Engeneering Thesis

Tjuntjuntjara Groundwater Desalination

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1 Abstract

The Tjuntjuntjara Groundwater Desalination Thesis was conceived to solve the operational faults of a Vacuum-Multi-Effect-Membrane-Distillation (VMEMD) Pilot Plant. The National Centre for Excellence in Desalination (NCED), Murdoch University and other contributing parties intend to power the plant with renewable energies in order to supply the Tjuntjuntjara indigenous community with water.

The thesis involved research into VMEMD technology and an assessment of the control system and instrumentation that operated it. During the assessment process, operational faults as well as potential improvements in the operation of the plant were recorded. It was found that the control system had a number of software based faults. The design and implementation of a new Programmable Logic Controller (PLC) operating code was undertaken to correct these faults. In parallel to this work, the design and implementation of systems to improve the operation of the plant was also undertaken.

When all upgrades to the plant were complete, the vigorous process of validating the new additions commenced. As well as testing the new code and system improvements, a series of continuous trial periods was conducted. These proved that the plant can now operate continuously and at varying system temperatures for over 100 hours. During the trial periods, operating point data was collected and methods for increasing distillate output were found.

The plant has been brought up to a stable operating standard and the additional systems installed to improve the plant have further increased its reliability. A number of recommendations have been provided to stimulate further development of the VMEMD pilot plant.
2 Acknowledgments

The writer would like to thank Murdoch University, the National Centre of Excellence in Desalination, friends and family for the continuing support of this thesis project.
3 Terminology and Abbreviations

NCED – National Centre for Excellence in Desalination
VMED – Vacuum-Multi-Effect-Membrane-Distillation
MEMSYS – VMEMD module manufacturer
P&I – Piping and Instrumentation Diagram
PLC – Programmable Logic Controller
HMI – Human-Machine Interface, a computer display for monitoring and control
CV – Control Valve
SV – Solenoid Valve
B&R – Bernecker and Rainer, a German based Automation Company
Code – Written on a PLC to operate various instrumentation
Flash – Change of state from fluid to vapour
JSA – Job Safety Analysis
KNF – Vacuum pump manufacturer
Gemu – Valve manufacturer
DRAM – Dynamic random-access memory
SCADA – Supervisory Control and Data Acquisition
VNC – Virtual Network Connection
I/O – PLC electrical inputs and outputs
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