THE WATER HAULER'S BULLETIN

VOLUME 13, FALL 1983

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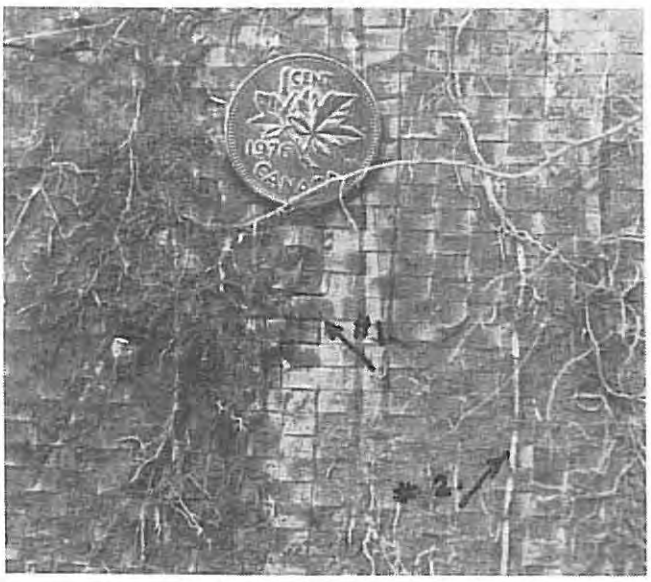
TESTING OF FLEXIBLE CANAL LINERS

The Research Section of the Project Planning Branch under the direction of Svat Jonas has undertaken a research project to test and assess buried flexible canal lining materials which have been used in Southern Alberta for the past 24 years. An attempt will be made to evaluate their performance and possible changes in physical properties under various field conditions and installation techniques. The project is being financed by the Irrigation Council of Alberta from its research fund.

The Bow River Irrigation District (B.R.I.D.) was selected as the major study area for obtaining samples of the liners because they have some of the oldest installations. A total of 50 km (31 miles) of lined canal are being tested and 41 test sites have been selected.

(continued on page 2)



FABRENE TP
#1 Gaps Between Strands
#2 Roots Weaving Through Strands

To obtain a polyethylene sample, the canal earth cover has to be carefully removed with hand shovels, a square 1.2 m^2 sample cut out, identified and tagged. The liner is then patched with a repair material, properly resealed and then backfilled. The burial depth of the various liners varies from 0.3 to 0.8 m (1 to 2.5 ft).

According to Jonas "some liners are showing superior qualities". He states that "many of the polyethylene membranes (4, 6 and 8 mil) are in fairly good shape, however, one sample of Fabrene TP, as shown in the picture, has some problems".

Another surprising discovery was found in a 20 mil PVC membrane liner installed 2½ years ago. The roots of quack grass have penetrated the liner in several places. In the 1.2 m^2 sample four holes, ranging in size from 1 to 5 mm in diameter, were found. A piece of a root was still protruding through the plastic sample.

At press time, random ponding tests are being conducted in order to determine the waterproofness of the various liner materials obtained. Results of these tests will be published in a later edition. Results of the completed study will be published under separate cover in the spring of 1984.

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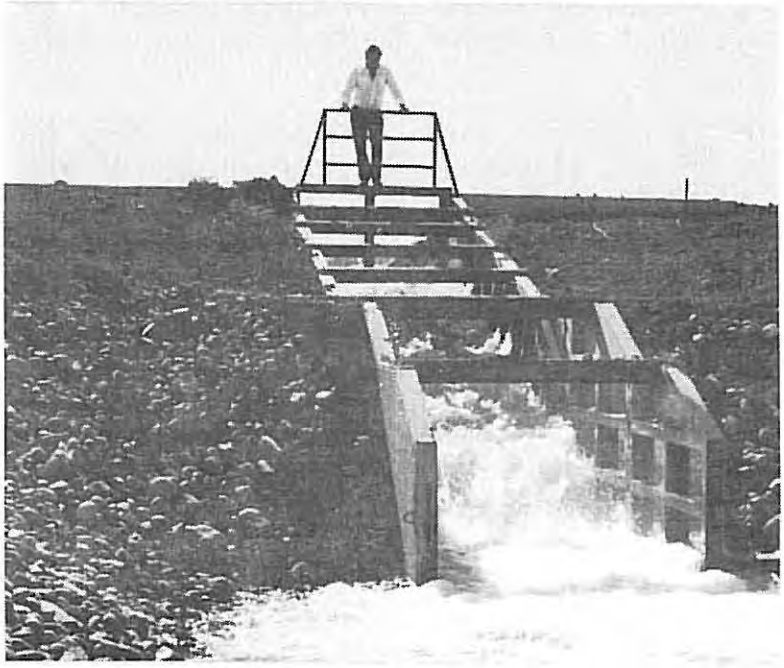
PRECAST PANEL - ANOTHER BREAKTHROUGH

