



Wednesday 8th May 2013

Ref: 122-002

Mr T McCormick
 Opuha Water Ltd
 tony@opuha.co.nz

Dear Tony,

**Opuha Downstream Weir Enhancement
 Generation Feasibility Report - Preliminary Update**

Last year MTL undertook a Feasibility Study (also referred to as a Scoping Study) of the conceptual design and financial feasibility for hydropower generation on an outlet from the Opuha Dam Downstream Weir. Subsequently a Request for Clarification (RfC) was submitted to HydroWorks Ltd (HW) on 9th April 2013, and HW responded with a plant quotation and supporting documentation on 1st May 2013, and an email on various matters on 7th May 2013. Based on these responses from HW, this letter updates specific aspects of last year's Feasibility Study in order for OWL to consider whether to take this investigation further or not. We identify a number of aspects which are not fully resolved at this stage. but which would be addressed should OWL decide to to take this investigation further.

- Annual Generation:** Based on the plant performance data in HWs' quote there is a slight increase in the estimated annual generation from that presented in Table 1 last year, as follows:

Plant outages		5%	
Value of power		6.5 c/kWh	
O&M costs		4%	
Penstock velocity		2.00 m/s	
		27-Nov-12	1-May-13
		Scoping Study	RfC (HW)
Rated flow	m³/s	7	7
Net head	m	6.31	6.31
Penstock diameter	m	2.1	2.1
H'works - Tubular variable pitch propeller			
Loss due to variable head			
Minimum Flow			
Rated power	kW	375	380
Minimum Flow	m ³ /s	1.4	1.4
Generation	kWh pa	2,271,823	2,329,996
Plant factor			
Generation	\$ pa	\$ 148,000	\$ 151,000
O&M costs	\$ pa	\$ (6,000)	\$ (6,000)
Total Income	\$ pa	\$ 142,000	\$ 145,000



It is important to note that the above value of generation (6.5 c/kWh) is that applied last year, and should be reviewed by OWL based on recent developments in the electricity supply industry (including possible Tiwai Pt closure and possible state purchase of all generation).

2. **Capital Cost:** Based on HWs' quote option A, and the installation and container costs in HWs' subsequent email dated 7th May 2013, there is a slight reduction in the project capital cost from that presented in Table 2 last year, as follows:

		27-Nov-12	1-May-13
		Scoping Study	RfC (HW)
Rated flow	m³/s	7	7
Net head	m	6.31	6.31
Penstock diameter	m	2.1	2.1
<u>Tubular variable pitch propeller</u>			
Cost ratio			
Civil cost		\$ (320,000)	\$ (320,000)
Civil P&G (15%)		\$ (48,000)	\$ (48,000)
Civil contingency (35%)		\$ (128,800)	\$ (128,800)
Intake gate and screen		\$ (111,000)	\$ (41,736)
TG, incl draft tube		\$ (708,268)	\$ (763,770)
Elec & control		\$ (224,040)	\$ (202,440)
E&M Commissioning (7.5%)		\$ (78,248)	\$ (75,596)
E&M Contingency (15%)		\$ (168,233)	\$ (162,531)
Engineering (15%)		\$ (267,988)	\$ (261,431)
Total cost		\$ (2,055,000)	\$ (2,004,000)

Note that HWs' quote is not fixed price - the contract price is subject to material price variations exceeding ±5%.

It is important to note that the 'Intake gate and screen' cost item above is reduced because HWs' propose an intake arrangement similar to that originally proposed last year by MTL in discussion with T&T. This arrangement involves a high retaining wall at the intake, which allows location of the inlet gate at the penstock inlet rather than at the turbine inlet. T&T were concerned at the cost of the retaining wall, and preferred the gate located at the turbine inlet. Hence I expect that HWs' proposed arrangement will have cost implications which have not been allowed for in the 'Civil cost' item above. This will be discussed with T&T on Tim's return to work on 20th May. Consequently I expect the civil cost item above to increase, and thus the total cost above to increase somewhat above last year's total cost.

