fallout of the recent boom-and-bust cycle in gas-turbine-based merchant generation is new equipment on skids, paid for by owners who find themselves with no place to build a combined-cycle plant that can turn a profit. At least not now.

And with no viable secondary market today for this equipment—including gas turbines (GTs), steam turbines (STs), generators, heat-recovery steam generators (HRSGs), auxiliaries, and consumables—the only real option for owners is to place it in long-term storage.

Sounds simple, but it’s not. Proper storage of powerplant equipment requires a combination of practical engineering know-how, solid organizational and record-keeping skills, and an active maintenance program. An appreciation for the equipment is important, too, because the primary goal of storage is to retain the various components in their as-manufactured condition for future use.

There are several storage options to consider:

■ Build a warehouse or modify an existing indoor facility.
■ Prepare a suitable site for outdoor storage—to the extent that is possible.
■ Contract with a commercial warehouse specializing in equipment storage.

For situations where plant construction was suspended indefinitely after some or all major equipment already was installed, temporary shelters probably will have to be erected around critical components.

To gain the insights needed to guide your decision-making on equipment storage, the editors of the COMBINED CYCLE Journal spoke with the following experts:

■ Tom Burns, project director, Sterling Energy International Inc (www.sterling-energy.com), Capistrano Beach, Calif. Sterling is a consulting firm specializing in O&M staff mobilizations for new generating plants, project acquisitions and divestitures, and equipment storage and preservation programs (refer to “The future in plant knowledge management is now at Mesquite,” Summer 2004, at www.psimedia.info/ccj.htm).
■ Karl Mattes, CT business segment manager, ReGENco LLC (www.regencoservices.com), West Allis, Wis. ReGENco is a diversified third-party parts supplier and repair firm with shop and storage facilities capable of overhauling, upgrading, balancing, and storing power-plant rotating equipment of all types and sizes.
Rick Zint, project manager, and Bob Dill, director of quality assurance, Calpine Corp, San Jose, Calif. Zint manages Calpine’s outdoor and indoor storage facilities in the Las Vegas area, while Dill is most knowledgeable in preserving equipment at plants where construction has been suspended (see sidebar). Calpine owns or leases more than 80 GT-based peaking, cogeneration, and combined-cycle facilities and is perhaps North America’s largest merchant generator in terms of gas-turbine capacity.

Sterling’s Burns, who has done “receiving, storage, and preservation programs” for three clients and is actively managing two ongoing projects, says that the primary decisions for equipment owners with respect to equipment storage are financial. Handling of the equipment during transport and upon receipt at the storage facility, preparation prior to storage, and maintenance during storage are impacted most heavily by manufacturer’s specifications and first-hand experience.

“The tax considerations,” continues Burns, “have to be at the top of your list when making a decision on where to store equipment.” First question to ask: Will you be required to pay property tax at the end of each year based on the assessed value of the equipment? Some states are more tax-friendly than others. Some counties in Texas, says ReGENco’s Mattes, have an annual tax on personal property of as high as 2.5%. That could amount to millions of dollars each year for, as Burns puts it, “the privilege” of storing your equipment.

Mattes adds that you should dig deeper than just the local tax codes. ReGENco, for example, is a manufacturer, so equipment can remain in its warehouses tax-free because it is considered “inventory in transit.” Also, the company has “good neighbor” status making it tax exempt on personal property.

It currently is storing GTs, generators, and STs—including an assembled high-pressure/intermediate-pressure unit and the unassembled components for low-pressure rotors—for several owners such that the warranties on that equipment will be maintained. A typical arrangement with a third-party central storage facility, such as ReGENco’s, is a standard annual warehouseman’s agreement that does not necessarily involve title transfer.

Tax is not the only consideration in where to store your equipment. Access to transportation corridors is critical and equipment size may be a big factor in that regard. Bridges and tunnels come to mind. And transportation itself is a risk that demands consideration.

Mattes considers as an advantage the rail spur that leads directly into ReGENco’s storage facility, which is equipped with a 300-ton crane capable of handling an assembled generator for a GE Model 7FA. Another advantage, he says, is the firm’s ability to repair any damage from pre-storage handling before the equipment is returned to the owner. Also, to repair, upgrade, or modify the equipment, as required by the OEM or owner, while it is being stored. Mattes adds that customers with equipment in storage generally qualify for preferential rates on such repair and upgrade work.

Evaluating storage facilities

Once you’ve decided on an approximate location to store your equipment, the search for available space begins. Due diligence of alternative facilities demands an experienced eye. The task is simple when visiting a warehouse already configured and managed to handle and store powerplant equipment—like ReGENco’s. But it is a challenging assignment to select the optimum storage location
when you’re looking at empty warehouses and bare ground in a desert location.

