FIRST TIME RIGHT

Luder Zegarra, AST Turbo Switzerland, discusses utilising IT tools to help execute turnaround operations right first time.

The success of a turnaround execution is measured by the performance on three key elements: quality, safety and timely completion.

Doing it right the first time means zero quality issues, zero safety incidents and no re-work.

It has been proven that only proper project planning and preparation can ensure a smooth and well-controlled execution.

The preparation work, including the particularities of the equipment and site, is detailed and tailored for the scope of work.

The decision-making process and the selection of the suitable personnel play a key role in ensuring that the right decisions are made the first time.

HYDROCARBON ENGINEERING Reprinted from November 2018

Figure 1. Compressor rotor axial alignment.

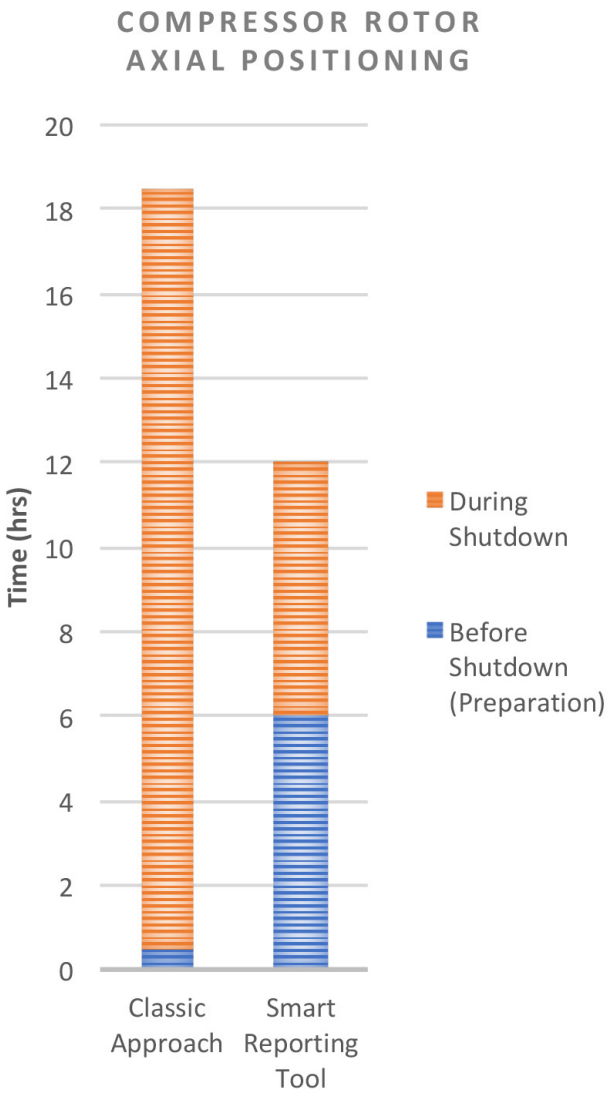

Figure 2. Time savings using the AST Smart Reporting Tool.

Case study

In a recent case scenario, AST Turbo's Field Service team demonstrated the benefits of using the company's Smart Reporting Tool. The team was tasked with supporting the rotor exchange work following a premature shut down on two process gas centrifugal compressors. The service engineers supervised the activities on a double-shift working schedule. Mechanical technicians and tools were provided by the equipment operator.

As part of the work scope, the impeller line-up had to be checked and adjusted by means of shimming the thrust bearing as required, with the new rotor in place.

A typical approach for this line-up check would be to record the rotor axial position at disassembly, duplicate this position with the new rotor in place at reassembly and re-check the impeller line-up of each stage. Once the clearance values are recorded they are compared with the nominal values on the compressor assembly drawings, a task that is typically done at the field office or trailer located downstairs, away from the compressor deck. After analysing all readings, a rotor movement is manually calculated by the service engineer, the rotor is moved on the deck and all readings are re-checked to confirm the effectiveness of the movement. Once the ideal position is achieved, in some cases after a few attempts, the compressor casing is closed. Thereafter, the dry gas seals (DGS) are installed. Axial positioning of the shaft with respect to the DGS cartridges must also be verified within the specifications given by the manufacturer. It is not unusual that in placing the new rotor in the ideal position for the impeller line-up, the DGS axial positioning is out of tolerance. As a consequence, a new movement must be calculated at the downstairs office. The service engineer needs to figure out the impeller line-up if the rotor is moved to ensure the DGS axial position is within tolerance. An optimum position satisfying both requirements must then be calculated, the rotor moved and DGS positioning re-checked. DGS cartridges are installed and after assembling the thrust bearing, the shim changes required to place the rotor on the optimum position need to be calculated; once more downstairs and away from the compressor deck.

The rotor setup described above could easily last between one and two shifts of work, excluding the time required to reinstall the upper casing and tighten the split line bolts. Human error is a variable during all required calculations. There is always the inherent risk that plus/minus might be inverted, thus causing additional iterations. The location of the trailer or office where the drawings are located will also influence the duration of this process.

Optimising the process

AST Turbo, using its Smart Reporting Tool, developed a calculation sheet that integrates all calculation steps on a single page. All dimensions and associated tolerances required to define the optimum rotor position satisfying both impeller line-up and DGS cartridge axial positioning are found in one location. The calculation sheet was designed to calculate how all variables are affected by

every movement of the compressor rotor. Shim changes on the thrust bearing are also considered.

The service engineers prepared the calculation sheet in advance with the nominal impeller line-up values and the specifications for the DGS axial positioning, including clearances. This task was implemented ahead of time in a controlled office environment and double checked by peers, all while the machines were still in production mode.

At disassembly, the thrust bearing shim measurement was entered into the calculation sheet, along with the 'as found' rotor positioning and DGS axial position. At reassembly the rotor position was duplicated with the new rotor on the lower half casing. The impeller line-up, as well as DGS axial positioning, were then checked and all recorded values were directly entered in the calculation sheet at the compressor deck. The calculation sheet has the capability of colour-marking every clearance: green for those clearances within tolerance and red for those beyond tolerance, plus indicating the deviation from the nominal value. As a result, the service engineer had a complete and clear overview of all related axial clearances. They could then assess readings for re-check and determine whether a rotor movement was required to achieve an optimal line-up.

The calculation sheet also allows the service engineer to simulate the change of clearances for every rotor movement in either direction. The rotor position to achieve the optimal impeller line-up and DGS cartridge position could then be determined. The rotor was then moved to the desired rotor position. A few axial clearances were re-measured and compared to those calculated by the Smart Reporting Tool to double check the calculation outputs. This meant that the optimal axial positioning of the new rotor was determined in less than six hours, less than one-third of the time required by the usual approach.

In addition to time-saving and risk-reduction benefits, the calculation sheet has the capability of calculating the change in the thickness of the thrust bearing shims to determine the new desired rotor position. A new shim can be fabricated in parallel to the closing of the compressor casing. By the time the shim is required during the thrust bearing reassembly, it is on hand and ready to fit.

Conclusion

The Smart Reporting Tool has helped to achieve the first time right goal. The tool is designed to serve as a support to a qualified service engineer, and its effectiveness relies on the engineer's expertise and know-how.

The decision-making process is optimised by defining acceptance criteria during the preparation phase, while the machine is in operation, minimising the number of manual calculations and reducing the risk of miscalculations.