FOURTH AUSTRALASIAN CONFERENCE
on
HYDRAULICS AND FLUID MECHANICS
at
Monash University, Melbourne, Australia
1971 November 29 to December 3

HAZELWOOD POWER STATION - DATA COLLECTION AND ANALYSIS OF COOLING POND PERFORMANCE

by

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SUMMARY

The history of the Hazelwood Power Station cooling pond system is given, and the recording instrumentation and analysis of the data collected is described.

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The operation of a large thermal power station, such as at Hazelwood, necessitates the use of vast quantities of water to circulate through the condensers for cooling purposes in addition to the water physically consumed in the generating process.

In an area devoid of large rivers, natural lakes, estuaries, etc. this requirement makes the recirculation of cooling water essential. Not only must the water be recirculated, but it must be cooled and returned at a temperature suitable for reuse.

In order to obtain sufficient cooling of the circulating water, it is necessary to either install cooling towers (mechanical or natural draft) or provide a cooling pond of sufficient area.

In the case of Hazelwood Power Station a cooling pondage having surface are of 1,250 acres has been provided. At the time it was constructed the power station capacity was planned to be 1,200 MW making the loading on the pondage nearly 1 MW/acre, which was amongst the highest values used anywhere in the world at that time. Subsequently the power station capacity was increased to 1,600 MW without increasing the size of the cooling pondage.

The cooling pondage was first filled in 1964 and the first 200 MW generating unit commenced operation the same year. The eighth unit was completed late in 1970.

The performance of the cooling pondage has been monitored continuously since it first went into service and a programme of theoretical research and special field observations has been undertaken to increase understanding of water circulating patterns, cooling rates, etc. These studies were sufficiently advanced at the time the power station's capacity was increased from 1,200 to 1,600 MW to indicate that a larger cooling pondage would not be required to serve the enlarged power station. Observations of the surface water temperature in other lakes in the Latrobe Valley area were also undertaken in order to determine the reference point "natural water temperature" from which to assess the temperature rise being experienced at Hazelwood due to the input of the artificial heat load.

The original concept of a single pond was shown to be conservative and was replaced by a system in which successive areas of the pond were analysed, the output from one area becoming the input into the next. An initial outlet temperature was assumed and routing of the flow through the various areas was carried out until the inlet stage was reached. Outlet temperature was adjusted until a heat balance was obtained.

A further parameter was introduced at this stage, namely the turbulent mixing between the upper warm and lower cool layers of the pond. This mixing reduces the temperature of the surface layer without a corresponding reduction of heat content, thereby reducing the efficiency of the pond and increasing the base temperature. Mixing rates were assumed using previous overseas work and were further checked by field studies. Although limited by available equipment these tests showed that the assumptions made were reasonable.

A computer programme was developed to forecast probable temperature conditions throughout the cooling pond under varying power station outputs, natural water temperatures, wind velocities, etc.

Additional recording equipment has been installed and further field studies carried out as found necessary in order to check the various aspects of the study. This has resulted in minor modifications to the analysis program, and in turn better agreement between the actual temperature obtaining and the predicted temperatures.

The paper describes the Hazelwood Power Station cooling water system and the history of the development of theories designed to describe the performance of the Hazelwood Cooling Pondage, the installation of data recording instrumentation, the conduct of special field surveys and the processing and analysis of the data collected.

Comparisons are made between actual operating water temperatures and water temperatures predicted by the various theoretical methods. Examples of thermal dispersion patterns are given together with summary listings of data.

The use of basic meteorological data instead of "natural water temperature" as a basic reference point is discussed.

Note: The author regrets that the full text of this paper is not available for inclusion in the Proceedings of the Conference. However those participants who are desirous of obtaining copies of the paper prior to the conference should write to: Civil & Architectural Department, State Electricity Commission of Victoria, 15-27 William Street, Melbourne, Vic. 3000. Australia.