Burns suggests that you pay particular attention to these points when selecting a warehouse to serve as your storage facility:

- Flexibility of access—by road, rail, and/or water.
- Degree of difficulty in delivering to, unloading at, and moving equipment into a given warehouse. Ceiling height and location of structural members are particularly important when there are special lifting considerations.
- Building condition. The structure, including the roof, must provide adequate shelter from the elements and be in a location with adequate drainage, fire protection, and physical security. Important to look for evidence of leaks, flooding, etc., when conducting your inspection.
- Lighting and climate control system, if any. Adequate lighting must be available inside and outside. Heating and cooling probably will be necessary to control temperature and humidity. If the building does not have central utility services, temporary “rooms,” typically wood frames built around critical equipment and covered in plastic, will have to be built and portable heaters and air conditioning units installed for each.
- Accessibility of equipment in storage. If necessary to “borrow” a piece of equipment for another facility, will you be able to find and retrieve it easily?
- Cost per square foot of storage space and insurance, type of lease, term, etc.

Outdoor storage obviously involves additional considerations. Calpine’s Zint manages such a facility in the Las Vegas area that is a temporary home to several Siemens Westinghouse 501Fs and GE LM6000s. Some generators and steam turbines are stored indoors nearby and in a couple of other strategic locations in the Midwest and the East.

Most of the turbines were moved to Las Vegas from Houston, says Zint, because storage is less expensive in Nevada and the company was able to consolidate its inventory there in a facility under its direct control. Nevada has a more favorable tax structure than Texas and its dry climate facilitates storage, he adds. Plus the location selected is in close proximity to a rail spur and laydown space is generous, allowing immediate access to equipment.

Outdoor sites are relatively inexpensive to lease but they must be developed into an acceptable storage location. What Calpine had to do to the desert tract it leased near Las Vegas after planning a grid system to accommodate all the equipment to be located there was grade the area and cover it with gravel, then install a durable fence and security lighting. Plus, design and install a
What to do when plant construction stops

Suspension of construction is a call to immediate action for equipment preservation experts. Over the last five years, construction was halted on several merchant combined-cycle projects prior to completion because the presumed market for power evaporated. When construction is stopped at say the 50%-70% mark, which appears typical, the major equipment already is in place and extremely vulnerable to the elements and normal changes in temperature. Reason is that most or all of the protective packaging installed by the manufacturer prior to shipment has been removed.

Calpine Corp, San Jose, Calif, has been in this position. Protection of equipment at partially completed facilities falls to Bob Dill, director of quality assurance (QA), who manages a global staff of about two dozen professionals. Reason the responsibility falls to Dill: One of the many functions his staff is to monitor supplier and contractor compliance with applicable codes and standards. To be proactive in this regard, a QA team visits monthly plants under construction to run through a 250-point checklist that puts them face-to-face with virtually every piece of equipment, supplier, and contractor onsite. Thus in a general sense, the QA staff knows perhaps about the condition and specifications for more equipment than anyone else.

When construction is suspended at a site, Dill’s team revisits manufacturer manuals and specifications to develop a long-term storage strategy for each piece of equipment requiring special protection. Goal is to maintain equipment in the as-new condition to ensure full warranty provisions are in force when the plant ultimately starts up. Calpine thinks conservatively and believes that even a six-month suspension is a “long time.”

Dill recalls a couple of GE 7F machines that were disassembled a couple of years ago—after a period of storage in the Atlanta area—to verify certain upgrades prior to their sale. The inspection confirmed that the long-term storage procedures suggested by the OEM were indeed effective. Only a little “cosmetic” rust was found on the compressor casing.

When Calpine’s Hillabee project in Alabama was suspended after about 70% completion, Dill’s staff directed the complete encapsulation of turbines and generators in insulated plywood structures with required climate control services. Auxiliary electrical cabinets, control systems, motor-actuated valves, pump motors, etc, all required special enclosures or shrink wrapping. All equipment not permanently installed was placed on cribbing and protected against precipitation, dirt, dust, insects, and small animals. In the South, insects are a big consideration. And rodents are known to consider electrical insulation a delicacy.

It is not just enough to pay special attention to critical equipment when construction is suspended, according to Dill. He says that Calpine ensures that the entire site is preserved and secure, including properly maintaining grounds. At least one company representative is on duty around the clock. A QA team visits sites where construction has been suspended monthly until they go six consecutive months without identifying a concern. At that point, visits can be quarterly.

The easiest components to store outside are structural and architectural steel, and piping, according to Zint. Pipe ends must be carefully capped after putting desiccant inside to keep out dust, moisture, insects, birds, and small animals. Zint says that metals exposed to the elements may eventually have to be re-primed because of the beating the as-manufactured coating takes when exposed to the elements. For storage periods of six months or less this is not a consideration.

