

## APPENDIX H 90% DESIGN COST ESTIMATE

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Item	Normal Pond El. 40.4 ft NAVD 1988			
	Unit	Quantity	Unit Price (\$/Unit)	Cost (\$)
<b>Mobilization/demobilization</b>	LS	1	139,674	<b>\$139,674</b>
<b>Temporary Construction Facilities</b>				
Silt Fences	LF	1,000	4.37	\$4,370
Prepare Staging Areas	AC	1.4	7,804	\$10,926
Security Fencing	LF	250	18	\$4,542
Access Road Improvements	LS	1	6,243	\$6,243
Site Restoration	LS	1	6,243	\$6,243
<b>Subtotal Temporary Construction Facilities</b>				<b>\$32,325</b>
<b>Spillway Modifications</b>				
<b>Ogee</b>				
Excavation	CY	720	21	\$15,284
Concrete demolition and disposal	CY	62	400	\$24,774
Prepare concrete surface	SF	1,092	12.5	\$13,636
Concrete dowels	TN	5.8	1,985	\$11,515
Concrete	CY	75	250	\$18,730
Rebar (epoxy coated)	TN	5.8	1,985	\$11,515
Formwork	SF	560	15	\$8,391
<b>Subtotal</b>				<b>\$103,846</b>
<b>Abutment Walls / Approach Channel</b>				
Prepare concrete surface	SF	30	12.5	\$375
Concrete dowels	TN	0.1	1,985	\$199
Concrete	CY	165.0	250	\$41,207
Rebar (epoxy coated)	TN	5.3	1,985	\$10,523
Formwork	SF	1,200	15.0	\$17,981
Backfill and compaction	CY	720	65	\$46,751
<b>Subtotal</b>				<b>\$117,034</b>
<b>Crest Gate</b>				
Procure and Deliver Gate and Control System	LS	1	237,700	\$237,700
Mechanical Installation of Gate	HRS	400	75	\$30,000
Control System (hydraulic power unit)	LS	1	24,974	\$24,974
Powerline Upgrade (1/0 in existing conduit)	LF	700	8	\$5,856
Water level sensor	LS	1	6,243	\$6,243
Water level sensor underwater cable to gate motor	LF	100	125	\$12,487
SCADA system update	LS	1	18,730	\$18,730
Security fence and gate	LF	160	43.70	\$6,993
Crane	Days	3	4,472	\$13,415
<b>Subtotal</b>				<b>\$356,398</b>
<b>Pedestrian Bridge Across Spillway</b>				
Procure and Deliver footbridge	LS	1	32,466	\$32,466
Install footbridge	HRS	72	75	\$5,400
Handrail on spillway walls	LF	65	37	\$2,435
Crane	Days	1	4,472	\$4,472
<b>Subtotal</b>				<b>\$44,772</b>
<b>Subtotal Spillway Modifications</b>				<b>\$622,050</b>
<b>Fishway Modifications</b>				
<b>Exit Channel</b>				
Excavation and on-site stockpiling	CY	635	21	\$13,480
Concrete Demolition (sawcut and disposal)	CY	45	320	\$14,400
Concrete dowels to cutoff wall	TN	0.2	1,985	\$397