When Keith Strong from Eastern Irrigation District (E.I.D.) and Kirt Woolf from United Irrigation District (U.I.D.) assembled the precast panels to produce a chute drop and a cascade drop, respectively, they gave the precast panels a new dimension. Over the years the "waffle" precast panels originally designed by Ron Francis have been used to build various types of small hydraulic structures such as checks, check drops, drops and turnouts. Revisions in recent years to the original design have increased the versatility of the precast panels. Today it is possible to build pipe inlets, pipe outlets, and manholes, and to build checks and very low drops and check drops for discharge as high as 5.0 m^3/s (175 cfs). The actual drop, however, remains low with drop from 0.3 to 0.6 m (1 to 2 ft) for the larger capacity.

The drop structure as designed and assembled by E.I.D.'s Keith Strong has a total drop of 2.9 m (9.5 ft) and a capacity of 2 m^3/s (70 cfs). The structure has essentially precast panel wingwalls, side walls and floor for the upper end. The chute leads into a normal precast vertical drop structure complete with an extra pair of wingwalls, cut-off and side panels. Because of the change of direction at the top and bottom of the chute section, four similar panels forming transitions had to be designed and constructed to make the connections. All joints were made water tight using neoprene gaskets. The waffle of the floor faces upwards to assist in reducing the water velocity. There is some concern that the floor panel (which is only 50 mm thick between waffles) may not survive the action of the water and possible frost heave, so it will be monitored for some time in the future.

The U.I.D. structure as built by Kirt Woolf is in fact a series of vertical precast drops complete with side panels, center panels and cast-in-place concrete stilling basin floors. The center panels provide extra cut-offs. The total drop of this structure is 2.8 m (9 ft) and the capacity is 2 m^3/s (70 cfs) but greater drop is possible. One merely continues to provide more drops in series.

Both these structures are functioning as designed, however, Keith, Kirt and Jack Ganesh of the Project Planning Branch, have developed ideas on how to improve both design and construction of the structures. For further information please contact Jack Ganesh at 329-5164.



Note Energy Dissipation in E.I.D.'s Precast Structure

U.I.D.'s Precast Structure

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CONCRETE LINED CANAL CRACKING STUDY

April 1983 was the final inventory taken on a study initiated in April 1979 to measure and categorize the cracking in all concrete lined canals installed in the Irrigation Districts of Southern Alberta. Although a complete study of all concrete lined canals will not be taken, inventories will continue on all wire mesh reinforced canals and the more recent constructed unreinforced canals.

The cracks in 250 km of 280 km of concrete lined canals, both wire mesh reinforced and unreinforced, were measured for length and categorized for width, vertical displacement and location on the canal cross section. The cracks on the remaining 30 km were not inventoried due to siltation or newly completed repairs.

Overall, the percentage of canals remaining virtually uncracked since the 1979 study has increased from 65% to 71% due to the introduction of wire mesh in 1980 as a reinforcing agent in concrete lining. This increase of 6% is justifiable by the fact that 10% of the 280 km of concrete lining is wire mesh reinforced with 98% of that being virtually uncracked.

The study does show that although horizontal cracks are increasing very slowly, vertical displacement of cracks is increasing at a faster rate in unreinforced concrete canals.

Summary of April 1983 Inventory

	Virtually Uncracked	Up to 5 mm	5 mm to 40 mm	Over 40 mm
Overall (250 km)	71.52%	25.03%	2.27%	1.18%
Unreinforced (221 km)	68.73%	27.12%	2.46%	1.69%
Reinforced (28 km)	98.35%	1.64%	0.01%	--

Some interesting facts derived from this study:

(1) The total length of all cracks amounts to 211,740 metres or approximately 2.87 lineal metres of crack for every metre of canal that is in a cracked condition.

(2) 90% of all cracking is found in the bottom third of the cross section and a significant amount of this is in the toe of the canal.

