

CIGRE KEY TAKE AWAY 2020

SCA1 ROTATING ELECTRICAL MACHINES

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Dutch study committee NSC A1

Topic	2014	2015	2016	2017	2018	2019	2020
Dutch NSC A1 participants	5	9	13	17	21	21	21
Interested in NCS A1	0	10	7	4	3	4	3
Number of specialists participating in WG's	1	7	8	9	8	8	10
Number of WG's with Dutch participation		5	5	6	7	6	8

Working groups SCA1

Topic		WG's	Active Dutch Experts
A1.01	Turbo generators	6	6
A1.02	Hydro generators	12	0
A1.05	New technologies	3	1
A1.06	Motors	7	7

Publications

The following technical brochures were published in 2019 and 2020:

- TB 769 Dielectric dissipation factor measurements on new stator bars and coils
- TB 772 Turbogenerator stator windings support system experience
- TB 774 State of the art of stator winding supports in slot area and winding overhang of hydro generators
- TB 776 Factor quality assurance testing requirements for turbo generator components – stator bars

Including an Electra article

Publications

The technical brochure of the following WGs will be published soon:

- A1.33 Guide for cleanliness and storage of generators
- A1.43 State of the art of rotor temperature measurements
- A1.48 Guidance on the requirements for high speed balancing / over-speed testing of turbo generator rotors following maintenance or repair
- A1.49 Magnetic core dimensioning limits in hydro generators

Highlights technical e-session 25th and 26th of August 2020



The preferential subjects for Paris 2020 were the following:

- PS1 Generation mix for the Future
- PS2 Asset Management of Electrical Machines
- PS3 Latest developments

27 Papers were accepted.

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The provided papers concerned the following areas:

- Energy transition, rotating condensers and grid related topics 6 papers
- Partial discharge and vibration sparking 5 papers
- Service issues, operational maintenance and diagnostics 7 papers
- Machine design 6 papers
- Others 3 papers

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Energy transition, rotating condensers and grid related topics

- One paper states that “synchronous machines are holding us back” to evolve the power grid to facilitate renewables (A1-101)
 - This paper is pleading that a grid without synchronous machines is the far future
 - The frequency and voltage limits should be abolished

A question that raises is: Is the synchronous machine really the problem

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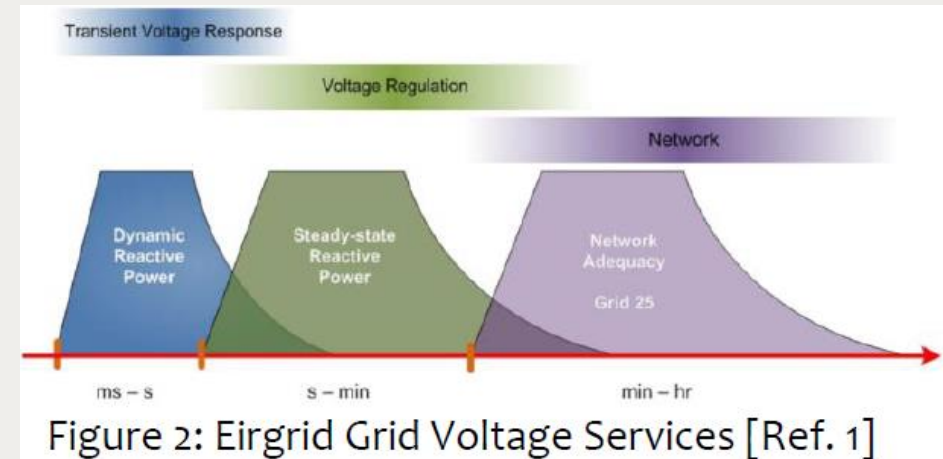
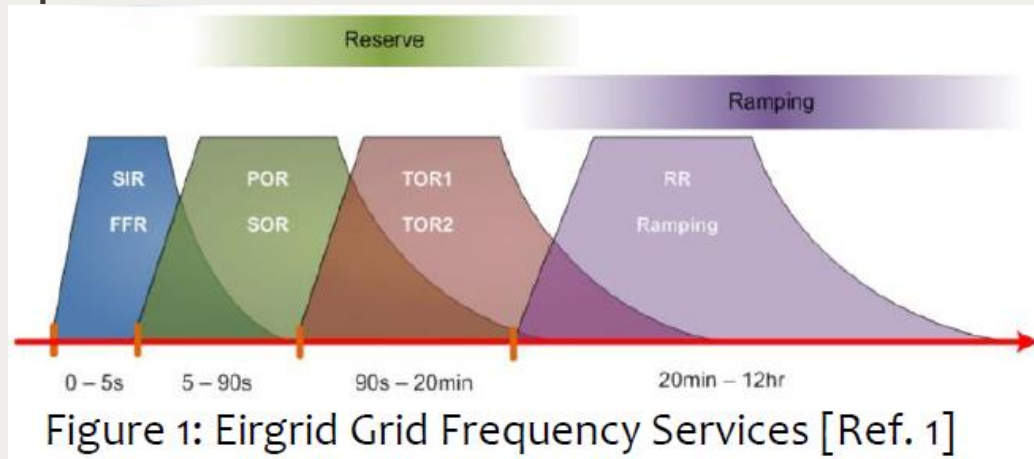