Item	Normal Pond El. 40.4 ft NAVD 1988			
	Unit	Quantity	Unit Price (\$/Unit)	Cost (\$)
Concrete	CY	170	69	\$11,675
Rebar	TN	17	1,985	\$33,752
Formwork	SF	2,400	15.0	\$35,962
Backfill and compaction	CY	530	65	\$34,414
Seeding	SY	1,000	6.24	\$6,243
Access platform support steel	TN	2	5,994	\$11,987
Access platform grating	SF	180	50	\$8,991
Access platform handrail	LF	88	37	\$3,297
Security fence and 2 gates	LF	86	31.22	\$2,685
<b>Subtotal</b>				<b>\$177,282</b>
<b>Exit Channel Removable Baffles</b>				
Aluminum Guides	TN	0.7	12,487	\$8,741
Aluminum Dual-Leaf Weir Gates (7 sets)	EA	7	18,000	\$126,000
Procure and deliver Dual-Leaf Weir Gate motors and operators	EA	7	4,000	\$28,000
Operator support columns and beams installed	TN	0.7	5,994	\$4,196
Install weirs and operators	HRS	280	75	\$21,000
<b>Subtotal</b>				<b>\$187,936</b>
<b>Exit Channel Isolation Slide Gate</b>				
Procure and Deliver Gate with Guides and Manual Operator	LS	1	6,400	\$6,400
Procure and Deliver Gate Motor Operator (5 HP)	LS	1	4,370	\$4,370
Install Guides and Gates	HRS	100	75	\$7,500
<b>Subtotal</b>				<b>\$18,270</b>
<b>Reservoir Dam Fishway Weir Modifications</b>				
Repair concrete weirs and walls	CY	5	3,122	\$15,609
Install Aluminum Guides for Fixed Notched Weirs	EA	16	343	\$5,494
Fabricate and Install Weir Boards	EA	16	499	\$7,992
<b>Subtotal</b>				<b>\$29,094</b>
<b>Entrance Channel Improvement</b>				
Clean Concrete Fishway Entrance	HRS	8	67	\$539
Procure and deliver weir stones	TNS	40	125	\$4,995
Modify channel stone and install to stone weirs to Fishway Entrance	HRS	120	77	\$9,290
<b>Subtotal</b>				<b>\$14,824</b>
<b>Tack Factory Pond Fishway Modifications</b>				
Repair concrete weirs and walls	CY	5	3,122	\$15,609
Install Aluminum Guides for Fixed Notched Weirs	EA	4	343	\$1,374
Fabricate and Install Weir Boards	EA	4	499	\$1,998
Modify weir structure gate	EA	1	4,995	\$4,995
<b>Subtotal</b>				<b>\$23,975</b>
<b>Reservoir Dam Eel Fishway</b>				
Install 12 inch eel fishway	LF	65	250	\$16,233
Install eel fishway brackets	LS	2	1,249	\$2,497
Modify entrance streambed stone	Tons	4	250	\$999
Install attraction water piping	LF	150	25	\$3,750
Install attraction water pump	LS	1	2,497	\$2,497
<b>Subtotal</b>				<b>\$25,977</b>
<b>Subtotal Fishway Modifications</b>				<b>\$477,359</b>

Item	Normal Pond El. 40.4 ft NAVD 1988			
	Unit	Quantity	Unit Price (\$/Unit)	Cost (\$)
<b>Infrastructure Improvements</b>				
<b>Route 3A Erosion Protection</b>				
Clear and Grub	AC	0.10	7,804	\$780
Remove Guardrail	LF	400	6	\$2,400
Excavation	CY	120	21	\$2,547
Geotextile Fabric	SY	450	2.7	\$1,214
Foundation Material	CY	150	65	\$9,684
Riprap Slope Protection	TNS	720	100	\$72,000
Asphalt curb	LF	135	15	\$2,025
Install Guardrail	LF	400	31	\$12,487
Lane Painting	LF	1,200	0.4	\$435
Signage	EA	2	425	\$849
Traffic Control	LS	1	10,000	\$10,000
<b>Subtotal</b>				<b>\$114,421</b>
<b>Sherman Drive Drainage</b>				
Remove existing stormwater catch basin	HRS	24	75	\$1,800
Procure and deliver oil/grit separator and discharge pipe	EA	1	7,500	\$7,500
Install oil/grit separator	HRS	48	75	\$3,600
Install drain pipe to bioswale	HRS	32	75	\$2,400
Clear and Grub for bioswale	AC	0.10	7,804	\$780
Excavation for bioswale	CY	125	24	\$2,966
Bioswale Fill	CY	65	57	\$3,709
Geotextile Fabric	SY	115	2.7	\$310
Riprap Stabilization	TNS	9	125	\$1,124
Top Soil	CY	60	50	\$2,997
Seeding/Plantings	SY	200	6.24	\$1,249
<b>Subtotal</b>				<b>\$28,435</b>
<b>Tack Factory Pond Weir Gate Upgrade</b>				
Concrete dowels to cutoff wall	TN	0.1	1,985	\$199
Concrete	CY	1	250	\$250
Rebar	TN	0	1,985	\$199
Formwork	SF	60	15.0	\$899
Access platform support steel	TNS	0.4	5,994	\$2,397
Access platform handrail	LF	30	37	\$1,124
Access platform grating	SF	100	50	\$4,995
<b>Subtotal</b>				<b>\$10,062</b>
<b>Property Flood Protection</b>				
Silt Fences	LF	1,000	4.37	\$4,370
Top Soil	CY	1,000	50	\$49,947
Seeding/Plantings	SY	3,400	6.24	\$21,228
<b>Subtotal</b>				<b>\$75,545</b>
<b>Septic System Upgrade</b>				
Silt Fences	LF	300	4.37	\$1,311
Excavation top mounded system	CY	180	24	\$4,271
Infiltration chambers	LF	125	50.00	\$6,250
Backfill	CY	710	24	\$16,845
Top Soil	CY	20	50	\$999
Seeding/Plantings	SY	1,100	6.24	\$6,868
<b>Subtotal</b>				<b>\$36,543</b>
<b>Subtotal Infrastructure Improvements</b>				<b>\$265,006</b>

