§29. First Overhaul and Control-System Improvement of 250 MVA Motor-Generator

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The motor-generator (MG) system was constructed in March 1993 (about nine years ago). Its specification is described in Ref. 1. The MG has been totally operated for nearly 8,000 hours and the number of power generation reached approximately 165,000 shots until February 2002. Nevertheless, large-scaled maintenance of the principal components (*i.e.* 250 MVA generator and 8.5 MW driving motor) was slightly performed during this operation. It is because the period and budget were limited. On the contrary, upgrade of control system and partial maintenance of auxiliary devices were annually carried out as occasion demands.

To check the principal components, and to keep soundness of them, their overhaul was executed in this fiscal year. In addition the control system was more improved. Furthermore annual maintenance of auxiliary devices was partially performed.

i) Overhaul of the generator and motor

It is the first time since the construction that overhaul was carried out. Therefore main staff for this work was selected from those who have experienced the construction.

Since the MG is of vertical shaft type, the motor was first dismantled and removed. After taking out the upper bearing bracket and fixing of the generator's rotor, then 16 pole-pieces were all pulled up and checked. Figure 1 shows a photograph under pulling-up work of a generator's pole-piece. As the time is limited, the main bodies of stator and rotor were not demounted.

It was found after electrical and mechanical checking that the principal components would be kept sound after some years. However two items are pointed out to keep longer lifetime.

a) Reduction of electrical resistance in lower bracket

In the normal operation this resistance reduction does not induce serious trouble. However, in case of short-circuiting between the exciting winding and the ground, the lower bearing metal might be deteriorated by flowing current. To avoid such a case, this has to be repaired at the next overhaul. This work requires disjoint of all the parts of the rotor, hence more difficult and long-time operation would be necessary than this time overhaul.

b) Slight shrinkage of stator wedges

The stator windings and support ring are fixed by inserting nearly 2500 pieces of wedges. At hammering test, approximately 60 % wedges were found to slightly loosen. Since the wedges are of FRP, their shrinkage will gradually progress during operation. At present, however, their shrinkage is not so large that the vibration of rotor windings might not induce deterioration of the insulator. Then all the wedges would be needed to change at the next overhaul.

ii) Improvement of control system

a) Replacement of I/O system

So far I/O system for operating data was composed of the combination of old I/O processors and a computer. However, this system is somewhat poor in reliability and extensibility, and parts for maintenance become difficult to obtain. As a new I/O system, PLC (Programmable Logic Controller) was introduced. This system does not require processing computer, and so reliability is improved. Moreover, because many data can be treated, new data, for example, the temperature of exciting winding can be measured on time, which is important for long time power generating operation.

b) Modification of simulators

Off-line simulator, which shows the relation of output energy, generating time, and repetition rate, was already installed. In this year, on-line simulator was newly added. This simulator can check operation of various main devises without rotating the MG. Furthermore, time relation of timer start, start of acceleration and start of generation, can be easily calculated and displayed.

iii) Annual maintenance of auxiliary devices

The maintenance of auxiliary devices was performed every year, in accordance with their forecasting lifetime. However maintenance of special large-size devices (*i.e.* liquid rheostat: LRH) was slightly done. During the overhaul, the LRH was disjointed, and inside cleaning was performed.

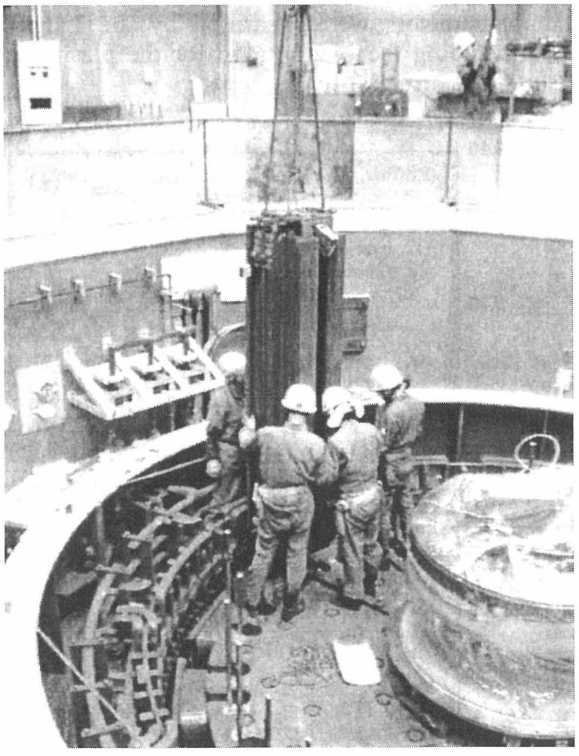

Fig. 1. Operation during pulling-up of generator pole-piece

Reference

1) Kitagawa, S. *et al.,* Annual Report of National Institute for Fusion Science (April 1999 - March 2000) 147.