Fogs and power stations

If you pump 38 cubic metres of warm water into Hobson's Bay near the mouth of the Yarra River every second, will you cause a fog problem for shipping? Williamstown Council asked CSIRO for an opinion after plans were announced for a big new power station at Newport, beside the Yarra mouth.

On the way to working out that the warm water would not make the fog situation much worse, Dr Kevin Spillane of the Division of Atmospheric Physics devised methods that can be applied anywhere for determining the height and intensity of 'steaming fogs' caused by warm water discharge.

The new station, due to be completed in 1978, will burn natural gas—or oil if gas supplies are interrupted—and generate up to 1000 megawatts of electricity. This is equal to about a quarter of Victoria's present generating capacity.

At full load the station will convert 37% of the heat energy from its burners to electrical energy, so the equivalent of 1620 megawatts of waste heat will be produced with 1000 megawatts of electricity. Of this, 1250 megawatts will be discharged into Hobson's Bay and the rest into the atmosphere.

Cooling water will be drawn from the Yarra, passed through the station's condensers, and, according to initial design proposals, put back into the bay about 8°C warmer. A plume of warm water will spread out from the discharge point. Working from measurements of the effects of warm water discharged by the existing Newport power station, which can generate up to 228 megawatts of electricity, Dr Spillane calculates that about 1·6 sq km of the surface water of the bay will become 2°C or more warmer than the intake water. The temperature will rise 5° or more in an area of about 0·5 sq km and 7° for about 0·15 sq km.

Dr Spillane began his study by bringing together existing data on fogs in the area between 1961 and 1971. He found great variation from year to year. He found also that most fogs occur when light easterly winds are blowing and, rather than forming over the bay, form over the city and drift over the bay. The gain in moisture on the water crossing to Williamstown is not a primary factor controlling fog formation there.

Using the fog and heat plume data and the methods he devised for predicting intensity and height of steaming fog, Dr Spillane estimated likely fog effects of the power station at heights of 3 m and 10 m. Visibility from small craft would be affected at 3 m, and 10 m is a typical bridge height for ships using the dredged channel into the Yarra.

His figures are based on fog averages for 1961–71; the figures for particular years would vary proportionally with the total fog figures for those years. He made estimates for continuous operation of the power station and for restricted operation (with generation halted for 8 hours at night). The restricted hours are expected to apply normally, with the station also being closed down at week-ends.

Dr Spillane found that significant effects would be limited to the region of the plume to about 3 km downstream of the warm-water outlet and some hundreds of metres downwind of the plume. They would coincide with naturally occurring fogs, extending the duration of these and causing them to become denser.

He found that, if the station operated 24 hours a day every day, additional fog would reduce visibilities for small-boat operators from 1200 m to less than 350 m for 15 hours in an average year. Visibilities of about 600 m would be reduced to less than 300 m for 11·6 hours and visibilities of about 300 m to less than 200 m for 8·5 hours.

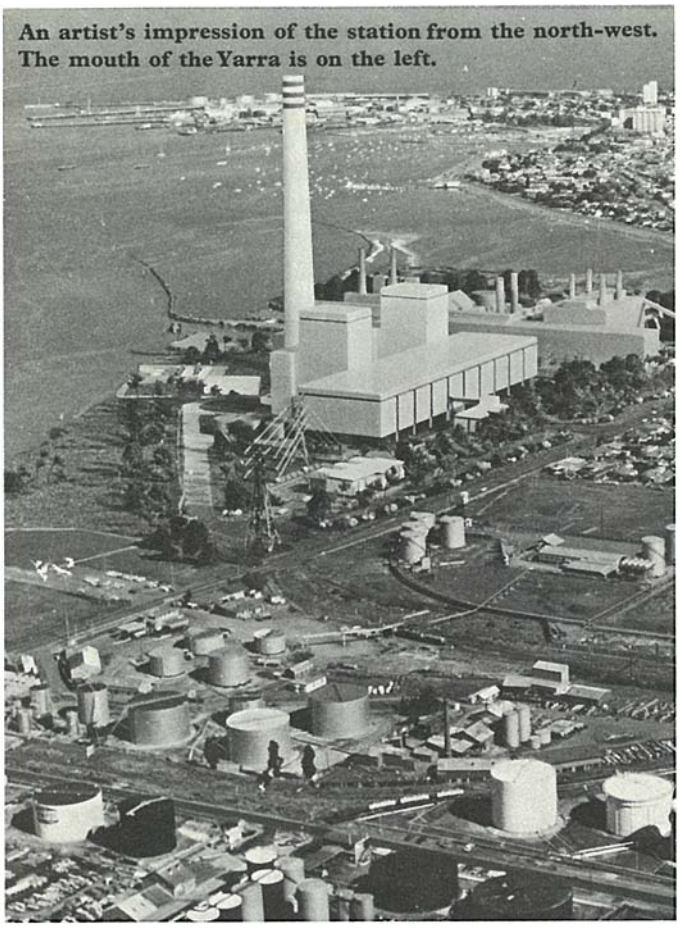
However, if the station was switched off at night these times would be reduced to 7 hours, 5 hours, and 4 hours respectively, and if it did not work at week-ends they would be reduced again by five-sevenths.

For ships' captains, additional fog at bridge height—10 m—would reduce visibilities of about 1200 m to about 350 m for 7 hours in an average year if the station operated continuously. For 5 hours, visibilities of about 600 m would fall to less than 300 m and visibilities of about 300 m to less than 200 m.

If the generators stopped at night, these times would fall to 3 hours and 2 hours respectively, and again they would be further reduced by five-sevenths if the station closed at week-ends.

By comparison, natural fogs on average reduce visibility in the area to less than 266 m for 35 hours a year and to less than 183 m for 22 hours.

'Fog and the Proposed Newport Power Station.' K. T. Spillane. (CSIRO Division of Atmospheric Physics: Melbourne 1973.)



An artist's impression of the station from the north-west. The mouth of the Yarra is on the left.