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C-A OPERATIONS PROCEDURES MANUAL

15.3.1.3 AGS Main Magnet Rebuild

(Booster/AGS Ring Power Supply Systems Group Procedure EPS-A-003)

Note: This document was formerly a C-A Group Procedure. The content of the group procedure was reviewed by the Technical Supervisor. All approvals and/or issue dates of the original group procedure are maintained for present use.

Hand Processed Changes

<u>HPC No.</u>	<u>Date</u>	<u>Page Nos.</u>	<u>Initials</u>
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Approved: \_\_\_\_\_ Signature on File \_\_\_\_\_  
 Collider-Accelerator Department Chairman                      Date

M. Bannon

Booster/AGS Ring Power Supply Systems  
Group Procedure EPS-A-003  
Revision 00

## CHECKLIST TO ASSEMBLE MAIN MAGNET

1. Clean out coil gap. [ ]
2. Put in two upper coils in lower gap. [ ]
3. Install upper Micarta channel [ ]  
(1) Spacers on channel should face front of magnet.
4. Lift upper coils into place [ ]  
(1) Make sure that end spacing on bus bar end is correct; use spacer block on this.
5. Clamp with temporary end clamps, use "C" clamps to make secure. [ ]
6. Install lower channel and Micarta spaces on lower brackets. [ ]
7. Install lower coils and space as same as upper coils. [ ]
8. Install wedge jacks. [ ]
9. Install coil support jacks. [ ]
10. Install coil clamps on top coils. [ ]  
(1) Make sure that Micarta insulators are made square with coils.
11. Install pressure plates and insulation and tighten lock bolts on top coils. [ ]
12. Remove temporary end clamps. [ ]
13. Install coil clamps on lower coils [ ]  
(1) Make sure that spacers are square with coils.
14. If coil clamps do not take up on insulators loosen four nuts on coil clamps  
and adjust by moving clamps. [ ]
15. Install fiberglass covers. [ ]

**CHECKLIST TO DISASSEMBLE MAIN MAGNET**  
**MAIN RING DIPOLE MAGNET REMOVAL CHECKLIST**

**MAGNET #** \_\_\_\_\_

1. Power to the magnets must be LOTO. [ ]
2. Power to the woodsmetal circuit secure and LOTO at MCR. [ ]
3. Power to any back leg winding must be LOTO.
4. Vacuum Group must secure high voltage to vacuum pump. [ ]
5. Equipment adjoining the magnet being worked on must be LOTO. [ ]
6. Magnet must be surveyed before removal.
7. Pump Room will secure water and remove necessary hoses. [ ]
8. Power Supply Group will disconnect any NU-Quad or dipoles. [ ]
9. RF Group will disconnect PUE'S.
10. Vacuum Group will vent sectors.
11. Vacuum Group will release clamps and remove seals on pipe .[ ]
12. Power Supply Group will disconnect and remove
  - a.) Main magnet bus
  - b.) Low field backleg winding (label before removal) [ ]
  - c.) Power backleg winding (where applicable; label cables) [ ]
  - d.) Woodsmetal wiring (label before removal) [ ]
13. Remove beam pipe ground where applicable. [ ]
14. Magnet is now ready to be removed from girder. [ ]

## AGS RING MAGNET “B” ASSEMBLY

1. 4 Short Coils D03-M-669-5
- 5 Wedge jacks, Brass D03-M-899-1
- 5 Wedges, shotted, Micarta D03-M-897-1
- 5 Wedges, Guidehole, Micarta D03-M-972-1
- 10 Wedges, Plain, Micarta D03-M-896-1
- 5 Coil jacks, Brass D03-M-674-1
- 10 Coil jack spacers, S/S D03-M-673-1
- 10 Coil jack insulators, Micarta D03-M-672-1
- 2 Channels, 70” long, Micarta D03-M-895-4
- 2 End brackets, short, Alum. D03-M-676-4
- 2 End brackets, long, Alum. D03-M-678-4
- 2 End bracket pressure plates, Alum. D03-M-683-2
- 2 End bracket insulators, Micarta D03-M-682-2
- 16 End bracket set screws, 5/8” x 11 NC Allen Hd. Recessed, S/S
- 56 5/8” x 11 NC locknuts
- 72 3/4” x 10 NC cad. plated threaded studs D03-M-874-1
- 10 Coil support brackets D03-M-677-4
- 72 3/4” lockwashers, S/S
- 72 3/4” x 10 Hex nuts, S/S
- 72 3/4” cutwashers, S/S
- 40 5/8” x 11 NC set screw Allen Head, S/S
- 10 Front bracket clamp plates, Alum. D03-M-680-1
- 10 Front bracket clamp plate insulators, Micarta D03-M-971-1
- 10 Coil clamp plates, Alum. D03-M-684-1
- 10 Coil clamp plate insulators, Micarta D03-M-681-1
- 20 5/8” x 11 clamp plate Hex Head cap screws, S/S
- 20 5/8” locking nuts, Hex, S/S (Nylock)
- 20 5/8” cutwashers, S/S
- 20 5/8” lockwashers, S/S
- 10 Clamp plate insulators, Micarta D03-M-679-2
- 1 Set Fiberglass coil covers, “B” Magnet
- 2 End Bracket pressure plates, Alum. D03-M-875-2
- 2 End Bracket insulators, Micarta D03-M-876-2

# MAIN MAGNET POWER SYSTEM

## Technical Work Document for Changing AGS Main Magnet Coils

### 1. Introduction

This procedure is to be used when coils have to be changed on the AGS Main Magnets in the ring. The procedure is applicable for both maintenance periods and emergency changes.

