

Replacing turboexpanders

CASINGS, AS WELL AS IMPELLERS AND BEARINGS, CAN BE SUPPLIED NEW

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For more than forty years, radial expansion turbines or turboexpanders have been widely used to produce refrigeration or recover power for petrochemical hydrocarbon separation plants. Nearly all modern gas processing and ethylene plants rely on turboexpanders to achieve the coldest levels of process refrigeration.

Modern turboexpanders typically drive a single-stage, centrifugal compressor (Figure 1), with both the expander and compressor optimized for the process duty. With the increasing economic demands of the global market, it is important that turboexpanders be designed for maximum efficiency and reliability.

Over the typical lifespan of a turboexpander installation, the operating conditions often change significantly from the original design. These changing conditions frequently justify the re-rating of the turboexpander to optimize its performance. Other reasons may include chronic wheel failures, sticking inlet nozzles, thrust problems, excessive vibration, and excessive seal gas consumption. To address process changes, turboexpander suppliers have traditionally provided re-rated flowpath components that are installed during a specified plant turnaround window.

With the traditional method, the common need to reuse or field-modify the existing housings adds mechanical and schedule risk, and can limit the overall performance and flow range of the re-rated equipment. A field installed re-rate of a turboexpander must be managed carefully as the new components are typically delivered untested, and performance is not confirmed until the plant is returned to service. Machinery performance deficiencies identified during plant re-commissioning must often be accepted “as-is.”

Traditional re-rating projects must factor in the considerable risk and uncertainty associated with site-based machinery modifications. A new “flange 2

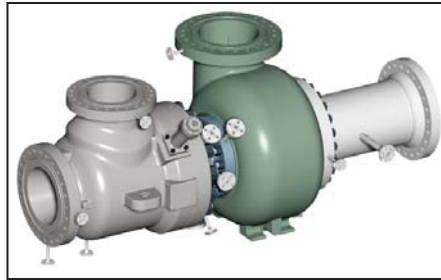


Figure 1: Typical turboexpander with the compressor shown in green

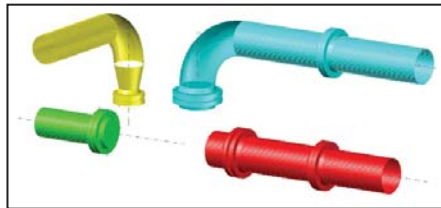


Figure 3: Interface data obtained by laser radar inspection of site

flange” technique that replaces all parts of the turboexpander can mitigate these risks [1].

Today, lifecycle cost is playing a greater role in machinery decisions. With major purchase decisions being deferred, plants are operating beyond their design lives. There is also a greater emphasis on reducing downtime. All these factors drive “flange 2 flange” replacement.

Better than re-rating

In this technique, the complete machine, including the casings fabricated from weldments, is replaced. A set of welded casings can be designed, fabricated and installed into the existing unmodified process piping even if the original expanders are of a different design [2].

The turboexpander is treated as a completely new design, with new parts and technology, facilitating maximum performance for the given envelope.

Before replacing the turboexpander, the outline dimensions should be confirmed (Figure 2, 3). Careful attention must be paid to material specifications, plant design requirements, as well as applicable industry, plant standards. Modern design and analysis tools help to optimize the new casings (Figure 4).

Once the design is finalized, the project



Figure 2: Expander interface data have to be collected to design replacement equipment

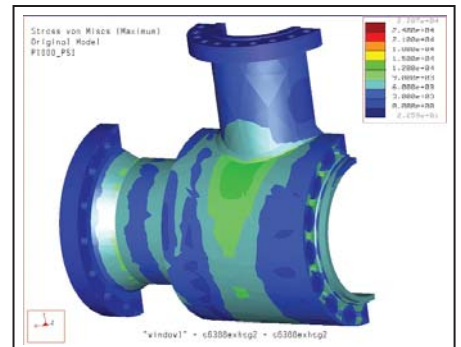


Figure 4: Weldment stress analysis. New welded casings replace the old



Figure 5: Preparing for mechanical test

proceeds to the manufacturing stage. The new machine components can then be assembled for a factory test (Figure 5) to API-PTC standards in the turboexpander manufacturer’s shop, before shipping to site (Figure 6).

Installing the replacement turboexpander reduces overall turnaround time, uncertainty and risk, because the reuse or modification of existing turboexpander parts is not required. (Continued on p. 30)



Figure 6: Replacement equipment

This type of replacement of an existing turboexpander brings “new unit” benefits compared to a “loose parts re-rate” option.

Replacement is an effective alternative to re-rating of existing equipment. Installation times are shorter. Availability is improved and API efficiency guarantees are provided. The latest technologies in bearings, seals and inlet guide vanes can be incorporated. Updated instruments can be added. Factory testing provides “as-built” performance curves.

Further, start-up risks are reduced. Existing support systems can be reused,

and aftermarket support is provided for the complete package.

The modern hydrocarbon turboexpander is a mature product with an exceptionally high reliability, maintainability and safety record. As the installed equipment base continues to age, and as ongoing opportunities for upgrading are considered, it is now possible to introduce new equipment benefits into the existing system with minimum risk and disruption.

Technology options

The majority of turboexpander replacement projects to date can be classified as “like-for-like” designs without major changes to the oil, seal, and related support systems. Future projects will offer new benefits wherein the oil system will be de-commissioned in favor of oil-free magnetic bearing replacement turboexpanders. As before, the existing foundations and primary process piping arrangements will require little or no modification. This option is available today and gaining momentum with operating companies who stand to benefit from the low lifecycle costs of oil-free designs. **TI**

Footnotes

[1] *Flange2Flange* is a Mafi-Trench trademark for the turboexpander replacement technique.

[2] *Mafi-Trench* is both an OEM turboexpander manufacturer, as well as a leading supplier of aftermarket services and replacement units to operators of turboexpanders originally manufactured by other OEM suppliers.

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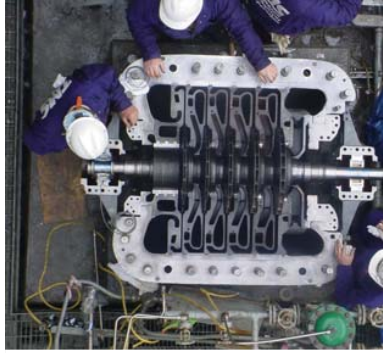


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