THE BENEFITS OF INDEX TESTS IN THE PRODUCTION ENVIRONMENT

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BACKGROUND

To confirm our efficiency gain on the Deriaz type turbines with a draft tube nose cone installed, Index Tests were done in 1998. It was proved and recorded, there is a definite gain in double digits of efficiency improvement with the draft tube cone in place.

The tests were done at the SAB – Pumps Storage Plant. There are six 30MW Deriaz type reversible pump turbines in service since 1958.

The water to the plant comes in from an open canal and two tunnels from the Niagara River, just upstream from Niagara Falls Canada.

The pump storage forebay reservoir provides about 15,400acres/Ft. storage capacity; the tail water variation of 13 Ft.

DESIGN FEATURES

The Deriaz type runners have eight adjustable blades. The water to the turbine is guided via stationary blades, eight adjustable diffuser flaps, runner blades and via draft tube, the water drains into the tailrace.
The tailrace is part of a headground for the Sir Adam Beck I and II powerhouse. Each draft tube was originally equipped with a "Draft Tube Cone". The cone is built from reinforced concrete and lined with ¾" thick steel liner.

During the first three unit overhauls, the cones were removed. Maybe due to the vibration and surging during the "cross-over" operation, the turbines were operated in regime not suitable for this type of turbine design.

THE PROBLEM

When the fourth unit overhaul came up, in the planning stage, a request came to remove the draft tube cone from the unit. This activity was three weeks in duration (critical activity) and the cost was above $80,000.00 in material, equipment rental and labour.

I started looking for the data and resource in why the cones were removed. The information available did hardly support such an activity, so with support of the PGS Station Manager, we challenged the request.

A Team was formed to review the credibility of the data supporting the nose cone removal. It was suggested an Index Test be done on our unit with the nose cone in place, and one with the nose cone removed.

The results speak for itself !!!!!!!!!!!
There also is a definite efficiency improvement recorded for the units with the nose cone in place.

As it can be found from the test results, the turbine power gain benefits are across the whole range of pump turbine operation. In the pump mode, however, the benefits are most significant. (e.g. Blade angle 17.5°, the pump input drops from 29.4 MW to 28.5 MW, this saving of .9 MW).

Note in the Generator mode, the power gains are not as significant, but the efficiency improvement extended further past the Best Efficiency Point operation and able to generate more power at higher blade openings.

FINAL REMARKS

Each hydraulic turbine has its own design characteristics and parameters. Often two turbines of the same design next to each other in one powerhouse have its own operating characteristics. Before you make any changes to the wetted parts of the turbine, consult the proposed changes with the manufacturer and experts before you do more damage than good!!!!!!!

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Worked for Utilities in Europe, Worthington Pump Company in Canada and after twenty-four years with Ontario Power Generation (formerly Ontario Hydro) has retired in June 2002.