GTs and controls and electrical cabinets require much more care. Turbine components typically are bathed in a grease-type coating for protection. Then the GTs are shrink-wrapped with a 7-mil material and covered again with custom-fitted tarps. Latter are made of heavy-duty vinyl and have inspection ports with Velcro “locks.” Control and electrical cabinets are appropriately stored in enclosures outfitted with heat strips and dehumidifiers. Such packaging and climate control facilities also are used in warehouses, depending on the location and available of central services.

Sterling maintains an outdoor facility in close proximity to Calpine’s in Las Vegas to store HRSGs. Components—such as harps and drums—are covered with shrink wrap. Tarps tied down tightly add another layer of protection. Piping also is stored in a manner similar to Calpine’s, off the ground and resting on wood beams (so-called cribbing).

Managing the process

Management systems for equipment receipt, inventory, and preservation are critical to the success of any storage project, stresses Sterling’s Burns. Meticulous records are an important deliverable. They demonstrate the care and attention that has been given to the equipment. “It all means very little if not well documented,” adds Zint.

“There are lots of starts and stops during receiving,” continues Burns, “with costly inactive periods bounding. Delivery of the hundreds of crates and major pieces of equipment to be stored is sporadic
at best. Some days you’ll get more than a dozen deliveries and everyone keeps busy; on others, perhaps only a single shipment.”

Burns suggests that at the contract negotiation stage you make a special effort to ensure that operators and riggers are available to perform any and all work for which they are qualified so teams are productive during slack periods. For example, when they aren’t operating forklifts or cranes, or rigging equipment for lifts, they can put tarps on equipment, prepare cribbing for the next day’s deliveries, and similar low-skill, but necessary, tasks.

Planning for receiving, unloading, and storage must be well thought out in advance, warns Burns. Last thing you want is to have to relocate equipment after it has been moved into storage. Moving equipment a second time increases cost and the risk of damage.

The first thing that Burns does when formulating a plan is to determine where the heavy pieces will be stored and the sequence in which equipment will be received. The “heavies” typically require the highest headroom and most open space for maneuvering, having been delivered by the largest rigs and handled by the largest cranes. Knowing to the extent possible, the sequence of shipment post storage is very helpful at this stage of the project.

The receiving and inventory record-keeping function confirms that the owner has received
what he has paid for, and that the shipments are
complete, undamaged, and without shortages.
Accurate and complete data entry is extremely
important because these records serve as the
starting point for shipment of equipment to the
final destination.

Preservation set-up, says Burns, is the “catch-
all” period where the inconsistencies of project
agendas are identified and resolved. A common
inconsistency is equipment that has been packaged
by a vendor for shipment and immediate installa-
tion versus that required for long-term storage. In
such a case, the following would be required:

■ Removal of shrink-wrap or other enclosures
  provided for equipment transport to gain access
to the equipment for inspection of general condi-
tion, check of motor rotation, etc.
■ Repainting of equipment beyond the prime
  coat given at the factory (nominal six-month life-
time) may be necessary.
■ Vapor corrosion inhibitors and desic-
cant installed in the factory usually must be
replaced.
■ Viewing/access windows may be required
  in shipping containers and crates to facilitate
  inspection and change-out of corrosion inhibitors
during storage.
■ On major electrical and control equipment,
  including generators, installation of tempera-
ture and humidity instrumentation and record-
ers often is recommended.

Burns, Mattes, and Zint agree that a major
challenge faced by anyone charged with the
responsibility for storing equipment is that the
owner generally does not know how long the
equipment will be stored. Storage term has a
major impact on the degree of preservation speci-
fied. For example, if storage is for six months or
less the manufacturer’s packaging probably is
sufficient. If the term is upwards of a year, or
more, a significant effort by qualified technicians
is required to prepare equipment for storage
according to specifications provided by the vari-
ous manufacturers. Failure to do this will result
in a loss of warranty.

As a check on proper storage, daily, weekly,
monthly, and quarterly tasks are assigned to the
technicians responsible for monitoring the facil-
ity. Daily tasks might include visual inspection for
storm and animal damage and packaging integrity;
weekly and monthly walk-downs most probably
involve data taking and trending; and desiccant
might be replaced quarterly.

Do not underestimate how rapidly equipment
can degrade in storage if it is not properly pre-
pared. One project manager told the COMBINED
CYCLE Journal that his company did not pay much
attention to equipment installed at a southern site
after construction was stopped because of changing
market conditions. Everyone thought the hiatus
would be short-lived. Eighteen months later the
turbine required a complete rebuild. CCJ