

Real-Time Diagnostics and Monitoring

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NYPA Goals

- Monitor its assets in real time
- Determine if any abnormal conditions exist
- Repair any abnormalities before catastrophic failures
- Maintain peak capacity
- NYPA has at least one form of monitoring system on all its hydro generators. The following monitoring systems have been deployed at NYPA's hydro plants:
 - ✓ FluxTrac
 - ✓ HydroTrac
 - ✓ Vibration Monitoring System
 - ✓ GCS (Generator Control System) provides conventional process data. GCS is a Distributed Control System (DCS) that manages and maintains the operation of the hydro generator (not by R&D department)
 - ✓ HydroX

FluxTrac

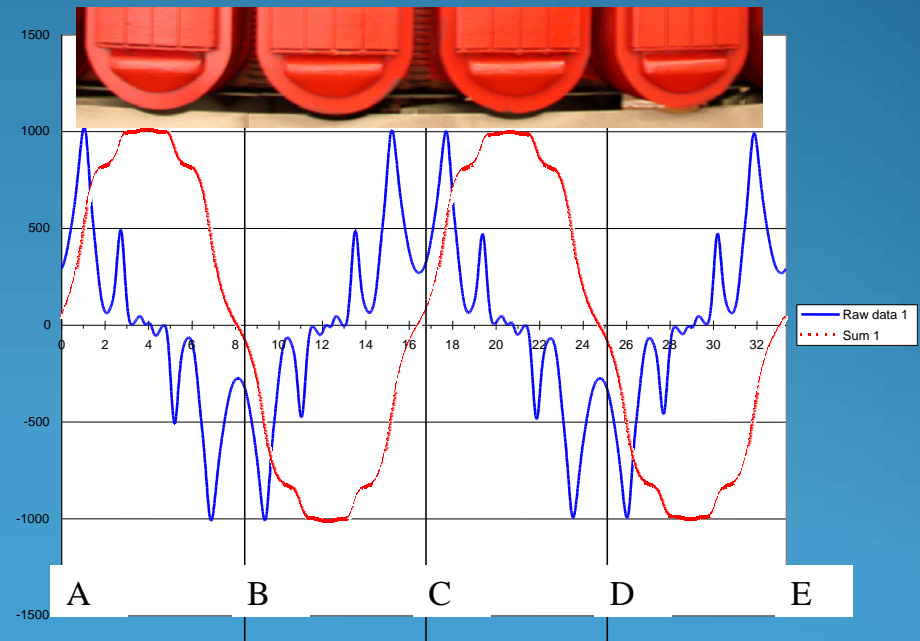
- The purpose of the Fluxtrac is to reliably determine shorted turns in the rotor pole windings
- By detecting shorts on-line under real operating conditions, NYPA can avoid pole drop test which:
 - ✓ must be performed offline (hydro unit not in service)
 - ✓ is time consuming to perform
 - ✓ often not effective at detecting problems that occur in service where operating temperature and mechanical stresses are a factor

FluxTrac: *Principles*

- In a salient pole machine, the radial magnetic flux profile across each pole depends on the MW and MVAR loading of the machine.
- Any change in the flux profile within a pole at a given load must be due to shorted turns or the distance between the rotor and stator.
- A flux probe is installed on the stator surface and measures the magnetic flux in the air gap in a generator during machine operation
- The flux in the air-gap induces a current in the flux probe as each pole passes the sensor



