



# GENERATOR ON-LINE MONITORING



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IRMC June 27-28, 2023

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# AGENDA

- Intro
- A little history - our PD journey
- Where we are now
- Interesting cases
- Where we are going
- Challenges

# SASKATCHEWAN'S PRIMARY ELECTRICITY SUPPLIER

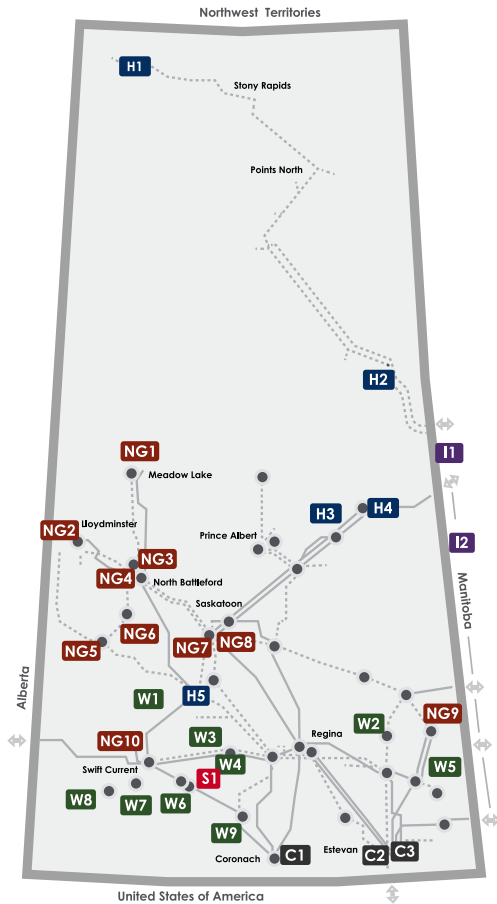
**545,000  
CUSTOMERS**

**5,246 MW  
CAPACITY**

**157,000 KM OF  
POWER LINES**

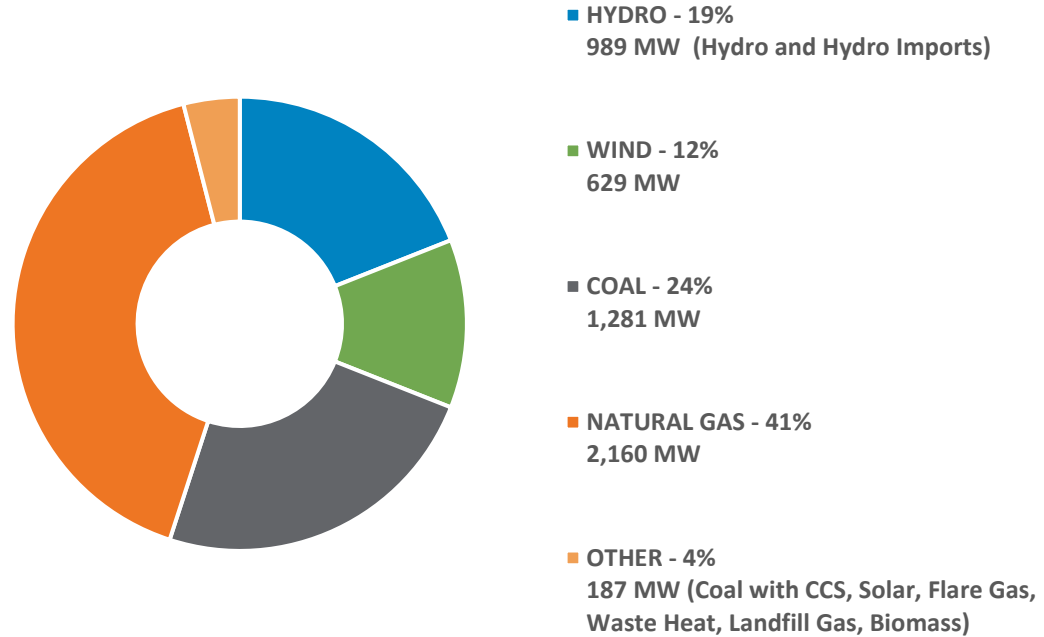
**3,910 MW HIT ON  
DEC. 30, 2021**





# SASKPOWER SYSTEM MAP

TOTAL AVAILABLE GENERATING CAPACITY AS AT MARCH 31, 2022:  
5,246 MEGAWATTS (MW)





# OUR PD JOURNEY



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# SOME HISTORY

- CEA PD project with Ontario Hydro Research Division - 1981

Date ..... 1981-03-04 .....

