Time and tide...

The Thames Barrier has just undergone a comprehensive maintenance overhaul. Chris Leede, project manager of Monitran, explains how part of that overhaul included the fitting of sensors to monitor bearing wear and other parameters

Operated by the Environment Agency, the Thames Barrier is London's main defence against flooding. It became operational in 1982 and protects parts of the city against abnormally high tides and tidal/storm surges.

The barrier divides the river into four non-navigable spans (closest to the river's banks) and six navigable spans; of which four are 61m wide and two are 30m wide. The non-navigable spans have falling radial gates, in that they lower into the water to form a barrier, whereas the navigable spans have rising sector gates which, in their open positions, lie flat with the river bed.

Each of the four main gates weighs more than 3300t, presents a 20m high barrier when in its defence position and can hold back loads of up to 9000t.

During its almost 30-year history the barrier has been closed more than 400 times. Of these closures about 80 were against tidal surges and about 40 were to prevent rainfall/fluvial flooding. Most though have been for maintenance and test purposes.

To adopt their defence positions the main gates rotate through about 90°; the maintenance position requires a further 90° of rotation. The bearings of the main gates have only ever experienced quarter and half turns since the early 1980s, and any wear will reflect this life of partial rotations. Under a contract awarded in early 2010 by the company responsible for the barrier's maintenance and upgrade projects, Monitran was tasked to design, install and commission a system to measure bearing movement and gate position.

Figure 1

Also, the system had to be a permanent fixture and would require some equipment to be placed on the outer faces of the bearings; and therefore be subjected to the full force of a tidal river.

Four eddy current probes are used to make distance measurements as the gate/bearing rotates through 180°. Positioned at 90° intervals around the end of the bearing (see Figure 1), the probes were optimised for maximum sensitivity over a 10mm displacement range and positioned a nominal 5mm away from the chamfered face of the end of the inner bearing.

The bracket seen at 6 o'clock in Figure 1 also holds a pressure sensor - used to derive water depth (tide height). The cables for the pressure sensor and eddy current probes terminate in the junction box seen at 10 o'clock. This box (stainless steel and sealed to IP68) also contains an inclinometer for recording gate position/angle. In some instances, most notably for the larger gates and where space permitted, Monitran adopted a Russian Doll approach with the junction boxes.

A single cable feeds through the centre of the bearing and into the inner trunnion support structure; and then on into a GRP junction box enclosure that contains the eddy current probe drivers. In addition, the inner face of each bearing is fitted with an accelerometer in order to measure vibration levels; and those of the larger gates also have water leak detectors.

All signals and power lines from/to the sensors converge at a single cabinet (on one of the barrier's 'decks'). The cabinet has six displays which, between them, show the displacements being recorded by the 48 eddy current probes, the outputs of the 12 pressure sensors, the gate positions (as either 0, 90 or 180°) and the status of each of the eight water leak detectors. BNC connectors make available the accelerometer's outputs for vibration monitoring or analysis.

The overall project was something of a diversion from Monitran's core business, in that the company is recognised as an OEM of vibration, displacement and proximity sensors. The Thames Barrier project warranted far more than just the provision of standard or custom products, and Monitran had to assemble a team of skilled engineers and put them through training in order to work in confined spaces and on floating platforms. Accordingly, there was a relatively steep learning curve – but this was offset by many things the company did to reduce risks during the installations. For example, as much circuitry as possible was wired, enclosed and pressure-tested at Monitran's HQ in High Wycombe before going out to the barrier.

In addition, a complete installation and commissioning was done on a single bearing before the others were tackled. Doing so led to the early detection of a problem with a water-tight bulkhead, and gave its manufacturer time to devise an alternative method of construction.

Monitran has undertaken a variety of smaller projects during recent years – all the while honing its project management skills (including the use of specialist sub-contractors), but the Thames Barrier project is considered to be its most prestigious, and at times challenging, to date.

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