### 2. Preparation

The MMPS must be shutdown and the Ring Magnet circuit grounds and tagged out at the 242 magnet area. The Wood's metal control circuit breaker must be shut off and tagged out. All magnet parts and tools are to be assembled and readied before Ring entry.

### 3. Prerequisites

3.1 The following tasks must be performed prior to removal of magnet from girder:

3.1.1 HP to check magnet area for radiation.

- a) If >100mr area must be posted a HIGH RADIATION AREA. This could prevent magnet from being removed from ring to be worked on in the assembly area.
- b) Dose rate must be less than 1000 mrem/hr. \_\_\_\_\_
- c) Individual dose must be less than 100mrem \_\_\_\_\_
- d) Collective dose must be less than 200 mrem \_\_\_\_\_
- e) Contamination must be less than 1000dpm per 100cm<sup>2</sup> \_\_\_\_\_
- f) Activation check required \_\_\_\_\_
- g) Contamination check required \_\_\_\_\_

3.1.2 Magnet to be surveyed by survey group.

3.1.3 Power Supply Group shall remove nu-quads and RF Group remove the PUE'S.

3.1.4 Vacuum Group shall remove chamber. (For closed magnets the Vacuum chamber will be removed after magnet is off girder).

3.1.5 Pump Room Group shall disconnect water system for magnets as well as main magnet bus work.

3.1.6 Remove bus and disconnect small backleg windings and woodsmetal button wiring (label cables for easy re-installation).

3.2 Riggers shall remove magnet from girder and put on four “C” blocks at selected ring location or transport magnet to 911a assembly area. (HP resurvey required prior to the removal of magnet from the ring and have it smeared for contamination concerns.)

3.2.1 Leave room for removing coils.

3.2.2 If the magnet has large backleg windings, leave about 100 ft. upstream and 100 ft. downstream as a work space.

3.3 Have HP check the magnet for radiation on the upstream and downstream ends and inside the gap of the magnet. If needed, have a smear test done.

4. **Workforce Requirements**

Three (3) people are required for replacing coils. If the magnet has large backleg windings, then four (4) people are required.

5. **Detailed Work Procedure**

After preparation and prerequisites are completed, the removal of the coils shall proceed as shown in Appendix I.

**Notes::**

- 1) Some magnets have old type bus installation and some are conversion type.
- 2) Magnets are either long or short type; as well as open or closed type.
- 3) Some magnets have large backleg windings, which consist of:
  - a. Pre-form
  - b. 250 MCM
  - c. #6 wire
  - d. 3/0
  - e. 4/0

Some of the 3/0 or 4/0 cable is flexible, some quite stiff. All large backleg windings are to be removed first before removing coils.

4. Replace any Micarta pieces that are radiation damaged.
5. All AGS work and safety procedures shall be followed.

## TOOLS REQUIRED

1. Vacuum cleaner (radiation use).
2. Drop lights (2).
3. Blocks of wood, 2 x 4 (12 pieces).
4. Nylon slings if needed (2) (from box remove coils).
5. Tools made for magnet work:
  - a. Pancake lifting rig
  - b. coil positioning blocks
  - c. coil support clamps
  - d. jack support rig
6. Tools needed:
  - a. Allen wrench 3/8"
  - b. Allen wrench 5/16"
  - c. Socket 1/2" drive 15/16"
  - d. Socket 1/2" drive 3/4"
  - e. Ratchet 1/2"
  - f. Break bar 1/2"
  - g. Socket 3/8" drive 1/2"
  - h. Socket 3/8" drive 5/8"
  - i. Socket 3/8" drive 7/16"
  - j. Socket 3/8" drive 9/16"
  - k. Ratchet 3/8"
  - l. Wrench box/open 7/8"
  - m. Wrench box/open 3/4"
  - n. Wrench box/open 1/2"
  - o. Wrench box/open 5/8"
  - p. Wrench box/open 9/16"
  - q. Wrench box/open 7/16"

## Appendix I

### Detailed Work Procedure for Removing and Reinstalling Pancakes

See Dwg. D03-M-671

#### 1. **Preparation (Picture #1)**

- 1.1 Remove magnet lifting rig.
- 1.2 Remove all water connections on coils to be replaced (Pump Room).
- 1.3 Remove all bus work, clamps, cross-over pieces (2):
  - 1.3.1 On conversion magnet, remove ring bus support bracket.
  - 1.3.2 On other magnets, support bracket remains.
  - 1.3.3 Remove woods metal (4)

