Designing a technical change management system at Palabora Mining Company Limited.

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Uittreksel

In die skripsie word 'n stelsel vir die bestuur van tegniese verandering te Palabora Mining Company ontwerp. Die stelsels wat tans te Palabora aangewend word om tegniese verandering te bestuur, is bestudeer. 'n Literatuurstudie betreffende die bestuur van tegniese verandering is gedoen. Onderhoude is met die hoof rolspelers ten opsigte van die bestuur van tegniese verandering te Palabora gevoer ten einde te bepaal of so 'n stelsel lewensvatbaar sou wees en wat die Palabora unieke behoeftes is waaraan so 'n stelsel sal moet voldoen. 'n Onderhoud is ook met 'n spesialis te Sasol Sintetiese Brandstowwe gevoer ten einde te poog om nie dieselfde foute te maak met die implimentering van die stelsel te Palabora nie.

Die ontwerp is daarop ingestel om 'n standaard prosedure daar te stel om die tegniese verandering te bestuur en om te verseker dat alle stelsels waarop die tegniese verandering 'n impak mag hê, evalueer word. Die stelsel moet alle tegniese veranderinge op die myn monitor, duplisering uitskakel en standardisasie bevorder. Daar is ook gekyk na die hantering van dokumentasie betreffende die bestuur van die tegniese verandering.

Verskeie stelsels te Palabora is betrokke by die bestuur van 'n tegniese verandering. Daar is gekyk na hoe dit moontlik sal wees om die vordering van die tegniese verandering deur die onderskeie stelsels te volg. Die bestuurstelsel is sodanig ontwerp dat kundiges uit die onderskeie divisies betrek word by die bestuur van verandering in die divisie.

Die bestuurstelsel is ontwerp om deur middel van die elektroniese netwerk wat tans op die myn in gebruik is, die tegniese veranderinge in die onderskeie divisies te monitor en vanaf 'n sentrale punt te bestuur.

PREFACE

The author started working as Electrical Services Manager with Palabora Mining Company Limited (Palabora) in March 1997. Experience was gained at Sasol Synthetic Fuels with implementing a Management of Change (MOC) system. A need was identified to establish a system at Palabora to conform to the legal requirements regarding hazardous area and the related explosion protected equipment. The system was implemented, but problems were soon experienced with unauthorised changes taking place in these areas.

Problems were also experienced with electrical personnel on the property implementing equipment that does not conform to the technical requirements of the environment. This was either done because the personnel were inexperienced or ignorant.

The author identified a need at Palabora to manage technical change to:

- Ensure that a uniform, systematic approach is followed with all changes.
- Optimise the utilisation of scarce resources on site.
- Enable the tracking of technical changes across the various systems.

The author would like to thank the following people for their inputs during the study period and in designing this technical change management system.

a) My fellow students for their inputs during various interventions.
b) My family for the time they set aside to allow me to concentrate on my studies and the dissertation.
c) All the Palabora employees, Sasol employees and consultants who have contributed to this dissertation.
d) All the lecturers for the quality of their inputs that contributed to me attaining a MBA.

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Chapter One

1.1 Introduction

Palabora Mining Company Limited (Palabora) is an open cast copper mine situated in the Northern Province. The Mine was founded in 1965 and has developed to a stage where it is currently producing ± 110 000 tons of copper per year, meeting the total South African demand (± 80 000 tons/year) for copper and exports copper cathode. Palabora also produces and supplies 38% of global consumption of vermiculite (Palabora Mining Company, 1997:8) and 70 % of global consumption of baddeyelite (Palabora Mining Company, 1997:7) to international markets in Europe, USA and the East. Palabora Mining Company is managed by the largest shareholder, Rio Tinto plc, one of the largest mining houses in the world.

Palabora currently employs 2668 employees (Palabora Mining Company, 1997:3). In the South African context, according to article 2(1) of the Mines health and safety act (1996), the owner is for the safety and health of all personnel on the mine. According to article 3(1) the owner must appoint a manager and according to regulation 2.6.1, the manager may appoint subordinate managers. In terms of regulation 2.13.1 of the Mines health and safety act (1996):

> *"Responsibility for machinery. At any mine or works where-*
>
> *(a) The designated rating of machinery used in the generation of power, together with the power supplied from outside sources, exceeds the equivalent of 2500 kilowatts; or*
>
> *(b) Any winding plant intended for conveying persons is installed,*

- Note: The Mines health and safety act of 1996 is in the process of being transformed from the Minerals act. The act is updated often and page numbers are changing frequently. The author has decided to rather refer to the regulation or article number than the page number.

> *all machinery shall, subject to regulation 2.13.6.1, be under the general charge of an engineer who shall be appointed in writing by the manager."*

the manager must appoint an engineer and, according to regulations 2.13.3.1 and 2.13.3.2 of the Mines health and safety act (1996), may appoint one or more subordinate engineers to assist the engineer appointed, in terms of regulation 2.13.1, in ensuring the safety of personnel and to create and maintain a safe working environment.

The maintenance function on the property mainly consists of three disciplines, mechanical, electrical and instrumentation maintenance. The central engineering division (See figure 1.1) is accountable for the integrity of the engineering practices and standards on the property. The decentralised maintenance function (See figure 1.2) on the property is responsible to maintain the process equipment in such a condition that the requirements concerning safety, availability and performance are met.

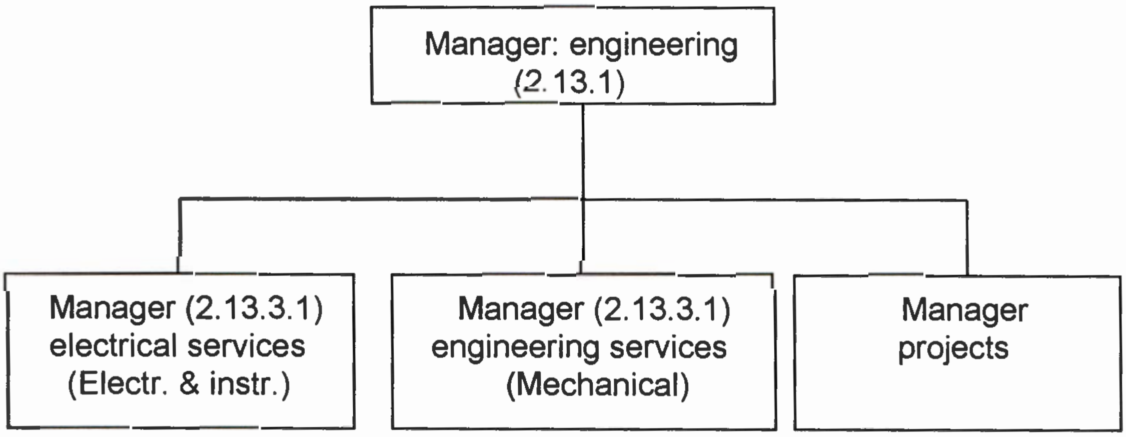

Figure 1.1: Engineering division management structure

The instrumentation maintenance was centralised to engineering in May 1997, due to the lack of knowledge and expertise on the rest of the property and the impact of this discipline on production. The engineers, appointed in terms of regulations 2.13.3.1/2 in the various divisions, are responsible for the mechanical and electrical maintenance in those divisions (See figure 1.2). These engineers report to the divisional managers, heading up the different divisions, with a dotted line responsibility to the manager, engineering.

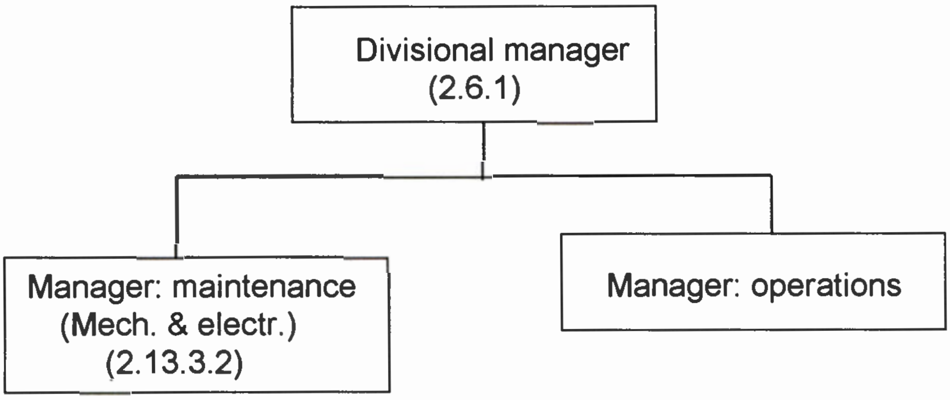

Figure 1.2: Typical divisional management structure

Currently the mine has a functional management structure and is divided into the following divisions (Palabora Mining Company, 1998(a):8):

- Mining
- Concentrator/ZBS
- Smelter/Refinery
- Engineering
- Human resources
- Safety, health, environment and quality.
- Vermiculite operations
- Financial

1.2 Problem statement

Most of the current plant and equipment have been in operation for thirty years. Modifications and projects are conducted frequently to replace obsolete equipment, to keep the plant in a technological renewed state and to ensure that the stability of the different processes is not interrupted. The engineering division is ultimately responsible for the integrity of these projects and modifications.

1.2.1 Sharing of best practices

Technical expertise is available in some of the divisions, but are currently not shared across the property. Palabora being 500 kilometers away from Gauteng, the center of technology in South Africa, means that best practices need to be shared. The management of big changes, like big projects, is well controlled, but the majority of the changes is small and not recorded or handled according to any formal technical change management system.

1.2.2 ISO 9002 and 14001 requirements

Palabora is accredited with ISO 9002 (International Standard for Quality systems) and ISO 14001 (International Standard for Environmental systems). The mine has been awarded with the highest national safety awards by NOSA for the last nine years. All these systems require proper documentation and control over all activities that could have an impact on safety, health, the environment and quality.

1.2.3 Managing technical change

The plant maintenance or production personnel can raise a request to the engineering division to investigate the feasibility of replacing a piece of equipment or plant by either generating a project request or a request for services. A project request is completed for "big changes" that might require engineering work. A request for services is normally completed for standard replacement work where contracted labour, but no engineering is required. The engineering division, projects department or the services department then conducts an investigation, and a proposal is made to the production division on estimated time to implementation and cost of the technical change.

1.2.4 Financing the change

Once the proposal is approved, funds need to be obtained to implement the proposal. Funds can either be obtained from the operating budget or from the capital plan. The operating budget is normally used to finance the small replacement-in-kind technical changes and the capital plan is used to finance projects. A capital plan is developed on a yearly basis and these projects are included in the capital plan. Emergency projects are handled outside of the approved capital plan and will be classified as "not in plan ".

1.2.5 Documentation

With big changes, handled as projects, the required paperwork will be completed and filed after successful completion and hand over of the project from the project department to the responsible division.

1.2.6 Tracking changes between systems

Tracking the progress of the change across the various systems is currently a problem at Palabora. A lot of time is wasted in tracking the change. Palabora has identified the need to develop an integrated system to ensure seamless operation across the various interfaces. Horisontal integration will ensure that information is shared between the different maintenance groups. Vertical integration will ensure that progress with the change can be tracked shameless across the technical, financial, operations and safety systems.

Palabora has implemented a paperless system for managing the safety, quality and other repetitive administration systems. This system is software supported, with hardware infrastructure serving the whole of the property and critical suppliers. Some systems are currently interfaced, but not integrated.

1.3 The purpose of this study

The purpose of this study is:

1.3.1 Main objective

- Design a system to manage technical change that will ensure uniform handling of all technical changes on the property.

1.3.2 Sub-objectives

- Investigate and propose how to effectively track change across the current technical, financial, safety, health, environmental, quality and operations systems in the organisation. (See figure 1.1)
- Design a central system that will make the sharing of information and experience regarding technical changes possible at Palabora.
- Develop an audit trail for projects, temporary and permanent modifications and tests to ensure the compliance of all technical changes to pre-determined standards.
- The outcome of this study will also serve as input for developing a paperless system to effectively handle all technical change. These guidelines will be applied in designing the new integrated system (Palabora Mining Company, 1998(a):16) for the new Palabora from 2004 to 2023.

