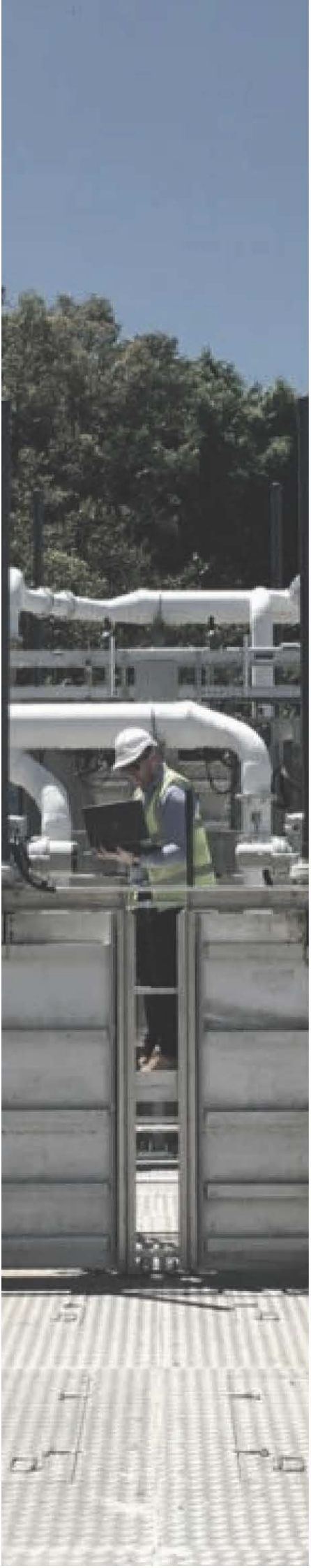

Operation & Maintenance Manual

Australian Water Engineers

F35 Penstocks
ZW Penstocks
P1000 Penstocks & Stopboards

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OPERATION AND MAINTENANCE INSTRUCTIONS FOR PENSTOCKS

Prior to Operation

1. The penstock should be brushed off to clear all dirt, grit and grout particularly around the seals and gate rear and sealing faces. A high pressure wash down with clean water is also recommended.

2. Clean the stem from grit and debris. The entire threaded portion of the stem is to be adequately lubricated with grease prior to operation. Should grit or other foreign matter contaminate the grease it should be cleaned off and re-greased as necessary prior to operating.

   If the penstock has a non-metallic nut, there is no requirement to lubricate the stem.

3. Do not lubricate the seals. The seal material is of wear resistant low friction material (UHMWPE). Applying grease will only entrap grit and debris into the seals which may cause damage.

General Operation

1. Ensure the handwheel or tee key provided with the penstock is of the correct size for the operation of that penstock. Oversizing these or the use of bars etc., to gain additional leverage may result in damage to the penstock and its components.

2. Penstocks are generally clockwise closing. Refer to handwheel markings to confirm opening and closing directions.

3. The penstock should operate freely and unlaboured throughout its full travel. A sudden increase in the input effort means that the gate has reached the end of its travel or something has caused the gate to jam mid travel. Increasing input force will overstress the penstock and may result in damage.

4. Electric actuators, bevel and spur gearboxes and pneumatic and hydraulic cylinders should be operated in accordance with the manufacturer's standard instructions.

General Maintenance

1. Penstocks in frequent use require the stem and nut to be cleaned and re-greased at least on a monthly basis. It is recommended that the old grease be cleaned off before new grease is applied. Any debris should be cleaned from the threads before re-greasing. Failure to provide consistent adequate clean lubrication will result in accelerated wear of the drive nut threads.

2. Penstocks in frequent use are inherently subject to a greater wear rate on the nut threads and this should be inspected at a minimum of 3 monthly intervals. When the wear becomes excessive the nut should be replaced. A quick check is to examine the amount of backlash in the threads by rotating the handwheel back and forth noting the angle of engagement from one direction to the other.

3. Penstocks in occasional use should have stems cleaned and re-greased at 6 monthly intervals.

4. It is recommended that penstocks be washed down and cleaned from grit and debris build up at 12 monthly intervals. This opportunity should also be used to inspect seals and other components for wear and damage and check bolt tension.

5. Upon each inspection it is important to ensure that each penstock will open and close fully. Cycling the penstock through its full stroke should form part of the maintenance schedule.

6. Infrequent use of a penstock can result in stiff operation. In this case all old grease must be removed from the stem threads with a suitable solvent and re-greased accordingly.

7. Electric actuators, bevel and spur gearboxes should be maintained in accordance with the manufacturer's standard instructions.

8. The recommended grease to lubricate stem threads and thrust bearings is Castrol EPL-2 grease or equivalent.

OPERATION AND MAINTENANCE INSTRUCTIONS FOR STOPGATES

General Operation

1. Stopgates are generally made from aluminium for its lightness and easy of handling. As such, aluminium is relatively soft and care should be taken when handling so as not to knock or drop the boards resulting in damage especially to the sealing edges and surfaces. Should boards be knocked or dropped they should be inspected for burrs, scratches and dents and treated with emery cloth or hand file accordingly prior to inserting into the frame as seals can be easily damaged by sharp irregularities.

2. Under no circumstances are boards to be dragged across any surface.

3. Segmented stopgates incorporate an intermediate cross seal. These are somewhat exposed at the corners and care should be taken in the same way so as not to damage these.

4. Stopgates are bidirectional in their sealing capabilities. That is, boards may be placed in either orientation provided they spatially fit in that orientation.

5. Stopgates should be inserted and removed under balanced head conditions. Attempting to remove the board under unbalanced head conditions will require significant extra force.

6. Ensure the correct size stopgate is used for the frame. Forcing a stopgate inside an incompatible frame will result in damage to both the frame seals and the board. Equally, placing a board of insufficient width inside a frame may result in the board jamming or failure of the board under hydrostatic loading.

7. Under no circumstance are boards to be dropped into place. This may result in damage to the bottom seal.

8. Inserting and removing segmented stopgates is a two man operation and the lifting ladders supplied should be used. Lifting ladders hook onto the lifting pins located at the top corners of each segment. Segments should be inserted and removed at a steady rate whilst keeping it level. Inserting or removing one side faster or slower than the other will result in the board segment jamming in the frame.

9. Larger stopgates requiring a crane lift are provided with lifting lugs for others D-shackle and slings to attach to. Boards must be lifted straight and vertically so as not to place undue stress into the frame, seals and board.

10. Do not lubricate the seals. The seal material is of wear resistant low friction material (UHMWPE). Applying grease will only entrap grit and debris into the seals which may cause damage.

Maintenance and Storage

1. After stopgates have been used they should be washed down, cleaned and stored away in an orderly fashion. The manufacturer can provide a purpose built storage frame for this upon request.

2. Check sealing edges and faces for burrs, scratches and dents. These can generally be treated with some emery cloth or hand file. It is important that these are attended to as the seals could be damaged.

3. If a purpose built storage frame is not used, stopgates should be stored with wooden chocks underneath to protect them from damage and secured appropriately to prevent wind blowing them over.

4. It is recommended that stopgate frames be washed down and cleaned from grit and debris build up at 12 monthly intervals. This opportunity should also be used to inspect seals for wear and damage and check bolt tension.