MAINTENANCE GUIDE

Grounding Application in Wind Generators

GENERATOR MAINTENANCE RECOMMENDED BEST PRACTICES

CONTENTS

Purpose and Scope

The purpose of this procedure is to provide guidance in installing the new Mersen HCH-4X1 ground brushes in those generators that are currently equipped with Mersen HCH-4 ground brushes. The procedure will also provide guidance in assessment of ground ring conditions and corrective actions that would be recommended for different levels of ground ring grooving in the relevant wind turbines.

RELEVANT COMPONENTS FOR THIS UPGRADE

- Turbines with Mersen OEM retrofit brush-holders are eligible for this upgrade.
- Figure 1 shows the brush-holder where this change applies. Figure 2 shows the HCH-4 brush which is now to be upgraded. Engraving on the brush can be used to identify the exact brush model.

Figure 1 - Ground brush-holder - Mersen retro kit for HCH-4X1

Figure 2 - HCH-4 ground brush

- Note: For optimum performance, brush grades/part numbers are not to be mixed. Identification for HCH-4 and HCH-4X1 brushes seen in Figure 3

Figure 3 - HCH-4 to be upgraded to HCH-4X1

- Engraving on brush indicates part number. New HCH-4X1 brushes are heavier and can be identified easily as seen in Figure 3.
- HCH-4X1 brushes now feature a base which will allow faster seating if a groove is present.

Figure 4 - HCH-4X1 brush with pre-machined base for faster seating into grooved or worn ground rings

- The turbine is to be inspected to determine if the generator is equipped with stainless steel or bronze rings. New HCH-4X1 brush is compatible with both bronze and stainless steel rings.
- Figure 5 shows the two primary types of slip rings found in the GE Hitachi wind turbines: stainless steel and bronze

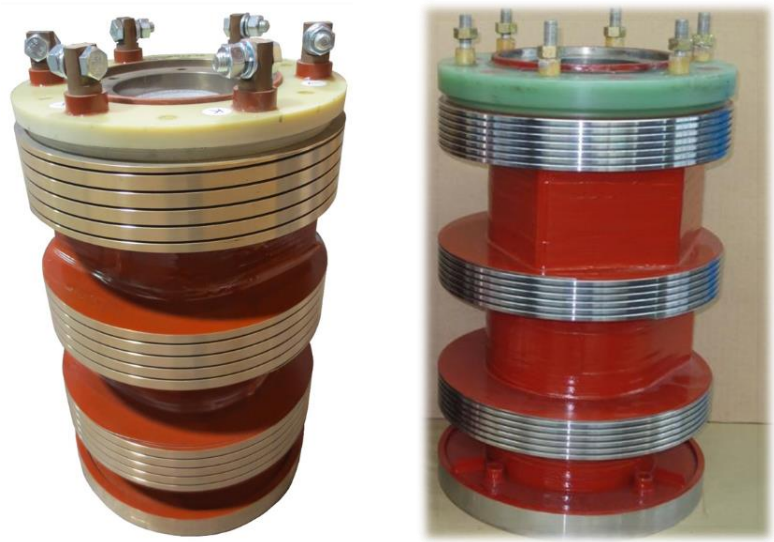

Figure 5 - (Left) Mersen SR 13-15 bronze ring
(Right) Stainless steel ring

- If unit is equipped with Mersen rings and brushes, inspect to determine if generator is equipped with HCH-4 Ground brushes. See Figures 2 and 3.
- HCH-4X1 brush is heavier and a technician can differentiate it immediately based on engraving and weight difference
- If unit is equipped with Mersen HCH-4 ground brushes, those ground brushes are recommended to be removed and replaced with the updated HCH-4X1 ground brushes

INSPECTION PRACTICES

Figure 6 shows the varying degrees of ground ring grooving in a wind generator.