This will ensure that a system is developed that requires the least amount of energy to manage the interfaces between the various systems by effectively managing technical change, communicating best practices and providing an audit trail.

1.4 Frame of reference

1.4.1 Introduction to the reader

This study was conducted on the systems currently employed at Palabora to manage technical change. Currently these systems are a combination of technical, financial, safety, health, environmental, quality, operations and maintenance systems (See figure 1.2). A specific technical change cannot easily be tracked across the various systems and personnel are used to manage the interfaces. This requires a lot of energy and it is envisaged that large benefits can be realised with a properly integrated system for sharing of expertise, technology and best practices. (Palabora Mining Company, 1998(a): 16)

Figure 1.1 - Systems involved in managing technical change.

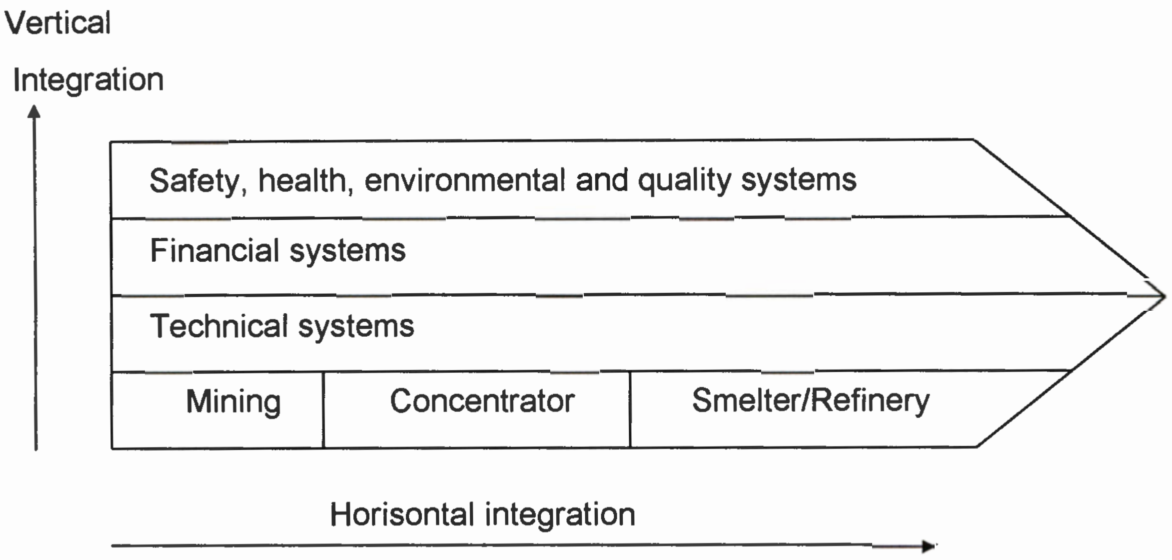

Figure 1.2 - Vertical and horisontal integration of systems.

The same project (technical change) can currently be awarded more than one number and it could refer to either the technical or the financial system.

Small changes initiated in the divisions and managed by the divisions are not formally recorded, are not well documented and cannot be audited.

1.4.2 Scope of the study

The study was conducted on the systems currently in place at Palabora. Recent literature on technical change management systems was studied and a system designed to effectively manage technical change, considering Palabora unique requirements. A procedure for the handling of all technical change was designed, resulting in an audit trail being put in place.

Management of change is a very popular subject currently. According to the congruence model (Nadler et al, 1992) a system approach should be followed for designing any system or any change to a system. Strategy, the task, the formal organisation, the informal organisation and the individual should be considered before implementing change (See figure 1.3). The interaction and interdependence between the various components need to be considered.

This dissertation focuses on the formal organisation. The formal organisation is defined as the various structures, processes and methods that are formally created to get individuals to perform tasks. This dissertation does not consider any of the other components.

Referring to management of change can create confusion. The author is of the opinion that management of change refers to total system change management, such as changes to culture, personnel, remuneration and structure. This dissertation was focused on designing a system to manage *technical* change only and the system is called a technical change management system.

1.5 Method of research

- A literature study was conducted as the primary method of research. The literature that was studied included the most recent articles on the mentioned subject and similar systems at other companies.

- Interviews were conducted with the key decision-makers concerning management of technical change at Palabora to gather information regarding the current technical change management systems and to ensure that the system will fit the unique Palabora requirements.

- An interview was also conducted with G. Papenfus (1998), a specialist at Sasol Synthetic Fuels, that has already implemented a similar system. This was done to speed up the learning process and try and prevent making similar mistakes.

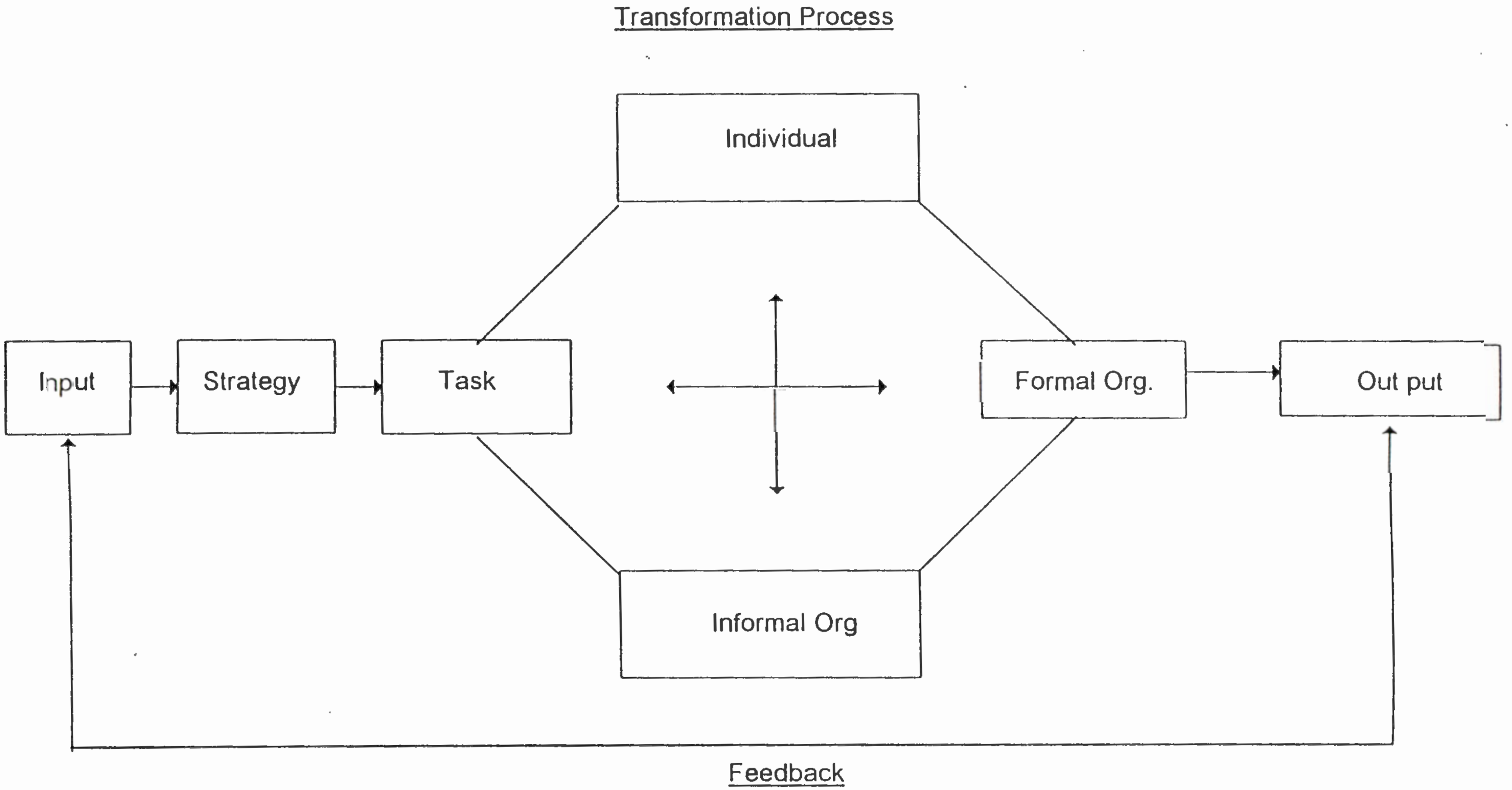

Figure 1.3 Congruence model (Nadler et al, 1992)

1.6 Actuality

Effective management of change is daily becoming more important. Decentralised maintenance poses a problem, as modifications are made to keep the plant running, to employ new technology and to improve availability and increase production. These modifications must be done according to set standards, but this is not always the case. According to regulation 2.13.1 of the Mines health and safety act (1996), the manager: engineering, appointed as the 2.13.1 engineer on the property, is ultimately responsible for the technical integrity of systems on the property. The proposed management of change system will enable engineering to monitor the progress of the different changes on the property, to ensure the sharing of best practices and will ultimately result in improved failure investigation, engineering-out-maintenance and lower unit cost.

Currently uncontrolled changes are leading to serious failures. The likelihood of this happening will drastically reduced once the new system is implemented. The new formalised technical change management will enable engineering to do frequent audits to assess the integrity of technical changes implemented on the property. The systematic approach to managing technical change will ensure a properly developed audit trail.

1.7 Further deployment

In chapter two the current systems on the mine for managing technical change are being identified. In chapter three literature on technical management systems is studied. In chapter four the Palabora unique requirements are taken into consideration and a system fit for Palabora is designed. The minimum requirements to ensure a successful system is discussed, as well as practical experience gained by Sasol from implementing a similar system. (See figure 1.4)

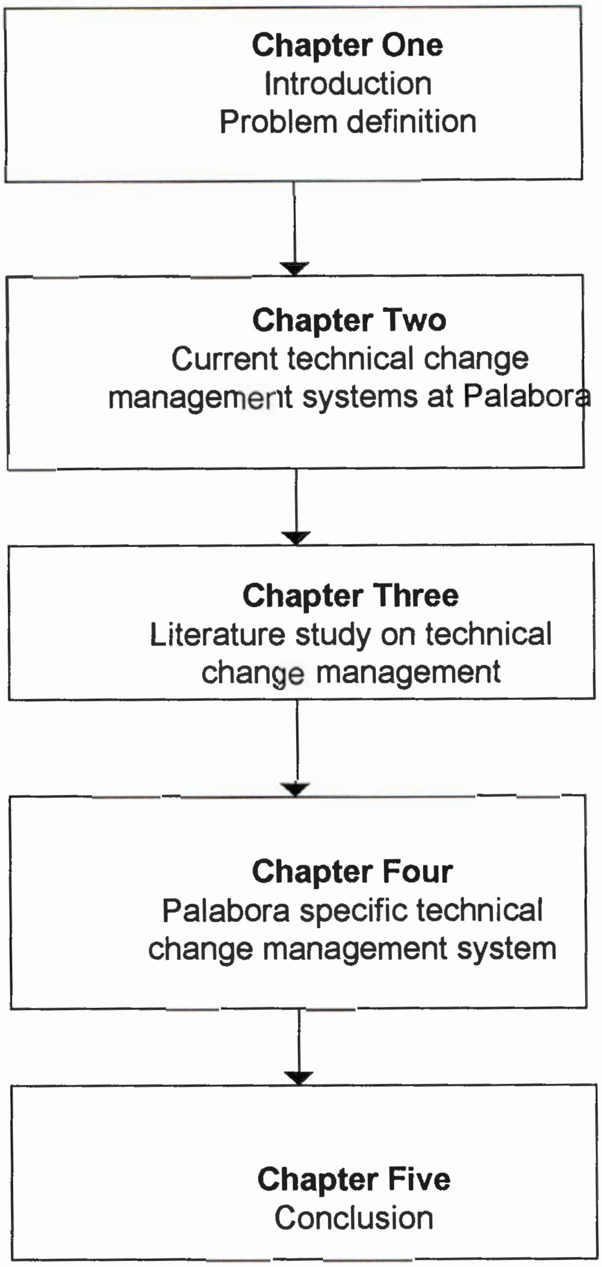

Figure 1.4: Flow diagram for dissertation on designing a technical change management system at Palabora Mining Company Limited.