Item	Normal Pond El. 40.4 ft NAVD 1988			
	Unit	Quantity	Unit Price (\$/Unit)	Cost (\$)
<b>Total Construction Costs</b>				<b>\$1,536,415</b>
<b>Contingency (10%)</b>				<b>\$153,641</b>
<b>Subtotal Probable Construction Costs</b>				<b>\$1,690,056</b>
<b>Permitting and Construction Bid Support</b>				<b>\$291,000</b>
<b>Access Easements</b>				<b>\$10,000</b>
<b>Construction Management and Administration (8%)</b>				<b>\$135,204</b>
<b>Total Project Cost</b>				<b>\$2,126,261</b>

# BUDGET PROPOSAL



June 04, 2019

PLEASE REPLY TO:

Atlantic Fluid Technology Inc.

354 West Boylston Street

Suite 221

West Boylston, MA 01583-2373

Phone : 508-755-0440

Fax : 508-755-9589

## Budget Quotation No. BP-8718

370 South Athol Road

Athol, MA 01331

Phone : 978-249-7924

Fax : 978-249-3072

**Subject :** Reservoir Dam Spillway Fishway Baffles  
Scituate, MA

**Engineer :**

Dear Sirs :

We are pleased to offer the following quotation for

<b>Item No.</b>	<b>01</b>	<b>Tag No.</b>	<b>DL-01</b>
Location - Dwg No :	Spillway Dam -		
Quantity	1		
Size - Model :	36" Wide x 44" High. – Series Model 800- Aluminum Dual Leaf Gate Assembly		
Invert To Floor :	9.82'		
Description :	The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 20"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS.		
Mounting Style :	Wall Mounted Inside Existing Channel.		
Lifting Mechanism :	Electric and Manual Actuator.		<b>Budget Price: \$21,000 each</b>
<b>Item No.</b>	<b>02</b>	<b>Tag No.</b>	<b>DL-02</b>
Location - Dwg No :	Spillway Dam -		
Quantity	1		
Size - Model :	36" Wide x 53" High. -Series Model 800 Aluminum Dual Leaf Gate Assembly		
Invert To Floor :	9.12'		
Description :	The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 29"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS		
Mounting Style :	Wall Mounted Inside Existing Channel.		
Lifting Mechanism :	Electric and Manual Actuator		<b>Budget Price: \$21,200 each</b>
<b>Item No.</b>	<b>03</b>	<b>Tag No.</b>	<b>DL-03</b>
Location - Dwg No :	Spillway Dam -		
Quantity	1		
Size - Model :	36" Wide x 62" High. -Series Model 800- Aluminum Dual Leaf Gate Assembly		
Invert To Floor :	8.42'		
Description :	The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 38"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS		
Mounting Style :	Wall Mounted Inside Existing Channel.		
Lifting Mechanism :	Electric and Manual Actuator.		<b>Budget Price: \$21,400 each</b>

**Item No.** 04 **Tag No.** DL-04

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Location - Dwg No : Spillway Dam -

Quantity 1

Size - Model : 36" Wide x 71" High. – Series Model 800- Aluminum Dual Leaf Gate Assembly

Invert To Floor : 7.72'

Description : The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 47"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS

Mounting Style : Wall Mounted Inside Existing Channel.

Lifting Mechanism : Electric and Manual Actuator.

**Budget Price: \$21,800 each**

**Item No.** 05 **Tag No.** DL-05

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Location - Dwg No : Spillway Dam -

Quantity 1

Size - Model : 36" Wide x 80" High. - Series Model 800- Aluminum Dual Leaf Gate Assembly

Invert To Floor : 7.02'

Description : The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 55"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS

Mounting Style : Wall Mounted Inside Existing Channel.

Lifting Mechanism : Electric and Manual Actuator.

**Budget Price: \$22,000 each**

**Item No.** 06 **Tag No.** DL-06

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Location - Dwg No : Spillway Dam -

Quantity 1

Size - Model : 36" Wide x 88" High. - Series Model 800- Aluminum Dual Leaf Gate Assembly

Invert To Floor : 6.32'

Description : The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 64"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS

Mounting Style : Wall Mounted Inside Existing Channel.