The ring surface and Total Indicated Runout (TIR) are possibly affected by high frequency shaft noise or "common mode current" over the course of the turbine's life. Increasing the number of ground brushes on the ground ring does not usually solve the problem but only provides temporary relief. A number of solutions to address this phenomena are available. Analysis and corrective actions are listed in the below sections.

Figure 6 - Varying degrees of ground ring grooving from EDM effect

- If a ring has a groove developed in it – either one of 2 actions can be adopted:
  - If groove depth less than 0.5mm: Use emery cloth to sand edges of brush to ensure that the brush sits in the grooved slot and makes contact with the ring. Monitor ground ring in every maintenance cycle for groove depth change. Allowing the turbine to run in "speed control" mode at 300RPM for 30 minutes before going online also helps to seat in the brush. Brush seating inside grooved ground ring brush track is illustrated in figure 7:
  - A technician can check the brush contact face before bringing the turbine back online to verify if the seating method above improved contact area under brush. Visual guide is provided below

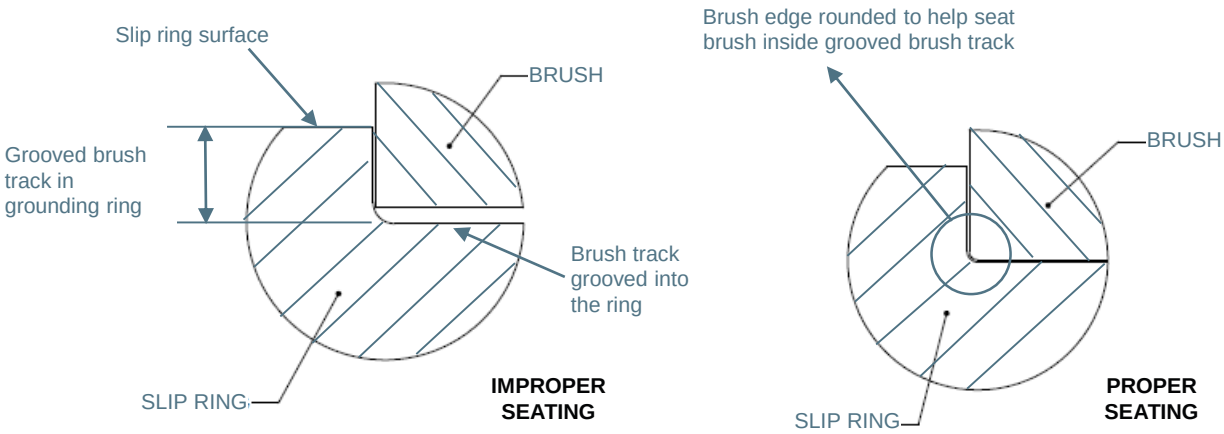

Figure 7 - Brush seating into groove on ground ring
(drawing not to scale)

  - If groove depth is greater than 0.5mm: we recommend to use the Mersen portable up-tower lathe to machine the slip ring.
  - Mersen offers training and up-tower service on site for the portable lathe. Please enquire for further details.
  - In extreme cases, when the groove depth exceeds 1.5mm, slip ring replacement should be considered.

- Measuring Total Indicated Runout (TIR) of slip rings:

  Slip ring surface condition is one of the key factors for optimum brush performance. A technician can easily measure TIR to identify the condition of a slip ring, using various tools.

  Two of the most common methods are a dial indicator, or a digital tool, the CL-Profiler. Both methods can help a site to analyze their slip rings and identify the candidates for repair/replacement. The dial indicator however lacks accuracy and does not allow recording the data for future reference.

  Figure 8 illustrates both tools.

  The probe is placed on top of the brush clip or a flat surface on top of the brush to detect the brush movement in its holder. A magnetic base holds the CL-Profiler probe in place as shown.

Figure 8 – Dial indicator (Left) – CL-Profiler (Right)

Mersen technical support can provide on-site analysis and training for the CL-Profiler tool.