Chapter Two

Current systems for managing technical change at Palabora

2.1 Introduction

In this chapter the Palabora systems to manage technical change are studied. These systems are addressed in the following categories:

- The current organisational structure affecting the management of technical change
- The legal requirements in the South African environment on managing technical change
- The ISO 9002 and 14001 requirements
- The management of technical changes in chemical processing plant and hazardous areas
- Current systems for the management of permanent technical changes
- Current systems for the management of temporary technical changes
- Current systems for the management of emergency technical changes

2.2 Organisational structure

Palabora currently has a functional organisational structure and is organised around the different processes; mining, milling and concentrating, and not along the process streams; copper, vermiculite and ZBS. Vermiculite and ZBS are viewed as by-products, in spite of the fact that the feed stock is totally independent of copper. A divisional manager, with production and maintenance managers reporting to him heads up every division.

Currently the mine is divided into the following divisions (Palabora Mining Company, 1998(a):8).

2.2.1 Mining

The mining division is responsible for removing the ore from the pit and feeding it to the surface stockpiles in front of the milling department. The mining division is responsible for maintaining its own equipment.

2.2.2 Concentrator/ZBS

This division crushes and grinds the ore and recovers the copper. In the process heavy minerals are separated out. This division is also responsible for maintenance of it's own equipment.

2.2.3 Smelter/refinery

In this division the copper is purified through various processes and then cast into copper rod. This division is also responsible for it's own maintenance.

2.2.4 Engineering

The engineering standards and practices are developed in this division. This division is responsible for the engineering workshops on the property and for all the instrumentation maintenance on the property as well as the distribution of electricity. This division manages all projects and contracted services.

2.2.5. Human resources

This division is responsible for the industrial relations and human resource practices on the property. It also manages recruitment and training of personnel.

2.2.6 Safety, health, environment and quality

All safety, health, environmental and quality standards are developed by this division. It renders a support service to the other divisions concerning safety, health, environment and quality issues.

2.2.7 Vermiculite

This operation mines, recover and grade the vermiculite. It is also responsible for the maintenance of it's own equipment.

Duplication regarding the management of technical change is taking place amongst the divisions as expertise and resources are not shared. The lowest cost platform for the different processes could be achieved by standardising on technology employed, sharing of best practices and scarce resources.

2.3 Legal environment in South Africa

In terms of article 2(1) of the Mines health and safety act (1996), in South African, the owner is responsible for the safety and health of all personnel on the mine. According to article 3(1) of the Mines health and safety act (1996) the owner must appoint a manager. According to regulation 2.6.1 of the Mines health and safety act (1996), the manager may appoint subordinate managers.

In terms of regulation 2.13.1 of the Mines health and safety act of 1996:

> *"Responsibility for machinery. At any mine or works where-*
>
> *(a) the designated rating of machinery used in the generation of power, together with the power supplied from outside sources, exceeds the equivalent of 2500 kilowatts; or*
>
> *(b) any winding plant intended for conveying persons is installed,*
>
> *all machinery shall, subject to regulation 2.13.6.1, be under the general charge of an engineer who shall be appointed in writing by the manager."*

the manager shall appoint an engineer according to regulation 2.13.1 of the Mines health and safety act (1996) and one or more subordinate engineers, according to regulation 2.13.3.1/2, to assist the engineer in ensuring the safety of personnel and to create and maintain a safe working environment.

The maintenance function on the property mainly consists out of three disciplines, mechanical, electrical and instrumentation maintenance. The central engineering division at Palabora is accountable for the integrity of the engineering practices and standards on the property. The decentralised maintenance function on the property is responsible to maintain the process equipment in such a condition that the requirements concerning safety, availability and performance are met.

According to regulations 2.13.3.1 and 2.13.3.2 of the Mines health and safety act (1996), the engineers in the various divisions are responsible for the mechanical and electrical maintenance in those divisions and are reporting to the divisional managers, with a dotted line responsibility to the manager, engineering. Changes are taking place on the property without the knowledge of the manager, engineering. These changes are made in isolation, without proper documentation.

2.4 ISO 14001 requirements

"The organisation shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment." (ISO 14001, 1996: 4)

It is therefore important that consideration be given to the impact of change on the environment prior to implementing any change. A multi-disciplinary team or a specialist should evaluate the possible impact of any change on the environment. Big changes, such as new projects and large shutdowns, and modifications are currently evaluated, but not the small changes in the different divisions.

2.5 ISO 9002 requirements

"**4.2.4 Quality planning**

The supplier shall define and document how the requirements for quality will be met. Quality planning shall be consistent with all other requirements of a supplier's quality system and shall be documented in a format to suit the supplier's method of operation. The supplier shall give consideration to the following activities, as appropriate, in meeting the specified requirements for products, projects or contracts:

a) the preparation of quality plans;

b) the identification and acquisition of any controls, processes, equipment (including inspection and test equipment), fixtures, resources and skills that may be needed to achieve the required quality;

c) ensuring the compatibility of the production process, installation, servicing, inspection and test procedures and the applicable documentation;

d) the updating, as necessary, of quality control, inspection and testing techniques, including the development of new instrumentation."
(ISO 9002, 1994: 4)

From the above it is evident that all changes must be evaluated to determine the possible impact on quality. As with the environmental impact, big changes, such as new projects and large shutdowns are currently evaluated to establish the impact on the environment, but not the "small changes" in the different divisions.

2.6 Chemical processing plants and hazardous areas

Several facilities exist on the property that produce, handle and store hazardous materials and changes are necessary for various reasons. Ammonia is processed in the heavy minerals plant, sulfuric acid in the acid plant, ammonia in the new refrigeration plant and hydrochloric acid in the ZBS plant.

According to regulation 21.17.1 of the Mines health and safety act (1996): "*The manager shall identify and define any hazardous area referred to in regulation 1 (11A)(ii) in or on a mine or at a works and record it on a plan or in a register provided for that purpose.*"

According to regulation 21.17.6 of the Mines health and safety act (1996) "*The manager shall take all reasonable precautionary measure to ensure that all persons operating, running and maintaining explosion-protected apparatus are properly* *instructed in the conditions and requirements contained in the appropriate specifications in accordance with which the apparatus was tested.*"

From the above mentioned it can be seen that it is important to identify any change in the area classification due to technical change. Certificates need to be obtained and presented to the inspector of the department of minerals and energy for approval of any equipment to be installed in a hazardous area. All the personnel in the area need to be informed and trained on the conditions and requirements of the apparatus.

Several areas were classified as hazardous areas due to the potential of flammable liquids and gasses being present in these areas. New facilities and major plant modifications are thoroughly addressed through capital projects and the project management system. Small changes that can have catastrophic consequences are done in isolation and often without the required engineering input due to the scarcity of resources and the lack of a uniform system for technical change management on the property.

There is a need to share best practices, experience and scarce resources. Very little exchange of information is currently taking place amongst processing divisions and between processing divisions and engineering.

2.7 Projects

Big changes, new plants, major modifications and big shutdowns are managed as projects (See figures 2.1, 2.2 and appendix C). These changes are properly engineered. The impact on all disciplines is considered as well as the impact on safety, health, environmental and quality systems. Proper documentation control is taking place and the change package is filed once the change is completed (Palabora Mining Company, 1998(b):).

The updating of operating and maintenance procedures and the identification of training requirements, due to the new technology and/or processes, were the only short comings identified in the current project management procedure. It is left to the operations function whether it is required or not and is managed on an ad hoc basis.

2.8 Temporary change

Temporary changes are often made to test a proposal for process improvements, safety improvements, etc. These changes are normally not well documented and engineered prior to installation. Drawings and operating procedures are not updated and adjusted accordingly. Several near misses and serious accidents have occurred due to these "temporary changes". (Sanders, 1992: 78) On several occasions it was found that the "temporary changes" have become permanent without proper engineering being done on the change. There is a need at Palabora to manage these temporary technical changes, as there is currently no formal system in place to manage these technical changes.

2.9 Emergency changes

During breakdowns, normally after hours, it might be necessary to carry out emergency technical changes. It is important that these changes are properly engineered in normal working hours to ensure the integrity of the change and that the required documentation is updated and training given, if required. There is currently no formal system in place at Palabora to manage emergency change.

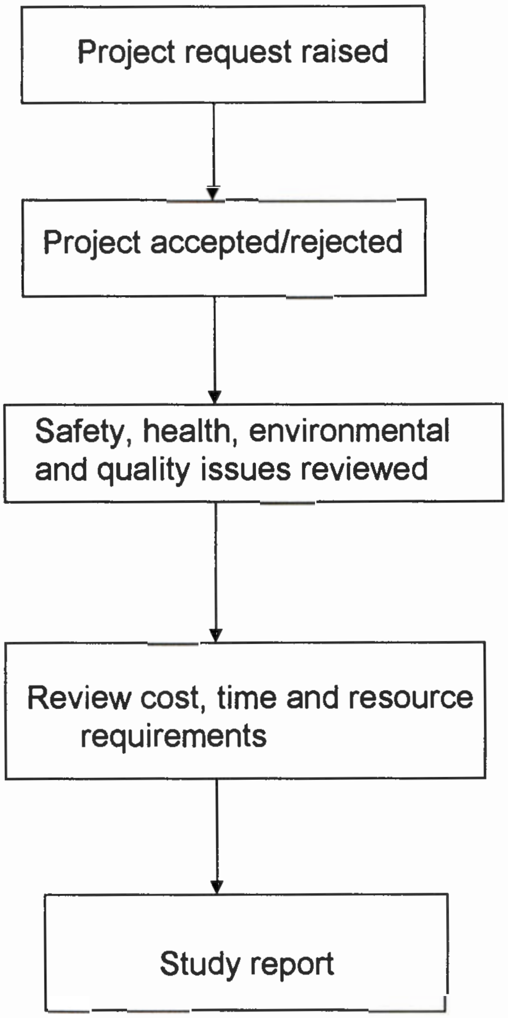

Figure 2.1 Palabora project management: feasibility study (Phase 1)

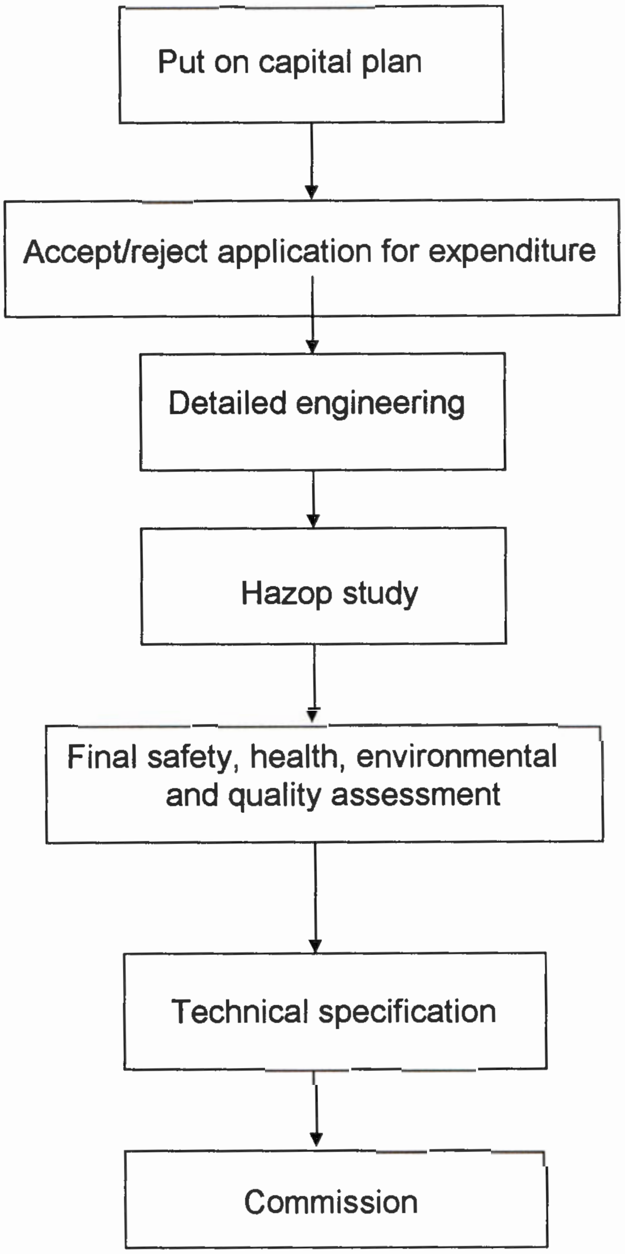

Figure 2.2 Palabora project management: execution (Phase 2)

Chapter Three

Management of technical change

3.1 Introduction

"Modifications that require process engineering activities or major maintenance changes are most often being examined for undesirable side effects within the chemical process industries. However, well-meaning employees can introduce unacceptable "Mini modifications" with simple changes in lubricants, additives, temporary changes, gasket substitutions, piping changes, misuse of hoses, and other activities, which require little time. Each plant must persistently train and create awareness of such dangers to their employees. This message must be given not only to the engineers and supervisors, but also to the chemical process operators and mechanics."

