ANVIL RANGE MINE, YUKON

WATER STORAGE DAM INTERNAL PIPE INSPECTION

SEPTEMBER 2001

DIVING DYNAMICS COMMERCIAL DIVING DIVISION

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THIS REPORT HAS BEEN PREPARED IN SUPPORT OF TERRITORIAL DIVING TECHNOLOGIES, WHITEHORSE, YUKON.

DIVING DYNAMICS
COMMERCIAL DIVING DIVISION

September 2001

TECHNICAL REPORT

Anvil Range Mine, Yukon

Water Storage Dam / Pipeline Inspection

1. Project overview.
2. Compilation of the Cygnus 1 ultrasonic data taken during the inspection dives.
3. Evaluation of the ultrasonic data.
4. Evaluation of the pipe elevations.
5. Compromising indicators.
6. Proactive site recommendations.
7. Consulting intervention.
8. CAD drawing.
9. Cygnus 1 calibration certificate.

Technical report prepared by: Vern Johnston
Director of Operations
Commercial Diving Division
Diving Dynamics

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PROJECT OVERVIEW

ITEM 1.1.0 TERMINAL OBJECTIVES

The primary mission of the project was to conduct an internal non-destructive evaluation of the pipeline at the water storage dam located at the Anvil Range Mine in the Yukon. Our dive teams utilized a Cygnus #1 ultrasonic echo sounder that is specially designed for divers conducting non-destructives evaluations of this nature. A current calibration certificate for our Cygnus #1 is attached for your records.
The entire pipe from the offshore 'T' to the 'stop gate valve' has been inspected visually with ultrasonic tests conducted at 1m, 2m or 3m intervals. At each ultrasonic station the invert, obvert, spring line left and spring line right locations were tested. The pipe invert elevation was also taken at each of these locations.

The secondary objective was to take a video of the inside of the pipe. Conditions were far from ideal with respect to internal visibility and consequently the video is acceptable but not remarkable. It was not safe to the divers to create a flow in the pipe, which would have enhanced the video quality.

It should be mentioned that the top plate of the intake cage assembly has not been re-installed. Anvil Range personnel were consulted on this matter. The intake can be operated if need be but is open to debris and presents considerable danger to any future divers on inspection if the system is open.

ITEM 1.1.1 PERSONNEL

It should be noted that 28 dives were conducted on this project with 14 total man-hours spent inside the pipe from station 0m to station 112m. The protocol for the penetration diving procedure was established using the guidelines from the Canadian Association of Diving Contractors (C.A.D.C.) and the Canadian Standards Association (C.S.A.) guidelines for Commercial Diving Operations. This project was filed with the appropriate regulatory bodies that oversee commercial diving projects.

Combining professional personnel and advanced sub-sea technology has produced 'data' from a unique environment.

1. Vern Johnston. Director of Operations, Diving Dynamics. (Penetration Diver.)
2. Alex Ramsbottom. Penetration Diver. Diving Dynamics.
3. Kyle Pittman. Penetration Diver. Diving Dynamics.
4. Sean McTeer. Outside Support Diver. Diving Dynamics.
5. Jorgen Ponsioen. Territorial Diving Technologies.
6. Richard Vanderclay. Territorial Diving Technologies.

ANVIL RANGE / WATER STORAGE DAM / PIPE PENETRATION

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
Orginal Pipe Wall Thickness.					**.375 Carbon steel non coated.**
Ultrasonic indicators.					**Critical areas are highlighted.**
Tactile & Visual Indicators.					**2" of growth material (avg.)**
					throughout the pipe.
					Inclusions found at all test
					site.
1m					
2					
3	0.207	0.301	**0.201**	**0.24**	60fsw
4	**0.21**	**0.25**	**0.235**	**0.24**	
5	**0.195**	**0.165**	**0.285**	**0.295**	60fsw
6	**0.2**	**0.25**	**0.145**	**0.155**	
7	**0.265**	0.335	0.33	0.33	60fsw
8	0.34	0.32	0.335	0.329	
9	**0.27**	0.335	**0.26**	0.34	59fsw
10	0.33	0.349	0.33	0.33	

