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Abstract. The electric drives main parameters post-repair adjustment, in particular, torque ratings setting represents an important problem at power equipment. The electric drive inaccurate settings can cause damage to the valve stem or valve plate. The article is purposed to develop a torque diagnostic device (TDD) designed to determine and clarify the settings of power valves' A and B type electric drives limit coupling. Such device development allows a quick, in-situ, configuration of electric drive limit coupling basic settings according to the passport data, thus reducing the scheduled repair work time.

The torque is transmitted directly from the electric drive to the torque sensor. The sensor signal enters the secondary reader and is displayed on the LCD screen. When repair works, these settings are often lost, therefore they must be restored. In the absence of special devices in the NPP repair shops, used are the torque control wrenches.

The designed TDD tests demonstrated that when torque readings directly transmitted from an operative electric drive, such torque values are overestimated in contrast to manual tightening with a torque wrench.

That is due to the limit coupling extra-tightening by an electric motor's inertial rotation. It can be assumed that on more powerful electric drives, such valve "after-twisting" can be significantly larger and can lead to the valve damage that should be considered when using torque wrenches at limit coupling manually setting.

Keywords: Power Fittings, Torque, Study, Limit Coupling, Electric Drive.

1. Introduction

A significant share in complex preventive maintenance works at any nuclear power plant relates to repair of power valves' electric drives. The electric drives main parameters post-repair adjustment, in particular, torque ratings setting represents an important problem [1,2]. This procedure among others is provided for by the manufacturer's instruction set out in the electric drive's passport. So, the Tula electric drives factory recommends performing the electric drive torque values post-repair adjustment using this factory test benches [3] that is unacceptable for Ukrainian NPPs. Current practice at NPPs' repair shops relates to determining the electric drive torque using the amperage and voltage values [4,5]. However, such approach does not give us the

direct effort applied to the valve stem [6]. The methodology for calculating efforts on the valve stem proposed by the CDBA [7] is intended mainly for design organizations, but NPP personnel needs for a method allowing these forces rapid assessment.

The electric drive inaccurate settings can cause damage to the valve stem or valve plate; at several nuclear power plants there occurred bellows gaskets breakdown, or cases of insufficiently tight valve closure with an unacceptable medium passage [8]. Thus, the timely detection of valve damage will help to avoid unexpected shutdowns and accidents of NPP thermal equipment. And conversely, critical equipment failure can lead to serious accidents. An illustrative example here is the experience of pressure compensator pulse valve failure at the Three Mile Island NPP, which ended in the first serious NPP accident in the world [9-11]. A similar failure of pilot operated pressure relief valve has been registered at the Rovno NPP, however, it was discovered and eliminated within due time delay.

A preliminary analysis showed that Ukraine does not produce special compact devices that allow adjusting the valves' drives torque immediately at their regular operation point.

2. Material exposition

This article is purposed to develop a torque diagnostic device (TDD) designed to determine and clarify the settings of power valves' A and B type electric drives limit

coupling in the torque values range — 0…250 N·m with an accuracy of ± 0,1 N·m.

The measurement results shall be displayed on a LCD screen.

Such device development shall allow a quick, in-situ, configuration of electric drive limit coupling basic settings according to the passport data, thus reducing the scheduled repair work time and eliminating the from supervisory institutions' questions about the correctness of settings made.

Mostly, the electric drives currently used in the Ukrainian NPPs, are not equipped with built-in torque meters. Firstly, such design complicates the valves' structure, and accordingly increases the number of their possible failures, and secondly, a fairly simple NPP element becoming more sophisticated this introduces special features into the system operation, and most important, repair of power valves. Therefore, it is advisable to have a compact portable device allowing to quickly configure each electric drive at the NPP's repair shop.

The designed device shall be installed on the valve, and on its top the adjusted electric actuated is mounted. This device general appearance is shown in Fig. 1.

Fig. 1. TDD – general view.

In Fig. 1 observed is a square slot through which the torque is transmitted directly from the electric drive to the torque sensor. The sensor signal enters the secondary reader and is displayed on the LCD screen. The TDD is mounted on special supports allowing it to be installed on a pipeline next to the tested fittings. If necessary, the supports are removed and you can mount the TDD on the valve flange or on a special stand.

3. Experimental study of the device

In the absence of built-in valve closure degree sensors, the NPP repair shop's personnel use torque wrenches, manually closing the valve and adjusting the electric drive's limit coupling.