Subject: CEA/Ontario Hydro Partial Discharge Analyzer Testing

Arrangements have now been finalized to have Mr. Greg Stone of Ontario Hydro come to Saskatchewan to give a presentation and demonstration on the latest developments associated with Partial Discharge Testing of rotating machinery.

The presentation and demonstration will take place 1981-03-16, Monday, at 13:00 hours at the Coteau Creek generating station. You or your representative are invited to attend the demonstration.

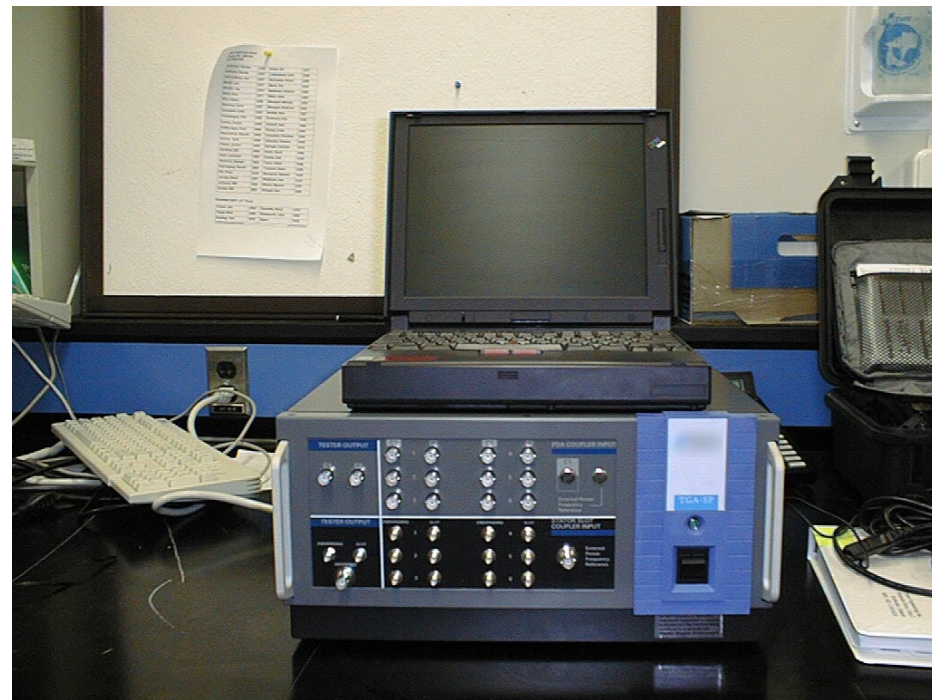
Mr. Stone, in the presentation, intends to spend some time discussing the latest developments in permanent couplers. Permanent couplers if installed allow the PDA test to be performed without taking an outage to the generator. It is hoped that with the information presented and questions asked by various SPC personnel, SPC will be able to ascertain what is required to install permanent couplers on our own generators.

It is the intent of Ontario Hydro to leave the PDA unit with SPC and allow us to test all of our generators on a biannual basis. The results will then be forwarded to Ontario Hydro who will compile comparative results from across Canada. Through CEA, it is intended to develop the PDA test into a meaningful on the line qualitative test. The test in the past has been found very meaningful when testing 'hard insulated' generators.

