MAGNET RECYCLING

M. Negrazus, D. George

During the past year, a number of projects could be realised by modifying old magnets or by using magnetic quality steel taken from scrapped spectrometers. A solenoid was provided for the UCN experiment by modifying an old calibration magnet. Spare yokes were manufactured for the AHA, AHB, AHC, AND01 and AND02 proton beam line magnets. For the LEM project, we could produce three large pieces of the WSX return yoke together with yokes for the ASR61 and ASR62 bending magnets.

INTRODUCTION

A number of large spectrometer magnets have been used at PSI over the years. For three of these systems, their useful life came to an end. There is a limit to the knowledge to be gained and they have to give way to new methods and ideas. Such magnets are normally made using high quality magnet steel. After the magnets had been carefully disassembled, we were left with a large reservoir of raw material. In view of the present situation with the ongoing rationalisation processes in the steel industry and the resulting difficulties in obtaining good quality magnet steel in small quantities at a reasonable price, this presented an opportunity not to be ignored. Since the Von Roll Company in Gerlafingen, Switzerland closed the magnet steel production section, there is no Swiss manufacturer in this field.

A PILE OF STEEL FROM 3 SPECTROMETERS

The spectrometers in question are:

- The Pair Spectrometer AEB, weighing 112 tons including 100 tons of steel.
- The Low Energy Pion Spectrometer LEPS, which was built and paid for by the Karlsruhe Research Centre in Germany. See Fig. 10.
- The Susi TSA Spectrometer, consisting of two spectrometer magnets with a total of about 80 tons of steel.

During the dismantling process, the steel must be carefully checked for the radiation level. Only steel which is declared as non-radioactive can be used for new magnets. The resulting pieces of steel come in all shapes and sizes. Small pieces, which do not appear to be of useful dimensions, are scrapped immediately. Very large pieces are difficult to dispose of and generally get in the way. Storage space is a chronic problem at PSI and there is great pressure to dispose of scrap as quickly as possible. Luckily, we now have a useful pile of steel behind the experimental hall.

NEW MAGNETS

The following list of magnet yokes made out of the three spectrometers is presented with their pictures:

The AHA, AHB, AHC, AND01 and AND02 magnets form parts of the 590 MeV Ring extraction and 72 MeV injection proton beam lines respectively.

Fig. 1: The PSI magnet steel reserve.

Fig. 2: The WSX solenoid base plate weighing 4.7 tons. The WSX forms part of the new μE4 beam line (LEM beam line). The plate did not have to be machined for the thickness of 450 mm.

Fig. 3: The two larger lower pieces will form the magnet yoke for a spare AHC magnet. The blocks on top are for a spare AHB magnet. AHB weighs about 4 tons and AHC 15 tons.

Fig. 4: The WSX solenoid upper return yokes each weighing 1.22 tons.

Fig. 5: Four yokes for two spare AHA magnets. Together, they weigh about 2.3 tons. This magnet is the 590 MeV Ring extraction magnet, which operates within the vacuum chamber of the cyclotron and is exposed to radiation due to the extraction losses. Maintenance is therefore difficult and it is imperative to have spares ready for operation. This work is performed by our colleagues from ABE.

Fig. 6: The exposed pole of the BBC magnet after drilling.

Fig. 7: The upper picture shows the two halves of the ASR61 yoke, which were cut out of Susi TSA Spectrometer pole plates together with the top and bottom yoke sections of the ASR62 magnet (lower picture). The original thickness of 180 mm was retained. Each ASR61 piece weighs 550 kg and the ASR62 sections each weigh about 450 kg. The missing top and bottom corners on the left hand sides are part of the original pole geometry but have no effect on the performance of the new magnets. These magnets are also part of the new μE4 beam line (LEM beam line).

OLD MAGNETS

Many years ago, we were given a 5 tons calibration magnet by BBC (now ABB) Oerlikon. Despite sporadic use for tests, the magnet had not proved to be a very valuable acquisition. However, when we were approached by the UCN experimental group, looking for a somewhat exotic magnetic solenoid field, we found that their requirements could be realised by drilling a large hole through the yokes and poles of our gift. The result can be seen in Figs. 6 and 8.

Fig. 8: The modified 5 ton BBC magnet after drilling the central large hole, four new bolt holes and a ring of threaded holes to attach the experimental vacuum chamber. This work was performed at PSI in the main workshop.