Lifting Mechanism : Electric and Manual Actuator.

**Budget Price: \$22,500 each**

**Item No.** 07 **Tag No.** DL-07

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Location - Dwg No : Spillway Dam -

Quantity 1

Size - Model : 36" Wide x 97" High. - Series Model 800- Aluminum Dual Leaf Gate Assembly

Invert To Floor : 5.62'

Description : The downward opening aluminum weir disc (36" x 24"), and upward opening slide disc (36" x 73"), will have the following features : Aluminum 6061 construction, UHMW side and invert seals, and a neoprene top seal. The single operating stem for weir disc, two operating stems for the slide disc will be 304 SS

Mounting Style : Wall Mounted Inside Existing Channel.

Lifting Mechanism : Electric and Manual Actuator.

**Budget Price: \$23,000 each**

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**Item No.** 08 **Tag No.** SG-01

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**Location - Dwg No :** Spillway Dam -

**Quantity** 1

**Size - Model :** 36" Wide x 72" High. - Model 823 Aluminum Gate

**Invert To Floor :** 11.57'

**Max Design Head :** 12' seating / 12' unseated

**Description :** The upward opening aluminum slide gate will have the following features : Aluminum 6061 construction, UHMW side seals, and a neoprene invert seal. The single operating stem will be 304 SS.

**Mounting Style :** Wall Mounted.

**Anchor Bolts :** 5/8" Anchor studs and nuts included.

**Lifting Mechanism :** Manual Gearbox Operator.

**Budget Price: \$6,400 each**

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## **ADDITIONAL NOTES:**

This quotation represents our best interpretation of the project plans and specifications. Any subsequent changes may result in a price change.

**INCLUDED:** Submittal drawings and O&M manuals.

**EXCLUDED:** Installation, concrete, grout, deck sleeves, blind flanges, mastic, lubricant, control panels, instrumentation, wiring and epoxy capsules for anchor bolts. Field measurements are also not included as part of this quotation.

**FREIGHT:** The price quoted is F.O.B. our factory in Athol, Massachusetts with freight allowed to jobsite. Partial shipments may be provided upon request for an additional charge. Price includes shipment via common carrier. (Open top truck shipment may be provided upon request for an additional charge). Price does not include unloading at job site.

Sincerely,  
Tim Aguda  
Whipps, Inc.  
370 South Athol Road  
Athol, MA 01331  
Phone : 978-249-7924  
Fax : 978-249-3072  
Email : tima@whipps.com

Whipps, Inc. Budget Quotation No. 8718

Page 1 of 1



# STEEL-FAB, INC.

Water Control Gates • Gate Operating Systems • Steel Fabrications

June 10, 2019

Tetra Tech  
160 Federal Street  
Boston, MA 02110

Attention: Tom Cook

Reference: First Herring Brook

Dear Tom,

We are pleased to submit our updated estimate with the corrected gate size for the First Herring Brook crest gate as follows:

One (1) 36''6'' x 5' fabricated steel, hydraulically operated regulating crest gate: \$237,700

Our scope of supply will include the gate leaf, hinge brackets, side seal plates, horizontal seal assembly, erection support struts, gate stop brackets, anchor bolts, hydraulic cylinder with hydraulic power unit and local control system.

The gate leaf is supplied fully assembled with side seals and corresponding hinge bracket assemblies.

Stainless steel side seal plates will be furnished for embedment in the end piers allowing for sealing the crest gate in any position. The horizontal seal and seal support angle are supplied in one continuous length.

Four erection support struts are included to hold the gate in place during installation in advance of placement of the hydraulic cylinder.

Our scope of supply will also include stainless steel anchor bolts for the gate hinges, horizontal seal support, side seal plates, gate stops and manual operator mounting bracket.

The hydraulic power unit will be as described in the attached Steel Fab Crest Gate Specification. Please note that we are supplying a gate mounted Rittmeyer position transmitter to allow for reading the actual gate position at the power unit control enclosure, (catalog cut attached),

All exposed steel surfaces of the gate and corresponding components will be iron grit blasted then coated with 16 mils of Tnemec N69 High Solids Epoxy. The downstream surface of the gate,

hydraulic cylinder and mounting bracket will also be top coated with Tnemec Enduroshield for UV protection.

**Preliminary Schedule:**

Approval drawings:	90 days after receipt of purchase order
Anchor bolts:	6 weeks after return of approved drawings
Side Seal Plates/Horizontal Seal:	10-12 weeks after return of approved drawings
Crest Gate and Hydraulic System:	18-20 weeks after return of approved drawings

Feel free to call me or our Moji Amini, (508-755-0440), if you have any questions.