An example of a good slip ring inspected using the CL-Profiler tool is in Figure 8 page 6.

TIR of the ring show below in Figure 9 is 1.40mils (=0.0014in). This ring is within operation specifications.

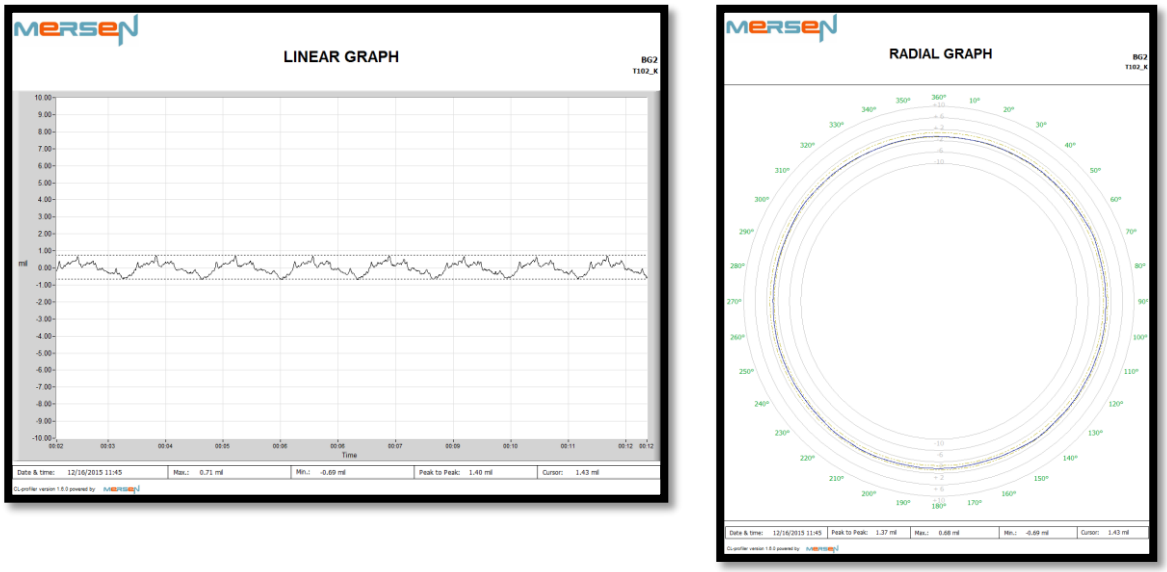

Figure 9 – CL-Profiler inspection of a slip ring within operation specifications

As slip rings undergo wear and tear, their surface imperfections can be captured accurately and Figure 10 shows one such example of a slip ring needing attention.

The ring shows a TIR of 16.76 mils. Recommended TIR for normal operation is <3mils.