(Sanders, 1992:78)

"Management of change" or "control of change" is becoming a common phrase in industry today. It was developed in the chemical processing industry to reduce the number of incidents related to changes made in facilities that handle hazardous material (Hoskins & Worn, 1993:77). The ISO 9002 and 14001 systems have established the following as key elements of a quality or an environmental system:

- defined responsibilities
- written procedures
- training
- document control
- assessment
- corrective action, and
- records

Now that computers have become so important in maintaining documentation, they have antiquated the static, hard copy manuals by putting documents at the fingertips of all employees. More and more companies are developing extensive documentation systems for maintaining and assessing the various manuals required in their operations. However, even computer-stored manuals can become static if they are not kept up-to-date and revised to reflect the changes within the company. That is why a management of technical change system has to integrate the documentation and procedural changes.

Management of change is important, because improper changes can directly cause or lead to catastrophic accidents as well as degrade the quality of manufacturing options (Chemical Manufacturers Association, 1993:ix). Changes to a process occur when modifications are made to the operation or replacement equipment does not meet the design specification of the equipment it replaces. Other, more subtle changes to the process can occur when new chemical suppliers are hired, procedures are modified, or plant staffing is revised. Such changes, if not carefully implemented, can potentially increase the risk of process operation (Chemical Manufacturers Association, 1993:1)

Table 3.1 Examples of changes that could increase risk

• Increasing process throughput without considering its impact on relief capacity requirements.
• Using a single seal to replace a tandem seal in a pump.
• Increasing velocity in process lines such that erosion, increased corrosion, or electrostatic problems result.
• Uncontrolled changes to the software of the decentralised control system.
• Modifying operating procedures to reduce or eliminate operator rounds in an area without considering benefits of operator presence, such as leak detection.

3.2 Replacement-in-kind

This can be identified as a replacement or restoring of equipment, plant structure or part thereof to the reliable safe functional state that existed prior to the need for replacement, without deviation from the original design parameters.

This can be an identical replacement or any other design alternative specifically provided for in the design specification, as long as the alternative does not in any way adversely affect the use and integrity of the equipment or associated items. (Sasol Synthetic Fuels, 1998:5)

The list (See appendix B) is designed to help personnel in determining the difference between an in-kind change and a not-in-kind change. An in-kind change does not require the use of the management of change procedure. All not-in-kind changes should be handled through the request for change process (Appendix A). It is not a complete list and serves only as an example.

3.3 Minor modifications

It is widely recognised that new facilities or major plant modifications need to be thoroughly reviewed to ensure safe operation, and this need is typically addressed through capital project reviews. However, even small changes can have catastrophic consequences if done improperly. When taken in this context, changes can range from installation of a new piece of process equipment, to installation of a different gasket material, to a simple instrument setpoint adjustment outside of the normal limits (Center for Chemical Process Safety, 1992:73).

All such changes must be identified and reviewed *before* implementation. Management of change is a critical element in a process safety management program. This element includes the following components:

- Change of process technology
- Change of facility

- Organisational changes that might have an impact on process safety
- Variance procedures
- Permanent changes
- Temporary changes
- Tests (Center for Chemical Process Safety, 1992:74)

3.3.1 Changes of process technology

Economic considerations frequently dictate that technical changes be made. Six major reasons for making process technology changes are listed below:

- Maintain process continuity
- Compensation for equipment unavailability
- Start-up or end-of-run shutdown
- Experimentation (Yield or quality improvement, new product)
- Change of production rate
- New equipment (Center for Chemical Process Safety, 1992:74)

Changes are also made to comply with legislation regarding safety, health, environment and quality. A management for process change should incorporate planning for each of these situations, and should consider the unique circumstances of each.

3.3.2 Change of facility

The process safety implications must be carefully considered when equipment changes are contemplated. The organisational responsibility for approving such changes should be clearly defined and approval should only occur after an appropriate review has been completed. The implementation of the change should be limited to the specific equipment changes that have been reviewed and approved. There should be control over the equipment change process. Both operating and maintenance personnel must sign off on the specific equipment changes.

Often equipment changes will require changes in the process conditions. Major new equipment changes will normally be included in capital requests and be reviewed as part of any new capital project. There are certain types of equipment changes made in the field that are not included in the capital project review, such as:

- Process improvements
- Piping rearrangements
- Experimental equipment
- Temporary equipment
- Decommissioning
- Change in the materials of construction
- Change in computer programs
- Change in instrumentation (Center for Chemical Process Safety, 1992:77)

Although changes may seem harmless, without proper review process hazards can be created.

Equipment changes not covered by capital project reviews must still be controlled by a review and approval procedure. There should be systems for ensuring that these changes are identified in advance so that a review will be scheduled. Appropriate personnel should be involved in the review. A checklist of issues to be considered will ensure appropriate review. Completion of the review should be documented to assure accountability and facilitate subsequent audits.

3.3.3 Organisational changes

Personnel changes may be more frequent than hardware or process changes. Arrivals and departures will occur at both the operating and management levels. This presents challenges to the management of process safety. New staff must learn process characteristics and their roles in the process safety management system. Both documentation and training are key elements in this transaction.

Changes in the organisational responsibilities may require careful review of the process safety management system. This will ensure that all process safety responsibilities are appropriately assigned. The departure of experienced staff creates special challenges. Certain individuals normally possess specialist knowledge such as routes of underground piping, why equipment is operated in a specific manner, what major accidents have occurred and other valuable information.

The loss of multiple personnel can be even more significant. As companies continue to streamline staffing, there comes a point beyond which any further reductions can have serious safety implications. This is usually not a problem during normal operation, but in an emergency a minor problem can escalate to become a major incident. When staffing experience in a unit becomes too low, certain measures should be initiated, such as increased training, the temporary retention of transferees, or the engaging of retirees as temporary consultants.

3.3.4 Variance procedure

Situations arise in any operation where the operating parameters are outside those foreseen in the design of the plant. In situations like the aforementioned, personnel may want to conduct operations in a way that differs from the standard operating procedures. It is important to have variance procedures to ensure that these conditions do not create unacceptable risk. The variance procedure will require review of the planned deviation and acceptance of the risk it poses. The procedure should require explanation of the deviation planned; the reason it is necessary; the safety, health and environmental issues; control measures to be taken; and the duration of the variance.

Variances should require approval by a suitable level of management and be documented to ensure a consistent understanding by all affected individuals and departments of what specific departure from normal practice is to be allowed.

3.3.5 Permanent changes

It is important that a written procedure be developed to manage technical change. This procedure will ensure the consistent interpretation and application of management's policy for controlling changes throughout the life of the mine (Center for Chemical Process Safety, 1992: 80)(Chemical Manufacturers Association, 1993:15). The following tasks need to be considered (See appendix A):

- Identify the need for the change.
- Review the impact on the safety, health, environment and quality systems.
- Review the impact on procedures;
    - startup/shutdown/emergency procedures
    - maintenance procedures
    - normal operation procedures
- Review the training requirement of:
    - operations personnel
    - maintenance personnel
    - contractors
- Review the effect on process safety information:
    - process & instrumentation drawing
    - spare parts lists
    - electrical drawings
    - process flow diagrams

A technical change management team of multi-disciplinary personnel needs to be appointed in every division that can evaluate all the requests for change. In making these decisions, the team should use, as a guide, the criteria provided in the technical change management system to approve certain types of changes. There are generally five key steps that companies should consider in their technical change management procedure (See table 3.1)

In designing the request-for-change form for a company, the size of the company and the systems employed at that company should be considered (See appendix A).

3.3.6 Temporary changes

There should be no differentiation between the issues to consider for changes that are intended to be permanent versus those changes that will have a limited life or are of a "temporary" nature. If the right set of conditions occurs, a hazard will proceed to an incident, regardless of whether the changes were permanent or temporary. A temporary change made without a proper review caused the Foxborough disaster, a major process plant explosion which killed 28 people. (Sanders, 1996:153)

In many respects "temporary" changes require closer scrutiny, since the engineering controls or hardware needed for a permanent solution is not present, and reliance is often placed on administrative controls or alternative hardware solutions.

Accordingly, additional considerations that are specific to temporary changes are listed below:

Step	Focus
Initial review	Is the proposed change necessary? Based on the technical change management system definitions, is it a change?
Classification review	Is the change extensive or complex enough to require a multi-disciplinary review? Who needs to review the change?
Hazard review	Have potential problems been identified and have required controls been documented?
Authorisation review	Have all identified hazards and associated tasks required before implementation of the change been addressed and documented?
Close-out review	Have all identified hazards and associated tasks required after implementation been addressed and documented?

Table 3.1 Key steps in a technical change management system (Chemical Manufacturers Association, 1993:19)

- A time limit for temporary changes must be defined, requiring re-approval for any extensions. Too often temporary changes become permanent because either the change is perceived to be beneficial, or no effort is made to remove the temporary change. Without proper documentation, these changes will become part of the process, but the safety implications of these changes may not be incorporated into the procedures. A temporary change should be considered permanent and should be reviewed and documented as such.

- An additional control step needs to be added to ensure that all modified equipment and procedures are returned to their normal mode at the end of the approved time for the change.

3.3.7 Tests

All tests should be treated similar to temporary changes.

3.4 Proposed procedure for handling technical change

The following procedure is a guide (Sasol Synthetic Fuels, 1998:10) in completing the request for change form (Appendix A). The process flow diagram in figures 3.1 and 3.2 illustrates the decision making process in completing the request for change.

3.4.1 Request for change

- The change proposer must identify all relevant information required to formulate a clear problem definition.

- The proposer must complete the request for change document.

- The request for change must then be registered on the central system and an unique number will be awarded to the request for change.

- The divisional manager appointed in terms of regulation 2.6.1 of the Mines health and safety act (1996) must assign a change controller, responsible for managing change and the relevant documentation must be handed to this person.

- A technical change management file can now be opened by the person controlling the change, where all the documentation relating to the change can be filed, simplifying control and ensuring an audit trail.

- The person responsible for the change must ensure that the technical change management form is updated frequently.

3.4.2 Design conditions

The change controller must evaluate whether the request is a change or a replacement-in-kind and decide whether engineering input is required, as well as further actions required. The responsible person must:

a) Identify plant equipment or process involved and the priority of the change.

b) Verify whether the proposal has not been investigated previously.

c) Identify alternatives.

d) Carry out economic evaluation of the alternatives.
e) Identify other projects that run simultaneously, possibly influencing the project.

3.4.3 Risk management reviews

The change controller and the technical change committee must ensure that a competent person determines what risk management reviews need to be carried out.

3.4.4 Authorisation to proceed with the change.

- The change controller and the technical change committee must investigate alternatives and ensure that a feasibility study is conducted to determine the most suitable alternative /best proposal.

- Change recommendations must then be submitted and the necessary approvals need to be obtained to proceed with the change.