Energy transition, rotating condensers and grid related topics

- The other five papers discuss several solutions for short energy storage. Two interesting papers
 - 1) Static a synchronous compensator is compared with a (STATCOM) in combination with a battery energy storage system (BESS) (A1-102)
 - 2) Technical challenges of standardized synchronous compensators - not create every time something new (A1-304)

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Paper A1-102



Comparison between synchronous condenser with SVC and STATCOM in relation to functionality, technical performance, costs, others like lifetime

Conclusion: With current technology the synchronous condenser remains the best-economical choice when it relates to improving grid services such as inertia, voltage regulation and short-circuit power

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Paper A1-304

The investigation identified the synchronous condenser flywheel systems as the most effective solution for counteracting the decrease of network short circuit power and inertia.

Standard design synchronous condenser and flywheel to reduce costs, increase availability, maintainability and management of spare parts

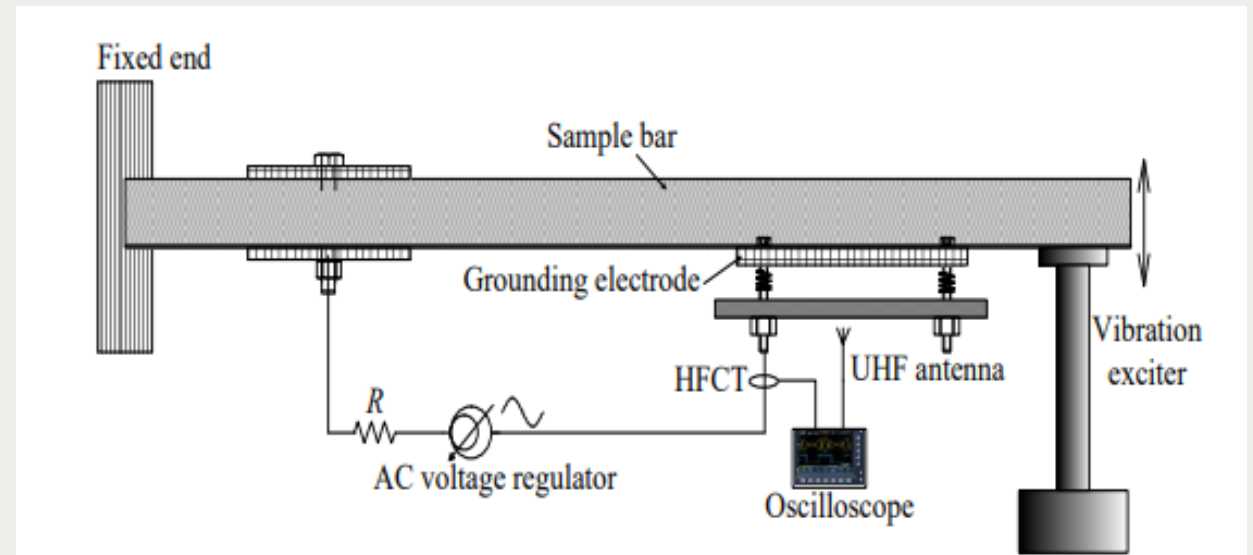
Technical important aspects:

