Selecting the appropriate vendor to refurbish parts for your turbines

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This is the second in a series of four articles defining the six critical steps to successful refurbishment of industrial gas-turbine (GT) parts. The first two steps, which were presented in the last issue of the COMBINED CYCLE Journal (2Q/2005), covered onsite assessment of component condition and development of repair specifications (access at www.psimedia.info/ccjarchives.htm). This article, Step 3, provides guidelines for selecting the appropriate repair vendors to meet your plant's specific needs. The third article (4Q/2005) will cover Step 4, the vendor verification process for incoming inspection; the final article (1Q/2006), vendor verification of repairs, coatings, and inspections performed during the refurbishment process of your components (Step 5), and final inspection (Step 6).

When selecting a repair facility to refurbish parts for your plant's GTs, keep in mind that cost—the variable upon which many decisions are based—is only one of several important considerations. Shop capabilities, experience of employees, vendor performance on similar jobs, quality control, and other factors are equally important—perhaps even more so.

A thorough evaluation of alternative service companies is critical to selecting the best repair facility for the work required in support of your next outage. The sector of the GT services industry concerned with parts refurbishment is dynamic in nature. Most companies are small, so it is common for them to be acquired, relocate, expand through acquisition, or close with little or no public disclosure.

Don't assume the facilities that did an acceptable job of repairing compressor, combustor, and hot-section parts for your last outage are necessarily the best partners for the next overhaul. Likewise, a company rejected previously may have acquired new capabilities, hired new people, etc, and deserves reconsideration. The competitive nature of the GT-based generation business suggests the need for continual monitoring of service companies.

Every experienced plant manager has his or her methodology for evaluating alternative repair shops—procedures that may differ depending on the GT component, work to be performed, and schedule. For someone with limited vendor auditing experience, the guidance offered here for evaluation of (1) experience and reputation, (2) in-house and subcontractor technical capabilities, and (3) HR and management systems, will help you get started. The scorecards provided are particularly valuable and should be customized to suit your specific requirements.

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3-1. Special fixtures are designed to facilitate repair and inspection of transition pieces

Experience and reputation

Generally, it is in your best interest to select a repair facility with experience both on your type of GT and on the specific components requiring refurbishment. Such experience helps the end user because the service provider has a better understanding of the condition of the components, what the critical dimensions are, which coating systems will provide the level of protection desired, etc.

If a candidate facility does not have direct experience on your machine, perhaps it has done comparable work on models similar in design, base material, and coating and cooling systems. The facility's reference list of projects completed over the last three to five years pertinent to the work you require should contain adequate detail for follow-up due diligence and decision-making.

Valuable insights on the performance of repair facilities can be gained

by interviewing the candidates' customers—past and present. One of the most important things to learn is how the prospective facility resolves quality issues. All repair facilities will run into problems at some point, but how quickly the company communicates and responds to problems, and the methods it uses to address them, is of vital importance to you.

Your interviews will reveal that most repair facilities are willing to develop repair methods and coating applications to suit specific needs. This is positive; however, if your components are the first articles repaired by a new method, more time and resources must be put against this effort than required by a proven procedure. And don't forget to consider the end-user's risks associated with any new procedure.

Table 3-1. Experience and reputation assessment

	Rating points		
	1	3	5
Field service experience	Similar unit	< 3 years	> 3 years
Conducted overhaul	Similar unit	< 3 years	> 3 years
Performed incoming inspection of part	< 2 years	< 5 years	> 5 years
Performed repair on part	1 year	< 5 years	> 5 years
Fixtures available for your specific components (inspection, repair, and coating)	In development	Available	Qualified
Coated part	1 year	< 5 years	
Technician/supervisor with company (the person who will direct your repairs)	> 2 years	> 4 years	> 8 years
Quality as seen by customers	Not meeting specifications	Not meeting expectations	Meets specs and expectations
Resolving quality issues	Unwilling, must be forced	Willing, but slow	Proactive, highest priority
Delivery time	Within two weeks of date promised	Always on time	
Documentation of repair and coating	Critical inspection steps	Summarized and complete	Summarized and complete, in digital format

As part of your assessment, be sure to inquire about the fixtures available to facilitate the inspection and repair of components (Table 3-1). Fixtures can pay dividends in the inspection of complex components, such as transition pieces (Fig 3-1), while reducing shop time. Also, the availability of fixtures offers an indication of how much work a particular shop does, or has done, on specific components for a given GT model.

