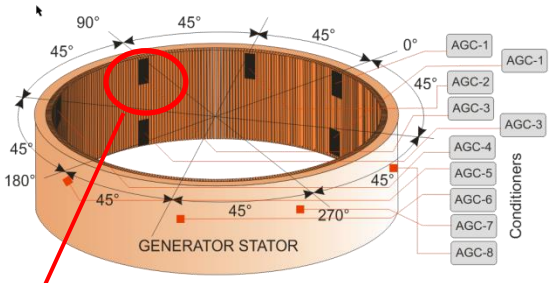
The operational dynamics of the generator depend on the influence of mechanical and magnetic forces and geometry within the air gap, and any errors could lead to adverse conditions, and even to damage as a result of a rotor rub of the stator.
Therefore, monitoring the air gap is increasingly more important as issues arise due to poor rotor and stator geometry and the downward trend of the nominal air gap for new designs of hydro generators.
The fact that generated energy is transferred from rotor to stator through the air gap, makes reliable identification of the conditions in the air gap one of most important tasks in machine behaviour control, providing reliability, efficiency and quality of electric power generation.

CoDiS (Computerized Diagnostic System) Air Gap module is designed to monitor the condition inside the air gap in real time and also to provide the comprehensive diagnostics tools to identify the irregularities or faults that might result in severe damage or production losses.



REAL TIME ANALYSIS:

Every probe installed on stator will be analysed in real time, on **CoDiS-RT** processing unit enabling the quick response and protection triggering in case of sudden condition deterioration.

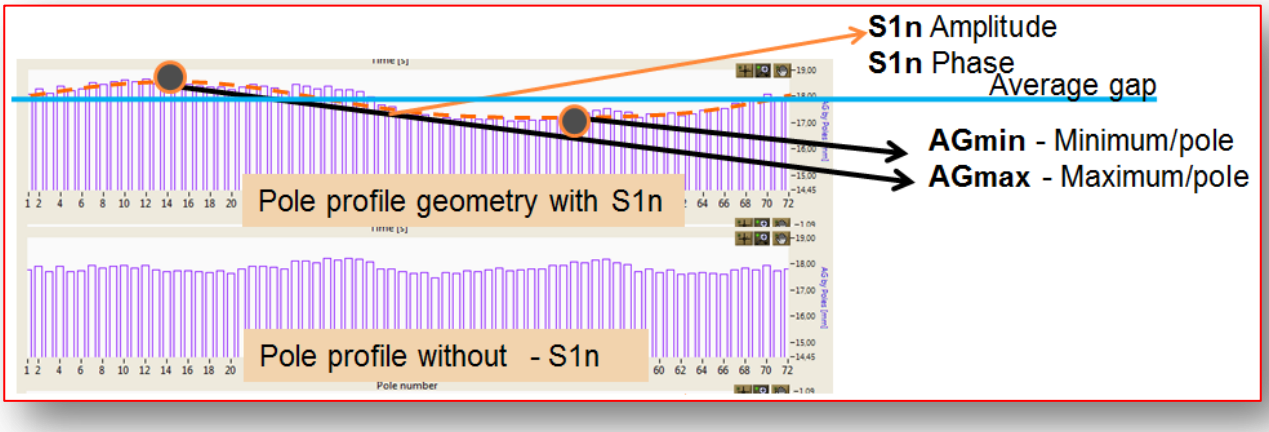


Fig 1.- Compensation of dynamic part of the signal from geometry of rotor body

Analysis per each air gap probe:

- AGmin (and pole number)
- AGmax (and pole number)
- Average gap (per probe)
- S1n (A and Ph) – dynamic eccentricity
- S2n (A and Ph) – loose rim detection
- Adjacent pole analysis – loose pole detection

