Development of Murdoch University Pilot Plant Maintenance & Demonstration Programs

"A report submitted to the School of Engineering and Energy, Murdoch University in partial fulfilment of the requirements for the degree of Bachelor of Engineering"

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Executive Summary

The structure of the Instrumentation and Control Engineering stream at Murdoch University exposes students to significant practical components as well as extensive development of theoretical knowledge. One of the most industry-like practical components that these students have access to is the Murdoch University Pilot Plant. For this reason, it is important that the Pilot Plant is operating smoothly and kept as up to date as possible. The main purpose of this thesis paper is to ultimately improve the performance of the Pilot Plant and hopefully enable it to become an even more valuable resource.

Throughout the time spent on this thesis paper, various improvements and new aspects have been developed and implemented into the Pilot Plant. One of the first ideas explored through this thesis was a significant recoding of the way instrumentation was activated and controlled, enabling all device control function blocks to be operated when the mode attribute is set to program. It is envisaged that this will allow for significantly less operator confusion as has been experienced since the recent upgrade. Further to this, a significant portion of this thesis examined the development and implementation of both maintenance and demonstration programs. Existing research provided evidence that sequential control modules would be the easiest method for coding the maintenance program. This program was designed to activate both upon user demand and automatically on a preset time to cycle various aspects of the Pilot Plant that are susceptible to seizing during extended periods of dormancy. Minimal running time was an important aspect that needed to be considered and this was achieved, with the program completing in two minutes.

The thesis then goes on to explore the development and implementation of the demonstration program. The demonstration program is quite similar to the maintenance program as it also employs sequential control modules. Its design allows for a systematic approach to turning on pumps and waiting until predefined conditions are met to allow the Pilot Plant to reach a steady state operating condition without any input from an operator. This was successfully achieved with a fully automated program from start to finish which it is envisioned will aid during times when tours of the Pilot Plant are being performed, allowing the tour guide to simply press a button and direct full focus to the explanation about the Pilot Plant. Finally this thesis explores the adaption and creation of new human machine interface pages to be implemented into Station to take full advantage of the newly developed code. Three new pages are created to allow easy integration of the new program settings, while minor modifications are also performed, to make operation of the Pilot Plant significantly simpler.

Through the significant research and development undertaken throughout this thesis, it has become evident that there are many more opportunities and directions that further projects could take to build upon this knowledge base and further improve the Murdoch University Pilot Plant and ultimately the Instrumentation and Control Engineering stream.

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Acronyms

Acronym	Definition
ASM	Abnormal Situation Management
CEE	Control Execution Environment
CM	Control Module
CVP	Output of PID in percentage
FB	Function Block
HMI	Human Machine Interface
IO	Input/Output
IOM	Input/Output Module
K	Proportional/Gain Term
L^{-1}	Inverse Laplace Transform
MEDE	Microsoft Excel Data Exchange
MV	Manipulated Variable
OP	Operating Point
PID	Proportional Integral Derivative
PKS	Process Knowledge System
PLC	Programmable Logic Controller
PV	Process Variable
PVP	Process Variable in Percentage
S	Laplace Operator
SCM	Sequential Control Modules
SP	Set Point
SPP	Set Point in Percentage
T1	Integral Time (minutes)
T2	Derivative Time (minutes)
α	Filter Constant