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
11m	0.335	0.345	0.345	0.325	59fsw invert elevation.
12	0.335	0.32	0.32	0.345	
13	0.34	0.34	0.34	0.345	59fsw invert elevation.
14	0.33	**0.29**	**0.29**	0.35	
15	0.33	0.34	0.34	0.33	60fsw invert elevation.
16	0.325	**0.295**	0.315	0.345	
17	0.265	0.315	0.315	0.35	62fsw invert elevation.
18					
19	0.33	**0.29**	**0.28**	**0.245**	62fsw invert elevation.
20					
21	**0.29**	0.365	0.305	**0.265**	62fsw invert elevation.
22	**0.245**	**0.203**	**0.225**	0.34	
23	0.34	0.32	0.34	0.355	62fsw invert elevation.
24					
25	**0.22**	0.345	0.345	**0.29**	62fsw invert elevation.
26					
27	0.355	**0.245**	**0.265**	0.305	62fsw invert elevation.
28	**0.29**	**0.245**	0.365	0.355	62fsw invert elevation.
29					
30	0.325	**0.2**	**0.185**	**0.2**	62fsw invert elevation.

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
31m	0.33	**0.265**	**0.29**	**0.24**	62fsw invert elevation.
32					
33	**0.2**	0.345	0.375	0.36	62fsw invert elevation.
34					
35	0.32	0.35	0.335	0.35	62fsw invert elevation.
36					
37	0.325	0.345	0.33	0.345	62fsw invert elevation.
38					
39	0.32	**0.265**	**0.27**	0.35	62fsw invert elevation.
40					
41	0.345	**0.23**	0.36	0.345	***60fsw invert elevation.***
42					
43	0.34	0.355	**0.265**	0.34	***59fsw invert elevation.***
44					
45	0.355	0.355	**0.235**	**0.185**	***59fsw invert elevation.***
46					
47	**0.29**	0.35	**0.245**	**0.25**	***59fsw invert elevation.***
48					
49	0.33	0.3	0.35	0.34	***60fsw invert elevation.***
50					

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
51m	0.325	0.345	**0.245**	**0.29**	60fsw invert elevation.
52					
53	0.34	0.34	0.345	0.325	60fsw invert elevation.
54					
55					
56	0.44	0.345	0.366	0.34	***61fsw invert elevation.***
57					
58					
59	0.34	0.3	**0.2**	0.345	62fsw invert elevation.
60					
61					
62	0.345	**0.245**	0.35	**0.2**	***63fsw invert elevation.***
63					
64					
65	0.34	0.34	**0.25**	0.33	***65fsw invert elevation.***
66					
67					
68	0.305	**0.2**	**0.2**	0.345	***65fsw invert elevation.***
69					
70	0.315	**0.22**	0.345	**0.285**	***64fsw invert elevation.***

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
71m					More inclusions.
72					
73	0.345	0.305	0.345	0.335	62fsw invert elevation.
74					
75					
76	0.32	**0.245**	**0.205**	**0.21**	***61fsw invert elevation.***
77					
78					
79	0.35	0.35	0.35	0.345	***60fsw invert elevation.***
80					
81					
82	0.305	0.345	0.345	0.35	***8" of material growth.***
83					
84					
85	0.315	0.325	0.35	0.35	60fsw invert elevation.
86					
87					
88	0.35	0.345	0.35	0.36	60fsw invert elevation.
89					
90					

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
91m	**0.205**	**0.205**	**0.205**	0.33	60 fsw invert elevation.
92					
93					
94	0.335	0.36	0.3	0.365	60fsw invert elevation.
95					
96					
97	0.245	0.305	0.31	0.335	60fsw invert elevation.
98					
99					
100	0.35	0.345	0.34	0.355	60fsw invert elevation.
101					
102					
103	0.34	0.33	**0.205**	0.35	61fsw invert elevation.
104					
105					
106	0.34	0.335	0.345	0.325	61fsw invert elevation.
107					
108					
109	0.325		**0.285**		61fsw invert elevation.
110					