*D. W. Hollands/p.w.*  
System Test Superintendent



# SOME HISTORY



# SOME HISTORY

- 3 Mid-1980s CGE hydro-generators
- Original 80pF capacitors
- Integrated into the winding during construction





# SOME HISTORY

- Limited access to install bus couplers – late 1990s



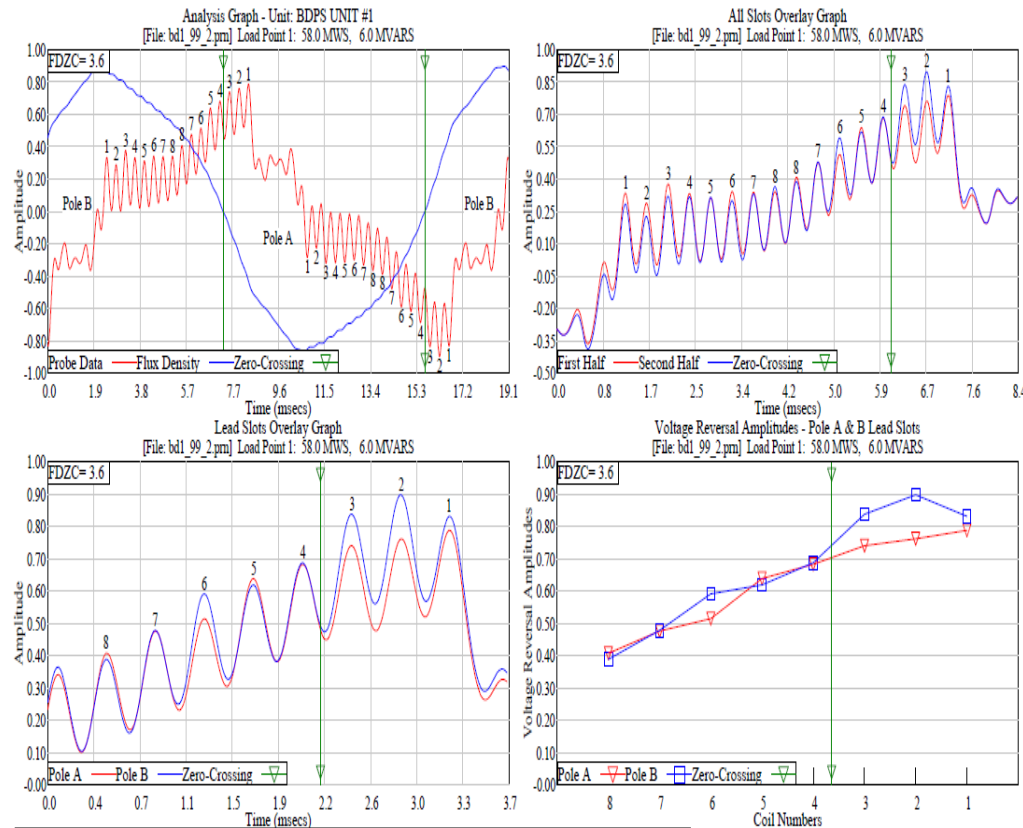
# SOME HISTORY

- Our first continuous PD monitors installed 2002
- Two generators of interest



# WHERE WE ARE NOW

- On-line 2 & 4 pole rotor shorted turn detection
- Air gap monitoring on select Hydro units
- Continuous PD monitoring installed on select hydro and thermal generators
- Continuous PD monitoring installed on critical Carbon Capture (CCS) 13.8kV motors
- Dissolved Oxygen on-line monitoring for water cooled stator windings
- OSI PI historian
- Remote monitoring & diagnostics





