmerhagen and Berg (2002) define the integration of management systems as a process of putting together different function-specific management systems into a single and more effective integrated management system (IMS). They also write that different degrees of integration can be distinguished starting with partial coordination of documentation, which is the least stringent degree of integration. Taking it one more step further means to broadening the scope and enhancement of the combined systems using integrated audits and resource deployment. According to them is full integration achieved when the management systems are amalgamated into a new and comprehensive integrated management system.

There is a difference between integrating the standards (ISO 9001, ISO 14001, OHSAS 18000 etc.) and integrating a management system. While the integration of management system standards is under the support of standardization bodies such as ISO, it is up to the each company to align their own management systems. Although ISO have been making efforts to harmonize the structure of the existing and emerging management systems standard, is a fully integrated management system standard not to be expected. (Jonker, 2004) The harmonisation of the management system standards have increased with every revision and new editions of the different standards evidence of this is that.

- ISO 9001:2000 has a process focusing on continuous improvements, which is one of the fundamentals if the environmental as well as the health and safety management system standards.
- ISO 14001:2004 have been developed to improve the compatibility with ISO 9001:2000 and the connection to EMAS is clarified. (Jørgensen et al., 2006)

Beckmerhagen and Berg (2002) states that is due to increasing numbers of management systems standards and their revisions together with the cost that comes with them that need for integration origin from. At the same time it has become vital for organisations to continuously improve their overall quality, environmental, safety and even public accountability performance. By developing and implementing integrated management systems can organisations theoretically “kill both these birds with one stone”. Beckmerhagen and Berg (2002) also present two lists of what they see have advantages and concerns with integration of management systems.

Advantages:	Concerns:
<ul style="list-style-type: none"> <li>• Simplification of standards and requirements for management systems</li> </ul>	<ul style="list-style-type: none"> <li>• Perception that existing management systems are sufficient and should remain separate</li> </ul>
<ul style="list-style-type: none"> <li>• Reduction of auditing and registration costs.</li> </ul>	<ul style="list-style-type: none"> <li>• Doubts about added value</li> </ul>
<ul style="list-style-type: none"> <li>• One-stop approach for auditing through simultaneous, joint, round robin or integrated audits</li> </ul>	<ul style="list-style-type: none"> <li>• External and internal audits may still be performed separately, even though the systems are integrated into a single entity</li> </ul>
<ul style="list-style-type: none"> <li>• Executive management buy in</li> </ul>	<ul style="list-style-type: none"> <li>• Scepticism of middle management, partly due to inadequate information</li> </ul>
<ul style="list-style-type: none"> <li>• Organisations can choose which modules (i.e. quality, environment, safety, social accountability) they prefer to implement</li> </ul>	<ul style="list-style-type: none"> <li>• Insufficient communication with and involvement if supervisors and workers</li> </ul>
<ul style="list-style-type: none"> <li>• Provision of a simple transition from existing management systems and standards, rather than a radically new approach.</li> </ul>	<ul style="list-style-type: none"> <li>• Past bad experience with failed quality programs, management by objectives, or other management models</li> </ul>
<ul style="list-style-type: none"> <li>• Cost reduction in the areas of standards interpretation and implementation</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of pressure from customers or competitors to implement and integrated management system.</li> </ul>
<ul style="list-style-type: none"> <li>• Harmonisation of management system documentation</li> </ul>	
<ul style="list-style-type: none"> <li>• Reduction of paperwork</li> </ul>	
<ul style="list-style-type: none"> <li>• Synergy effects occur when different systems are integrated</li> </ul>	
<ul style="list-style-type: none"> <li>• Duplication of efforts and redundancies are eliminated</li> </ul>	
<ul style="list-style-type: none"> <li>• Improved system effectiveness.</li> </ul>	

Table 2. Advantages and concerns regarding IMS (Beckmerhagen Bergl., 2002)

## 2.9 Ringhals Verksamhetssystem

Ringhals AB is according to the Kärntekniklagen, KTL (Act on nuclear activities) proprietor of a nuclear facility and has the permission to operate nuclear activities. With the permission comes an obligation to establish and implement a system for quality assurance programme that includes a system for handling non-conformances.

To meet this requirement Ringhals has implemented their management System, Ringhals Verksamhetssystem (RVS). The following section will give a deeper description of how it is constructed and what is included within it.

According to the description of the management system has the President established the management system to be able to manage the company in a structured and systematically way. The President has complied the company policy, which points out in what direction the company is headed. The policy is connected with a number of strategies, which demonstrates how the company is to act in certain areas to reach the set goals.

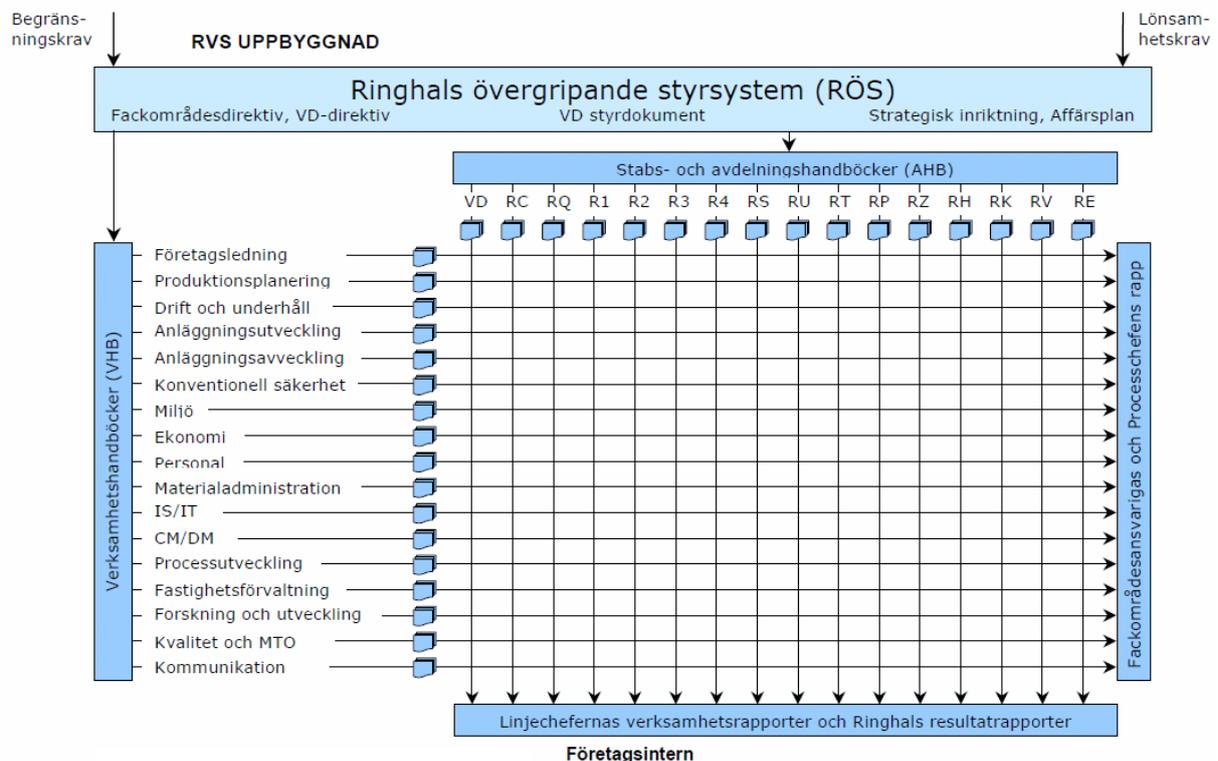


Figure 3. Ringhals Verksamhetssystem

The figure above is way of visualising how different departments are connected with certain parts of the management system. It also shows how Ringhals has to amend with both requirements that are limiting and requirements on profitability.

The management system is written in Swedish to ensure that as many as possible can understand and use the management system, since the majority of the employees have Swedish as their mother tongue. The translations used in this section are made by the author and are in no way officially used by RAB. The point of the translation is to make the text more understandable for English readers. First will the Swedish word be written in the headline followed by the English word in brackets, in the text will the English translation be used.

### **Ringhals Övergripande Styrssystem (Ringhals overall management system)**

Ringhals overall management system includes all the documents that describes the organisation and its responsibility, overall goals and plans of the organisation. Furthermore identifies it and interpret the requirements that RAB needs to adjust to. The following documents are included in Ringhals overall management system.

- VD styrdokument (President's governing document)
- Fackområdesdirektiv and VD-direktiv (Special field area directive and President directive)
- Strategisk inriktning and Balanserat Styrkort (Strategic direction and balanced scorecard)
- Målbrev and Affärsplan (Target letter and Business Plan)

### **VD Styrdokument (President's governing document)**

The President's governing document describes the management of the company and how it is governed, evaluated and developed, and how the organisation is assembled. The documents are first and foremost intended for departmental managers but nevertheless also for co-workers in general. The documents also consist of guidelines and requirements of how the organisation should be controlled and designed.

### **Fackområdes och VD-direktiv (Special field area directive and President directive)**

The responsible for each special field area, sees to that all requirements that sets limitations on the organisation are identified, kept under surveillance and filed as a special field area requirement. The requirements are then interpreted to suit the President directives. In relation to interpretation of the requirements suggests the responsible for the special field area the proper level of ambition. The requirements are documented in the right President directive and to control that the company is heading towards the decided goals are frequent measurements of requirement fulfilment conducted.

### **Strategisk inriktning och balanserat styrkort (Strategic direction and balanced scorecard)**

The strategic planning derives from the requirements of the owners and the society and is connected to the company policy and included the strategies. The company controller (RC) works in co-operation with the President to follow what is happening around the world and is continuously developing the strategic direction for RAB.

Under given intervals are the strategies evaluated and strengths, weaknesses and opportunities and threats are analyzed in what is called SWOT-analysis. Based on the result from the different SWOT-analysis are the balanced scorecards designed. They are used to formulate, measure and develop the business goals, to manage the company in the decided direction.

### **Målbrev och Affärsplan (Target letter and Business Plan)**

The president distributes the profitability requirements to staff and department managers through so called target letters. In the target letters are frames and guidelines given, furthermore are also the general goals included. These are valid for approximately a year, and are then updated. The alignment communicated in the strategy is the foundation of RAB's Business plan. In the business plan are goals and plans for implementing given under a specific period of time. It is developed by the economic department and approved and acknowledged by the board of RAB. The business plan is reviewed on a yearly basis.

### **Stabs och avdelningshandböcker (Staff and department manuals)**

Every department manager governs its own department according to its department manual, which is the top document in every department. Within this documented it is presented how each

division is to be managed, governed, planned, implemented, reported and how the results should be evaluated and improved.

### **Verksamhetshandböcker (Organisation manuals)**

The organisation manuals are drawn up for each overall process given in President's governing document. All the interpret requirements are transmuted in the organisation manuals to a set of regulations on how the process shall be managed. These documents are valid for all individuals within the organisation. Appointed individuals are responsible for keeping the contents up-to-date see to that they cover everything important and also that the material is revised when needed.

## **2.10 Organisational change**

The management system RVS is a living system according to Sten Bergman (2007), who is responsible for the updating and management of RVS. It is continually improved and changed in order to facilitate the daily business. This is one of the foundations in ISO-family. The continuously improvement of the management system meant that it has changed during the time for this dissertation. In order to illustrate this follows an example of an organisational change, which took place during the time for the dissertation.

As of the 15<sup>th</sup> of November 2007 were the position result manager removed and its tasks implemented into President position. Furthermore has the management conventions been phased out. Its function was to formulate the organisations overall goal, this is now conducted on strategic management meetings. On top of this is also the responsibility to update and manage RVS moved from the department of organisational support to the quality department. This section is supposed to exemplify that the management system is a dynamic and not a static system.

### 3 Method

*Here are the methods and strategies the author used when developing this dissertation presented.*

#### 3.1 Strategies of inquiry

According to Creswell (2003) it is the strategies of inquiry that gives the specific direction for the procedures in a research design. The strategies of inquiry contribute to the overall research approach. The most frequently used approaches in social research are according to Creswell (2003), quantitative, qualitative or mixed methods approach.

- Having a quantitative approach means that the researcher primarily uses post-positivist claims for developing the knowledge. This by using such strategies as experiments and surveys that yields statistical data. (Creswell. 2003)
- Whereas in a qualitative approach the researcher often makes knowledge claims based on constructive angles with the intent o develop a theory or pattern. The most commonly used strategies are narratives, phenomenologies, ethnographies, grounded theory and case studies. Furthermore states Merriam (1998) that a characteristic of a qualitative approach is that the researcher is the primary instrument for data collection and analysis. The data is analysed through this “human instrument” rather than a questionnaire or a computer.
- The mixed methods approach combines the two earlier mentioned and tends to base knowledge claims on pragmatic grounds. It uses strategies of inquiry that involve data collection either as they occur or in a sequential order. The data collection consists of both data collected numerical as well as text information from interviews, making it an approach that mix the quantitative and qualitative approach.