Record-keeping is another area to investigate. After repairs are complete, you want documentation on the condition of your components (ID by serial number) "as received" and "final," in addition to certifications for important process steps—such as heat treatments, stripping, coating, and shot-peening.

During the request-for-quotation process the evaluation of repair facilities can be confirmed. Facilities with good experience will come up with some intelligent questions and offer some options to reduce the costs or prolong the lives of your components.

Technology and subcontracting

The assessment of GT components conducted as part of Step 1 and the repair scope developed in Step 2 provide information of value for determining the optimum technologies for parts refurbishment. At this stage, keep in mind that it is not always necessary to apply the same coating system provided by the OEM (see sidebar for definition of acronyms) on new parts. For example, MCrAlY typically is applied on advanced blades and buckets with LPPS or VPS (Fig 3-2), but for most applications HVOF-applied MCrAlY is sufficient.

Information gathered from the onsite visual inspection, and from the "as received" NDT and metallurgical inspection at the repair facility, sometimes suggests a customized repair and coating solution that can reduce the expected cost of refurbishment and/or extend the service life of components. Make sure you don't miss an opportunity for competitive advantage by selecting a service provider that will partner with you to advise unselfishly on repairs and coating systems (Table 3-2). An independent consultant could also be helpful in this.

Refurbishment of GT components for late-model machines often requires sophisticated repair technologies that are expensive to install and support. Thus many shops are not equipped to perform all repair and coating steps in-house for all GT models and they rely on subcontractors for certain tasks. To illustrate: Chemical stripping of GT components poses environmental and health concerns and is often subcontracted to a specialty shop (Fig 3-3).

To have certain repair or coating steps performed by a specialized subcontractor can be advantageous. However, your repair facility is still responsible for final product quality and must monitor the subcontractor to ensure conformance to specifications. And, since the subcontractor is an extension of the primary company, it should be audited as part of your capabilities assessment.

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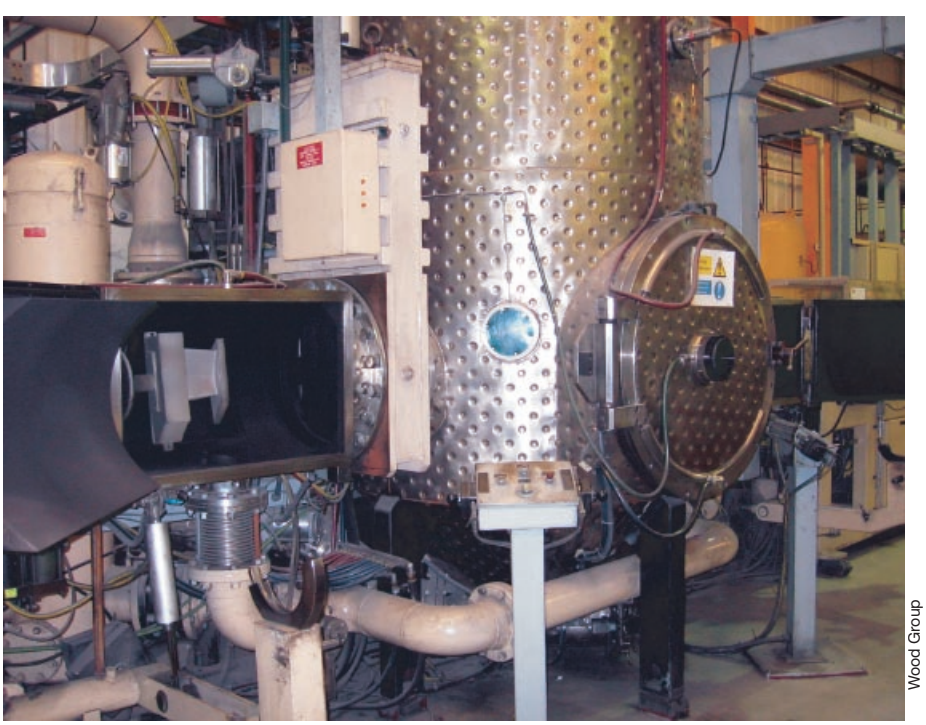
Acronyms defined