Thank you for considering Steel Fab.

Yours truly,



Louis Bartolini  
Vice President  
Steel Fab, Inc.



# STEEL-FAB, INC.

Water Control Gates • Gate Operating Systems • Steel Fabrications

## **HINGED CREST GATE:**

### **SUMMARY:**

This specification is for the design, manufacture, quality control, shop testing, delivery, installation and field testing, of two spillway hinged crest gates with hydraulic operating system.

This section includes requirements for providing the gate leafs, hinges brackets, sealing system, maintenance supports, anchors, hydraulic cylinders, cylinder supports, aeration piping, hydraulic power unit, hydraulic piping and hoses, local control panel, gate position indicators, transportation to site, design calculations and drawings, installation procedures, operation and maintenance manuals, and all other necessary appurtenances to provide complete operating crest gate systems.

Each gate shall be operated by two (2) hydraulic cylinders located at each end of the gate atop the adjacent concrete pier. The operating system shall be operational with an ambient temperature from 10 degrees Fahrenheit to 100 degrees Fahrenheit. All electrical components shall operate from 480 volt, 3 phase power.

The vendor shall submit to the Owner for review, shop drawings of all equipment including the gates, cylinders, seals, hydraulic power unit, control panel, and layout of all hydraulic piping, electrical conduit and wiring.

The crest gate shall be as manufactured by Steel Fab, Inc. or preapproved equal who has been regularly engaged in the design and manufacture of hinged crest gates for a minimum of fifteen years with at least ten crest gate systems with a gate length of 40' and effective height of 5' in satisfactory use for over 5 years.

### **RELATED SECTIONS:**

- A. Concrete
- B. Electrical

### **REFERENCES:**

- A. American Institute of Steel Construction, (AISC), Steel Construction Manual, 9<sup>th</sup> Edition.

- B. American Society of Testing and Materials, (ASTM).
- C. American Welding Society, (AWS).
- D. American Concrete Institute, (ACI).
- E. The Society for Protective Coatings/National Association of Corrosion Engineers, (SSPC/NACE).
- F. American Water Works Association
- G. American Society of Mechanical Engineers, (ASME)
- H. National Fluid Power Association, (NFPA)
- I. Society of Automotive Engineers, (SAE).
- J. American National Standards Institute, (ANSI)

**GENERAL:**

Hinged crest gates shall be supplied for the spillway sections shown on the drawings. The top edge of the gates will be fitted with nappe breakers to eliminate flow induced vibrations. When in fully raised position, the gate leafs shall lean downstream approximately 20 degrees. The gates will rotate approximately 70 degrees from the fully raised to fully lowered position as shown on the drawings. The gates shall be capable of extended use in any position without vibration.

The upstream surface of the gate leafs shall be curved to a constant radius such as that when the leaf is in the fully lowered position the shape of the leaf shall approximate that of the spillway crest. The shape shall provide at the design head a minimum coefficient of discharge of  $C=3.2$  in the weir equation  $Q=CWH^{3/2}$  where Q is the flow in CFS; W is the length of the weir in feet and H is the total energy head above the fixed crest in feet. The radius shall be sufficiently great as to prevent negative pressure on the gate surfaces for any head up to the specified design head.

**OPERATING REQUIREMENTS:**

A. The crest gates shall be designed and manufactured to be safely operated under the following conditions.

B. Gate Leaf Assemblies:

Number:

Width of Gate:

Top of Raised Gate: El.

Dam Crest: El.

Nominal Gate Height:

### C. Hydraulic Conditions:

Normal Water Level: El.

## DESIGN REQUIREMENTS:

### A. Loading Conditions

1. The gate hoisting system shall have sufficient thrust capacity to raise the leaf from the fully lowered position to the fully raised position when the upstream water level is at elevation XXX.
2. The gates shall be structurally designed to withstand the worst combination of all axial, bending, shear, torsion and thermal loads and shall be subject to fatigue loading from the worst loading condition caused by static and dynamic loadings in any position with the upstream water surface at elevation XXX. In the event of a power loss, it shall be possible to lower the gate leaves from the fully raised position to the fully lowered position by manually opening a bypass valve at the hydraulic power unit.
3. The gate leaves and anchors shall be designed to withstand in an overloading condition the combined forces of a normal water level and a seismic acceleration of 0.15g. The gate manufacturer shall also detail, as needed, any special modifications to the concrete crest gate structure to assure the overall structural adequacy of the gate system.
4. The gates shall be designed to withstand a horizontal ice load of 1500 pounds per lineal foot of gate applied horizontally within 1' of the top of the gate.
5. Each gate shall take no more than 10 minutes to move from a fully open position to a fully closed position and no more than 10 minutes to move from a fully closed position to a fully open position.