As this study is an attempt to benchmark the management system RVS against a management system standard released by IAEA it is clearly a qualitative study. Even though many requirements are covered, are all of them processed by the author in order to draw conclusions. This also suits one of characteristic that Creswell presents (2003), which is that qualitative research fundamentally, is interpretive. This means that the researcher makes an interpretation of the data.

#### 3.2 Types of qualitative research

Merriam (1998) describes qualitative research as an umbrella term with numerous variations. Below is a table presented that should provide the reader with some background to the most commonly used types of qualitative research. It also serves as motive to why the author chose a certain type of research.

<i>Type</i>	<i>Characteristics</i>
Basic or Generic	<ul style="list-style-type: none"><li>• Includes description, interpretation and understanding</li><li>• Identifies recurrent patterns in the form of themes or categories</li><li>• May delineate a process</li></ul>
Ethnography	<ul style="list-style-type: none"><li>• Focus on society and culture</li><li>• Uncovers and describes beliefs, vales, and attitudes that structures behaviour of a group</li></ul>

Phenomenology	<ul style="list-style-type: none"> <li>• Is concerned with essence or basic structure of a phenomenon</li> <li>• Uses data that are the participant's and the investigator's firsthand experience of the phenomenon</li> </ul>
Grounded Theory	<ul style="list-style-type: none"> <li>• Is designed to inductively build a substantive theory regarding some aspect of practice</li> <li>• Is "grounded" in the real world</li> </ul>
Case Study	<ul style="list-style-type: none"> <li>• Is intensive, holistic description and analysis of a single unit or bounded system</li> <li>• Can be combined with any of above types</li> </ul>

*Table 3. Common Types of Qualitative Research (Merriam, 1998)*

The most suited type of qualitative research was a case study, where the case is RVS and the study is the benchmark between the IAEA standard and RVS. It is a bounded system where the author can really fence in what it is he is going to study. Furthermore gives Merriam (2003) a technique for assessing the bound ness of the topic, which is to ask your self how finite the study is, whether the study has a limited amount of time for observations or if there is a limit to the amount of observations that could be conducted. In the case of this thesis, it is clear that both the time constrains and the limited numbers of requirements within the IAEA standard makes this thesis suitable for a case study.

An advantage of case studies are that unlikely experimental and, surveys or historical research they does not claim any particular method for data collection or data analysis. The case study is also anchored in real-life situation, which makes the case study a rich and holistic account of a phenomenon. A problem with case studies is that although rich, thick description and analysis of the phenomenon is wanted, may the time and money not be sufficient, in other words it is time consuming. Even if enough time is available it is possible that the case becomes too lengthy and too detailed making it hard to read. (Merriam, 1998)

### **3.3 Data collection**

Creswell (2003) writes that one of the main ideas of qualitative research is to select participants or documents that will help the researcher understand the problem and the research question in the best way. He continues by stating that the collection procedures in qualitative research consist of four basic types, observations, interviews, documents and audio and visual material.

The collection procedures used in this thesis have primarily been collecting documents and conducting interviews.

#### **Documents**

An advantage that documents have over interviews and observers is that they never intrude upon or alter the setting as the presence of an investigator often does. Furthermore it is safe to say that they do not depend on the cooperation of human being with a sudden whim, which can be essential for good data collection. (Merriam, 1998) Creswell (2003) mentions advantages such as availability and time saving as two factors for using documents.

The documents that mostly have been studied during this dissertation are those included in RAB's management system, RVS, they have been collected through their intranet web page Insidan (2007). As this information is not public the author needed authorisation to be able to retrieve it. Another problem with collecting the documents was that because the strict security at

nuclear power plants could the information only be retrieved within the RAB's computer system. Other documents that the author found vital are reports and articles that were used in order to gain knowledge on the subject. This information was gathered from scientific databases such as, Science Direct and Elsevier through the Chalmers library web page.

Yin (1995) expresses the importance of being able to understand that documents are written for another purpose and audience than those of the case study. As this dissertation has the purpose of benchmarking an existing management system with a management system standard was this an issue that the author had to address many times.

### **Interviews**

Merriam states (1998) that the most common type of interview is the person-to-person encounter where one person elicits from another. She continues by presenting a table of three different types of interviews, highly structured, semi structured and unstructured interviews. Highly structured interviews are those that have a predetermined order of questions, in semi structured interviews are the interviews a mix of more and less structured question, finally unstructured interviews where the interview consists of open-ended questions, which turns the interview into more of a conversation (Merriam, 1998).

Interviews were used in this dissertation whenever the author ran into problem in understanding or locating the relevant information within the management system, RVS. Most of these interviews were conducted over telephone due to the distance to the nuclear power plant, although some took place at the sight in a face-to-face situation. These interviews were unstructured and a good tool for the author in the search for text in RVS matching the requirements in the IAEA safety standard.

### **3.4 Data analysis**

A strategy that suits the author is presented by Yin (1995), which is to rely on the theoretical proposition. Yin prefers this strategy as it follows the theoretical proposition that led to the case study. Which means that the data collection plan is based on the purpose of the dissertation, in this case to identify and evaluate contingent differences between RVS and the IAEA safety standard.

When conducting a qualitative research with a case study shall the data be analysed simultaneously as it is collected. This because it is easy to forget why certain data was important for the result of the study. On-going data analysis makes the data both more parsimonious and illuminating. (Merriam, 1998)

As the author collected the data needed to compare the management system, RVS, with the standard it was recorded where the data was found. This produced a table with references to where the data could be found, see appendix 1. The table could be seen as a beginning to an analysis, as the author choose not to make the whole analysis from start to end, which would have been very time consuming and could have led to loss of enthusiasm. Instead did the table make the analysis easier and also gave the author a second chance to think through what the requirements of IAEA safety standard really meant.

## 4 Analysis

*Below are 77 requirements presented, after each requirement follows a short statement of where in the RVS verified that the requirement is fulfilled. If the author believes that the requirement is not fulfilled is this noticed. The requirements from the LAEA standard are written in bold, the author's viewpoints are presented in regular fonts. In appendix 1 is presented a map, which tells where in RVS the answer to the requirements is located. Appendix 2 gives an overview of how many deviations RVS has in each chapter of the Safety Standard as well as the total amount of identified deviations.*

## 2. Management System

General requirements

**2.1. A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement. The main aim of the management system shall be to achieve and enhance safety by:**

- Bringing together in a coherent manner all the requirements for managing the organization;**
- Describing the planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied;**
- Ensuring that health, environmental, security, quality and economic requirements are not considered separately from safety requirements, to help preclude their possible negative impact on safety.**

It is written in the introduction of the document Beskrivning av RAB verksamhetsstyrssystem, that Ringhals as proprietor of a nuclear facility is obligated (KTL) to establish and implement system for quality management. RAB have chosen to establish a management system that integrates quality, environmental, health, safety, and economy and risk management. Furthermore states section 1.6 of the document Ringhals Ledningshandbok that the president is responsible with the support the RC and RVQ to keep the systems up to date and regularly improved. It is also written that RVS's task is to identify and interpret both the limiting requirements and the requirements on profit and from them are policies and strategies created. They are then formulated into directives and goals for the organisation. RAB writes in section 1.5 of Ledningshandboken that safety and environmental issues are integrated in RVS, although it is hard to find any certain proves of the all requirements not considered separately from the safety requirements.

**2.2. Safety shall be paramount within the management system, overriding all other requirements.**

The document Ringhals Verksamhetspolicy states that first priority shall be to protect the surroundings, staff and the facility from damages. Under the headline Ansvarstagande, it is written that safety and environment should be prioritized in all activities. In the business idea is the word safety mentioned to describe the product, electricity. Both requirement 2.1 and 2.2 write about prioritizing safety, it could be an issue that Ringhals Ringhals place environment and safety on equal level in the policy.

**2.3. The management system shall identify and integrate with the requirements contained within this publication:**

- The statutory and regulatory requirements of the Member State;**
- Any requirements formally agreed with interested parties (also known as 'stakeholders');**

- All other relevant IAEA Safety Requirements publications, such as those on emergency preparedness and response and safety assessment;
- Requirements from other relevant codes and standards adopted for use by the organization.

Within the management system there is a document called Sammanställning av identifierade krav för RAB that complies and keeps all the requirements the organisation is faced with under surveillance. The requirements derive from:

- Authorities
- Laws and regulations passed by the Riksdag and the government, constitutions issued by authorities and group and owner requirements issued by Vattenfall AB
- Norms and standards
- Permissions, non commercial agreements and decisions

It is not mentioned in the management system how they will meet other requirements from IAEA publications, such as emergency preparedness and response and safety assessment.

#### **2.4. The organization shall be able to demonstrate the effective fulfilment of its management system requirements.**

In the section 5 Utvärdera verksamhetens resultat in the document Ledningshandboken it is stated that the organisation is reviewed every spring to see that it is working accordance to its requirements. It is also stated that the body is gathered from individuals as well as manager at all levels then processed by the department RQ and presented for FL.

#### Safety Culture

#### **2.5. The management system shall be used to promote and support a strong safety culture by:**

- Ensuring a common understanding of the key aspects of safety culture within the organization;
- Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, taking into account the interaction between individuals, technology and the organization;
- Reinforcing a learning and questioning attitude at all levels of the organization;
- Providing the means by which the organization continually seeks to develop and improve its safety culture.

The document Verksamhetspolicy includes an appendix, which describes how RAB shall work with safety. It covers a couple of the issue in the requirement such as, that RAB employees should have a questioning attitude and gives the needed guidelines to ensure a common understanding of the safety culture. In addition to the policy provides the document Övergripande mål och förhållningssätt för Reaktorsäkerhet an insight in RAB's safety culture. From the ambition given in this document it is clear that all departments and individual that have any effect on the reactor safety shall be able to affect and develop the safety culture. It also states that even though in hard competition RAB should always work with continuous improvement of its safety. Furthermore it is also stated in the appendix time and resources should not be prioritised over quality of work.

#### Grading the application of the management system requirements

#### **2.6. The application of management system requirements shall be graded so as to deploy appropriate resources, on the basis of the consideration of:**

- The significance and complexity of each product or activity;

—The hazards and the magnitude of the potential impact (risks) associated with the safety, health, environmental, security, quality and economic elements of each product or activity;

—The possible consequences if a product fails or an activity is carried out incorrectly.

The regulation SKIFS 2004:1 4§ declares that all structures, systems, components and devices shall be designed, manufactured, installed, controlled and tested in accordance with requirements, which are adapted to their function and importance for facility safety. In its recommendations it is stated that a classifications system should be applied to ensure that the components are in adapted for their importance to safety.

Verksamhetshandboken Drift och Underhåll section 4.3 PAKT-dokument, klassningsregler declares that in order to gather all the requirements put on products used in nuclear power plants the Swedish nuclear companies have compiled the PAKT documents as a collective interpret. It sets requirements on the supplier, which must be met in order to deliver the product. Although can the author not find any information linking between classification of safety, environment, function etc. and application of management requirements. Meaning that although grading systems for the products exists, it lacks the feature of telling how much requirements should be applied to a certain grade.

## **2.7. Grading of the application of management system requirements shall be applied to the products and activities of each process.**

Subject covered in requirement 2.6.

Documentation of the management system

## **2.8. The documentation of the management system shall include the following:**

—The policy statements of the organization;

—A description of the management system;

—A description of the structure of the organization;

—A description of the functional responsibilities, accountabilities, levels of authority and interactions of those managing, performing and assessing work;

—A description of the processes and supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved.

This requirement is fulfilled on the basis that the management system includes a policy statement, a description of the management system, a organisational description with levels of authority and a description of the processes. The supporting information for all processes is described in each Verksamhetshandbok.

## **2.9. The documentation of the management system shall be developed to be understandable to those who use it. Documents shall be readable, readily identifiable and available at the point of use.**

Even if this requirement can be seen as an appraisal of what make something understandable or not, it is clearly stated in Ledningshandboken 1.6 Ringhals Verksamhetsstyrsystem that the documents in the management system have to be written in Swedish. If foreign consultancies are regarded could this be seen as a problem. Even though it makes it more understandable for those with Swedish as mother tongue. Every single document is identified with a number or DARWIN-code, which makes it easy to locate either using the web page Insidan or the computer application DARWIN. A document called Definitioner av begrepp som används i Ringhals

verksamhetsstyrssystem RVS provides definitions of terms that are commonly used in the management system to help the reader understand the content.

**2.10. The documentation of the management system shall reflect:**

- The characteristics of the organization and its activities;
- The complexities of processes and their interactions.

