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Regarding: Pumped Hydro – It's already built!

Dear Madam or Sir,
This is an open letter from the Sustainable Energy Forum (SEF) Inc. to the Minister of Energy and Resources the Hon Dr Megan Woods, the Parliamentary Commissioner for the Environment Simon Upton, the Energy spokespersons of all parliamentary parties and representatives of the media.

The mission of SEF is to assist "Facilitating the use of energy for economic, environmental, and social sustainability". As such, we feel compelled to contribute vital information to the currently unfocused and unproductive discussion around the New Zealand Battery Lake Onslow project, and the proper application of pumped hydro technology within a future-proof New Zealand electricity system. The consensus among SEF members, many of which have decades of electrical, structural, environmental or civil engineering expertise, is that pumped hydro energy storage is a highly valuable and important technology for a sustainable New Zealand energy future, but that the current NZ Battery Project proposal for Lake Onslow is woefully inadequate, ill-targeted, and above all - obsolete. The project should therefore be abandoned sooner rather than later, as it is unfitting and too expensive to provide electricity back-up for generation shortfalls occurring on the decade scale. All other features expected from Lake Onslow, including buffer and back-up capacity for the integration of more intermittent renewable generation and price peak modulation ability, can alternatively be provided from New Zealand's already built, tested, but unused pump hydro scheme on the Pukaki-Tekapo canal.

History lesson: Pukaki-Tekapo pumped hydro storage.
Early in 1977, the Power Division of the Ministry of Works completed construction of their Tekapo canal, joining Lakes Tekapo and Pukaki to form the core water reservoirs for the Upper Waitaki Power Development. However, there were concerns about introducing design flows of 120cumecs to the new canal, which could be expected to potentially cause significant channel damage. Would the compacted gravel bed withstand erosion? Could the untried 25km canal overflow somewhere and degrade or damage the billion-dollar investment? Would the new gates at the Tekapo A power station (Figure 1) control inflows reliably enough?

The solution proposed by a specialist systems engineer (Dr Alastair Barnett, seconded to power division) was to manage the planned canal commissioning programme in stages via a computational model of the canal. The first stages would be at half design steady flow (60cumecs) with later stages run at more challenging flows, culminating with the final test required by Ministry compliance rules: the surge resulting from sudden rejection of full design flow through the Tekapo B station downstream. Such severe conditions would arise only if all transmission of power from

the station failed (for example, through the collapse of a transmission pylon). However rare, such a possible station trip event must not endanger the power stations and the connecting canal.

Figure 1: Calibration of new inflow control gate at Tekapo A on 1st of July 1977.

At each stage, model predictions of the outcome were compared with observed results. Only after the match between predicted outcomes and observed results was accepted by the design office, was authorisation given for the next stage to proceed. A schematic test programme prepared by Dr Barnett is shown below (Figure 2). This was issued as an appendix to "Tekapo B Power Project M.W.D. Commissioning Procedures H.D. 1154" dated April 1977. It schedules the on-site presence of 36 specialist staff over the four-month canal commissioning period, twelve of some one hundred staff-years spent on testing during the whole Upper Waitaki Power Development. Of Interest is the approval of the Chief Design Engineer, Bill Fookes, the architect of the Pukaki-Tekapo concept, who already envisaged a national battery in the Upper Waitaki over 45 years ago.

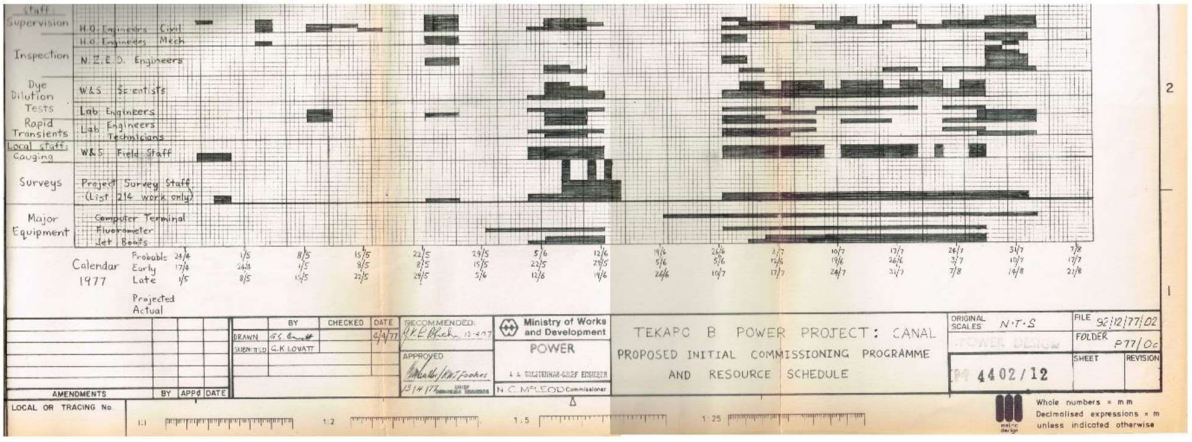

Figure 2: A schematic test programme prepared by Dr Barnett in 1977.

An example of the model predictions, plotted below (Figure 3) shows the maximum safe reverse flow through the canal. Although such a flow would require the addition of pumps at Tekapo A and B, significant reverse flows occurred during reflection from suddenly closed gates during the final flow rejection test. Successful model prediction of these flows gives full confidence that this estimate of maximum flow capacity for pumped storage development is accurate.

