



**A GENERIC FRAMEWORK FOR CONTINUOUS
ENERGY MANAGEMENT AT CRYOGENIC AIR
SEPARATION PLANTS**

by

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Submitted in partial fulfillment of the requirements for the degree of
Master of Engineering (Electrical Engineering)

in the

Faculty of Engineering, Built Environment and Information
Technology

UNIVERSITY OF PRETORIA

December 2003

Acknowledgements

To thank all the people who gave me their continuous support throughout, will not be possible in the available space and, to them, I would like to express my deepest gratitude in making this study possible.

- To my Heavenly Father, my God, to live in Your Name truly is what it is all about.
- Dominique Rouge of Air Liquide, your insight into cryogenic plants was invaluable and I thank you for your willingness in assisting me during this study.
- Jan Lewis of Sasol oxygen plant, thank you for your continued willingness and patience in sharing your valuable plant experience with me in the countless sessions we had.
- Sasol, for giving me the opportunity and means for conducting this study.
- James Calmeyer for his guidance during this study.
- My parents, Sina and Theuns you always gave me your unconditional love and support to which I am infinitely grateful. Maryna and Rina you are the best sisters a brother could ever hope to have.
- Lastly, to Marilene, my wife and soul mate; your unconditional love and never-ending support have always truly been a great inspiration to me. I dedicate this to you.

To Marilene

SUMMARY

Steel, petrochemicals, metallurgy, explosives, food and many other industries require large amounts of air products such as oxygen and nitrogen. Cryogenic air separation technology is, unlike other air separation technologies, in a mature stage of its life cycle and currently the only practical means available for mass-production of these air products. Inherent to its operation, cryogenic air separation plants are generally energy intensive and power input is considered the main factor on which the ultimate production cost will depend. Experience has shown that relatively small improvements in energy efficiency on these plants generally result in significant reduction of production cost.

This dissertation discusses the means for effective energy management at these plants, aimed at ultimately reducing the electrical cost per quantity of air product produced. It introduces a model, aimed at the manager responsible for energy management at plants of this nature.

At the core of the model is the definition of the energy management structure, which consists out of the following main managerial functions: organizing, planning, leading, and controlling.

Organization implies a formalized intentional structure of roles and positions whereas the planning process entails setting up the energy policy and defining the energy strategy. The managerial function of leading involves leadership, motivation and communication and in controlling, the energy manager sets energy standards, measures performance and initiate appropriate corrective actions.

KEYWORDS

Cryogenic Air Separation plant, Energy Management Model, Energy Policy, Energy Strategy



Opsomming

OPSOMMING

Die staal industrie, petrochemiese maatskappye, metallurgie, plofstofvervaardigers en die voedselbedryf benodig groot hoeveelhede gasprodukte soos suurstof en stikstof. Kriogeniese lugskeiding tegnologie is, anders as ander lugskeidingstegnologieë, in 'n volwasse stadium van sy lewensiklus en is huidiglik ook die enigste praktiese manier beskikbaar vir massa produksie van die laasgenoemde gasprodukte. Inherent tot sy proses, is kriogeniese lugskeidingsaanlegte normaalweg energie intensief en energie-inset word normaalweg beskou as die hoof faktor waarop die uiteindelijke produksie koste sal afhang. Ondervinding het bewys dat relatiewe klein verbeterings in die energie effektiwiteit van hierdie aanlegte normaalweg lei tot beduidende verlagings in produksiekoste.

Hierdie verhandeling bespreek 'n metode waarop effektiewe energiebestuur by hierdie aanlegte toegepas kan word en is daarop gemik om die uiteindelijke energie koste per uitsetprodukhoeveelheid te reduceer. Dit stel 'n model bekend wat gemik is op die bestuurder wat verantwoordelik is vir energiebestuur by hierdie aanlegte.

Die definisie van die energiebestuurstruktuur vorm die kern van die model, en bestaan uit die volgende hoof bestuursfunksies: organisering, beplanning, leiding en beheer.

Organisering impliseer 'n geformaliseerde en beplande struktuur van take en funksies, terwyl die beplanningsproses die bepaling van die energiebeleid en formuleering van die energiestrategie insluit. Die bestuursfunksie van leiding sluit in leierskap, motivering en kommunikasie en in die beheer funksie stel die energiebestuurder energiestandaarde vas, meet prestasie en inisieër relevante korrektiewe aksies.

SLEUTELWOORDE

Kriogeniese lugskeiding, Energiebestuurmodel, Energiebeleid, Energiestrategie

List of Abbreviations

LIST OF ABBREVIATIONS

Abbreviation		Meaning
AC	-	Air Compressor
Ar	-	Argon
AR	-	Average Recovery
ASU	-	Air Separation Unit
CB	-	Coldbox
CBM	-	Condition-based maintenance
CO ₂	-	Carbon Dioxide
CT	-	Current Transformer
FTM	-	Fixed-Time maintenance
GAN	-	Gaseous Nitrogen
GOX	-	Gaseous Oxygen
He	-	Helium
HP	-	High Pressure
IA	-	Instrument Air
Kr	-	Krypton
LOX	-	Liquid Oxygen
LP	-	Low Pressure
MG-set	-	Motor-Generator set
MP	-	Medium Pressure
N ₂	-	Nitrogen



List of Abbreviations

Nm^3/h OR nm^3/h	-	Normal Cubic Meters per hour. This is the flow of a commodity (gas or liquid) at normal conditions ($0^\circ C$ and 1.013 <i>absolute bar</i>).
O ₂	-	Oxygen
OC	-	Oxygen Compressor
OEM	-	Original Equipment Manufacturer
PM	-	Preventive Maintenance
PT	-	Potential Transformer
tpd	-	Tons per Day
WN ₂	-	Waste Nitrogen
Xe	-	Xenon

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