#### 2. **Removal of Jacks and Wedges (Picture #2 & #3)**

- 2.1 Remove large jacks (orange) one at a time, put one in each corner as shown and sock up tight.
  - 2.1.1 There are 6 jacks on a long magnet and 5 jacks on a short magnet.
- 2.2 Remove the remaining jacks (orange).
- 2.3 Install temporary support clamps on the top coils. There are different clamps for long and short magnets.
- 2.4 Remove all small wedge jacks (blue). There are 6 wedges on a long magnet and 5 on a short magnet.
- 2.5 Remove the clamps (green) and loosened Micarta pieces (red).

#### 3. **Removal of Corner Jacks (Picture #4)**

- 3.1 Remove the 4 corner jacks that were installed in Step 2.1.

#### 4. **Pancakes #3 and #4 Removal (Picture #5)**

- 4.1 Using the wooden paddle, lift an end of the freed coil one at a time and put a small 2 x 4 block between the coils.
- 4.2 Repeat step 4.1 for the other end of the coil.
- 4.3 Use the coil lifting rig for removal of the coils.
  - 4.3.1 Remove coil #3 first.
  - 4.3.2 Then coil #4 is removed.
- 4.4 After both bottom coils have been removed, remove remaining Micarta pieces (red) and (purple) as well as wedges (yellow).

#### 5. **Pancake #1 and #2 Removal (Picture #6 & #7)**

- 5.1 Using the coil lifting rig, lower #1 and #2 coils to position where #3 and #4 coils were.
- 5.2 Remove Micarta pieces (red) and (purple) when coils are in lower position.
- 5.3 Remove coils #1 and #2 as described in steps 4.1 to 4.4

6. **Reinstallation of Coils**

- 6.1 Place coils #1 & #2 in lower position.
- 6.2 Replace Micarta pieces (red & purple).
- 6.3 Using coil lifting rig, raise coils #1 & #2 to top position.
- 6.4 Align coils using coil position blocks.
- 6.5 Install top coil temporary support clamps (see picture #3) before removing lifting rig.
- 6.6 Replace lower Micarta pieces (red & purple).
- 6.7 Install lower coils #3 & #4 using lifting rig.
- 6.8 Align coils using coil position blocks.
- 6.9 Reinstall 4 corner jacks (orange). Snug up jacks do not over tighten. Refer to picture #3.
- 6.10 Put clamps (green) on bottom coils but do not tighten. Add Micarta pieces (red) in clamp area.
- 6.11 Remove top support clamps.
- 6.12 Reinstall wedges (yellow) on top and bottom. Tape wedges at ends.
- 6.13 Install small jacks (blue) and tighten so jack is not too tight between the wedges.
- 6.14 Using T-bar and jack support rig, tap wedges gently putting jack and wedges in proper position.
- 6.15 Tighten all small jacks.
- 6.16 Tighten all clamps (green)
  - 6.16.1 Move inside corner jacks to final position and tighten.
  - 6.16.2 Then install previously removed jacks into final position and tighten.
  - 6.16.3 Move outside corner jacks to final position and tighten.
- 6.17 Reinstall cross-over pieces.

7. **Insulation Tests**

All coils must be tested before they are put back into service. The following tests shall be done based upon the condition of the replace coils following Ring magnet Insulation test procedure.

- 7.1 If some of the coils were not replaced, then all coils shall be tested with 1000v megger.
- 7.2 For reconditioned or new coils a 7500v High potential test shall be performed.

8. **Reassembly for Service**

- 8.1 Have Pump Room personnel replace coil water connections.
- 8.2 Replace bus work and clamps.
  - 8.2a Replace woods metal (4)
- 8.3 On conversion magnets, replace ring bus support bracket.
- 8.4 For closed magnets have Vacuum personnel install vacuum chamber.
- 8.5 Reconnect Back Leg windings.
- 8.6 Have riggers replace magnet onto girder.
- 8.7 Have power supply group replace NuQuads and RF Group replace PUE's.

- 8.8 Reconnect magnet to Ring bus.
- 8.9 Have pump room reconnect water connections.
- 8.10 Have magnet surveyed.
- 8.11 Inform MCR that locks and tag will be removed and then remove all locks and tags.
- 8.12 Upon instruction from MCR restart MMPS.

Before a magnet rebuild is started note the serial # and position of the coils in the magnet.

Magnet # \_\_\_\_\_

Position 1	S/N _____
Position 2	S/N _____
Position 3	S/N _____
Position 4	S/N _____

After the rebuild

Magnet # \_\_\_\_\_

Position 1	S/N _____
Position 2	S/N _____
Position 3	S/N _____
Position 4	S/N _____