- Design of flywheel
- Vacuum chamber, special cooling system for the flywheel vacuum chamber
- Mechanical brake
- Special emergency ventilation system
- Innovative monitoring system

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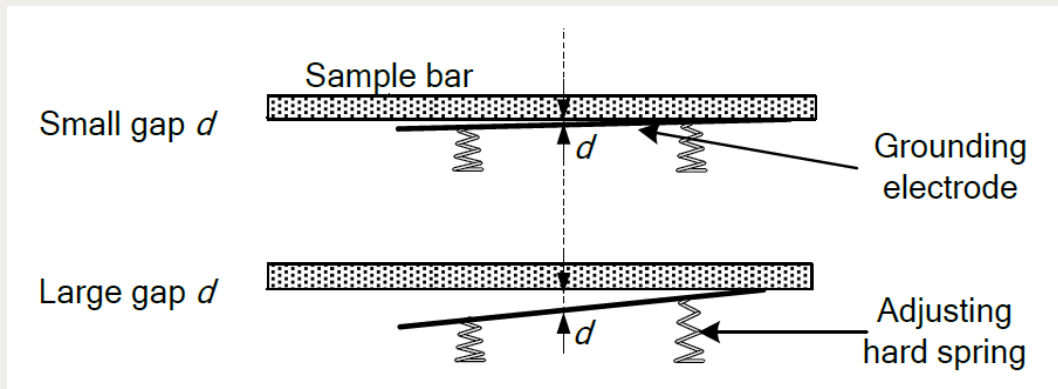
Partial discharge and vibration sparking

- One paper is related to vibration sparking (A1-201). The interesting fact of this paper is that an experimental study was carried out in which the influence of the following parameters were assessed:
 - The influence of the magnitude of the current
 - The influence of the size of the gap



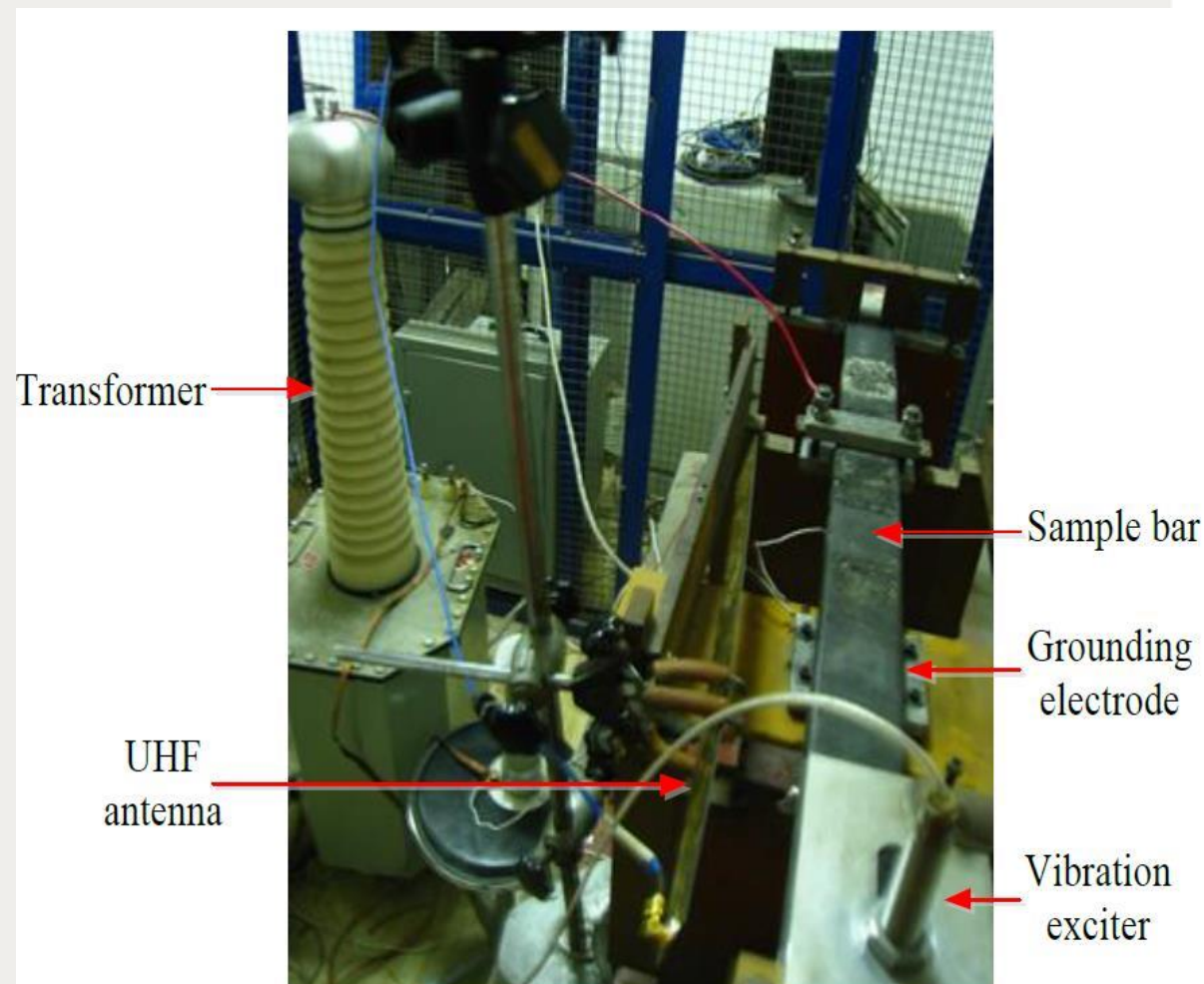
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Vibration sparking (A1-201)