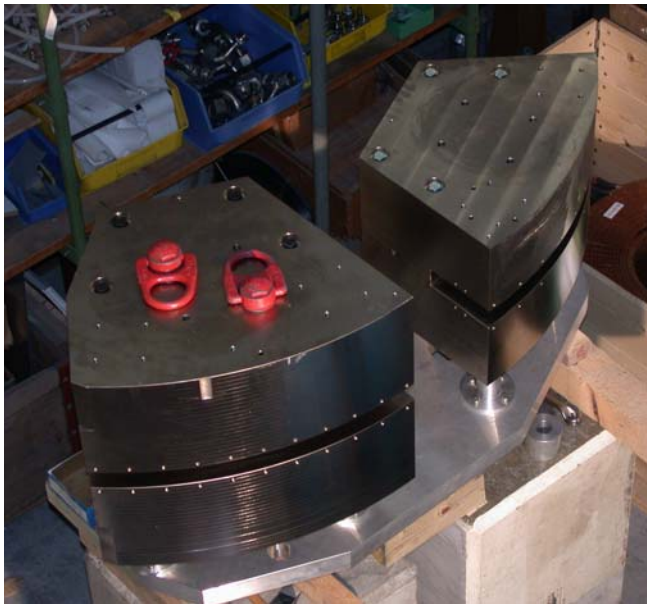

Fig. 9: Another four yokes for the spare Ring 72 MeV injection magnet module consisting of the AND01 and AND02 magnets, shown here assembled on their common base plate. Altogether, they weigh about 1.25 tons. The magnets presently in operation were also manufactured using the same spectrometer steel.

BIG MAGNETS

The two pole pieces left over from the Pair Spectrometer AEB caused a problem. Each piece was 5.3 metres long, 1.2 metres wide, 670 mm thick and weighed 23 tons. It is nearly impossible to cut such dimensions and every move around the open storage area meant hiring an expensive mobile crane. Finally, the two pieces, stacked one on top of the other, started to dig themselves into the ground, tilting dangerously towards a small outbuilding. We were given a disposal ultimatum. Luckily, we found one of our standard suppliers, who was very happy to accept the steel, also paying for all transport costs and fees. Perhaps one day we will get some of this steel back in the form of new magnets.

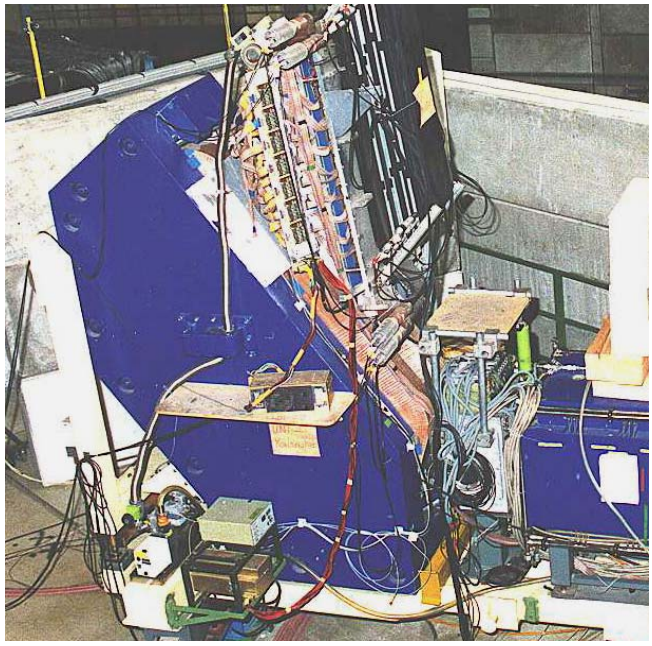

Fig. 10: The LEPS Spectrometer in operation (1996).

HISTORICAL COMMENTS

The magnets described here are not the first magnets produced from scrap steel at PSI. The 12 ton spare pole made for the Ring Cyclotron was reworked into the AEC 90° bending magnet, which is still in operation in the μE5 beam line following its initial application in the original vertical πE3 beam line.

Two of the bending magnets in the SINQ proton beam line, AHM and AHN are refurbished DESY magnets, originally obtained for use in the NA medical hall.

The AND01 and AND02 magnets presently in operation were also manufactured using old spectrometer steel.

CONCLUSION

The old and new magnets described above comprise a total machined finished weight of over 35 tons of recycled steel. Furthermore, we could save another 46 tons of high quality steel from the scrap yard. This represents an ongoing process at PSI.