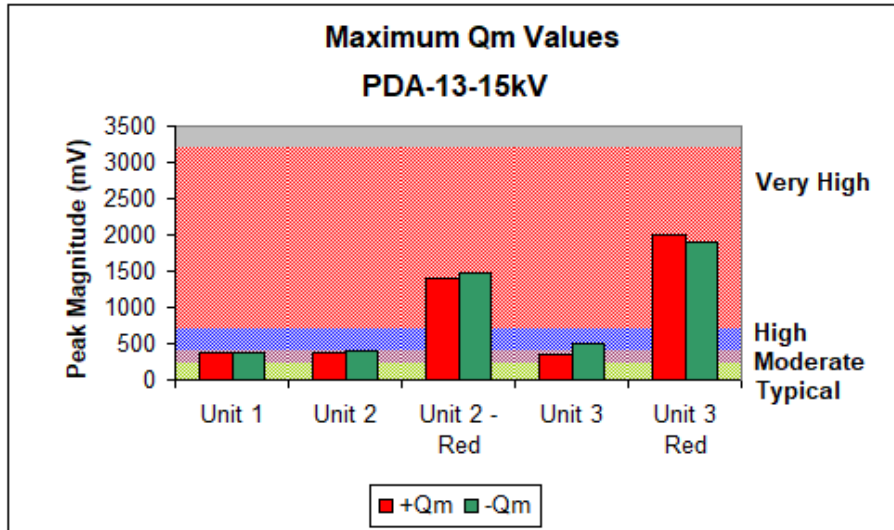
# INTERESTING CASES



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# INTERESTING CASES

- Patching & repairs
- Limited access
- Limited success



# INTERESTING CASES

- 2010 Unit 3 rewind
- What did we find?