According to the electric drive passport data, the setup schedule diagram looks like a line plot (Fig. 2).

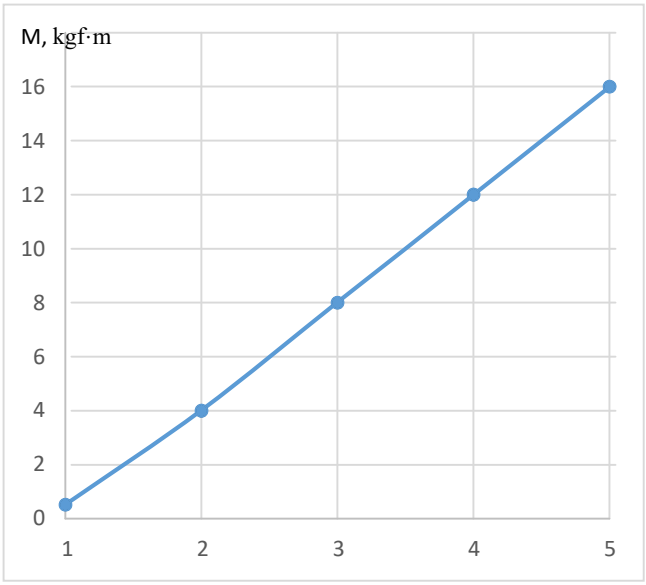

Fig. 2. Dependence of maximum torque transmitted to the valve from the limit coupling settings.

When repair works, these settings are often lost, therefore necessary is to verify the electric drive limit coupling settings the according to the factory schedule (Fig. 2). When the settings values do not match, they must be restored. In the absence of special devices in the NPP repair shops, used are the torque control wrenches, installed on the limit coupling stem to set the torque according to schedule as shown in Fig. 2, for adjusting the limit coupling settings.

A value below the relevant drive switching off torque leads to the valve's incomplete closure with unacceptable medium flow. An excessive torque value can involve the valve stem damage. Thus, the limit clutch post-repair adjustment is a necessary and relevant operation.

The designed TDD tests demonstrated that when torque readings directly transmitted from an operative electric drive, such torque values are overestimated in contrast to manual tightening with a torque wrench. These tests results are presented in Fig. 3.

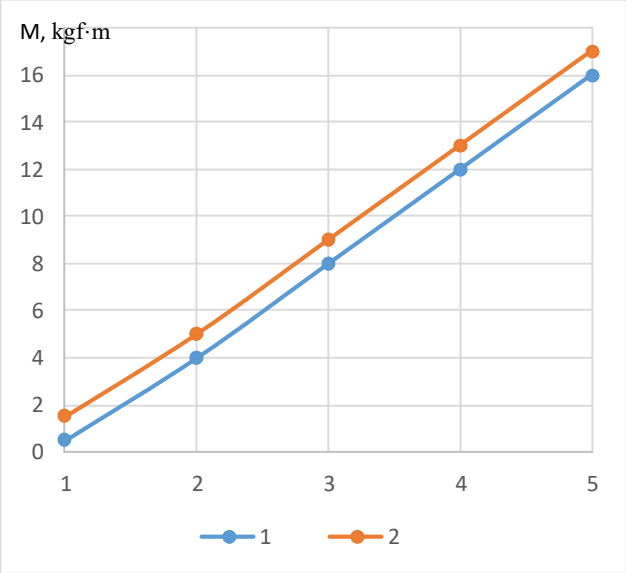

Fig. 3 Comparative dependence of torque values obtained with a torque wrench - 1 and with a TDD, on a working electric drive = 2.

From torque direct measurement at the limit coupling established is a stable deviation of the values obtained "manually". The only explanation for that fact is the limit coupling extra-tightening by an electric motor, which does not stop immediately when the power is turned off, and, due to the inertial rotation, turns the fixture further. It can be assumed that on more powerful electric drives, such valve “after-twisting” can be significantly larger and can lead to the valve damage that should be considered when using torque wrenches at limit coupling manually setting.

4. Conclusions

1. Exposed is the design of a torque diagnostic device for setting the power equipment electric drives’ limit couplings.

2. It has been established that the electric drive manual adjustment leads to an underestimation of the real values of torques created by the electric drives.

3. It seems appropriate to use such devices in the post-repair setup of electric drive fittings.

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