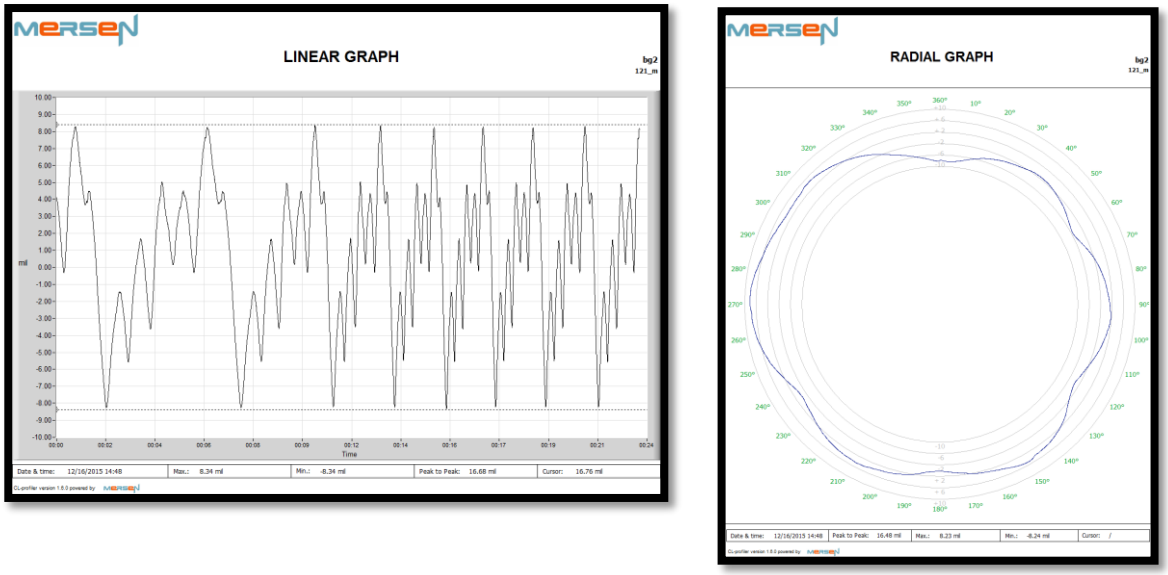

Figure 10 – CL-Profiler inspection of a slip ring needing attention

CORRECTIVE ACTIONS AND INSTALLATION PROCEDURE

Once a slip ring has been identified as a candidate for re-surfacing, there are a few possibilities of corrective actions. The Mersen portable lathe for up-tower generator slip ring resurfacing is one of the quickest methods to bring a slip ring back into operational specification.

On a day with good winds, slip ring pin-wheeling at 300-400RPM should suffice for this operation. A trained operator can complete setup and machining of the ground ring in 1-1.5 hours. All phase rings and ground rings can be re-surfaced in around 2.5 hours.

Please refer to Mersen Portable Lathe instruction manual for safe operation and usage instructions.

Figure 11 shows a lathe in position inside the slip ring cabinet. If the phase rings are in normal operating condition, the portable lathe can be used to resurface the ground ring only, by itself. The CL-Profiler can be used to verify a slip ring's runout after it has been re-surfaced using the portable lathe.

Mersen offers technical training and hands on up-tower training sessions for the portable lathe.

Figure 12 shows the ground ring before and after the lathe was used to correct surface imperfections.

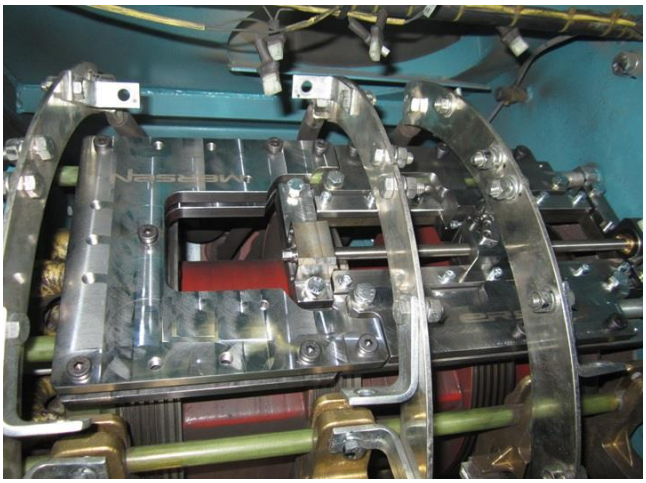

Figure 11 - Mersen portable lathe in place inside the slip ring cabinet

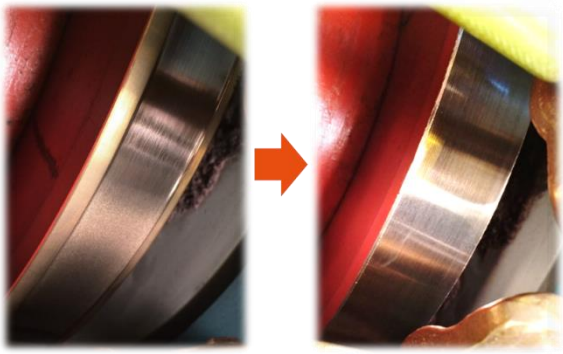

Figure 12 - Mersen Hitachi Lathe and machining of ground ring. Before (Left) and After (Right)