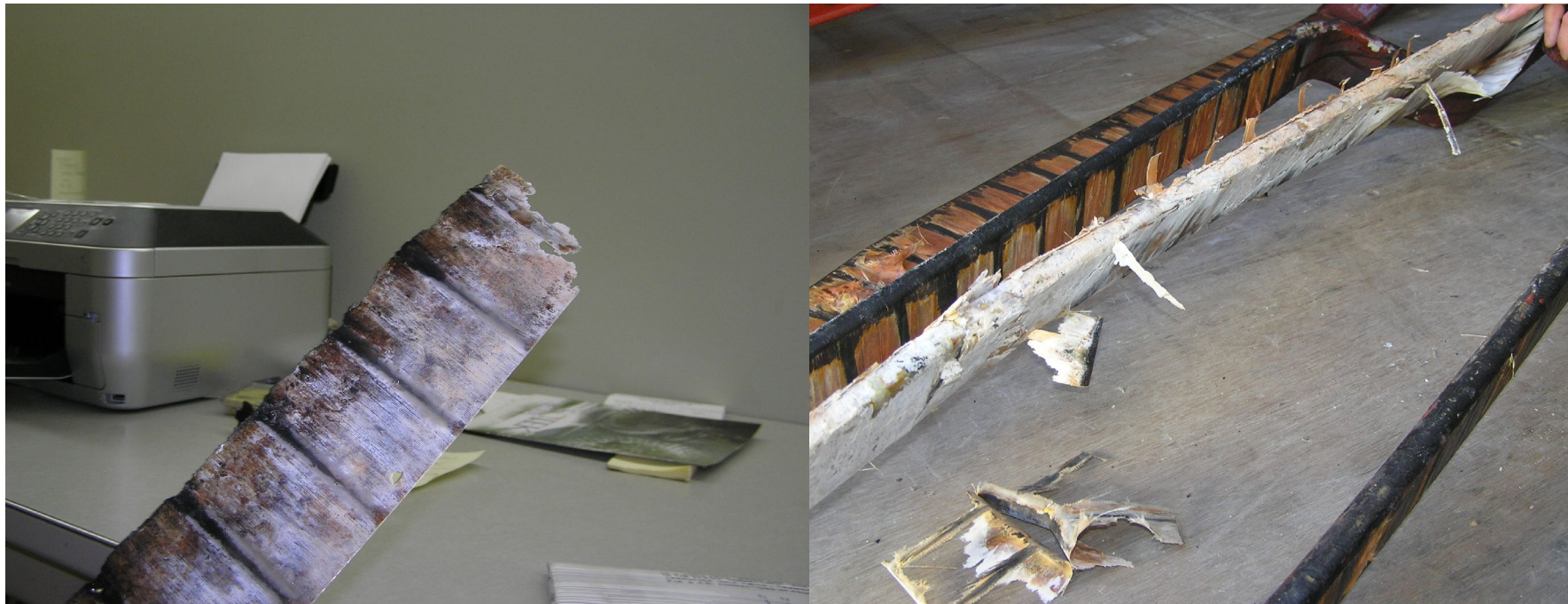


# INTERESTING CASES



# INTERESTING CASES

- 1968 hydro original winding - monitored high PD





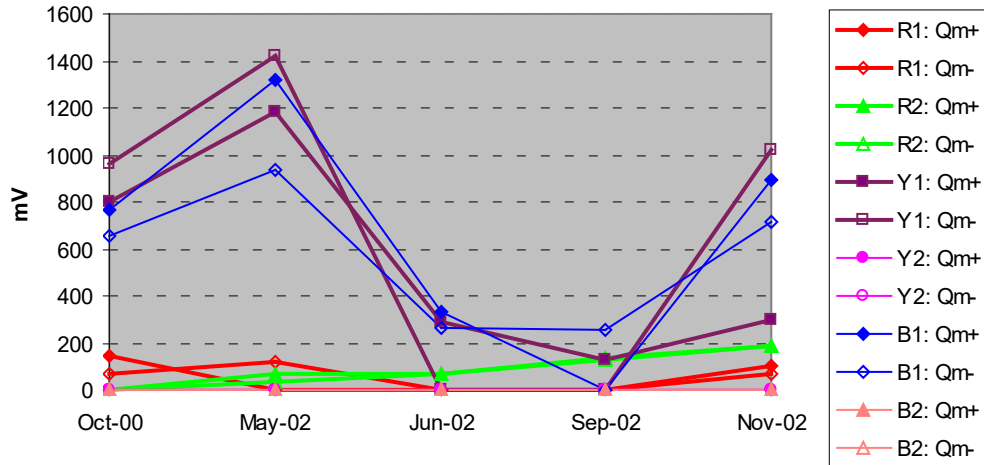
# INTERESTING CASES

- Mid-December 2001
- Split phase CT ground arcing
- Silicon sealant on bus penetration

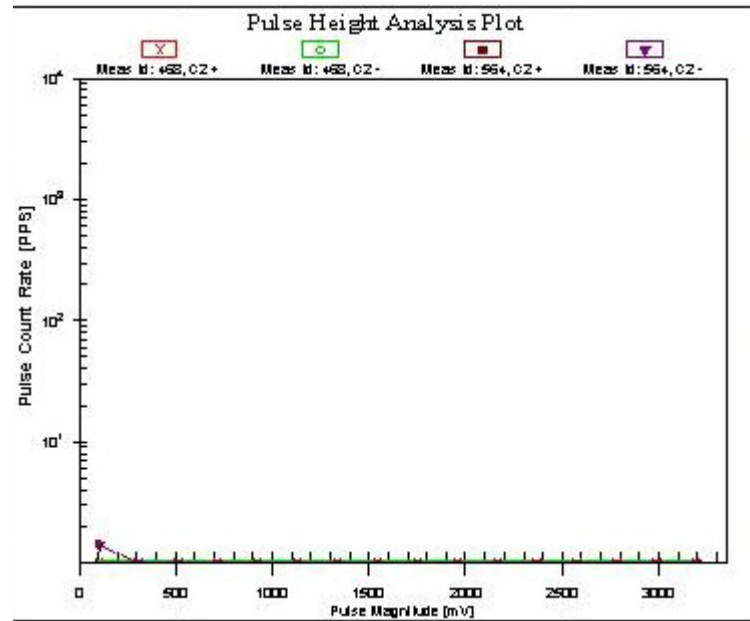
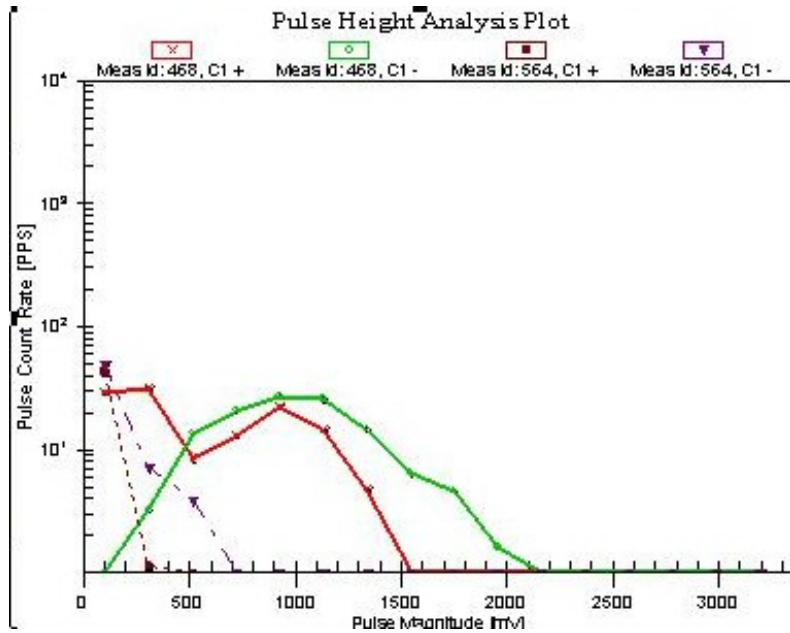