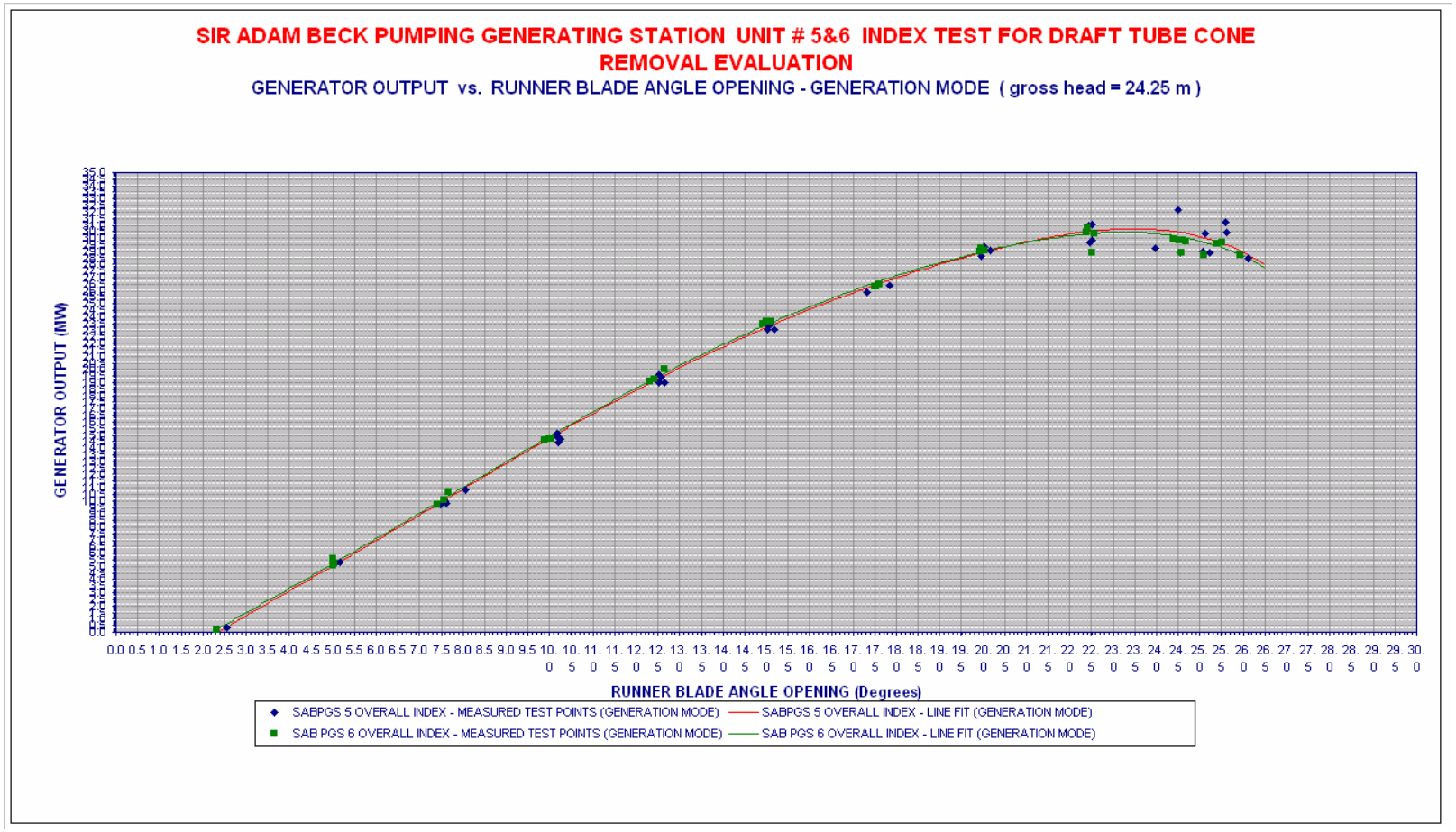

FIGURE 1 UNIT OUTPUT VS. RUNNER BLADE ANGLE OPENING

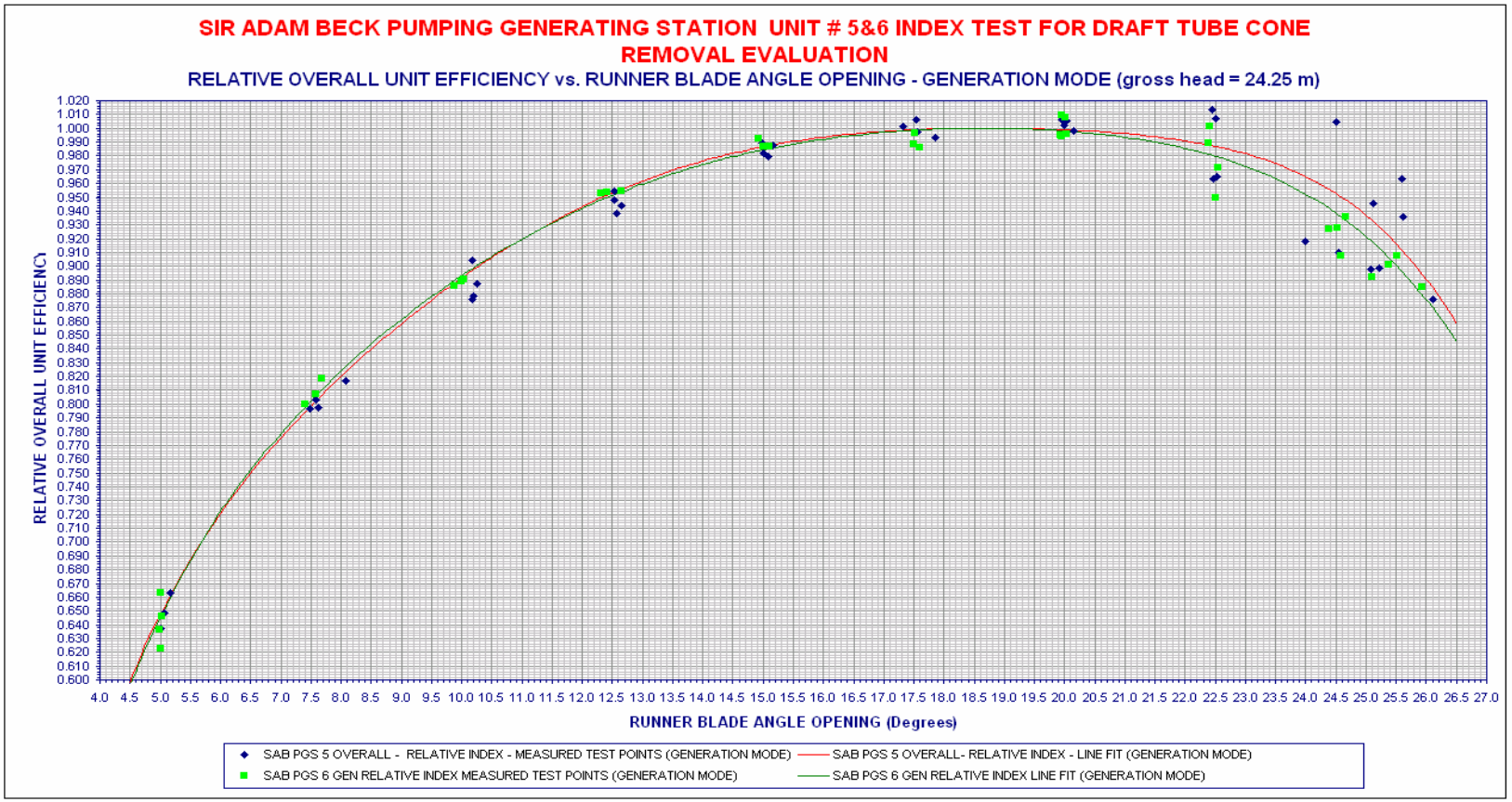