APS—Air plasma spraying
CNC—Computer numeric control
CVD—Chemical vapor deposition
EDM—Electrical discharge machining
GT—Gas turbine
EB—Electron beam
HVOF—High-velocity oxygen fuel
ISO—International Organization for Standardization
LPPS—Low-pressure plasma spraying
MCrAlY—Nickel, cobalt, iron, or a combination of these elements, plus chromium, aluminum, and yttrium
NDT—Nondestructive testing
ET—Eddy current test
PT—Liquid penetrant test, also called LPT
MT—Magnetic particle test
RT—Radiographic test
UT—Ultrasonic test
VT—Visual test
Nadcap (see note below)
OEM—Original equipment manufacturer
TIG—Tungsten inert gas (same as GMAW)
VPS—Vacuum plasma spraying

Nadcap began as an acronym for National Aerospace and Defense Contractors Accreditation Program. Today that program is international in scope and known simply as Nadcap. The Performance Review Institute (http://www.pri-network.org/Nadcap), Warrendale, Pa, administers the program, which "provides unbiased, independent manufacturing process and product assessments and certification services for the purpose of adding value, reducing total cost, and facilitating relationships between primes and suppliers."

Table 3-2. Technology and subcontractor experience assessment

	Rating points		
	1	3	5
Nondestructive testing (see sidebar for alternative technologies)	Technologies < 3 years	Technologies < 5 years	Technologies > 5 years
Metallurgical laboratory (experience of metallurgical engineer)	Qualified vendor > 10 years	Internal > 3 years	Internal > 10 years
Stripping (similar coating, base material, design)	Qualified vendor > 10 years	Internal > 5 years	Internal > 10 years
Heat treatment: Vacuum	Qualified vendor (Nadcap, ISO)	Internal	Internal (Nadcap, ISO)
Heat treatment: Controlled atmosphere, other	Internal	Internal (Nedcap, ISO)	
Weld repair: TIG, plasma	> 1 year	> 3 years	> 5 years
Weld repair: Plasma or EB	Qualified vendor > 5 years	Internal > 3 years	
Weld method/application qualification	Performed	Performed to ASME Section 9	Up-to-date per ASME Section 9
Braze repair	> 2 years	> 4 years	> 8 years
Braze method/application qualification	Performed	External qualification	Published
Machining: Conventional, CNC, EDM, laser	Conventional	And CNC	And EDM or laser
Coating: Thermal spray	Qualified vendor > 5 years	Internal APS, HVOF > 3 years	Internal robotic application > 5 years
Coating: Diffusion	Qualified vendor > 5 years	Pack segmentation > 3 years	True CVD > 3 years