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Distance	Invert	Obvert	Spring - L	Spring - R	Description
111m					
112	0.335				*Stop gate. / Terminal Point.*
113					
114					
115					
116					
117					
118					
119					
120					
121					
122					
123					
124					
125					
126					
127					
128					
129					
130					

EVALUATION OF THE ULTRASONIC DATA

ITEM 1.1.3 ULTRASONIC DATA

The ultrasonic data has indicated three general regions in the pipe that are showing pipe wall thickness averages of 44% to 54% of original wall thickness. All readings of less than 0.3 have been highlighted for easy reference. I would encourage the reader to take the data to the pipe elevation CAD drawing for better visualization of the pipe's existing integrity.

A reading of 0.165 was taken at the 5-meter mark. This would be the location where the pipe leaves the concrete encasement at the intake / T structure. The region between the 22-meter mark and the 30-meter mark is also an area where consistent readings of low 0.2's were taken. The pipe at this location is entering into the offshore foot of the dam. The general substrate topography you can see on the dry side of the dam is essentially duplicated on the wet side of the dam.

From the 45-meter mark to the 68-meter mark is the location where additional low readings were taken. This region is essentially from the current water line on the wet side to the first bench on the dry side. The lowest reading we recorded in this area was 0.185. It would be very important to look at the elevations of the invert of the pipe at this region as you look at the ultrasonic readings.

From the 76-meter mark to the 103-meter mark there were also some low readings taken. The readings however where not as consistently low as taken in the 45-meter to 68-meter mark.

I was asked to put a time line on the pipe's integrity while onsite. It would be reasonable to assume that the pipe wall will not experience a significant failure for the next five years but it would be reasonable to assume the pipe may well fail between five to 10 years. This estimation has been derived based on the original installation date and the depreciation of the pipe on an accelerated curve. (Extrapolation of the ultrasonic data over time.) This however is not as a serious concern as will be discussed in the next item.

ITEM 1.1.4 EVEVATION OF THE PIPE

Upon the first survey of the site prior to the beginning of the diving operations I saw the water flowing out of the dam just a meter above the valve house. It was indicated to me that the water was thought to be flowing from the mountainside. This is simply not the case. This water is travelling alongside the pipe going through the dam. During construction there were fifteen pipe collars installed on the pipe at nearly equal distance from the 'T' to the stop gate valve. Some of the pipe collars were according to the plans installed right into the bedrock. Some of these collars were not installed in the bedrock as indicated by the pipe invert elevations taken during our dives.

The area of concern is specifically the 60-meter station to the 70-meter station. Our elevations of the invert show a drop in the pipe as much as 5' over the 10 meters. Past experience has demonstrated that pipe collars force any transient water to pool typically below the pipe as it moves along to the next collar and is then forced to repeat itself again. Thus generating a void or simply water saturated loose material below the pipe. I would suggest that if you look at the dam surface carefully the slight depression that exists over the pipe in the centre of the dam is the beginning of a sinkhole. This slight depression has a diameter of approximately 3 meters and an elevation drop of approximately 7". At no other location on the dam is there a depression of this nature. The fault line that is visible from one end of the dam to the other passes through the edge of this depression.

There is another slight dip in the pipe near the 'T' as well. It should be noted that our divers when being extracted from the pipe noticed the drop in pipe elevations physically. Our outside diver tenders would be assisting our exit by coming up on the umbilical and hence with greater speed we would notice these drops.

It should be noted that we did not feel or find any joint failures during the pipe inspection. The CAD drawing shows the elevations of the pipe.

ITEM 1.1.5 COMPROMISING INDICATORS

1. Pipe wall thickness of below 0.2 inches is indicative of significant loss of pipe wall thickness and pipe integrity.
2. Significant invert elevation drop of the pipe through the middle of the dam.
3. Running water from directly behind the valve shed.
4. Depression in the dam nearly directly above the pipe.