3.4.5 Procedures revised

- The change controller must ensure that marked-up drawings and procedures, of the equipment and plant affected, are attached to the technical change management package.
- A list of all the materials required to execute the change should be included in the technical change management package.

3.4.6 Training

The change controller and the technical change committee responsible for the change must identify all training required to successfully operate and maintain the change after implementation

3.4.7 Process safety information revised

The change controller and the technical change committee must ensure that the process safety information is revised according to the effect of the change.

3.4.8 Pre-startup review

The technical change committee must conduct a pre-startup review to ensure that all the relevant reviews, which have been identified in terms of the request for change, have been completed.

3.4.9 Authorisation to commission

The responsible divisional manager must approve the commissioning of all the changes and must indicate who will be responsible for the evaluation of the implemented change.

3.4.10 Close out review

The success of the change must be evaluated, the outstanding actions identified in the request for change document finalised and the technical change management package must be signed off. The change controller is then accountable to ensure that the complete package is filed at the central archive.

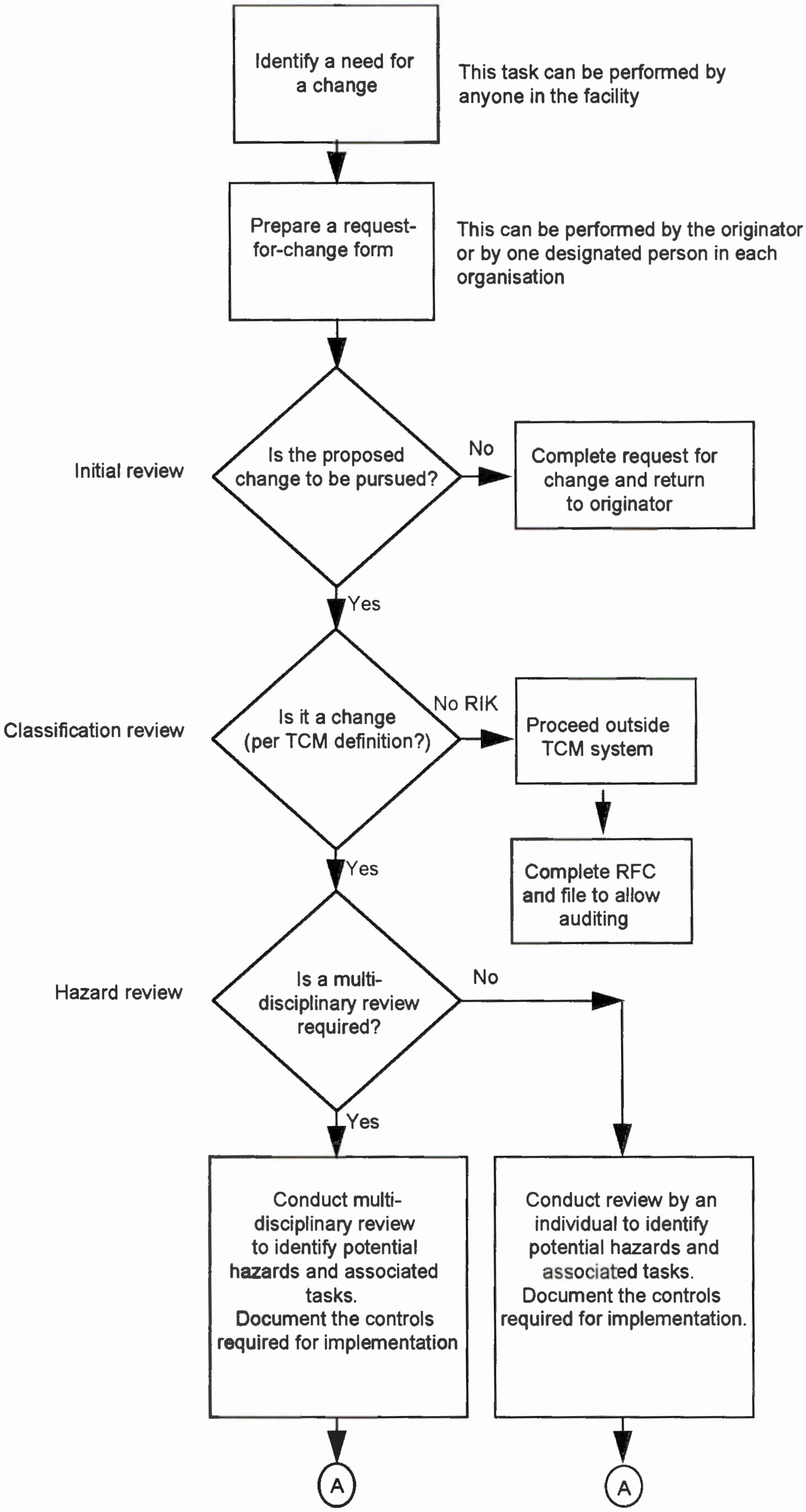

Figure 3.1: Technical change management for standard/temporary change

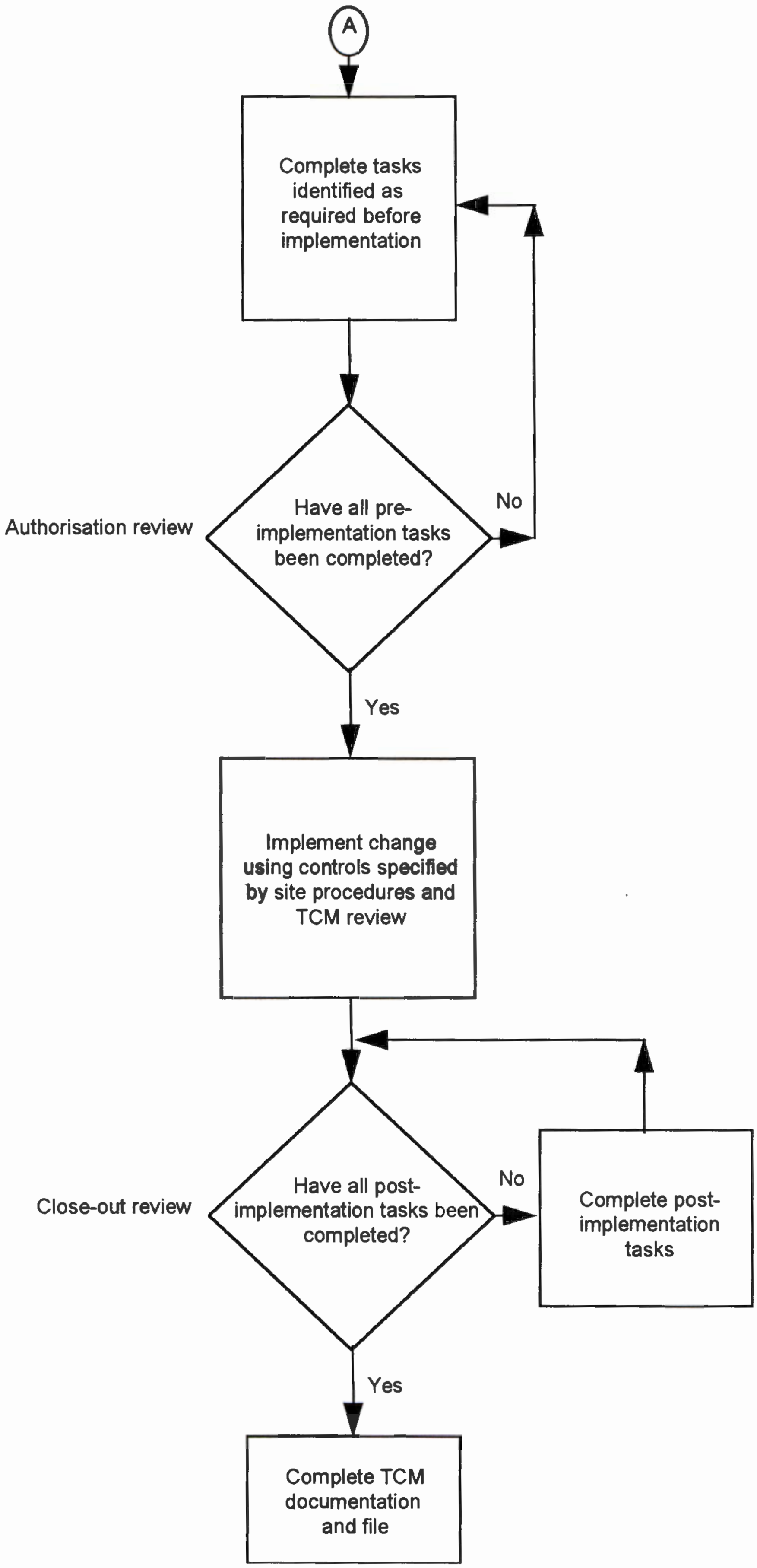

Figure 3.1 (Cont.): Technical change management system for standard/temporary technical change

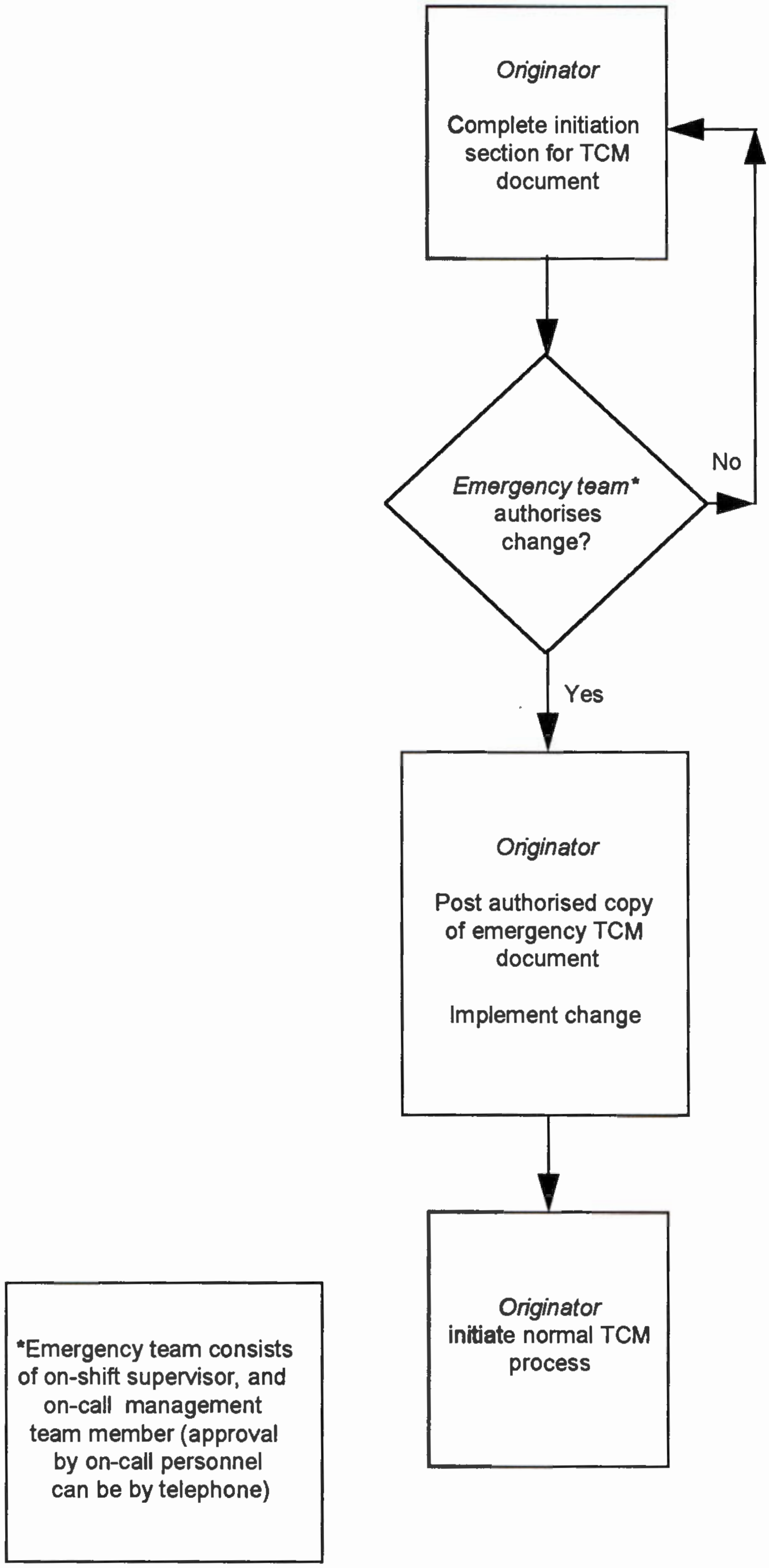

Figure 3.2: Technical change management system for emergency change.