### B. Design Criteria

1. The gate leaf shall be designed as an integral torsion member subjected to fatigue loading.
2. A factor of safety applied to the material yield strength of 2.5 for normal loading conditions and 2.0 for overloading conditions shall be applied when considering the elastic instability of the gate structure.
3. The gate leaf shall be continuously welded. The welds connecting the upstream and the downstream skin plates to each other and to the vertical ribs shall develop the full strength of the plates. The weld joint shall be designed to consider fatigue.

4. Welds shall be proportioned as to not exceed 80% of the allowable loading of AWS D1.6, Section 9.

## **GATE COMPONENTS:**

### **A. Leaf**

The gate leaf shall consist of curved upstream and downstream skin plates and flat vertical diaphragm plates arranged to form an integral torsion member that will avoid negative pressure zones. The curved plates shall be A516 Grade 70. The remainder of the leaf structure shall be ASTM A36 steel.

A curved Type 304 stainless steel surface shall be provided directly above the gate hinges to mate with the horizontal seal. The top edge of the upstream skin plate shall form a discharge lip of a design which when in combination with air vent piping located downstream of the gate, will eliminate flow induced vibrations.

The space between the upstream and downstream skin plates shall be made airtight by welding hermetically and the welds checked for air tightness. The leaf side seals shall be mounted so as not to penetrate the gate leaf thereby eliminating any access ports in the downstream skin compartments that would compromise water tightness.

The gate leaf shall transmit the forces from the hydraulic cylinders to the skin plates and bearings and, in turn, to the embedded anchors through the bearings.

When it is necessary to manufacture and ship the gate leaf in multiple sections, the joint between the sections shall be bolted together using high strength A325 fasteners and then field welded along the seams to avoid leakage.

### **B. Hinges**

The gate leaf shall rotate on pin type hinges. The hinge pins shall be A564 Grade 17-4PH high strength stainless steel and fixed to the gate leaf. The pins will rotate in permanently lubricated bronze bearings which shall be retained in fabricated A36 steel bearing brackets. The brackets shall be anchored to the concrete structure in a manner to allow adjustment in all three planes during erection of the leaf sections. The hinge bracket anchor bolts shall be Type A325 Galvanized Steel and have a minimum diameter of 1 ½ inch.

### C. Side Seals:

Side seal plates gates shall be manufactured from Type 304 Stainless Steel and allow for sealing in all gate positions. Leaf side seals shall be fluorocarbon clad neoprene and attached to the sealing ends of each leaf with Type 304 Stainless Steel retainers and fasteners. The seal attachment shall allow for replacement of the seal without removal of the leaf. Embedded side seal plates shall consist of the stainless steel seal plate surfaces with steel reinforcing on the backside. Double nutted L or J Type 304 Stainless Steel anchor bolts shall be provided for alignment of the embedded seal plates in secondary pour concrete. The sealing surface of the side seal plates shall have a surface finish smoother than 125 micro-inch RMS.

### D. Erection and Maintenance Supports

Erection struts and associated brackets provided to support the leaf in the full up position with the operator detached from the leaf. Each strut and bracket shall be manufactured from A36 Steel and strong enough to support the leaf in the full up position with a normal water surface elevation to facilitate future maintenance work.

### E. Leaf Stops

When the leaf is in the fully lowered position the weight of the leaf shall be supported by adjustable gate stops contacting pads on the downstream surface of the channels. The pads shall be manufactured from A36 steel and anchored in place using Type 304 Stainless Steel anchor bolts.

### F. Aeration Piping

It shall be the responsibility of the gate manufacturer to determine the necessity of aeration piping and size, location and shape of the aeration piping system if needed. Aeration piping shall be sized to prevent excessive negative pressure under the gate with reasonable velocities in the aeration pipes. The aeration vent piping shall be galvanized steel and have protective screens on both the inlets and outlets.

### G. Heating



Provisions for heating embedded side seal plates shall be incorporated in the design of the side seal plates for future installation of immersion type heaters.

## **ELECTRICAL CONTROL AND HYDRAULIC OPERATING SYSTEM:**

### **A. Hydraulic Power Unit**

One (1) hydraulic operating system shall be provided to operate the two (2) crest gates. The system shall be designed to operate smoothly and uniformly operate the gates and hold the gates in the desired position. The crest gates shall be operated manually via push buttons at the local control panel at the hydraulic power unit.