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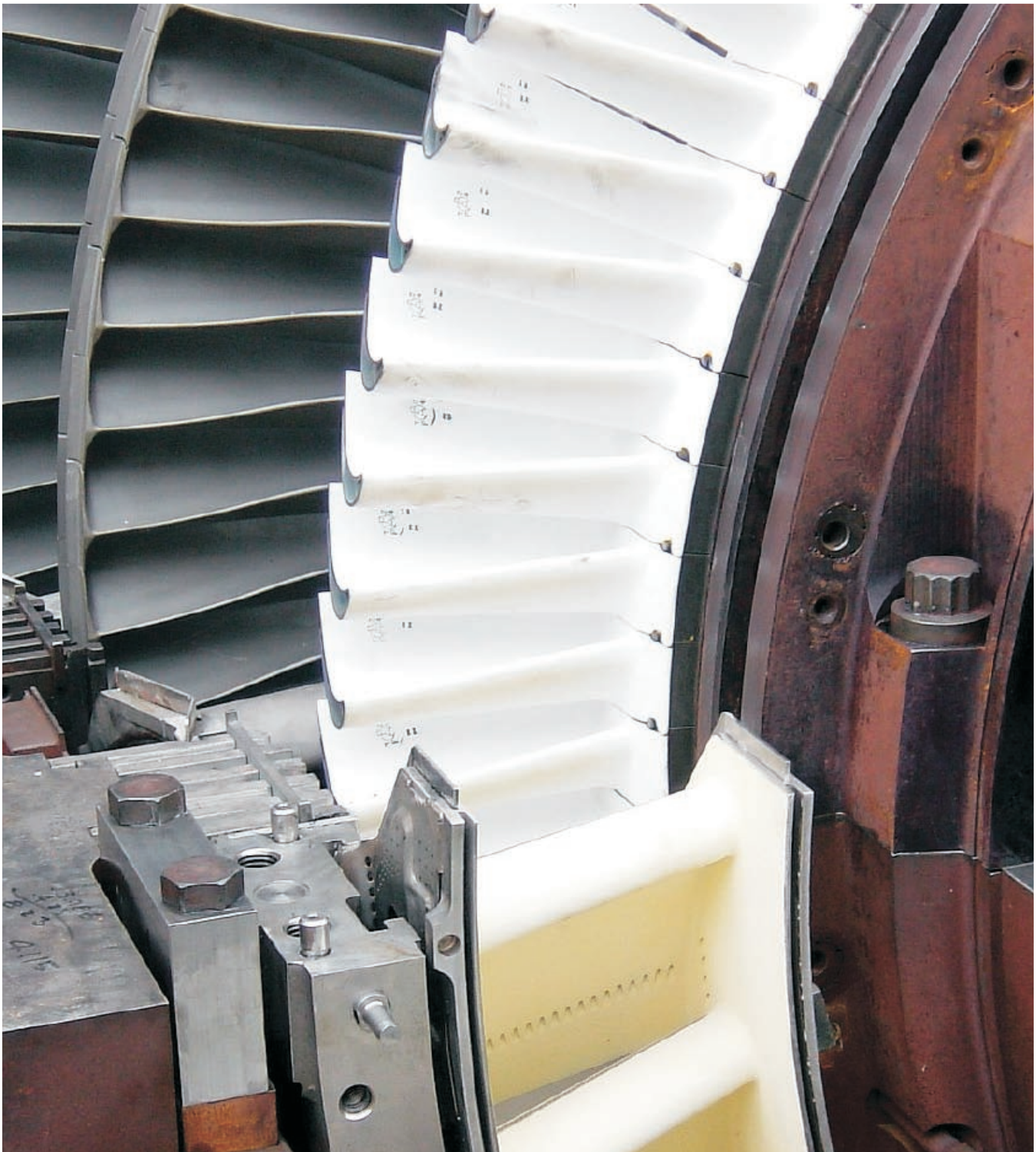
3-2. MCrAlY coating applied under vacuum requires sophisticated equipment



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Human resources and management systems

Over the last several years, competition in the GT services sector has forced the closure or sale of marginal companies and driven out of work many capable engineers and repair technicians. Some of these people have joined forces and started small specialty shops, contributing to the relatively large number of repair facilities—well over a dozen in the Houston area alone.

Currently, the end-users' perspective is that the increasing number of engines in service, and growing production of GT-based megawatt-hours has filled the most competitive and capable repair shops at times when outages traditionally are conducted. Result: Existing staff is challenged by the workload, thereby creating demand for experienced managers, engineers, and technicians. Such market dynamics result in rotating of human resources internally and throughout the industry.

Goodrich

3-3. Chemical stripping setup is audited at subcontractor's shop

What this means to end users—especially with regard to new repair facilities—is that organizational charts, job descriptions, quality manuals and systems, procedures, and qualifications are not always in place. When conducting vendor assessments, be mindful that training and qualification of inspectors, welders, blenders, and other technicians is the foundation for quality work. The scorecard presented in Table 3-3 offers a valuable reminder of items to investigate.

Important to remember with respect to small organizations is that an experienced core staff is capable of performing quality repairs and coatings at a competitive price on specific GT components. However, if the repair process increases in complexity—as it does for advanced components—or when the organization grows too fast, quality issues can arise.

When turn-around time is important, a small company may not have the resources to repair and coat your components in time. On the other hand, larger companies may not always give the attention that you and your components deserve. Therefore, the best result sometimes can be achieved by dividing the component repair and coating work to small, specialist facilities. **CCJ OH**