(3) Approximately 12% of all cracks show a vertical displacement of more than 5 mm.

(4) Cracking occurring in wire mesh reinforced lining is transverse and is mostly found midway between expansion joints.

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LARGE ALBERTA WIND TURBINES

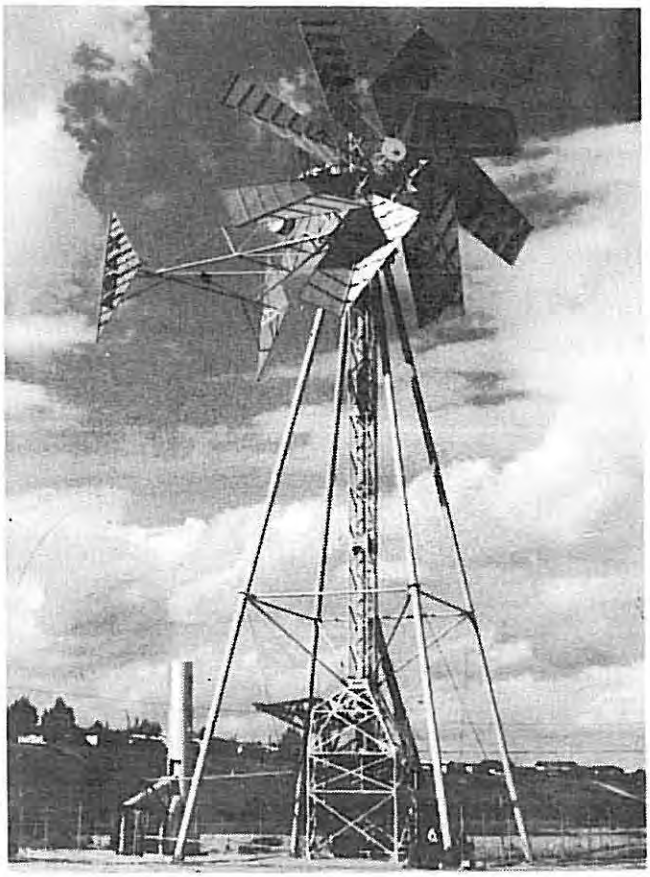
A large wind turbine has made its first appearance on the Alberta skyline: the ABAX "Delta-Blade" wind turbine. The 16 m (52.5 ft) diameter prototype, the first of a series of large machines, is now erected at the Company's plant in northeast Calgary following five years of research and development work.

ABAX Energy Services Ltd. developed this Delta turbine, a design by Dr. J. A. C. Kentfield, Department of Mechanical Engineering, University of Calgary, as an alternative energy source for pumping large quantities of water. Its prime use is for irrigation, water storage and hydro-electric power generation, with turbine sizes ranging from 15 m to 45 m (50 to 150 ft) in diameter, and pumping lifts from 3 m to 300 m (10 to 1000 ft). The system, constructed entirely of steel, features slow operating speed, direct displacement pumps and simplistic automatic controls, emphasizing long service life with minimal attention and maintenance.

The prototype, developed with funding assistance from the Alberta/Canada Energy Resources Research program, was set up to prove out the calculated performance of these wind-powered pumping systems.

Design specifications are:
- Rotor Diameter 16 m (52.5 ft)
- Overall Height 40 m (130 ft)
- Operating Wind Speed 10 to 100 km/h (7 to 60 mph)
- Pumping Head 9 m (30 ft)
- Design for Survival in Winds Gusting to 260 km/h (160 mph)
- Rotor Speed 7 to 30 rpm
- System Life 30 years
- Rated Output 48 km/h Wind (30 mph) 205 kW (275 hp)
- Pumping 1.57 m^3/s (24,000 U.S. gallons) per Minute

As an illustration of installation in southern Alberta, and based on long term wind records at Lethbridge, where winds average 27.7 km/h (13.5 mph), a 15 m (50 ft) diameter unit lifting water 30 m (100 ft) from water source to land pumps 801 dam^3 (650 acre-feet) during the summer season, an amount sufficient to irrigate about 162 ha (400 acres). Since winds vary from day to day, calculations show that water storage in a natural or dyked depression equivalent to 5 to 10 days of turbine output would ensure continuous seasonal water supply. A single 23 m (75 ft) diameter Delta



The Location of this "First" is 5929 - 9 Street N.E., Calgary

turbine pumps 3 times more than the 15 m machine. A single 45 m (150 ft) unit pumps 15 times as much, an average of 12,330 dam^3 (10,000 acre-feet) of water in a summer season, the equivalent of a lake 3 m (10 ft) deep covering 405 ha (1,000 acres). ABAX cost estimates show Delta turbine pumping to be readily competitive with electric or gas-powered pumping. Since the major cost is the initial capital investment, the wind-powered system has a further advantage in providing assurance of stable pumping costs for several decades.