The document Beskrivning av Ringhals verksamhetsstyrssystem declares that Ringhals Övergripande Styrssystem (Ringhals overall management system) consists of documents that describes the organisation and its responsibilities, goals and plans and identifies and interpret the requirements for the organisation. The documents included in RÖS are not as detailed and instructive as the Stabs and avdelningshandböcker and verksamhetsböcker, which are documents further down in the hierarchy.

### **3. Management responsibility**

Management commitment

**3.1. Management at all levels shall demonstrate its commitment to the establishment, implementation, assessment and continual improvement of the management system and shall allocate adequate resources to carry out these activities.**

According to the Ledningshandboken 1.6 Ansvar is the president responsible that the systems are maintained and updated. He does this with the support of RC and RVQ. To manage RVS have RC and RVQ created the RVS-kommittén. It is described in RVS förvaltning och utveckling that the committee is responsible for designing and takes decisions on the systems management and its development. RVQ have created a management and developing organisation to make sure that the adequate resources are available and to get support for the development of the system. This chain of managers fulfils this requirement.

**3.2. Senior management shall develop individual values, institutional values and behavioural expectations for the organization to support the implementation of the management system and shall act as role models in the promulgation of these values and expectations.**

RVS is an implemented management system that the organisation utilizes, Ringhals Ledningshandbok states in chapter 2.9 ethics values that the employer should follow.

The senior management also has developed an organisational policy that is supposed to pervade the whole organisation. The key elements of the organisational policy are;

- Openness
- Accountability
- Effectiveness

It also provides the organisation with guidelines on how it is supposed to work with safety and environmental issues.

**3.3. Management at all levels shall communicate to individuals the need to adopt these individual values, institutional values and behavioural expectations as well as to comply with the requirements of the management system.**

Under the section 2.2 Medarbetarnas kompetens, medvetenhet och utbildning it is written that policy understanding and the organisations goals for safety, environment, competence and value

creating shall be include in the training of the employees. Although it is also stated that it shall also be clear what the consequences are if the requirements are not fulfilled.

**3.4. Management at all levels shall foster the involvement of all individuals in the implementation and continual improvement of the management system.**

Section 2.1 Medarbetarnas engagemang of Ledningshandboken states that the management shall with the support and involvement of the staff improve the effect and efficiency of both the organisation and of RVS. It also says that routines are to be created which leads to improvement of functions as well as results that will stimulate the individual's involvement and development.

**3.5. Senior management shall ensure that it is clear when, how and by whom decisions are to be made within the management system.**

In the document RVS Förvaltning och utveckling it is stated that it is the RVS-Kommittén task to monitor and take decisions regarding the management system. They meet twice a year to formulate and decides the guidelines for the systems administration and development. Section 1.6 of ledningshandboken clearly states that the president is responsible for RVS but he has the support of the RC and the department RVQ to keep it up to date.

Satisfaction of interested parties

**3.6. The expectations of interested parties shall be considered by senior management in the activities and interactions in the processes of the management system, with the aim of enhancing the satisfaction of interested parties while at the same time ensuring that safety is not compromised.**

In Ledningshandboken section 6.6 Processutveckling it is written in that requirements and guidelines that are specified by interested parties is considered as a part of the process inflow. Section 2.2 Medarbetarnas kompetens, medvetenhet och utbildning in the same document also states that the management is to stress the importance of meet the requirements and needs of the interested parties. It shall also be clear what the consequences can be if these requirements are not meet. The organisational policy states in the topic openness that the relationship with co-operating partners and suppliers should be based on good business ethics and with the safety and environmental requirements in mind.

Organisational Policies

**3.7. Senior management shall develop the policies of the organization. The policies shall be appropriate to the activities and facilities of the organization.**

The senior management have developed an organisational policy and it is possible to say that it is appropriate to the activities and facilities of a nuclear power plant. The organisational policy is based on the corporate group Vattenfall's core values, which are openness, accountability and effectiveness. Although have RAB adapted them to suit its own organisation.

Planning

**3.8. Senior management shall establish goals, strategies, plans and objectives that are consistent with the policies of the organisation.**

The president has appointed the RC to ensure that a document with goals, strategies plans and objectives is created. Ringshals calls this document Strategisk inriktning and it is written in the

ledningshandbok section 2.3 that the strategic planning is based on the requirements from the owner and the society and should be linked to the organisational policy.

**3.9. Senior management shall develop the goals, strategies, plans and objectives of the organization in an integrated manner so that their collective impact on safety is understood and managed.**

The document strategisk inriktning is written in an integrated manner and covers, safety, environment, production, competences and resources, organisation and management, interested parties and information management. Ledningshandboken section 3 Planera verksamhetens inriktning declares that it is the Presidents duty to own/manage, maintain, develop and possibly liquidate the facilities so that the short term and long term and economical goals are satisfied, without neglecting the requirements set on safety and environment. Although it is not stated that working in an integrated manner will help in understanding the collective impact on safety it probably does so.

**3.10. Senior management shall ensure that measurable objectives for implementing the goals, strategies and plans are established through appropriate processes at various levels in the organization.**

Both the organisations mid-term and its long-term goals for the different strategic areas are measurable; the goals are gathered in the document strategisk inriktning from section two to section four.

**3.11. Senior management shall ensure that the implementation of the plans is regularly reviewed against these objectives and that actions are taken to address deviations from the plans where necessary.**

From the Ledningshandbok section 3.2 Strategisk planering it is possible to extract that the evaluation of the determined direction is regularly conducted during management conferences.

Under the headline 2.3 Strategisk inriktning och balanserat styrkort in the document Beskrivning av RVS you can read that under given intervals is the strategy work examined with SWOT analysis to visualise the Strengths, Weaknesses, Opportunities and Threats of the work. Out of the results of these SWOT analyses are Balance Scorecards created and with the support of them can business goals be formulated, measured and developed in the determined direction.

### Responsibilities and Authority for the Management System

**3.12. Senior management shall be ultimately responsible for the management system and shall ensure that it is established, implemented, assessed and continually improved.**

In Ledningshandbok it is stated in section 1.6 Ringhals Verksamhetsstyrsystem that the one who is ultimate responsibility for establishment and development of the management system is the President of RAB, he does this with the support of the RC and the department RVQ. Furthermore has RAB according to the document RVS förvaltning och utveckling formed a RVS-committee that is responsible for monitoring and taking decisions of the structure of the management system.

**3.13. An individual reporting directly to senior management shall have specific responsibility and authority for:**

—Coordinating the development and implementation of the management

**system, and its assessment and continual improvement;**  
**—Reporting on the performance of the management system, including its influence on safety and safety culture, and any need for improvement;**  
**—Resolving any potential conflicts between requirements and within the processes of the management system.**

In the description of RVS Beskrivning av RVS it is written that an appointed representative is supposed to have the total responsibility for that the management system is working adequacy and that it is systematical and regularly improved. The document RVS förvaltning och utveckling declares that it is RAB's company strategic that has been appointed the responsible to manage and develop RVS and he utilize the department RVQ to manage, develop and quality assure the structure of RVS. In the department RVQ it is according to the document Funktionsbeskrivning RVQ, the Verksamhetsutvecklare together with the support of RVS-samordnare that is responsible for keeping RVS up-to-date. RVS-samordnare collects and follows up the requirements addressed within RVS.

From the document Delegering av arbetsuppgifter rörande förvaltning och utveckling av Ringhals verksamhetsstyrssystem RVS, från Björn Sjöström till Sten Bergman, it is possible to extract some of the definitions that RAB demands from the person working with the management system. It covers some of the points in the requirements such as, reporting on the performance of RVS and keeping the document updated and to spread the knowledge of the management system within RAB.

**3.14. The organization shall retain overall responsibility for the management system when an external organization is involved in the work of developing all or part of the management system.**

The management system is developed internally, but if an external organisation would develop a part of the management system it still would be the one who is appointed to be responsible for the management system that has the final responsibility for the content.

## **4. Resource Management**

**4.1. Senior management shall determine the amount of resources necessary and shall provide the resources to carry out the activities of the organization and to establish, implement, assess and continually improve the management system.**

The senior management writes in the Ledningshandbok section 2 Hantera resurser, that it shall be settled that the resources needed to operate and improve the RVS and to carry out the activities, as a whole is available. Although it is not written where it is published and how much resources are needed, just that it is settled, the author believes that the information is published in the business plan, which is a documents not available for him. When RAB talks about resources they mean, employees, suppliers, co-operators, and infrastructure, working environment, information and economical resources.

**4.2. The information and knowledge of the organization shall be managed as a resource.**

As mentioned above (4.1) is information seen as a resource by RAB, It is not written that knowledge is a resource, but in section 2.2 in ledningshandboken are employees mentioned, as a

resource it is almost certain that their knowledge is seen as a resource. Although could this use some clarification.

## Human resources

**4.3. Senior management shall determine the competence requirements for individuals at all levels and shall provide training or take other actions to achieve the required level of competence. An evaluation of the effectiveness of the actions taken shall be conducted. Suitable proficiency shall be achieved and maintained.**

Section 2.2 of Ledningshandboken tells that the senior management shall ensure that the competence necessary to effectively operate the facility is available. Furthermore it declares that the senior management shall regularly review and analyse both the present and the forecasted competence requirements against the competence that exist. The plan to cover the need for theoretical and practical training is in RAB based on the expected changes within the employee development and organisational culture. The goal with the training is to provide the employees with knowledge and skills, which together with experience will mean that the necessary competence always is available. This section also tells that the training shall be evaluated to see the effect on the organisations efficiency, the evaluations also serve as a tool to improve the training.

**4.4. Senior management shall ensure that individuals are competent to perform their assigned work and that they understand the consequences for safety of their activities. Individuals shall have received appropriate education and training, and shall have acquired suitable skills, knowledge and experience to ensure their competence. Training shall ensure that individuals are aware of the relevance and importance of their activities and of how their activities contribute to safety in the achievement of the organization's objectives.**

This requirement is covered in Ledningshandboken section 2.2; it states that the senior management shall ensure that the necessary competence for running the facilities effectively is available. Furthermore it states that training shall provide the employees with skills and knowledge, which together with experience ensures the necessary competence. In addition to this it is written that the training also shall give the insight of the link between the organisational policy and the management system goals for safety, environment, competence and value creating. It shall also be declared what the consequences can be for the organisation and its employees if the requirements not are fulfilled.

According to the document instruktion R1-R4 Kompetens- och behörighetsprövning av driftpersonal demands RAB that all the control room operators and stations technicians goes through a yearly competence check. If an employee's competence does not meet the set standard shall a plan of actions be established, it shall include what competence the person lacked, how it can be fixed and what the time line for such action is. All education and training are evaluated against set targets.

## Infrastructure and the working environment

**4.5. Senior management shall determine, provide, maintain and re-evaluate the infrastructure and the working environment necessary for work to be carried out in a safe manner and for requirements to be met.**

Under section 2.3 in the Ledningshandbok it is stated that the senior management shall ensure that the required infrastructure to sustain a safe, environmental, persevering energy production is

available. Section 2.4 says that the senior management shall see to that the working environment has a positive influence in employee motivation, satisfaction and performance with the intention to improve the organisations functions and result.

Furthermore states the directive Arbetsmiljö that the working environment shall be evaluated on an on yearly basis. It also says that it is the department of RSM that is responsible for the evaluation that shall see to those requirements on working environment are met. The result from the evaluation shall be presented to working environment committee and shall also be used as basis for improvements.

## **5. Process implementation**

Developing process

**5.1. The processes of the management system that are needed to achieve the goals, provide the means to meet all requirements and deliver the products of the organization shall be identified, and their development shall be planned, implemented, assessed and continually improved.**

The processes are identified in the document Ringhals Processrelationsschem, and it is according to Ledningshandboken section 6.6 Processutveckling used to describe how the organisation is managed seen from a process perspective. Furthermore claim the same section that the process owner shall contribute to make the process more efficient and the continually improvement of the processes.

**5.2. The sequence and interactions of the processes shall be determined.**

The process map gives a clear view of the sequence and the interaction between the processes. RAB has divided their process into three sections, management processes, core processes and support processes. This information is available in Ringhals Processrelationsschema, the process map is also divided in two levels of details.

**5.3. The methods necessary to ensure the effectiveness of both the implementation and the control of the processes shall be determined and implemented.**

In the document Verksamhetsbok Processutveckling section 5 Genomförande presents RAB their model for process development. It consists of four phases, preparing, analyse of “current position”, development of “wanted position” and implementation. Before the implementation phase is started should a process owner be appointed, it is his task to see to that the new process reaches the set goals.

**5.4. The development of each process shall ensure that the following are achieved:**

—Process requirements, such as applicable regulatory, statutory, legal, safety, health, environmental, security, quality and economic requirements, are specified and addressed.

—Hazards and risks are identified, together with any necessary mitigatory actions.

—Interactions with interfacing processes are identified.

—Process inputs are identified.

—The process flow is described.

—Process outputs (products) are identified.