Chapter Four

Palabora specific technical change management system

Each company should establish objectives for its technical change management system, considering local plant needs and regulatory requirements. This should help development efforts for the technical change management system and ensure that the system meets management's' expectations. The following features must be addressed: (Chemical Manufacturers Association, 1993:7)

- Terminology
- Roles and responsibilities
- Scope of the system
- Interfaces with other company practices and programs
- Requirements for review and authorisation
- Guidelines to key management of change issues

A team, of which the author is a member, was assigned to investigate the positioning of Palabora from 2004 to 2023. The team is of the opinion that being a low cost producer is the only sustainable competitive advantage that can be accomplished at Palabora. The value chain method (Porter, 1985:63) was used to analyse the current cost behaviour on the mine and to help identifying a sustainable cost advantage.

The Palabora technical change management system is designed to ensure technical integrity, the sharing of information and best practices, and to ensure an audit trail for all technical changes across the various systems. The author is of the opinion that sharing of information and experience will lower the cost of maintenance and will therefore be in line with the new design.

An interview was conducted with M Thurston, responsible for the safety, heath, environmental and quality systems at Palabora. The purpose and contents of the dissertation was discussed with her and she recommended that the documentation flow in the proposed technical change management system should be added to the dissertation. (See figure 4.1)

4.1 Proposed technical change management system at Palabora

The proposed technical change management system was discussed with R von Maltitz, manager engineering and other key decision-makers on site. The people interviewed agreed that there is a need at Palabora for the system. The technical change management system will be a new system for Palabora and would require a phased implementation. It is recommended that the system proposed in chapter three is implemented at the acid plant or ZBS first and that experience is gained in managing such a system.

The system for managing technical change, as well as the following was agreed:

4.1.1 Central system

Palabora utilises an electronic system to operate a "paperless" system for document control. It is proposed that the request-for-change document be put on the electronic system. The change originator can then access the request-for-change document and register the request for change. A unique number will be awarded to this request by the electronic system.

The change coordinator at engineering, to track all the technical changes taking place at Palabora, can use the central electronic system. The change controller can monitor changes and prevent duplication and re-inventing the wheel.

The unique number awarded to the change can be tracked through the financial, technical, safety, health, environmental, quality and operations systems. This will ensure that a proper audit trail exists.

4.1.2 Accountability

The divisional manager must appoint a person in the division responsible to manage the change. This person will be known as the change controller. The execution and progress of the change will be monitored from a central location. The change controller will be accountable to manage a specific change in the division. He must see that the technical change management procedure is followed. He is responsible to control all the paperwork relevant to the change and to see that a complete package is handed over to the archive once the close out review has been completed.

4.1.3 Technical change management coordinator

An individual should be appointed that directs activities associated with the technical change management system at Palabora and that has the responsibility for leading the development, installation, operation and the maintenance of the technical change management system procedures and records. This individual is responsible to monitor change on the property, to ensure the sharing of best practices and experience. This person will be located at engineering.

4.1.4 Sharing of information

An index of all changes registered on the mine must be available on the electronic system. The change controller must ensure that no duplication is taking place and that the information regarding a similar change, in another division, is available to the multi-disciplinary team or specialist addressing the technical issues regarding the change. This information could be obtained from the central change coordinator.

4.1.5 Multi-disciplinary/specialist input

The change controller must evaluate the change and decide whether multi-disciplinary or specialist input is required. Multi-disciplinary input is normally required with technical change that affects more than one discipline.

4.1.6 Documentation

The person responsible for the change in the division must open a file for all the documentation regarding that change. All the documentation must be

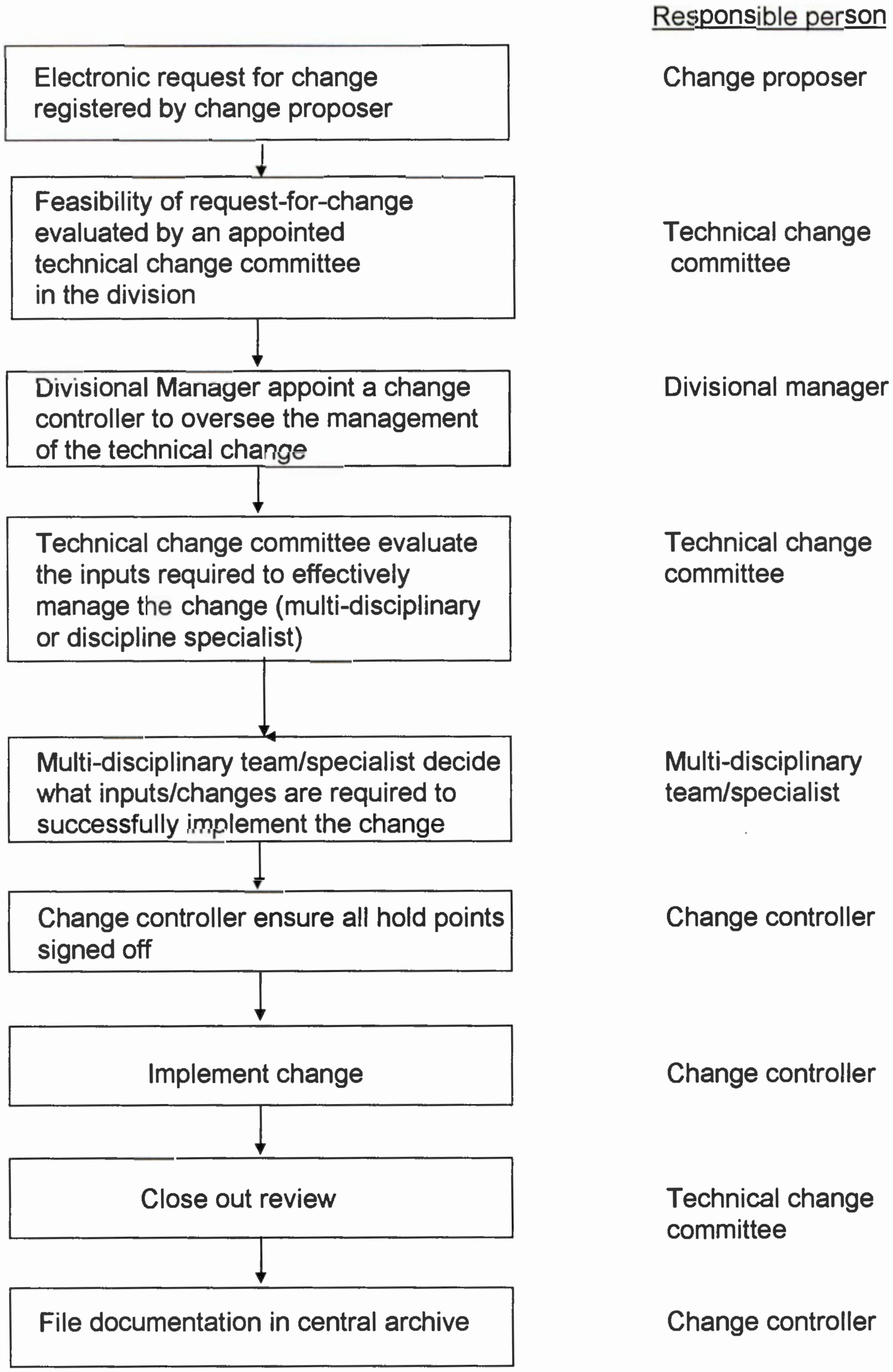

Figure 4.1: Flow chart for Palabora specific system to manage technical change.

properly indexed and recorded in the file. The file must be kept in the division until the change review is completed and the request-for-change document signed off.

4.1.7 Archiving

The person responsible for the change must ensure that the technical change management file is complete. Once the document has been signed of the file must be send to the central archive to ensure proper storage and control.

4.2 Minimum requirements for implementing change

a) All proposed changes must be processed via the management of change system.

b) All requests must be evaluated to determine whether it is a change or a replacement-in-kind and the engineering input required.

c) Records of all relevant documentation applicable to each change must be kept in a technical change management package in the originating area for the operating duration of the plant.

d) The following changes should be done by engineering or other accredited design authorities:

i) All jobs which entail changes, repair and new fabrication of vessels under pressure and critical pipelines.

ii) All jobs involving metallurgical issues.

iii) Pressure safety devices: design, sizing and data sheets

iv) Any request that require drawings to be updated.

4.3 Pitfalls

An interview was conducted with Mr. G. Papenfus, Section Leader, Process Safety at Sasol Synthetic Fuels at Secunda in August 1998. SSF has implemented a similar system in 1995 and he, as facilitator, shared his experience with the author. These issues should be considered once Palabora is ready to implement the proposed management of technical change system.

4.3.1 Training.

Training of all personnel in using the new technical change management system is very important. All personnel (maintenance and production) need to be aware of the system and how to use it to handle all change. All personnel need to be aware that no change can be implemented unless properly engineered through the technical change management system. *The required training will be provided prior to implementing the technical change management system and on request there after.*

4.3.2 Documentation.

One of the biggest advantages of the proposed technical change management system is that all changes are properly documented and that these documents are filed in a controlled manner. It is therefore very important that access to these documents be controlled. It can happen that important documentation is removed after an accident, prior to an investigation. *The completed technical change management files will be filed at the central archive where proper document control is exercised.*

4.3.3 Handing over.

It is important that the technical change management documentation must be handed over properly from one change controller to another. It is recommended that the documentation be handed over by memorandum and that the change controller receiving the documentation must sign for it. *This proposal will be implemented as above.*

It is very important that an index is kept of all the documentation filed in the request-for-change file (See table 4.1). The person taking over controlling the change can ensure that all the relevant documentation is present in the file before accepting it.

Nr	Date	Description
1		
2		
3		
4		
5		
6		

Table 4.1 Proposed index to be kept in the front of every request-for-change file.

4.3.4 Electronic request for change.

It is important that clear accountability exist for updating the electronic form on the network to enable tracking of the progress of the change. *The person responsible for the change in the division (Change controller) will be responsible for updating the electronic system.*

Chapter Five

Conclusion

A technical change management system was designed that suits the Palabora requirements. This will be an electronic system and will be controlled from a central point by the technical change management coordinator. A standard procedure has been created to ensure uniform management of all changes. This will ensure that all related systems are considered when evaluating the effect of the technical change.

Horisontal integration between the various technical sections will be achieved by centralising the control over all technical changes. This will ensure the sharing of best practices and experience. Vertical integration is not possible with the current systems and only interfacing can be achieved. The electronic system will award a unique number to every request-for-change. This number can be used to track all changes through the various systems.

The standard procedure for technical change management will ensure that an audit trail is created. Document control will be the responsibility of the change controllers in the various divisions. The request-for-change package will remain in the division until the change is implemented and the closeout review completed. The documentation will then be filled in the archive.

The author is of the opinion that the technical change management system, as designed in this dissertation will integrate the technical, financial, safety, health, environmental, quality, maintenance and operations systems regarding the change. (See figure 5.1).