Table 3-3. HR and management system assessment

	Rating points		
	1	3	5
Years since last organizational change (location, ownership, and/or management)	> 2	> 4	> 8
Organization chart	Available	Available and up to date	
Job descriptions	Available	Available and up to date	
Quality manual	Available	Available and up to date	
Quality system audit to ISO, Nadcap, etc	Internal audit	External audit	External audit > 5 years
Procedures (welding, coating, inspection)	Available	Available and up to date	In use
Workscopes	Available	Available and up to date	In use and signed off
Materials/parts tracking (replacement parts, filler, and coating materials)	Order requires certification	Verification	Traceability
Subcontractor work (heat treatments, coating, shot peening)	Vendor audited	First-article verification	Verification of work performed
Engineering department (mechanical, metallurgical, process)	One person > 10 years	Three people > 10 years (avg)	Five people > 10 years (avg)
Inspection department (VT, PT, UT, MT, RT, ET)	One Level II > 3 years per discipline	Three Level II > 5 years per discipline	More than three Level II/III > 5 years per discipline
TIG welding (experience/qualifications for each material)	More than two welders > 3 years experience (avg)	More than five welders > 5 years experience (avg)	Five welders > 5 years qualified
Blenders and experience	Two blenders > 3 years	More than two blenders > 5 years	
Coating operators and experience	Two operators > 3 years	More than two operators > 5 years	Two robotics operators > 5 years

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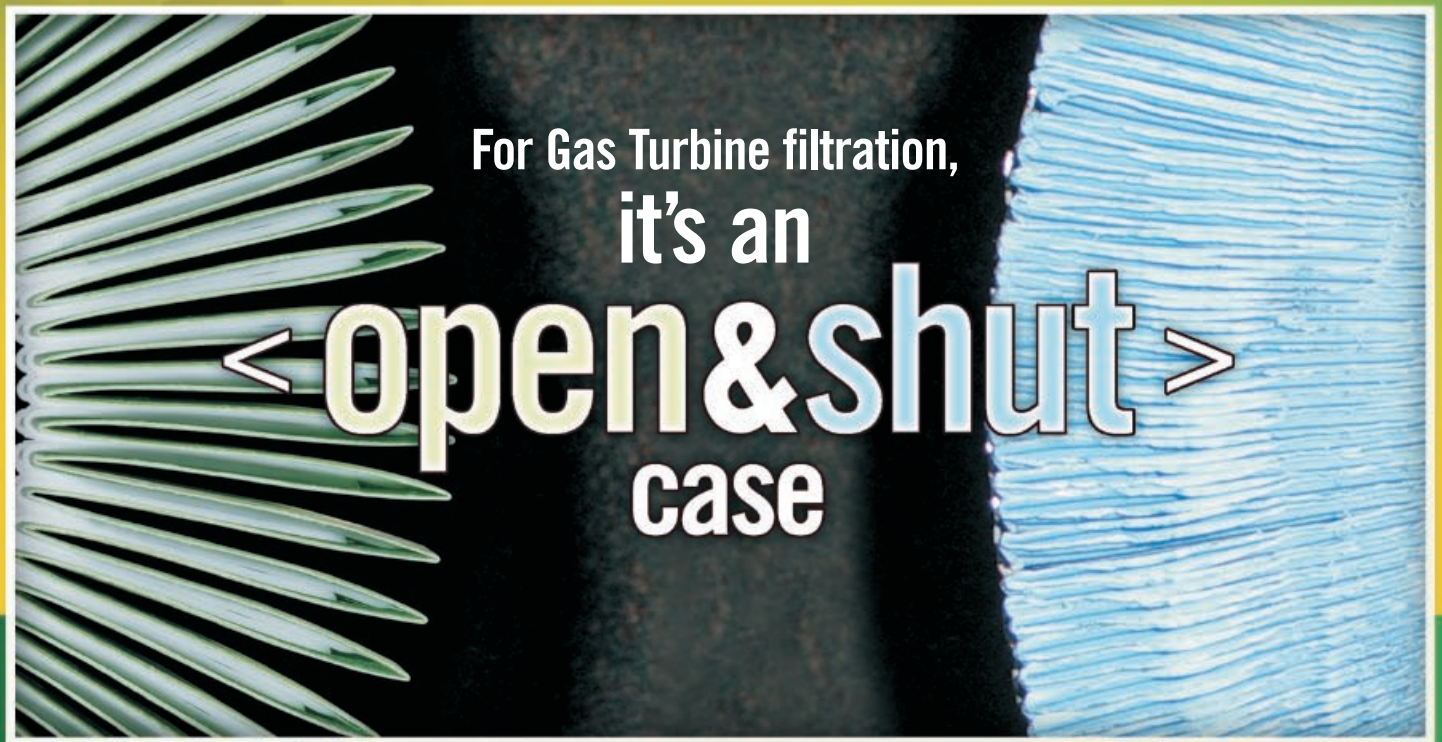

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