FIGURE 2 RELATIVE OVERALL UNIT EFFICIENCY VS. RUNNER BLADE ANGLE

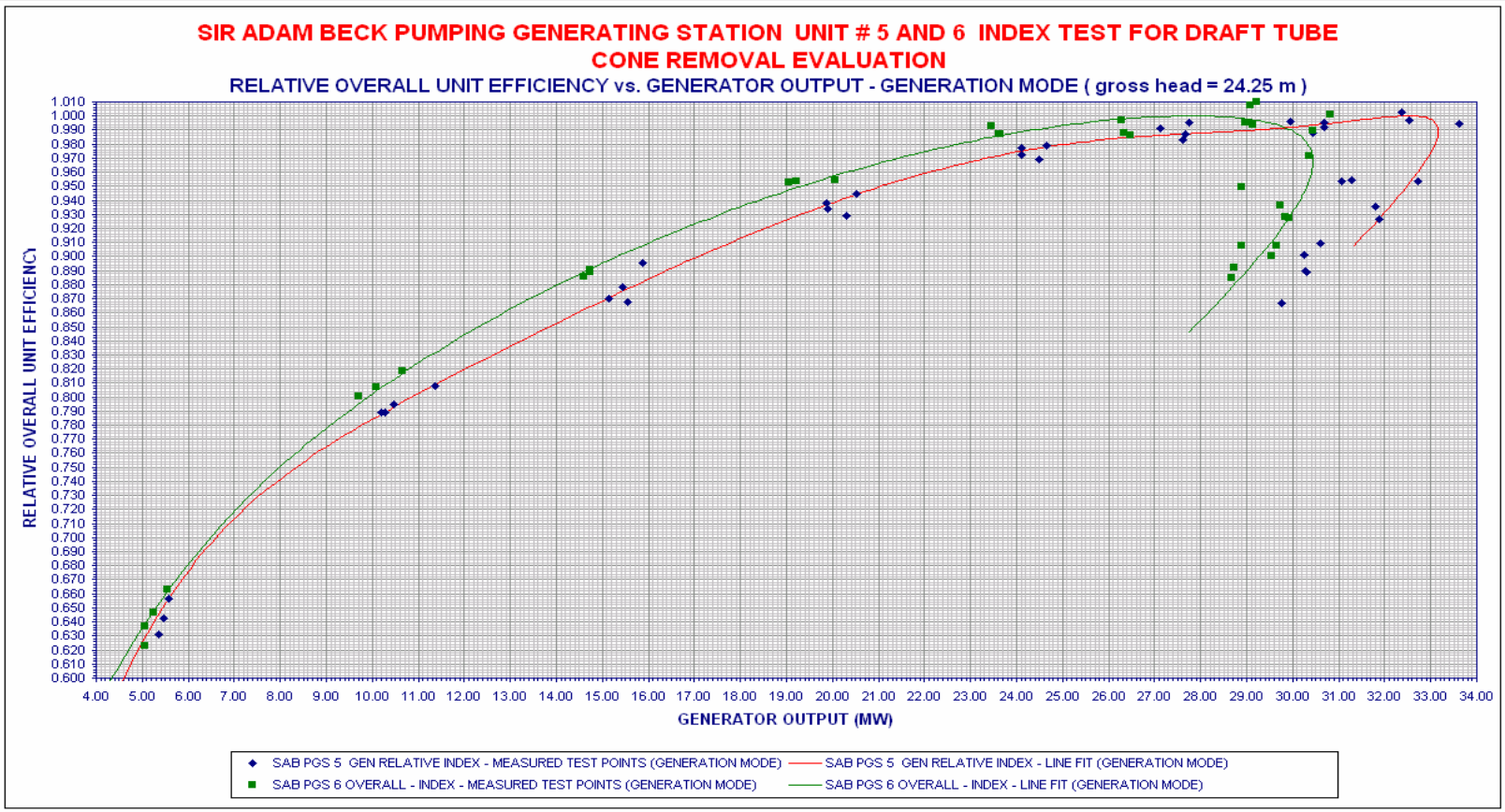

FIGURE 3 RELATIVE OVERALL UNIT EFFICIENCY VS. GENERATOR OUTPUT