The hydraulic power unit shall be a nominal 2000 psi hydraulic fluid system of sufficient size and capacity to operate the crest gates. The hydraulic operating system shall be sized to operate each gate through a full close (raise) stroke in 10 minutes.

The system shall include dual automatically alternating motor/pumps. Manually operated valves and interconnections between each gate's hydraulic hoses shall be provided to allow one (1) of the motor/pumps to operate gates sequentially in the event that the other motor/pump fails.

A hand pump shall be provided to allow manual operation of the gates in the event there is not electric power. No downward movement of the crest gate shall occur in the event of a power outage unless manually overridden through means of a hand pump or portable generator, or by opening bypass valving. The hydraulic power unit will be designed to be placed in a non-heated, weather-tight area. A 500 watt thermostatically operated immersion heater shall be provided in the oil reservoir. Trouble indicating lights and a single general alarm dry contact shall be provided to signal a power unit fault for at least the following: low oil level, low temperature and motor/pump failure.

Simultaneous with the low oil level alarm, an automatic switch shall shut-off power to the pump and motor. Power shall continue to be supplied to other parts of the hydraulic power unit such as the heaters.

The hydraulic power unit shall be designed and manufactured in compliance with good engineering practice and shall include all necessary pressure relief valves, control valves, switches, filters, accumulators, etc., to provide a complete operating system. Stainless steel ball valve shut-offs shall be provided on each hydraulic line where it leaves the hydraulic power unit.

The hydraulic power unit shall be designed to operate using environmentally friendly hydraulic fluid .

Field hydraulic lines shall be stainless steel supplied and installed by the General Contractor. All field lines shall be properly supported, installed, flushed and pressure tested to 150% of the maximum system operating pressure prior to connection of the field piping to the hydraulic cylinders and power unit.

## B. Hydraulic Cylinder

The hydraulic cylinders shall be of the heavy duty industrial type suitable for immersion service and designed in accordance with AWWA C501 Section 3.16. Seals and glands shall be compatible with the hydraulic fluid used.

The hydraulic cylinders shall be single acting 3000 psi rated cylinders. Cylinder rods shall be chrome plated A564 Type 630 Condition H-1150 stainless steel.

Cylinder head, cap, body and tie rods shall be steel. The piston shall be equipped with lip seals. The rod end of the cylinder shall have rod wipers and ice scrapers. The cylinder design shall incorporate lifting lugs.

A velocity fuse shall be provided on the lower cylinder port to prevent inadvertent gate lowering and loss of hydraulic fluid upon sudden breach of the interconnecting hydraulic lines.

A set of four (4) stainless steel ball valves and two (2) flexible hoses shall be installed at each cylinder to allow for removal of the cylinder without requiring the cylinder or the interconnecting hydraulic lines to be drained.

The hydraulic cylinders shall be provided with all necessary mounting brackets and anchor bolts for installation of the cylinders underneath each gate leaf on the dam crest. The support brackets shall be fabricated from A36 steel with A325 Galvanized Steel anchor bolts provided for mounting each cylinder.

## C. Controls

One (1) NEMA 4 local control panel shall be provided with and located at the hydraulic power unit. Solenoid valves shall be controlled by Open or Close pushbuttons for each gate. Solenoids shall be de-energized by the gate open/close limit switches when the corresponding gate reaches the fully open or fully closed position. It shall be possible to stop each gate at any intermediate position. Continuous position indication using a gate mounted Rittmeyer Rivert transducer shall be displayed at the local control panel.

## **MANUFACTURE:**

### **A. Fabrication and Workmanship**

The fabrication of all structural steel parts shall conform to the requirements of the latest revisions of the AISC and AWS specifications or any other standards fully acceptable to the Owner that equal or exceed the standards stated above. Surface finishes shall be indicated on the manufacturer's shop drawings in accordance with ANSI requirements.

The gate and associated components shall be fabricated in sections that are convenient for shipment and field erection. All major components shall have lifting ears, eye and/or lug arranged to facilitate handling during site off-loading and erection.

### **B. Certification of Materials**

All materials shall be new. Certified material test reports shall be available in the manufacturer's project file for all steel materials. All materials shall be certified to the appropriate American Standards such as ASTM, AISI, ANSI, and AWS or any other standards fully acceptable to the Owner that equal or exceed the American Standards.

