Review of "Effect of tidal stream power generation on the region-wide circulation in a shallow sea" by G. I. Shapiro. Submitted to Ocean Science.

In principle, this is an interesting paper, quantifying the way in which an array of turbines in a laterally unbounded flow will reduce the tidal current, thus leading to less power production than if the current were unaffected. There are however, a number of points that need clarification and improvement, so that major revision is recommended prior to publication.

Major comments:

1) The results of the paper depend critically on having the drag coefficient associated with the turbines independent of the vertical coordinate. This seems very unrealistic in water some tens of metres deep. Isn't it more likely that the turbines would be moored near the sea bed? If so, there is the likelihood that the bottom boundary layer would be modified, with the tidal current flowing over the turbines and leading to even more reduction in power than estimated in this paper. The author uses a 3D model and so could examine this question. It at least needs to be mentioned.
2) Even with the assumption of depth-uniform drag coefficient, the value of this needs to be related to the type and spacing of turbines that might give the assumed drag coefficient. The quantitative results of the paper would be more useful if they were related to a realistic array of turbines.
3) Choosing a linear, Rayleigh, drag, rather than a more realistic quadratic drag, seems curious and unnecessary.
4) A number of reductions of the estimated power need to be made. For a start, there are the wake losses described by Corten (ECN Report ECN- RX–01-001, 2001) and further by Garrett and Cummins (J. Fluid Mech. 588:243–51, 2007). Beyond this, there is the drag on supporting structures and internal losses in the turbines.
5) Whatever form of turbine drag is used, it would be helpful if the model could be run for more values so that the absolute maximum power can be estimated. Figure 3 of the present paper shows a power that seems to be leveling out with increasing drag coefficient, but has not quite reached a maximum. Or maybe the maximum is between the last two points!
6) Unless these problems are addressed, there is a danger that the estimated available power will be taken too seriously by proponents and politicians.

Other comments (Lxx for line xx):

7) L41: Saying that "tidal energy is almost inexhaustible" is true but misleading as the possible rate of extraction, the power, is very constrained.
8) L54: "high levels of tidal energy fluxes from the ocean". This is irrelevant. The natural energy flux could be zero but not rule out the extraction of tidal power.
9) L55: "deemed to become a stable source … for the future". Hmm, and the Severn Barrage project has just been cancelled?!
10) L61-68: Some inaccuracies here. The Uldolmok scheme is not a barrage. Please check all this.

11) L78: “the velocity through the device itself may increase”. Because of ducting? In general, the flow has to slow to build up the head required to overcome the resistance of the turbine.
12) L81: Garrett and Cummins (2008) was a review with some new material. The relevant original paper on the effect of a complete fence in a channel was Garrett and Cummins (Proc. R. Soc. A 461:2563–72, 2005).
13) L125-135: This seems muddled. There are two effects. The first is the reduction factor due to the nature of turbine operation, with results dating back to the work of Lanchester and Betz. The second is the reduction in regional flow due to the presence of turbines. Using a drag coefficient in models such as the present one is okay, but see point 4) above about wake losses.
14) L153: The result of equation (4) was for quasi-steady flow. The numerical factor varies a little with the importance of acceleration.
15) L253-255: Please give the units of alpha (s^{-1}).
16) L299-300: Please explain this alleged factor of 3. Also, the 14-fold reduction seems very specific to the situation in the present paper.
17) L305: Lateral diversion of the flow was a factor in the two-channel study of Sutherland et al. (J. Power Energy 221:147–57, 2007).
18) The figures are generally very poor. Please show the farm location on all the maps (and tell us in the text how deep the water is in that location) and make the figure labels legible.
19) Many statements in the abstract will need to be modified once the main parts of the paper have been revised.
20) A little more attention is needed to the English and to correct typos.
21) While I appreciate that the present study is for a specific area with specific assumptions about the form of the turbine array, it would be nice if the author or others could undertake a more generic study.