—Process measurement criteria are established.

RAB has a instruction for how a process development should be conducted called Rutin för organisations och Verksamhetsförändringar. A sponsor with a leading role within the affected process is appointed to the process development mission. The unit RVU then assign coaches that together with the sponsor select a project team for the assignment. When the process development has comes as far as implementation is a project owner selected and it is his responsibility to see to that the requirements are meet. In the appendix to this document are frame works and guidelines available that include routines for the safety, inner and outer environment. In section 8 of the appendix it is stated how to deal with risk analysis.

**5.5. The activities of and interfaces between different individuals or groups involved in a single process shall be planned, controlled and managed in a manner that ensures effective communication and the clear assignment of responsibilities.**

Verksamhetshandboken Processutveckling describes in section 5.2 that during the "Current position" phase performs the coaches several interviews with individuals involved in the process teams in order to put together a cross functional process map, which describes the workflow and communications between the different functions and groups.

#### Process Management

**5.6. For each process a designated individual shall be given the authority and responsibility for:**

- Developing and documenting the process and maintaining the necessary supporting documentation;
- Ensuring that there is effective interaction between interfacing processes;
- Ensuring that process documentation is consistent with any existing documents;
- Ensuring that the records required to demonstrate that the process results have been achieved are specified in the process documentation;
- Monitoring and reporting on the performance of the process;
- Promoting improvement in the process;
- Ensuring that the process, including any subsequent changes to it, is aligned with the goals, strategies, plans and objectives of the organization.

The process owner is described in the document Funktionsbeskrivning Processägare. He/She fulfils the requirements that IAEA sets on an individual responsible for a process. Under section 2 of that document are his/hers responsibilities listed, and it covers most of the requirement. It is not mentioned that it is up to the designated individual responsible for the process to ensure that there is an effective interaction with interfacing processes. Although it is should be covered by the meetings between the process owners called, Process Ägar Rådet (PÄR).

**5.7. For each process, any activities for inspection, testing, verification and validation, their acceptance criteria and the responsibilities for carrying out these activities shall be specified. For each process, it shall be specified if and when these activities are to be performed by designated individuals or groups other than those who originally performed the work.**

The description of the process owner (Funktionsbeskrivning Processägare) says that it is his responsibility to measure the performance of the process, he then report this at a Process Owner meeting (PÄR), which are held once bimonthly. The instruction Internrevision section 2 Ansvar states that inspections are planned on a 4-year basis, in excess of those can inspections be ordered by manager at all levels in depending on their responsibility area. Although it could be

mentioned in the document Verksamhetshandbok for each process to clarify who is responsible for the inspections.

**5.8. Each process shall be evaluated to ensure that it remains effective.**

As mentioned above it is the task of the process owner to evaluate the process in order for it to remain effective.

**5.9. The work performed in each process shall be carried out under controlled conditions, by using approved current procedures, instructions, drawings or other appropriate means that are periodically reviewed to ensure their adequacy and effectiveness. Results shall be compared with expected values.**

In the document Verksamhetshandbok Drift och underhåll in section 3.2 Arbetsbeskrivning it is stated that the work within the operation shall follow established routines. The routines, which are documented and established endorse that the facility in each and every aspect fulfils the requirements dictated in STF (Säkerhetstekniska driftförutsättningar) to guarantee the safety for the surroundings. Though this is only mentioned in the handbook for maintenance and operations, which of course are key areas of the plant, but the issue could also be stressed in other areas of the management system.

**5.10. The control of processes contracted to external organizations shall be identified within the management system. The organization shall retain overall responsibility when contracting any processes.**

Suppliers of services are evaluated the in same way as suppliers of goods; all suppliers are evaluated on their performance in the areas of quality, technical performance, economical performance and environmental performance, according to the instruction leverantörsbedömning section 3. The instruction Internrevision states that the control of outsourced process shall be a part of supplier evaluation. Although regarding the responsibility of the contracted processes cannot the author find any written proves of who is responsible.

#### Generic Management System Processes

**5.11. The following generic processes shall be developed in the management system.**

RVS has systems for all the generic processes and they will be presented under each requirement.

#### Control of documents

**5.12. Documents shall be controlled. All individuals involved in preparing, revising, reviewing or approving documents shall be specifically assigned this work, shall be competent to carry it out and shall be given access to appropriate information on which to base their input or decisions. It shall be ensured that document users are aware of and use appropriate and correct documents.**

The document Verksamhetshandboken CM/DM chapter 3 describes RAB's system for creation and usage of documents. A reviewer controls the documents before publishing. He/she has to have knowledge in the area, which the document covers. A documentation system has been implemented to ensure that the users use the correct documentation.

**5.13. Changes to documents shall be reviewed and recorded and shall be subject to the same level of approval as the documents themselves.**

According to the Verksamhetshandbok CM/DM Chapter Six, gets an updated document a new version number. The document has to have a revision list, where changes to the document are listed. Furthermore have the changes in the document go through the same process of approval as the document once did.

Control of products

**5.14. Specifications and requirements for products, including any subsequent changes, shall be in accordance with established standards and shall incorporate applicable requirements. Products that interface or interact with each other shall be identified and controlled.**

The technical requirements set on products that are to be used within the nuclear power plant are divided into mechanical and electrical product requirements. For mechanical products it is the document TBM and for electrical governs TBE what requirements both new and modified products shall meet if they are to be installed and used in Swedish nuclear power plants.

TBM and TBE shall be used together whenever a product contains both mechanical and electrical components. TBM states under the section 2.4 Konstruktionspecifikationer that the construction specification should include analysis of how the change will affect both the current and the interacting system.

**5.15. Activities for inspection, testing, verification and validation shall be completed before the acceptance, implementation or operational use of products. The tools and equipment used for these activities shall be of the proper range, type, accuracy and precision.**

Also when it comes to inspection, testing, verification and validation are mechanical and electrical products differentiated from each other. KBM declares in section 2.2 that the general control requirements for mechanical products consist of five classifications.

- Control before manufacturing, installation or repairing. IP-100
- Control of original material and ready manufactured detail. IP-200
- Control during manufacturing, welding or other concatenence. IP-300/500
- Control of complete devices and parts of devices. IP-400
- Control of completed installation or repairment. IP-600

Whereas the control requirements for electrical products on the supplier according to KBE 100-3 section 3.3 Produktverifiering consists of:

- A type check where the supplier must specify what types of control the product have gone through and what standards have been the foundation for these controls.
- Shall be specified what overall control the product undergo during and after manufacturing.
- Delivery control normally consists of a Factory Acceptance Test (FAT). Which if successful gives the supplier a permit to deliver the product.
- Before the product can be taken in operation it have to go through a practical test called Site Acceptance Test (SAT) to see that it meets the requirements of the power plant.

It is written in section 1.4.3 Ackreditering of KBM, that company's that perform controls and tests of products need a certificate that say that they meet the specified requirements of SWEDAC. But if the accredited company's use tool tools and equipment of proper range is not found within the management system.

**5.16. The organization shall confirm that products meet the specified requirements and shall ensure that products perform satisfactorily in service.**

This requirement is fulfilled with the Site Acceptance Test for electrical products and IP-600 control requirement for mechanical products. See requirement 5.16.

**5.17. Products shall be provided in such a form that it can be verified that they satisfy the requirements.**

The author has had problems identifying in what state the products shall be provided in, but realize that it is hard to approve a product if it cannot be tested.

**5.18. Controls shall be used to ensure that products do not bypass the required verification activities.**

The characteristics for controls are similar for both mechanical products and electrical products. It is written in KBM section 2.1.3 Kontrollmomentbeskrivningar that the general control features, EP, consists of references and directions of control and testing execution, operations, range, acceptance level and requirements on reporting of the performed control or testing process. KBE states in section 3.3.1 that deviations from the buyers control plan regarding the range of the testing and controls must be reported by the manufacturer in order to start the manufacturing. Furthermore shall the buyer have the rights to participate in the deliberations between the manufacturer and the third party control company regarding control issues.

**5.19. Products shall be identified to ensure their proper use. Where traceability is a requirement, the organization shall control and record the unique identification of the product.**

In TBE 100 section 3.14 Märkning it is written that products shall be identified with the facilities in-plant identification system in accordance with the buyer's directions. The delivered material shall be labelled with clear and lasting signs to enable identification after the installation to facilitate the operations, inspections and maintains.

It is described how the products should be identified and there by made traceable in chapter 16 of Verksamhetshandboken CM/DM.

**5.20. Products shall be handled, transported, stored, maintained and operated as specified, to prevent their damage, loss, deterioration or inadvertent use.**

TBE section 6 set requirements on that the manufacturer shall package and transport the goods in a way that not causes them any damage. The manufacturer shall also provide the buyer with written directions on how the products shall be stored in order to preserve its performance. Furthermore it is stated that supplier shall leave an offer on a training program for the staff of the buyer. Verksamhetsboken MA section 3.6.6 declares that it is up to the storage function to see to that the products are stored in a safe, rational and economical way.

Control of records

**5.21. Records shall be specified in the process documentation and shall be controlled. All records shall be readable, complete, identifiable and easily retrievable.**

Verksamhetshandboken CM/DM chapter 5 section 1.1.2 Anläggningsdokument describes the document group Anläggningsdokument and declares that it is within this document group that the records are kept. The documents in the group Anläggningsdokument should be as readable, complete, as other documents within the management system. (see requirement 2.9)

**5.22. Retention times of records and associated test materials and specimens shall be established to be consistent with the statutory requirements and knowledge management obligations of the organization. The media used for records shall be such as to ensure that the records are readable for the duration of the retention times specified for each record.**

Chapter 9 of Verksamhetshandboken CM/DM states in section 11.8 that a document within the group Anläggningsdokument cannot be removed as long the facility still is up and running. Section 15 Arkivmedia of the same document describes the different medias available for storage. But the author believes that associated test materials and specimens not are included in the group anläggningsdokument.

Purchasing

**5.23. Suppliers of products shall be selected on the basis of specified criteria and their performance shall be evaluated.**

The suppliers should according to verksamhetshandboken MA section 3.3.4.2 Utvärdering and 3.5 Uppföljningsfas be chosen on its ability to deliver goods that meets the requirements. Suppliers are evaluated for upcoming purchases and evaluations according to the instruction Leverantörsbedömning.

**5.24. Purchasing requirements shall be developed and specified in procurement documents. Evidence that products meet these requirements shall be available to the organization before the product is used.**

In section 3.2.6.4 Specifikation av anskaffningsunderlaget Verksamhetshandboken MA, it is specified what requirements shall be a part of the procurement document. Regarding control of product before use, see requirement 5.15.

**5.25. Requirements for the reporting and resolution of non-conformances shall be specified in procurement documents.**

Reporting of non-conformances is one of the terms that RAB states that shall be included in the procurement document according to the list in section 3.2.6.4 in Verksamhetshandboken MA. Section 3.4.7 of verksamhetshandboken MA states that when a non-conformance occurs should the purchaser always make a complaint.

**5.26. Information relevant to safety, health, environmental, security, quality and economic goals shall be communicated to individuals in the organization and, where necessary, to other interested parties.**

Verksamhetshandbok Kommunikation section 9 declares that RAB have several channels for internal communication such as, company newspaper, intranet, meetings etc. From their view are all these of different channels working complementary to spread the information to the individuals. RAB declares in section 8 of Verksamhetshandboken Kommunikation that the

purpose of external communication is to create acceptance and build confidence and good relations with staff, opinion-makers, politicians, neighbours and future employees.

**5.27. Internal communication concerning the implementation and effectiveness of the management system shall take place between the various levels and functions of the organization.**

In ledningshandboken section 5.2 it is written that the results from the managements review regarding improvements of RVS is to be communicated to individuals within the organisation.

Managing organisational Change

**5.28. Organizational changes shall be evaluated and classified according to their importance to safety and each change shall be justified.**

The effects and consequences of an organisational change shall be evaluated and documented states the document Rutiner för organisations- och verksamhetsförändringar. RAB has two classifications for changes, either a major or a minor change. This depends on amount of requirements, extent of change and the complexity.

**5.29. The implementation of such changes shall be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised.**

The instruction, Rutiner för organisations- och verksamhetsförändringar has the purpose of managing organisational change and ensure that they are planned, implemented and evaluated to fulfil the requirements. One of the goals with the change shall be that the nuclear safety maintained after the change has taken place. The purpose and goal shall according to section 3 Kommunikation, be communicated to, the employer, employees, staff associations and safety supervisor. Section 10 of the same document states that experiences shall be written down during the on-going change in order to ensure the knowledge management.