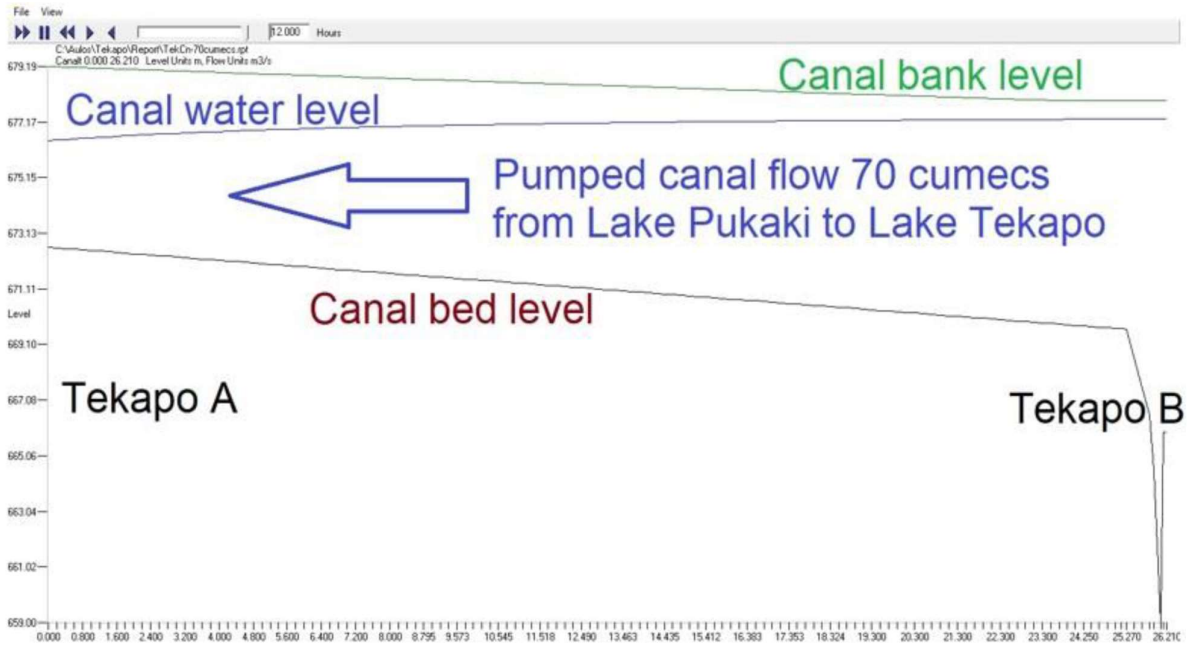

Figure 3: Model predictions of the maximum safe reverse flow through the Tekapo canal; prepared by Dr Barnett.

Future outlook: Pumped hydro storage is already built!

What does all the work conducted in the Upper Waitaki in 1977 and before, mean for New Zealand's energy future today? It means that, if there is a scope or need for pumped hydro storage in New Zealand, it has already largely been built and tested on the Tekapo canal. All that is technically required to make use of this existing asset is to buy pumps and install them in their pre-built locations at Tekapo A and B power stations. This could be accomplished in less than two years at an estimated cost of less than NZ$100 million, and, assuming the completed pumped hydro scheme would be operated coordinated with other adjacent generation assets, could provide back-up, firming and energy storage capacity for several hundred MW of new and future wind or solar generation development. There are no technical barriers preventing the completion of the pumped hydro scheme at the Tekapo canal and the comparatively small financial outlay required, would make it one of the most cost-effective pumped hydro schemes realizable anywhere in the world.

All it requires for New Zealand to utilize this unique pumped hydro opportunity, would be to reverse the ill-conceived 2011 ownership transfer of Tekapo A and B power stations. Furthermore, like any other energy storage concept in NZ, the Tekapo canal pumped hydro scheme cannot operate under the existing electricity spot market pricing system, which provides no revenue base, but an assured revenue reduction during the most profitable trading hours of the year, for the operators of this, or any other, electricity storage scheme. Just like for the realisation of Lake Onslow pumped hydro, a revenue base for a Tekapo canal pumped hydro scheme would require a

compensation model outside the electricity spot market, or fundamental reform of this system. We encourage political decision makers and the New Zealand public to focus on overcoming these legal, market order and financial barriers, holding back all electricity storage concepts in Aotearoa, rather than to continue arguing about the disadvantages and problems of Lake Onslow. Once a sound basis for the operation of energy storage concepts is established, the Tekapo canal pumped hydro scheme would be able to provide capacity and services at extremely low cost and with minimal environmental impact.

This is an open letter issued by the Sustainable Energy Forum Inc.
The Sustainable Energy Forum Inc. is registered as a charitable entity under the Charities Act 2005, under registration number CC36438.

The open letter was compiled by EnergyWatch editor Stephan Heubeck and Dr Alastair Barnett, immediate Past Chair, IAHR Flood Risk Management Technical Committee. More detailed reference engineering data and model descriptions will be presented in Dr Barnett's book "Practical Flooding Risk Assessment for Development Projects", to be launched at the 40th IAHR World Congress, 21-25th of August 2023, Vienna, Austria.