Output of Probe: *Measures change in flux*



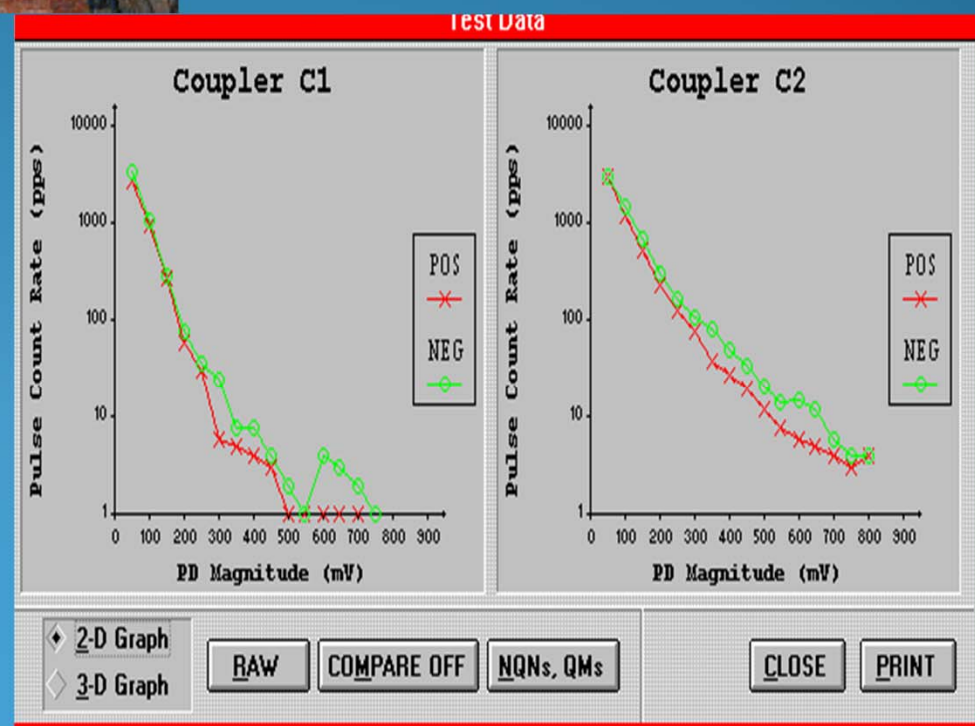
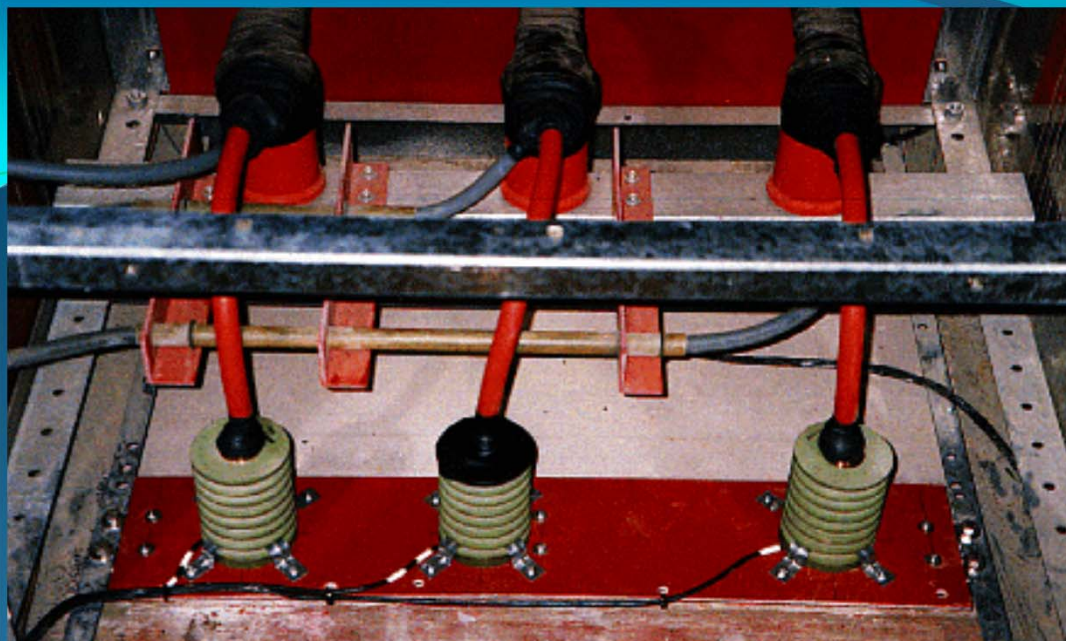
HydroTrac

- The Hydrotrac system is used to detect partial discharge (PD) activity in stator windings
- By installing the Hydrotrac, NYPA can detect stator winding insulation system problems online and in addition:
 - ✓ No shut down or outage is required
 - ✓ Problems are detected years before failure
 - ✓ Enables predictive maintenance
 - ✓ Helps avoid in-service failure
 - ✓ Determines the effectiveness of any maintenance performed

HydroTrac : *Principles*

- Partial discharges (PD) are small electrical sparks that occur when air pockets exist within high voltage insulation and possible causes are:
 - ✓ Poor impregnation of coils (voids)
 - ✓ Overheating of coils
 - ✓ Looseness of windings (slot discharge)
 - ✓ Deterioration of semi conductive or grading coatings (slot or end winding discharge)
 - ✓ Contamination of windings (tracking)

- Two couplers per phase are installed near the junction of the circuit ring



Vibration Monitoring

- The vibration monitoring system is more than simply a vibration monitoring system. It monitors:
 - ✓ Vibration (shaft displacement)
 - ✓ Air gap
 - ✓ Temperature

- Each monitoring cabinet consist of several monitors/modules:
 - ✓ TDI module (3500/22) is used to configure the rack and receive machinery information as well as communicate with the DAQ/System1™.
 - ✓ The 3500/46 module is used for vibration & air-gap. Some I/O modules were configured for specific operation requiring modification software.
 - ✓ Module 3500/61 is used for temperature probes
 - ✓ 3500/25 Keyphasor module which uses the signal from a proximity probe as a starting reference point.
 - ✓ Module 3500/50 (Tachometer) is used for rotor speed measurement.
 - ✓ 3500/33 Relay module is used to provide relay outputs by using alarm drive logic.
 - ✓ VGA Module 3500/94 converts data into graphical representation.





HydroX

- HydroX is an extension of Bently Nevada's System1™
- Its goal is to combine all monitoring systems/points, provide diagnostic information and give plant personnel an overview of the hydro generator's performance.
- The monitoring systems/points refers to:
 - ✓ Fluxtrac
 - ✓ HydroTrac™
 - ✓ Vibration Monitoring System (BN3500™)
 - ✓ SCADA and DCS for conventional sensor data and process variables

TYPES OF INPUTS
COMING INTO THE
HYDROX SYSTEM AND
THE BASIC SYSTEM
INTERCONNECTIONS.

FIG. 1