## **6. Measurement, Assessment and improvement**

Monitoring and measurement

**6.1. The effectiveness of the management system shall be monitored and measured to confirm the ability of the processes to achieve the intended results and to identify opportunities for improvement.**

Ledningshandboken 3.2.1 states that RAB use balanced scorecards to manage the organisation in the wanted direction, it translates the mission statement to strategies, critical success factors, goals and measures both in a long and short perspective. It is then broken down and the goals are concretised to fit to all the departments and to help employees understand how the vision and strategies affect their daily work. The results from measurements of the balanced scorecards are analysed and shall be used to come up with corrective actions.

Self-assessment

**6.2. Senior management and management at all other levels in the organization shall carry out self-assessment to evaluate the performance of work and the improvement of the safety culture.**

In section 5 Ledningens genomgång of the ledningshandbok, declares RAB that the senior management evaluate the strategy and the organisations result shall within planned intervals to

ensure RVS continuing adequacy and efficiency. The evaluation should also include an assessment of the result, possibilities for improvement and the need for changes within the management system including the long-term strategy, organisational policy and overall goals. The improvement of the safety culture is not mentioned.

Independent assessment

**6.3. Independent assessments shall be conducted regularly on behalf of senior management:**

- To evaluate the effectiveness of processes in meeting and fulfilling goals, strategies, plans and objectives;
- To determine the adequacy of work performance and leadership;
- To evaluate the organization's safety culture;
- To monitor product quality;
- To identify opportunities for improvement.

Under the section 5.3.1 Internrevisjoner in Ledningshandboken it is written that independent assessments are conducted on all the activities within the organisation that affects the safety and environment. Furthermore provides the instruction Internrevisjon a more detailed description of independent assessments. It says that in general is the task of independent assessment to see the management systems adequacy, pertinent and effectiveness. The assessments focused on the processes and activities shall state that these activities fulfil the requirements and are run both safe and environmental. Regarding the safety culture work did the author find that it is measured through surveys but not that it is performed by an independent audit.

**6.4. An organizational unit shall be established with the responsibility for conducting independent assessments. This unit shall have sufficient authority to discharge its responsibilities.**

Under the headline Ansvar in the instruction Internrevisjon it is stated that the department RQA is initiating the independent audits according to the plans, on behalf of the President. It is not mentioned what their authority is.

**6.5. Individuals conducting independent assessments shall not assess their own work.**

As the instruction Internrevisjon stated is the unit RQA the responsible for conducting the Independent audits, but if the department of RQ and senior management are to be audited will these be conducted by an external auditor. Also here is RAB responsible for the evaluations quality. Furthermore declares the instruction Internrevisjon in section 4.2.1 Val av revisjonsgrupp that the individual in charge of the review can not have or in recent time have had any direct influence in the process that is to be reviewed, in addition can not the majority of the review group belong to the same process as is the target for the review. This is in direct conflict with the requirement.

**6.6. Senior management shall evaluate the results of the independent assessments, shall take any necessary actions, and shall record and communicate their decisions and the reasons for them.**

Section 5.3 of the instruction Internrevisjoner tells that observations that the auditor sees as general weaknesses are presented by RQ to the senior management. These are according to the ledningshandbok section 5.1 supposed to be evaluated in the senior management-briefing meeting. The result from these meetings shall according to section 5.2 Ledningshandboken be

made public and to show the employees that management briefings are making good for the organisation.

#### Management system review

**6.7. A management system review shall be conducted at planned intervals to ensure the continuing suitability and effectiveness of the management system and its ability to enable the objectives set for the organization to be accomplished.**

Section 5,1 Ledningens genomgång in Ledningshandboken states that the senior management shall in planned intervals review the company's strategy and the results to ensure that the management systems adequate, sufficiency and efficiency.

**6.8. The review shall cover but shall not be limited to:**

- Outputs from all forms of assessment;**
- Results delivered and objectives achieved by the organization and its processes;**
- Non-conformances and corrective and preventive actions;**
- Lessons learned from other organizations;**
- Opportunities for improvement.**

RAB declares in Section 5,1 Ledningens genomgång in Ledningshandboken that the review shall cover an evaluation of the result, opportunities for improvement, need for changes in management system, long-term strategy, organisational policy and the overall goal for the organisation.

The review shall be based upon material and opinions gathered from both managers and individuals on all levels of the organisation. It shall be put together by department managers and then processed by RQ on the behalf of the senior management. Furthermore it states that strengths and weaknesses, both existing and potential shall be identified and reported. The material presented to the senior management shall also include other organisations and suppliers opinion of RAB's organisation. What it does not say is whether or not they should use lessons learned from other organisations.

**6.9. Weaknesses and obstacles shall be identified evaluated and remedied in a timely manner.**

Subject covered in requirement 6.8.

**6.10. The review shall identify whether there is a need to make changes to or improvements in policies, goals, strategies, plans, objectives and processes.**

Subject covered in requirement 6.8.

#### Non-conformances and corrective and preventive actions

**6.11. The causes of non-conformances shall be determined and remedial actions shall be taken to prevent their recurrence.**

In section 6.4 Avvikelsehantering och erfarenhetsåterföring in Ledningshandboken it is written that a system for identification and handling of non-conformances shall exist. The instruction Beskrivning av avvikelsetprocessen for the process of handling with non-conformances tells in

section 4.5 Analys av inträffade avvikelser that the purpose with the analyses of non-conformances is gather experience and establish actions that prevent reoccurrence.

**6.12. Products and processes that do not conform to the specified requirements shall be identified, segregated, controlled, recorded and reported to an appropriate level of management within the organization. The impact of non-conformances shall be evaluated and non-conforming products or processes shall be either:**

—Accepted;

—Reworked or corrected within a specified time period; or

—Rejected and discarded or destroyed to prevent their inadvertent use.

According to the PAKT document PBM 1, 8.5 Avvikelser shall all non-conformances that are identified and not accepted be subject for a non-conformances report or with a documented proposal of how to correct the non-conformance. Ringhals states in the instruction Internrevisison that a non-conformance must be adjusted and if it is not shall it be motivated why. The responsible department manager shall approve either the action or the motive not to act. All non-conformances are according to the document beskrivning av avvikelseprocessen section 4.4 Kategorisering categorised to be able to analyse them in an effective manner.

**6.13. Concessions granted to allow acceptance of a non-conforming product or process shall be subject to authorization. When non-conforming products or processes are reworked or corrected, they shall be subject to inspection to demonstrate their conformity with requirements or expected results.**

Concessions for non-conforming products and processes are subjects to authorisation, see previous requirement. Section 6 of Internrevisison tells that every department shall ensure that the decided actions are implemented, registered and followed-up. It is the department manager that is responsible for the follow up of the planned actions and the effect of the implemented actions.

**6.14. Corrective actions for eliminating non-conformances shall be determined and implemented. Preventive actions to eliminate the causes of potential non-conformances shall be determined and taken.**

Section 6 of the document Internrevisison declares that every department shall have organised system that ensures that all corrective actions are carried out, registered and evaluated. Furthermore states section 5.2 of the same document that signature of the revision manager and RQA is the proof that tells that an evaluation on efficiency and relevance of the corrective actions has taken place. This concludes that the corrective actions are now to be seen as a permanent solution to the non-conformances.

**6.15. The status and effectiveness of all corrective and preventive actions shall be monitored and reported to management at an appropriate level in the organization.**

According to the document Internrevisison section 6 it is the department manager that is responsible for the evaluation of the planned actions and the efficiency of the taken actions. Section 6 continues by stating that it is RQA that makes the follow up to see that the departments work with corrective actions is performed well.

**6.16. Potential non-conformances that could detract from the organization's performance shall be identified. This shall be done: by using feedback from other organizations, both internal and external; through the use of technical advances and research; through the**

**sharing of knowledge and experience; and through the use of techniques that identify best practices.**

In the section 8 Utveckling of the document Internrevision it is written that RQA constantly develops its internal review process. It is stated that their tools for doing this are, management review board, questionnaire from those that are audited, development meetings with the review managers, a yearly experience meeting with auditors and yearly networking meetings with P Norden and KSK (Kärnkraftverkens Samarbetsgrupp Kvalitet).

Improvement

**6.17. Opportunities for the improvement of the management system shall be identified and actions to improve the processes shall be selected, planned and recorded.**

According to Ledningshandboken section 5.1 and 5.2 shall the management review include an analysis and evaluation of RVS; the result from the review shall lead to an improvement of RVS with the intention to improve its effect. The instruction Arbetsordning för Ringhals ledningsfora tells in section 2.3.1 that every decision made by senior management shall be recorded. The progress of the decision shall then be controlled and can only be seen as closed when the actions taken shows the expected result.

**6.18. Improvement plans shall include plans for the provision of adequate resources. Actions for improvement shall be monitored through to their completion and the effectiveness of the improvement shall be checked.**

Section 2 Hantera resurser in Ledningshandboken states that the needed resources to manage and to improve RVS shall be settled and accessible. Furthermore it is written in the instruction RVS förvaltning och utveckling section 2.2 that the department RVQ have put together an administration and development organisation to RVS. The purpose of the organisation is to ensure that the required resources are available. Although it is not mentioned whether any improvement plans for RVS exists. The requirement regarding monitoring is covered in the previous requirement.

## 5 Discussion

*This discussion cover those requirements that the author thinks RVS does not fulfil completely. There may be a certain part or the whole requirement that deviate from what the IAEA safety requirement state. The requirements are first described in short terms, then the author provides an explanation of what he thinks RVS lacks. Furthermore is a suggested improvement as well as a description of where in RVS the improvement is needed. Moreover are the differences in the overall approach to management system between IAEA safety standard and RVS discussed.*

### 5.1 Identified deviations

#### General Requirements

In requirement 2.1 it is stated that by ensuring that the management system considers all requirements in an integrated manner helps to understand their negative impact on safety. Although RVS, is written in an integrated manner it lacks a description, which promotes the thought of not considering any requirement separate from safety. The author believes that this should either be presented in the document Ledningshandbok, as a part of the Presidents general requirements or in the document Beskrivning av RVS.

IAEA writes in requirement 2.2 that safety should paramount all other requirements. The author has had problems finding such a statement in RVS, although it is written in the Verksamhetspolicy (Organisational Policy) that first priority is to protect the surroundings, staff and facility from damages. It is also stated under the headline Ansvarstagande that safety and environment should be prioritised in all activities. It could be a problem that RAB place the environment and the safety on an equal level, what happens when two requirements comes in conflict. It needs to be clarified which of them are prioritised.

Requirement 2.3 focuses on other requirements the publication GS-R-3 that RVS should identify and integrate. Among those mentioned are other relevant IAEA Safety Requirements publications, such as Emergency and Preparedness and Response and Safety Assessment. These publications are not mentioned in the document Sammanställning av identifierade krav, which shall be the document where all requirements are gathered. In fact is IAEA not mentioned at all. The author has both read and heard indications that IAEA will use their Safety Requirements as a base for their plant evaluations, is this something that RVS should cover, or at least discuss.

Requirement 2.5 deals with safety culture, RAB have guidelines in the document Verksamhetspolicy for the safety culture in RAB, furthermore gives the document Övergripande mål och förhållningssätt a detailed view of their safety work. But as IAEA stresses the importance of the common understanding of the key aspects of safety culture in the organisation should this be given more room within RVS. The author does not say that RAB lacks safety culture, just that it should be more accountable if written down in RVS. IAEA provides a good framework for what is important and what should be included in the safety culture in a nuclear facility.

Requirement 2.6 says that the application of the management system shall be graded so the right amount of resources can be deployed. As an interpretation of SKIFS:1 chapter 4 §4 has the Swedish nuclear industry developed the PAKT documents, which is supposed to gather all the requirements set on products in the nuclear industry. Furthermore are the products classified, there are different classification systems depending on the function of the product. The author believes that IAEA want RAB to be able say that a product with a certain grade needs to fulfil this amount of requirements in order to be used in the facility. A problem is that the many different classification standard are hard to compare.

Requirement 2.9 states that the documents shall be understandable to those who use them, at RAB this means that RVS is written in Swedish, as most of those working at RAB have Swedish as their mother tongue. Although, what happens whenever a person not speaking Swedish what to use a document, i.e., a foreign consultant? The author does not mean that the management system should be bilingual, but it could be mentioned what the routine for this is.

### **Management responsibility**

Requirement 3.9 tells that the senior management shall develop goals, strategies and objective in an integrated manner to facilitate their collective impact on safety. It is stated that RVS is written in an integrated manner but not that it is so to help understanding the collective impact on safety. Is this the case? If so, could this be promoted in the description of RVS?

Requirement 3.13 declares that an individual reporting directly shall have specific responsibility and authority for the management system. At RAB is the RC appointed as responsible for the management and development of RVS. He utilises the unit RVQ to manage, develop and quality assure the structure in RVS. But decisions regarding RVS can he not take solely, this is up to a RVS-committee to do. But as of later this year (2008) will the structure around RVS change whereas RVQ will be a part of the Quality department. It is important that the senior management does not move the responsibility of RVS to far down in the hierarchy, to prevent authority issues.

