Our Ref LJ2375/L9920 :sge

Contact P.D. Treloar

Cardno Lawson Treloar

Engineering the Future

29 September 2006

BlueScope Steel
PO Box 1854
WOLLONGONG NSW 2500

Attention: Mr Ben Margetts - Project Manager - Steelworks Cogeneration Project

Dear Sir,

NUMERICAL MODELLING OF COOLING WATER FIELD – PLANKTON FATALITY AND FLUSHING ISSUES

Preamble

Following the meeting with DEC representatives in Wollongong on 25 August, 2006, it was identified that some additional investigations were required to assess the likely impacts of the proposed SPC works on plankton within Port Kembla Harbour.

These investigations required at least two aspects to be addressed; namely, harbour flushing versus the volume of seawater turned over by the existing and post-SCP cooling water systems, and then the actual impacts themselves, to be addressed by others). This letter addresses the first issue.

In Attachment B of their letter (Reference 282151A7:WOF13617:PW) to BlueScope Steel in late 2005, DEC suggest that an extraction index be used to provide a basis for assessing the likely present condition and change to plankton impacts. The calculation of this index (I) would be as follows:-

$I = T_i/T_r$

where T_i = time required to extract a volume of cooling water equal to the volume of water Port Kembla Harbour (taken as the Inner and Outer Harbours)

T_r = average residence time of harbour water (can be estimated from existing models based on flushing).

Assessment

T_i requires an estimate of the harbour volume. This was determined to be about $24.25 \times 10^6 m^3$, based on the model bathymetry.

Cooling water flows were based on the flows presented in our draft report (Cardno Lawson Treloar, 2006), Tables 4.1, 5.1 and 6.1, including only those flows drawn in from the Outer Harbour by the lift-pump.

Flushing times were determined by re-running the cooling water simulations for:-

- existing average summer and typical summer post-SCP cases

Cardno Lawson Treloar Pty Ltd
ABN 55 001 882 873

Level 2, 910 Pacific Highway
Gordon New South Wales
2072 Australia
Telephone: 02 9499 3000
Facsimile: 02 9499 3033
International: +61 2 9499 3000
Email: cltnsw@cardno.com.au
Web: www.cardno.com.au

Cardno Offices
Brisbane
Sydney
Canberra
Melbourne
Perth
Darwin

Cairns
Townsville
Mackay
Rockhampton
Hervey Bay
Sunshine Coast
Toowoomba
Gold Coast
Gosford
Baulkham Hills
Wollongong
Busselton

Papua New Guinea
Indonesia
Vietnam
China
Kenya
United Arab Emirates
United Kingdom
United States

ACEA
ASSOCIATION OF CONSULTING ENGINEERS AUSTRALIA
MEMBER

Quality System
Quality Endorsed Company
ISO 9001 Lic 7229

- existing average winter and typical winter post-SCP cases
- existing peak summer and peak summer post-SCP cases,

including all cooling water flows, winds and tides.

That is, these simulations were the same as those undertaken for Cardno Lawson Treloar (2006). However, they now included a conservative marker contaminant with no density or temperature. This marker was set initially to be 100 everywhere within Allans Creek and the Inner and Outer Harbours. As each model simulation progressed the marker contaminant diluted. The rate of dilution depended on cooling water flows, as well as the tide and wind driven flows. Flushing time was estimated using the e-folding time which is defined from:-

$C_T = C_o/e$

where flushing time T is the time for concentration to reduce to 1/e of an initial concentration. These seasonal and pre and post-SCP differences arise from the different cooling water flows and environmental conditions.

Results

The overall outcomes are presented in Table 1.

Parameter	Summer-Pre-Ave	Summer-Post-Ave	Winter-Pre-Ave	Winter-Post-Ave	Summer-Pre-Peak	Summer-Post-Peak
T_i (days)	28.5	18.4	26.9	18.4	26.9	17.9
T_r (days)	3.8	3.2	6.5	6.0	3.2	2.4
Index	7.5	5.8	4.1	3.1	8/.4	7.5
Pump Flow (m^3/s)	9.85	15.26	10.43	15.26	10.44	15.72

Typically, an index greater than 1 is theoretically 'good' because it means that harbour water is replaced more quickly than it is passed through the cooling water system. However, as a factor of safety, I would recommend that a minimum index of 3 would indicate satisfactory conditions.

Yours sincerely,

P.D. Treloar
Manager - Coastal and Estuarine Studies
for **Cardno Lawson Treloar**

References

Cardno Lawson Treloar (2006): Steelworks Co-Generation Plant (SCP). Proposed Saltwater Cooling, Numerical Cooling Water Studies. Report (LJ2504/R2257) Prepared for BlueScope Steel Limited.