The results showed that the development of vibration sparking in this experimental test had three stages:

- < 30h and > 70h: low average peak current and low number of sparks
- Between 30h – 70h: high average peak current and increased number of sparks



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Partial discharge and vibration sparking

- Five papers were related to partial discharge, some interesting ones:
 - Influence of temperature and load PD (A1-203): no significant relation was found
 - Off-line PD measurements on 50-year-old bars– comparison VLF and 50 Hz measurements (A1-205):
 - Similarity in phase resolved partial discharge patterns was found
 - As well as equal PDIV (partial discharge inception voltage)
 - However regarding maximum PD amplitude and repetition rate a clear correlation with frequency was found. 50 Hz measurements results in higher levels
 - Experimental study focused on VLF (A1-212):
 - VLF-PD measurements are substantially less sensitive for significant insulation problems

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Service issues, operational maintenance and diagnostics

- Three papers were focused on maintenance management based on on-line condition monitoring including modern data processing (A1-202, A1-204 and A1-208)
- Three papers were focused on rotor issues:
 - Detection of damper faults (A1-211)
 - Rotor eccentricity detection by analysis of the measured magnetic field (A1-302)
 - Mitigate rotor unbalanced pull by magnetic balancing (A1-303)
- One paper concerned a case study on storage of large turbo generators (A1-312)

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Service issues, operational maintenance and diagnostics

Detection of damper faults by means of a drop test (A1-211)

- The drop test is used to detect rotor shorted turns: shorted turns lead to a voltage drop on the concerned pole
- An AC voltage is applied to the rotor terminals and the voltage of each pole is measured. The three phases of the stator winding are short-circuited and grounded
- The voltage per pole = total voltage / number of poles
- The shorted turn lead to a drop of the voltage of the faulty pole and to a lesser extend at the neighboring poles

A finite element modelling study was performed because uncommon results in actual measurements in the field were found:

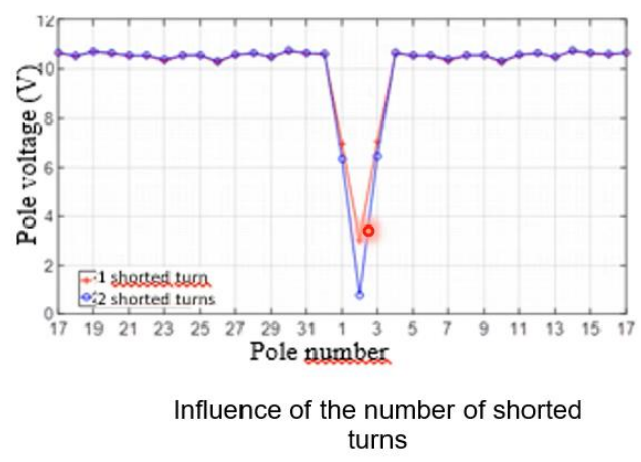
- Not only drops but also peaks
- Drops without shorted turns