- Recommended Brush Seating procedure as per Figure 13:
  - Seat ONLY 2 brushes at once.
  - Seat a brush in its final intended position in the holder.
  - Slide the garnet paper underneath the brushes as shown.
  - Fit the springs on the brushes.
  - Slide the abrasive paper back and forth as shown on the right till 80% or more of the brush face is making contact with the abrasive paper (refer schematic).
  - Use abrasive strips of sand-paper or garnet paper 60/80 grit when heavier sanding is required.

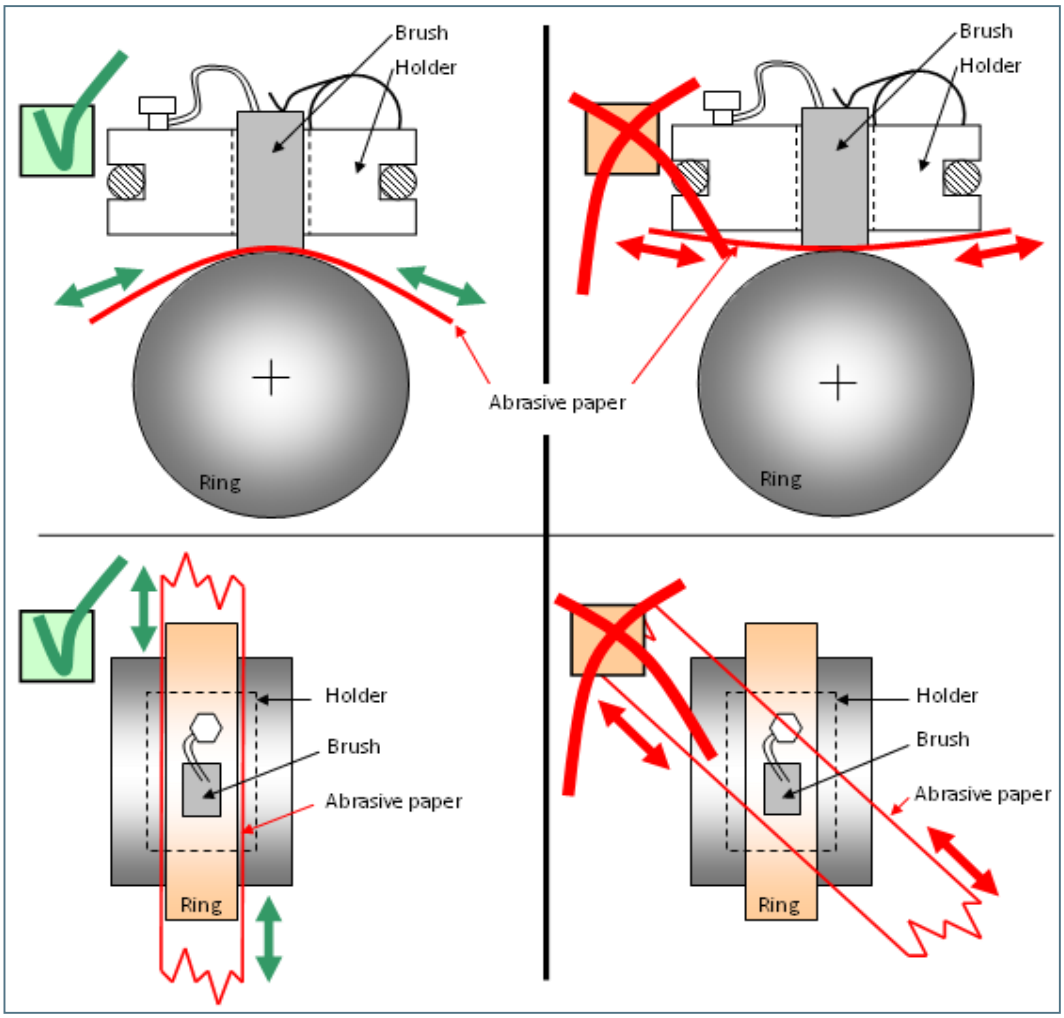

Figure 13 - Brush seating process

- Checking Brush Spring pressures and springs for lost tension. Recommended pressure on brushes is 3-6 PSI for optimized wear patterns. Springs can be checked visually or by using a fish scale. Uncoiled springs as shown below in