In year-round pumping applications, the total annual output is far greater (by 2.8 times) due to higher winter wind speeds. As the most efficient means for converting wind energy to electric energy, the Delta turbine is utilized for recirculating water to upper storage for hydro-electric power generation. By so using water as the energy storage medium, prime electric power can be reliably produced to meet peak demand periods. An illustration of such a system is a small group of ten 45 m (150 ft) diameter Delta turbines operating in average 21.6 km/h (13.5 mph) winds. The system would provide 3,000 kW of power, totalling 25,000,000 kW hours per year, sufficient to service 3,000 homes or 1,500 farms. In locations of higher wind speeds, 24 km/h (15 mph) for example, the net energy output becomes 34,000,000 kW hours per year.

Very few large wind turbines are presently installed in Canada, however, over 500 large wind-electric turbines are now operating in the United States, with 7,000 more being planned. The ABAX turbine is useful in that market in applications to water pumping, for which it is unique.

The final stage in the development of ABAX Delta turbine is the testing and monitoring of the 16 m prototype in the months ahead, in cooperation with the Alberta Research Council and National Research Council, to test and prove out the performance of the system.

For additional information, contact ABAX Energy Services Ltd., Calgary, Alberta, 275-6260.

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BOW ISLAND LATERAL 12 PRESSURE PIPELINE

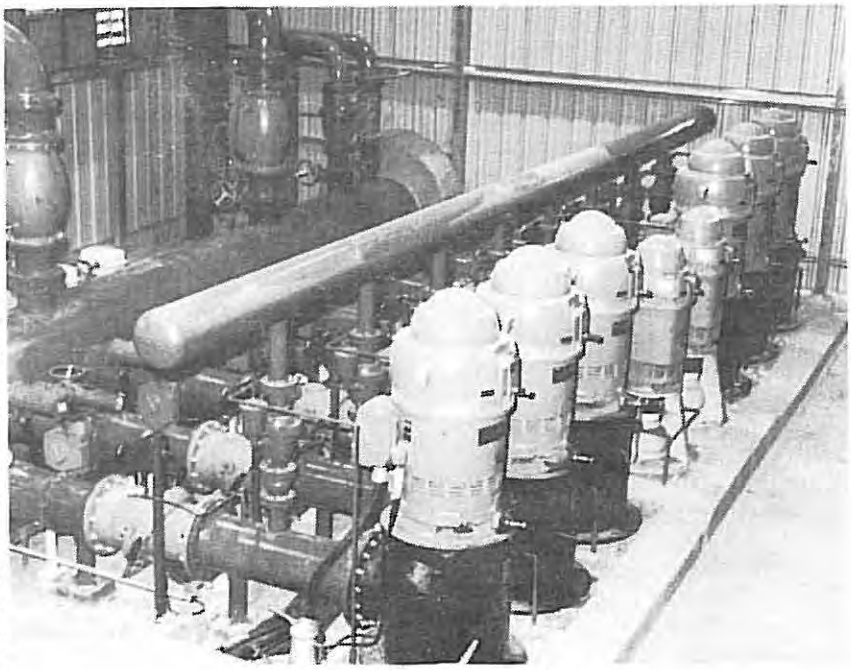
In 1982/83 the St. Mary River Irrigation District (S.M.R.I.D.), with assistance from Alberta Agriculture, constructed a pressurized pipeline directly south of Bow Island, Alberta.

This irrigation pipeline serves a block of approximately 2,024 ha (5,000 acres) south of Bow Island with water under pressure and another approximately 405 ha (1,000 acres) northwest of Bow Island with gravity flow. The pipeline also provides water to the Town of Bow Island and the golf course.

This system replaces the old irrigation distribution system which consisted of a number of earth ditches constructed along the contour of the land.

