OPTIMAL DESIGN OF GAS PIPELINE NETWORKS

by

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SUMMARY

In constructing a pipeline network to collect gas from a number of fixed wells and transport it to a factory, prior to entry into a trunk main for onward transmission, several interdependant optimization problems arise. The configuration of the network, i.e. the number of junction nodes and the links of the network, has to be determined. Then the junctions have to be located and finally the diameter of each link of the network has to be selected. The thesis studies this area of problems and investigates optimization models that may be of use in the design of such networks. The models are tested on data from a developing gas field at Moomba, in the desert center of Australia.

Optimal networks are trees. Under fairly general assumptions it is proved that the optimal network is a tree. This justifies the policy in this thesis of considering only tree networks and ignoring all other types.

Optimal diameter selection. Two optimization models are developed for this problem. Firstly a Dynamic Programming formulation, secondly a Linear Programming model. Properties of an optimal diameter assignment are proved. Computational results are given for both models and the models compared.

Junction location problem. For a given configuration, the

problem of locating junctions in a pipeline network is considered. The problem is shown to be convex. The problem is solved and computational results presented. The case of 3 given nodes is analysed in depth and some properties of an optimal solution for this case are derived. Experimental results based on a parameter study are presented.

Configuration Problem. This is a complex, combinatorial problem. It is shown that for a small number of given nodes, the positions of these nodes are far more important than the flows in determining the optimal configuration.