Figure 14 will result in improper brush wear patterns. Springs should sit centered on the brush for optimum operation and pressure delivery on top of brush.
- Mersen recommends replacing springs once every 4-5 years of normal operation. If a turbine experiences a flash event, or if slip ring runout is resulting in significant brush vibration, a spring change is recommended to bring the brushes back into stable operation.

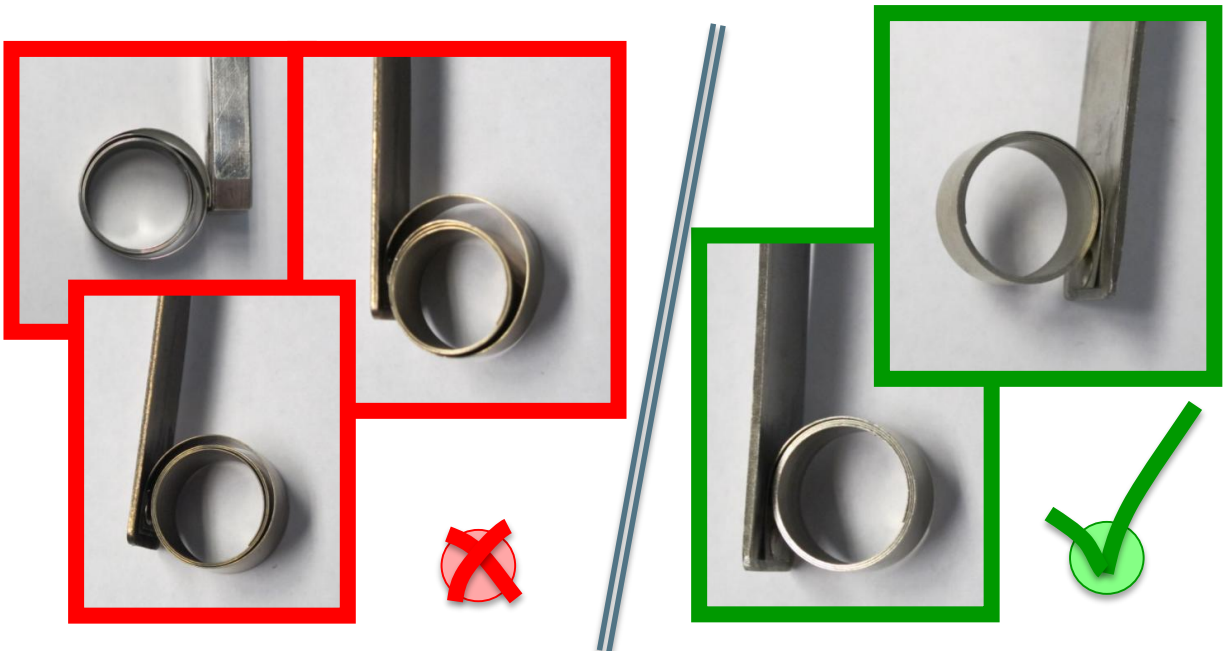

Figure 14 - Visual check for spring condition

- Final Inspections – PERFORM a final visual check to ensure that all connection / mounting hardware is secure, and that the area is free of dust, rags, tools, hardware, etc. prior to bringing the turbine back online.

RETURN GENERATOR TO ACTIVE SERVICE

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