### **Resource management**

IAEA states in requirement 4.1 that information and knowledge shall be managed as a resource. RAB does not list knowledge as a resource, but they do list employees as resources and they probably mean that the knowledge is included in the employee. But it could be noted that the employee's knowledge is seen as a resource.

### **Process implementation**

Requirement 5.6 covers different responsibilities for the process owner, one of these are that he/she shall ensure that there is an effective interaction between interfacing processes. It is not mentioned in the funktionsbeskrivning Processägare how the process owner can ensure this, although the author believes that this is covered during the process owner meetings. This information could be added to the work description for the process owner, to ensure that this requirement is fulfilled.

Requirement 5.7 states that it shall be specified in each process who is responsible for the inspections, verification and validation and what the acceptance criteria are for them. It continues by saying that it shall be specified when and if these tasks are to be performed by a designated group or by someone other than those that performed the work. It is not specified within the process manuals who and when the inspections are to be performed. Although it is stated in the instruction Internrevision that it is the task of the process owner to order an inspection of his/hers process. Furthermore provides the appendix of the same instruction a 4 year plan of when inspections are to be performed within each process. This information could be integrated into each process manual.

Requirement 5.9 states that the work in each process shall be carried out under controlled conditions, by using approved procedures, instructions and drawings. The only document that the author found stating this was the process manual for operation and maintenance. It says that the routines, which are documented and established endorse that the facility fulfils the requirements in STF to guarantee the safety for the surroundings. Maintenance and operation is

of course a key area of the plant, but the requirement states that "each" process shall be carried out under controlled conditions. This should than be noticed in every process manual.

It is stated in requirement 5.10 that the control of processes contracted to external organisations shall be identified and that RAB shall retain the overall responsibility of those processes. The author has not found any written evidence that RAB has any outsourced processes but knows from an oral source that it exists, i.e., IS/IT. But RAB place suppliers if services on the same level as suppliers products, which mean that suppliers of services are evaluated in the same way as suppliers of products. As the information on external processes is not so comprehensive has the author not been able to locate out who is responsible for them.

Requirement 5.22 covers the retention times of records, test materials and specimens. As the records are a part of the document group Anläggningsdokument, shall they remain as long as the facility is up and running. But whether or where the specimens and test material are stored has the author not been able to validate. It should be specified where the test material and specimens are stored and what the retention time are for them. As it is stated within the PAKT documents i.e. PBM section 6 Dokumentation that the records shall be stored, it could be noted what to do with the specimens and test-materials there as well.

### **Measurement, Assessment and improvement**

Requirement 6.2 tells that senior management and all management shall carry out self-assessment to evaluate the work and the improvement of the safety culture. The author has interpreted this requirement as that the self-assessment of the senior management is a part of what in RVS is called Ledningens genomgång. Here are topics such as assessments of result, possibilities for improvement and need change in strategies and organisational policy's covered. All other management self-assessments are supposedly included in the Balanced Scorecards, as it is with that tool that the performance for each unit is measured. But also in this requirement it is of the author's opinion that RAB does not stress the importance of safety culture as much as IAEA want them to. A proof that safety culture is important to IAEA is that they have included a framework with the characteristics and attributes of what makes an organisation have a good safety culture. In the IAEA document DS349 it is written that the framework can be used to evaluate strengths and weaknesses in an organisation both through self-assessments and by external review. This could be taken as an insinuation that IAEA could use this framework for coming safety culture evaluations at RAB.

Requirement 6.3 covers the topic of independent assessments, RAB describe in general how the work with independent assessments in section 5.3.1 in the document Ledningshandbok. A more detailed description is presented in the instruction Internrevision. It is written in section 5.4 of ledningshandboken that the safety culture is measured through survey's, but it does not tell whether or not this is performed by an independent audit or not. If it is done through an independent assessment should this be written in either or both of the document refereed to earlier.

The requirement 6.4 writes IAEA that a unit responsible for the independent assessments shall be established, it also states that this unit shall have sufficient authority to discharge its responsibilities. At RAB it is the unit RQA that is responsible for the independent assessments, but is not written what their authority is. It should be stated how much authority they have, at least in the instruction Internrevision. An independent assessment unit without proper authority will have problems performing their obligations.

Furthermore it is written in requirement 6.4 that individuals conducting independent assessments shall not assess their own work. In RVS it is written in the instruction Internrevision section 4.2.1 that the individual responsible for the assessment cannot have or in recent time had direct influence in the process that is to be assessed. It continues by stating that the majority of the group performing the assessment cannot belong to the same process, as is the target for the assessment. There is a conflict between the requirement and the content in RVS, although it can be understandable that RAB want the people assessing the work to have some knowledge about the process. Problems can arise when individuals assess their own work, important matters or non-conformances could be missed out in the assessment just because they do not see the problems.

Requirement 6.8 declares that management system reviews shall include certain topics, one of them are that it shall include lessons learned from other organisations. In the document Ledningshandbok there is a section, which states what RAB includes in the management system reviews. This section lacks any information regarding if they consider lessons learned from other organisation. The author has found other areas where it is stated that they do so, and if they do not do so during management system reviews should this topic be added to the agenda.

Requirement 6.18 sets a requirement for what the improvement plans of the management system shall include. The author has found documents, which describes the organisation around the management system and also statements saying that the needed resources to improve RVS shall be settled and available. What he has not found are the improvement plans or even a sentence saying that they exist. Although the author is certain that this information exist, it is just not available in RVS.

## **5.2 Differences in overall approach**

That the standards of the International Organisation for Standardisation on environmental management systems and on quality management systems as well as IAEA's code on Quality Assurance were considered when this Safety Standard was developed, and that RAB have developed a management system that integrates quality, environment and health makes it possible to understand that the differences between the standard and RVS should not be substantial. One example of correspondence between the management system standards is presented in table 1 in the theory.

The section of GS-R-3 where the most deviations in RVS could be identified is the general requirements on management systems (2.1-2.10). It is in this part that the author believes that the IAEA safety standard differentiate it self the most against the commonly used management systems standards ISO 9001 and ISO 14001. It is in this section where requirements are sat on integration of requirement, nuclear safety, safety culture and grading of management system requirements, which all are things that other management system standards does not cover. This is probably the reason to most of the identified deviations between IAEA GS-R-3 and RVS.

An example of this can be illustrated by the term safety culture. Safety culture is only mentioned once in the document Ledningshandboken, which is regarded has top document within RVS. Even though this document is written with department managers in mind and not all individuals of the organisation. If more focus is put on this matter in the document Ledningshandbok could this be a good way of transmitting the importance of safety culture all the way from department managers to all individuals of RAB. The author is sure that RAB have a safety culture program that is structured, implemented and continually improved. Although it should be presented in a better way to gain in understanding and to make it known within the organisation.

An experience of the author is that it sometimes is hard to locate the wanted material in RVS. I.e. to find answers to the requirements from IAEA safety standard GS-R-3. This could have to do with the fact that RVS is constructed in an a way that is supposed help the reader only look at information interesting for him/her. This makes it hard for someone as the author of this dissertation who tries to get an overlook of the management system and look for specific information in almost all processes. This may have lead to that the author can have missed out on information within RVS that was important to him. In some cases may this be a problem even for the users of RVS, as if the needed link between documents does not exist. This may lead to that important information is left out. An example of this is the control of products, if safety is of such importance as it is in nuclear power plant should it be described that products in the facility is controlled. The author had problems locating such an elementary issue within RVS. He found it within the PAKT document PBM, the author believes that a reference to the PAKT should exist both in Verksamhetshandboken MA and Ledningshandboken.

A problem with this management system standard is the validity, IAEA state that each nuclear facility shall follow the requirements (GS-R-3) to further strengthen this have they included that as a requirement within the standard. This though they nuclear power plant has no obligations towards IAEA, they answer to the Swedish government and their authorities SKI and SSI. SKI only state in their injunction SKIFS:2001 §8 that nuclear facilities shall have implemented a quality management systems and that this could be done with the influence of IAEA's system standard for quality assurance. No new injunction is published which state their management system must be in accordance with IAEA GS-R-3. The author has not found any specific information that points to that evaluations of the nuclear power plants management systems will be done using IAEA GS-R-3. During the third convention on Nuclear Safety it was stated that the IAEA Safety Standards could be used in IAEA's evaluation process, but the safety requirements consist of much more than just requirements on the management system.

RVS is as it was stated in the theory a living management system, meaning that it is continually evaluated, corrected and improved. This is in accordance with the requirements IAEA present in GS-R-3, it is also one of the key components in management system standards such as ISO 9001 and ISO 140001. Although this it can cause problems when someone are to perform an assessment or benchmark of the management system as the author have done. As information and documents can disappear, be updated or even be completely rewritten, this mean that something that the auditor once stated and pointed to could have disappeared from the document. There have been such issues with this dissertation, especially as the organisation around the management system has been reconstructed. Furthermore has documents that been referred to changed during the time for the dissertation which made it harder to evaluate certain requirements.

## **6 Conclusion**

This dissertation origin out of a previous study a study that benchmarked RVS against IAEA's code for quality assurance. When IAEA released their new management system standard GS-R-3 became the previous study out of date and it was decided that a new benchmark would be performed against the new standard. IAEA's latest management system standard focus on integration of management system, which tries to combine requirements on safety, health, environment and quality. This suits RVS, as it is written in an integrated manner.

The author recommends RAB to analyse the result of this evaluation and use the experiences that the author provides in the discussion. Even though the general impression of RAB's management system is that it is thoroughly worked through it still lacks some of the features that IAEA requires that a management system shall fulfil. In appendix 2 the reader can get an overlook of where in the Safety Standard the most of the deviations appear. Examples are such things as safety culture routines and descriptions of external processes, which shall be included. Some of the things the author has pointed out, as differences are things that RAB does, though it is not written within the management system. This means that it does not need to be a to large investment in time and resources to correct the non-conformances within the management system to fulfil IAEA GS-R-3. As the nuclear industry is under a constant requirement pressure from government and interested parties stating how the shall work, believes the author that the changes needed to fulfil all the requirements in GS-R-3 would be viable for a organisation such as RAB.

Although reasons have been raised in the discussion that the standard has validity issues because Swedish nuclear power plants answer to SKI it is possible that it may be part of IAEA evaluation process called Operational Safety Review Team (OSART). There is also a chance that the standard will be a part own SKI's own requirement on management systems. In either case feels the author that the study of RVS has been of importance both for testing strength and weaknesses of RVS and to raise notion that the management system standard from IAEA exist.

If RAB wants to further improve their management system can they use the safety guide GS-G-3.1, which according to IAEA provides guidance on how to develop a management system that strives to achieve a high level of safety.

## References

- ANALYSGRUPPEN (2006) *Kärnsäkerhetskonventionen. Bakgrund*. Nyköping, KSU. [Online] Available at: <http://www.analys.se/lankar/Bakgrunder/2006/Bkg 2-06.pdf> (Accessed at: December 7<sup>th</sup> 2007)
- ARBETSMILJÖVERKET (2001) *AFS 2001:1, Systematiskt arbetsmiljöarbete*. Arbetsmiljöverket.
- BECKMERHAGEN, I. A. & BERG, H. P. (2003) Integration of management systems: focus on safety in nuclear industry. *International Journal of Quality & Reliability Management*, 20.
- BERGMAN, B. & KLEFSJÖ, B. (2007) *Kvalitet: Från behov till användning*, Lund, Studentlitteratur.
- EUROPEAN COMMISSION (2007) *EMAS Leaflet*. European Communities, Brussels. [Online] Available at: [http://ec.europa.eu/environment/emas/pdf/leafletemas05\\_en.pdf](http://ec.europa.eu/environment/emas/pdf/leafletemas05_en.pdf) (Accessed at: November 30<sup>th</sup> 2007)
- EUROPEAN COMMISSION (2007) *EMAS and ISO/EN ISO 14001: differences and complementarities*. Environment Directorate-General European Commission Brussels. [Online] Available at: [http://ec.europa.eu/environment/emas/pdf/factsheet/fs\\_iso\\_en.pdf](http://ec.europa.eu/environment/emas/pdf/factsheet/fs_iso_en.pdf) (Accessed at: November 30<sup>th</sup> 2007)
- CRESWELL, J. W. (2003) *Research design: Qualitative, Quantitative and Mixed Methods Approaches*, Thousand Oaks, Sage Publications.
- DAHLGREN, K. (2007) IAEA Safety Standards on management systems and safety culture. *Atom Indonesia*, 33. Tangerang: National Nuclear Energy Agency of Indonesia
- ECONOMIST (2007) 'Atomic renaissance'. *The Economist*, Vol. 384, Number 8545, 8 Sept, pp. 66-68.
- EFQM (2007) *The EFQM Excellence Model Glossary of Terms*. EFQM, Brussels. [Online] Available at: <http://www.efqm.org/Portals/0/Glossary.pdf> Accessed at: November 24<sup>th</sup> 2007)
- FISCHER, D. (1997) *History of the International Atomic Energy Agency: First forty years*, Vienna, IAEA. Division of publications.
- IAEA (1996) *Safety Series No. 50-Sg-Q1-Q7*. Vienna, Division of publications.
- IAEA (2007) *Application of the Management System for Nuclear Facilities - Draft Safety guide, DS349*, Wien, IAEA.
- IAEA (2007) *What is the IAEA?* Vienna, IAEA.
- IAEA (2007) *About IAEA: About the IAEA*. [Online] Available at: <http://www.iaea.org/About/index.html> (Accessed at December 5<sup>th</sup> 2007)
- IAEA (2007) *Our work: Safety*. [Online] Available at: <http://www.iaea.org/OurWork/SS/index.html> (Accessed at December 5<sup>th</sup> 2007)