# INTERESTING CASES

Trend of PD Summary Variables



# INTERESTING CASES



# INTERESTING CASES

- Rebuilt hydro unit, high partial discharge detected on start-up
- Visual inspection revealed instrumentation conductor was the source and corrected



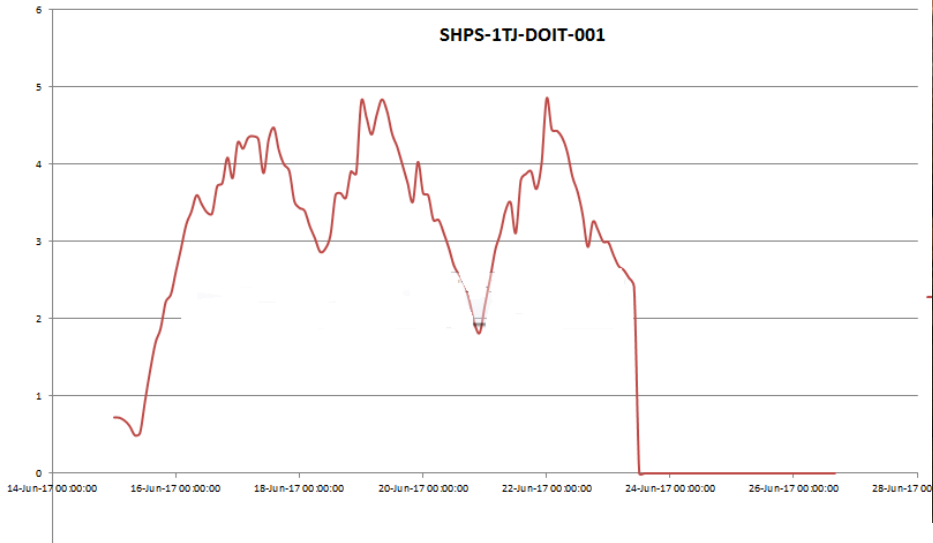
# SOME 'SAVES'

- Circuit ring vibration 2019 in service failure phase A-An (phase to neutral)
- Sensors installed on temporary repair
- On-line monitoring indicated excessive movement post-repair
- Validated phased repair steps



# SOME 'SAVES'

- Dissolved Oxygen (DO) deviations in stator cooling water system
- Several units, different causes



# WHERE WE ARE GOING

- 'core monitor' installed on 'important' unit
- Slip ring brush monitoring
- Hydro stator sole plate movement
- Endwinding vibration
- EMI
- Shaft voltage/current
- Digital Fault Recorders



# CHALLENGES

- Buy-in/costs/benefits
- Resources (review and maintenance)
- Transfer/capture of knowledge
- Typical electronics obsolescence management
- Cyber security





# QUESTIONS?

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