A pumphouse at the main canal, which is the high point of the project, pressurizes the pipeline. A total of eight pumps provide a maximum design capacity of 2.32 m^3/s (82 cfs) at a guaranteed minimum pressure of 485 kilopascals (70 psi). The system has six large pumps each with a capacity of 0.34 m^3/s (12 cfs) and two small pumps each with a capacity of 0.17 m^3/s (6 cfs). If every landowner takes water at the same time, each quarter section would receive a flow of 0.057 m^3/s (2 cfs). The pumps are driven by 300 and 150 horsepower electric motors.

The buried pipeline has two primary lines which branch off into secondary lines. The primary lines consist of Hyprescon pipe varying in diameter from 915 mm (36") to 609 mm (24"), and each line is approximately 4.8 km (3 miles) long. Branch lines consist of 200 mm (8") to 450 mm (18") diameter PVC pipe, with a total length of approximately 8 km (5 miles).



Interior of Pumphouse

Turnouts that are readily accessible to the District Operators provide water to each quarter section. The turnouts consist of above ground control valves and piping directly connected to on-farm main lines to sprinkler systems. The control valves can be set to provide a constant pressure in the farmers main lines at any level ranging from 310 kilopascals (45 psi) to 485 kilopascals (70 psi). Each turnout contains a flow meter which measures the instantaneous flow and the cumulative volume of flow. A total of 33 turnouts serve 25 center pivots, 7 wheel move systems, and the golf course.

The system is automated. The station automation uses programmable logic control for sequence operation of the pumps and it provides remote station monitoring through a voice communication controller.

After the first pump is started, farmers with center pivot systems start their units by pressing a button that starts their sprinkler in operation. This automatically accentuates the solenoid valve at the turnout which opens the control valve at the turnout. Similarly the valve is shut off automatically when the farmer shuts off his pivot. The flow to wheel move system is started and stopped by moving a control lever located at the outside of the turnout box.

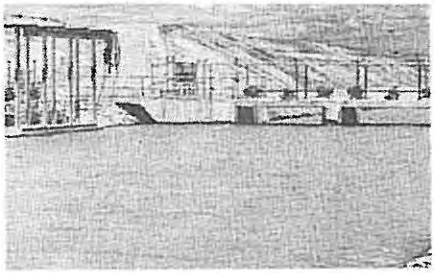
Additional pumps start automatically whenever the pressure in the pipeline drops below a predetermined level. On the other hand pumps shut off automatically based on flow control. An ultrasonic flow meter in the main line accurately registers the flow which is conveyed to the control apparatus in the pumphouse.

The capital cost of the project was approximately $6,000,000 of which 86% was funded by Alberta Agriculture. The remaining 14% was equally shared by the Irrigation District and by the landowners on this project. The landowners pay the annual costs for electric power, maintenance costs for the system, and the District annual assessment per irrigated acre.

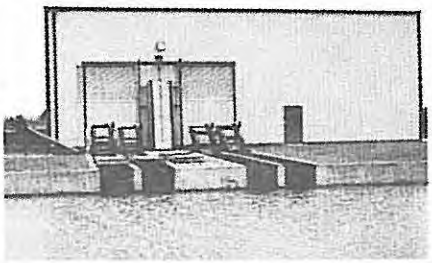
Annual costs for electric power based on 1983 rates and an average annual water application of 300 mm (12") will be approximately $9 per acre. Annual maintenance costs for the system were established at approximately $12 per acre. The annual water rate for 1983 is $12. Total cost per acre is $33 per acre.

This project has important advantages for the irrigation area. The pipeline has replaced earth ditches and has thus eliminated seepage, weed growth, and land severance problems. On the other hand the system provides a reliable water supply. The centralized pump station operated by the Irrigation District has eliminated the need for individual farmers to have their own pumps and the associated operation and maintenance. District operation and maintenance costs have also been reduced.

SNC Consultants were responsible for the design and construction of the system. Additional technical details of the project may be obtained from Irv Martens at 320-8886 in Lethbridge and Jim Brown, Manager, S.M.R.I.D.



Main Canal Check Structure and Turnout



Pumphouse and Automated Trash Screens

B.F. Wilson, Bryan Wilson Photography

Computer Controls

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Designed to provide the operation and management personnel of Irrigation Districts with items of interest in their line of work. Comments are welcome. Please contact Duncan Lloyd at 329-5164, Lethbridge.

Published quarterly by the Evaluation & Management Section, Project Planning Branch, Resource Planning Division, Alberta Agriculture, Agriculture Center, Lethbridge, Alberta T1J 4C7.

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