- IAEA (2007) *Our work: Technology* [Online] Available at:  
<http://www.iaea.org/OurWork/ST/index.html> (Accessed at December 5<sup>th</sup> 2007)
- IAEA (2007) *Our work: Verification*. [Online] Available at:  
<http://www.iaea.org/OurWork/SV/index.html> (Accessed at December 5<sup>th</sup> 2007)
- IAEA (2007) *Safety Guide No. GS-G-3.1*. Vienna, Division of publications.
- IAEA (2007) *What is the IAEA?* Wien, IAEA.
- ISO (2007) *Understand the basics*. [Online] Available at:  
[http://www.iso.org/iso/iso\\_catalogue/management\\_standards/understand\\_the\\_basics.htm](http://www.iso.org/iso/iso_catalogue/management_standards/understand_the_basics.htm)  
(Accessed at: 12th November 2007)
- JONKER, J. (2004) Systems thinking for integration of management systems. *Business Process Management Journal*, 10, 608-615.
- JØRGENSEN, T. H., REMMEN, A. & MELLADO, M. D. (2006) Integrated management systems - three different levels of integration. *Journal of cleaner production*, 14, 713-722.
- KARLÖF, B. & HELIN, F. (2007) *Management från A till Ö*, Stockholm, SIS Förlag AB.
- KOLK, A. (2004) *Economics of environmental management*, Essex, Pearson Education Limited.
- MERRIAM, S. B. (1998) *Qualitative research and case study applications in education*, San Fransisco, Jossey-Bass.
- MILJÖDEPARTEMENTET (2007) DS 2007:16. IN MILJÖDEPARTEMENTET (Ed., Regeringskanliet.
- RINGHALS (2006) *Ringhals Årsredovisning 2006*. Väröbacka.
- SIS (2002) *SS-EN ISO 9001*. Stockholm: Standardiseringsgruppen i Sverige
- SIS (2004) *SS-EN ISO 14001*. Stockholm: Standardiseringsgruppen i Sverige
- SKI (2004) SKIFS 2004:1. IN CODE, T. S. N. P. I. R. (Ed. Sweden, SKI.
- SKI (2007) *About SKI*. [Online] Available at:  
[http://www.ski.se/extra/tools/parser/index.cgi?url=/html/parse/index\\_en.html&selected=2&mainurl=/page/5/2.html](http://www.ski.se/extra/tools/parser/index.cgi?url=/html/parse/index_en.html&selected=2&mainurl=/page/5/2.html) (Accessed at 14th November 2007)
- SSI (2007) *About SSI*. [Online] Available at:  
<http://www.ssi.se/en/About.html?MenuType=7&Menu2=about> (Accessed at 14th November 2007)
- TAGUE, N. R. (2005) *The Quality Toolbox*, Milwaukee, ASQ Quality Press.
- TT/The Local (2008) Build four new nuclear reactors. *The Local*. [Online] Available at:  
<http://www.thelocal.se/9623/20080111/> (Accessed at 14<sup>th</sup> January 2008)

UN (2007) Human Development Report 2007/2008. New York, United Nations Development Programme.

WHITELAW, K. (2004) Integration of environmental management systems with other management systems. *ISO 14001 Environmental Systems Handbook*. Butterworth-Heinemann.

WINTOUR, P. & ADAM, D. (2007) *Brown to endorse new generation of nuclear power*. The Guardian 26<sup>th</sup> November 2007. [Online] Available at: <http://www.guardian.co.uk/politics/2007/nov/26/uk.theairlineindustry> (Accessed at 15<sup>th</sup> January 2008)

YIN, R. K. (1995) *Case study: design and methods*, Thousand Oaks: Sage Publications.

### **Other references**

HARTZELL, P. (2007) Telephone conversation with Henrik Jonsson, 18 December 2007. Peter Hartzell Project manager quality management, Swedish Standards Institute

BERGMAN S. (2008) Interviews and conversations with Henrik Jonsson, 2<sup>nd</sup> October 2007 to 6<sup>th</sup> February 2008. Organisational developer and thesis supervisor at Ringhals AB

RINGHALS (2007) *Insidan Database* [Online] Available at: Not accessible for external audience. (Accessed between 1<sup>st</sup> October 2007 and 6<sup>th</sup> February 2008)

## Appendix 1

<b>2. Management System</b>	Document – Darwin Code
<b>General requirements</b>	
<b>Requirements</b>	
2.1. A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement. The main aim of the management system shall be to achieve and enhance safety by: —Bringing together in a coherent manner all the requirements for managing the organization; —Describing the planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied; —Ensuring that health, environmental, security, quality and economic requirements are not considered separately from safety requirements, to help preclude their possible negative impact on safety.	Beskrivning av Ringhals Verksamhetsstysystem – 1717264 Ledningshandbok 1.6 – 1706456
2.2. Safety shall be paramount within the management system, overriding all other Requirements.	Verksamhetspolicy – 1718256
2.3. The management system shall identify and integrate with the requirements contained within this publication: —The statutory and regulatory requirements of the Member State; —Any requirements formally agreed with interested parties (also known as ‘stakeholders’); —All other relevant IAEA Safety Requirements publications, such as those on emergency preparedness and response [8] and safety assessment [9]; —Requirements from other relevant codes and standards adopted for use by the organization.	Sammanställning av identifierade krav – 1721578
2.4. The organization shall be able to demonstrate the effective fulfilment of its management system requirements.	Ledningshandboken 5 – 1706456
<b>Safety Culture</b>	
<b>Requirements</b>	
2.5. The management system shall be used to promote and support a strong safety culture by: —Ensuring a common understanding of the key aspects of safety culture within the organization; —Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, taking into account the interaction between individuals, technology and the organization; —Reinforcing a learning and questioning attitude at all levels of the organization; —Providing the means by which the organization continually seeks to develop and improve its safety culture.	Verksamhetspolicy – 1718256 Övergripande mål och förhållningssätt för reaktor säkerhet – 1839723
<b>Grading the application of the Management Systems requirements</b>	
<b>Requirements</b>	
2.6. The application of management system requirements shall be graded so as to deploy appropriate resources, on the basis of the consideration of:	Verksamhetshandboken Drift och Underhåll 4.3 –

<ul style="list-style-type: none"> <li>—The significance and complexity of each product or activity;</li> <li>—The hazards and the magnitude of the potential impact (risks) associated with the safety, health, environmental, security, quality and economic elements of each product or activity;</li> <li>—The possible consequences if a product fails or an activity is carried out incorrectly.</li> </ul>	1719890 FSAR
2.7. Grading of the application of management system requirements shall be applied to the products and activities of each process.	
<b>Documentation of the management system</b>	
<b>Requirements</b>	
2.8. The documentation of the management system shall include the following: <ul style="list-style-type: none"> <li>—The policy statements of the organization;</li> <li>—A description of the management system;</li> <li>—A description of the structure of the organization;</li> <li>—A description of the functional responsibilities, accountabilities, levels of authority and interactions of those managing, performing and assessing work;</li> <li>—A description of the processes and supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved.</li> </ul>	
2.9. The documentation of the management system shall be developed to be understandable to those who use it. Documents shall be readable, readily identifiable and available at the point of use.	Ledningshandbok 1.6 – 1706456 Definitioner av begrepp som används i Ringhals – 1744063
2.10. The documentation of the management system shall reflect: <ul style="list-style-type: none"> <li>—The characteristics of the organization and its activities;</li> <li>—The complexities of processes and their interactions.</li> </ul>	Beskrivning Ringhals Verksamhetsstyrsystem – 1717264
<b>3. Management responsibility</b>	
<b>Requirements</b>	
3.1. Management at all levels shall demonstrate its commitment to the establishment, implementation, assessment and continual improvement of the management system and shall allocate adequate resources to carry out these activities.	Ledningshandboken 1.6 – 1706456 RVS förvaltning och utveckling – 1740550
3.2. Senior management shall develop individual values, institutional values and behavioural expectations for the organization to support the implementation of the management system and shall act as role models in the promulgation of these values and expectations.	Ledningshandboken 2.9 – 1706456 Verksamhetspolicy – 1718256
3.3. Management at all levels shall communicate to individuals the need to adopt these individual values, institutional values and behavioural expectations as well as to comply with the requirements of the management system.	Ledningshandboken 2.2 - 1706456
3.4. Management at all levels shall foster the involvement of all individuals in the implementation and continual improvement of the management system.	Ledningshandboken 2.1 – 1706456
3.5. Senior management shall ensure that it is clear when, how and by whom decisions are to be made within the management system.	RVS förvaltning och utveckling – 1740550 Ledningshandboken 1.6 – 1706450

<b>Satisfaction of interested parties</b>	
<b>Requirements</b>	
3.6. The expectations of interested parties shall be considered by senior management in the activities and interactions in the processes of the management system, with the aim of enhancing the satisfaction of interested parties while at the same time ensuring that safety is not compromised.	Ledningshandboken 6.6 – 1706450 Ledningshandboken 2.2 – 1706450 Verksamhetspolicy – 1718256
<b>Organisational Policies</b>	
<b>Requirements</b>	
3.7. Senior management shall develop the policies of the organization. The policies shall be appropriate to the activities and facilities of the organization.	Verksamhetspolicy – 1718256
<b>Planning</b>	
<b>Requirements</b>	
3.8. Senior management shall establish goals, strategies, plans and objectives that are consistent with the policies of the organization.	Ringhals Strategisk inriktning 2008 – 1862105
3.9. Senior management shall develop the goals, strategies, plans and objectives of the organization in an integrated manner so that their collective impact on safety is understood and managed.	Ringhals Strategisk inriktning 2008 – 1862105 Ledningshandboken 3 – 1706450
3.10. Senior management shall ensure that measurable objectives for implementing the goals, strategies and plans are established through appropriate processes at various levels in the organization.	Ringhals Strategisk inriktning 2008 – 1862105
3.11. Senior management shall ensure that the implementation of the plans is regularly reviewed against these objectives and that actions are taken to address deviations from the plans where necessary.	Ledningshandbok strategisk planering 3.2 – 1706456 Beskrivning RVS 2.3 – 1717264
<b>Responsibilities and Authority for the Management System</b>	
<b>Requirements</b>	
3.12. Senior management shall be ultimately responsible for the management system and shall ensure that it is established, implemented, assessed and continually improved.	VD Ledningshandbok 1.6 – 1706456 RVS Förvaltning och Utveckling – 1740550
3.13. An individual reporting directly to senior management shall have specific responsibility and authority for: —Coordinating the development and implementation of the management system, and its assessment and continual improvement; —Reporting on the performance of the management system, including its influence on safety and safety culture, and any need for improvement; —Resolving any potential conflicts between requirements and within the processes of the management system.	Beskrivning av Ringhals AB verksamhetsstyrssystem, RVS – 1717264 RVS Förvaltning och Utveckling – 1740550 Funktionsbeskrivning Kvalitetsstöd RVQ - 1864074
3.14. The organization shall retain overall responsibility for the management system when an external organization is involved in the work of developing all or part of the management system.	RVS Förvaltning och utveckling - 1740550