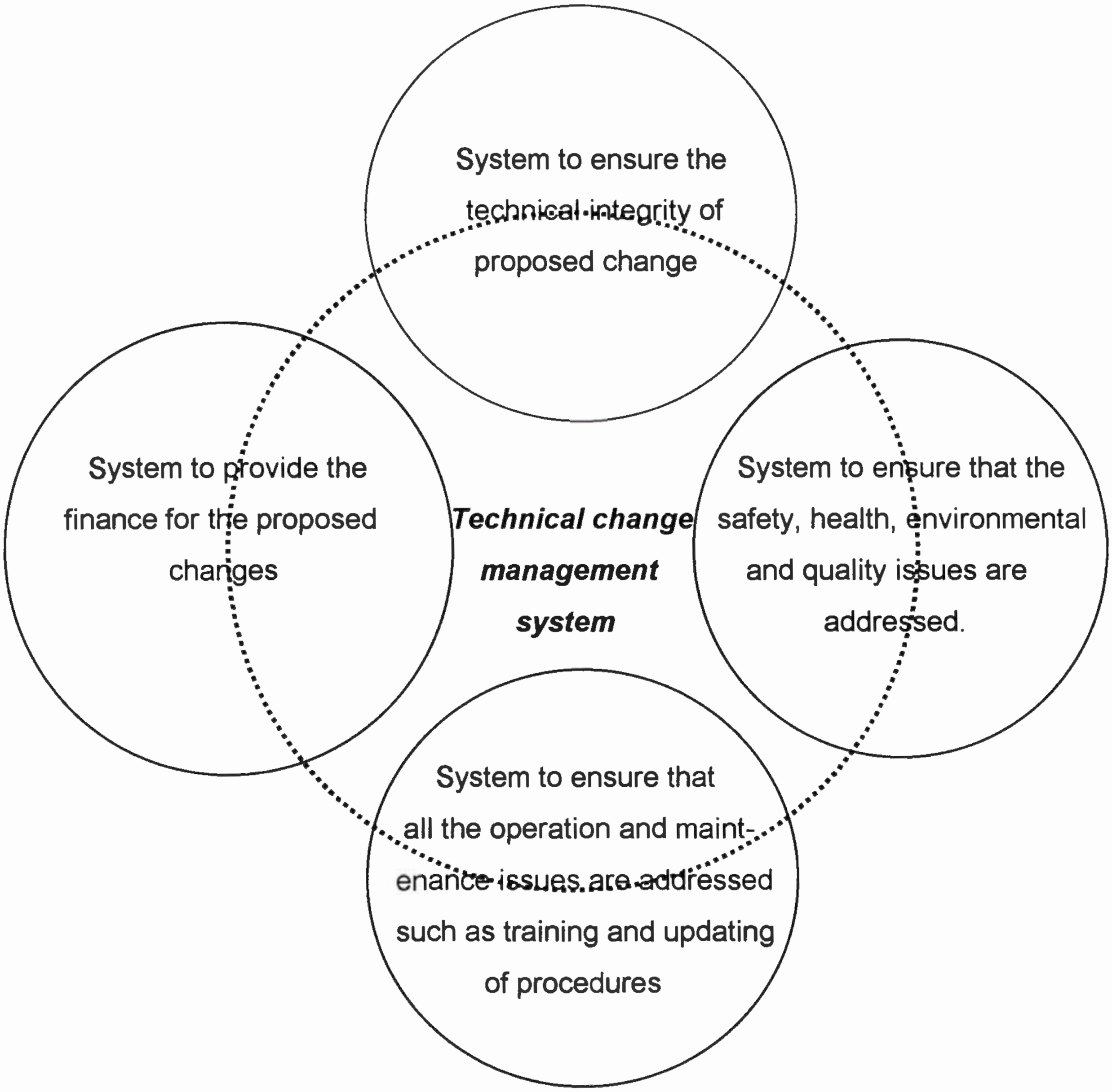

Figure 5.1: Integration of the various systems via the proposed technical change management system designed for Palabora.

Appendix A

REQUEST FOR CHANGE FORM

Standard change ☐ Request for change no.: ____________________

Emergency change ☐ Date requested: ____________________

Temporary change ☐ Date required: ____________________

Unit ________________________ System or equipment ________________________

Description (include technical basis for change):

____

Originator

---

i) Temporary changes (Skip for permanent changes)

This information may be provided in a temporary procedure (attach copy)

Why is this designated a temporary change?

Additional precautions required:

Contingency plan:

Dates valid:

Person responsible for removing the change:

---

ii) Safety, health and environmental reviews

	Req'd (Y/N)	Responsible party	Target date	Date completed	Initials
Process safety (specify method)					
Occupational safety/industrial hygiene					
Environmental reviews					

*Complete = action items with immediate impact are resolved and plan is in place to address long range items.

iii) Procedures revised

	Req'd (Y/N)	Responsible party	Target date	Date completed	Initials
Startup/shutdown/emergency shutdown					
Normal operation					
Maintenance					
Emergency response					
Other (e.g. administrative)					

** Complete = revised procedures issued; any obsolete procedures discarded.

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iv) Training

	Req'd (Y/N)	Responsible party	Target date	Date complete	Initials
Operations					
Maintenance					
Contractor					
Other					

+ Complete = all specified personnel have received and understood training. Responsibility for any change to permanent training materials (e.g. learning blocks) is assigned and scheduled.

---

v) Process safety information revised

	*Req'd (Y/N)	Responsible party	Target date	Date complete	Initials
Process & instrument drawings					
Process flow diagram					
Electrical system documentation					
Spare parts lists					
MSD					
Documented operation limits					
Other					

*Complete if there are any "yes" responses:

Follow-up responsibility: ____________________

PSSR responsibility: ____________________
(Pre-startup safety review)

PSSR No.: ____________________

---

v) Authorisation

This change has met the appropriate review requirements and has been approved.

Divisional manager   Date

Maintenance manager   Date

---

vi) Close-out review

All of the indicated process safety information revisions (section v) have been completed. This technical change management action is complete.

Divisional manager   Date

Maintenance manager   Date

Appendix B

Equipment type	In-kind changes	Not-in-kind changes
Valves	1. Change in vendors. a) Crane gate valve to Ramondi gate valve, etc.	1. Change in style. a) Gate to globe, globe to gate, 2. Change in material. a) Carbon steel to carbon steel, 3. Change in rating. a) 150# to 300#, 300# to 600#, 4. Change in size. a) 4" to 6", 6" to 8", etc. 5. Change in packing material.
Piping and Flanges	1. Temporary piping when process is not involved. a) Temporary piping used for the purpose of cleaning units following shutdowns. b) Temporary piping utilised in the pre-startup phase of a new unit for the purposes of flush out or pickling. 2. Utilising current materials as noted in the appropriate piping specifications. a) Old spec "A" spec utilised garlock gaskets, updated "A" spec utilises flexitalic. b) Old spec utilised ring joint flanges, updated spec utilised raised-faced flanges. (Note: specification changes require management of change review, but need not be re-reviewed when utilised.) 3. Changing steam/electric tracing routing on a line, valve or fitting.	1. Any addition or change to the P&ID. 2. Change in size. a) 6" to 8", 8" to 6", etc. 3. Change in piping schedule. a) sch 40 to sch 80, sch 80 to sch 40, etc. 4. Change in material. a) Carbon steel to stainless steel. b) 304 stainless steel to 316 stainless steel, etc. 5. Change in flange rating. a) 150# to 300# b) 300# to 600#, etc. 6. Change in flange facing. a) Raised face to ring joint b) Flanged to screwed, etc. 7. Adding steam/electric tracing to a line.
Pumps and compressors	1. Different vendors parts. a) Metal bellows seals b) Bearings c) Non-original equipment manufacturer parts built to their specifications or drawings. 2. Non-pressure containing, static internals a) Wear rings b) Internal labyrinths/ spacers	1. Change in material (includes pressure retaining components, and dynamic internals). 2. Change in flange rating, size, and facing. 3. Change in capacity. a) 300 GPM to 500 GPM, 2000 SCFD to 1000 SCFD, etc. 4. Change in type/materials of seal. O-ring material changes. 5. Change in packing material. 6. Change in impeller size.

Appendix B (Cont.)

Equipment type	In-kind changes	Not-in-kind changes
Turbines, steam drivers (Reciprocating) and motors	1. Motor vendor change. 2. Changes in carbon seal rings on turbines.	1. Change in material (includes dynamic internals). 2. Turbines and steam drivers change in flange rating, size and facing. 3. Change in capacity a) 200 hp to 500 hp, 400 hp to 800 hp, etc. 4. Change in motor's electrical rating a) 460 volts to 2400 volts, 240 volts to 360 volts, etc.
Pressure vessels	1. Replacing corroded heads or plates with identical material. 2. Weld overlay of like metallurgy on corroded surface. 3. Cleaning or replacement to restore to like new condition. 4. Replacement with identical R1 vessel.	1. Nozzle addition. 2. Stress relieving an existing process vessel. 3. Re-rating for higher/lower pressure, temperature. 4. Distillation column internals modifications. a) Remove trays, install packing b) Install higher capacity trays. c) Install spray or distribution header. 5. Turnaround modifications to pressure containing components. a) Clad or weld overlay of a different metallurgy.
Shell & tube heat exchangers	1. Refractory: not covered. 2. Shell: not covered. 3. Structural supports: not covered.	1. Tube change; metallurgy, size, thickness, studding. 2. Tube supports; metallurgy, spacing. 3. Numbers of tubes. 4. Burner model, tip model. 5. Maximum heater firing rate.
Chemical and catalyst	1. Replace one brand of generic catalyst or chemical, with a different brand with the same activity and composition. a) Buy sulfuric acid for the alkylation unit from a different supplier. b) Buy nickel-moly hydroprocessing catalyst with the same activity from a different vendor. c) Buy mole sieve of like activity from a different vendor. d) Buy filming amine from a different vendor. 2. Change catalyst and chemical addition rates within the safe limits of operation.	1. Replacing catalyst or chemicals with one with a different composition. 2. Change catalyst or chemical technology. Catalyst or chemical with different 'new' activity, or having a different performance. a) Change FCC catalyst to obtain improved yields. b) Replace a filming amine with a neutralising amine. 3. Add a new chemical to the process. 4. Change a chemical injection point.

Appendix B (Cont.)

Equipment type	In-kind changes	Not-in-kind changes
Operating procedures changes	1. The addition of a safety warning to a procedure. 2. The correction of punctuation or spelling. 3. The clarification of any step within a procedure that does not require the operator to change the way the job task is performed. (If the operator does the job in the same way, the clarification was not a 'change').	1. An operating procedure change that affects plant operation or the process. a) A change in any operating procedure that affects operator action. b) Resetting alarm limits outside the safe limits of operation. c) Resetting control parameters out of the safe limits of operation. d) Changing to a feedstock that a plant is not designed for. 2. Adding operating procedures, including temporary operating procedures. a) Adding a procedure to remove a flare line from operation. b) Adding a procedure for operation of a unit with a key upstream unit off line. c) Adding a procedure for operation of a unit with a portion of the unit bypassed and off line.
Operations changes	1. Increasing a pressure, temperature, flow or composition within the defined safe limits of operation. 2. Unit shutdowns where the limits of operations for downstream units are not exceeded. 3. Utilisation of a unit's temporary operating procedures. 4. Bypassing equipment with existing bypasses, utilising existing procedures. 5. Changing alarms within the defined safe limits of operation for a process unit.	1. A change in operational software that could affect plant operations. a) The reconfiguration of control loops. b) Implementation of advanced control. 2. Addition of a new chemical to the process. 3. Gagging a pressure relief device. 4. Changing a limit stop on a valve.
Relief system changes	1. Changing a relief valve with an identical valve that has the same pressure setting. 2. Utilising pre-defined relief system temporary operating procedures during flare line shutdowns.	1. The emergency line-up of one flare line, to another, due to leak or blocked flow that has not had a pre-defined emergency operating procedure developed for it. 2. Leaving a testing gag on a pressure relief valve. 3. Adding additional relief.

Appendix B (Cont.)