ITEM 1.1.6 PROACTIVE SITE RECOMMENDATIONS

1. Work to reduce the head pressure on the dam and on the pipe. This will add to the time line of the pipe and the water movement along side the pipe.
2. Be extremely cautious about running significant volumes of water through the pipe. If the pipe was to a have a near failure point or undisclosed existing failure location any water through the pipe will hydraulically make the situation worse.
3. By not using the pipe at all would be the safest protocol at this point.
4. Using large diameter siphons would assist immediately in reducing the head pressure.
5. Increasing the depth of the spill way would also be a proactive step.
6. Determine elevations below the dam and water volumes if a partial breach was to occur. This would provide environmental impact data.
7. If further testing is required to determine dam integrity I would suggest conducting a hydrostatic test over several locations along the pipe and a couple in areas of the dam that would be considered solid. These tests could help determine the size and nature of the voids.

CERTIFICATE OF CALIBRATION

CALIBRATION DATE: September 6, 2001

CALIBRATION DUE: September 6, 2002

CALIBRATION REPORT #: 090601

CUSTOMER: Diving Dynamics
#6-2070 Harvey Avenue
Kelowna BC V1Y 8P8
Canada

GAUGE TYPE: Cygnus 1 Underwater

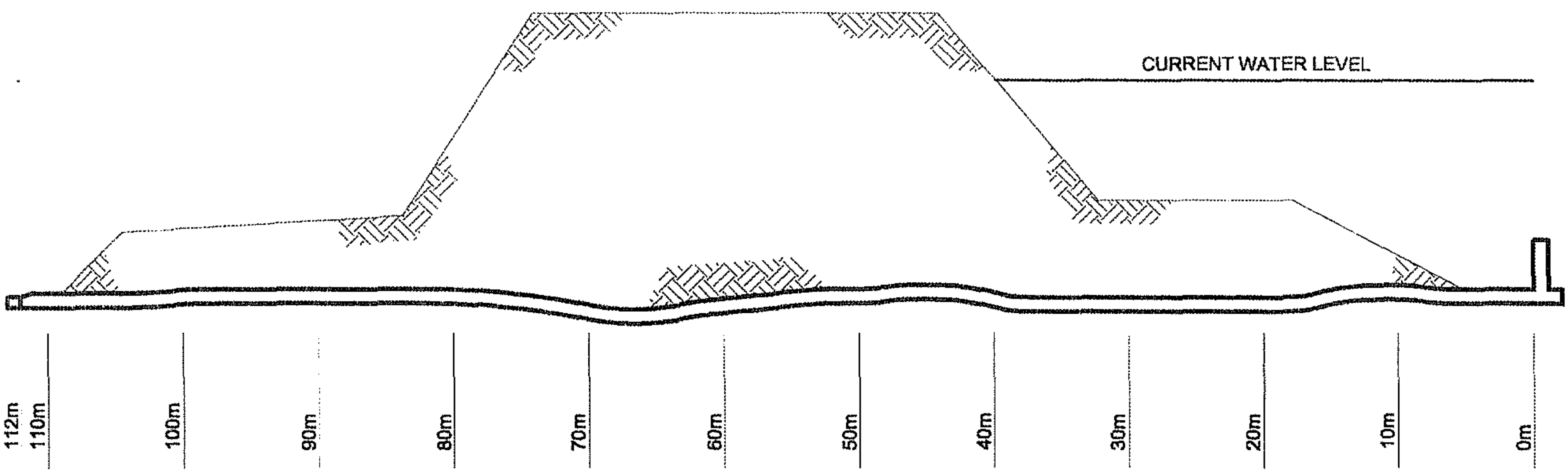
SERIAL NUMBER: # 3448

TRANSDUCER: 2.25MHz ½" UW Remote Probe #83177

NIST TEST BLOCK NUMBER: NIST Registry #821125008292
Test blocks used for this calibration have been calibrated against reference standards certified by the National Institute of Standards and Technology and systems compliance in ISO/IEC Guide 25, MIL-STD-45662A, ANSI/NCSL Z540.1. Instrument Serial Number #3448 was found to be within tolerance.

[signature] 9-6-01

CERTIFICATION MANAGER **DATE**



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DRAWN BY:	SCALE:	DATE:
W.B.S.	NOT TO SCALE	24/9/01

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Commercial Division