At this stage the E&M contingency and engineering allowances are not adjusted from those applied last year. On the one hand, receipt of a firm quotation from HW prompts their review. On the other hand, the HW proposal requires fleshing out with some important requirements (eg cavitation erosion guarantees, as referred to in the RfC), and there are identified technical risks. Both these factors suggest caution for a major reduction of the E&M contingency and engineering. We are considering these aspects and would



like to discuss them with you.

3. **Financial Analysis:** Based on the revised Tables 1 and 2 above, and subject to the above comments about the value of generation, likely increased civil costs, and E&M contingency and engineering, the financial return is slightly improved on that presented in Table 3 last year, as follows:

Plant outages	5%		
Value of power	6.5 c/kWh		
O&M costs	4%		
Penstock velocity	2.00 m/s		
		27-Nov-12	1-May-13
		Scoping Study	RfC (HW)
Rated flow	m ³ /s	7	7
Net head	m	6.31	6.31
Penstock diameter	m	2.1	2.1
Tubular variable pitch propeller			
Total Income	\$ pa	\$ 142,000	\$ 145,000
Total cost		\$ (2,055,000)	\$ (2,004,000)
IRR (25 yrs operation)		4.7%	5.2%
Payback period	yrs	14.5	13.8

4. **Design Innovations**

Should OWL purchase generating plant from HW, MTL is concerned to ensure that HWs' successful plant operating experience at Fereday Is is also obtained at Opuha. Consequently the RfC requested HW to specifically identify all proposed design innovations proposed for Opuha compared with Fereday Is. The following innovations proposed for Opuha are considered significant:

Gearbox

The noisy toothed belt drive connection between the turbine and generator is replaced by a right angle bevel gear drive. In principle this is a practical and elegantly simple change. However, it is of concern that there is a split in design and manufacturing responsibility between the gearing components (by Brown or Brevini) and the gearbox (by HW). It will be essential to gear life that the gearbox has sufficient rigidity. The proposed gear box design is integral with the turbine hub casing and thus is directly or indirectly subject to all hub casing forces, such as water hydrodynamic forces, torque reaction forces, and generator weight. MTL has discussed this with HW, and HW are well aware of the requirement to maintain high gearbox rigidity under all operating conditions. Consequently they intend a rigorous design process and extensive utilization of advanced Finite Element Analysis (FEA). Nonetheless the gearbox will be a prototype, with potential for unexpected problems.

HW have offered a 5 year maintenance contract, with a 'fix or replace' within 3 working days requirement. Adoption of a maintenance contract is considered a prudent provision against the risk from the gearbox design innovation. However the financial terms of this contract are not yet determined, and may exceed the O&M allowance above of \$6,000 pa (based on 4% of annual generation income).



Note: We requested HW consider an external, standard off-the-shelf, gearbox. HW advise that this would require an upstream bend arrangement as per Fereday Island, which would not be their standard InRace generator design. Only with this latter arrangement will they offer a maintenance contract. The advantages of compactness with the standard InRace arrangement allow HW to use a hiab truck to replace the entire turbine if necessary (they state that they will keep a spare available for this) and ensure minimum downtime whatever the operational issue is.

Runner Blades

The turbine runner blades are modified to provide slightly improved efficiency, but have slightly increased cavitation. This design innovation is considered within HWs' proven design capability track record. HWs' cavitation erosion guarantee should be specifically confirmed, otherwise no further review/investigation appears necessary.

Main Bearing

Turbine NDE main bearing is changed from a (water lubricated?) Thordon bush to a rolling bearing. The reason for this change, and the susceptibility of the proposed to water damage, has not yet been reviewed with HW. (Note: Turbine NDE main rolling bearing life, possibly due to water damage, is a problem for Watercare's HW turbines).

I would like to discuss the above comments with you before proceeding further.

Yours faithfully,
Mechanical Technology Ltd

A handwritten signature in blue ink, appearing to read 'Chris Lucas', is written over a light grey rectangular background.

Chris Lucas
Senior Hydromechanical Engineer