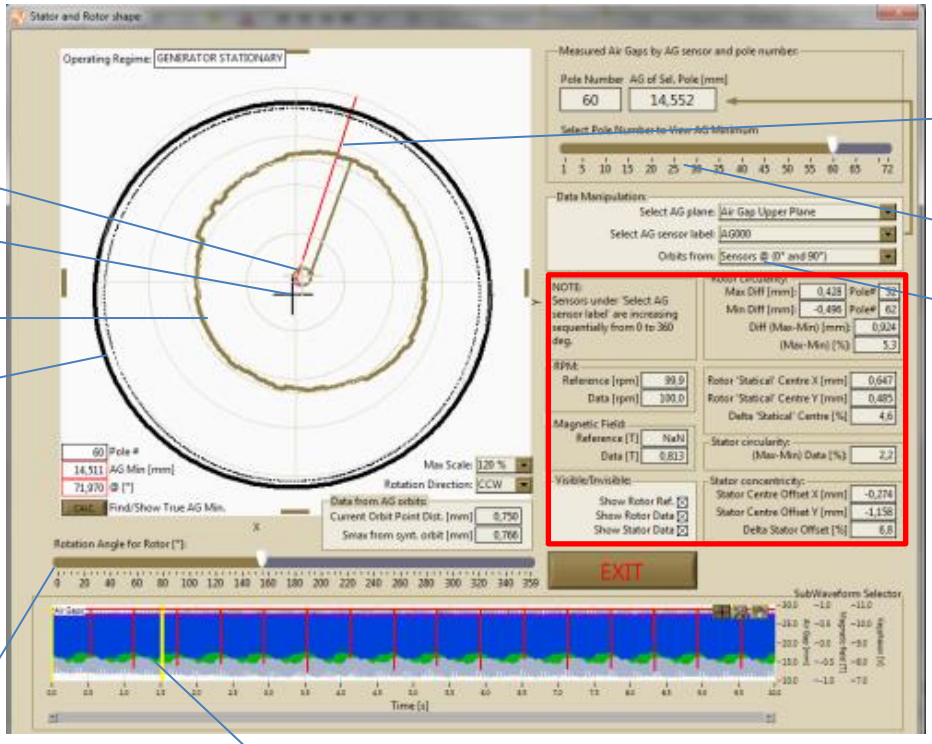
The real time analysis includes pole based rotor profile analysis. Each probe is referenced to trigger signal (once per revolution) enabling the adequate analysis based on each pole rather than time based analysis which does not compare the geometry of rotor from all positions.

The most important part of air gap analysis is extraction of dynamic eccentricity (vibrations of rotor body inside the air gap) from the geometry as both are captured by the air gap probe.

Special method for dynamic center movement (S1n – vibrations of rotor body on first harmonic of rotational frequency) detection is developed enabling the measured signal compensation and true geometry analysis. This can help in identifying the source of the problem such as rotor circularity offset, rim distortion or pole loosening without rotor dynamics signal parts influencing the actual geometry signal parts (rim shape or rotor spider geometry).

POST PROCESS ANALYSIS:

All of the data is stored to adequate database table enabling the post process analysis of multiple probes installed around the stator circumference. Multiple probes installation enables the most important analysis which is polar plot of both stator and rotor with calculation of real minimum position inside the air gap.



ROTOR DYNAMIC CENTER (ORBIT PLOT)

STATOR CENTER

ROTOR GEOMETRY (S1n Extracted)

STATOR GEOMETRY (interpolated from the measured points)

ROTATION OF ROTOR INSIDE THE STATOR

ACTUAL MINIMUM AIR GAP

POLE SELECTION FOR AIR GAP READINGS

PLANE SELECTION (if probes are installed in multiple planes)

ANALYSIS RESULTS:
Rotor circularity offset
Stator circularity offset
Rotor concentricity offset
Stator concentricity offset
Rotor Dynamic precession (Smax)

INTERACTIVE EVENT ANALYSIS (cursor referenced)
One turn to multiple turns avaliable for analysis