### **C. Welding**

All welding, welding procedures and qualifications, and welder qualifications shall be in accordance with the most recent revision of AWS D1.6. All welding shall be in strict accordance with these procedures and shall be made only by qualified welders. Procedures and qualifications shall be maintained in the manufacturer's project file.

### **D. Inspection**

All welds shall be visually inspected to the requirements in Sections 6 and 9 of AWS D1.1. The welds joining the upstream and downstream skin plates to each other and to the vertical rib plates shall receive 100% magnetic particle inspection.

All steel surfaces that cannot be blast cleaned, such as electrical control cabinets, the hydraulic power unit, etc., shall be surface cleaned in accordance with SSPC-SP3 and receive a primer and two finish coats of an alkyd paint system.

## E Painting

All exposed steel surfaces of the crest gate equipment shall be blast cleaned to the requirements of SSPC-10 then coated with 12-14 mils of Tnemec N69 Epoxy Coating. Additionally, the downstream face of each gate and hydraulic cylinder mounting brackets will be top coated with Tnemec Enduroshield 74 for UV protection..

Steel surfaces embedded in concrete, stainless steel, bronze and other corrosion resistant materials, and machined surfaces for field assembly shall not be painted. However, machined steel surfaces shall receive a rust inhibiting grease coating.

## **INSTALLATION PROCEDURES, ERECTION ADVISOR, FIELD TESTING AND OPERATING AND MAINTENANCE MANUALS:**

A. The gate manufacturer shall prepare a written, detailed procedure for the erection and installation of the gate equipment. The installation procedure shall include the sequence of steps necessary for installation, precautions to be taken, description of adjustments to be made and tolerances to be maintained.

B. The gate manufacturer shall provide an erection advisor to advise the Vendor in matters of methods, procedures and precautions to be followed in the erection of the equipment. The erection advisor shall be available on site as a minimum for the following events:

1. Construction planning meeting with the Vendor and Owner, to be held prior to shipment of the equipment.
2. Placement of the embedments in the primary poured concrete and prior to assembly of the hinge brackets and leaf.
3. Erection of the leaf.
4. Trial "dry operation" of the assembled gate; prior to final "grouting in" of the fixed parts of the gate.
5. Start-up of the hydraulic power unit.
6. Final operational "wet" testing of the gate and control system.

## C. Operational Tests

After the installation is complete, the gate operating system shall be tested under the direction of the erection advisor. The gates shall be operated through all modes of operation, testing, all

monitoring and control functions and all necessary adjustments made.

The manufacturer shall have in effect at all times a QA program which clearly establishes the authority and responsibility of those responsible for the QA program. Persons performing quality functions shall have sufficient and well-defined responsibility and authority to enforce quality requirements, to identify, initiate, recommend and provide solutions to quality problems and to verify the effectiveness of the solutions.

#### F. Shop Assembly and Testing

The gate leaf shall be completely assembled in the shop. The gate pivot bores shall be sighted to assure correct alignment of the centers. Each hinge bracket shall be assembled to the leaf at its respective location and the bracket rotated through its full range of operating swing. All mating parts shall be trial fitted. During shop assembly, the gate shall be checked for dimensions, tolerances, accuracy of alignment and squareness. Before disassembly, each part shall be match-marked and identified in accordance with the erection drawings; such marking shall be done so as to retain its legibility until field erection is complete.

The manufacturer shall make a record of the shop measurements of all critical dimensions which may affect the field erection and alignment or the operation and maintenance of the equipment. This record shall be included as part of the operation and service manual.

The operational test of the hydraulic and electrical control system shall be made to demonstrate proper functioning of the system including the functioning and sequencing of all control and alarm devices.

The hydraulic cylinders shall be hydrostatically tested in the cylinder manufacturer's shop at a pressure of 150% of the hydraulic power unit design pressure.

#### D. Operating and Maintenance Instructions

Detailed operating and maintenance instructions, which shall include reduced-size copies of applicable drawings, applicable parts lists, and catalogs covering all equipment furnished and which may be needed or useful in the operation, maintenance, repairs, dismantling or assembling, and for repair and identification of parts for ordering replacements, shall be submitted. The liquid levels, flows, and pressure settings and settings of all auxiliary protective devices shall be identified in the maintenance instructions. All catalog pages shall be marked to show the model number selected for each item of equipment. The salient features of the equipment supplied shall be clearly stated and the operation of the hydraulic and electrical controls fully explained. A troubleshooting chart, maintenance timetable, lubrication diagrams, and disassembly, reassembly and adjustment procedures shall also be provided.



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