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Detection of damper faults by means of a drop test (A1-211)

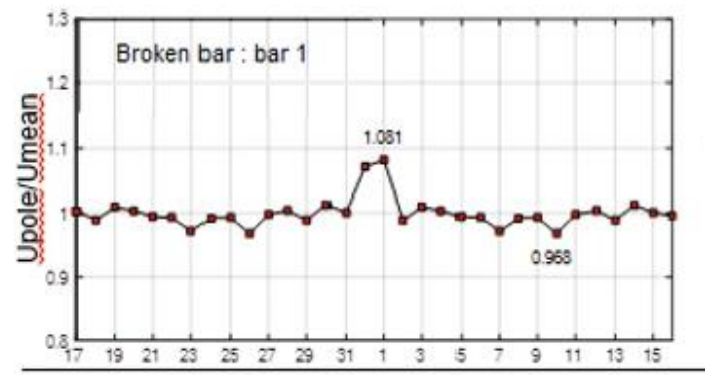
Simulations show the following:

With shorted turns



A shorted turn creates a drop

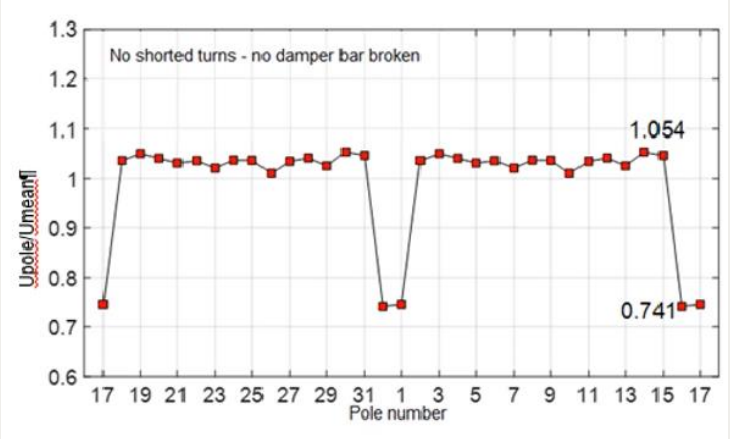
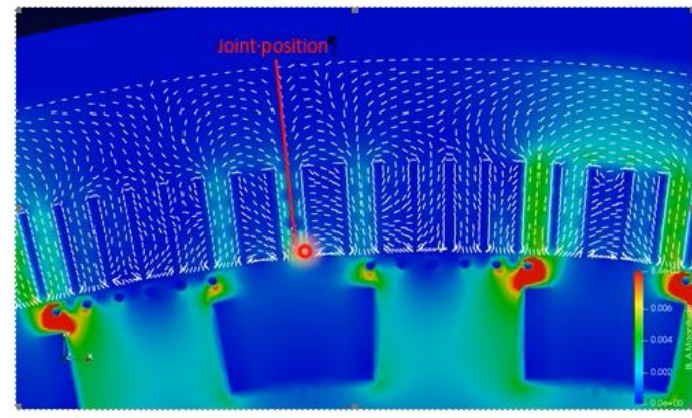
With broken damper bars



A broken damper bar creates a peak

- When rotor in stator
- When crack in one side bar

Without fault – With core joints



A core joint creates a drop too

Preview

The following symposium, conference, colloquium are scheduled for the coming years:

- Joint Symposium Ljubljana, Slovenia, June 1 – 4, 2021
- Cigre Centennial Meeting Paris, August 21 – 25, 2021
- Cigre Conference Paris, August 2022
- SC A1 Colloquium Kyoto, Japan, 2023
- Cigre Conference Paris, August 2024
- SC A1 Colloquium Moscow, Russia, 2025

THANK YOU FOR YOUR ATTENTION