<b>4. Resource Management</b>	
<b>Provision of resources</b>	
Requirements	
PROVISION OF RESOURCES 4.1. Senior management shall determine the amount of resources necessary and shall provide the resources to carry out the activities of the organization and to establish, implement, assess and continually improve the management system.	Ledningshandboken 2 - 1706456
<b>Managing information and knowledge</b>	
Requirements	
4.2. The information and knowledge of the organization shall be managed as a resource.	Ledningshandboken 2.2 - 1706456
<b>Human Resource</b>	
Requirements	
4.3. Senior management shall determine the competence requirements for individuals at all levels and shall provide training or take other actions to achieve the required level of competence. An evaluation of the effectiveness of the actions taken shall be conducted. Suitable proficiency shall be achieved and maintained.	Ledningshandboken 2.2 - 1706456
4.4. Senior management shall ensure that individuals are competent to perform their assigned work and that they understand the consequences for safety of their activities. Individuals shall have received appropriate education and training, and shall have acquired suitable skills, knowledge and experience to ensure their competence. Training shall ensure that individuals are aware of the relevance and importance of their activities and of how their activities contribute to safety in the achievement of the organization's objectives.	Ledningshandboken 2.2 - 1706456 Instruktion R1-R4 Kompetens- och behörighetsprövning av driftpersonal - 1710550
<b>Infrastructure and the working environment</b>	
Requirements	
4.5. Senior management shall determine, provide, maintain and re-evaluate the infrastructure and the working environment necessary for work to be carried out in a safe manner and for requirements to be met.	Ledningshandboken 2.3 - 1706456 Arbetsmiljö - 1721842
<b>5. Process implementation</b>	
<b>Developing process</b>	
Requirements	
5.1. The processes of the management system that are needed to achieve the goals, provide the means to meet all requirements and deliver the products of the organization shall be identified, and their development shall be planned, implemented, assessed and continually improved.	Ringhals Processrelationsschema - 1866591 Ledningshandboken 6.6 - 1706456
5.2. The sequence and interactions of the processes shall be determined.	Processrelationsschema - 1866591
5.3. The methods necessary to ensure the effectiveness of both the implementation and the control of the processes shall be determined and implemented.	Verksamhetshandboken Processutveckling 5 - 1835354
5.4. The development of each process shall ensure that the following are achieved:	Rutin för organisations och

<ul style="list-style-type: none"> <li>—Process requirements, such as applicable regulatory, statutory, legal, safety, health, environmental, security, quality and economic requirements, are specified and addressed.</li> <li>—Hazards and risks are identified, together with any necessary mitigatory actions.</li> <li>—Interactions with interfacing processes are identified.</li> <li>—Process inputs are identified.</li> <li>—The process flow is described.</li> <li>—Process outputs (products) are identified.</li> <li>—Process measurement criteria are established.</li> </ul>	Verksamhetsförändringar - 1734863
5.5. The activities of and interfaces between different individuals or groups involved in a single process shall be planned, controlled and managed in a manner that ensures effective communication and the clear assignment of responsibilities.	Verksamhetshandboken Processutveckling 5 - 1835354
<b>Process Management</b>	
<b>Requirements</b>	
5.6. For each process a designated individual shall be given the authority and responsibility for: <ul style="list-style-type: none"> <li>—Developing and documenting the process and maintaining the necessary supporting documentation;</li> <li>—Ensuring that there is effective interaction between interfacing processes;</li> <li>—Ensuring that process documentation is consistent with any existing documents;</li> <li>—Ensuring that the records required to demonstrate that the process results have been achieved are specified in the process documentation;</li> <li>—Monitoring and reporting on the performance of the process;</li> <li>—Promoting improvement in the process;</li> <li>—Ensuring that the process, including any subsequent changes to it, is aligned with the goals, strategies, plans and objectives of the organization.</li> </ul>	Funktionsbeskrivning Processägare – 1836378
5.7. For each process, any activities for inspection, testing, verification and validation, their acceptance criteria and the responsibilities for carrying out these activities shall be specified. For each process, it shall be specified if and when these activities are to be performed by designated individuals or groups other than those who originally performed the work.	Funktionsbeskrivning Processägare – 1836378 Internrevision – 941122041
5.8. Each process shall be evaluated to ensure that it remains effective.	
5.9. The work performed in each process shall be carried out under controlled conditions, by using approved current procedures, instructions, drawings or other appropriate means that are periodically reviewed to ensure their adequacy and effectiveness. Results shall be compared with expected values.	Verksamhetshandboken Drift och Underhåll 3.2 – 1719890
5.10. The control of processes contracted to external organizations shall be identified within the management system. The organization shall retain overall responsibility when contracting any processes.	Leveranstörsbedömning 3 – 1754845 Internrevision – 941122041
<b>Generic Management System Processes</b>	
<b>Requirements</b>	
5.11. The following generic processes shall be developed in the management system.	
<b>Control of documents</b>	

<b>Requirements</b>	
5.12. Documents <sup>10</sup> shall be controlled. All individuals involved in preparing, revising, reviewing or approving documents shall be specifically assigned this work, shall be competent to carry it out and shall be given access to appropriate information on which to base their input or decisions. It shall be ensured that document users are aware of and use appropriate and correct documents.	Verksamhetshandboken CM/DM 3 – 1752212
5.13. Changes to documents shall be reviewed and recorded and shall be subject to the same level of approval as the documents themselves.	Verksamhetshandboken CM/DM 6 – 1752212
<b>Control of products</b>	
<b>Requirements</b>	
5.14. Specifications and requirements for products, including any subsequent changes, shall be in accordance with established standards and shall incorporate applicable requirements. Products that interface or interact with each other shall be identified and controlled.	TBM TBE TBM 2.4
5.15. Activities for inspection, testing, verification and validation shall be completed before the acceptance, implementation or operational use of products. The tools and equipment used for these activities shall be of the proper range, type, accuracy and precision.	KBM 2.2 KBE 100-3, 3.3 KBM 1.4.3
5.16. The organization shall confirm that products meet the specified requirements and shall ensure that products perform satisfactorily in service.	
5.17. Products shall be provided in such a form that it can be verified that they satisfy the requirements.	
5.18. Controls shall be used to ensure that products do not bypass the required verification activities.	KBM 2.1.3 KBE 3.3.1
5.19. Products shall be identified to ensure their proper use. Where traceability is a requirement, the organization shall control and record the unique identification of the product.	TBE 100, 3.14 Verksamhetshandboken CM/DM – 1753660
5.20. Products shall be handled, transported, stored, maintained and operated as specified, to prevent their damage, loss, deterioration or inadvertent use.	TBE 6 Verksamhetshandboken MA 3.6.6 – 981013017
<b>Control of records</b>	
<b>Requirements</b>	
5.21. Records shall be specified in the process documentation and shall be controlled. All records shall be readable, complete, identifiable and easily retrievable.	Verksamhetshandboken CM/DM 5 – 1752219
5.22. Retention times of records and associated test materials and specimens shall be established to be consistent with the statutory requirements and knowledge management obligations of the organization. The media used for records shall be such as to ensure that the records are readable for the duration of the retention times specified for each record.	Verksamhetshandboken CM/DM 9 – 1753664
<b>Purchasing</b>	
<b>Requirements</b>	

5.23. Suppliers of products shall be selected on the basis of specified criteria and their performance shall be evaluated.	Verksamhetshandboken MA 3.3.4.2 – 981013017 Leverantörsbedömning – 1754845
5.24. Purchasing requirements shall be developed and specified in procurement documents. Evidence that products meet these requirements shall be available to the organization before the product is used.	Verksamhetshandboken MA 3.2.6.4 – 981013017
5.25. Requirements for the reporting and resolution of non-conformances shall be specified in procurement documents.	Verksamhetshandboken MA 3.2.6.4 – 981013017 Verksamhetshandboken MA 3.4.7 – 981013017
<b>Communication</b>	
<b>Requirements</b>	
5.26. Information relevant to safety, health, environmental, security, quality and economic goals shall be communicated to individuals in the organization and, where necessary, to other interested parties.	Verksamhetshandboken Kommunikation 9 – 1891747 Verksamhetshandboken Kommunikation 8 – 1891747
5.27. Internal communication concerning the implementation and effectiveness of the management system shall take place between the various levels and functions of the organization.	Ledningshandboken 5.2 – 1706456
<b>Managing organisational Change</b>	
<b>Requirements</b>	
5.28. Organizational changes shall be evaluated and classified according to their importance to safety and each change shall be justified.	Rutin för organisations och verksamhetsförändringar – 1734863
5.29. The implementation of such changes shall be planned, controlled, communicated, monitored, tracked and recorded to ensure that safety is not compromised.	Rutin för organisations och verksamhetsförändringar – 1734863 Verksamhetshandboken Kommunikation 3 – 1891747 Verksamhetshandboken Kommunikation 3 – 1891747
<b>6. Measurement, Assessment and improvement</b>	
<b>Monitoring and measurement</b>	
<b>Requirements</b>	
6.1. The effectiveness of the management system shall be monitored and measured to confirm the ability of the processes to achieve the intended results and to identify opportunities for improvement.	Ledningshandbok 3.2.1 – 1706456
<b>Self assessment</b>	
<b>Requirements</b>	

6.2. Senior management and management at all other levels in the organization shall carry out self-assessment to evaluate the performance of work and the improvement of the safety culture.	Ledningshandbok 5 – 1706456
<b>Independent assessment</b>	
<b>Requirements</b>	
6.3. Independent assessments shall be conducted regularly on behalf of senior management: —To evaluate the effectiveness of processes in meeting and fulfilling goals, strategies, plans and objectives; —To determine the adequacy of work performance and leadership; —To evaluate the organization’s safety culture; —To monitor product quality; —To identify opportunities for improvement.	Ledningshandbok 5.3.1 – 1706456 Internrevision – 941122041
6.4. An organizational unit shall be established with the responsibility for conducting independent assessments. <sup>11</sup> This unit shall have sufficient authority to discharge its responsibilities.	Internrevision 5.3 – 941122041
6.5. Individuals conducting independent assessments shall not assess their own work.	Internrevision 4.2.1 – 941122041
6.6. Senior management shall evaluate the results of the independent assessments, shall take any necessary actions, and shall record and communicate their decisions and the reasons for them.	Internrevision 5.3 – 941122041 Ledningshandbok 5.1 – 1706456 Ledningshandbok 5.2 – 1706456
<b>Management system review</b>	
<b>Requirements</b>	
6.7. A management system review shall be conducted at planned intervals to ensure the continuing suitability and effectiveness of the management system and its ability to enable the objectives set for the organization to be accomplished.	Ledningshandbok 5.1 – 1706456
6.8. The review shall cover but shall not be limited to: —Outputs from all forms of assessment; —Results delivered and objectives achieved by the organization and its processes; —Non-conformances and corrective and preventive actions; —Lessons learned from other organizations; —Opportunities for improvement.	Ledningshandbok 5.1 – 1706456
6.9. Weaknesses and obstacles shall be identified evaluated and remedied in a timely manner.	Ledningshandbok 5.1 – 1706456
6.10. The review shall identify whether there is a need to make changes to or improvements in policies, goals, strategies, plans, objectives and processes.	Ledningshandbok 5.1 – 1706456
<b>Non-conformances and corrective and preventive actions</b>	
<b>Requirements</b>	
6.11. The causes of non-conformances shall be determined and remedial actions shall be taken to prevent their recurrence.	Ledningshandbok 6.4 – 1706456 Beskrivning av avvikelseprocessen 4.5 –

	1830125
6.12. Products and processes that do not conform to the specified requirements shall be identified, segregated, controlled, recorded and reported to an appropriate level of management within the organization. The impact of nonconformances shall be evaluated and non-conforming products or processes shall be either: —Accepted; —Reworked or corrected within a specified time period; or —Rejected and discarded or destroyed to prevent their inadvertent use.	PBM 8.5 Internrevision – 941122041 Beskrivning av avvikelseprocessen 4.4 – 1830125
6.13. Concessions granted to allow acceptance of a non-conforming product or process shall be subject to authorization. When non-conforming products or processes are reworked or corrected, they shall be subject to inspection to demonstrate their conformity with requirements or expected results.	Internrevision 6 – 941122041
6.14. Corrective actions for eliminating non-conformances shall be determined and implemented. Preventive actions to eliminate the causes of potential nonconformances shall be determined and taken.	Internrevision 5.2 – 941122041
6.15. The status and effectiveness of all corrective and preventive actions shall be monitored and reported to management at an appropriate level in the organization.	Internrevision 6 – 941122041
6.16. Potential non-conformances that could detract from the organization's performance shall be identified. This shall be done: by using feedback from other organizations, both internal and external; through the use of technical advances and research; through the sharing of knowledge and experience; and through the use of techniques that identify best practices.	Internrevision 8 – 941122041
<b>Improvement</b>	
<b>Requirements</b>	
6.17. Opportunities for the improvement of the management system shall be identified and actions to improve the processes shall be selected, planned and recorded.	Ledningshandbok 5.1 – 1706456 Ledningshandbok 5.2 – 1706456 Arbetsordning för Ringhals ledningsfora 2.3.1 – 1823648
6.18. Improvement plans shall include plans for the provision of adequate resources. Actions for improvement shall be monitored through to their completion and the effectiveness of the improvement shall be checked.	Ledningshandbok 2 – 1706456 RVS förvaltning och utveckling 2.2 – 1740550

## Appendix 2

<i>Chapter</i>	<i>Identified deviations per requirement</i>
Management system	6/10
Management responsibilities	2/14
Resource management	1/5
Process implementation	4/30
Measurement, assessment and improvement	6/18
<i>Total amount of identified deviations</i>	<i>19/77</i>