Equipment type	In-kind changes	Not-in-kind changes
Equipment specification changes	1. Correction to punctuation. 2. Clarification of wording to assure that the specification is not mis-interpreted. 3. Addition of caution statements or warnings. 4. Update of acceptable vendor's listings.	1. Any change that would cause a different functional item to be purchased for a process service. a) Change from screwed to socket welded fittings. b) Changes in metallurgy. c) Addition or deletion of heat treating requirements. .
Instruments	1. Must have same range a) 0-10, 0-150, etc. 2. Must have same multiplier. a) X10, X50, X100, etc. 3. Must measure same units. a) GPM, SCFD, lb/hr, etc. 4. Must use same sensing element. a) Orifice plate, P/D cell, etc.	1. Change in range. a) 0-10 to 0-150, 0-15- to 0-20, etc. 2. Change in multiplier. a) X10 to X50, X100 to X200, etc. 3. Change in measuring units. a) GPM to lb/hr, SCFD to SCFH, etc. 4. Transmitter model changes. 5. Transmitter manufacturer changes; analog to smart. 6. DCS control strategy changes. 7. PLC logic changes. 8. Control body type changes. 9. Control valve trip changes; type, metallurgy. 10. Control valve port changes. 11. Control valve actuator size changes. 12. Adding or removing positioners. 13. Thermowell metallurgy changes. 14. Thermowell length changes 15. Impulse tubing metallurgy changes that are outside of current specification. 16. Sight glass model changes.

Appendix C

Symbols :

▽ Activity

◇ Decision

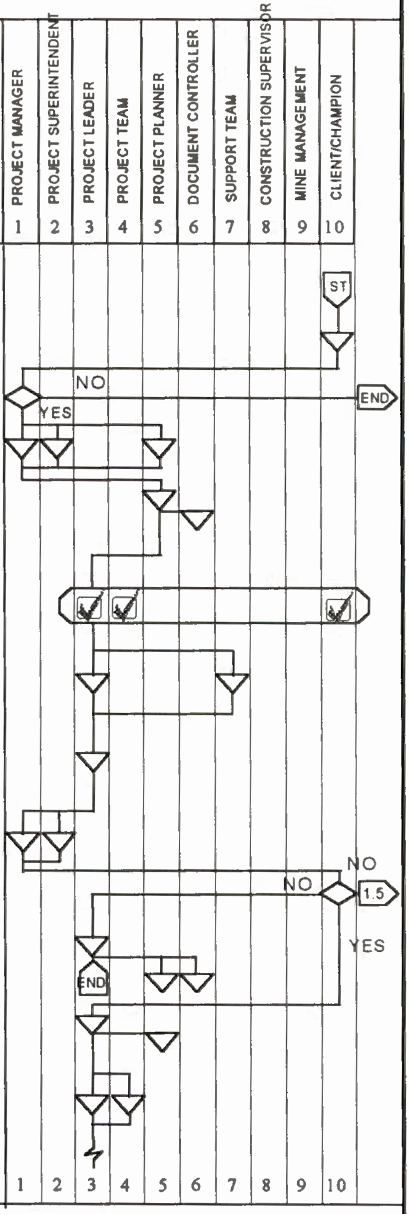
ST / END Start/End

ϟ Continuation

✓ Meeting / Conference Participant

◁ or ▷ Interface Activity

No.	Activity Description	Document Record	REFERENCE PROCEDURE
1.0	**FEASIBILITY STUDY (PHASE 1)**		
1.1	Submit project request.	Project Request	
1.2	Accept / reject project request.		
1.3	Assign Project Leader and Project Team.		
1.4	Register study and allocate project file number. Forward file number and open project file.	Project file	Proj 3.1
1.5	Hold kick-off meeting, confirm scope, schedule and deliverables.	Minute	
1.6	Review Safety, Health, Environmental, Quality and Fire requirements (SHEQ).	SHEQ check list	
1.7	Prepare Cost, Time and Resource (CTR) estimate for study.	CTR	
1.8	Review CTR, submit for review.		
1.9	Review (accept / reject).	File note	
1.10	Submit handover certificate, end study.	Handover Certificate	
1.11	Process RFS for CTR. Submit study schedule.	RFS: SC Schedule	Proj 8.1 Proj 7.1
1.12	Conduct engineering study.	Drawings Calculations	Proj 4.1



References:

Appendix C (Cont.)

Symbols :

- ▽ Activity
- ◇ Decision
- ⬠ / ⬠ Start/End
- ϟ Continuation
- ✓ Meeting / Conference
- Participant
- ◁ or ▷ Interface Activity

No.	Activity Description	Document Record	REFERENCE PROCEDURE	PROJECT MANAGER 1	PROJECT SUPERINTENDENT 2	PROJECT LEADER 3	PROJECT TEAM 4	PROJECT PLANNER 5	DOCUMENT CONTROLLER 6	SUPPORT TEAM 7	CONSTRUCTION SUPERVISOR 8	MINE MANAGEMENT 9	CLIENT/CHAMPION 10
1.0	**FEASIBILITY STUDY (PHASE 1) (continued)**					ϟ							
1.13	Conduct SHEQ investigation as per SHEQ check list.					▽				▽			
1.14	Submit project updates.	Update Form	Proj 7.1			▽							
1.15	Compile monthly report	Monthly Report	Proj 7.1					▽					
1.16	Prepare study report.	Report				▽	▽						
	- Cost estimate for the project	Estimate	Proj 5.1										
	- CTR for execution phase	CTR											
	- Preliminary engineering	Drawings	Proj 4.1										
	- Preliminary project execution schedule	Schedule	Proj 7.1										
	- Preliminary site plan approval	Site plan	MinSur1.4										
1.17	Review and approve study report.			▽	▽								
1.18	Submit report for review.					▽							
1.19	Review study report, accept / reject.	File note											NO ◇ ▷ 1.5 YES
1.20	Approve study handover certificate, end study.	Handover Certificate		▽		▽			▽				▽
1.21	Update central filing system.		Proj 3.1						▽ END				
				1	2	3	4	5	6	7	8	9	10

References:

Appendix C (Cont.)

Symbols :

▽ Activity

◇ Decision

ST / END Start/End

↯ Continuation

✓ Meeting / Conference — Participant

◁ or ▷ Interface Activity

No.	Activity Description	Document Record	REFERENCE PROCEDURE	PROJECT MANAGER 1	PROJECT SUPERINTENDENT 2	PROJECT LEADER 3	PROJECT TEAM 4	DOCUMENT CONTROLLER 5	COST CONTROLLER 6	SUPPORT TEAM 7	CONSTRUCTION SUPERVISOR 8	CONTRACT ADMINISTRATOR 9	CLIENT/CHAMPION 10
2.0	**EXECUTION (Phase 2) (continued)**					↯							
2.17	Project review. Sign off approval drawings.	Minute	Proj 4.1			✓	✓			✓	✓		✓
2.18	Prepare Technical Specifications.	Technical Spec	Proj 8.1			▽	▽						
2.19	Review Technical Specification.		Proj 9.1								▽		
2.20	Submit Permission to Invite Tenders and RFS.	RFS				▽	▽						
2.21	Approve Technical Specification, Permission to Invite Tenders and RFS.	Permission to Invite Tenders	Proj 8.1	▽									
2.22	Register and submit RFS.	Register	Proj 8.1						▽				
2.23	Tender, adjudicate and award contracts.	Contracts	AS/CA/ 01-10	▽		▽	▽		▽			▽	
2.24	Generate approved purchase orders.	Purchase Orders	AS/MM/01	▽		▽	▽						
2.25	Control committments and expenditure against budget. Generate input to monthly reports.	Cost Reports	Proj 6.1						▽				
2.26	Produce Issued for Construction Drawings.	Drawings	Proj 4.1			▽							
2.27	Forward construction files.		Proj 10.1			▽		▽			▽		
2.28	Perform quality control and manage contract execution.		Proj 9.1 Proj 10.1								▽		
2.29	Conduct site inspection and prepare punch list.		Proj 11.1			▽	▽			▽	▽		▽
2.30	Commission.		Proj 11.1			▽	▽						▽
						↯							
				1	2	3	4	5	6	7	8	9	10

References:

Terminology

Change - any temporary or permanent alteration, addition, removal or demolition to any part of plant, equipment, systems (soft and hardware), facilities, or in material and procedures that is not a replacement-in-kind.

Change controller - the individual appointed in the division responsible to see that the technical change management process is followed.

Change proposer - the individual who identifies the need for a change and initiates the technical change management process with a request-for-change.

Closeout review - approval mechanism to verify that associated tasks required for a change, but not necessary prior to implementing the change, have been completed.

Emergency change - change which is required in a situation where the time required for complying with the normal technical change management procedure is not available, following equipment failure or any incident that may affect safety, health, environmental, quality or production issues.

Engineer - a person who is the holder of an appropriate mechanical or electrical engineer's certificate of competency appointed in terms of these regulations.

Engineering-out-maintenance - improvements to equipment and systems to reduce the required frequency of maintenance and/or the maintenance cost.

Hazard review- identification of potential problems to be resolved and required controls to be implemented prior to and following a change.

Initial review- preliminary determination of whether a proposed modification is worth pursuing and whether it is a change or a replacement-in-kind, based on technical change management system definitions.

Manager - the person appointed to be responsible for the control, management and direction of a mine or works and includes the terms “general manager”.

Management of change register - this is a list of all projects and changes presently being carried out and record must be kept on the status of all these projects.

Replacement-in-kind - replacement or restoring of equipment, plant structure or part thereof to the reliable safe functional state which existed prior to the need for replacement without deviation from the original design parameters. This can be an identical replacement or any other design alternative specifically provided for in the design specification, as long as the alternative does not in any way adversely affect the use of the item or associated items.

Request-for-change - the formal suggestion of a modification to a process or operation made with a formal written document (Request-for-change form). See appendix A.

Responsible divisional manager - the authorised manager, according to the Mines health and safety act (1996), reg. 2.6.1, responsible for a pre-defined area according to set coordinates.

Responsible person for the project - the person assigned to ensure that all the requirements of the management of change code are initiated and executed.

SHEQ - Safety, health environmental and quality.

Technical change management coordinator - individual responsible for the activities associated with a technical change management system in all or part of the plant.

Technical change committee - multi-disciplinary committee appointed in the division to evaluate all the requests for change.

Technical change management - the management of any technical change to

- plant and equipment

- computers and their software
- process
- operating procedures and
- personnel

Temporary change - an installation or a repair that is implemented on a short term or trial basis.

Written program - a written description of the roles, responsibilities, practices, procedures, and desired results of a management system for process safety.

References

- Center for Chemical Process Safety/American Institute of Chemical Engineers. 1992. Plant Guidelines for Technical Management of Chemical Process Safety.
- Chemical Manufacturers Association Inc. 1993. Managing Process Changes - A Manager's Guide to Implementing and Improving Management of Change systems, CMA, Washington, D.C.
- Hoskins, R.K. & Worn, G.H. 1993. Develop an Effective Management of Change System Manual. Chemical Engineering Progress. 77-80, November.
- ISO 9002. 1994. Quality systems - Model for quality assurance in production, installation and servicing.
- ISO 14001. 1996. Environmental Management Systems - Specification with guidance for use.
- South Africa. 1996. Mines Health and Safety Act. Act 29 of 1996. Pretoria: Government printers.
- Nadler, D.A., Gerstein, M.S., Shaw, R.S. and Associates. 1992. Organisational architecture. San Francisco. Jossey-Bass.
- Palabora Mining Company. 1963. Prospectus. Phalaborwa.
- Palabora Mining Company. 1997. Annual report. Phalaborwa.
- Palabora Mining Company. 1998(a). Core Process Re-design. Phalaborwa.
- Palabora Mining Company. 1998(b). Engineering:Projects. [Available on the Palabora electronic system] PQS/procedures/engineering/projects /proj1-1 [Date of use 26 August 1998]. Phalaborwa.
- Palabora Mining Company. 1998(c).Macro Design. Phalaborwa.
- Papenfus,G. 1998. Interview with author. Secunda. (Notes in possession of author)
- Porter, Michael E. 1985. Competitive advantage. Creating and sustaining superior performance. London: The Free Press. 557p.
- Sanders, R.E. 1992. Mini modification miseries - Small quick changes in a plant can create bad memories. Chemical Engineering Progress: 78-83, May.
- Sanders, R.E. 1996. Human factors: Case histories of improperly managed changes in chemical plants. Process Safety Progress: 150-153, Fall.

- Sasol Synthetic Fuels. 1998. Minimum requirements for management of change - 2SH011(Rev 1). Secunda.